APPENDIX C

STORM WATER ANALYSES
TECHNICAL MEMORANDA

- May 18, 2000 Mall of America Expansion EIS P-8 Modeling for Water Quality (Montgomery Watson)
- March 21, 2002 P-8 Modeling for AUAR (Montgomery Watson Harza)

MEMORANDUM

MONTGOMERY WATSON

To:	Jennie Ross, SRF	**Date:**	Draft May 18, 2000
From:	Sabrina Cook	**Reference:**	
Subject:	City of Bloomington Airport South District AUAR/EIS Water Quality Impacts Assessment		

1.0 Background/Study Area Description

This water quality assessment was conducted for the "Airport South District" (ASD) in Bloomington. The area is defined by I-494 to the north, TH 77 to the west and the Minnesota River Valley to the south and east. The study was prepared in conjunction with two environmental review processes being conducted concurrently within the Airport South District: the Mall of America Expansion – Met Center Site Environmental Impact Statement (EIS) and the Airport South Alternative Urban Areawide Review (AUAR) process.

Both environmental reviews address impacts of proposed developments in the ASD through year 2006. The AUAR assumes development of the properties identified as: the Met Center Site, Adjoining Lands, RPZ (Runway Protection Zone), Metro Office Park redevelopment, Olnick property, and the Muir property. The Scoping Document for the EIS describes the locations and types of development planned for each property. The primary difference between the EIS and AUAR development scenarios relates to the intensity of development planned on the Met Center and Adjoining Lands properties. The EIS compares the impact of a "No-Build" alternative on these two properties (i.e. the existing parking land uses remain) to four "Build" alternatives of varying intensities. For the purposes of the water quality assessment study, all Build alternatives were assumed to have the same surface water runoff quantity and quality characteristics (since they would likely result in the same amount of impervious area for all Build alternatives). The AUAR does not address a separate "No-Build" scenario, but it does review the impacts of the proposed developments (compared to the existing conditions).

To provide an assessment of water quality impacts for the EIS and AUAR studies, this memorandum will compare the existing ("Baseline") water quality conditions for runoff from the ASD to two development scenario alternatives. The first development scenario, identified as "EIS No-Build Alternative" in the remainder of this study, addresses the "No-Build" alternative for the EIS: i.e. it assumes the existing land use (parking) at the Met Center and Adjoining Lands properties and assumes development of the remaining parcels as described in the EIS Scoping Document. The second development scenario, identified as "EIS/AUAR Build" or "Proposed Action" in the remainder of this study, assumes the 2006 "Build" conditions for all of the proposed re-development parcels in the ASD. It should be noted that the proposed development scenarios include conversion of the RPZ property from its existing developed (mostly impervious) condition to an undeveloped, pervious condition and that the proposed Olnick development plan includes construction of on-site ponding for surface water detention and treatment.

Most stormwater drainage from the City of Bloomington Airport South District (ASD) Area outfalls to Long Meadow Lake after being routed through a stormwater treatment pond. Long Meadow Lake is part of a US Fish and Wildlife Service Refuge located within the Minnesota River Valley Floodplain. During low flow (less than 25 cfs), stormwater is routed through Pond C (Figure 1). During high flow, flows in excess of 25 cfs from the northern portion of the watershed are routed through Hogback Pond, with 25 cfs plus southern watershed inflows continuing through Pond C. Two small areas (subwatersheds Direct North and Direct Middle) always drain directly into the lake.

The AUAR/EIS study area does not include the area west of Highway 77, however stormwater inflows from this area are used in the impact assessment because they are also routed through Pond C. This additional stormwater will affect Pond C removal efficiencies, and consequently, pollutant loads to Long Meadow Lake.

2.0 Impact Analysis Methodology

2.1 Load Assessment

Effect of development on stormwater quality entering Long Meadow Lake was assessed using the P-8 Urban Catchment Model v. 2.2 (W. Walker, Jr. 1998). This model is widely used for determining relative effects of land use changes and best management practices on urban storm water quality.

P-8 model inputs for the area west of Highway 77 were provided by the City of Bloomington and are used only to reflect total load conditions at Pond C and to Long Meadow Lake. Included with the model provided by the City is the Minneapolis particle data file, which provides measured pollutant-particle association information for the City of Minneapolis. Using this empirical data set created for Minneapolis provides for more likely load estimates and more accurate load removal efficiencies than using the "default" assumptions in the P-8 model. Pollutant loads were modeled for Total Suspended Solids (TSS), Total Phosphorous (TP), Total Kjeldahl Nitrogen (TKN), copper (Cu), lead (Pb), zinc (Zn), Hydrocarbons (HC), Chemical Oxygen Demand (COD), and Biochemical Oxygen Demand (BOD).

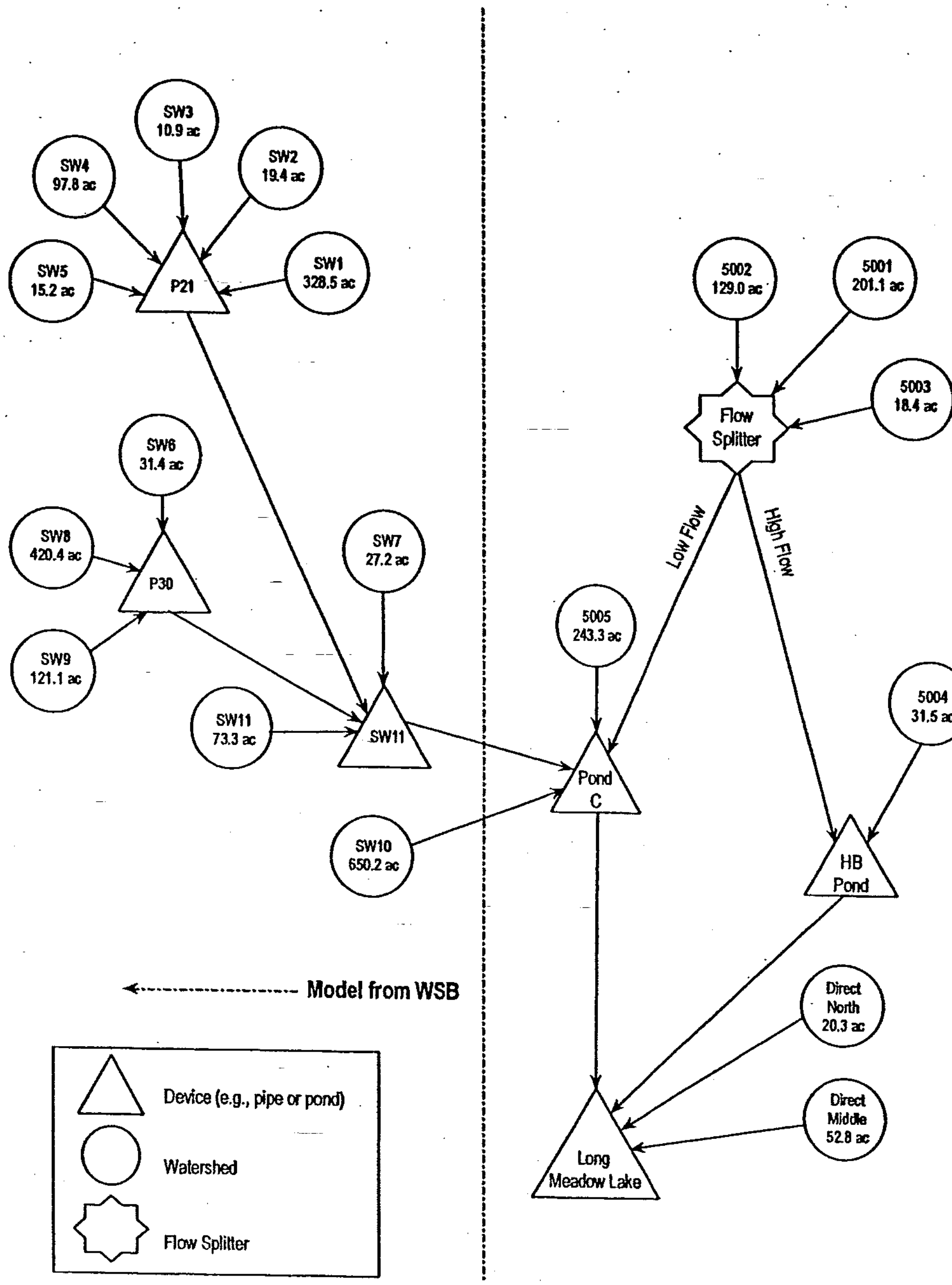


Figure 1. City of Bloomington Airport District South P8 Model Flow Network: Baseline Conditions

The original City of Bloomington P-8 model for the ASD Area is described in the technical memorandum, "P-8 Modeling for Existing and Future Conditions Airport South, February 1999," by Montgomery Watson. This model was calibrated for stormwater flow based on monitoring and XP-SWMM hydrologic/hydraulic modeling. Subwatersheds draining directly into Long Meadow Lake were added to this model, the flow splitter function was adjusted, and watershed areas were slightly adjusted based on the revised XP-SWMM model (SRF, 2000).

Pollutant load analysis and stormwater treatment device efficiencies were analyzed for Baseline, EIS No-Build Alternative, and EIS/AUAR Build (Proposed Action) conditions as described in Section 1.0. Baseline is modeled using existing watershed characteristics and current treatment device design characteristics. The No-Build Alternative includes redevelopment of the Olnick, Metro Office Park, Robert Muir and RPZ properties without redevelopment of the Met Center or Adjoining Lands sites.

Several development plan alternatives are considered within the Build option; however, there is no difference between their pertinent watershed and device characteristics for water quality assessment purposes. All development alternatives are therefore assessed in the Build option scenario. Build alternative redevelopment of the Olnick property includes construction of four new stormwater treatment ponds to treat almost half of the area that currently drains directly into Long Meadow Lake from subwatershed Direct Middle (Figure 2). Some storm water from subwatershed 5002 is also rerouted through the new treatment ponds. Two of the new ponds were modeled as a single large pond (Figure 2, Ponds 1 and 2) due to limited information on pond design and structure. Proposed design configurations for these ponds may result in less pollutant removal efficiency than predicted by the model; since the model can only simulate conditions for correctly configured ponds and current design plans show inefficient configurations. It is anticipated that the pond configurations will be corrected during City review of the development plans, when they are submitted for approval. Table 1 lists all watershed characteristic input values used for the various options modeled.

Relative pollutant loads during three standard storm event situations were analyzed:

1. Type 2 Storm, of 2 inches of rainfall typically used for assessing urban runoff impacts;

2. Normal Year precipitation for Minneapolis/St. Paul area (based on 1981 climate data) to provide realistic situation analysis; and

3. High Precipitation condition (Normal Year x 1.25) to assess impact sensitivity to wet years, when more runoff is likely.

Table 1. Watershed Characteristic Values

Subwatershed	Baseline			No-Build			Build		
	Area	Impervious Fraction	Pervious Area CN†	Area	Impervious Fraction	Pervious Area CN†	Area	Impervious Fraction	Pervious Area CN†
	acres			*acres*			*acres*		
5001	201.1	0.733	49	201.1	0.733	49	201.1	0.680	49
5002	129.0	0.566	49	117.0	0.510	49	117.0	0.510	49
5003	18.4	0.330	49	18.4	0.364	49	18.4	0.364	49
5004	31.5	0.384	49	31.5	0.384	49	31.5	0.755	49
5005	243.4	0.496	49	243.4	0.496	49	243.4	0.496	49
Direct North	20.3	0.680	61‡	20.3	0.604	61‡	20.3	0.604	61‡
Direct Middle	52.8	0.563	61‡	NA	NA	NA	NA	NA	NA
Direct Middle-1	NA	NA	NA	6.4	0.522	61	6.4	0.522	61
Direct Middle-2	NA	NA	NA	2.8	0.522	61	2.8	0.522	61
Direct Middle-3	NA	NA	NA	31.0	0.477	61	31.0	0.477	61
Direct Middle-4	NA	NA	NA	28.6	0.485	61	28.6	0.485	61

†CN = Curve Number

‡Assume 61; conservative estimate based on City of Bloomington West of Hwy 77 P8 model

*Build scenario includes rerouting of water from subwatershed 5002 through subwatershed Direct Middle and additions in subwatershed drainage area

Figure 2 diagrams the flow network used in the P8 model analysis for No-Build and Build conditions.

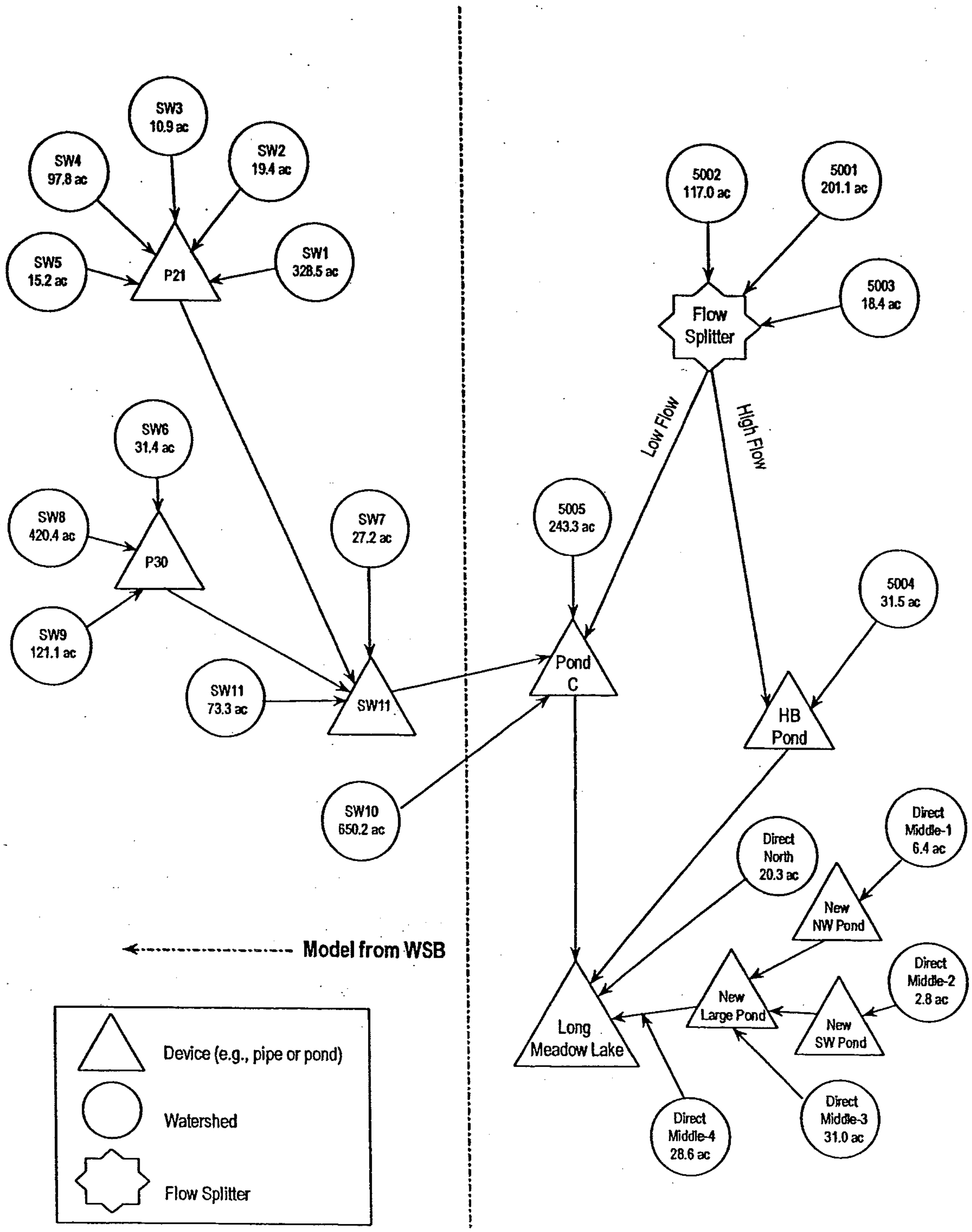


Figure 2. City of Bloomington Airport South District P-8 Model Flow Network: Proposed Plan Conditions

2.2 Criteria for Evaluating Impacts

Estimated numerical loads are included in this report as an indication of relative pollutant load magnitudes. However, since there was no stormwater outfall water quality concentration data available, the estimated loads are not suitable for determining actual loading amounts or to assess impacts based on numerical standards. The model chosen for impact analysis is well suited for assessing relative effects. A conservative criteria of ± 5% change between Baseline and Proposed Action (Build) or No-Build Alternative loads and removal efficiencies was used to determine significance. Continuity errors inherent in the analyses method (P-8 model) can be ± 2%, therefore a change of at least ± 5% can be considered significant and any smaller change is considered insignificant.

Stormwater treatment devices designed according to NURP standards (MCES criteria) will have long term average phosphorous removal efficiencies of 47 to 68% for the Twin Cities area (W. Walker, Jr., 1987). Total Suspended Solids (TSS) removal of 70% to 85% is generally recommended by state environmental management organizations. Best Management Practices (BMPs) expected removal efficiencies in Minnesota for wet detention pond stormwater treatment devices, such as Pond C and Hogback Pond, are listed in Table 2. These removal efficiencies can be expected when ponds are designed according to NURP standards (2 inch rainfall permanent pool storage).

Table 2. Long-Term Wet Pond Pollutant Removal Efficiencies (Protecting Water Quality in Urban Areas: Best Management Practices for Minnesota, MPCA 1989)

Pollutant	Range of Removal
Suspended Solids	80-95%
Oxygen Demand	45-90%
Total Phosphorous	40-70%
Dissolved Phosphorus	40-70%
Nitrate Nitrogen	60-80%
Kjeldahl Nitrogen	20-40%
Copper	60-80%
Lead	80-95%
Zinc	40-80%

Impacts of development alternatives on stormwater treatment device efficiencies that result in improvements or reductions to their efficiency will be considered significant if existing condition removal efficiencies that do not meet guidelines move closer to guidelines (significant positive increase) or if removal efficiencies meet guidelines but move further from guidelines (significant negative decrease).

2.3 Baseline Conditions

2.3.1 Loads to Long Meadow Lake

A summary of estimated Baseline pollutant loads to Long Meadow Lake is shown in Table 3 for Type 2 Storm, Normal Year, and High Precipitation events. Detailed estimated load information is provided in Table A-1 (Appendix A). "Total Load in System" includes all pollutants in stormwater prior to any treatment. The area west of Highway 77 accounts for approximately 41% of all flow and 37% of pollutant loads going to Pond C (and, ultimately, Long Meadow Lake), depending on the type of storm event. Most of the stormwater passes through at least one treatment device prior to discharge into Long Meadow Lake resulting in a total load reduction 74% Total Suspended Solids (TSS) and 45% Total Phosphorous (TP) during Normal years, and 62% TSS and 22% TP removals during a single 2" Type 2 Storm.

Table 3. Baseline Estimated Pollutant Loads to Long Meadow Lake.

Scenario	Flow	TSS	TP	TKN	Cu	PB	ZN	HC	COD	BOD
	acre-ft	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*
Type 2 Storm										
Total Load in System	250.5	34045	235.1	1143.8	11.99	27.49	65.58	936.2	40062	5908
Load to Long Meadow Lake	251.2	12959	182.4	938.5	9.84	13.54	53.81	461.0	23901	3451
Normal Year										
Total Load in System	2718	949166	4708	20761	217.7	681.2	1190	22203	1098748	161990
Load to Long Meadow Lake	2723	235543	2475	12022	126.0	207.9	689.3	7080	436228	62587
High Precipitation										
Total Load in System	3442	1083195	5520	24579	257.7	784.2	1409	26711	1255345	185080
Load to Long Meadow Lake	3447	283743	3065	14983	157.1	254.1	859.0	8655	526259	75518

2.3.2 Treatment Device Efficiency

Pond C receives inflows from 2,419 acres (low flow only for 380 acres). Of this 2,419 acres, 893.5 acres (37%) receive no treatment prior to Pond C. Hogback Pond receives flow from 411.5 acres (380 acres during high flow only) and 31.5 acres (8.3%) receive no treatment prior to Hogback Pond. This large difference in quantity and quality of water entering the treatment devices affects their pollutant removal efficiencies. Long term expected treatment device performance when designed according to NURP standards are shown beneath pollutants in the header.

- Baseline Pond C removal efficiencies do not meet expectations for any parameters modeled (Table 4).
- Baseline Hogback Pond removals:
  - do not meet expectations for Type 2 storms except for TKN, COD, and BOD
  - meet expectations for Normal Years
  - meet expectations for High Precipitation years except for Cu and Pb.

- Baseline Hogback Pond removals meet City of Bloomington target removals for only TSS under Normal and High Precipitation conditions.

Table 4 lists the relative treatment device efficiencies for Baseline conditions. Generally, removal efficiencies were only slightly lower (2-6%) for High Precipitation conditions compared with Normal Year conditions. Type 2 Storm event removal efficiencies were more than 10% less than Normal Year conditions. Although Type 2 Storms do not represent long term impacts, they do provide an indication of severe storm situation effects on stormwater treatment device efficiency.

Table 4. Baseline Treatment Device Pollutant Removal Efficiencies.

	TSS (80-95%)	TP (47-68%)	TKN (20-40%)	Cu (60-80%)	Pb (80-95%)	Zn (40-80%)	HC (NA)	COD (45-90%)	BOD (45-90%)
Baseline	%	%	%	%	%	%	%	%	%
Type 2 Storm									
Pond C	47.6	12.8	9.9	9.9	35.9	10.0	35.9	25.5	26.5
Hogback Pond	64.5	30.1	**24.9**	25.3	54.7	25.0	54.6	**50.5**	**51.5**
Normal Year									
Pond C	62.8	29.8	25.3	25.3	55.2	25.3	55.2	42.0	43.4
Hogback Pond	**85.3**	**63.9**	**58.2**	58.2	**80.1**	**58.2**	80.1	**78.8**	**79.3**
High Precipitation									
Pond C	60.9	27.4	23.0	23.0	52.9	23.0	52.9	39.7	41.1
Hogback Pond	**82.7**	**57.9**	**51.8**	51.8	76.5	**51.8**	76.5	**74.9**	**75.4**

Values in parenthesis are MPCA wet pond long-term expected removal efficiencies for NURP ponds. City of Bloomington target reductions are 80% TSS and 60% TP. Bold values are within expectations.

Overall, Pond C is responsible for removing approximate one-third of all TSS, 15-20% of all metals and nutrients, 25% of oxygen demand, and 30% of the lead in stormwater flowing to Long Meadow Lake. Although Hogback pond has a higher removal efficiency, because it treats a smaller volume of stormwater than Pond C, its effect on total load reduction is less; a less than 7% reduction in all pollutant loads. Table 5 lists the estimated amount of each pollutant removed by each device.

Table 5. Baseline Estimated Amount of Pollutant Removed by Each Treatment Device.

	TSS	TP	TKN	Cu	Pb	Zn	HC	COD	BOD
Baseline	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*
Type 2 Storm									
Pond C	9775	23.68	91.59	0.96	6.46	5.26	219.9	7117	1084
Hogback Pond	1915	5.86	23.36	0.25	1.29	1.34	43.76	1764	265.3
Normal Year									
Pond C	325433	931.6	3622	37.96	215.3	207.7	7333	276766	41782
Hogback Pond	57941	211.4	843.1	8.84	38.81	48.36	1322	62001	9192
High Precipitation									
Pond C	361243	1016	3950	41.36	239.0	226.8	8139	302130	45668
Hogback Pond	70044	249	987.9	10.37	46.80	56.66	1594	73618	10931

3.0 Impact Analysis

3.1 Proposed Action

3.1.1 Loads to Long Meadow Lake

Table 6 summarizes the Build scenario's effect on water quality entering Long Meadow Lake. Negative values indicate load reductions compared to Baseline, while positive values indicate increased loads. For all storm events and pollutants, the Build scenario reduced total load in the system and loads reaching Long Meadow Lake. Addition of new ponds and reduced total impervious area contributes to the load reductions. Detailed load information is included in Table A-2 (Appendix A).

The significance of these load reductions are shown in Table 7. For all storm event situations, Build scenario load reductions to Long Meadow Lake were not significant (≥ 5% difference) except for Normal Year and High Precipitation TSS (Table 7). Reduction in load and flow are attributable to a net decrease in amount of impervious surface area and addition of new treatment ponds in subwatershed Direct Middle that reduced direct inflow loads 37-40% in all situations and inflows to Hogback Pond in Normal Year and High Precipitation situations. In summary:

- Build scenario reduced all loads to Long Meadow Lake;
- Load reductions to Long Meadow Lake were not significant except for TSS Normal Year and High Precipitation conditions.

Table 6. Build Scenario Effect on Pollutant Transport to Long Meadow Lake

Scenario	Flow	TSS	TP	TKN	Cu	PB	ZN	HC	COD	BOD
	acre-ft	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
Type 2 Storm										
Total Load in System	-1.10	-137	-0.90	-4.8	-0.05	-0.11	-0.28	-3.80	-162	-24
Load to Long Meadow Lake	-1.20	-464	-2.30	-10.2	-0.11	-0.34	-0.59	-11.40	-503	-75
Normal Year										
Total Load in System	-13.0	-6168	-29	-124	-1.30	-34.30	-7.00	-147	-7122	-1050
Load to Long Meadow Lake	-13.0	-14648	-66	-271	-2.80	-10.10	-15.60	-343	-17327	-2556
High Precipitation										
Total Load in System	-18.0	-7230	-35	-151	-1.60	-5.10	-9.00	-175	-8359	-1232
Load to Long Meadow Lake	-17.0	-16608	-75	-311	-3.30	-11.40	-17.80	-389	-19503	-2880

Table 7. Significance of Build Scenario Effect on Pollutant Loads.

Scenario	Flow	TSS	TP	TKN	Cu	PB	ZN	HC	COD	BOD
	% Difference from Baseline									
Build										
Type 2 Storm										
West of 77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pond C Inflow	-0.6	-1.0	-0.8	-0.7	-0.8	-0.9	-0.7	-5.8	-0.9	-0.9
Hogback Pond Inflow	-2.8	-1.8	-2.3	-2.3	-3.0	-2.5	-2.2	-2.2	-2.1	-2.1
New Ponds Inflow		NA	NA	NA	NA	NA	NA	NA	NA	NA
Direct Inflow	-37.7	-37.7	-37.6	-37.7	-37.5	-37.0	-37.7	-37.7	-37.7	-37.7
Total in System	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Total to Long Meadow Lake	-0.5	-3.6	-1.3	-1.1	-1.1	-2.5	-1.1	-2.5	-2.1	-2.2
Normal Year										
West of 77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pond C Inflow	-0.6	-0.8	-0.7	-0.7	-0.7	-0.8	-0.7	-0.8	-0.7	-0.7
Hogback Pond Inflow	-3.3	-5.9	-5.2	-5.0	-5.0	-5.7	-5.0	-5.7	-5.9	-5.9
New Ponds Inflow	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Direct Inflow	-39.9	-40.0	-40.0	-39.9	-40.0	-40.0	-39.9	-39.9	-40.0	-40.0
Total in System	-0.5	-0.6	-0.6	-0.6	-0.6	-5.0	-0.6	3.8	-0.6	-0.6
Total to Long Meadow Lake	-0.5	-6.2	-2.7	-2.3	-2.2	-4.9	-2.3	-4.8	-4.0	-4.1
High Precipitation										
West of 77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pond C Inflow	-0.6	-0.8	-0.7	-0.7	-0.7	-0.8	-0.7	-0.7	-0.7	-0.7
Hogback Pond Inflow	-3.2	-5.8	-5.2	-5.0	-5.0	-5.6	-5.0	-5.6	-5.8	-5.8
New Ponds Inflow	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Direct Inflow	-36.7	-39.9	-39.9	-39.9	-39.8	-39.9	-39.8	-39.9	-39.9	-39.9
Total in System	-0.5	-0.7	-0.6	-0.6	-0.6	-0.7	-0.6	-0.7	-0.7	-0.7
Total to Long Meadow Lake	-0.5	-5.9	-2.4	-2.1	-2.1	-4.5	-2.1	-4.5	-3.7	-3.8

Grey areas denote significant differences

3.1.2 Treatment Device Efficiency

P-8 modeled treatment device efficiencies for the Build scenario are listed in Table 8 and estimated loads are listed in Table 9. Pond C removal efficiencies do not meet expectations for any parameters modeled except Normal Year TKN, however, there is no significant difference in performance compared to Baseline (Table 10). Hogback Pond removals meet pollutant removal expectations for Normal Year conditions except for Cu, and High Precipitation conditions, except for Cu, TP, and Pb. Although there is a slight improvement in performance compared to Baseline, this improvement is not significant (Table 10). The new ponds associated with redevelopment of the Olnick property were assessed as one unit (New Ponds) for efficiency and impact analysis. If New Ponds function according to basic design consideration, efficiencies will generally meet guidelines for most conditions and pollutants except for Cu and TP and Type 2 Storm events. New Ponds performance cannot be compared to Baseline since they are an addition of the Build scenario. Both Hogback Pond and New Ponds met City of Bloomington target reductions for TSS (80%) [for Normal and High Precipitation] and for TP (60%) [for Normal Year events].

Table 8. Build Scenario Treatment Device Efficiency

	TSS (80-95%)	TP (47-68%)	TKN (20-40%)	Cu (60-80%)	Pb (80-95%)	Zn (40-80%)	HC (NA)	COD (45-90%)	BOD (45-90%)
Build	%	%	%	%	%	%	%	%	%
Type 2 Storm									
Pond C	47.5	12.8	9.9	9.8	35.8	9.9	32.5	25.4	26.5
Hogback Pond	65.9	31.1	**25.9**	26.0	55.7	26.1	55.8	**51.7**	**52.8**
New Ponds	68.0	23.0	14.7	15.8	54.5	15.9	57.4	**53.2**	**54.7**
Normal Year									
Pond C	62.8	29.8	**25.2**	25.2	55.2	25.2	55.2	42.0	43.3
Hogback Pond	**86.3**	**64.7**	**58.9**	58.9	**80.9**	**58.9**	80.9	**80.0**	**80.5**
New Ponds	**90.3**	**60.9**	**52.3**	52.0	**82.2**	**52.2**	82.3	**82.3**	**83.0**
High Precipitation									
Pond C	60.9	28.2	**23.0**	23.0	52.9	23.0	52.9	39.7	41.0
Hogback Pond	**83.5**	**58.5**	**52.2**	52.2	77.1	**52.2**	77.1	**75.9**	**76.4**
New Ponds	**88.7**	**56.3**	**47.4**	47.2	79.8	**47.4**	79.8	**65.6**	**62.5**

Values in parenthesis are MPCA wet pond long-term expected removal efficiencies for NURP ponds. City of Bloomington target reductions are 80% TSS and 60% TP. Bold values are within expectation.

Table 9. Build Scenario Estimated Amount of Pollutant Removed by Each Treatment Device

	TSS	TP	TKN	Cu	Pb	Zn	HC	COD	BOD
Build	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*
Type 2 Storm									
Pond C	9662	23.48	90.7	0.94	6.39	5.21	187.4	7039	1073
Hogback Pond	1919	5.93	23.7	0.25	1.28	1.37	43.73	1768	265.9
New Ponds	377	0.88	2.7	0.03	0.24	0.17	8.73	346.8	52.65
Normal Year									
Pond C	322685	923.3	3588	37.60	213.4	205.7	7269	274545	41446
Hogback Pond	55140	202.7	810.0	8.49	36.96	46.44	1258	59234	8780
New Ponds	13385	44.99	170.8	1.78	8.75	9.78	298.7	14135	2100
High Precipitation									
Pond C	358339	1037	3915	41.07	237.0	224.8	8072	299868	45326
Hogback Pond	66637	238.2	946.8	9.93	44.56	54.30	1518	70240	10429
New Ponds	15013	48.81	183.1	1.91	9.79	10.49	333.5	12868	1807

Table 10. Build Scenario Impact on Treatment Device Efficiency Significance.

	TSS	TP	TKN	Cu	PB	ZN	HC	COD	BOD
Build	*Difference from Baseline, %*								
Type 2 Storm									
Pond C	-0.2	-0.1	-0.2	-1.3	-0.2	-0.2	-9.5	-0.2	-0.2
Hogback Pond	2.1	3.6	3.8	3.1	1.8	4.6	2.2	2.4	2.4
Normal Year									
Pond C	0.0	-0.2	-0.2	-0.2	-0.1	-0.3	-0.1	-0.1	-0.1
Hogback Pond	1.1	1.2	1.1	1.1	1.0	1.1	1.0	1.5	1.5
High Precipitation									
Pond C	0.0	2.8	-0.2	0.0	-0.1	-0.2	-0.1	0.0	0.0
Hogback Pond	1.0	1.0	0.8	0.8	0.8	0.8	0.8	1.3	1.2

Generally, removal efficiencies were only slightly lower (<7%) for High Precipitation conditions compared with Normal Year conditions for all ponds and pollutants. However, Type 2 Storm event removal efficiencies were more than 10% less than Normal Year conditions for Pond C and greater than 20% less for Hogback and New Ponds. Although Type 2 Storms do not represent long term impacts, they do provide an indication of severe storm situation effects on stormwater treatment device efficiency.

Total removals are based on how much of each pollutant in the entire system, which could possibly discharge into Long Meadow Lake (including area west of Highway 77), is removed by the treatment device. This provides an indication of relative importance of each treatment device in reducing total loads. Overall, Pond C is responsible for removing approximate one-third of all TSS, 15-20% of all nutrients, 25% of oxygen demand, and 30% of the lead in stormwater flowing towards Long Meadow Lake during Normal Year and High Precipitation conditions. For single 2" Type 2 Storm events these removals are reduced by 5 to 10%. Although Hogback Pond and New Ponds have higher individual removal efficiencies than Pond C (Table 8), because they treat smaller volumes of stormwater than Pond C, their effect on total load reduction is less; a less than 6% and 2% reduction in all pollutant loads, respectively. Table 9 lists the estimated amount of each pollutant removed for an indication of relative effects.

- Pond C did not meet removal expectations for all parameters except TKN Normal Year and High Precipitation under the Build scenario.
- No significant impacts on Pond C efficiency can be attributed to the Build scenario.

- Hogback Pond Build scenario removals:
  - do not meet expectations for Type 2 Storm except for TKN, COD, and BOD
  - meet expectations for Normal Year except for Cu
  - meet expectations for High Precipitation except for Cu, Pb, and TP
  - meet City of Bloomington targets for TSS (80%) [for Normal and High Precipitation] and for TP (60%) [for Normal Year events].

- New Ponds Build scenario removals:
  - do not meet expectations for Type 2 Storm except for COD and BOD
  - meet expectations for Normal Year except for Cu
  - meet expectations for High Precipitation except for Cu and TP
  - meet City of Bloomington targets for TSS (80%) [for Normal and High Precipitation] and for TP (60%) [for Normal Year events].

- Overall there were generally no impacts to current device efficiency as a result of the Build scenario

- Addition of new treatment ponds, however, contributes additional load reductions and improves the overall system's removal efficiency.

3.2 EIS No-Build Alternative

3.2.1 Loads to Long Meadow Lake

Table 11 summarizes the EIS No-Build scenario's effect on water quality entering Long Meadow Lake. Negative values indicate load reductions compared to Baseline, while positive values indicate increased loads. For all storm events and pollutants, the No-Build scenario reduced total load in the system and loads reaching Long Meadow Lake. Addition of new ponds and reduced total impervious area contributes to the load reductions. Detailed load information is included in Table A-3 (Appendix A).

The significance of these load reductions are shown in Table 12. For all storm event situations, No-Build scenario load reductions to Long Meadow Lake were not significant ($\geq$ 5% difference) except for Normal Year and High Precipitation TSS. Reduction in load and flow are attributable to a net decrease in amount of impervious surface area and addition of new treatment ponds in subwatershed Direct Middle that reduced direct inflow loads 37-40%. No-Build conditions significantly reduced Hogback Pond inflows for all situations, but also reduced the amount of pollutant removed for Normal Year and High Precipitation situations. In summary:

- No-Build scenario reduced all loads to Long Meadow Lake;

- Load reductions were not significant except for TSS Normal Year and High Precipitation conditions.

Table 11. No-Build Scenario Effect on Pollutant Transport to Long Meadow Lake

Scenario	Flow	TSS	TP	TKN	Cu	PB	ZN	HC	COD	BOD
	acre-ft	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
Type 2 Storm										
Total Load in System	-0.70	-161	-1.10	-5.5	-0.06	-0.13	-0.32	-4.40	-189	-28
Load to Long Meadow Lake	-1.40	-463	-2.40	-10.7	-0.11	-0.34	-0.62	-11.50	-505	-75
Normal Year										
Total Load in System	-14	-6829	-32	-137	-1.50	-4.80	-8.0	-163	-7885	-1163
Load to Long Meadow Lake	-14	-14037	-63	-260	-2.70	-9.70	-15.0	-330	-16268	-2402
High Precipitation										
Total Load in System	-20	-8008	-39	-167	-1.8	-5.7	-9.0	-194	-9257	-1364
Load to Long Meadow Lake	-19	-16037	-72	-303	-3.2	-11.1	-17.3	-378	-18531	-2737

Table 12. Significance of No-Build Scenario Effect on Pollutant Loads.

Scenario	Flow	TSS	TP	TKN	Cu	PB	ZN	HC	COD	BOD
	% Difference from Baseline									
No Build										
Type 2 Storm										
West of 77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pond C Inflow	-0.3	-0.5	-0.4	-0.4	-0.4	-0.5	-0.4	-0.5	-0.5	-0.5
Amt. Removed by Pond C		-0.6	-0.7	-0.5	-1.0	-0.6	-0.6	-0.6	-0.6	-0.6
Hogback Pond Inflow	-6.7	-5.9	-6.4	-6.4	-7.1	-6.4	-6.3	-6.2	-6.1	-6.1
Amt. Removed by Hogback		-3.7	-1.7	-1.0	-4.0	-3.9	-0.7	-3.9	-3.1	-3.1
New Ponds Inflow		NA	NA	NA	NA	NA	NA	NA	NA	NA
Amt. Removed by NewPonds		NA	NA	NA	NA	NA	NA	NA	NA	NA
Direct Inflow	-37.7	-37.7	-37.6	-37.7	-37.5	-37.0	-37.7	-37.7	-37.7	-37.7
Total in System	-0.3	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5
Total to Long Meadow Lake	-0.6	-3.6	-1.3	-1.1	-1.1	-2.5	-1.2	-2.5	-2.1	-2.2
Normal Year										
West of 77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pond C Inflow	-0.3	-0.4	-0.3	-0.5	-0.3	-0.4	-0.3	-0.4	-0.4	-0.4
Amt. Removed by Pond C		-0.4	-0.5	-1.2	-0.5	-0.5	-0.7	-0.5	-0.4	-0.4
Hogback Pond Inflow	-8.7	-10.0	-9.7	-9.6	-9.6	-9.9	-9.6	-9.9	-10.0	-10.0
Amt. Removed by Hogback		-9.4	-8.5	-8.2	-8.1	-9.2	-8.3	-9.2	-9.0	-9.0
New Ponds Inflow	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Amt. Removed by NewPonds	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Direct Inflow	-39.9	-40.0	-40.0	-39.9	-40.0	-40.0	-39.9	-39.9	-40.0	-40.0
Total in System	-0.5	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7	-0.7
Total to Long Meadow Lake	-0.5	-6.0	-2.5	-2.2	-2.1	-4.7	-2.2	-4.7	-3.7	-3.8
High Precipitation										
West of 77	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Pond C Inflow	-0.3	0.2	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3	-0.3
Amt. Removed by Pond C		0.4	-0.5	-0.6	-0.3	-0.4	-0.6	-0.4	-0.4	-0.4
Hogback Pond Inflow	-7.8	-9.6	-9.2	-9.0	-9.0	-9.5	-9.0	-9.5	-9.6	-9.6
Amt. Removed by Hogback		-8.9	-8.2	-7.9	-8.0	-8.8	-8.0	-8.8	-8.6	-8.6
New Ponds Inflow	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Amt. Removed by NewPonds	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Direct Inflow	-36.7	-39.9	-39.9	-39.9	-39.8	-39.9	-39.8	-39.9	-39.9	-39.9
Total in System	-0.6	-0.7	-0.7	-0.7	-0.7	-0.7	-0.6	-0.7	-0.7	-0.7
Total to Long Meadow Lake	-0.6	-5.7	-2.3	-2.0	-2.0	-4.4	-2.0	-4.4	-3.5	-3.6

Grey areas denote significant differences

3.2.2 Treatment Device Efficiency

P-8 modeled treatment device efficiencies for the No-Build scenario are listed in Table 13 and estimated loads are listed in Table 14. Pond C removal efficiencies do not meet expectations for any parameters modeled except Normal Year and High Precipitation TKN, however, there is no significant difference in performance compared to Baseline (Table 15). Hogback Pond removals meet pollutant removal expectations for Normal Year conditions except for Cu, and High Precipitation conditions, except for Cu and Pb. There is a slight improvement in performance compared to Baseline that is significant for TP, TKN, and Zn removal under Type 2 Storm conditions (Table 15). The new ponds associated with redevelopment of the Olnick property were assessed as one unit (New Ponds) for efficiency and impact analysis. If New Ponds function according to basic design consideration, efficiencies will generally meet guidelines for all Normal Year and High Precipitation conditions and all pollutants except for Cu and TP. New Ponds performance cannot be compared to Baseline since they are an addition of the No-Build scenario. Both Hogback Pond and New Ponds met City of Bloomington target reductions for TSS (80%) [for Normal and High Precipitation] and for TP (60%) [for Normal Year events].

Table 13. No-Build Scenario Treatment Device Efficiency

No-Build	TSS (80-95%) %	TP (47-68%) %	TKN (20-40%) %	Cu (60-80%) %	Pb (80-95%) %	Zn (40-80%) %	HC (NA) %	COD (45-90%) %	BOD (45-90%) %
Type 2 Storm									
Pond C	47.6	12.8	9.9	9.9	35.8	9.9	35.8	25.4	26.5
Hogback Pond	66.0	31.5	**26.4**	26.1	56.1	26.4	56.0	**52.2**	**53.2**
New Ponds	68.0	23.0	14.7	15.8	54.5	15.9	57.4	**53.2**	**54.7**
Normal Year									
Pond C	62.8	29.8	**25.1**	25.2	55.2	25.2	55.2	42.0	43.3
Hogback Pond	**86.0**	**64.8**	**59.1**	59.1	**80.7**	**59.1**	80.7	**79.8**	**80.2**
New Ponds	**90.3**	**60.9**	**52.3**	52.0	**82.2**	**52.2**	82.3	**82.3**	**83.0**
High Precipitation									
Pond C	61.1	27.3	**23.0**	23.0	52.9	23.0	52.9	39.7	41.0
Hogback Pond	**83.3**	**58.6**	**52.4**	52.4	77.0	**52.4**	77.0	**75.8**	**76.3**
New Ponds	**88.7**	**56.3**	**47.4**	47.2	79.8	**47.4**	79.8	**65.6**	**62.5**

Values in parenthesis are MPCA wet pond long-term expected removal efficiencies for NURP ponds. City of Bloomington target reductions are 80% TSS and 60% TP. Bold values are within expectation.

Table 14. No-Build Scenario Estimated Amount of Pollutant Removed by Each Treatment Device

	TSS	TP	TKN	Cu	Pb	Zn	HC	COD	BOD
No-Build	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*
Type 2 Storm									
Pond C	9715	23.51	91.09	0.95	6.42	5.23	218.6	7072	1077
Hogback Pond	1844	5.76	23.13	0.24	1.24	1.33	42.07	1711	257.0
New Ponds	377.1	0.88	2.73	0.03	0.24	0.17	8.73	346.8	52.65
Normal Year									
Pond C	324027	927.1	3580	37.76	214	206.3	7300	275521	41595
Hogback Pond	52518	193.5	773.8	8.12	35.23	44.36	1200	56434	8363
New Ponds	13385	44.99	170.8	1.78	8.75	9.78	298.7	14135	2100
*All Devices**	720831	2264	8862	92.90	478.2	507.7	16290	670903	100642
High Precipitation									
Pond C	362860	1011	3928	41.22	238.0	225.5	8105	300920	45486
Hogback Pond	63792	228	909.5	9.54	42.67	52.13	1454	67313	9991
New Ponds	15013	48.81	183.1	1.91	9.79	10.49	333.5	12868	1807

Table 15. No-Build Scenario Impact on Treatment Device Efficiency Significance.

	TSS	TP	TKN	Cu	PB	ZN	HC	COD	BOD
No-Build	*Difference from Baseline, %*								
Type 2 Storm									
Pond C	-0.1	-0.3	-0.1	-0.6	-0.1	-0.2	-0.1	-0.2	-0.2
Hogback Pond	2.3	5.0	5.7	3.3	2.6	6.0	2.5	3.3	3.2
Normal Year									
Pond C	0.0	-0.1	-0.7	-0.2	-0.1	-0.3	-0.1	-0.1	-0.1
Hogback Pond	0.7	1.4	1.5	1.6	0.8	1.5	0.8	1.2	1.1
High Precipitation									
Pond C	0.3	-0.2	-0.3	0.0	-0.1	-0.3	-0.1	-0.1	-0.1
Hogback Pond	0.7	1.1	1.2	1.1	0.7	1.1	0.7	1.1	1.1

Generally, removal efficiencies were only slightly lower (<7%) for High Precipitation conditions compared with Normal Year conditions for all ponds and pollutants. However, Type 2 Storm event removal efficiencies were more than 15% less than Normal Year conditions for Pond C and greater than 25% less for Hogback and New Ponds. Although Type 2 Storms do not represent long term impacts, they do provide an indication of severe storm situation effects on stormwater treatment device efficiency.

Total removals are based on how much of each pollutant in the entire system, which could possibly discharge into Long Meadow Lake (including area west of Highway 77), is removed by the treatment device. This provides an indication of relative importance of each treatment device in reducing total loads. Overall, Pond C is responsible for removing approximate one-third of all TSS, 15-20% of all nutrients, 25% of oxygen demand, and 30% of the lead in stormwater flowing towards Long Meadow Lake during Normal Year and High Precipitation conditions. For single 2" Type 2 Storm events these removals are reduced by 5 to 10%. Although Hogback Pond and New Ponds have higher individual removal efficiencies than Pond C (Table 13), because they treat smaller volumes of stormwater than Pond C, their effect on total load reduction is less; a less than 6% and 2% reduction in all pollutant loads, respectively. Table 14 lists the estimated amount of each pollutant removed for an indication of relative effects.

- Pond C did not meet removal expectations for all parameters except TKN Normal Year and High Precipitation under the No-Build scenario.

- No significant impacts on Pond C efficiency can be attributed to the No-Build scenario.

- Hogback Pond No-Build scenario removals:

  - do not meet expectations for Type 2 Storm except for TKN, COD, and BOD
  - meet expectations for Normal Year except for Cu
  - meet expectations for High Precipitation except for Cu and TP
  - meet City of Bloomington targets for TSS (80%) [for Normal and High Precipitation] and for TP (60%) [for Normal Year events].

- New Ponds No-Build scenario removals:

  - do not meet expectations for Type 2 Storm except for COD and BOD
  - meet expectations for Normal Year except for Cu
  - meet expectations for High Precipitation except for Cu and TP
  - meet City of Bloomington targets for TSS (80%) [for Normal and High Precipitation] and for TP (60%) [for Normal Year events].

- Overall there were generally no impacts to current device efficiency as a result of the No-Build scenario except for significant improvement of Hogback Pond Type 2 Storm TP, TKN, and Zn removals.

- Addition of new treatment ponds, however, contributes additional load reductions and improves the overall system's removal efficiency.

3.2.3 No-Build Comparison to Build Alternative

Differences between the No-Build Alternative and the Build Alternative are slight due to only small changes in overall impervious surface fraction for the two alternatives. The main difference between the Build and No-Build alternatives is the development of Met Center and Adjoining Lands for the Build Alternative. Currently, these sites are parking lots with a high impervious fraction that will not be changed greatly under Build Alternatives conditions. The significance of these differences is shown in Table 16. Positive values indicate higher inflows or removals under the Build scenario compared to No-Build. Changes greater than or equal to 5% are considered significant. There are no significant differences between the Build and No-Build scenario on Total System load or load to Long Meadow Lake. For the Normal Year situation, loads to Hogback Pond are significantly higher for the Build Alternative due to the slight increases in impervious surface of subwatersheds flowing to Hogback Pond. Higher removals by Hogback Pond negates this increase and, therefore, the total load to Long Meadow Lake is not affected.

- No significant difference between Build and No-Build pollutant transport.

Table 16. Significance of Build Compared to No-Build Loads.

Scenario	Flow	TSS	TP	TKN	Cu	PB	ZN	HC	COD	BOD
	% Difference from No-Build									
Build										
Type 2 Storm										
West of 77	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Pond C Inflow	-0.3	-0.5	-0.3	-0.3	-0.4	-0.4	-0.3	-5.3	-0.4	-0.4
Amt. Removed by Pond C		*-0.5*	*-0.1*	*-0.4*	*-1.1*	*-0.5*	*-0.4*	*-14.3*	*-0.5*	*-0.4*
Hogback Pond Inflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Amt. Removed by Hogback		*4.1*	*3.0*	*2.4*	*4.2*	*3.2*	*3.0*	*3.9*	*3.4*	*3.5*
New Ponds Inflow	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Amt. Removed by NewPonds		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Direct Inflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total in System	-0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total to Long Meadow Lake	0.1	0.0	0.1	0.1	0.0	0.0	0.1	0.0	0.0	0.0
Normal Year										
West of 77	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Pond C Inflow	-0.4	-0.4	-0.4	-0.2	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Amt. Removed by Pond C		*-0.4*	*-0.4*	*0.2*	*-0.4*	*-0.4*	*-0.3*	*-0.4*	*-0.4*	*-0.4*
Hogback Pond Inflow	5.9	4.6	5.0	5.1	5.0	4.7	5.1	4.7	4.6	4.6
Amt. Removed by Hogback		*5.0*	*4.8*	*4.7*	*4.6*	*4.9*	*4.7*	*4.9*	*5.0*	*5.0*
New Ponds Inflow	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Amt. Removed by NewPonds		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Direct Inflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total in System	0.0	0.1	0.1	0.1	0.1	-4.4	0.1	0.1	0.1	0.1
Total to Long Meadow Lake	0.0	-0.3	-0.1	-0.1	-0.1	-0.2	-0.1	-0.2	-0.3	-0.3
High Precipitation										
West of 77	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Pond C Inflow	-0.3	-0.9	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4	-0.4
Amt. Removed by Pond C		*-1.2*	*2.6*	*-0.3*	*-0.4*	*-0.4*	*-0.3*	*-0.4*	*-0.3*	*-0.4*
Hogback Pond Inflow	4.9	4.2	4.4	4.5	4.5	4.3	4.5	4.3	4.2	4.2
Amt. Removed by Hogback		*4.5*	*4.3*	*4.1*	*4.1*	*4.4*	*4.2*	*4.4*	*4.3*	*4.4*
New Ponds Inflow	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Amt. Removed by NewPonds		*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
Direct Inflow	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total in System	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.1	0.1	0.1
Total to Long Meadow Lake	0.1	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2

4.0 Summary

P-8 modeling of Baseline, Build (Proposed Action), and EIS No-Build Alternative scenarios indicate that no significant effects on pollutant transport to Long Meadow Lake will occur under any of the Alternatives, except for a reduction in TSS load during Normal Year and High Precipitation conditions. There are no significant differences between Build and No-Build scenarios with respect to Long Meadow Lake water quality impacts.

Currently, the Pond C treatment device is not operating at NURP pond expected removal efficiencies. Pond C was constructed prior to establishment of NURP standards and therefore cannot be realistically expected to operate at NURP removal rates.

Hogback Pond is currently operating within expected removal efficiencies for most situations when assessed annually. TP removals for High Precipitation events, however, still remain below City of Bloomington target reductions.

In general, despite treatment device inefficiencies, estimated pollutant concentrations indicate likely compliance with current water quality standards (MN Rule 7050). Although these rules are not directly applicable to this situation, they provide a benchmark for assessing impacts. Table 17 provides a summary of currently water quality criteria and P-8 model estimated annual concentrations. Because this model has not been calibrated, concentrations cannot be considered valid but are useful for indicating potential impacted areas. It should be noted that Aquatic Life Support criteria are for concentrations within the water body and for chronic (lowest value) exposure situations. NPDES standards apply to NPDES permitted point source dischargers only.

Table 17. Estimate Flow Weighted Mean Concentration and Water Quality Standards.

Scenario	TSS	TP	TKN	Cu	Pb	Zn	HC	COD	BOD
	ppm	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*	*ppm*
Aquatic Life Support (class 2B)-chronic receiving water	NC	NC	NC	0.007-0.015*	0.0013-0.0077*	0.059-0.191*	NC	NC	NC
NPDES	30	1.0	NC	NC	NC	NC	NC	NC	25.0
Baseline									
Type 2 Storm	19	0.3	1.37	0.014	0.020	0.079	0.675	35.0	5.1
Normal Year	32	0.3	1.62	0.017	0.028	0.093	0.957	58.9	8.5
High Year	30	0.3	1.6	0.017	0.027	0.092	0.924	56.2	8.1
Build									
Type 2 Storm	18	0.3	1.37	0.014	0.019	0.078	0.662	34.4	5.0
Normal Year	30	0.3	1.60	0.017	0.027	0.092	0.915	56.9	8.2
High Year	29	0.3	1.57	0.017	0.026	0.090	0.887	54.4	7.8
No Build									
Type 2 Storm	50	0.3	1.37	0.014	0.019	0.078	0.662	34.5	5.0
Normal Year	30	0.3	1.60	0.017	0.027	0.092	0.917	57.0	8.2
High Year	29	0.3	1.58	0.017	0.026	0.090	0.888	54.5	7.8

NC = No criteria

* Actual value depends on Hardness

5.0 Recommendations

To reduce current and future transport to Long Meadow Lake, additional stormwater treatment strategies may be necessary. It is suggested that the following options be considered:

1. Enhancement of Pond C to more closely meet current NURP pond design standards.

2. Construction of planned improvements (included in the City's *Wetland Protection and Management Plan* and the CIP) to the sub-watersheds west of Highway 77, to enhance treatment of those storm water flows to Pond C.

3. Construction of small ponds or pervious surfaces in subwatersheds such as Direct N, which currently have no treatment prior to outfall.

4. Construction of additional regional ponding.

5. Evaluation and installation of innovative storm water treatment systems (e.g., V3, stormceptor, underground infiltration basins, etc.) in conjunction with planned new development in the watershed.

Appendix A

P-8 Model Results

Table A-1. Baseline Loads

Scenario	Flow	TSS	TP	TKN	Cu	PB	ZN	HC	COD	BOD
	acre-ft	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*
Baseline										
Type 2 Storm										
West of 77	*208.8*	*15134*	*145.3*	*728.8*	*7.64*	*13.56*	*41.79*	*461.7*	*21555*	*3145*
Pond C Inflow	252.9	20533	184.5	921.4	9.66	18.00	52.84	613.0	27937	4086
Amt. Removed by Pond C		*9775*	*23.68*	*91.59*	*0.96*	*6.46*	*5.26*	*219.91*	*7117*	*1084*
Hogback Pond Inflow	19.99	2967	19.50	93.63	0.99	2.36	5.37	80.16	3492	515.0
Amt. Removed by Hogback		*1915*	*5.86*	*23.36*	*0.25*	*1.29*	*1.34*	*43.76*	*1764.4*	*265.3*
Direct Inflow	8.38	1149	7.91	38.42	0.40	0.92	2.20	31.55	1352	199.4
Total in System	250.5	34045	235.1	1143.8	11.99	27.49	65.58	936.2	40062	5908
Total to Long Meadow Lake	251.2	12959	182.4	938.5	9.84	13.54	53.81	461.0	23901	3451
Normal Year										
West of 77	*1880*	*320570*	*2142*	*9993*	*104.8*	*248.1*	*572.9*	*8453*	*429217*	*62582*
Pond C Inflow	2445	518058	3123	14314	150.1	389.8	820.7	13278	658215	96343
Amt. Removed by Pond C		*325433*	*931.6*	*3622*	*37.96*	*215.3*	*207.7*	*7333*	*276766*	*41782*
Hogback Pond Inflow	180.9	67910	330.8	1448	15.18	48.45	83.04	1650	78632	11593
Amt. Removed by Hogback		*57941*	*211.4*	*843.1*	*8.84*	*38.81*	*48.36*	*1322*	*62001*	*9192*
Direct Inflow	96.20	32949	164.2	725.5	7.60	23.69	41.59	806.7	38150	5624
Total in System	2718	949166	4708	20761	217.7	681.2	1190	23203	1098748	161990
Total to Long Meadow Lake	2723	235543	2475	12022	126.0	207.9	689.3	7080	436228	62587
High Precipitation										
West of 77	*2382*	*375072*	*2603*	*12248*	*128.4*	*294.2*	*702.5*	*10020*	*507598*	*73969*
Pond C Inflow	3061	592783	3708	17157	179.9	451.5	984.0	15377	760252	111218
Amt. Removed by Pond C		*361243*	*1016*	*3950*	*41.36*	*239.0*	*226.8*	*8139*	*302130*	*45668*
Hogback Pond Inflow	264.6	84736	429.6	1908	20.01	61.21	109.4	2085	98274	14489
Amt. Removed by Hogback		*70044*	*248.8*	*987.9*	*10.37*	*46.80*	*56.66*	*1594*	*73618*	*10931*
Direct Inflow	114.9	37511	191.9	855.7	8.97	27.19	49.05	926.2	43480	6410
Total in System	3442	1083195	5520	24579	257.7	784.2	1409	26711	1255345	185080
Total to Long Meadow Lake	3447	283743	3065	14983	157.1	254.1	859.0	8655	526259	75518

Table A-2. Build Loads

Scenario	Flow	TSS	TP	TKN	Cu	PB	ZN	HC	COD	B[illegible]
	acre-ft	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*[illegible]*
Build										
Type 2 Storm										
West of 77	*208.8*	*15134*	*145.3*	*728.8*	*7.64*	*13.56*	*41.79*	*461.7*	*21555*	*[illegible].45[illegible]*
Pond C Inflow	251.3	20328	183.1	914.6	9.58	17.84	52.45	577.4	27696	405[illegible]
Amt. Removed by Pond C		*9662*	*23.48*	*90.72*	*0.94*	*6.39*	*5.21*	*187.4*	*7039*	*[illegible]73[illegible]*
Hogback Pond Inflow	19.43	2912	19.05	91.43	0.96	2.30	5.25	78.41	3418	[illegible]4.[illegible]
Amt. Removed by Hogback		*1919*	*5.93*	*23.68*	*0.25*	*1.28*	*1.37*	*43.73*	*1768*	*265.[illegible]*
New Ponds Inflow	*4.04*	*554.3*	*3.82*	*18.54*	*0.19*	*0.44*	*1.07*	*15.22*	*652.2*	*9[illegible]17[illegible]*
Amt. Removed by NewPonds		*377.1*	*0.88*	*2.73*	*0.03*	*0.24*	*0.17*	*8.73*	*346.8*	*5[illegible]65[illegible]*
Direct Inflow	5.22	715.7	4.93	23.93	0.25	0.58	1.37	19.65	842.0	1[illegible]4.[illegible]
Total in System	249.4	33908	234.2	1139.0	11.94	27.38	65.30	932.4	39900	588[illegible]
Total to Long Meadow Lake	250.0	12495	180.1	928.3	9.73	13.20	53.22	449.6	23398	[illegible]7[illegible]
Normal Year										
West of 77	*1880*	*320570*	*2142*	*9993*	*104.8*	*248.1*	*572.9*	*8453*	*429217*	*6258[illegible]*
Pond C Inflow	2431	513871	3100	14213	149.0	386.7	814.9	13173	653358	9[illegible]2[illegible]
Amt. Removed by Pond C		*322685*	*923.3*	*3588*	*37.60*	*213.4*	*205.7*	*7269*	*274545*	*4[illegible]4[illegible]*
Hogback Pond Inflow	175.0	63910	313.5	1376	14.42	45.69	78.89	1556	74012	1091[illegible]
Amt. Removed by Hogback		*55140*	*202.7*	*810.0*	*8.49*	*36.96*	*46.44*	*1258*	*59234*	*[illegible]8[illegible]*
New Ponds Inflow	*43.31*	*14828*	*73.90*	*326.5*	*3.42*	*10.65*	*18.72*	*363.1*	*17168*	*[illegible]3[illegible]*
Amt. Removed by NewPonds		*13385*	*44.99*	*170.8*	*1.78*	*8.75*	*9.78*	*298.7*	*14135*	*210[illegible]*
Direct Inflow	57.77	19784	98.61	435.7	4.56	14.22	24.98	484.5	22906	[illegible]37
Total in System	2705	942998	4679	20637	216.4	646.9	1183.0	23056	1091626	16[illegible]4
Total to Long Meadow Lake	2710	220895	2409	11751	123.2	197.8	673.7	6737	418901	6[illegible]3
High Precipitation										
West of 77	*2382*	*375072*	*2603*	*12248*	*128.4*	*294.2*	*702.5*	*10020*	*507598*	*7[illegible]6[illegible]*
Pond C Inflow	3044	588200	3683	17043	178.7	448.1	977.5	15262	754929	11[illegible]3
Amt. Removed by Pond C		*358339*	*1037*	*3915*	*41.07*	*237.0*	*224.8*	*8072*	*299868*	*4532[illegible]*
Hogback Pond Inflow	256.1	79830	407.3	1813	19.01	57.80	104.0	1969	92601	1[illegible]5
Amt. Removed by Hogback		*66637*	*238.2*	*946.8*	*9.93*	*44.56*	*54.30*	*1518*	*70240*	*1[illegible]2[illegible]*
New Ponds Inflow	*54.69*	*16918*	*86.62*	*386.3*	*4.05*	*12.27*	*22.15*	*417.9*	*19611*	*289*
Amt. Removed by NewPonds		*15013*	*48.81*	*183.1*	*1.91*	*9.79*	*10.49*	*333.5*	*12868*	*[illegible]0*
Direct Inflow	72.79	22550	115.41	514.6	5.40	16.35	29.51	556.8	26139	[illegible]5
Total in System	3424	1075965	5485	24428	256.1	779.1	1400	26536	1246986	18384
Total to Long Meadow Lake	3430	267135	2990	14672	153.8	242.7	841.2	8266	506756	7[illegible]63

Table A-3. No-Build Loads

Scenario	Flow	TSS	TP	TKN	Cu	PB	ZN	HC	COD	BOD
	acre-ft	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*	*lbs*
No Build										
Type 2 Storm										
West of 77	*208.8*	*15134*	*145.3*	*728.8*	*7.64*	*13.56*	*41.79*	*461.7*	*21555*	*3145*
Pond C Inflow	252.0	20425	183.7	917.7	9.62	17.91	52.62	610.0	27809	4067
Amt. Removed by Pond C		*9715*	*23.51*	*91.09*	*0.95*	*6.42*	*5.23*	*218.6*	*7072*	*1077*
Hogback Pond Inflow	18.65	2793	18.26	87.67	0.92	2.21	5.03	75.19	3279	483.4
Amt. Removed by Hogback		*1844*	*5.76*	*23.13*	*0.24*	*1.24*	*1.33*	*42.07*	*1711*	*257.0*
New Ponds Inflow	*4.04*	*554.3*	*3.82*	*18.54*	*0.19*	*0.44*	*1.07*	*15.22*	*652.2*	*96.17*
Amt. Removed by NewPonds		*377.1*	*0.88*	*2.73*	*0.03*	*0.24*	*0.17*	*8.73*	*346.8*	*52.65*
Direct Inflow	5.22	715.7	4.93	23.93	0.25	0.58	1.37	19.65	842.0	124.2
Total in System	249.8	33884	234.0	1138.3	11.93	27.36	65.26	931.8	39873	5880
Total to Long Meadow Lake	249.8	12496	180.0	927.8	9.73	13.20	53.19	449.5	23396	3376
Normal Year										
West of 77	*1880*	*320570*	*2142*	*9993*	*104.8*	*248.1*	*572.9*	*8453*	*429217*	*62582*
Pond C Inflow	2439	516017	3112	14247	149.6	388.3	817.9	13228	655852	95994
Amt. Removed by Pond C		*324027*	*927.1*	*3580*	*37.76*	*214.3*	*206.3*	*7300*	*275521*	*41595*
Hogback Pond Inflow	165.2	61096	298.7	1309	13.73	43.63	75.06	1486	70752	10431
Amt. Removed by Hogback		*52518*	*193.5*	*773.8*	*8.12*	*35.23*	*44.36*	*1200*	*56434*	*8363*
New Ponds Inflow	*43.31*	*14828*	*73.90*	*326.5*	*3.42*	*10.65*	*18.72*	*363.1*	*17168*	*2531*
Amt. Removed by NewPonds		*13385*	*44.99*	*170.8*	*1.78*	*8.75*	*9.78*	*298.7*	*14135*	*2100*
Direct Inflow	57.77	19784	98.61	435.7	4.56	14.22	24.98	484.5	22907	3377
Total in System	2704	942337	4676	20624	216.2	676.4	1182.0	23040	1090863	160827
Total to Long Meadow Lake	2709	221506	2412	11762	123.3	198.2	674.3	6750	419960	60185
High Precipitation										
West of 77	*2382*	*375072*	*2603*	*12248*	*128.4*	*294.2*	*702.5*	*10020*	*507598*	*73969*
Pond C Inflow	3053	593676	3697	17105	179.3	449.9	981.0	15324	757771	110852
Amt. Removed by Pond C		*362860*	*1011*	*3928*	*41.22*	*238.0*	*225.5*	*8105*	*300920*	*45486*
Hogback Pond Inflow	244.0	76600	390.1	1736	18.20	55.42	99.5	1888	88856	13100
Amt. Removed by Hogback		*63792*	*228.4*	*909.5*	*9.54*	*42.67*	*52.13*	*1454*	*67313*	*9991*
New Ponds Inflow	*54.69*	*16918*	*86.62*	*386.3*	*4.05*	*12.27*	*22.15*	*417.9*	*19611*	*2891*
Amt. Removed by NewPonds		*15013*	*48.81*	*183.1*	*1.91*	*9.79*	*10.49*	*333.5*	*12868*	*1807*
Direct Inflow	72.79	22550	115.41	514.6	5.40	16.35	29.51	556.8	26139	3853
Total in System	3422	1075187	5481	24412	255.9	778.5	1400	26517	1246088	183716
Total to Long Meadow Lake	3428	267706	2993	14680	153.9	243.0	841.7	8277	507728	72781

MEMORANDUM

MWH
MONTGOMERY WATSON HARZA

To:	Ed Matthiesen, Dave Filipiak, Jennie Ross	**Date:**	September 27, 2001 Revised March 21, 2002
From:	Joe Bischoff	**Reference:**	2180352.011801
Subject:	Bloomington P-8 Model Update		

1.0 BACKGROUND/ASSUMPTIONS

The Alternative Urban Areawide Review (AUAR) process was initiated by the City of Bloomington to identify and document potential cumulative environmental impacts and infrastructure needs related to anticipated development and redevelopment in the Airport South District (ASD) in the next six years (i.e., through year 2006). This water quality assessment is a continuation of the water quality studies conducted by Montgomery Watson Harza for the ASD in Bloomington, Minnesota. The ASD is defined by I-494 to the north, TH 77 to the west and the Minnesota River Valley to the south and east. Previously, models have been developed for this area in order to determine the stormwater runoff water quality. The analyses summarized in this memorandum provide a comparison of surface water quality for existing and post-AUAR development conditions in the ASD drainage areas to allow for assessment of potential cumulative surface water impacts. The effects of the development between 2000 and 2007 were assessed using the P-8 Urban Catchment Model (W. Walker, Jr. 1998) previously developed for the study area in 1998. The model was updated to reflect current and proposed development conditions. It should be noted that the Mall of America Expansion–Met Center Site EIS included extensive analysis of water quantity and quality impacts. Technical memoranda, including our May 18, 2000 memorandum, were included in the appendix of the draft EIS for reference. The assumptions of that analysis included most of the same development assumptions for the ASD as this AUAR, with the following exceptions:

- Metro Office Park was assumed to be redeveloped (with a decrease in impervious area) in the EIS analysis, but is no longer slated for redevelopment within the AUAR analysis period.
- Ballfields property was assumed to have an existing use as ballfields for the EIS analysis, but is the area is now a gravel-surfaced parking area and NSP substation.
- Kelley property was not assumed to be developed for the EIS analysis, but is now assumed to be developed by year 2006.

- The AUAR 'Build' analysis assumes rate control and water quality ponding (meeting Nationwide Urban Runoff Pollution (NURP) standards [i.e., 70 percent TSS removal efficiency]) on all developing and redeveloping sites.

Because the above changes are relatively minor, the detailed water quality analyses performed for the EIS were not rerun for the new assumptions. The AUAR analyses included revising the impervious area assumptions, rerunning the XP-SWMM model to update the discharge quantity impacts analysis, and rerunning the P-8 analysis for total suspended solids (TSS), as a primary indicator of water quality impacts for the existing conditions versus the AUAR development scenario. The assumptions and results of these analyses are summarized in the discussion that follows.

2.0 METHODOLOGY

2.1 Load Assessment

The effects of the development between 2000 and 2007 (both with and without NURP ponding) were assessed using the P-8 Urban Catchment stormwater quality model previously developed for the study area in 1998. The model was updated to reflect current and proposed development conditions. The model was run using a Type 2 storm as the precipitation input.

2.2 Significance Criteria for Evaluating Impacts

Stormwater treatment devices designed according to NURP standards (MCES criteria) will have long-term average phosphorus removal efficiencies of 47 percent to 68 percent for the Twin Cities area (W. Walker Jr., 1987). Detention ponds are designed to remove pollutants from surface waters as a result of physical settling and are most effective for controlling those pollutants typically associated with sediment particles, including lead, phosphorus and zinc. These pollutants attached to sediment particles exhibit settling characteristics similar to those of sediment as illustrated in Figure 1. Consequently, if removal efficiencies are reached for TSS, then appropriate removal efficiencies will typically be reached for the other constituents of concern. Therefore, TSS was used as an indicator of pond effectiveness.

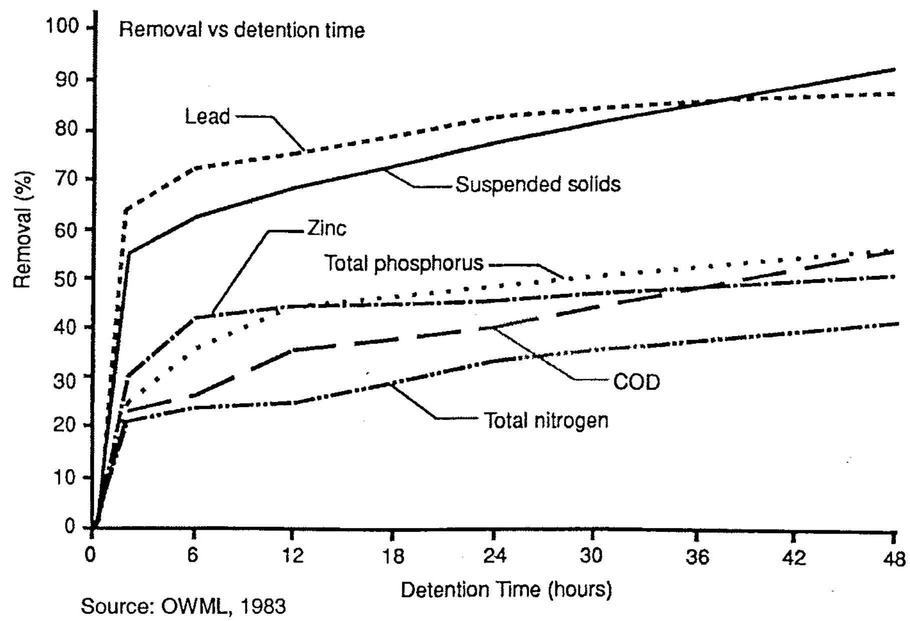


Figure 1

2.3 Analysis Conditions

Stormwater analyses were conducted for the following conditions:

1. Existing Airport South land use and storm sewer configurations.

2. AUAR development scenario including existing and proposed development through the year 2007, but assuming no on-site water quality treatment ponds are located within the ASD.

3. AUAR development scenario including existing and proposed development through the year 2007 including construction of on-site water quality treatment ponds. If an individual development property has submitted a proposed stormwater plan to the City (e.g., the Olnick property), pond sizes and locations were incorporated into the modeling assumptions Otherwise, pond sizes and configuration that would achieve 70-percent removal or TSS were assumed in the analysis.

Table 1 outlines the current conditions and changes in land use that will occur as a result of development. These data were incorporated into the existing model to develop the three previously mentioned design scenarios.

TABLE 1
SURFACE WATER MODELING ASSUMPTIONS
Changes to Site Hydrology

Site Name	Baseline Condition			Proposed 2007 Development				Comments
	Total Area (ac)	Impervious Area (ac)	Percent Impervious	Total Area (ac)	Impervious Area (ac)	Percent Impervious	Increase in Percent Impervious Area [1]	
Met Center	53.3	50.3	94.4%	53.3	*50.9*	*95.5%*	1.1%	Assumed 5-ft. pervious strip at site perimeter for future condition (worst case).
Adjoining Lands	34.1	21.0	61.6%	34.1	*32.6*	*95.5%*	33.9%	Assumed the same proposed impervious condition as for the Met Center site as worst-case condition. The existing impervious area includes 3.37 acres of pond area.
RPZ	29.7	24.5	82.4%	29.7	*0.0*	*0.0%*	-82.4%	Assumed proposed cover is 100% pervious.
Robert Muir Company	12.3	11.6	93.8%	12.3	*11.8*	*95.5%*	1.7%	Assumed the same proposed impervious condition as for the Met Center site.
Olnick Property	44.7	31.8	71.1%	44.7	31.0	69.3%	-1.8%	The impervious area includes 1.84 acres of pond area (4+ ponds). Based on plans dated 11/1/99.
Kelley Property	60.0	15.6	26.0%	*42.9*	*26.1*	*60.9%*	34.9%	Assumed that the remaining acreage is unbuildable will be left in current state (wooded bluffs). The year 2007 impervious area includes ~ 2.1 acres of pond area.
				17.1				Remaining acreage assumed to be unbuildable.
TOTAL AREA	234.1	154.8		234.1	152.4			
NET CHANGE IN IMPERVIOUS AREA					-2.4			

NOTES: [1] Positive numbers represent an increase in percent impervious as compared to the Baseline Condition. Italicized numbers above designate assumed future conditions since site plans have not yet been fully developed.

2.3.1 Baseline Conditions

Current development conditions were modeled to develop baseline water quality treatment efficiencies. These conditions are representative of the current conditions of the study area. Attachment 1 is a schematic representation of surface water routing assumed for baseline conditions.

2.3.2 Proposed AUAR Development Without On-Site NURP Ponding

The first of the models run for 2007 includes only the changes to the developments that are to occur between 2000 and 2007. Table 1 shows the predicted changes to the percentages of impervious area for the proposed development sites. The existing Adjoining Lands pond and pond 85 were deleted from the model assumptions and no NURP ponds were assumed at any of the proposed development sites for this run. This resulted in only pond C, Hogback Pond, Hogback Marsh being included to provide water quality treatment for the area east of Highway 77. The purpose of this run was to evaluate pollutant loading from the 2007 development conditions without any on-site treatment. Attachment 2 shows a schematic representation of surface water routing for this scenario.

2.3.3 Proposed AUAR Development with On-Site NURP Ponding

This model, in addition to incorporating the changes in impervious surface for the AUAR developments described in Section 2.3.2 above, also models the effect of incorporating water quality ponds into site development plans. This model run assumes that the proposed AUAR development at the Met Center, Adjoining Lands, Kelley, Muir, and Olnick properties will be constructed with NURP ponds sized to achieve approximately 70 to 80 percent removal of TSS. Attachment 3 shows a schematic representation of surface water routing for this scenario.

For the P-8 modeling, this means that the new ponds proposed in development plans prepared for the Olnick property were incorporated into the model to treat the runoff from the watershed (identified as Area F) prior to discharge to Long Meadow Lake via the Ceridian outfall. Treatment ponds were also added to the Met Center, Adjoining Lands, and Kelley properties, which drain to Pond C and Hogback Pond. The Met Center site drains to Pond C in low flows and Pond C and Hogback Pond in high flows. The Adjoining Lands parcel drains to Hogback Pond. The northern portion of the Kelley property currently drains to Pond C. The southern portion of the Kelley property (closer to the bluff edge) drains south to Long Meadow Lake. Following development of the Kelley parcel, all stormwater from the developed portion of the property will be discharged from the on-site treatment ponds to Hogback Pond. The treatment pond on the Muir property would drain to Long Meadow Lake via the 80th Street outfall.

The ponds included in the model for the Kelley, Muir, Adjoining Lands, and Met Center parcels were designed to remove approximately 70 percent to 80 percent of TSS in the runoff. The volume of runoff from the watersheds were first calculated. Using this information, it is possible to model the volume of water the ponds need to hold to provide 70 percent to 80 percent treatment. The dimensions assumed in the model for on-site treatment ponds in the Airport South area are shown in Table 2. It is important to note that the dimensions are in the form of a cylinder and not designed for incorporation into site plans. Rather, they are designed to meet the 70 percent TSS removal standard and developers will need to design the ponds to meet this criteria.

TABLE 2
CHARACTERISTICS OF DEVELOPMENT SITE NURP PONDS ASSUMED IN ANALYSIS

Device	Pond Bottom (ac)	Permanent Pool		Flood Pool		Outlet
		Area (ac)	Volume (ac-ft)	Area (ac)	Volume (ac-ft)	
Olnick(1)	0.5	1.69	6.08	2.56	18.6	30-foot weir
Met Center	1.45	1.45	5.8	1.45	7.5	48-inch pipe
Adjoining Lands	0.68	1.75	4.8	5.4	25	24-inch pipe
Kelley	1.5	1.54	6	1.5	10	46-inch pipe
Muir	0.5	1	4	1	5	40-inch pipe

(1) Pond design assumed for Olnick is based on development plans submitted to City. However, the Olnick site shows multiple ponds that are modeled as 1 pond in this analysis. All other treatment pond designs are estimated, based on an approx. 70 percent removal efficiency goal.

3.0 RESULTS/DISCUSSION

The impervious area and planned development assumptions described previously were utilized in the P-8 modeling. Also, because the stormwater inflows from west of TH 77 (see Figure 2 affect Pond C removal efficiencies, modeling performed for the area west of TH 77 was included in the water quality impact assessment.

Table 3 provides removal efficiencies for the ponds in the post-development scenario.

TABLE 3
DEVICE REMOVAL EFFICIENCIES FOR TOTAL SUSPENDED SOLIDS

Pond	Runoff Volume (ac-ft)	TSS input load (lb)	TSS output load (lb)	TSS removed (lb)	Percent (%) Reduction
Airport South District Development ponds (above bluff)					
Olnick Ceridian	7.28	1,194	352	843	71%
Met Center Pond	9.28	1,146	382	764	67%
Adjoining Lands	4.93	615	121	494	80%
Muir Pond	2.27	318	58	260	82%
Kelley Ponds	5.47	691	170	521	75%
Pond 85 (existing)	2.12	318	18	299	94%
Treatment ponds West of TH 77 (drain to regional Pond C)					
Smiths Pond	63.2	7,961	2,890	5,071	64%
Wrights Lake	119	10,126	6,017	4,109	41%
Regional Treatment ponds Below Bluff					
Hogback Pond	39.8	3,156	788	2,711	77%
Pond C	219	18,517	9,997	8,520	46%

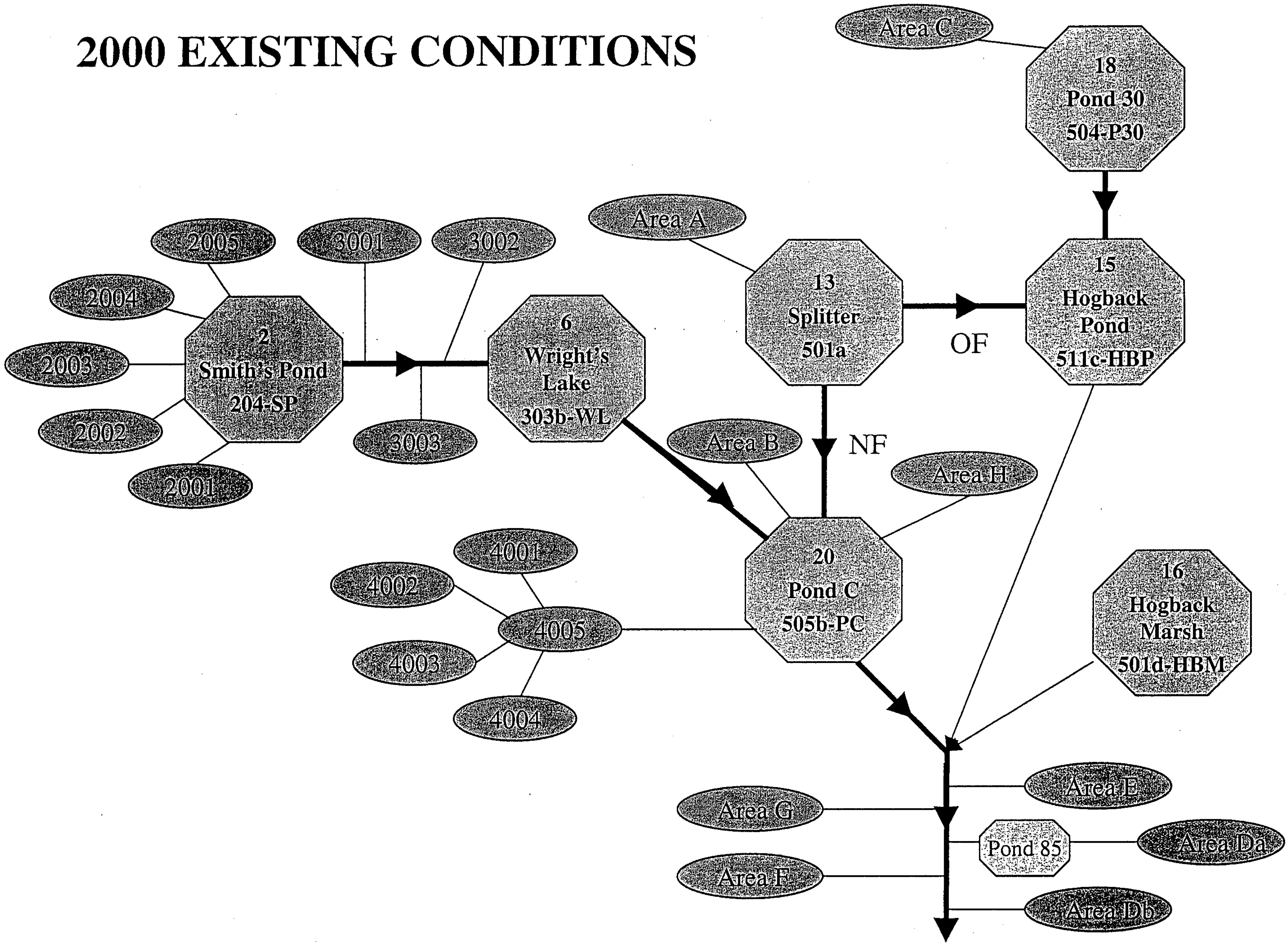
Analysis of existing and post-AUAR development scenario (with NURP ponds) water quality impacts show an increase in pollutant loading in the post-AUAR development pollutant transport due to increased development. Comparison of post AUAR-development (with NURP ponds) TSS outflow loading to existing conditions (see Table 4) indicates that loads were reduced approximately 6 percent. The post-AUAR improvements in water quality are due to increased detention/treatment at the development properties, compared to existing conditions, where detention is currently provided only at the Adjoining Lands property and Pond 85.

TABLE 4
PREDICTED TOTAL SUSPENDED SOLIDS (TSS) LOADINGS

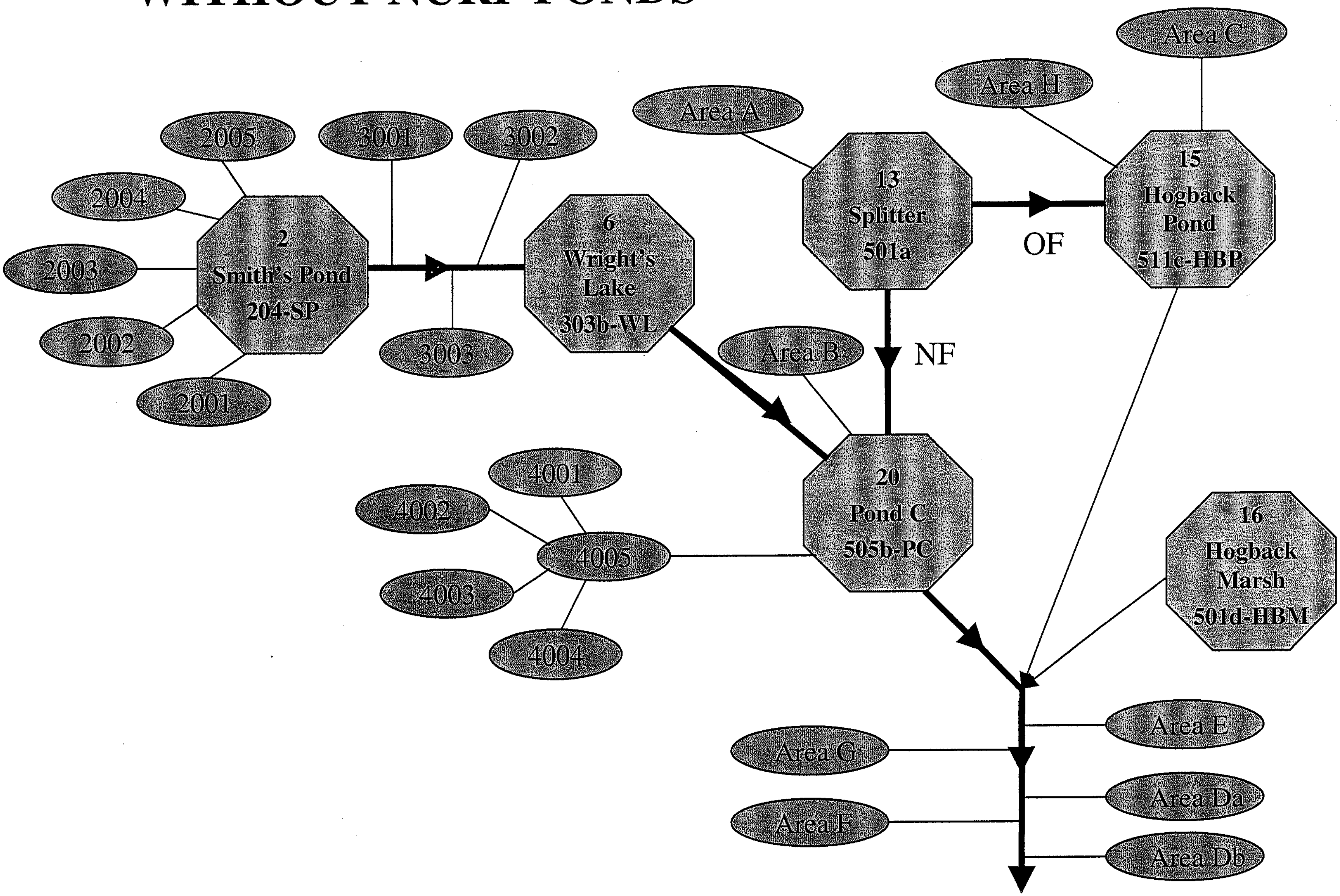
	Total TSS Loading (lb/yr)	Total TSS Removal by Ponding Systems (lb/yr)	Outflow Loading (lb/yr)
Existing Condition (2000)	35,495	21,920	13,575
Post-AUAR Development Conditions with NURP ponds (2007)	36,320	23,609	12,711
Post-AUAR Development Conditions without NURP ponds (2007)	36,320	21,926	14,394

There is a 12 percent decrease in outflow loading for the post AUAR development scenario with NURP ponding compared to the post AUAR development scenario without NURP ponding. The NURP ponds store an additional 1,683 pounds of sediment. Overall, the NURP and regional ponds remove approximately 66 percent of TSS loads in the post development scenario.

2000 EXISTING CONDITIONS



2007 DEVELOPMENT WITHOUT NURP PONDS



2007 DEVELOPMENT WITH NURP PONDS