11.0 T.H. 169 North

11.1 General Description of Drainage Area

Figure 11.1 depicts the T.H. 169 North drainage area and the individual subwatersheds within this area. The T.H. 169 North drainage area is located in the northwest corner of Edina. The drainage area encompasses approximately 140 acres that ultimately drain to the T.H. 169 drainage system.

11.1.1 Drainage Patterns

The stormwater system within this drainage area is comprised of storm sewers, ditches, overland flow paths, and ponding basins. Stormwater from this drainage area ultimately combines with the T.H. 169 storm sewer system at several locations along T.H. 169 between the intersection of Malibu Drive and T.H. 169 and the Edina city limits. The drainage area has been delineated into 23 subwatersheds. Table 11.1 describes the naming convention for subwatersheds within the drainage area. Land use within the drainage area includes low-density residential, open area, Van Valkenburg Park, and a small commercial area.

Table 11.1 Major Watershed within the T.H. 169 North Drainage Area

Major Watershed	Subwatershed Naming Convention	# of Subwatersheds	Drainage Area (acres)
T.H. 169 North	169N_##	23	140

11.2 Stormwater System Analysis and Results

11.2.1 Hydrologic/Hydraulic Modeling Results

The 10-year and 100-year frequency flood analyses were performed for the T.H. 169 North drainage area. The 10-year analysis was based on a ½-hour storm of 1.65 inches of rain. The 100-year analysis was based on a 24-hour storm event of 6 inches of rain. Table 11.2 presents the watershed information and the results for the 10-year and 100-year frequency hydrologic analyses for the T.H. 169 North drainage area.

The results of the 10-year and 100-year frequency hydraulic analysis for the T.H. 169 North drainage area are summarized in Table 11.3 and Table 11.4. The column headings in Table 11.3 are defined as follows:

Node/Subwatershed ID—XP-SWMM node identification label. Each XP-SWMM node represents a manhole, catchbasin, pond, or other junction within the stormwater system.

Downstream Conduit—References the pipe downstream of the node in the storm sewer system.

Flood Elevation—The maximum water elevation reached in the given pond/manhole for each referenced storm event (mean sea level). In some cases, an additional flood elevation has been given in parenthesis. This flood elevation reflects the 100-year flood elevation of Nine Mile Creek, per the *Nine Mile Creek Watershed Management Plan*, May 1996.

Peak Outflow Rate—The peak discharge rate (cfs) from a given ponding basin for each referenced storm event. The peak outflow rates reflect the combined discharge from the pond through the outlet structure and any overflow.

NWL—The normal water level in the ponding basin (mean sea level). The normal water levels for the ponding basins were assumed to be at the outlet pipe invert or at the downstream control elevation.

Flood Bounce—The fluctuation of the water level within a given pond for each referenced storm event.

Volume Stored—The maximum volume (acre-ft) of water that was stored in the ponding basin during the storm event. The volume represents the live storage volume only.

Table 11.4 summarizes the conveyance system data used in the model and the model results for the storm sewer system within the T.H. 169 North drainage area. The peak flows through each conveyance system for the 10-year and 100-year frequency storm events are listed in the table. The values presented represent the peak flow rate through each pipe system only and does not reflect the combined total flow from an upstream node to the downstream node when overflow from a manhole/pond occurs.

Figure 11.2 graphically represents the results of the 10-year and 100-year frequency hydraulic analyses. The figure depicts the T.H. 169 North drainage area boundary, subwatershed boundaries, the modeled storm sewer network, and surcharge conditions for the XP-SWMM nodes (typically manholes).

One of the objectives of the hydraulic analyses was to evaluate the level of service provided by the current storm sewer system. The level of service of the system was examined by determining the surcharge conditions of the manholes and catch basins within the storm sewer system during the 10-year and 100-year frequency storm events. An XP-SWMM node was considered surcharged if the hydraulic grade line at that node breached the ground surface (rim elevation). Surcharging is typically the result of limited downstream capacity and tailwater impacts. The XP-SWMM nodes depicted on Figure 11.2 were color coded based on the resulting surcharge conditions. The green nodes signify no surcharging occurred during the 100-year or 10-year frequency storm event, the yellow nodes indicate surcharging during the 100-year frequency event, and the red nodes identify that surcharging is likely to occur during both a 100-year and 10-year frequency storm event. Figure 11.2 illustrates that several XP-SWMM nodes within the T.H. 169 North drainage area are predicted to experience surcharged conditions during both the 10-year and 100-year frequency storm events. This indicates a probability greater than 10 percent *in any year* that the system will be overburdened and unable to meet the desired level of service at these locations. These manholes and catch basins are more likely to experience inundation during the smaller, more frequent storm events of various durations.

Another objective of the hydraulic analysis was to evaluate the level of protection offered by the current stormwater system. Level of protection is defined as the capacity provided by a municipal drainage system (in terms of pipe capacity and overland overflow capacity) to prevent property damage and assure a reasonable degree of public safety following a rainstorm. A 100-year frequency event is recommended as a standard for design of stormwater management basins. To evaluate the level of protection of the stormwater system within the T.H. 169 North drainage area, the 100-year frequency flood elevations for the ponding basins and depressed areas were compared to the low elevations of structures surrounding each basin. Based on the analysis, the current system in the T.H. 169 North drainage area is providing a 100-year level of protection. Therefore, no storm sewer or pond upgrades are being recommended at this time.

11.2.2 Water Quality Modeling Results

The effectiveness of the stormwater system in removing stormwater pollutants such as phosphorus was analyzed using the P8 water quality model. The P8 model simulates the hydrology and phosphorus loads introduced from the watershed of each pond and the transport of phosphorus throughout the stormwater system. Since site-specific data on pollutant wash-off rates and sediment characteristics were not available, it was necessary to make assumptions based on national average values. Due to such assumptions and lack of in-lake water quality data for model calibration, the modeling results were analyzed based on the percent of phosphorus removal that occurred and not based on actual phosphorus concentrations.

Figure 11.3 depicts the results of the water quality modeling for the T.H. 169 North drainage area. The figure shows the fraction of total phosphorus removal for each water body as well as the cumulative total phosphorus removal in the watershed. The individual water bodies are colored various shades of blue, indicating the percent of the total annual mass of phosphorus entering the water body that is removed (through settling). It is important to note that the percent of phosphorus removal is based on total phosphorus, including phosphorus in the soluble form. Therefore, the removal rates in downstream ponds will likely decrease due to the large soluble fraction of incoming phosphorus that was unsettleable in upstream ponds. The watersheds are depicted in various shades of gray, indicating the cumulative total phosphorus removal achieved. The cumulative percent removal represents the percent of the total annual mass of phosphorus entering the watershed that is removed in the pond and all upstream ponds.

Ponds that had an average annual total phosphorus removal rate of 60 percent or greater, under average climatic conditions, were considered to be performing well. For those ponds with total phosphorus removal below 60 percent, the permanent pool storage volume was analyzed to determine if additional capacity is necessary. Based on recommendations from the MPCA publication

Protecting Water Quality in Urban Areas, March 2000, the permanent pool for detention ponds should be equal to or greater than the runoff from a 2.0-inch rainfall, in addition to the sediment storage for at least 25 years of sediment accumulation. For ponds with less than 60 percent total phosphorus removal, the recommended storage volume was calculated for each pond within the drainage basin and compared to the existing permanent pool storage volume.

11.3 Implementation Considerations

11.3.1 Increased Storm Sewer Capacity Projects

The 100-year frequency hydraulic analysis identified that the 100-year level of protection is being provided by the current stormwater system in the T.H. 169 North drainage area. Therefore, no recommendations for storm sewer upgrades in this drainage area are being made at this time.

11.3.2 Construction/Upgrade of Water Quality Basins

Results of the water quality modeling in the T.H. 169 North drainage area indicated that the annual removal of total phosphorus from Pond 169N_16 was predicted to be below the desired 60 percent removal rate for soluble phosphorus, under average year conditions. The permanent pool storage volume was analyzed to determine if additional capacity is necessary. The basin was found to have sufficient dead storage volume, based on the MPCA recommended permanent pool storage volume for detention basins for the removal of particulate phosphorus. As a result, no recommendations for water quality basin upgrades in the T.H. 169 North drainage area are being made at this time.

Table 11.2
Watershed Modeling Results for Subwatersheds in the T.H. 169-North Drainage Area (Revised 12/2006).

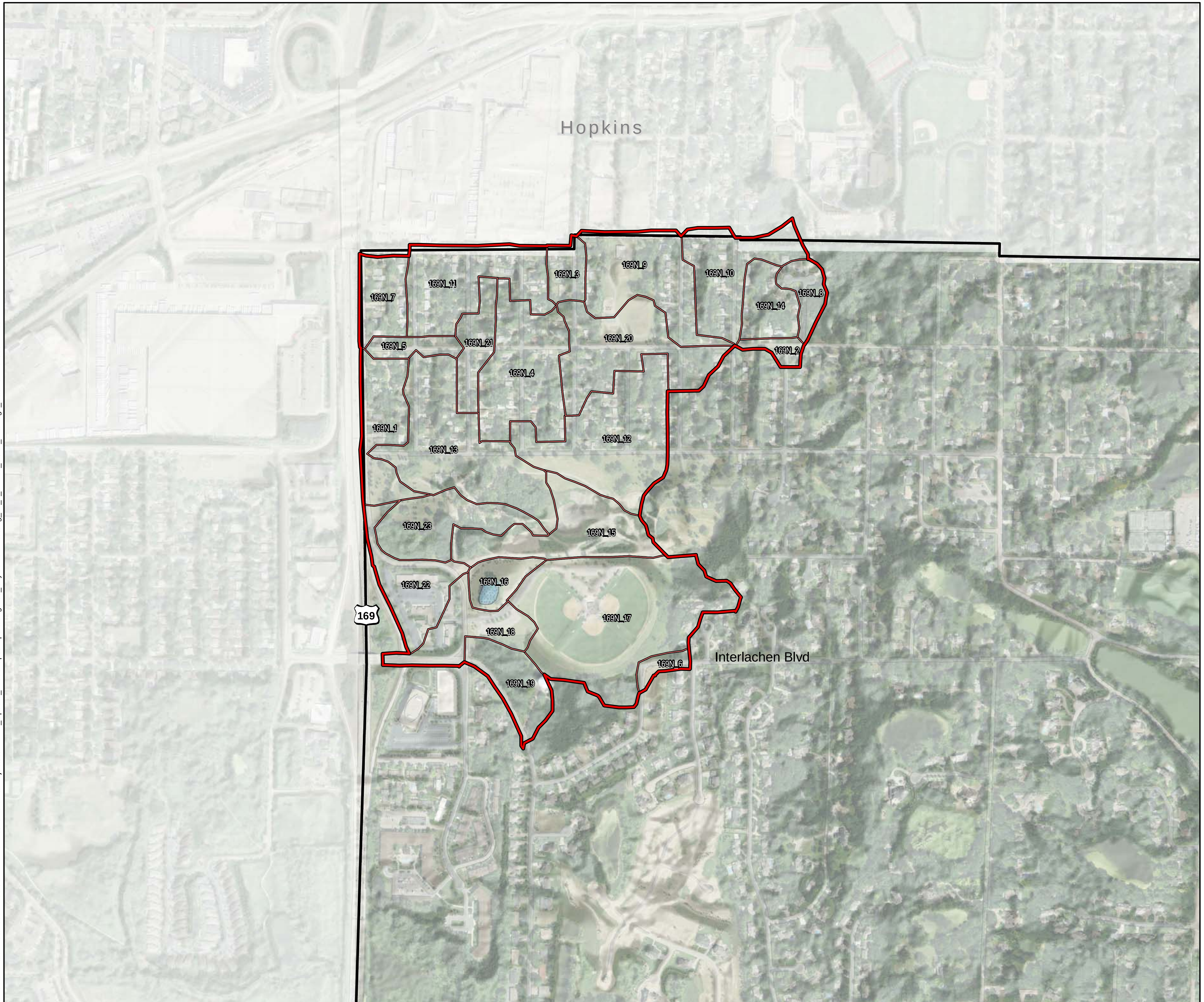
Watershed Information			100-Year Storm Results 24-Hour Event		10-Year Storm Results 1/2-Hour Event	
Watershed ID	Total Area (ac)	% Impervious Area	Peak Runoff Rate (cfs)	Total Volume Runoff (ac-ft)	Peak Runoff Rate (cfs)	Total Volume Runoff (ac-ft)
169N_1	5.5	21	23.5	1.58	12.5	0.33
169N_2	1.0	20	4.9	0.29	3.9	0.07
169N_3	2.0	20	9.0	0.56	5.1	0.12
169N_4	9.4	20	35.6	2.67	16.9	0.52
169N_5	1.7	20	7.9	0.47	5.9	0.11
169N_6	1.0	14	4.5	0.26	3.6	0.00
169N_7	3.6	24	15.7	1.13	9.2	0.25
169N_8	2.1	20	9.7	0.58	6.9	0.14
169N_9	8.5	12	29.3	2.15	11.1	0.36
169N_10	6.7	19	29.5	1.85	15.6	0.39
169N_11	8.5	20	33.6	2.35	16.1	0.45
169N_12	12.0	13	50.3	3.16	21.5	0.62
169N_13	12.4	9	46.4	3.07	16.1	0.53
169N_14	3.3	20	15.3	0.93	9.4	0.21
169N_15	8.2	0	33.2	1.87	10.9	0.32
169N_16	2.4	15	10.7	0.63	5.8	0.14
169N_17	19.5	2	66.1	4.36	19.0	0.70
169N_18	4.9	41	23.1	1.80	18.5	0.44
169N_19	4.2	3	18.5	0.99	7.7	0.19
169N_20	9.0	16	35.8	2.42	15.9	0.46
169N_21	3.2	20	11.1	0.86	5.1	0.16
169N_22	5.3	63	25.4	2.16	24.4	0.55
169N_23	6.0	0	25.3	1.47	9.8	0.29

Table 11.3
Hydraulic Modeling Results for XP-SWMM Subwatersheds/Nodes in the T.H. 169-North Drainage Area (Revised 12/2006)

Subwatershed or Node	Downstream Conduit	100-Year Storm Results 24-Hour Event				10-Year Storm Results 1/2-Hour Event		
		Flood Elevation (ft)	Type of Storage[1]	NWL (ft)	Flood Bounce (ft)	Flood Elevation (ft)	NWL (ft)	Flood Bounce (ft)
94	outlet to TH 169 system	914.5				912.5		
106	outlet to TH 169 system	912.7				912.2		
108	outlet to TH 169 system	909.3				908.8		
1395	1102	939.9				938.0		
1399	1104	939.3	byd	934.4	4.9	938.0	934.4	3.6
1400	1106	937.7				937.4		
1401	1107	937.4				937.1		
1402	1108	937.0				935.1		
1404	1110	925.4				923.9		
1406	1112	924.1				920.9		
1408	1114	923.4				918.8		
1409	1115	924.3				918.5		
1411	outlet to TH 169 system	918.5				915.9		
1413	1118	932.8				932.4		
1416	1121	928.2				927.9		
1427	1131	902.7				898.8		
1428	1132	908.7				904.9		
1429	1133	921.8				917.9		
1431	95	915.1				913.6		
1435	1137	924.2				913.0		
1436	1138	905.3				901.3		
1437	1139	901.6				897.4		
1439	1141	893.9				891.0		
1440	1142	893.8				890.3		
1441	1143	905.0				902.1		
1443	outlet to TH 169 system	877.3				876.4		
2486	1322	913.7				910.8		
2487	1323	913.7				910.7		
169N_1	107	914.3				913.6		
169N_2	1103	953.0				949.1		
169N_3	1113	923.0				919.1		
169N_4	1119	932.5				932.2		
169N_5	2021	918.0				917.1		
169N_6	1154	972.2				971.2		
169N_7	120	918.0				914.4		
169N_8	1101	943.7				942.5		
169N_9	1111	922.4				921.8		
169N_10	1109	925.9				924.9		
169N_11	1116	921.5				917.5		
169N_12	1130	935.2				932.6		
169N_13	1134	916.0				915.7		
169N_14	1105	939.2				938.9		
169N_15	landlocked	932.5	depression	925.5	7.0	928.7	925.5	3.2
169N_16	1136	923.8	pond	914.4	9.4	918.9	914.4	4.5
169N_17	1135	926.7				922.4		
169N_18	1144	899.5				898.9		
169N_19	1140	910.2				907.1		
169N_20	1117	935.0				934.8		
169N_21	1120	930.6				930.2		
169N_22	69	910.96				910.2		
169N_23	1321	913.67	depression	910.9	2.8	911.7	910.9	0.8

Table 11.4
Conduit Modeling Results for Subwatersheds in the T.H. 169-North Drainage Area (Revised 12/2006)

Conduit ID	Upstream Node	Downstream Node	Conduit Shape	Conduit Dimensions (ft)	Roughness Coefficient	Upstream Invert Elevation (ft)	Downstream Invert Elevation (ft)	Conduit Length (ft)	Slope	100Y Peak Flow through Conduit (cfs)	10Y Peak Flow through Conduit (cfs)
69	169N_22	108	Circular	2.0	0.013	904.16	903.93	31	0.7	38.4	34.2
95	1431	94	Circular	2.0	0.013	908.17	908.06	43	0.3	34.8	34.7
107	169N_1	106	Circular	1.0	0.013	909.31	909.27	19	0.2	6.9	6.1
120	169N_7	109	Circular	2.0	0.013	909.28	907.17	118	1.8	38.5	28.9
1101	169N_8	1395	Circular	1.25	0.013	941.86	936.25	123	4.6	9.7	6.9
1102	1395	1399	Circular	1.5	0.013	936.25	935.80	45	1.0	9.7	6.9
1103	169N_2	169N_14	Circular	1.0	0.024	944.57	934.04	280	3.8	4.5	3.8
1105	169N_14	1400	Circular	1.0	0.024	934.04	933.08	299	0.3	2.4	2.4
1106	1400	1401	Circular	1.0	0.013	933.08	932.50	161	0.4	2.4	2.3
1111	169N_9	1406	Circular	2.0	0.014	919.01	918.26	188	0.4	18.1	18.8
1112	1406_e	169N_3	Circular	2.0	0.013	918.26	916.56	335	0.5	17.0	17.0
1113	169N_3	1408	Circular	3.0	0.013	916.06	914.81	324.7	0.4	22.7	21.9
1114	1408	1409	Circular	3.0	0.013	914.80	913.28	331.1	0.5	29.3	24.1
1115	1409	169N_11	Circular	3.0	0.013	913.27	911.99	338.6	0.4	41.1	37.5
1116	169N_11	1411	Circular	3.0	0.013	912.05	910.51	290.2	0.5	62.9	49.3
1135	169N_17	169N_16	Circular	2.0	0.013	920.83	918.50	94	2.5	41.2	21.0
1136	169N_16	1435	Circular	1.0	0.013	919.50	917.10	65	3.7	6.8	0.0
1137	1435	1436	Circular	1.0	0.013	914.00	911.26	70	3.9	7.8	0.0
1138	1436	1437	Circular	1.0	0.013	911.26	906.11	220	2.3	7.5	0.0
1140	169N_19	1439	Circular	1.5	0.013	905.89	905.40	63	0.8	18.0	7.7
1141	1439	1440	Circular	1.75	0.013	905.40	899.92	218	2.5	23.2	7.7
1143	1441	169N_18	Circular	2.0	0.013	899.40	898.83	10	5.7	27.1	8.0
1154	169N_6	1462	Circular	1.0	0.013	970.20	969.34	59.8	1.4	4.5	3.6
1104	1399	169N_14	Circular	1.0	0.024	934.40	934.04	30	1.2	-4.1	-5.6
1107	1401	1402	Circular	1.0	0.013	932.23	931.91	66	0.5	6.6	6.3
1108	1402	169N_10	Circular	1.0	0.013	931.91	920.04	315	3.8	7.5	6.4
1109	169N_10	1404	Circular	1.75	0.013	920.04	919.58	60	0.8	26.1	20.5
1110	1404	169N_9	Circular	1.75	0.013	919.58	919.01	161	0.4	21.2	16.9
1117	169N_20	1413	Circular	1.5	0.013	928.60	926.10	331.3	0.8	10.9	10.4
1118	1413	169N_4	Circular	1.75	0.013	926.10	925.30	136.5	0.6	10.7	14.1
1119	169N_4	169N_21	Circular	1.75	0.013	925.30	924.20	197	0.6	23.9	24.4
1120	169N_21	1416	Circular	2.25	0.013	924.20	921.54	333	0.8	26.6	27.8
1121	1416	169N_5	Circular	1.5	0.013	921.54	911.00	270	3.9	22.2	22.6
1130	169N_12	1427	Circular	1.75	0.013	927.64	924.34	330	1.0	24.3	21.6
1131	1427	1428	Circular	1.75	0.013	924.34	918.40	151	3.9	27.2	21.2
1132	1428	1429	Circular	2.0	0.024	917.99	914.13	189	2.0	30.1	21.2
1133	1429	169N_13	Circular	2.0	0.013	914.13	908.72	266	2.0	32.1	19.5
1134	169N_13	1431	Circular	2.0	0.013	908.82	908.26	71	0.8	33.7	33.8
1139	1437	169N_19	Circular	1.0	0.013	906.11	905.89	27	0.8	7.0	-0.2
1142	1440	1441	Circular	1.75	0.024	899.67	898.95	10	7.2	16.8	8.0
1144	1442	169N_18	Circular	2.0	0.013	898.83	898.09	153	0.5	37.0	25.3
1321	169N_23	2486	Circular	2.0	0.013	910.87	908.70	6	36.2	21.8	9.9
1322	2486	2487	Circular	2.0	0.013	907.71	907.53	28	0.6	21.9	10.0
1323	2487	169N_22	Circular	2.0	0.013	907.51	904.29	68	4.7	31.0	14.2
2021	169N_5	1413	Circular	1.5	0.013	911.00	909.28	45.2	3.81	27.9	28.8



CITY OF EDINA, MINNESOTA INCORPORATED 1888

City of Edina Boundary
Roads/Highways
Creek/Stream
Lake/Wetland
T.H. 169 North Drainage Basin
Subwatershed

Imagery Source: Aerials Express, 2008

N

Feet
600 0 600

Meters
200 0 200

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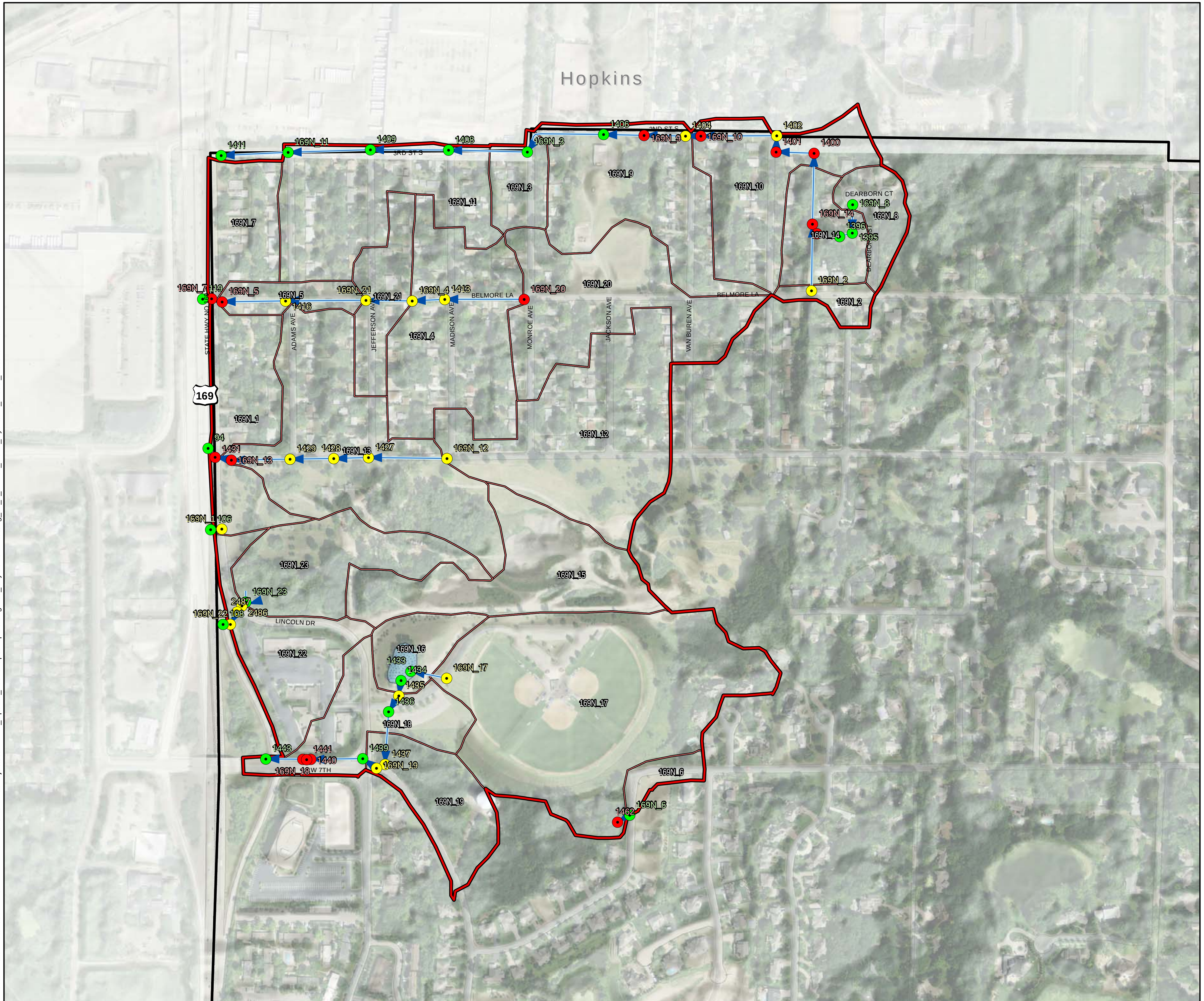
Figure 11.1

T.H. 169 NORTH
DRAINAGE BASIN
Comprehensive Water Resource
Management Plan
City of Edina, Minnesota



- City of Edina Boundary
- Roads/Highways
- Lake/Wetland
- T.H. 169 North Drainage Basin
- Subwatershed
- Major Watershed
- Pipes
- Manhole
- Manhole Surcharge During 100-Year Frequency Event
- Manhole Surcharged During 10-Year Frequency Event

Imagery Source: Aerials Express, 2008

N

Feet

400 0 400

Meters

150 0 150

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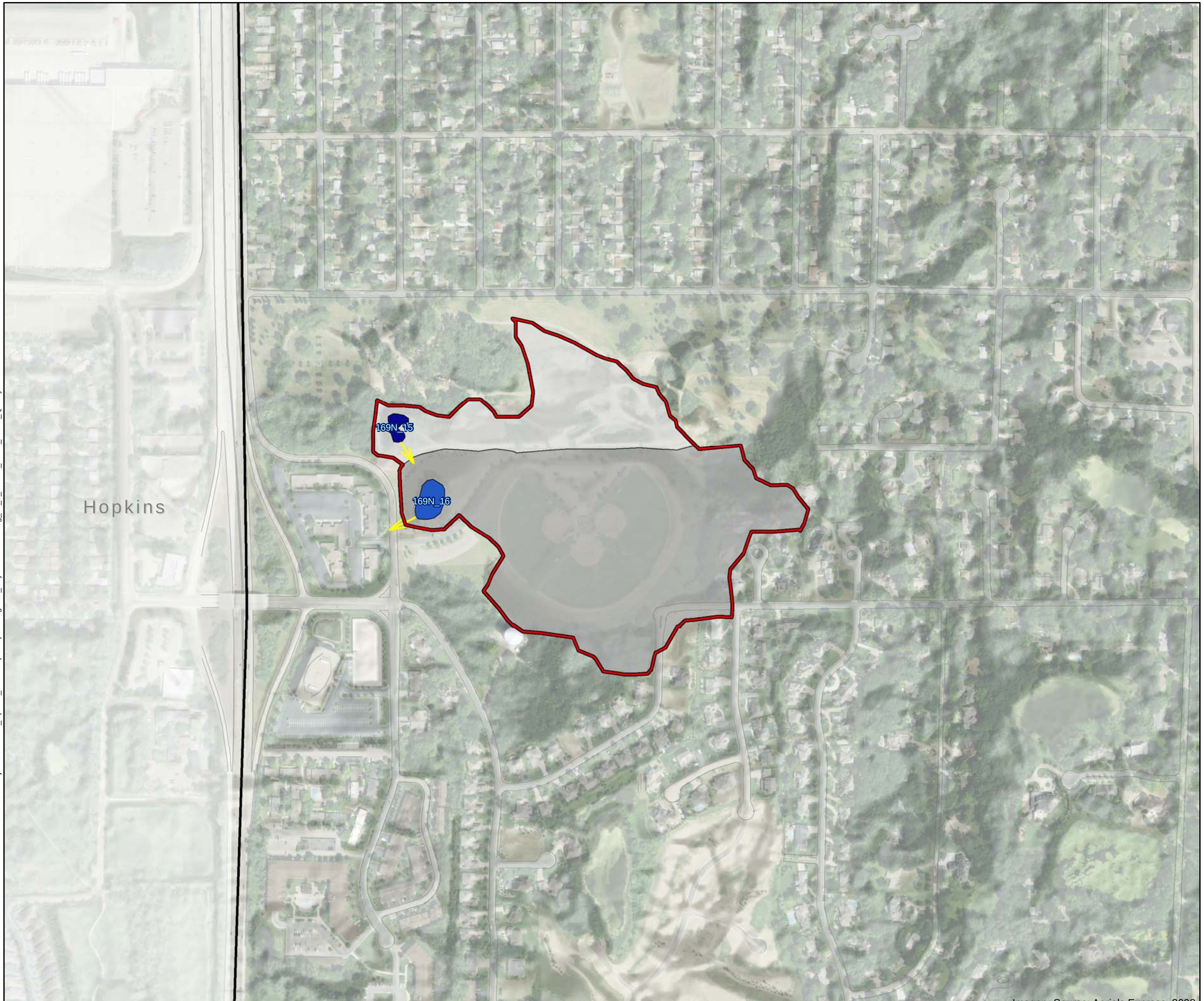
Figure 11.2

T.H. 169 NORTH
HYDRAULIC MODEL RESULTS
Comprehensive Water Resource Management Plan
City of Edina, Minnesota

Barr Footer: Date: 11/3/2009 12:40:22 PM File: I:\Client\Edina\Projects\CRWMP_Update_2009\Maps\Reports\Figures_CityReviewDraft\Fig_11_2_TH169_North_Hydraulic_Model_Results.mxd User: mbs2



Percent TP Removal in Water Body*
This number represents the percent of the total annual mass of phosphorus entering the water body that is removed.

- 0 - 25% (Poor/No Removal)
- 25 - 40% (Moderate Removal)
- 40 - 60% (Good Removal)
- 60 - 100% (Excellent Removal)

Cumulative TP Removal in Watershed*
This number represents the percent of the total annual mass of phosphorus entering the watershed and upstream watersheds that is removed in the pond and all upstream ponds.

- 0 - 25% (Poor/No Removal)
- 25 - 40% (Moderate Removal)
- 40 - 60% (Good Removal)
- 60 - 100% (Excellent Removal)

*Data based on results of P8 modeling.

Flow Direction

N

Feet
400 0 400

Meters
150 0 150

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Figure 11.3

T.H. 169 NORTH
WATER QUALITY
MODELING RESULTS
Comprehensive Water Resource
Management Plan
City of Edina, Minnesota