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Curtis Prairie Stormwater Plan

Report

Wisconsin Department of Administration

November 2012

STRAND ASSOCIATES®

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November 29, 2012

Mr. Jim McMillan, P.E.
Wisconsin Department of Administration
Division of State Facilities
P.O. Box 7866
Madison, WI 53707-7866

Re: University of Wisconsin–Madison
Curtis Prairie Stormwater Plan

Dear Jim,

Enclosed are three copies of the final Curtis Prairie Stormwater Plan report. We appreciate the opportunity to provide restoration-based stormwater planning services to protect Curtis Prairie, the world's oldest restored prairie and the birthplace of the ecological restoration movement over 75 years ago.

Please call with any questions.

Sincerely,

STRAND ASSOCIATES, INC.®

Jon H. Lindert, P.E., LEED AP

Enclosure: Report

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Report for
Wisconsin Department of Administration

University of Wisconsin-Madison
Curtis Prairie Stormwater Plan

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November 2012

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FOREWORD

This report is the culmination of previous stormwater planning efforts concerning the Curtis Prairie watershed and locale in the University of Wisconsin–Madison (UW-Madison) Arboretum. To date, the UW–Madison Arboretum moved forward with construction of a rehabilitated Pond 2 and upstream wetland basin in 2009. As part of those planning efforts, numerous alternatives were analyzed and vetted for stormwater treatment in the watersheds draining to Curtis Pond and Coyote Pond. A description of original alternatives considered is included in the September 2006 *UW–Madison Arboretum Stormwater Management Plan* and more recent alternatives analyzed are included in the March 2011 *UW–Madison Arboretum-Curtis and Coyote Ponds Stormwater Management Plan*. This report builds from the previous work to further formalize the plan for treatment at Curtis Pond and Coyote Pond. More specifically, at Curtis Pond this includes rehabilitation of the existing Curtis Pond, conveyance of stormwater flows from the Wisconsin Department of Transportation (WisDOT) right-of-way (R/W) to Curtis Pond with a new storm drain, and trash and sand collectors within the WisDOT R/W. At Coyote Pond, this includes a trash and sand collector on the south side of the US 12/14 (Beltline) in the WisDOT R/W and a liner to provide longevity to the existing corrugated metal pipe (CMP) leading from the WisDOT R/W to Coyote Pond. These stormwater features are further discussed in this report.

CONTRIBUTING WATERSHED CHARACTERISTICS

The amount of stormwater discharging from a watershed depends on a number of individual characteristics. Watershed size and topography, land use, soil types and degree of saturation, type of drainage system (storm drains or open channels), and amount of watershed storage available all affect stormwater discharge.

A. Watersheds

The watersheds in the project area are shown in Figure 1 and further described in Section 2 of the March 2011 report.

B. Soils

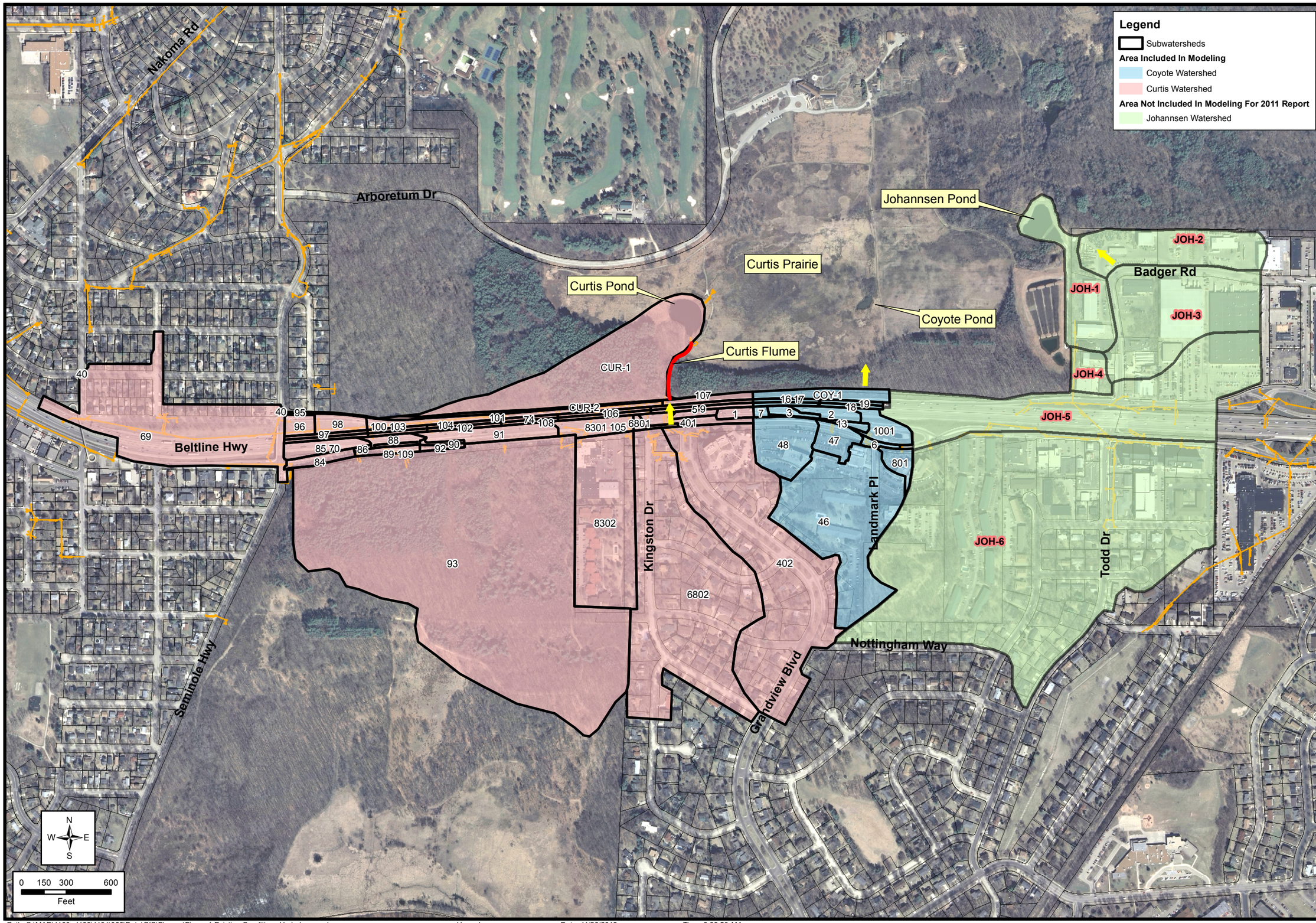
The soils in the project area are shown in Figure 2 and further described in Section 2 of the March 2011 report.

C. Land Use

The existing land use in the project area is shown in Figure 3 and further described in Section 2 of the March 2011 report.

D. Hydrologic Parameters

Table 1 summarizes the watershed number, drainage area, time of concentration, and runoff curve number for watersheds in the project area.



EXISITING CONDITIONS HYDROLOGY

CURTIS PRAIRIE STORMWATER PLAN
WI DOA/DSF AND UW-MADISON
MADISON, WISCONSIN

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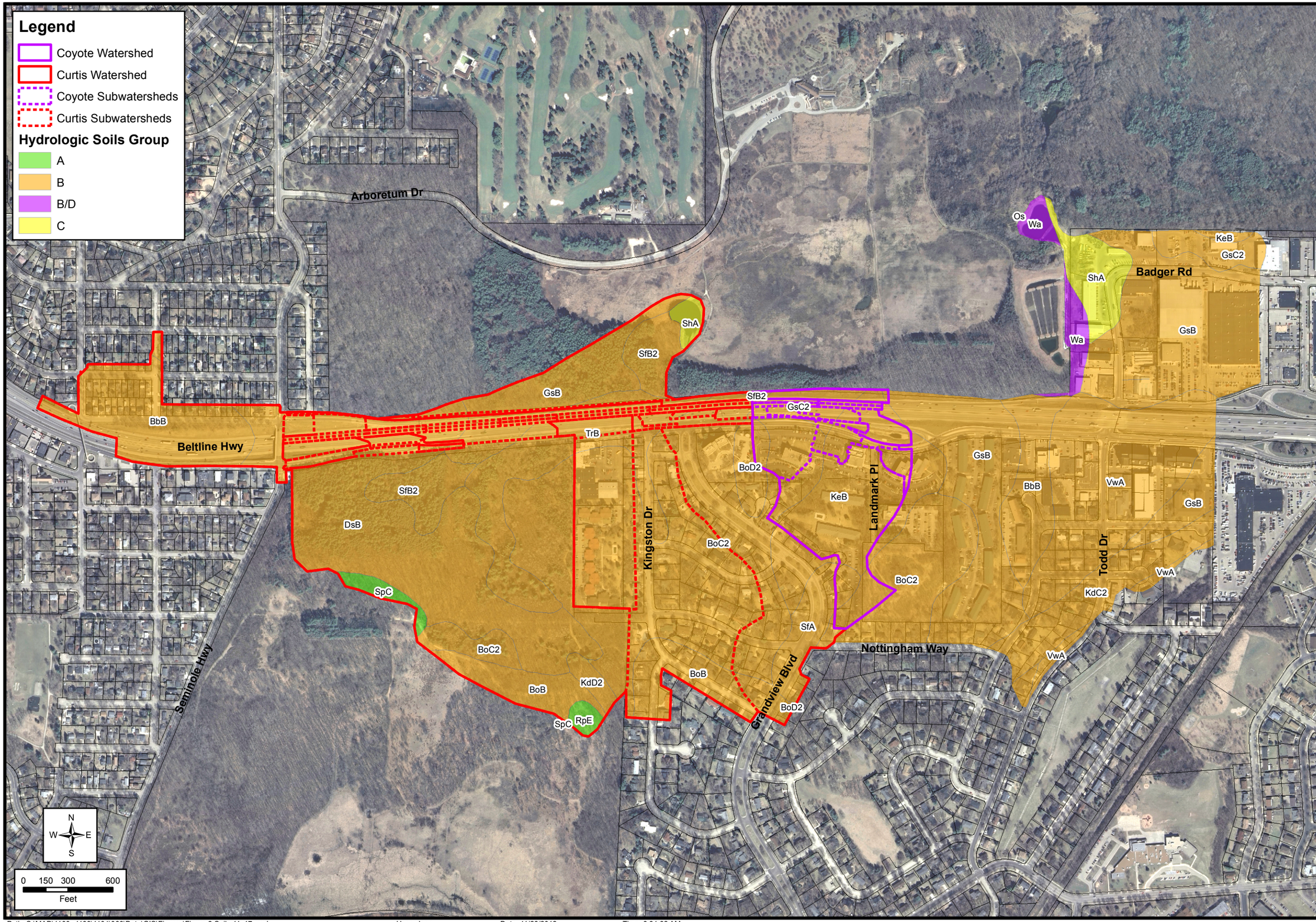
FIGURE 1
1104.066

Path: S:\MAD\1100--1199\1104\066\Data\GIS\Figures\Figure 1 Existing Conditions Hydrology.mxd User: danc Date: 11/28/2012 Time: 8:32:50 AM



SOILS MAP

CURTIS PRAIRIE STORMWATER PLAN
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FIGURE 2
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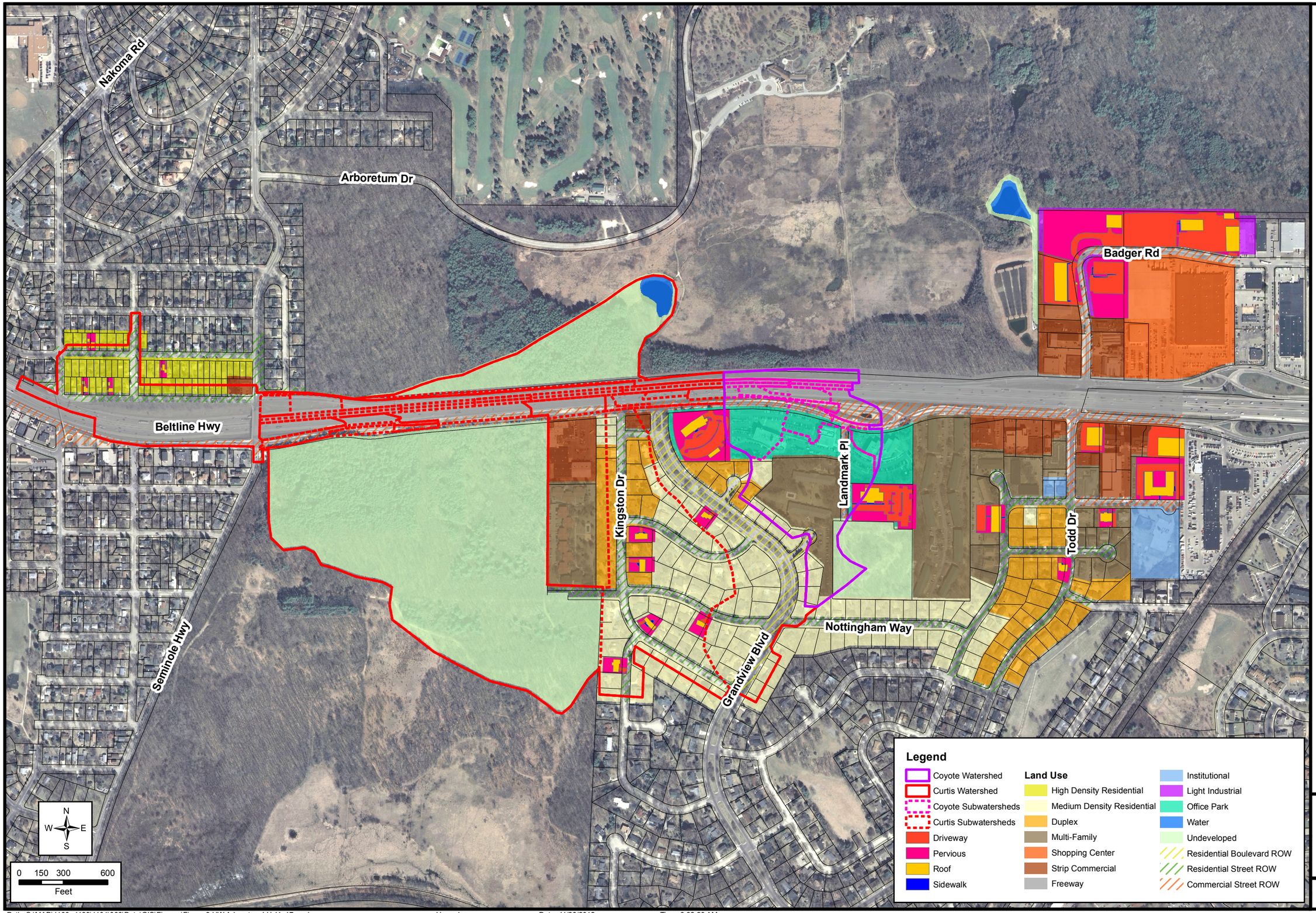

UW-MADISON ARBORETUM LAND USE

CURTIS PRAIRIE STORMWATER PLAN
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FIGURE 3
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TABLE 1

HYDROLOGIC PARAMETERS SUMMARY

Curtis Pond				
Basin ID	Drainage Basin Area (acres)	Tc (hrs)	Tc (min)	RCN
1	0.41	0.08	5	97
401	0.962	0.30	18	95
402	23.575	0.30	18	77
5	0.306	0.08	5	97
40	0.257	0.08	5	96
6801	0.256	0.19	11.1	95
6802	25.231	0.19	11.1	75
69	15.947	0.12	7.1	92
70	0.277	0.08	5	97
74	0.197	0.08	5	97
8301	1.344	0.20	11.7	96
8302	10.77	0.20	11.7	85
84	0.653	0.08	5	90
85	1.142	0.08	5	97
86	0.066	0.08	5	94
88	0.521	0.08	5	97
89	0.444	0.08	5	93
90	0.144	0.08	5	94
91	1.932	0.08	5	96
92	0.227	0.08	5	94
93	61.7	0.36	21.7	66
95	0.051	0.08	5	97
96	0.637	0.08	5	97
97	0.281	0.08	5	97
98	0.94	0.08	5	97
100	0.202	0.08	5	97
101	1.846	0.08	5	97
102	0.258	0.08	5	97
103	0.208	0.08	5	97
104	0.247	0.08	5	97
105	0.317	0.08	5	97
106	0.325	0.08	5	97
107	0.35	0.08	5	97
108	0.197	0.08	5	97
109	0.128	0.08	5	95
CUR-1	13.166	0.73	43.8	59
CUR-2	1.257	0.08	5	67
Total	**167.45**			

Coyote Pond				
Basin ID	Drainage Basin Area (acres)	Tc (hrs)	Tc (min)	RCN
1	0.41	0.08	5	97
2	0.72	0.08	5	97
3	0.37	0.08	5	97
6	0.242	0.08	5	92
7	0.164	0.08	5	97
801	0.826	0.08	5	83
9	0.396	0.08	5	97
1001	1.305	0.08	5	95
13	0.306	0.08	5	94
16	0.247	0.08	5	97
17	0.245	0.08	5	97
18	0.238	0.08	5	97
19	0.232	0.08	5	97
46	13.588	0.20	12.2	81
47	1.323	0.08	5	86
48	3.349	0.23	13.6	85
Total	**25.33**			

Note:
Tc Time of Concentration
RCN runoff curve number

E. Pollutant Source Areas

In addition to land use, pollutant loading from urban areas is dependent on the characterization of "source areas." Various urban source areas will contribute different quantities of runoff and associated pollutants depending on their characteristics. For instance, impervious areas such as roadways and parking lots will generate more runoff and pollutants than pervious areas such as lawns and gardens, especially for smaller, more frequent storms. However, pervious areas will contribute a larger portion of the runoff and pollutants as storm events get larger. For the smallest of rainfall events, almost all runoff and pollutants will be generated by impervious area. Rooftops contribute to increased runoff volumes but tend to contribute fewer pollutants than parking lots or streets.

Impervious cover in a watershed can be organized into two main categories:

1. Rooftops–created by buildings, homes, garages, stores, warehouses, and other buildings.

2. Transport systems–impervious cover created by roads, sidewalks, driveways, and parking lots.

For modeling purposes, all impervious surface area is described in two basic ways: total impervious area or effective impervious area. The total impervious area in a watershed includes all impervious cover, both rooftops and transport systems. The effective impervious area is the portion of total impervious cover that is directly connected to the storm drain network. Often, roof drains are directed to lawns or other pervious surface, allowing some stormwater runoff to infiltrate, which removes these rooftops as effective impervious area.

Table 2 summarizes the existing land use/source area for each drainage basin and watershed for use in water quality modeling calculations.

F. Rainfall Amount and Distribution

According to the Midwestern Regional Climate Center (MRCC) Web site, the City of Madison receives an average annual precipitation of 32.95 inches. Significant runoff-producing events typically occur during spring and summer thunderstorms as a result of stormwater runoff from short-duration, intense storm events. The depth and duration of rainfall in a watershed for a given storm event have a major impact on the amount of stormwater runoff produced.

Table 3 summarizes expected rainfall depths for the 1-year through 100-year storm frequencies for the region (*Bulletin 71, Rainfall Atlas of the Midwest, Floyd A. Huff and James R. Angel–Climatic Section 8*). These rainfall totals are used in conjunction with the *Huff distribution* to estimate peak storm discharges. Upcoming revisions to National Oceanic and Atmospheric Administration Atlas 14 rainfall statistics may be used during design if available.

TABLE 2

SLAMM LAND USE BY WATERSHED (ACRES)

Coyote Pond Watershed (Acres)																
Basin ID	**High-Density Residential**	**Medium-Density Residential**	**Multifamily Residential**	**Duplex Residential**	**Office Park**	**Strip Commercial**	**Shopping Center**	**Institutional**	**Light Industrial**	**Residential Street R/W**	**Residential Boulevard R/W**	**Commercial Street R/W**	**Freeway**	**Water**	**Undeveloped**	**Total**
1	---	---	---	---	---	---	---	---	---	---	---	0.03	0.38	---	---	0.41
2	---	---	---	---	---	---	---	---	---	---	---	0.10	0.62	---	---	0.72
3	---	---	---	---	---	---	---	---	---	---	---	0.01	0.36	---	---	0.37
5	---	---	---	---	---	---	---	---	---	---	---	---	0.31	---	---	0.31
6	---	---	---	---	0.05	---	---	---	---	---	---	0.19	---	---	---	0.24
7	---	---	---	---	---	---	---	---	---	---	---	0.02	0.15	---	---	0.16
801	---	---	---	---	---	---	---	---	---	---	---	0.03	0.79	---	---	0.83
1001	---	---	---	---	---	---	---	---	---	---	---	1.03	0.27	---	---	1.31
13	---	---	---	---	---	---	---	---	---	---	---	0.28	0.03	---	---	0.31
16	---	---	---	---	---	---	---	---	---	---	---	---	0.25	---	---	0.25
17	---	---	---	---	---	---	---	---	---	---	---	---	0.25	---	---	0.25
18	---	---	---	---	---	---	---	---	---	---	---	---	0.24	---	---	0.24
19	---	---	---	---	---	---	---	---	---	---	---	---	0.23	---	---	0.23
46	---	2.05	6.36	0.26	3.00	---	---	---	---	---	0.14	0.70	---	---	1.08	13.59
47	---	---	---	---	0.94	---	---	---	---	---	---	0.38	---	---	---	1.32
48	---	0.01	---	---	2.75	---	---	---	---	---	---	0.60	---	---	---	3.35
COY-1	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.46	1.46
Subtotal	**---**	**2.06**	**6.36**	**0.26**	**6.73**	**---**	**---**	**---**	**---**	**---**	**0.14**	**3.37**	**3.87**	**---**	**2.54**	**25.33**
Percent of Subtotal	**0%**	**8%**	**25%**	**1%**	**27%**	**0%**	**0%**	**0%**	**0%**	**0%**	**1%**	**13%**	**15%**	**0%**	**10%**	**100%**

Curtis Pond Watershed (Acres)																
Basin ID	**High-Density Residential**	**Medium-Density Residential**	**Multifamily Residential**	**Duplex Residential**	**Office Park**	**Strip Commercial**	**Shopping Center**	**Institutional**	**Light Industrial**	**Residential Street R/W**	**Residential Boulevard R/W**	**Commercial Street R/W**	**Freeway**	**Water**	**Undeveloped**	**Total**
401	---	---	---	---	---	---	---	---	---	---	---	0.52	0.45	---	---	0.96
402	---	9.89	0.00	1.81	3.13	0.19	---	---	---	1.06	7.12	0.38	---	---	---	23.58
9	---	---	---	---	---	---	---	---	---	---	---	---	0.40	---	---	0.40
40	---	---	---	---	---	---	---	---	---	---	---	0.07	0.19	---	---	0.26
6801	---	---	---	---	---	---	---	---	---	---	---	0.18	0.08	---	---	0.26
6802	---	13.86	---	5.01	---	0.23	---	---	---	6.00	---	0.12	---	---	---	25.23
69	3.48	---	---	---	---	0.22	---	---	---	3.56	---	1.07	7.62	---	---	15.95
70	---	---	---	---	---	---	---	---	---	---	---	---	0.28	---	---	0.28
74	---	---	---	---	---	---	---	---	---	---	---	---	0.20	---	---	0.20
8301	---	---	---	---	---	---	---	---	---	---	---	0.59	0.76	---	---	1.34
8302	---	0.30	5.36	1.74	---	3.24	---	---	---	---	---	0.13	---	---	0.00	10.77
84	---	---	---	---	---	---	---	---	---	---	---	0.56	---	---	0.09	0.65
85	---	---	---	---	---	---	---	---	---	---	---	0.19	0.95	---	---	1.14
86	---	---	---	---	---	---	---	---	---	---	---	0.07	---	---	---	0.07
88	---	---	---	---	---	---	---	---	---	---	---	0.02	0.50	---	---	0.52
89	---	---	---	---	---	---	---	---	---	---	---	0.42	---	---	0.02	0.44
90	---	---	---	---	---	---	---	---	---	---	---	0.13	0.02	---	---	0.14

Curtis Pond Watershed (Acres)																
Basin ID	High-Density Residential	Medium-Density Residential	Multifamily Residential	Duplex Residential	Office Park	Strip Commercial	Shopping Center	Institutional	Light Industrial	Residential Street R/W	Residential Boulevard R/W	Commercial Street R/W	Freeway	Water	Undeveloped	Total
91	---	---	---	---	---	---	---	---	---	---	---	0.60	1.33	---	---	1.93
92	---	---	---	---	---	---	---	---	---	---	---	0.23	---	---	---	0.23
93	---	0.14	0.11	0.01	---	0.04	---	---	---	0.44	---	0.67	---	---	61.29	62.70
95	---	---	---	---	---	---	---	---	---	---	---	---	0.05	---	---	0.05
96	---	---	---	---	---	---	---	---	---	---	---	---	0.64	---	---	0.64
97	---	---	---	---	---	---	---	---	---	---	---	---	0.28	---	---	0.28
98	---	---	---	---	---	---	---	---	---	---	---	---	0.94	---	---	0.94
100	---	---	---	---	---	---	---	---	---	---	---	---	0.20	---	---	0.20
101	---	---	---	---	---	---	---	---	---	---	---	---	1.85	---	---	1.85
102	---	---	---	---	---	---	---	---	---	---	---	---	0.26	---	---	0.26
103	---	---	---	---	---	---	---	---	---	---	---	---	0.21	---	---	0.21
104	---	---	---	---	---	---	---	---	---	---	---	---	0.25	---	---	0.25
105	---	---	---	---	---	---	---	---	---	---	---	---	0.32	---	---	0.32
106	---	---	---	---	---	---	---	---	---	---	---	---	0.33	---	---	0.33
107	---	---	---	---	---	---	---	---	---	---	---	---	0.35	---	---	0.35
108	---	---	---	---	---	---	---	---	---	---	---	---	0.20	---	---	0.20
109	---	---	---	---	---	---	---	---	---	---	---	0.05	0.08	---	---	0.13
CUR-1	---	---	---	---	---	---	---	---	---	---	---	---	---	0.93	12.23	13.17
CUR-2	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1.26	1.26
Subtotal	**3.48**	**24.20**	**5.48**	**8.57**	**3.13**	**3.92**	**---**	**---**	**---**	**11.06**	**7.12**	**5.99**	**18.69**	**0.93**	**74.89**	**167.45**
Percent of Subtotal	**2%**	**14%**	**3%**	**5%**	**2%**	**2%**	**0%**	**0%**	**0%**	**7%**	**4%**	**4%**	**11%**	**1%**	**45%**	**100%**
Total	**3.48**	**26.26**	**11.84**	**8.83**	**9.86**	**3.92**	**0.00**	**0.00**	**0.00**	**11.06**	**7.25**	**9.36**	**22.56**	**0.93**	**77.43**	**192.78**
Percent of Total	**2%**	**14%**	**6%**	**5%**	**5%**	**2%**	**0%**	**0%**	**0%**	**6%**	**4%**	**5%**	**12%**	**0%**	**40%**	**100%**

TABLE 3

DESIGN STORM RAINFALL DEPTHS (INCHES), BULLETIN 71

Frequency (yr)	Storm Duration (hours)						
	1	2	3	6	12	18	24
1	1.06	1.30	1.44	1.69	1.96	2.12	2.25
2	1.31	1.61	1.78	2.09	2.42	2.61	2.78
5	1.66	2.05	2.26	2.65	3.07	3.32	3.53
10	1.97	2.44	2.69	3.15	3.65	3.95	4.20
25	2.43	3.00	3.32	3.88	4.51	4.87	5.18
50	2.85	3.51	3.88	4.55	5.27	5.70	6.06
100	3.32	4.09	4.52	5.30	6.14	6.64	7.06

HYDROLOGIC AND HYDRAULICS ANALYSIS

The March 2011 report describes the hydrology and hydraulics methodology used for the analysis to date. The analysis included development of hydrologic models using the RUNOFF module of xpswmm (Version 11.3). Hydrographs were generated using the Soil Conservation Service (SCS) Type II distribution of 24-hour duration. While this method is an industry-accepted methodology, it does not allow the user to determine the critical duration storm event for the watershed and overestimates peak discharge rates. A revised methodology (as further described in this section) is appropriate to account for these factors and is based on more recent historic rainfall data and statistical analysis. This is important when sizing infrastructure including storm drains, wet detention basin outlets, and stormwater treatment devices. In some cases, the infrastructure sized for a smaller storm event using the SCS methodology can pass a larger storm event using the revised methodology. This comparison will likely show that the infrastructure is being sized correctly.

A. Purpose of Evaluation

A watershed model was developed for the Curtis and Coyote watersheds in the study area. This model estimated peak discharges and stormwater runoff volumes from the individual watersheds under existing conditions. Since the watershed is fully built-out, future land use conditions will be similar to existing land use conditions; therefore, total suspended solids (TSS) and phosphorous (P) loadings are not expected to increase significantly. This data was used to size and analyze stormwater features, herein.

B. Methodology

For this project, hydrologic models were developed using the RUNOFF module of the computer model xpswmm Version 14.0. xpswmm is a proprietary model based on the United States Environmental Protection Agency-developed Stormwater Management Model (swmm). xpswmm estimates peak stormwater discharges and volumes based on mathematical input parameters representing precipitation depth and time distribution, drainage area, land use, and time of concentration for each subbasin. Primary input parameters include the drainage area, runoff curve number (RCN), and time of centration (T_c). The RCN considers land use and percentage of impervious area, soil type, and saturation conditions to impact the volume of stormwater runoff generated for a given rainfall depth. The T_c is the time it takes for stormwater to travel from the most hydrologically remote point in the watershed to the subbasin outlet. Parameters representing rainfall depth and distribution and watershed storage are also included in the model.

Based on user input coding, xpswmm generates hydrographs for each subbasin, routes them through storage areas, and combines them at appropriate locations. The result is a rainfall-runoff model of the storm event of interest. For this project, hydrographs were generated for the 1-, 2-, 5-, 10-, 25-, 50- and 100-year storms under existing land use conditions. The Huff rainfall (1st Quartile for storms of duration 6 hours and less and 2nd Quartile for storms of duration of 6.1- to 12-hour) distribution was analyzed for this project. A sensitivity analysis was performed in the March 2011 report to identify the storm duration resulting in the highest probable peak discharges at various watershed locations (typically referred to as the “critical duration”). Our

analysis concluded that the critical storm duration creating the greatest peak discharges watershedwide under existing land use conditions is a 1-hour storm.

The Extended Transport (EXTRAN) module of the xpswmm computer model was used to calculate the hydraulic capacity of the existing storm drain system under existing conditions. EXTRAN is a dynamic flow routing model that routes inflow hydrographs through an open-channel and/or closed-conduit system computing the time history of flows and heads throughout the system. Input to EXTRAN includes the following:

1. Physical geometry of the storm drain system including storm drain sizes and shapes, ground and invert elevations, and storm drain connectivity information.

2. Data regarding special hydraulic structures in the system including weirs, check valves, and storage junctions.

3. Roughness coefficients for existing and proposed conduits.

4. Inflow hydrographs at critical nodes in the system. For this project, hydrographs were computed using the xpswmm RUNOFF module.

5. Boundary conditions defining starting water surface elevations and other inlet and outlet conditions.

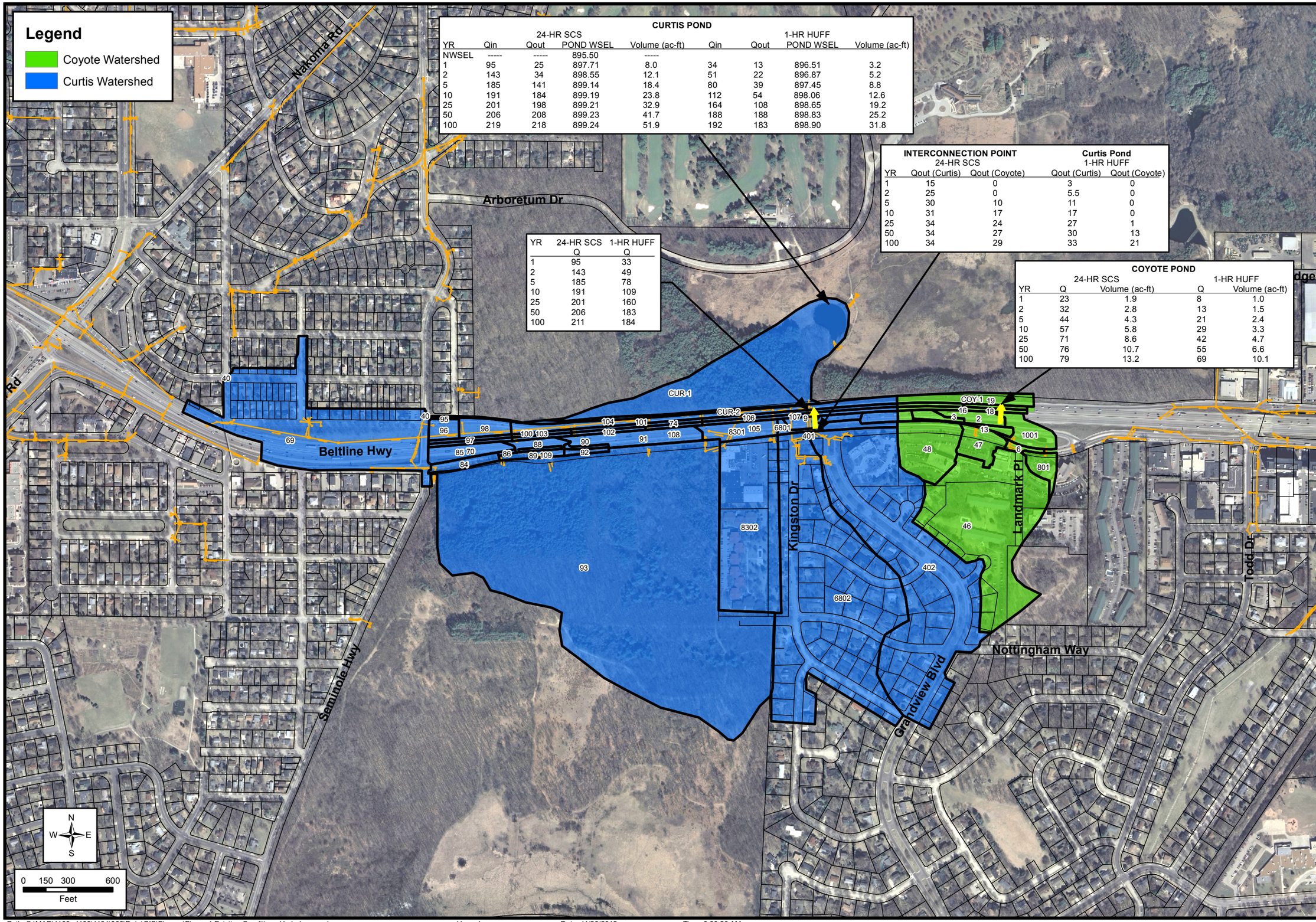
6. Stage-storage-outflow data for existing and proposed Curtis Pond.

Strand Associates, Inc.® obtained the WisDOT's xpswmm model that was used for storm drain design along the West Beltline. Known deficiencies in the model were corrected and modifications made as described in the study in Appendix C of the March 2011 report before its use. Data in the model has not been field-verified other than as discussed in the study in Appendix C. Therefore, the models used are based on the best readily available information. A more representative model would require field survey of the entire system and input of a storage node on the west side of 2802 Kingston Drive where a substantial in-yard ponding area exists, among other improvements to the model. These modifications are beyond the scope of our Agreement with the WDOA/WDSF; however, it appears the model used for the plan, herein, provides a reasonable representation of the operation of the storm drain system.

The xpswmm model and results herein incorporate the interconnection modification (recommended Alternative 3) constructed in fall 2010 as described in the study in Appendix C of the March 2011 report.

C. Modeling Results (Existing Conditions)

Tables 4 and 5 include summaries of peak discharges calculated by xpswmm for the Curtis and Coyote watersheds using existing land use conditions and Huff rainfall amounts and distribution for a 1-hour duration storm event. Figure 4 shows additional peak discharges at various points of interest including the south side of the Beltline, the two storm drain outfalls discharging into the Arboretum, the proposed location of the Coyote stormwater treatment device, and the interconnection point between the two watersheds. Curtis Pond operating scenarios are also shown on the figure.



CURTIS POND

	24-HR SCS				1-HR HUFF			
YR	Qin	Qout	POND WSEL	Volume (ac-ft)	Qin	Qout	POND WSEL	Volume (ac-ft)
NWSEL	-----	-----	895.50	-----				
1	95	25	897.71	8.0	34	13	896.51	3.2
2	143	34	898.55	12.1	51	22	896.87	5.2
5	185	141	899.14	18.4	80	39	897.45	8.8
10	191	184	899.19	23.8	112	54	898.06	12.6
25	201	198	899.21	32.9	164	108	898.65	19.2
50	206	208	899.23	41.7	188	188	898.83	25.2
100	219	218	899.24	51.9	192	183	898.90	31.8

YR	24-HR SCS Q	1-HR HUFF Q
1	95	33
2	143	49
5	185	78
10	191	109
25	201	160
50	206	183
100	211	184

	INTERCONNECTION POINT 24-HR SCS		Curtis Pond 1-HR HUFF	
YR	Qout (Curtis)	Qout (Coyote)	Qout (Curtis)	Qout (Coyote)
1	15	0	3	0
2	25	0	5.5	0
5	30	10	11	0
10	31	17	17	0
25	34	24	27	1
50	34	27	30	13
100	34	29	33	21

COYOTE POND

	24-HR SCS		1-HR HUFF	
YR	Q	Volume (ac-ft)	Q	Volume (ac-ft)
1	23	1.9	8	1.0
2	32	2.8	13	1.5
5	44	4.3	21	2.4
10	57	5.8	29	3.3
25	71	8.6	42	4.7
50	76	10.7	55	6.6
100	79	13.2	69	10.1

EXISITING CONDITIONS HYDROLOGY FOR CURTIS AND COYOTE BASINS

CURTIS PRAIRIE STORMWATER PLAN
WI DOA/DSF AND UW-MADISON
MADISON, WISCONSIN

STRAND ASSOCIATES®

FIGURE 4
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It appears that Curtis Pond is operating at a decent performance level considering the high peak discharge shaving that the modeling shows for up to approximately the 10-year storm. Peak discharge shaving is a result of storage of upstream flows in Curtis Pond allowing for a decreased discharge rate to Curtis Prairie downstream of the pond. As described in Section 3 of the *UW-Madison Arboretum-Curtis and Coyote Ponds Stormwater Management Plan*, Curtis Pond appears to be capable of achieving about 63 percent TSS reduction, which shows the pond affords the UW–Madison Arboretum with some level of protection from stormwater inflows.

Watershed Node	Area (ac)	1-Year (cfs)	2-Year (cfs)	5-Year (cfs)	10-Year (cfs)	25-Year (cfs)	50-Year (cfs)	100-Year (cfs)
1	0.41	0.74	1.02	1.43	1.80	2.36	2.87	3.44
2	0.72	1.29	1.79	2.51	3.16	4.14	5.04	6.04
3	0.37	0.66	0.92	1.29	1.63	2.13	2.59	3.11
5	0.31	0.55	0.76	1.07	1.34	1.76	2.14	2.57
6	1.07	0.42	0.73	1.23	1.73	2.54	3.35	4.29
7	0.16	0.29	0.41	0.57	0.72	0.94	1.15	1.38
10.01	1.31	1.72	2.38	3.50	4.57	6.26	7.84	9.64
13.01	0.31	0.36	0.51	0.73	0.96	1.33	1.70	2.11
16	0.25	0.44	0.61	0.86	1.09	1.42	1.73	2.07
17	0.25	0.44	0.61	0.85	1.08	1.41	1.71	2.06
18	0.24	0.43	0.59	0.83	1.05	1.37	1.67	2.00
19	0.23	0.42	0.58	0.81	1.02	1.33	1.62	1.95
46	13.59	2.56	4.88	9.10	13.65	21.42	29.35	38.97
47	1.32	0.56	0.95	1.61	2.24	3.29	4.33	5.52
48	3.35	1.10	1.89	3.22	4.57	6.81	9.03	11.68
COY-1	1.46	0.04	0.12	0.32	0.57	1.09	1.71	2.53
Total	**25.34**							

Table 4 Coyote Watershed–Peak Discharge for Huff 1st Quartile Distribution 1-Hour Storm

Watershed Node	Area (ac)	1-Year (cfs)	2-Year (cfs)	5-Year (cfs)	10-Year (cfs)	25-Year (cfs)	50-Year (cfs)	100-Year (cfs)
4	24.54	2.58	5.54	11.10	17.15	27.70	38.68	52.23
9	0.40	0.71	0.98	1.38	1.74	2.28	2.77	3.32
68	25.49	1.84	4.39	9.71	15.79	27.10	39.38	54.53
69	15.95	14.52	21.33	31.76	41.62	57.03	72.26	90.27
70	0.28	0.50	0.69	0.97	1.22	1.59	1.94	2.33
74	0.20	0.35	0.49	0.69	0.87	1.13	1.38	1.65
83	12.11	5.07	8.28	13.58	18.86	27.46	35.87	45.82
84	0.65	0.47	0.72	1.11	1.49	2.07	2.64	3.40
85	1.21	2.17	3.01	4.23	5.32	6.97	8.48	10.17
88	0.65	1.17	1.62	2.27	2.86	3.74	4.56	5.46
89	0.44	0.46	0.66	0.96	1.26	1.77	2.26	2.85
90	0.37	0.63	0.88	1.23	1.56	2.05	2.50	3.01
91	1.93	2.88	4.08	5.89	7.59	10.17	12.55	15.24
93	62.71	0.03	1.76	6.33	11.81	24.87	40.53	61.28
95	0.05	0.09	0.13	0.18	0.22	0.29	0.36	0.43
96	0.64	1.14	1.58	2.22	2.80	3.66	4.46	5.35
97	0.28	0.50	0.70	0.98	1.23	1.62	1.97	2.36
98	0.94	1.69	2.33	3.28	4.13	5.41	6.58	7.89
100	0.20	0.36	0.50	0.70	0.89	1.16	1.41	1.70
102	0.26	0.46	0.64	0.90	1.13	1.48	1.81	2.17
103	0.21	0.37	0.52	0.73	0.91	1.20	1.46	1.75
104	0.25	0.44	0.61	0.86	1.09	1.42	1.73	2.07
105	0.32	0.57	0.79	1.11	1.39	1.82	2.22	2.66
106	0.33	0.58	0.81	1.13	1.43	1.87	2.27	2.73
107	0.35	0.63	0.87	1.22	1.54	2.01	2.45	2.94
108	0.20	0.35	0.49	0.69	0.87	1.13	1.38	1.65
CUR-1 POND	13.17	0.00	0.00	0.18	0.74	2.03	3.65	5.88
CUR-2	3.11	0.78	1.33	2.25	3.26	5.09	6.93	9.19
Total	**167.22**							

Table 5 Curtis Pond Watershed–Peak Discharge for Huff 1st Quartile Distribution 1-Hour Storm

WATER QUALITY MODELING

As discussed in Section 3 of the March 2011 report, the computer program WinSLAMM Version 9.4.0 was used to perform stormwater quality modeling for the project. A summary of the analysis results is shown in Tables 6 and 7.

Watershed	Area (acres)	Baseline Loading (lbs)	Loading With Existing Controls (lbs)	Percent Reduction From Street Sweeping	Percent Reduction From Wet Detention Pond	Total Percent Reduction
Curtis Pond	167.22	38,393	14,166	0.00	63.12	63.12
Coyote Pond	25.34	10,135	9,419	7.07	0.0	7.07
Total	192.56	48,528	23,585	0.0	0.0	51.40

Note 1: Total Suspended Solids (TSS) Loadings are pounds a year.
Note 2: Coyote Pond Loading With Existing Controls does not include the effect of the WisDOT pond.

Table 6 SLAMM Modeling Results–Percent Reduction in TSS Loading

Watershed	Area (acres)	Baseline Yield (lbs)	Existing Controls Yield (lbs)	Percent Reduction From Street Sweeping	Percent Reduction From Wet Detention Pond	Total Percent Reduction
Curtis Pond	167.22	130	74	0.00	43.08	43.08
Coyote Pond	25.34	28	27	3.57	0.0	3.57
Total	192.56	158	101	0.0	0.0	36.07

Note: Phosphorous loadings are pounds a year.

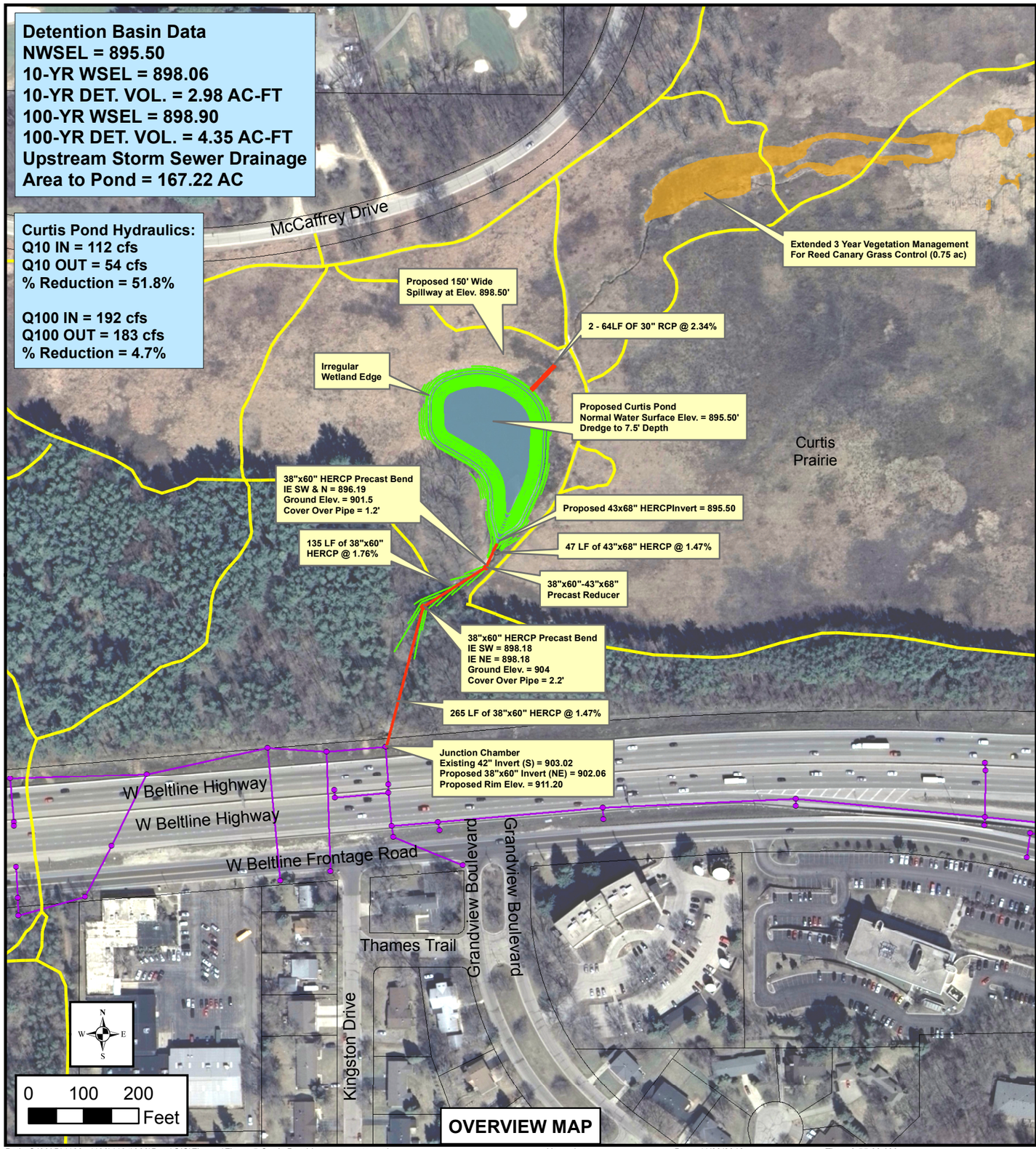
Table 7 SLAMM Modeling Results–Percent Reduction in Phosphorous Loading

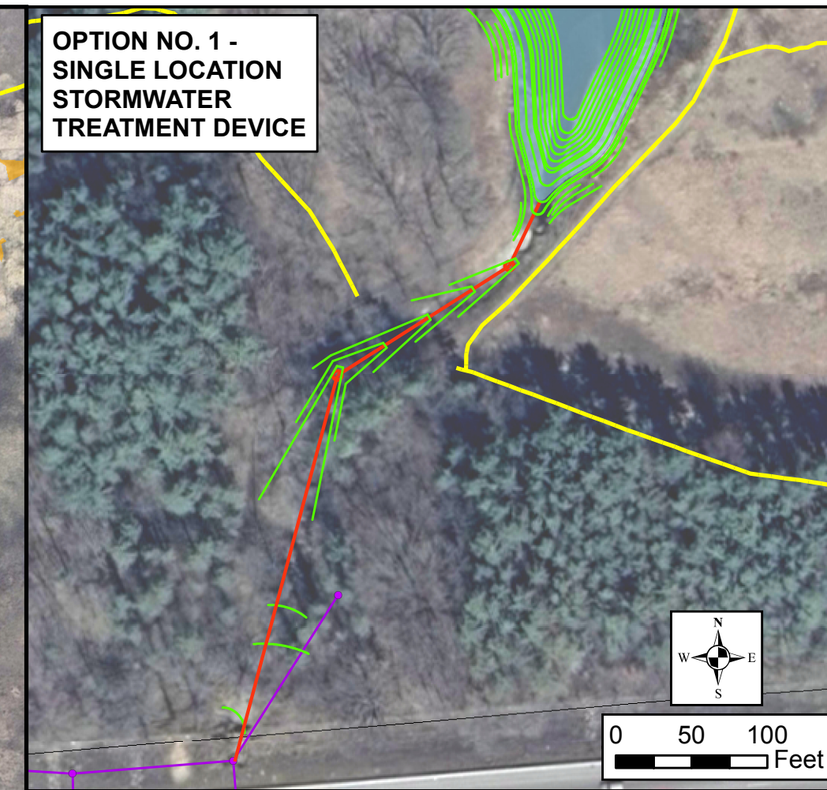
CURTIS POND FEATURES

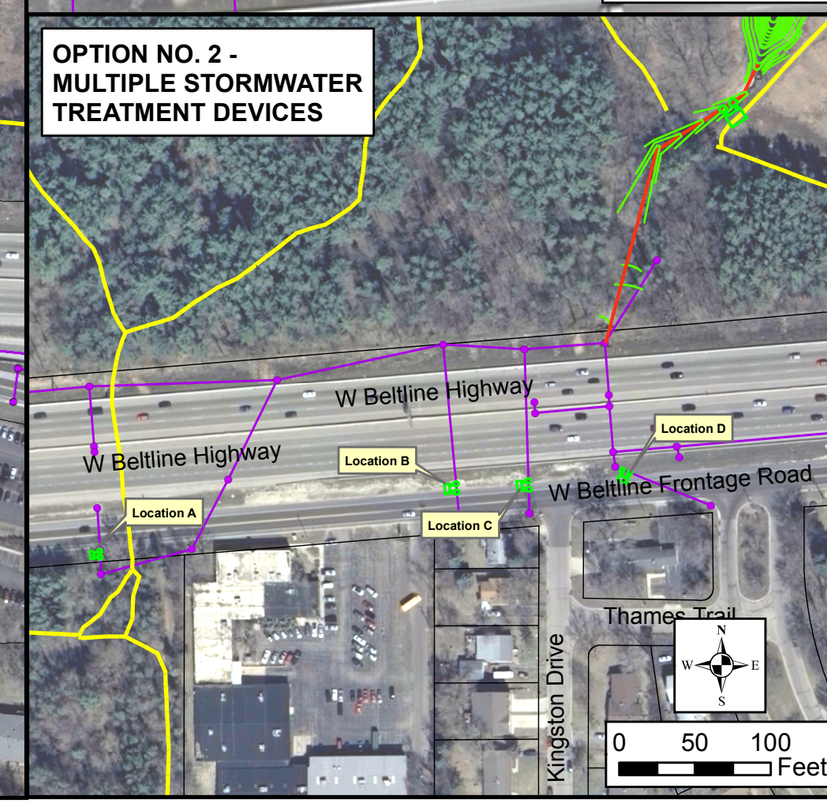
The UW-Madison Arboretum Stormwater Committee's selected alternative from the March 2011 report is a combination of Alternative 15b (rehabilitated Curtis Pond and storm drain from the Beltline to Curtis Pond) and Alternative 13a (trash and sand collector in WisDOT R/W). It also includes invasive species management in the swale downstream of Curtis Pond (as determined by UW-Madison Arboretum staff). Figure 5 shows the Curtis Pond features.

A. Pond Rehabilitation

The UW-Madison Arboretum desires to rehabilitate Curtis Pond similar to the Pond 2 and Marion-Dunn Pond rehabilitations with differences to minimize disturbance of the berm. This entails dewatering the pond to dredge sediment that has accumulated in the original pond basin. The features of the Curtis Pond rehabilitation include the following.







CURTIS POND STORMWATER IMPROVEMENTS

CURTIS PRAIRIE STORMWATER PLAN
WI DOA/DSF AND UW-MADISON
MADISON, WISCONSIN

STRAND ASSOCIATES®

FIGURE 5
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Path: S:\MAD\1100--1199\1104\066\Data\GIS\Figures\Figure 5 Curtis Pond Improvements.mxd User: danc Date: 11/29/2012 Time: 9:55:03 AM

1. Original Design Drawings

Original Design Drawings dated October 1969 were reviewed (see Figure 6). Drawings appear to indicate that the berm would have been constructed with a core trench (bottom elevation of 888.0) consisting of the most impervious material on-site compacted in 8-inch lifts and the remainder of the embankment built with fill material (free of sod, brush, roots, and other perishable material and stones having a maximum dimension of more than 6 inches) compacted in 8-inch lifts. In addition, the outlet appears to have been constructed as a single 24-inch-diameter CMP with upstream invert elevation at 891.0 and downstream invert elevation at 890.6. The bottom of the pond was at elevation 891.0 and the bottom of the pond was constructed at a 0.3 percent slope, meaning the original pond was constructed as a dry detention basin. No outlet structure appears to have been originally constructed. No clay liner appears to have been constructed.

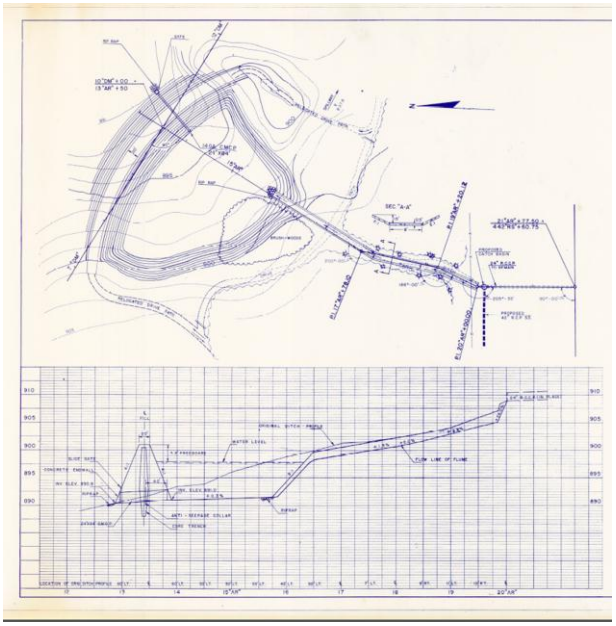


Figure 6 Original Curtis Pond Design Drawings

2. Forebay

Because of the small size of the pond, construction of a forebay would decrease the stormwater quality performance of the pond. Sediment removal would then be removed from the entire pond extents when it is needed, rather than from a forebay on a more frequent schedule.

3. Pond Edge

The intent of the rehabilitation will be to remove sediment below the normal water surface of the pond to minimize disturbance of the vegetated embankment. In this regard, a safety shelf will not be constructed, but rather the plan and design should seek to create an irregular wetland boundary.

4. Outlet Structure, Upstream, and Downstream Pipes

In our May 2001 *UW-Madison Evaluation of Stormwater Facilities*, an outlet structure not shown on the original design drawings for the pond was observed and is shown in Figure 7. This outlet structure appears to allow the originally designed pipe to drain if the slide gate is lifted. This could carry accumulated sediment downstream. Any dewatering of the pond should be pumped into a dewatering bag to collect sediment. The outlet structure (with slide gate closed) maintains a normal water surface elevation in the pond at elevation 895.50 by way of a rectangular weir. Outflow from the structure only occurs when the pond water surface elevation rises during a storm event and only after water reaches the structure through the underground corrugated metal pipe. We understand that the existing outlet structure is in good condition and that the downstream pipe was reconstructed from CMP to polyvinyl chloride (PVC) pipe in 2010. However, the inner working mechanisms are in need of replacement. Replacement options include a mechanically operated outlet, a weir(s), or an orifice. A mechanically operated outlet would be subject to deterioration from lack of maintenance. The chosen outlet replacement option will optimize the peak discharge attenuation to the extent possible. Dewatering required for future maintenance projects can be accomplished by pumping the water into dewatering bags so that the existing mechanically operated outlet can be removed. The upstream pipe will be replaced with a reinforced concrete pipe and currently at elevation 891.0. This lower outlet elevation supports the need for a deeper bottom of pond excavation to reduce sediment buildup in the pipe and maintain hydraulic capacity through this pipe.

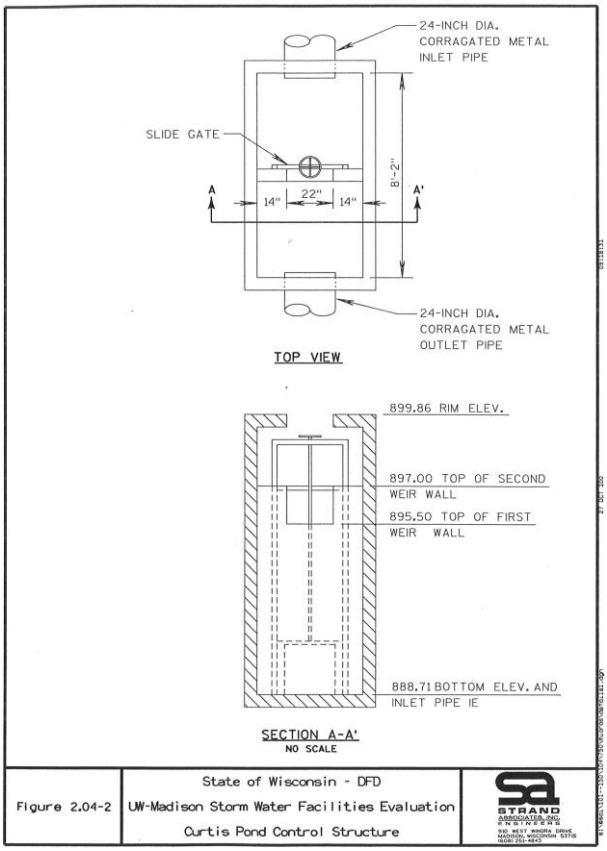


Figure 7 Existing Curtis Pond Outlet Structure

5. Clay Liner

Since the original pond appears to have been constructed to a bottom elevation ranging between 891.0 and 891.5 without a clay liner, it may be possible to dredge the rehabilitated pond down to these elevations without the need for a clay liner. With the current permanent pool elevation at 895.50, this would provide a water depth of between 4 and 4.5 feet. In order to assess the feasibility of deeper dredging (to provide greater sediment storage and less frequent dredging) without need for a clay liner, it is recommended that geotechnical borings be obtained

during design. For purposes of this report and to be conservative from a cost standpoint, we have assumed the pond will be excavated down to elevation 888 (7.5-foot water depth) and will require a clay liner. This elevation and depth would be reassessed during design after obtaining geotechnical and groundwater information. For comparison purposes, Marion-Dunn Pond, Pond 2, Pond 4, and Secret Pond were excavated to a water depth of 7.5 feet, 6.5 feet, 5 feet, and 5 feet, respectively. These vary because of specific issues at each location relative to cost, geotechnical, groundwater, and sediment storage.

6. Existing Pond Embankment

We understand the existing pond embankment is stable and has not suffered from erosion because of embankment overtopping. As discussed above, it appears the pond embankment was constructed with appropriate compacted materials. In this regard, the intent of the design is to avoid or minimize disturbance to the embankment during construction. Geotechnical borings in the berm, however, are recommended during design to confirm the character of the berm construction materials.

7. Dredging Options

To date, contractors have chosen to reconstruct each of the other UW-Madison ponds by dewatering the basins and using mechanical methods for sediment removal. For this project, the UW-Madison Arboretum has requested an evaluation of hydraulic dredging (see Figure 8) as an option to mechanical dredging. The following matrix provides advantages and disadvantages of each method. Permits typically would require specification of a dredging method, especially if hydraulic dredging is pursued, since permit verbiage differs between the two methods.

Figure 8 Hydraulic Dredging Photographs

TABLE 8

DREDGING METHOD COMPARISON

Potential Parameters	Dredging Method	
	Mechanical	Hydraulic
Cost w/Off-site Disposal	$15-$40 a CY	$80 to $120 per CY.
Mobilization	Backhoe will need to be brought in with likely dropoff at Arboretum Drive and drive down path to reach Curtis Pond.	Hydraulic dredge would need to be brought in on a trailer and launched into the pond.
High Groundwater	If high groundwater exists, may require a dewatering well system like at Pond 2.	High groundwater will have limited effect.
Make-up Water	Not required.	Sufficient water needs to be available to pump the sediment; can be collected from the dewatering bag field and recycled or augmented with city water.
Staging Area	Area required for dump trucks to enter, navigate through, and exit construction site.	Area is also required for large sediment dewatering bags. Bags are broken open, loaded on dump trucks, and hauled off-site like mechanical materials would be.
Grade Control	Can achieve fine grading and tolerances needed for an irregular wetland boundary.	More difficult to achieve fine grading and tolerance, especially at the water's edge.
Reuse of material as backfill over storm drain trench.	Suitability of the material determined by sediment sampling but would be high in moisture content. Original pond spoils pile may be preferable for this use, pending obtaining geotechnical data.	This would be the same material as with mechanical but would be dewatered in dewatering bag including polymer addition. Dewatered material may not be suitable and original pond spoils pile may still be preferable for this use.
Parent material removal to deepen pond	Mechanical dredging can accomplish this in all conditions but may be made more difficult depending on groundwater elevations.	Hydraulic dredging can accomplish this in more ideal conditions (no clay and no cobbles greater than 4- to 6-inch diameter) and is not affected by groundwater elevations. Significant time and cost increases accrue when clay materials are encountered. Cobbles greater than 4 to 6 inches in diameter are not hydraulically dredgeable.
Clay-liner construction	Mechanical methods are required to construct a clay liner.	Would require pond dewatering and mechanical placing of liner.
Reconstruction of the upstream outlet structure pipe	Since this pipe needs to be reconstructed, the entire pond needs to be dewatered. The entire pipe is under water with the upstream invert of the pipe at the bottom of the pond. The outlet pipe could be sheet piled to hold back the water but would incur additional cost.	The outlet pipe would not be constructible using hydraulic dredging methods unless additional cost were incurred to install a sheet pile to hold back the water.
Erosion Control	Dewatered pond serves as the sedimentation basin during rain events. If pond were to fill up and discharge, a downstream stone check dam before the fire lane crossing would provide additional treatment downstream of the settlement occurring in the pond.	Polymer is injected into the pumped sediment before discharge into the sediment dewatering bags. The polymer assists in flocculating the sediment to create "clear" water discharge from the sediment bag. Silt fence downstream of the bag is an added measure of control.

8. Restoration

Restoration will consist of restoring disturbed areas above the normal water surface with native vegetation. At the water's edge and to a depth of 6 inches of water, it is proposed to provide native plugs at a certain density. Restoration specifications will require extended 3-year maintenance and warranty requirements similar to Secret Pond requirements. There will also be an opportunity for existing wetland plants in the footprint of Curtis Pond to be replanted along the proposed irregular wetland boundary of the pond.

B. Storm Drain

In the March 2011 report, the storm drain was designed to pass the 10-year storm event using the SCS Type II 24-hour storm event of 196 cubic feet per second (cfs). The xpswmm model shows the 100-year storm event to this point would be 218 cfs (under surcharged conditions). The reason the 100-year peak flow is close to the 10-year peak flow is because the xpswmm model accounts for the theoretical ponding that would occur in the system upstream of the Arboretum lands once the storm drain system reaches capacity.

To better analyze the appropriate size of the proposed storm drain, we have used an alternative methodology to arrive at peak flow rates for the various storm events. Using the new methodology, the proposed storm drain will be able to pass the 100-year flow rate.

The March 2011 report included a storm drain at 1.76 percent slope ranging between a 48- and a 54-inch-diameter storm drain. As shown in Figure 5, the revised proposed storm drain size ranges from a 38-inch by 60-inch (48-inch-diameter equivalent) horizontal elliptical reinforced concrete pipe (HERCP) to a 43-inch by 68-inch HERCP (54-inch-diameter equivalent) at a 1.47 percent slope. The xpswmm model shows that these pipes will convey 192 cfs during the 100-year, 1-hour duration storm event. The 100-year, 1-hour duration storm event flow at this point is 184 cfs. In effect, the proposed storm drain has a 100-year, 1-hour duration storm event capacity. The lesser percent slope also allows for greater cover over the top of the storm drain and lower velocities at the discharge to the pond.

The area over the top of the storm drain would be restored with native vegetation. Since the storm drain route has a north-south orientation, a minimal clear zone would be required to encourage vigorous growth of native vegetation.

C. Stormwater Treatment Device

In addition to pond maintenance, the scope of work for this project calls for analysis of two alternatives for stormwater treatment devices to primarily provide removal of floatables, trash, and sand. A graphic representation of these alternatives is shown on Figure 5.

1. Option No. 1–Stormwater Treatment Device at Single Location: As shown in Figure 5, a centralized approach has been taken to stormwater treatment. This location provides pretreatment for the entire watershed before flows reaching Curtis Pond. The following manufacturers were contacted to obtain cost and performance data at this location. For purposes of this report, we have used the Vortechs layout (see Figure 9) because of its relative simplicity and minimal required sump distance. The cost used is the average of the cost for the five manufacturers.

    a. CDS
    b. Vortechs
    c. Terri Kleen
    d. Stormceptor
    e. Downstream Defender

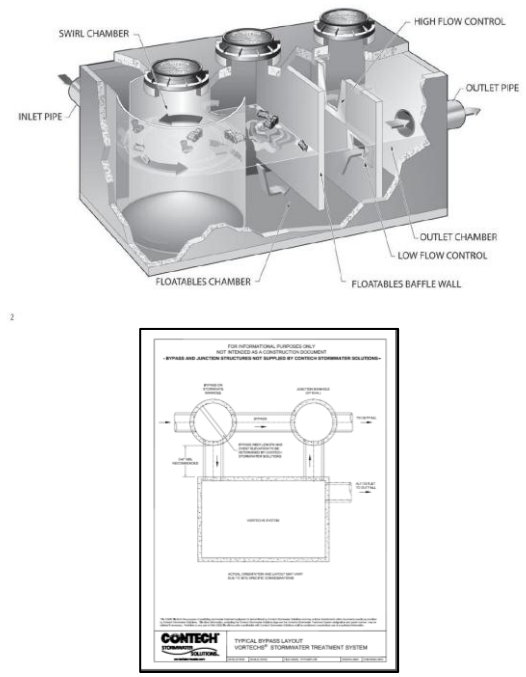


Figure 9 Vortechs Standard Layout Example

2. Option No. 2–Stormwater Treatment Device at Four Locations: As shown in Figure 5, a decentralized approach has been taken to stormwater treatment. In this scenario, 67.4 acres would be pretreated before flows reach Curtis Pond, and 100 acres (mainly WisDOT R/W and Arboretum lands) would not receive pretreatment before reaching Curtis Pond. The following manufacturers were contacted to obtain cost and performance data at these four locations. For purposes of this report, we have used the Vortechs layout on all but the westernmost device locations because of its relative simplicity and minimal required sump distance. The westernmost device location is conducive to a City of Madison Design, which requires a 2-foot drop in invert across the structure. The cost used is the cost received from the manufacturer of the Vortechs device and an estimated cost of the City of Madison design (see Figure 10).

a. CDS
b. Vortechs
c. Terri Kleen
d. Stormceptor
e. Downstream Defender
f. City of Madison Design

3. Advantages and Disadvantages of Various Stormwater Treatment Devices–Table 9 compares the advantages and disadvantages of each of the device manufacturers.

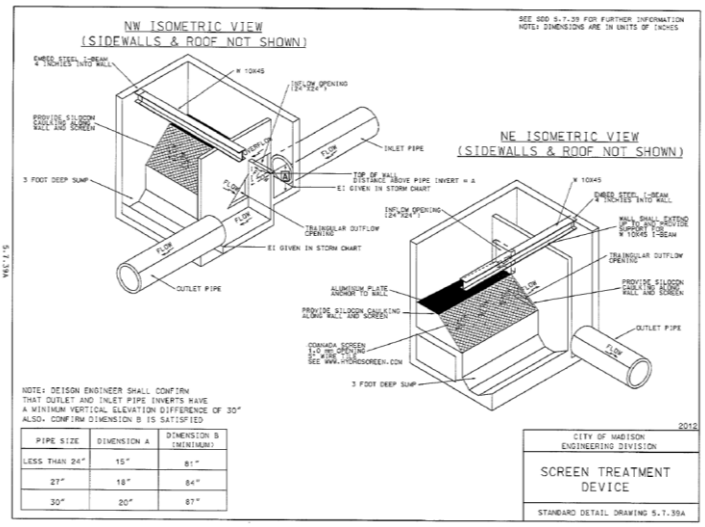


Figure 10 City of Madison Design Example

Manufacturer	Advantages	Disadvantages
CDS (Contech)	Equipped with self-cleaning screen to reduce risk of clogging.	Requires a deep sump to eliminate sediment resuspension.
Vortechs (Contech)	Minimal sump required below invert. Easy to clean and simple bypass layout.	Rectangular footprint may not fit in certain situations.
Terri Kleen	Minimal sump required below invert. Easy to clean.	The screen used to collect floatables may become clogged. Requires deep sump.
Stormceptor (Rinker)	Risk of failure because of clogging is minimal there is no internal screen.	Requires additional structure to remove floatables. Requires a deep sump to eliminate sediment resuspension.
Downstream Defender (Hydro International)	Low risk of blockage and hydraulic losses.	Requires a deep sump to eliminate sediment resuspension.
City of Madison Design	Competitive cost because of City of Madison design versus private vendor.	Requires elevation drop equivalent to the incoming pipe diameter. Screen may become clogged.

Table 9 Stormwater Treatment Device Comparison

D. Curtis Prairie Swale Vegetation Maintenance

For the swale area downstream of Curtis Pond, the UW-Madison Arboretum has indicated this component should consist of invasive species management and native species augmentation similar to that required on Secret Pond. The area to be managed is approximately 0.75 acres as shown in Figure 5. Utilizing the cost data for three years of management and warranty bid for the Secret Pond project, the high cost/acre converted to 2nd Quarter 2012 dollars is $20,000 an acre. The average of the four bids would equate to $17,500 an acre. For costing purposes, we use $20,000 an acre.

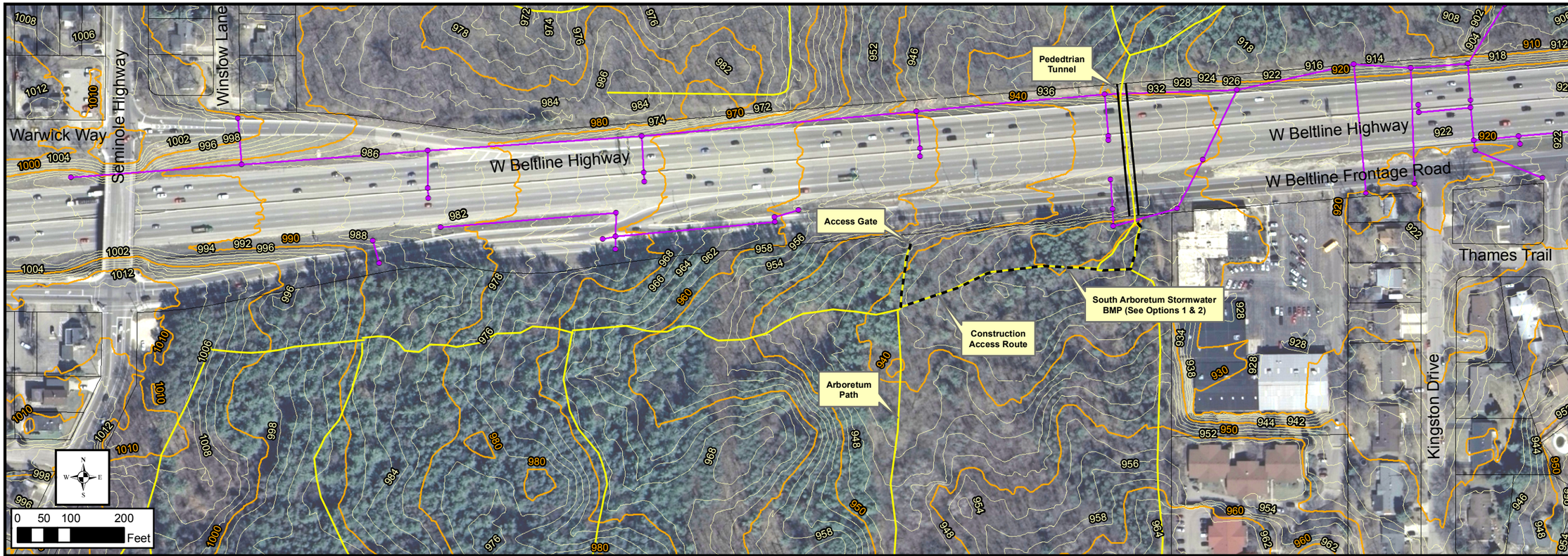
E. Grady Tract Drain-Stormwater Best Management Practice (BMP)

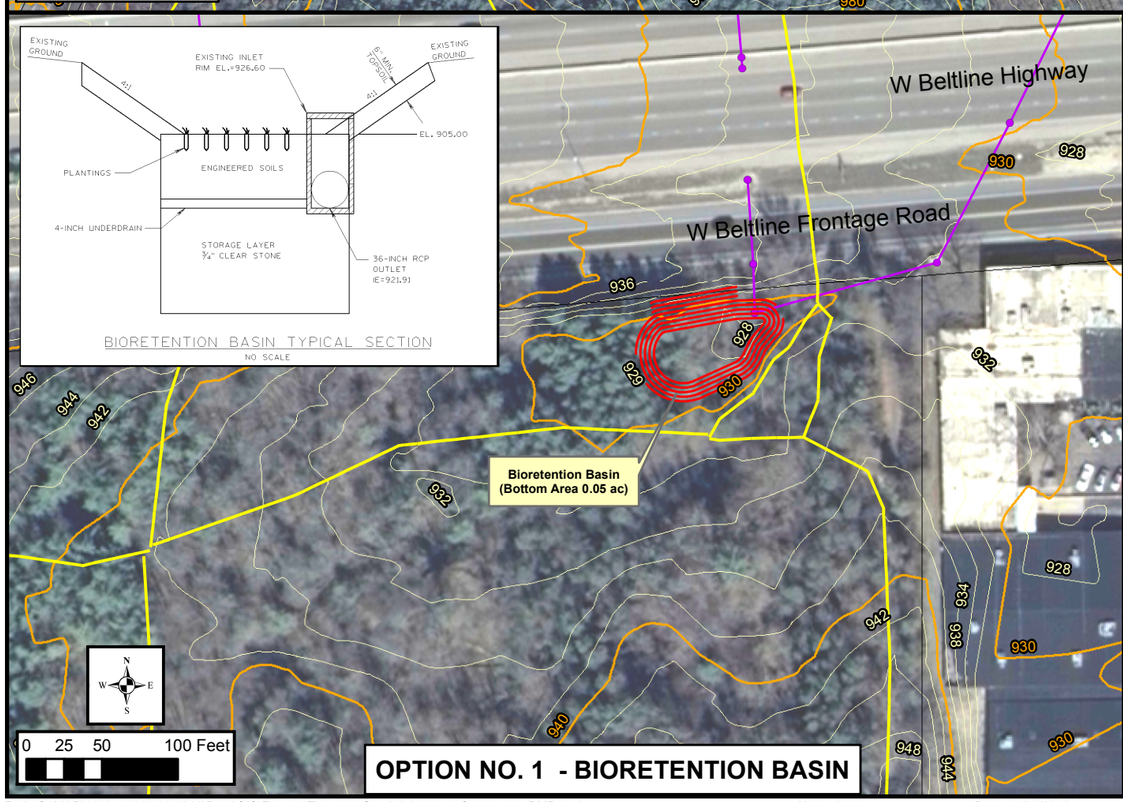
At this location, the northern portion of the Grady Tract drains to a grated inlet with outgoing 24-inch-diameter pipe. This inlet is currently surrounded by silt fence to keep debris from clogging the inlet grate and to provide a measure of sediment control. It is the desire of the UW-Madison to provide a stormwater BMP in the general area of the inlet to provide treatment and debris control. Herein, two alternatives are conceptually analyzed for this purpose as shown in Figure 11. Figure 12 shows the view looking northeast at the general location of the proposed BMP. It should be noted this area is dominated by invasive species (e.g., honeysuckle) that would beneficially be removed as part of this project.

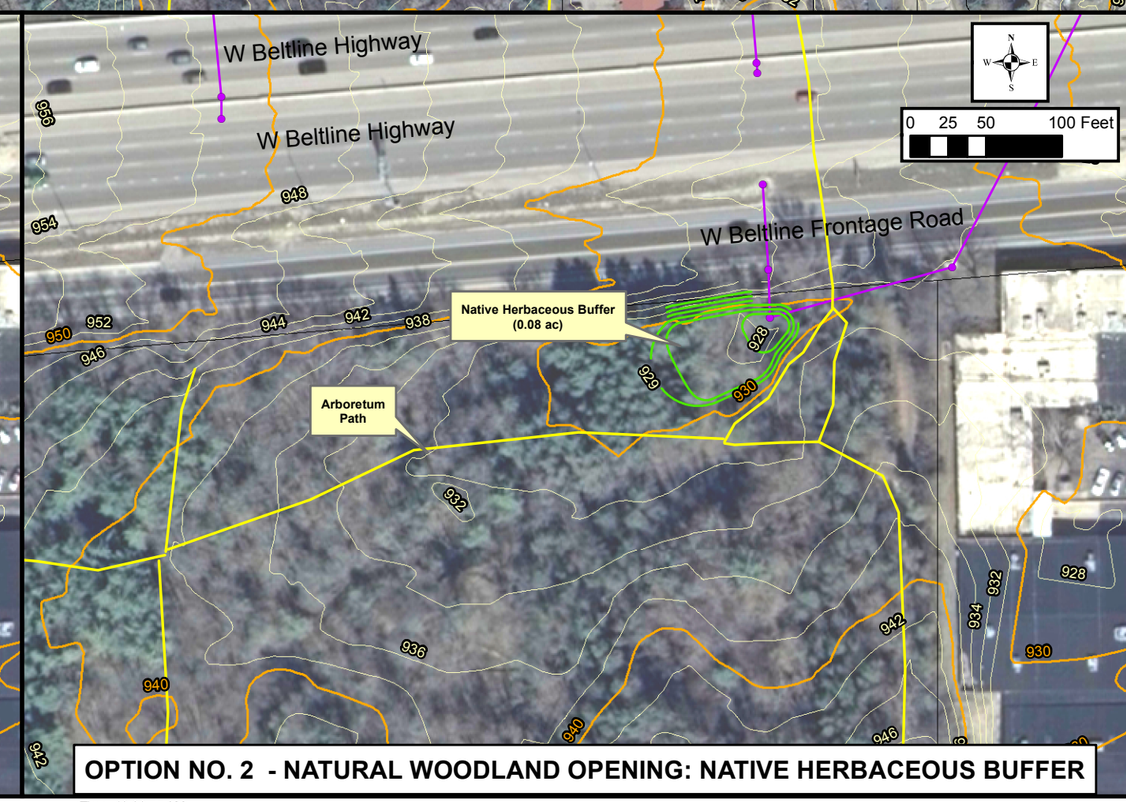
Figure 12 View Looking Northeast at Proposed BMP Location

1. Bioretention Basin–The bottom area of this basin as shown in Figure 11 would be approximately 0.05 acres. The intent of this BMP is to collect sediment, treat stormwater flows in the engineered soil, and provide an opportunity for stormwater infiltration. The seed mix and plant selection for the bottom of the basin would be determined during design by UW-Madison Arboretum staff. A clear zone of approximately 10 feet beyond the slope intercept would be appropriate to allow adequate sunlight for vigorous growth of sun-loving native plants and seeding. The total disturbed area including the clear zone would be approximately 0.22 acres. From a maintenance standpoint, accumulated sediment would have to be removed from the bottom of the basin every 10 to 20 years, which would require replanting of the bottom of the bioretention basin.

2. Natural Woodland Opening–Native Herbaceous Buffer: The total planted area of this BMP as shown in Figure 11 would be approximately 0.08 acres. The intent of this BMP is to reduce erosion and subsequent transport to Curtis Pond. The seed mix and plant selection for the native grass buffer would be determined during design by UW-Arboretum staff. A clear zone of approximately 10 feet beyond the slope intercept would be appropriate to allow adequate sunlight for vigorous growth of native plants and seeding. The total disturbed area including the clear zone would be approximately 0.22 acres. From a maintenance standpoint, accumulated sediment would have to be removed from the native grass buffer every 5 to 10 years, which would require replanting the native grass buffer area.







GRADY TRACT STORMWATER BMP

CURTIS PRAIRIE STORMWATER PLAN
WI DOA/DSF AND UW-MADISON
MADISON, WISCONSIN

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FIGURE 11
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Path: S:\MAD\1100--1199\1104\066\Data\GIS\Figures\Figure 11 South Arboretum Stormwater BMP.mxd User: danc Date: 11/29/2012 Time: 10:00:55 AM

F. Performance

The performance in terms of TSS and phosphorus reductions will be similar to that described in the March 2011 report. Since WinSLAMM is erroneous in calculating stormwater quality improvement with BMPs in series, the most effective BMP is typically modeled. In the case of the Curtis Pond watershed, the March 2011 report provides information showing that the most effective BMP is Curtis Pond. Modeling shows that the proposed Curtis Pond rehabilitation provides 60.3 percent TSS reduction and 41.5 percent phosphorus reduction. Version 10.0 of WinSLAMM is currently in development and will allow assessment of multiple BMPs in series. It is recommended that the full stormwater quality effect of the existing BMPs in the watershed (street sweeping and detention pond) as well as the proposed BMPs in the watershed (stormwater treatment device and South Arboretum stormwater BMP) be run in the new version of WinSLAMM once it is released, likely during design.

From an alternatives analysis standpoint for the stormwater treatment device, the stormwater quality performance of these is compared in Table 10.

Manufacturer	Option No. 1	Option No. 2-TSS (% Reduction)			
	TSS (% Reduction)	Location A	Location B	Location C	Location D
CDS	12.8	13.5	13.3	12.5	12.3
Vortechs	12.1	13.7	14	13.1	12.8
Terri Kleen	NA	NA	NA	NA	NA
Stormceptor	18.0	31	32	31	26
Downstream Defender	8.4	14.6	13.9	13.3	12.6

Table 10 Stormwater Quality Results–In-Line Treatment Device (Curtis Pond Watershed)

G. Cost

The opinion of probable costs for the Curtis Pond improvements is included in Table 11. Appendix A contains a detailed breakdown of the opinion of probable cost.

Description	Cost
Curtis Pond Rehabilitation and Conveyance Improvements	$486,000
Stormwater Treatment Device [Option No. 2 (4 Devices] (Note: Option No. 1 Cost = $396,000)	$343,100
Curtis Prairie Swale 3-Year Vegetation Management (0.75) acres)	$15,000
Grady Tract Stormwater BMP-Bioinfiltration Basin (Woodland Opening Cost = $75,600)	$80,900
Subtotal Project Cost	$910,000
Engineering and Contingencies (30%)	$273,000
Sediment Sampling	$12,000
Soils Investigation	$22,500
Total Project Cost	**$1,217,500**

Table 11 Opinion of Probable Cost

COYOTE POND FEATURES

The UW-Madison Arboretum Stormwater Committee's selected alternative from the March 2011 report is a combination of Alternative 13b (trash and sand collector in WisDOT R/W) and Alternative 14 (Pipe Liner from WisDOT R/W to Coyote Pond). Figure 13 depicts the Coyote Pond features.

A. Stormwater Treatment Device

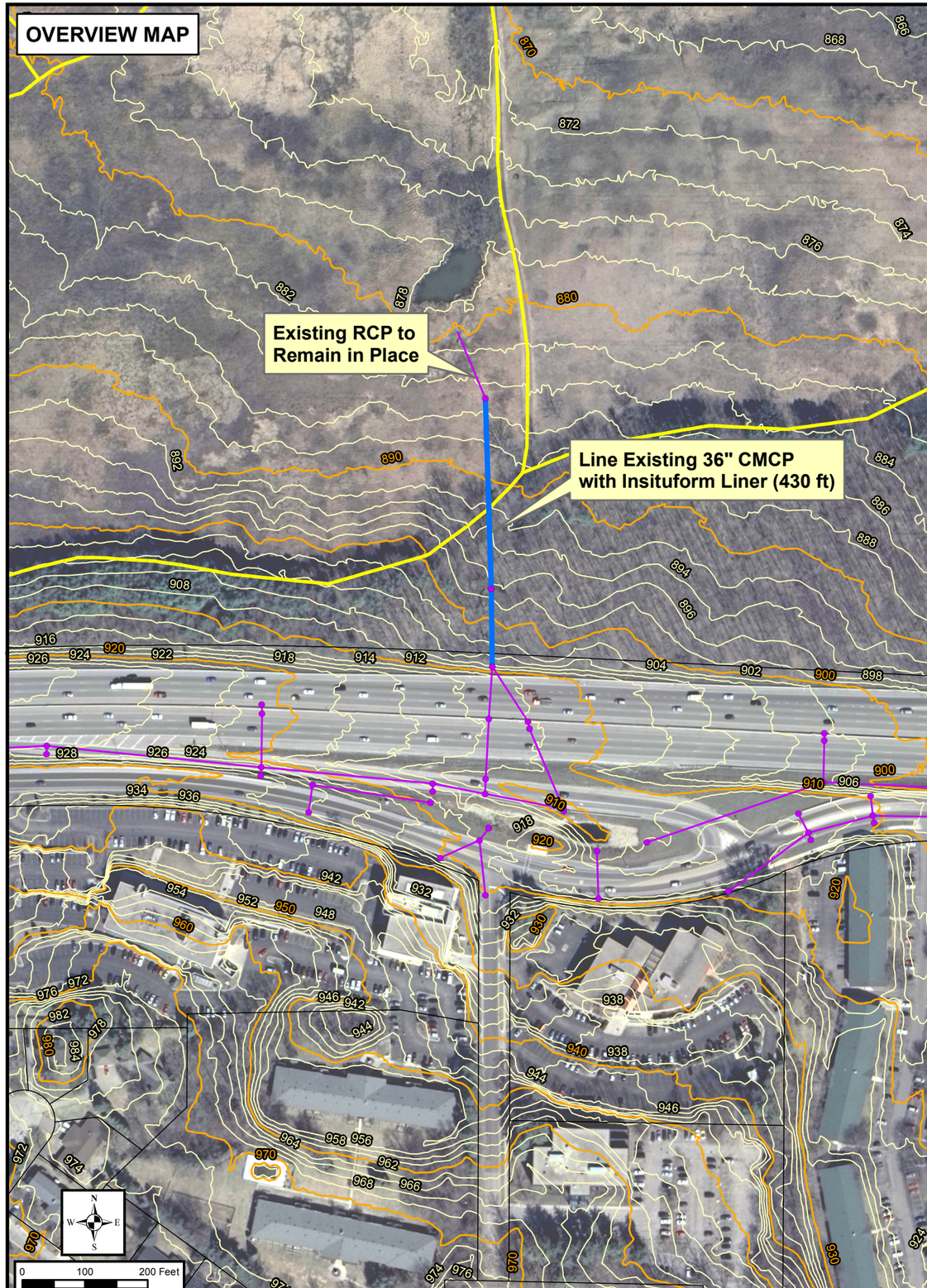
The scope of work for this project calls for analysis of two alternatives for a stormwater treatment device. A graphic representation of these alternatives is shown on Figure 13.

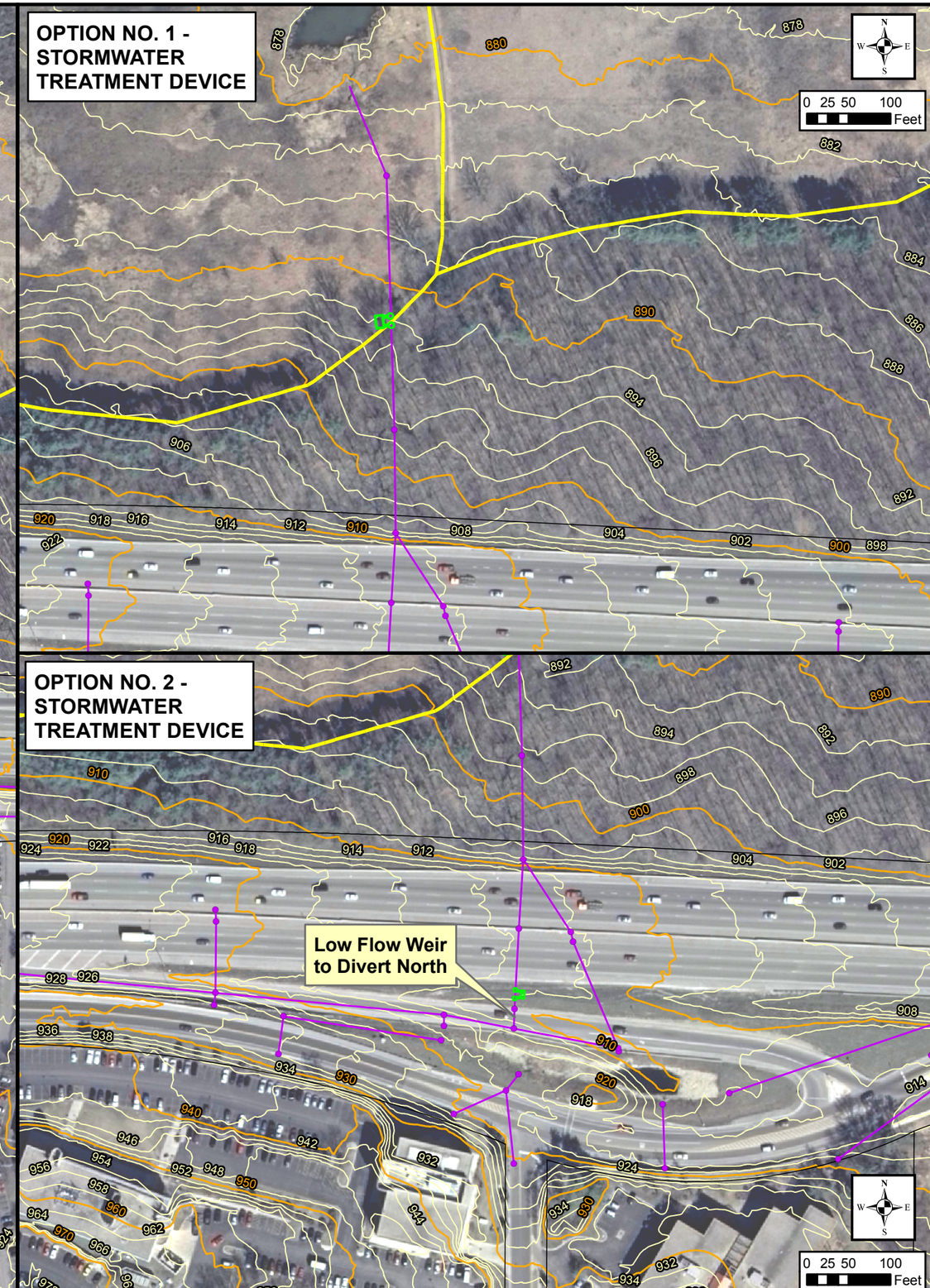
1. Option No. 1–Stormwater Treatment Device at Single Location: As shown in Figure 13, a centralized approach has been taken to stormwater treatment. This location provides pretreatment for the entire watershed before flows reach Coyote Pond. The following manufacturers were contacted to obtain cost and performance data at these four locations. For purposes of this report, we have used the Vortechs layout because of its relative simplicity and minimal required sump distance. The cost used is the average of the cost for the five manufacturers.

    a. CDS
    b. Vortechs
    c. Terri Kleen
    d. Stormceptor
    e. Downstream Defender

2. Option No. 2–Stormwater Treatment Device at Upstream Location: As shown in Figure 13, a decentralized approach has been taken to stormwater treatment. In this scenario, 2.05 acres would be pretreated by way of a stormwater treatment device and 21.36 acres would be pretreated by way of the existing detention basin on the south side of the Beltline before flows reach Coyote Pond; 1.93 acres (mainly WisDOT R/W and Arboretum lands) would not receive pretreatment before reaching Coyote Pond. The following manufacturers were contacted to obtain cost and performance data at this location. For purposes of this report, we have used the Vortechs layout because of its relative simplicity and minimal required sump distance. The cost used is the average of the cost for the five manufacturers.

    a. CDS
    b. Vortechs
    c. Terri Kleen
    d. Stormceptor
    e. Downstream Defender





COYOTE POND STORMWATER IMPROVEMENTS

CURTIS PRAIRIE STORMWATER PLAN
WI DOA/DSF AND UW-MADISON
MADISON, WISCONSIN

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FIGURE 13
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Path: S:\MAD\1100--1199\1104\066\Data\GIS\Figures\Figure 13 Coyote Pond Improvements.mxd User: danc Date: 11/29/2012 Time: 10:00:01 AM

B. Lining of CMP

To extend the life of the 36-inch CMP to Coyote Pond, a number of pipe rehabilitation methods could be used including pipe bursting, high density polyethylene liner, or cured-in-place liner. For purposes of this plan, rehabilitation of the pipe with an Insituform liner is analyzed (see Figure 13). Insituform liners are trenchless cured-in-place products that renew the structural integrity of an existing pipe and can be installed with minimal disturbance to the surrounding environment (see Figure 14).

Source: InSituForm Transportation Solutions Pamphlet

Figure 14 InSituform Pipe Lining

There will be no direct impact to the water quality as a result of the pipe lining. However, lining of the pipe will extend the life of the pipe with minimal disturbance to the surrounding environment as compared to traditional open cut pipe replacement techniques. Complete failure of the pipe could compromise upstream conveyance infrastructure and would require open cut replacement of the pipe. The total land disturbance for this alternative is approximately 0.46 acre. This disturbance is comprised of truck access to the downstream junction structure from Arboretum Drive. Truck access to the upstream structure does not appear to be necessary. Minimizing disturbance area is a consideration for choosing lining technology and contractor.

C. Performance

The performance in terms of TSS and P reductions will be similar to that described in the March 2011 report. Since WinSLAMM is erroneous in calculating stormwater quality improvement with BMPs in series, the most effective BMP is typically modeled. In the case of the Coyote Pond watershed, the March 2011 report provides information showing that the most effective BMP is the proposed stormwater treatment device. Modeling shows that the proposed stormwater treatment device provides 16.3 percent TSS reduction and 14.3 percent P reduction. Version 10.0 of WinSLAMM is currently in development and will allow assessment of multiple BMPs in series. It is recommended that the full stormwater quality effect of the existing BMPs in the watershed (street sweeping) as well as the proposed BMP in the watershed (stormwater treatment device) be run in the new version of WinSLAMM once it is released, likely during design.

From an alternatives analysis standpoint for the stormwater treatment device, the stormwater quality performance of these is compared in Table 12. No reduction in peak discharge will occur because of this project.

Manufacturer	Option No. 1 TSS (% Reduction)	Option No. 2 TSS (% Reduction)
CDS	12.9	15.7
Vortechs	12.9	15.4
Terri Kleen	NA	NA
Stormceptor	27.0	32.0
Downstream Defender	13.7	23.7

Table 12 Stormwater Quality Results–In-Line Treatment Device (Coyote Pond Watershed)

C. Cost

The opinion of probable costs for the Coyote Pond improvements is included in Table 13. Appendix B contains a detailed breakdown of the opinion of probable cost.

Description	Cost
Stormwater Treatment Device-Option No. 2 (Note: Option No. 1 Cost =$200,730)	$62,600
Pipe Lining (Note: Complete Pipe Replacement Cost = $119,000)	$ 89,000
Subtotal Project Cost	$151,600
Engineering and Contingencies (30%)	$45,500
Soils Investigation	$5,000
Total Project Cost	$202,100

Table 13 Opinion of Probable Cost

CONSTRUCTION ACCESS

Figure 15 shows turning templates at the construction access points.

Curtis Pond Stormwater Improvements–Two alternatives are shown in Figure 15 for access to the pond rehabilitation and storm drain portions of this project. As can be seen in Table 14, Option No. 2 appears to have less disturbance and would require less length of fire lane improved to support loaded dump trucks. The access to and from Arboretum Drive from the Arboretum path would require laying down of a compaction minimization system to minimize compaction. A maximum of 120 pounds per square inch (psi) ground contact pressure would be expected from a fully loaded dump truck. Figure 16 shows a couple of options for a system of this type. Further investigation of these systems and potential maximum truck weights across them should be completed during design. Construction of the stormwater treatment device (Option No. 2) would be in WisDOT R/W and would require coordination with WisDOT and Dane County for traffic control.

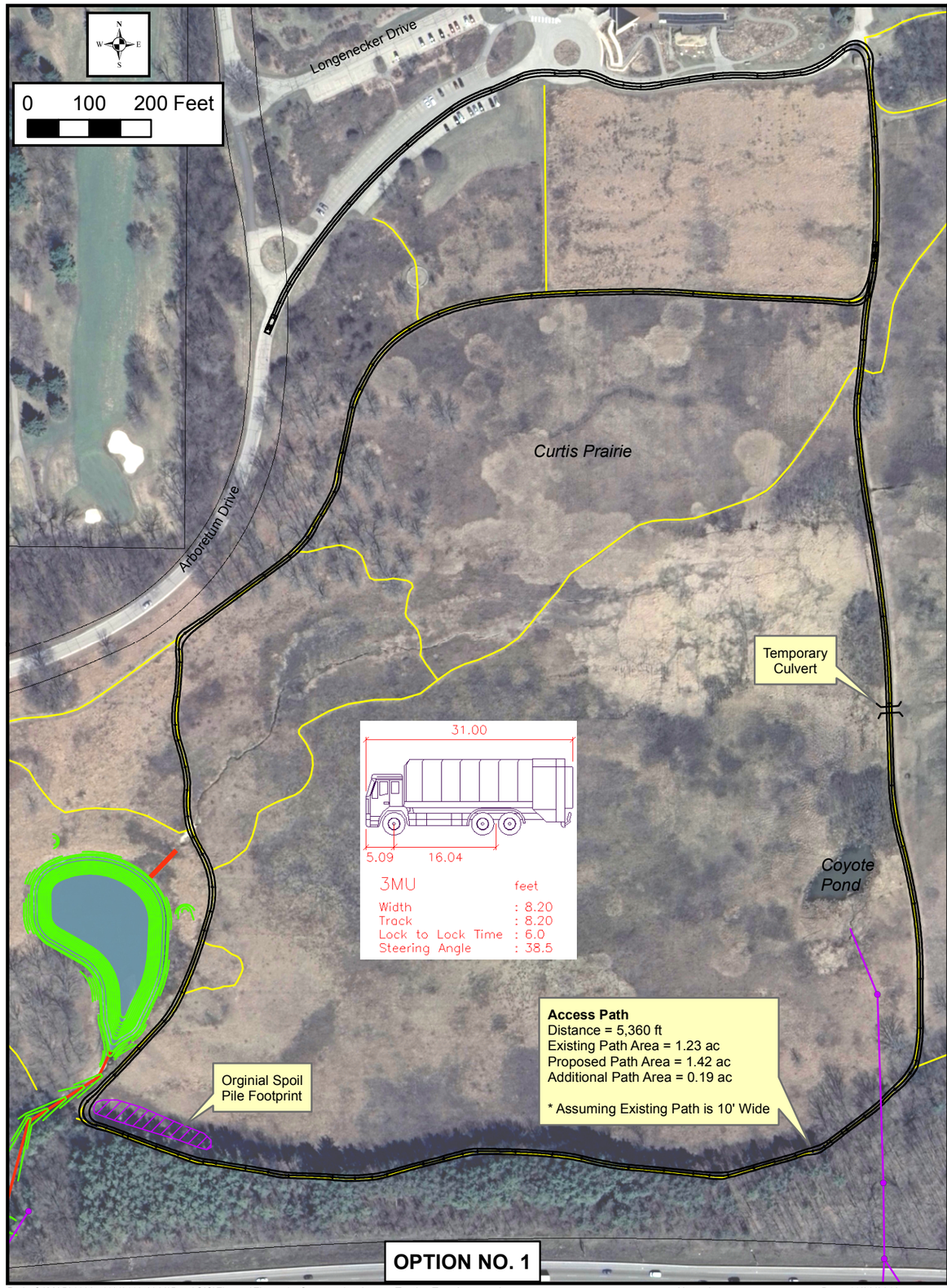
Figure 16 Example Compaction Minimization Systems

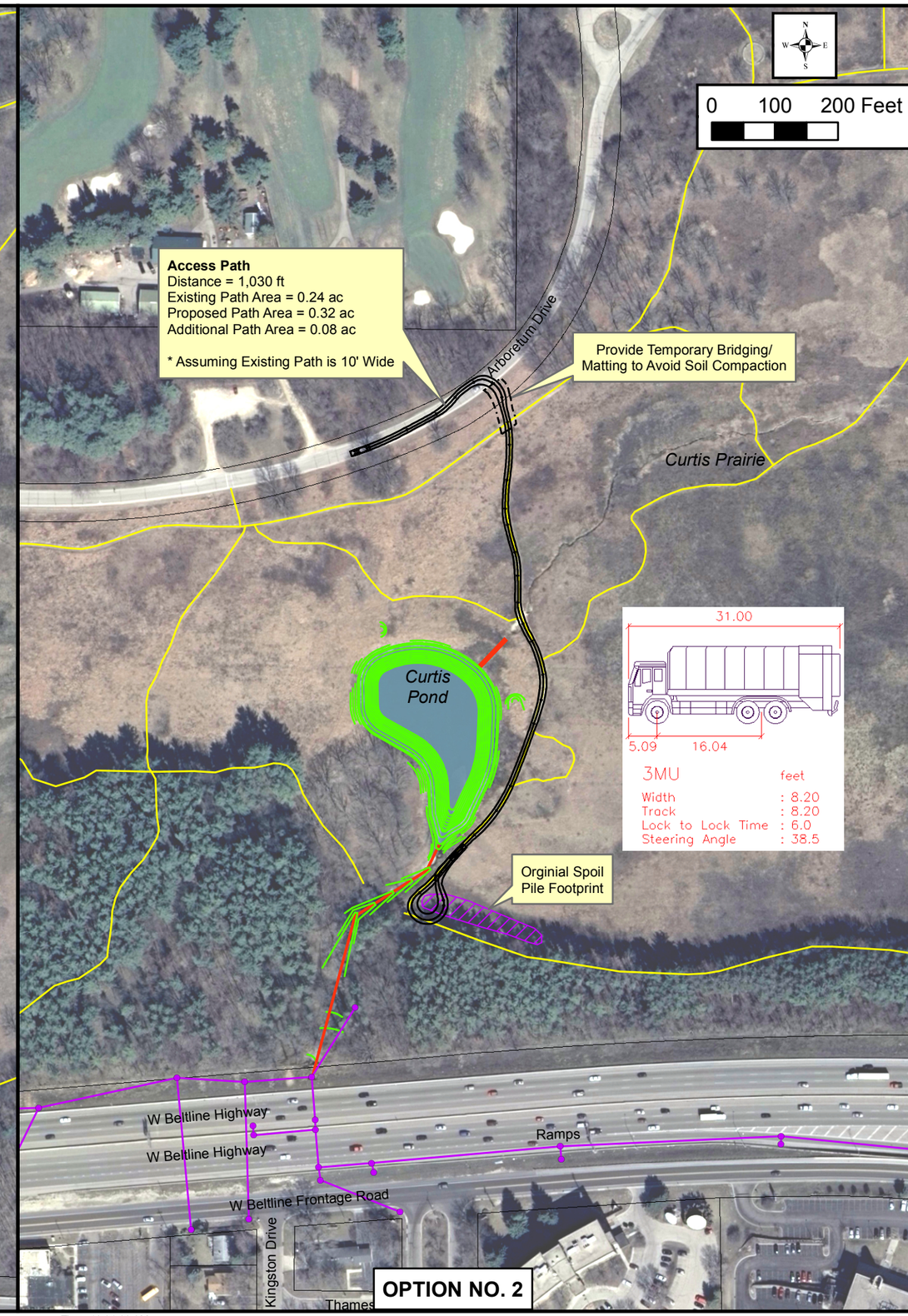
Grady Tract Stormwater BMP–As shown in Figure 11, the fire lane network will provide access that appears to be adequate for construction and maintenance of the "small-scale" improvement proposed in this location. There is a gate and concrete apron with access to a nearby fire lane as shown on Figure 11.

Coyote Pond Stormwater Improvements–The pipe liner portion of this project will require access down the fire lane east of Coyote Pond. However, the equipment necessary to perform this work will be lighter-duty and use will be more temporary, likely requiring minimal improvement to the fire lanes. Timing the construction of this portion to occur during the winter in frost conditions should be considered. Construction of the stormwater treatment device (Option No. 2) would be in WisDOT R/W and would require coordination with WisDOT and Dane County and traffic control.

Option No.	Area of Disturbance Outside of Existing Fire lanes (Assuming Existing Paths are 10 feet wide)
1	0.19 acres
2	0.08 acres

Table 14 Construction Access Options





CONSTRUCTION ACCESS TURNING TEMPLATES

CURTIS PRAIRIE STORMWATER PLAN
WI DOA/DSF AND UW-MADISON
MADISON, WISCONSIN

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FIGURE 15
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MAINTENANCE CONSIDERATIONS

Table 15 provides a listing of the probable responsible parties for maintenance of the various stormwater improvements.

Stormwater Facility	Probable Responsible Party For Maintenance	Comments
Curtis Pond	In accordance with Intermunicipal Agreement-WDOA/WDSF and UW-Madison.	Routine and nonroutine maintenance similar to the maintenance plans for Pond 2, Pond 4, and Secret Pond required. Dredging required every 15 to 20 years.
Curtis Pond Storm Sewer	In accordance with Intermunicipal Agreement-WDOA/WDSF and UW-Madison.	Minimal maintenance required.
Coyote Pond Pipe Slip Lining	In accordance with Intermunicipal Agreement-WDOA/WDSF and UW-Madison.	Minimal maintenance required.
Stormwater Treatment Device (In Arboretum)	Recommend discussions with City of Madison.	City of Madison has equipment to perform this maintenance; UW-Madison does not. Material removal required 2 to 4 times a year.
Stormwater Treatment Device (In WisDOT R/W)	Recommend discussions with City of Madison.	City of Madison has equipment to perform this maintenance; UW-Madison does not. Material removal required 2 to 4 times a year.
Pedestrian Tunnel Stormwater BMP	WDOA/WDSF and UW-Madison.	Routine and nonroutine maintenance similar to the maintenance plans for Pond 2, Pond 4, and Secret Pond required. Sediment removal at surface of BMP required on a 5- to 10-year or 10- to 20-year frequency, depending on the chosen BMP.

Table 15 Listing of the Probable Responsible Parties for Maintenance

RECOMMENDED PLAN

The recommended plan includes the combination of Curtis Pond and Coyote Pond improvements previously described. The opinion of probable cost and the approximate total disturbance for the project are included in Table 16. Appendix C includes an October 18, 2012, memorandum documenting the UW-Madison Arboretum Stormwater Committee's selected options as well as a PowerPoint history of the stormwater planning process.

Description	Cost	Access* Disturbance (Acres)	Construction Disturbance (Acres)	Total Disturbance (Acres)
Curtis Pond Watershed:				
Curtis Pond Rehabilitation and Conveyance Improvements	$486,000	0.32	2.05	2.36
Stormwater Treatment Device: Option No. 1 In-Arboretum Option No. 2 In WisDOT R/W	$343,100	0.32 0.00	.10 .22	0.42 0.22
Curtis Prairie Swale 3-Year Vegetation Management (0.75 acres)	$15,000	0.000	0.75	0.75
South Arboretum Stormwater BMP: Option No. 1 Bioretention Option No. 2 Natural Woodland Opening: Native Herbaceous Buffer	$80,900	0.19 0.19	0.22 0.22	0.41 0.41
Subtotal 1 Project Cost	**$925,000**			
Coyote Pond Watershed:				
Stormwater Treatment Device: Option No. 1 In-Arboretum Option No. 2 In WisDOT R/W	$62,600	0.45 0.000	0.06 0.03	0.51 0.03
Pipe Lining	$89,000	0.41	0.04	0.46
Subtotal 2 Project Cost	**$151,600**			
Total Project Cost	**$1,076,600**			
Engineering and Contingencies (30%)	$323,000			
Sediment Sampling	$12,000			
Soils Investigation	$27,500			
TOTAL PROJECT COST	**$1,439,100**			

*****Assumes Access Option No. 2.

Table 16 Opinion of Probable Cost and Land Disturbance Estimate

APPENDIX A
OPINION OF PROBABLE CONSTRUCTION COST–CURTIS POND

8/3/2012

Stormwater Facilities Improvements

University of Wisconsin - Madison

ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Alternative 15b Curtis Pond Outfall Storm Sewer Conveyance

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
	Curtis Pond Alternative 12a				
1	Mobilization/Demobilization	1	LS	$20,000.00	$20,000
2	Contractor Staking	1	LS	$20,000.00	$20,000
3	Dewatering	1	LS	$24,000.00	$24,000
4	Construction Access	1	LS	$7,500.00	$7,500
5	Unclassified Excavation - Parent	1,355	CY	$18.00	$24,390
6	Unclassified Excavation - Sediment	2,075	CY	$21.00	$43,575
7	Hauled-in Embankment Fill	425	CY	$13.00	$5,525
8	Excavation for 2' Clay Liner	3,300	CY	$18.00	$59,400
9	2' Clay Liner (Hauled-in and Installed to Elevation 897)	3,300	CY	$15.00	$49,500
10	Tree Protection	1	LS	$500.00	$500
11	Tree Removal	1	LS	$3,000.00	$3,000
12	Clearing and Grubbing	1	LS	$5,000.00	$5,000
13	Erosion Control and Maintenance	1	LS	$5,000.00	$5,000
14	Temporary Rock Check Dam	1	EA	$1,200.00	$1,200
15	30-IN RCP	128	LF	$55.00	$7,040
16	30-IN Endwall and Pipe Grate	4	EA	$700.00	$2,800
17	Outlet Control Structure	1	EA	$12,600.00	$12,600
18	Field Stone Rip Rap (1.0' D50)....including excav to bottom of bed	300	SY	$35.00	$10,500
19	6-IN Salvaged Topsoil Placement	800	SY	$2.50	$2,000
20	6-IN Hauled-in Topsoil Placement	800	SY	$3.50	$2,800
21	Temporary Fencing	1,000	LF	$3.00	$3,000
22	Turf Reinforcement Mat for Emergency Spillway	1,400	SY	$15.00	$21,000
23	Erosion Control Revegetative Mat	1,600	SY	$2.50	$4,000
24	Restoration of Arboretum Paths	1	LS	$3,000.00	$3,000
25	Landscaping Trees/Bushes	1	LS	$3,000.00	$3,000
26	Goose Fencing	1	LS	$1,500.00	$1,500
27	Wetland Emergent Rhizomes/Plugs	600	EA	$10.00	$6,000
28	Detention Basin Native Mix (Elev. 864.3to 866.3)	1,600	SY	$4.50	$7,200
29	Irregular Wetland Edge	1	LS	$5,000.00	$5,000
30	Vegetation Maintenance (3 Year)	0.33	AC	$20,000.00	$6,600
	Curtis Pond Conveyance				
31	Tree Protection	1	LS	$1,500.00	$1,500
32	Tree Removal	1	LS	$3,000.00	$3,000
33	38x60-IN HERCP	400	LF	$130.00	$52,000
34	43x68-IN HERCP	47	LF	$150.00	$7,050
35	43x68-IN HERCP Endwall and Pipe Grate	1	EA	$3,500.00	$3,500
36	38x60-IN HERCP Bend	2	EA	$4,000.00	$8,000
37	38x60-IN HERCP x 43x68-IN HERCP Reducer	1	EA	$4,000.00	$4,000
38	Storm Sewer Junction Chamber	1	EA	$12,000.00	$12,000
39	6-IN Salvaged Topsoil Placement	990	SY	$2.50	$2,475
40	Seeding	990	SY	$4.50	$4,455
41	Erosion Control Revegetative Mat (Class 1 Type A urban)	990	SY	$2.50	$2,475
42	Vegetation Maintenance (3 Year)	0.20	AC	$20,000.00	$4,000
	Curtis Prairie Vegetation Maintenance				
43	Vegetation Maintenance (3 Year)	1	AC	$20,000.00	$15,000

Subtotal Project Cost	**$486,090**
Engineering & Contingencies (30%)	**$145,830**
Sediment Sampling	**$12,000**
Soils Investigation	**$15,000**
Total Project Cost	**$658,920**

7/30/2012

Stormwater Facilities Improvements
University of Wisconsin - Madison
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Stormwater BMP's Curtis Pond No. 1

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
	Structural Treatment Device				
1	Mobilization/Demobilization	1	LS	$5,000.00	$5,000
2	Contractor Staking	1	LS	$3,000.00	$3,000
3	Dewatering	1	LS	$3,000.00	$3,000
4	Construction Access	1	LS	$5,000.00	$5,000
5	Tree Protection	1	LS	$1,500.00	$1,500
6	Bypass Structure	1	LS	$7,500.00	$7,500
7	Bypass Piping (Assume 24-Inch)	30	LF	$50.00	$1,500
8	Structural Device	1	LS	$267,000.00	$267,000
9	24-Inch AEW with Grate	1	EA	$1,200.00	$1,200
10	Topsoil - Seed - ECRM	500	SY	$7.50	$3,750
11	Restoration of Arboretum Paths	1	LS	$2,500.00	$2,500
12	Educational Sign	1	LS	$2,500.00	$2,500

Subtotal Project Cost	**$303,450**
Engineering & Contingencies (30%)	**$91,040**
Soils Investigation	**$1,500**
Total Project Cost	**$395,990**

7/30/2012

Stormwater Facilities Improvements
University of Wisconsin - Madison
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Stormwater BMP's Curtis Pond No. 2

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
	Structural Treatment Device				
1	Mobilization/Demobilization	1	LS	$5,000.00	$5,000
2	Contractor Staking	1	LS	$3,000.00	$3,000
3	Dewatering	1	LS	$3,000.00	$3,000
4	Traffic Control	1	LS	$5,000.00	$5,000
5	Topsoil, Seed, ECRM	598	SY	$7.50	$4,485
6	Bypass Structure	4	LS	$7,500.00	$30,000
7	Bypass Piping (Assume 24-Inch)	48	LF	$50.00	$2,400
8	Structural Device (Average of 5 Devices Multiplied by 2)	1	LS	$50,000.00	$50,000
9	Structural Device (Average of 5 Devices Multiplied by 2)	1	LS	$70,000.00	$70,000
10	Structural Device (Average of 5 Devices Multiplied by 2)	1	LS	$77,000.00	$77,000
11	Structural Device (Average of 5 Devices Multiplied by 2)	1	LS	$66,000.00	$66,000
12	Reconnection Structure	4	EA	$3,000.00	$12,000
13	Asphalt Sawcut	365	LF	$1.00	$365
14	Asphalt Restoration (removal, basecourse, base,surface)	475	SY	$30.00	$14,250
15	Curb and Gutter Removal and Replacement	47	LF	$13.00	$611

Subtotal Project Cost	**$343,111**
Engineering & Contingencies (30%)	**$102,930**
Soils Investigation	**$1,500**
Total Project Cost	**$447,540**

7/30/2012

Stormwater Facilities Improvements
University of Wisconsin - Madison
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Option No. 1: South Arboretum Stormwater BMP Bioinfiltration Basin

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
	Pond				
1	Mobilization/Demobilization	1	LS	$7,500.00	$7,500
2	Contractor Staking	1	LS	$7,500.00	$7,500
3	Dewatering	1	LS	$3,000.00	$3,000
4	Construction Access	1	LS	$5,000.00	$5,000
5	Unclassified Excavation - Parent	1,045	CY	$18.00	$18,810
6	Hauled-in Embankment Fill	100	CY	$13.00	$1,300
7	Tree Protection	1	LS	$1,500.00	$1,500
8	Tree Removal	1	LS	$3,500.00	$3,500
9	Clearing and Grubbing	1	LS	$3,500.00	$3,500
10	Erosion Control and Maintenance	1	LS	$5,000.00	$5,000
11	Temporary Rock Check Dam	1	EA	$1,200.00	$1,200
12	6-IN Salvaged Topsoil Placement	225	SY	$2.50	$563
13	6-IN Hauled-in Topsoil Placement	225	SY	$3.50	$788
14	Engineered Soil Layer	185	CY	$15.00	$2,775
15	Storage Layer	295	CY	$10.00	$2,950
16	Pea Gravel	25	CY	$10.00	$250
17	Bark Mulch	20	CY	$8.00	$160
15	6-Inch Underdrain	75	LF	$20.00	$1,500
16	Temporary Fencing	200	LF	$3.00	$600
17	Erosion Control Revegetative Mat	450	SY	$2.50	$1,125
18	Restoration of Arboretum Paths	1	LS	$2,500.00	$2,500
19	Landscaping Bushes/Shrubs (every other 5x5 area)	40	EA	$15.00	$600
20	Wetland Emergent Rhizomes/Plugs - 1 per SF on bottom only (No Sides)	40	EA	$10.00	$400
21	Detention Basin Native Mix (Elev. 864.3to 866.3)	450	SY	$4.50	$2,025
22	Vegetation Maintenance (3 Year)	0.22	AC	$20,000.00	$4,400
23	Educational Sign	1	LS	$2,500.00	$2,500

Subtotal Project Cost	**$80,945**
Engineering & Contingencies (30%)	**$24,280**
Soils Investigation	**$6,000**
Total Project Cost	**$111,230**

8/3/2012

Stormwater Facilities Improvements
University of Wisconsin - Madison
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Option No. 2: South Arboretum Stormwater BMP Woodland Opening: Native Vegetation Buffer

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
	Pond				
1	Mobilization/Demobilization	1	LS	$5,000.00	$5,000
2	Contractor Staking	1	LS	$5,000.00	$5,000
3	Dewatering	1	LS	$2,500.00	$2,500
4	Construction Access	1	LS	$5,000.00	$5,000
5	Unclassified Excavation - Parent	285	CY	$18.00	$5,130
6	Hauled-in Embankment Fill	100	CY	$13.00	$1,300
7	Tree Protection	1	LS	$1,500.00	$1,500
8	Tree Removal	1	LS	$3,500.00	$3,500
9	Clearing and Grubbing	1	LS	$3,500.00	$3,500
10	Erosion Control and Maintenance	1	LS	$5,000.00	$5,000
11	Temporary Rock Check Dam	1	EA	$1,200.00	$1,200
12	6-IN Salvaged Topsoil Placement	340	SY	$2.50	$850
13	6-IN Hauled-in Topsoil Placement	340	SY	$3.50	$1,190
14	Temporary Fencing	200	LF	$3.00	$600
15	Erosion Control Revegetative Mat	680	SY	$2.50	$1,700
16	Restoration of Arboretum Paths	1	LS	$2,500.00	$2,500
17	Detention Basin Native Mix (Elev. 864.3to 866.3)	680	SY	$4.50	$3,060
18	Vegetation Maintenance (3 Year)	0.22	AC	$20,000.00	$4,400
19	Educational Sign	1	LS	$2,500.00	$2,500

Subtotal Project Cost	**$55,430**
Engineering & Contingencies (30%)	**$16,630**
Soils Investigation	**$3,500**
Total Project Cost	**$75,560**

APPENDIX B
OPINION OF PROBABLE CONSTRUCTION COST–COYOTE POND

7/30/2012

Stormwater Facilities Improvements
University of Wisconsin - Madison
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Stormwater BMP's Coyote Pond No. 1

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
	Structural Treatment Device				
1	Mobilization/Demobilization	1	LS	$5,000.00	$5,000
2	Contractor Staking	1	LS	$3,000.00	$3,000
3	Dewatering	1	LS	$3,000.00	$3,000
4	Construction Access	1	LS	$5,000.00	$5,000
5	Tree Protection	1	LS	$1,500.00	$1,500
6	Bypass Structure	1	LS	$4,000.00	$4,000
7	Bypass Piping (Assume 24-Inch)	30	LF	$50.00	$1,500
8	Structural Device	1	LS	$120,000.00	$120,000
9	Reconnection to Existing System	1	EA	$3,000.00	$3,000
9	Topsoil - Seed - ECRM	300	SY	$7.50	$2,250
10	Restoration of Arboretum Paths	1	LS	$2,500.00	$2,500
11	Educational Sign	1	LS	$2,500.00	$2,500

Subtotal Project Cost	**$153,250**
Engineering & Contingencies (30%)	**$45,980**
Soils Investigation	**$1,500**
Total Project Cost	**$200,730**

7/30/2012

Stormwater Facilities Improvements
University of Wisconsin - Madison
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Stormwater BMP's Coyote Pond No. 2

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
	Structural Treatment Device				
1	Mobilization/Demobilization	1	LS	$5,000.00	$5,000
2	Contractor Staking	1	LS	$3,000.00	$3,000
3	Dewatering	1	LS	$3,000.00	$3,000
4	Traffic Control	1	LS	$5,000.00	$5,000
5	Topsoil, Seed, ECRM	300	SY	$7.50	$2,250
6	Bypass Structure	1	LS	$4,000.00	$4,000
7	Bypass Piping (Assume 12-Inch)	12	LF	$30.00	$360
8	Structural Device (Average of 5 Devices Multiplied by 2)	1	LS	$34,520.00	$34,520
9	Reconnection to Existing System	1	EA	$3,000.00	$3,000
10	Restoration of Arboretum Paths	1	LS	$2,500.00	$2,500

Subtotal Project Cost	**$62,630**
Engineering & Contingencies (30%)	**$18,790**
Soils Investigation	**$1,500**
Total Project Cost	**$82,920**

7/30/2012

Stormwater Facilities Improvements
University of Wisconsin - Madison
ENGINEER'S OPINION OF PROBABLE CONSTRUCTION COST

Coyote Pond Pipe Replacement

ITEM NO.	DESCRIPTION	Quantity	Units	Unit Price	Total
	Pond				
1	Mobilization/Demobilization	1	LS	$5,000.00	$5,000
2	Contractor Staking	1	LS	$1,500.00	$1,500
3	Dewatering	1	LS	$3,000.00	$3,000
4	Construction Access	1	LS	$5,000.00	$5,000
5	Tree Protection	1	LS	$1,500.00	$1,500
6	Tree Removal	1	LS	$5,000.00	$5,000
7	Clearing and Grubbing	1	LS	$5,000.00	$5,000
8	Erosion Control and Maintenance	1	LS	$5,000.00	$5,000
9	6-IN Salvaged Topsoil Placement	1,000	SY	$2.50	$2,500
10	Erosion Control Revegetative Mat	1,000	SY	$2.50	$2,500
11	36-Inch RCP	430	LF	$76.00	$32,680
12	5' Diameter Manhole	2	EA	$5,000.00	$10,000
11	Restoration of Arboretum Paths	1	LS	$2,500.00	$2,500
12	Seeding	1,000	SY	$2.50	$2,500
13	Vegetation Maintenance (3 Year)	0.20	AC	$20,000.00	$4,000

Subtotal Project Cost	**$87,680**
Engineering & Contingencies (30%)	**$26,300**
Soils Investigation	**$5,000**
Total Project Cost	**$118,980**

APPENDIX C
UW-MADISON ARBORETUM STORMWATER COMMITTEE MEMORANDUM AND POWERPOINT HISTORY OF PLANNING PROCESS

UNIVERSITY OF WISCONSIN-MADISON
Arboretum

October 18, 2012

To: Jon Lindert, STRAND Associates
Jim McMillan, Division of State Facilities

From: David S. Liebl, Chair, UW-Arboretum Stormwater Committee

Re: UW-Arboretum Curtis and Coyote Ponds - Stormwater Management Alternatives

The UW-Arboretum Stormwater Committee has completed its review of alternative concept designs for the management of stormwater runoff entering the UW-Arboretum at the Curtis and Coyote pond outfalls. The STRAND Associates draft report, *University of Wisconsin-Madison Curtis Prairie Strategic Stormwater Plan* (with additional comments, attached) represents the outcome of a long term inclusive process of sifting and winnowing through a variety of management alternatives (see chronology, below). We look forward to receiving a final copy of the report, so that the planning outcomes can be communicated to UW-Arboretum stakeholders.

As we move into the construction design phase, the following main elements of the planning process should guide the development of the construction plans, bid documents and contracts. The Arboretum Stormwater Committee has agreed to the following:

Coyote Pond:

- Install additional trash and sediment collection upstream in the Coyote Pond watershed.
- Line the corrugated metal pipe between the DOT right of way and the open grate in Curtis Prairie, to maintain the structural integrity of the pipe and prevent the need to excavate and replace the pipe.

Curtis Pond:

- Install trash and sediment collection upstream in the Curtis Pond watershed.
- Install a buried storm drain, sized to carry peak flow DOT outfall, in the ditch created by the collapse of the flume between the DOT right-of-way and the pond.
- Remove and dispose of vegetation on the soil pile adjacent to the E-W fire lane, and use the subsoil as fill over the new drain.
- Mechanically dredge the pond without disturbing the pond berm, and create an irregular wetland edge to promote nitrogen removal.
- Design the replacement pond outlet weir to attenuate peak flows to the downstream prairie, and install the weir and outlet pipes without mobilizing across the pond berm.
- Restore the area downstream of the pond by removing reed canary grass and replanting with native species. Arboretum staff will specify the restoration plan for this area and participate in choosing a contractor for an extended restoration warranty.

1207 Seminole Hwy.
Madison, Wisconsin
53711-3726

tel: 608 263-7888
fax: 608 262-5209
uwarboretum.org

Evjue Pines Inlet Grate:

- Biofiltration as the preferred option for this location. Arboretum staff will develop restoration details before final design begins.

Mobilization:

- Minimize construction impacts to the extent possible.
- Utilize the shortest access routes to minimize travel distance and disturbance of Arboretum activities.
- Mobilization improvements to the fire lane access to Curtis Pond will have minimum impact to the adjoining prairie. Restore the fire lane to its original condition at the end of the project.
- Prevent compaction of the prairie at the crossing to Arboretum drive.
- Minimize the disturbance around the Coyote storm drain grate from pipe lining activities.

In closing, it is essential that the designer, contractors and construction supervisors appreciate the importance of Curtis Prairie as the World's oldest restored prairie and the birthplace of the ecological restoration movement over seventy five years ago. All measures necessary must be taken to prevent damage to this unique scientific and cultural resource.

UW-Arboretum Stormwater Committee
Curtis – Coyote Planning Summary
September 13, 2012

Curtis Prairie 2010

UW- Arboretum Stormwater Committee

Tom Blewett – Cooperative Extension
Gary Brown – Facilities Planning and Management
Michele Chalice* – Arboretum
Matt Collins – Facilities Planning and Management
Pat Eagan – Engineering Professional Development
Steven Glass* – Arboretum
Michael Hansen – Arboretum
Brad Herrick – Arboretum
Evelyn Howell* – Landscape Architecture
Rhonda James – Facilities Planning and Management
David S. Liebl – Engineering Professional Development, Chair
Kevin McSweeney* – Arboretum
John Panuska – Biosystems Engineering
Donna Paulnock – Arboretum
Ken Potter – Civil and Environmental Engineering
Richard Straub – Biosystems Engineering
Mark Wegener – Arboretum
Joy Zedler* – Botany

*past member

Curtis / Coyote Pond Planning Timeline

c.1998 Curtis flume undermined

2001 UW Stormwater facilities report

2003 Arboretum stormwater planning begins

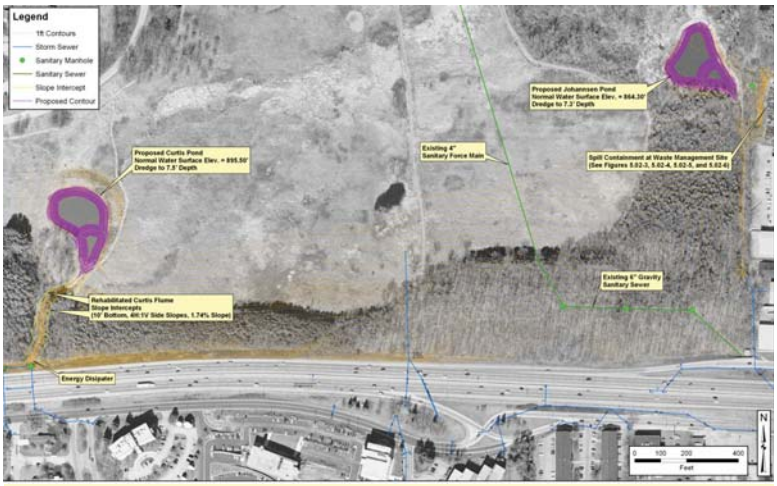
2006 Curtis/Coyote/Johannsen Stormwater Plan

2009 STRAND/MARS Alternatives 1-9

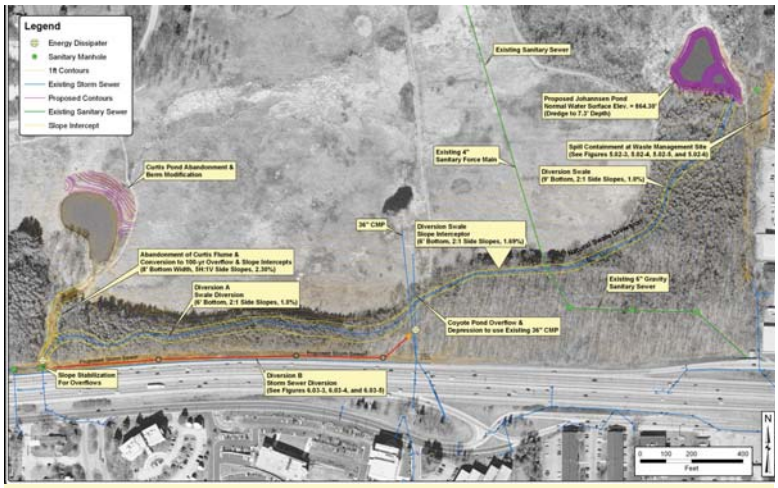
2010 STRAND/MARS Alternatives 10-17
Curtis Drain Repaired
Coyote Cross-connection reversed

2011 Additional re-analysis of options focused on minimizing disturbance

2012 STRAND develops final concept designs

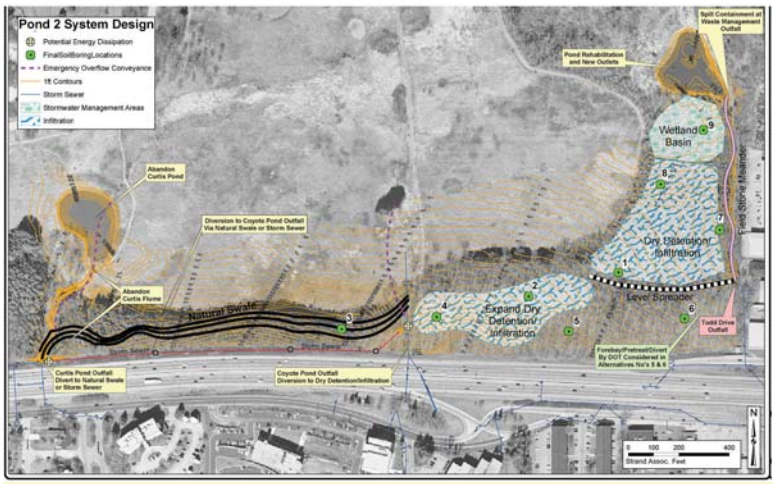


STRAND 2001 Campus Stormwater Report
Alternatives for Curtis Pond and Pond 2



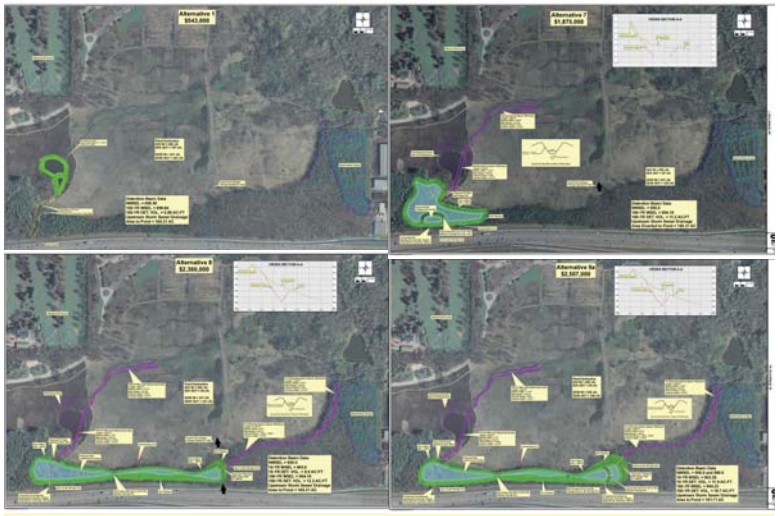
May 2005 Surface Conveyance to Pond 2

Rejected by Arboretum Committee due to maintenance and viewshed



November 2006 - UW-Arboretum Facility Stormwater Management Plan

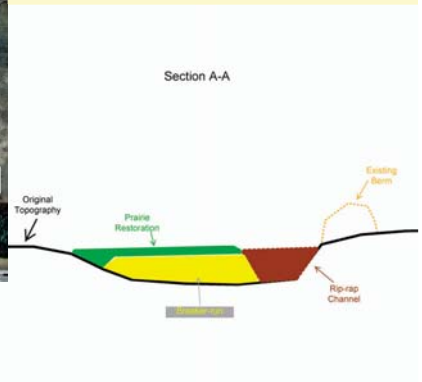
Rejected due to viewshed and disturbance



STRAND/MARS May 2009 Alternatives

Buried Drain to Wingra Slough
Rejected due to cost and disturbance

Calcareous Research Basin
Rejected due to disturbance and questions of feasibility



Alternative 10 Coyote Flow to Pond 2

Rejected due to disturbance

Goals:
1. 10-Year Coyote Flows to Pond 2
2. TSS Control

Alternative 11b Coyote Detention Basin

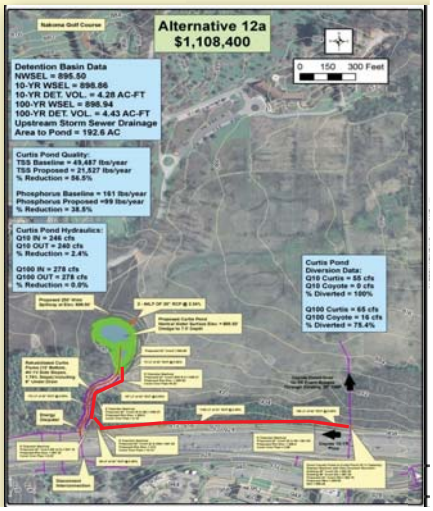
Rejected due to disturbance

Goals:
1. Stormwater Volume Reduction
2. TSS Control for Pretreatment

Alternative 12A Rehab Curtis with Coyote Flow

Rejected due to disturbance

Goals:
1. Dredge Pond for TSS Control
2. Rehab Flume for Curtis Flow
3. Divert Coyote Via Pipe to Curtis

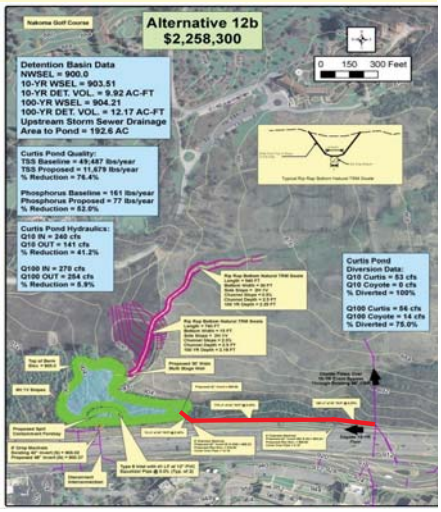


Alternative 12B Large Highway Pond

Rejected due to disturbance

Goals:
1. Abandon Curtis Pond
2. Large Highway Pond for TSS Reduction
3. Divert Coyote to Large Highway Pond
4. Downstream Swale Stabilization

Component Costs:
- Downstream Swale = $495,000
- Diversion From Coyote = $209,000
- Pond = $1,550,000



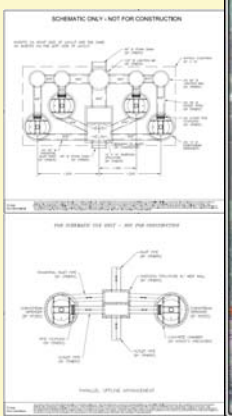
Alternatives 13A and 13B Trash and Sand Collectors

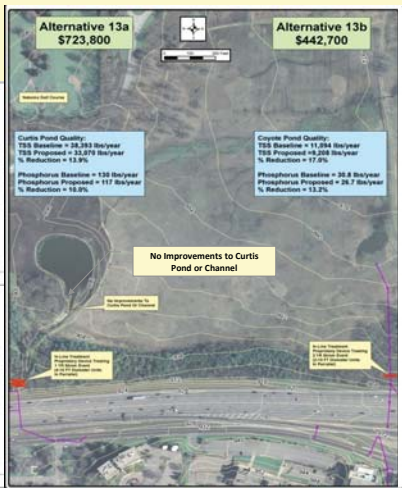
Rejected due to disturbance

Goals:
1. Trash Control
2. Collect Sand
3. Minor TSS Control

Alternative 13A (Curtis Outfall)

Alternative 13B (Coyote Outfall)





Alternative 14 Pipe Liner at Coyote

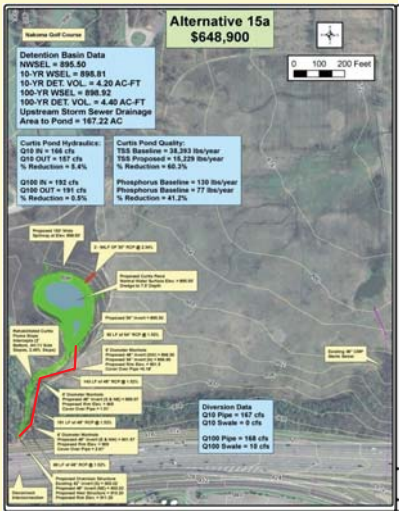
Goals:
1. Extend Life of Pipe to Coyote
2. Minimize Disturbance

2006 - DOT builds wet detention pond above Coyote Pond

Alternative 15A-Curtis Flume Buried and Surface Flow

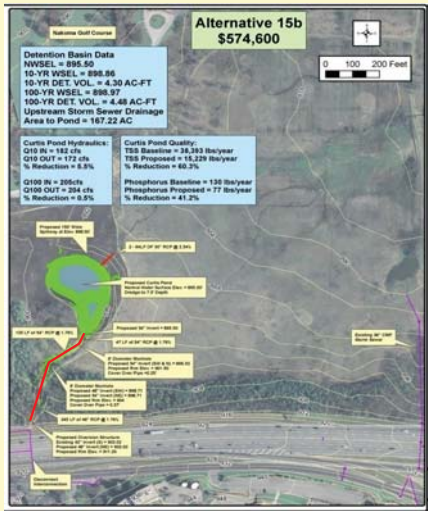
Rejected due to disturbance

Goals:
1. Dredge Pond for TSS Control
2. Pipe for 10-Year Flows
3. Shallow Swale for 10 Thru 100-Year Flows



Alternative 15B Curtis Flume Buried Flow

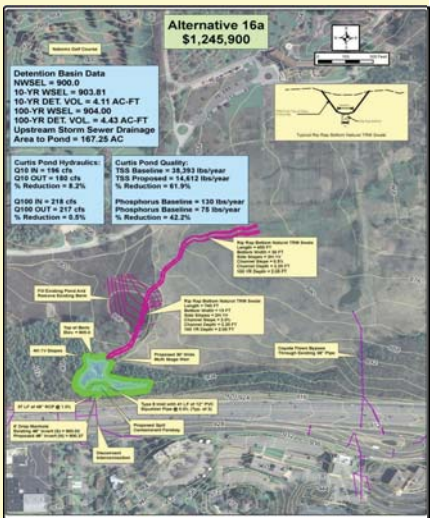
Goals:
1. Dredge Pond for TSS Control
2. Pipe for 10-Year Flows
3. Overland Flow for 10 Thru 100-Year Flows



Alternative 16A Small Highway Pond w/Spill Containment

Rejected due to disturbance

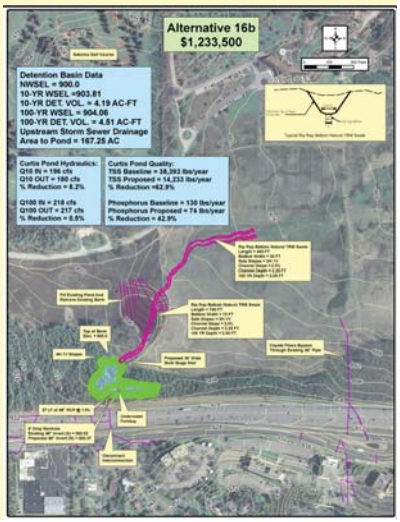
Goals:
1. Abandon Curtis Pond
2. Small Highway Pond for TSS Reduction
3. Spill Containment Forebay
4. Downstream Swale Stabilization



Alternative 16B Small Highway Pond

Rejected due to disturbance

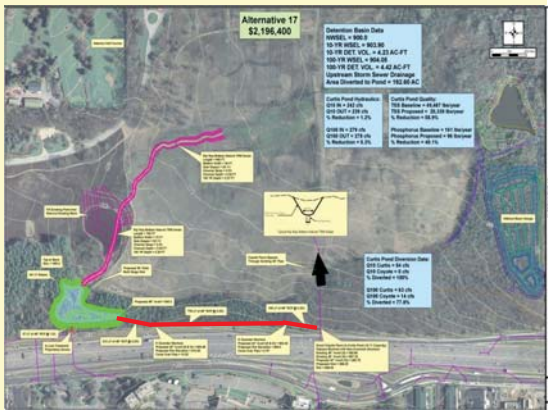
Goals:
1. Abandon Curtis Pond
2. Small Highway Pond for TSS Reduction
3. No Spill Containment Forebay
4. Downstream Swale Stabilization



Alternative 17 Small Highway Pond w/Coyote Flow

Rejected due to disturbance

Goals:
1. Abandon Curtis Pond
2. Small Highway Pond for TSS Reduction
3. Divert Coyote Via Pipe to Curtis
4. Downstream Swale Stabilization
5. In-Line Device At Curtis



Subsurface Detention

Rejected due to disturbance

0.6 acre installed + restoration of downstream area = 3.3 acre (Curtis pond)

15,000 CY excavation

Very expensive

Storm Chamber

Tank

8/20/12 – Arboretum Stormwater Committee Previously agreed upon options

Coyote:
- Add upstream (DOT) trash and sand removal
- Liner for CMP between DOT and surface grate

Curtis:
- Add upstream (DOT) trash and sand removal
- Buried drain in ditch, sized to carry outfall capacity
- Use spoil pile as fill over drain
- Wetland pond border for N removal
- Outlet weir to attenuate peak flow
- Restore downstream *RCG* to prairie
- Minimize construction impact

8/20/12 – Arboretum Stormwater Committee Decisions

Off-site treatment devices are preferred for both Curtis and Coyote, based on less impact from maintenance, and less disturbance during construction.

Mechanical dredging is preferable as likely causing less overall disturbance, better performance during pond construction, and greatly reduced cost.

The shorter mobilization corridor is preferred, due to reduced travel length and reduced disturbance. Access road to Curtis Pond to be improved for this project. Require minimal compaction of the prairie in the area of the road entrance.

Biofiltration at Evjue Pines should be included in the design plan. Arboretum staff will provide details for final design.

Arboretum will specify the restoration plan for Reed Canary Grass area downstream of Curtis Pond, and participate in choosing a restoration contractor.

For more location information
please visit www.strand.com

Office Locations

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Columbus, Ohio | 614.835.0460

Indianapolis, Indiana | 317.423.0935

Joliet, Illinois | 815.744.4200

Lexington, Kentucky | 859.225.8500

Louisville, Kentucky | 502.583.7020

Madison, Wisconsin* | 608.251.4843

Milwaukee, Wisconsin | 414.271.0771

Phoenix, Arizona | 602.437.3733

*Corporate Headquarters

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