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1.0 Introduction and Executive Summary

1.1 Purpose of the Plan

The City of Independence is located in western Hennepin County. The City has an abundance of water resources which include numerous wetlands, several large lakes, and wooded areas, parks, and recreational lands. This plan provides the framework to be followed to preserve these resources as the City develops.

This plan was prepared to fulfill the legal requirements of the Metropolitan Surface Water Planning Rules (Chapter 8410). This plan also meets the policies and requirements of the Pioneer-Sarah Creek Watershed Management Commission and the Minnehaha Creek Watershed District and other local, state, and federal agencies.

1.2 General Approach to Planning

The general approach to water resource planning focuses on wetland protection, water quality, and flood control; each are described below.

1.2.1 Wetland Protection

Stormwater runoff carries soil particles, nutrients, and contaminants which can change the ecological balance of the receiving water body. Changes in the volume or rate of stormwater entering or discharging from the water body can also change the ecological balance. Change in the ecological balance of a wetland often results in changes in the water quality, changes in animal and fish habitat, replacement of native vegetation with invasive and tolerant plant species, and/or other impacts to the wetland's functions and values.

The State of Minnesota has published a guidance document which develops a methodology for determining the susceptibility of wetlands to degradation by stormwater input. This methodology relates wetland type to a level of susceptibility as shown in Table 3-1. Wetlands such as bogs and fens can be easily degraded by changes in the stormwater inflows and are designated as highly susceptible. On the other hand, floodplain forests can tolerate relatively significant changes in the chemical and physical characteristics of stormwater inflow without degradation and are therefore slightly susceptible. Commonly observed shallow marshes and wet meadows dominated by cattail and reed canary grass (respectively) have a moderate susceptibility to stormwater fluctuations.

Wetland management standards were developed to determine how and when stormwater should be routed through a wetland to minimize potential impacts. These standards, shown in Table 3-2, were largely based on the state guidance document. These standards determine tolerable hydrologic change in terms of bounce (difference between the peak flood elevation and the wetland elevation), inundation period (time that flood waters temporarily stored in the wetland exceed the wetland elevation), and runout control (elevation of the outlet).

These standards provide guidance for the management of stormwater to minimize wetland impacts. It is assumed that wetland impacts will be minimized and existing wetland functions and values will be maintained if the proposed management system and criteria meet the management standards shown in Table 3-2.

1.2.2 Water Quality Protection

Within the 51 subwatersheds of the City of Independence, there are hundreds of water bodies ranging in size from lakes to small stormwater detention basins. Nonpoint pollution associated with stormwater runoff creates adverse impacts; the degree of impact depends on the water body's natural ability to remove, absorb, or process the pollutants through chemical, physical, or biological processes. Poor water quality usually indicates a situation where the resource receives more nutrients, or other pollutants, than can be processed naturally. Planning for water quality protection is necessary to preserve the beneficial uses of existing water bodies, as well as to evaluate wetland impacts as described above.

1.2.3 Flood Control

The flood and rate control portion of the planning consisted of estimating the 100-year flood elevation and discharge rate for each watershed. Independence has vast amounts of stormwater storage available in its wetlands and lakes. This storage was used in the development of the ultimate conditions hydrologic model for the City. The ultimate pipes were designed to take advantage of the large storage areas while maintaining the overall discharge rate leaving the City borders.

1.2.4 Stormwater Pollution Prevention Program

As required by the Clean Water Act, the City of Independence has prepared a Stormwater Pollution Prevention Program (SWPPP). The SWPPP is a requirement of the NPDES General Permit No. MNR040000, which authorizes Municipal Separate Storm Sewer System (MS4) operators to discharge stormwater. The goal of the Stormwater Pollution Prevention Program, when implemented, is to reduce the discharge of pollutants into receiving waters to the Maximum Extent Practicable. The Stormwater Pollution Prevention Program must be implemented or established in ordinance, plan or policy by June 30, 2010.

There are six minimum control measures outlined below that are required to be included in the Stormwater Pollution Prevention Program under the requirements of the permit. Within each of the six minimum control measures, there are a number of Best Management Practices (BMP's) that are required for each minimum control measure. The BMP summary sheets contained in the SWPPP are included in Appendix B of this report. The six minimum control measures are as follows:

1. Public Education and Outreach

   Public education and outreach is a major component of the SWPPP. Through education and outreach programs the operator of a MS4 can reduce the impacts on the receiving waters. There are ten BMP's that are required to address this

component of the program, which are outlined in the BMP summary sheets (BMP ID No. 1a-1 through 1e-1).

2. Public Participation/Involvement

Public participation is encouraged to receive input from the public on the SWPPP. Public input may be used as a gauge to determine the effectiveness of the SWPPP and associated BMP's. Based on public input, the City of Independence may modify components of the SWPPP if deemed beneficial. See BMP summary sheets for BMP ID No. 2a-1 through 2c-1 for the required Best Management Practices for Public Participation/Involvement.

3. Illicit Discharge Detection and Elimination

A major component of illicit discharge detection and elimination is the storm sewer map. The storm sewer map will assist the City of Independence in detecting non-storm sewer discharges (illegal dumping). The City of Independence is required to prohibit non-stormwater discharges to the extent allowable under law, through ordinance or other regulatory mechanism. See the BMP summary sheets for BMP ID No. 3a-1 though 3e-1 for the required Best Management Practices for Illicit Discharge Detection and Elimination.

4. Construction Site Stormwater Runoff Control

The City of Independence will develop an ordinance or other regulatory mechanism to reduce pollutants in stormwater runoff from construction activities. All construction activities which disturb greater than one acre of land, and construction activities which disturb less than one acre but are part of a larger common plan of development or sale will be controlled. See the BMP summary sheets for BMP ID No. 4a-1 through 4f-1 for the required Best Management Practices for Construction Site Stormwater Runoff Control.

5. Post-Construction Stormwater Management in New Development and Redevelopment

The City of Independence will implement and enforce an ordinance or other regulatory mechanism to address post construction stormwater management in new development and redevelopment. See the BMP summary sheets for BMP ID No. 5a-1 through 5c-1 for the required Best Management Practices for Post-Construction Stormwater Management in New Development and Redevelopment.

6. Pollution Prevention/Good Housekeeping

The City of Independence will operate and maintain the storm sewer system in a manner so as to reduce the discharge of pollutants to the maximum extent practicable. Key components for good housekeeping will be: inspecting 20% of

the MS4 outfalls, inspecting all exposed stockpiles and material handling and storage areas. Records of the inspections shall be retained, including the date of the completion of repairs and major additional protection measures. See the BMP summary sheets for BMP ID No. 6a-1 through 6b-7 for the required Best Management Practices for Pollution Prevention/Good Housekeeping.

1.3 Management Goals and Policies

As part of the planning process, goals and policies were developed for the management of resources within Independence. Goals propose the desired end and policies provide the means to achieve the goals. Goals and policies are provided for wetlands, water quality, water quantity, wetlands, erosion control, groundwater, public ditch systems, recreation, fish and wildlife, enhancement of public participation, information and education, floodplains, abstraction/filtration, ecological integrity, shorelines and streambanks, navigation, best management practices, public health, and regulation. The goals and policies of this plan are presented in Section 4, and Section 5 – Plan Implementation provides more specific details on how the goals and policies will be achieved.

1.4 Plan Organization

The Plan is organized as follows:

- **Section 1** presents the Introduction and Executive Summary.
- **Section 2** presents physical and general information, which relates to the City's resources.
- **Section 3** presents the wetland, water quality, and water quantity management strategies and problem areas.
- **Section 4** presents the City's water resource goals and policies**.**
- **Section 5** presents the implementation strategies to accomplish the goals and policies.
- **Section 6** presents inventory data and management information for each of the four major watersheds within the City.
- **Section 7** outlines the procedures for amending this Plan.
- **Section 8** presents the required submittals for a development.
- **Section 9** presents a description of the Hydrology Model used for the plan.
- **Section 10** presents the glossary of terms.

2.0 Physical Environment Inventory

2.1 Climate

Independence and the Twin Cities area have a temperate climate, characterized by wide variations in temperature, ample rainfall, and moderate snowfall. Table 2-1 shows the historical average monthly temperature, precipitation, and snowfall data.

In an average year, the freeze-free period for the area is long enough that the stable crops of the area reach maturity without much danger from frost. The 50% probability of temperatures of 32º or lower can be expected between September 27 and May 12.

Precipitation patterns are influenced by two well-defined systems. Strong southerly winds from the Gulf of Mexico are the main source of moisture. A diffuse secondary system from the Pacific Ocean also adds to annual rain and snowfall. Precipitation occurs as rain, freezing rain, hail, and snow. Tornadoes, severe thunderstorms, and hailstorms occur occasionally and are of short duration. Measurable precipitation of 0.01 inch occurs on about 119 days per year, 6 of which have 1 inch or more. Annual normal precipitation is approximately 27 inches, of which approximately two-thirds occurs during the summer months of May through September.

The annual snowfall in Independence averages approximately 46 inches. Runoff from snowmelt can occur any time during the winter. The most severe snowmelt runoff conditions usually occur in March and early April, especially when rain falls on top of the snowpack.

Table 2-1
Average Monthly Temperature, Precipitation, and Snowfall Data for Minneapolis/St. Paul Metropolitan Area

Month	Average Temp Fº	Precip. Inches	Snowfall Inches
January	13.6	0.85	10.0
February	17.7	0.83	7.8
March	30.4	1.62	9.4
April	46.2	2.23	3.6
May	58.3	3.40	0.2
June	68.1	4.18	0.0
July	73.3	3.51	0.0
August	70.7	3.51	0.0
September	61.6	2.91	0.0
October	49.6	2.06	0.6
November	33.1	1.45	6.2
December	19.6	0.93	8.8
Annual Average:	**45.2**	**Total: 27.48**	**Total: 46.0**

Source: State Climatology Office for the Minneapolis/St. Paul Airport

2.2 Precipitation Measurement Station

The State Climatology Office has a long-term precipitation station at the Minneapolis/St. Paul International Airport. This station was selected to be used as a reference for any entity conducting future water quality or quantity studies in Independence. The current thirty-year normal (1971-2000) for annual precipitation at the station is 29.41 inches.

2.3 Topography and Landforms

The topography in Independence is a result of glaciations that ended approximately 10,000 to 12,000 years ago. The topography has been influenced by two major glacial events: the Superior Lobe and the Grantsburg Lobe. These two events resulted in two general landscape units within Independence. The west central portion of the City, west of County Road 92, is part of the Corcoran Till Plain and is the best farmland in the community. The land is gently rolling with wet basins, low knolls, and ridges. Many of the soils in the area have a high seasonal water table and are unsuitable for dense residential developments utilizing conventional on site sewage treatment systems.

The balance of the City is in the Loretto Highlands, which is a landscape with more relief containing soils with more clay content. Steep slopes, deep marshes and poorly drained upland flats dominate the landscape. More details about area geology can be found in the Hennepin County Geologic Atlas from the Minnesota Geological Society. A topographic map of Independence is shown on Figure 2-1.

2.4 Watersheds and Drainage Patterns

The City of Independence is within the jurisdiction of the Pioneer-Sarah Creek Watershed Management Commission (PSCWMC) and the Minnehaha Creek Watershed District (MCWD). In general, water from the PSCWMC drains west to the Crow River then north to the Mississippi River and water from the MCWD drains to Lake Minnetonka and Minnehaha Creek then east to the Mississippi River.

With the existing creeks and ditches in place, the drainage patterns for the City of Independence are fairly well defined. This plan divides the City into four major watersheds; they include Painter Creek, Pioneer Creek, Sarah Creek and South Fork Crow River. These four watersheds and the Watershed District and Watershed Management Commission boundaries are shown on Figure 2-2. Each of these four major watersheds is further divided into subwatersheds. Each subwatershed is designated by a number that corresponds to the subwatershed and the outlet. The subwatersheds are summarized in Section 6. Figure 2-5 includes the subwatershed boundaries.

The Painter Creek Watershed is located in the southeast corner of Independence. This is the only watershed in Independence under the jurisdiction of the MCWD. The drainage area includes parts of Independence, Medina, Orono, Maple Plain and Minnetrista. The drainage flows from Katrina Lake in Medina to the west and south to Jennings Bay in Lake Minnetonka.

The Pioneer Creek Watershed is located in central Independence. It drains from Lake Independence to the west and south to Ox Yoke Lake in Minnetrista. The drainage area includes parts of Independence and Medina. Approximately 65% of the City drains to Pioneer Creek. Major water bodies in the watershed include Lake Independence and Lake Robina.

The Sarah Creek Watershed is located in northeastern Independence and includes drainage from Greenfield, Corcoran, Medina, and Independence. The general flow is from east to west through Lake Sarah to the Crow River. Lake Sarah is the only major water body in this watershed.

The South Fork Crow River Watershed is located in western and northwestern Independence. The drainage flows from east to west to the Crow River. Major water bodies in this watershed include Lake Rebecca and Haughey Lake.

2.5 MnDNR Protected Waters, Wetlands and Water Courses

The Minnesota Department of Natural Resources (MnDNR) has designated certain waters of the state as public waters (M.S. Section 103G.005, subdivision 15). MnDNR "Protected Waters and Wetlands" maps show public waters within the City. A MnDNR permit is required for work within a designated public water.

Figure 2-3 shows the protected waters, wetlands, and water courses located in the City. Sections 2.5.1, 2.5.2, and 2.5.3 summarize the protected waters, wetlands and watercourses in Independence.

2.5.1 Protected Waters

There are 12 protected waters in the City of Independence. The basins are relatively shallow, ranging from partially-drained wetland areas to moderately shallow lakes (average depth less than 10 feet). Table 2-2 lists the protected waters within Independence. Existing water quality data was available for Lake Independence, Lake Rebecca, Lake Robina and Lake Sarah. This data is summarized in Tables 2-3 through 2-7.

Table 2-2
Independence Protected Waters

I.D. No.	Name	Twp./Range	Section(s)	Local Government Unit	Area (acres)	DNR Shoreland Classification[1]	OHW
27-176P	Lake Independence	118/23,24	7,12,13,18,19,24	PSCWMC	851	RD	956.8
27-178P	Ox Yoke lake	117,118/24	5,6,31,32	PSCWMC	325	NE	915.4
27-188P	Lake Robina	118/24	8,9,16,17	PSCWMC	395	RD	N/A
27-189P	Lake Irene	118/24	22	PSCWMC	27	RD	N/A
27-191P	Lake Sarah	118,119/24	1,2,3,34,35	PSCWMC	635	RD	979.9
27-192P	Lake Rebecca	118,119/24	5,31,32	PSCWMC	260	NE	N/A
27-379P	Unnamed	118,119/24	6/31	PSCWMC	15	NR	N/A
27-380P	Unnamed	118/24	6	PSCWMC	24	NR	N/A
27-381P	Unnamed	118/24	5	PSCWMC	9	NR	N/A
27-411P	Unnamed	118,119/24	6,31	PSCWMC	81	NR	N/A

27-412P	Unnamed	118/24	6	PSCWMC	32	NR	N/A
27-926P	Unnamed	117,118/24	4,5,32,33	PSCWMC	245	NR	N/A

[1] NE = Natural Environment, RD = Recreational Development, GD = General Development, NR = Not regulated by DNR shoreland rules.

Table 2-3
Existing Water Quality Data
Lake Independence

Year	Parameter[1]						
	Chlorophyll A (µg/L)	Dissolved Oxygen (mg/L)	Kjeldahl Nitrogen (mg/L)	Field pH	Phosphorus (mg/L)	Temperature (ºC)	Secchi Disk (m)
1956		3.7			0.068	19.4	0.91
1974		3.5				20.6	1.04
1978							1.07
1979		4.8	1.99		0.083	18.3	1.17
1980	47.0	6.4	2.09		0.068	20.4	1.08
1981		5.4	1.80		0.120	18.3	1.25
1982							1.30
1983		5.1	1.61		0.138	17.4	1.70
1984							2.11
1985							1.63
1986							1.70
1987							1.32
1988							1.94
1989							2.52
1990		6.1	1.48		0.147	16.5	1.77
1991							1.35
1992							1.50
1993			1.08		0.042	17.3	2.53
1994		9.2	1.15		0.045	12.3	2.19
1995	28.4	5.3		8.74	0.083	14.4	1.88
1996	20.6	5.9		7.88	0.225	14.8	2.17
1997	22.5	5.7		7.89	0.170	15.2	1.16
1998	22.3	4.9		7.87	0.057	16.3	1.63
1999	30.2	6.3		7.94	0.055	14.5	0.86
2000	18.9	6.5		7.86	0.136	15.9	1.34
2001	18.3	6.0		7.85	0.063	16.0	1.66
2002	25.0	6.1		7.92	0.061	16.6	1.41
2003	34.8	6.2		7.57	0.221	16.3	1.38
2004	36.5	6.2		7.93	0.192	16.6	1.39
2005	25.1	5.9		7.52	0.193	16.4	1.92
2006	16.1	5.1		6.91	0.211	15.9	2.34
2007	28.0	6.0		7.78	0.177	15.9	1.09

[1] Results shown are average values. Detailed results can be obtained through the MPCA Environmental Data Access System.

Table 2-4
Existing Water Quality Data
Lake Rebecca

Year	Parameter[1]						
	Chlorophyll A (µg/L)	Dissolved Oxygen (mg/L)	Kjeldahl Nitrogen (mg/L)	Field pH	Phosphorus (mg/L)	Temperature (ºC)	Secchi Disk (m)
1979							2.68
1980							1.99
1981							1.39
1982							2.01
1983		5.9	1.6		0.268	19.4	2.12
1984		6.3	1.4		0.187	17.3	2.72
1985		6.5	1.3		0.119	17.8	3.16
1986							2.13
1987							1.60
1988							1.37
1989							0.91
1990							1.15
1991							0.97
1992							1.59
1993							1.99
1994	29.6	7.0	1.5	8.39	0.091	13.6	2.56
1995	35.9	7.6		9.01	0.081	13.8	1.58
1996	29.6	7.2		8.39	0.060	11.4	1.49
1997		3.6				2.9	
1999	33.7	7.6		8.24	0.069	15.1	1.35
2001	23.4	7.0		7.99	0.066	18.4	2.27
2002	29.7	6.1		8.11	0.091	18.7	1.73
2004	64.1	6.1		8.36	0.107	18.1	1.24
2006	47.6	6.5		7.35	0.072	17.7	1.56
2007	75.8	6.4		8.02	0.226	18.0	0.97

[1] Results shown are average values. Detailed results can be obtained through the MPCA Environmental Data Access System.

Table 2-5
Existing Water Quality Data
Lake Robina

Parameter[1]	Unit	4/21/98	5/27/98	6/11/98	6/24/98	8/6/98	9/4/98
Secchi Disk	m	0.46	0.37	0.06	0.49	0.09	0.09

[1] Detailed results can be obtained through the MPCA Environmental Data Access System.

Table 2-6
Existing Water Quality Data
Lake Sarah (West Bay)

Year	Parameter[1]						
	Chlorophyll A (µg/L)	Dissolved Oxygen (mg/L)	Kjeldahl Nitrogen (mg/L)	Field pH	Phosphorus (mg/L)	Temperature (ºC)	Secchi Disk (m)
1980		5.9	2.09		0.063	18.7	1.08
1981							0.76
1982							1.24
1983		4.7	1.77		0.163	15.6	1.51
1984							1.08
1985							1.32
1986							0.92
1987							1.02
1988							1.05
1989							1.36
1990	11.4	8.7	1.23	7.72	0.081	11.8	1.51
1991	19.2	4.7	0.84	8.15	0.221	12.5	1.38
1992		1.6					1.25
1993		8.4				3.0	1.56
1994							2.07
1995		6.8				2.7	2.98
1996	26.4	5.0		7.96	0.384	14.3	1.62
1997	36.4	4.8		7.81	0.096	15.0	1.37
1998	43.4	4.0		7.96	0.084	16.8	0.99
2000	25.0	5.9		7.90	0.076	14.9	1.66
2002	41.2	5.0		7.95	0.146	15.5	1.29
2004	57.6	4.8		8.09	0.132	15.5	1.62
2005	52.4	5.0		7.62	0.090	14.7	1.65
2006	48.6	4.3		6.91	0.404	13.3	1.30
2007	48.9	4.2		7.66	0.272	13.7	1.28
2008	44.1	4.9		7.65	0.263	14.2	1.10

[1] Results shown are average values. Detailed results can be obtained through the MPCA Environmental Data Access System.

Table 2-7
Existing Water Quality Data
Lake Sarah (East Bay)

Year	Parameter[1]						
	Chlorophyll A (µg/L)	Dissolved Oxygen (mg/L)	Kjeldahl Nitrogen (mg/L)	Field pH	Phosphorus (mg/L)	Temperature (ºC)	Secchi Disk (m)
1973							1.41
1974							1.07
1975							0.90
1990							1.73
1991	17.0	5.4	0.89	7.95	0.258	14.0	
1992							0.71
1993							1.45
1994							1.70
1995							1.81
1996							1.59
1997							1.61
1998							1.06
1999							1.43
2000							1.11
2001							0.79
2002							1.37
2003							1.17
2004							1.08
2005							1.15
2006							0.94
2007							0.93
2008	39.1	5.5		7.65	0.240	15.5	1.07

[1] Results shown are average values. Detailed results can be obtained through the MPCA Environmental Data Access System.

2.5.2 Protected Wetlands

In addition to the 12 protected waters, there are 40 other wetlands within the City of Independence that have been inventoried by the MnDNR. All of these wetlands are known as protected waters wetlands (M.S., Section 103G.005, subdivision 15) and therefore their beds along with the lakes are subject to regulatory authority of the MnDNR.

Protected waters wetlands means all types 3, 4 and 5 wetlands, as defined in United States Fish and Wildlife Service Circular 39 (USDI, 1971), not included within the definition of protected waters, that are ten or more acres in size in unincorporated areas, or 2.5 acres in incorporated areas. Table 2-8 lists the protected waters wetlands subject to MnDNR jurisdiction. Existing water quality data was available for Haughey Lake. This data is summarized in Table 2-9.

Table 2-8
Independence Protected Waters Wetlands

I.D. No.	Name	Twp./Range	Section(s)	Local Government Unit	Area (acres)	DNR Shoreland[1] Classification	OHW
27-187W	Haughey Lake	118/24	7,8	PSCWMC	51	NE	953.2
27-362W	Unnamed	118,119/24	1,36	PSCWMC	17	NR	N/A
27-367W	Unnamed	118/24	1	PSCWMC	12	NR	N/A
27-368W	Unnamed	118/24	1	PSCWMC	7	NR	N/A
27-369W	Unnamed	118/24	1	PSCWMC	5	NR	N/A
27-373W	Unnamed	118/24	12	PSCWMC	11	NR	N/A
27-374W	Unnamed	118/24	2,11	PSCWMC	20	NR	N/A
27-375W	Unnamed	118/24	2	PSCWMC	3	NR	N/A
27-376W	Unnamed	118/24	2	PSCWMC	10	NR	N/A
27-377W	Unnamed	118/24	2	PSCWMC	10	NR	N/A
27-378W	Unnamed	118/24	2	PSCWMC	68	NR	N/A
27-382W	Unnamed	118/24	4	PSCWMC	30	NR	N/A
27-383W	Unnamed	118/24	8	PSCWMC	7	NR	N/A
27-385W	Unnamed	118/24	16,21	PSCWMC	47	NR	N/A
27-386W	Unnamed	118/24	16	PSCWMC	6	NR	N/A
27-387W	Unnamed	118/24	16	PSCWMC	3	NR	N/A
27-388W	Unnamed	118/24	21	PSCWMC	18	NR	N/A
27-389W	Unnamed	118/24	21	PSCWMC	5	NR	N/A
27-391W	Unnamed	118/24	22	PSCWMC	4	NR	N/A
27-392W	Unnamed	118/24	22,27	PSCWMC	43	NR	N/A
27-393W	Unnamed	118/24	23,24	PSCWMC	278	NR	N/A
27-394W	Unnamed	118/24	13,14,23,24	PSCWMC	63	NR	N/A
27-395W	Unnamed	118/24	24	PSCWMC	4	NR	N/A
27-396W	Unnamed	118/24	25	MCWD	29	NR	N/A
27-397W	Unnamed	118/24	10	PSCWMC	8	NR	N/A
27-398W	Unnamed	118/24	11,14	PSCWMC	47	NR	N/A
27-399W	Unnamed	118/24	14,15	PSCWMC	15	NR	N/A
27-400W	Unnamed	118/24	14	PSCWMC	5	NR	N/A
27-401W	Unnamed	118/24	14	PSCWMC	4	NR	N/A
27-402W	Unnamed	118/24	12	PSCWMC	3	NR	N/A
27-413W	Unnamed	118/24	18	PSCWMC	12	NR	N/A
27-414W	Unnamed	118/24	19	PSCWMC	10	NR	N/A
27-921W	Unnamed	117,118/24	1,36	MCWD	88	NR	N/A
27-922W	Unnamed	118/24	25	MCWD	52	NR	N/A
27-923W	Painter Lake	117,118/24	2,3,34,35	MCWD	292	NR	938.4
27-924W	Unnamed	118/24	27	MCWD	36	NR	N/A
27-925W	Fox Lake	118/24	29,32	PSCWMC	49	NR	N/A
27-927W	Unnamed	117,118/24	4,33	PSCWMC	7	NR	N/A

27-1090W	Unnamed	118/24	7	PSCWMC	7	NR	N/A
27-1097W	Unnamed	118/24	8	PSCWMC	10	NR	N/A

[1] NE = Natural Environment, NR = Not regulated by DNR shoreland rules.

Table 2-9
Existing Water Quality Data
Haughey Lake

Year	Parameter[1]					
	Chlorophyll A (µg/L)	Pheophytin-A (H2O)	Kjeldahl Nitrogen (mg/L)	Phosphorus (mg/L)	Temperature (ºC)	Secchi Disk (m)
1995						2.09
2002	39.8	5.0	2.5	0.124	14.5	0.67

[1] Results shown are average values. Detailed results can be obtained through the MPCA Environmental Data Access System.

2.5.3 Watercourses

Protected waters also include all natural and altered watercourses with a total drainage area greater than two square miles. Painter Creek, Pioneer Creek, Robina Creek and Loretto Creek are the four protected watercourses in Independence. The four watercourses are discussed below.

2.5.3.1 Painter Creek

Painter Creek is located in the southeast corner of Independence. The creek is the outlet of Katrina Lake and flows south to Jennings Bay on Lake Minnetonka. Painter Creek has been monitored for water quality. The water quality data is included in Table 2-10.

Table 2-10
Existing Water Quality Data
Painter Creek @ County Road 6,
Between County Road 110 and County Road 19

Year	Parameter[1]						
	Suspended Solids (mg/L)	Dissolved Oxygen (mg/L)	Kjeldahl Nitrogen (mg/L)	Field pH	Phosphorus (mg/L)	Temperature (ºC)	Fecal Coliform #/100mL
1982	16	4.0			0.34	12.8	184
1983	12	3.8			0.38	14.7	241
1984	6	7.0			0.30	13.3	1183
1985	34	3.5			0.50	15.6	2817
1986	13	4.0			0.61	17.3	199
2002	11	5.0	1.5	7.33	0.20	14.2	96
2003	10	5.9	2.1	7.25	0.35	16.6	136
2004	14	6.0	1.9	7.52	0.33	15.2	
2005	14	7.3		8.05	0.41	14.4	
2006	8	4.4		7.33	0.20	14.7	
2007	18	5.1		7.25	0.27	14.5	

[1] Results shown are average values. Detailed results can be obtained through the MPCA Environmental Data Access System.

2.5.3.2 Pioneer Creek

Pioneer Creek is located in central Independence. The creek is the outlet of Lake Independence and flows west to south to Ox Yoke Lake in Minnetrista. Ox Yoke Lake eventually discharges to the South Fork Crow River.

2.5.3.3 Robina Creek

Robina Creek is a tributary of Pioneer Creek and is located in central Independence. The Creek is the outlet of Robina Lake and flows from north to south to Pioneer Creek.

2.5.3.4 Loretto Creek

A portion of Loretto Creek is located in the northeast corner of Independence. The creek flows from east to west and discharges to Lake Sarah. Lake Sarah then discharges through Sarah Creek to the west to the South Fork Crow River.

2.6 Other Regulated Wetlands

In addition to the MnDNR waters discussed in Section 2.5, many additional wetlands within the City are included on the National Wetland Inventory (NWI) maps but are not MnDNR water bodies. These wetlands are shown on Figure 2-6. The following three characteristics make these water bodies exclusive from the MnDNR public waters and public waters wetlands.

- First, an individual basin may be dominated by wetland habitat (Types 1, 2, 6, and 7 [USDI, 1971] not statutorily covered by MnDNR and yet is immediately adjacent to an inventoried MnDNR basin or watercourse.
- Second, an individual isolated wetland basin may be smaller than the minimum MnDNR size (2.5 or 10 acres) as discussed previously.
- Third, an individual isolated wetland basin may be dominated by habitat types (Types 1, 2, 6, and 7) not statutorily covered by MnDNR.

Excavation, filling, grading and/or development actions which may adversely affect these resources may be subject to federal permitting authority under Sections 401 and 404 of the Clean Water Act, (33 USC 125 et. seq.) and City approval under the 1991 Wetland Conservation Act (WCA), as amended. The City is the local governmental unit that administers the WCA.

2.7 Groundwater Resources

Two major aquifers are located within the City of Independence: the Franconia-Ironton-Galesville Aquifer and the Mt. Simon-Hinckley Aquifer. The lowest aquifer is the Mt. Simon-Hinckley. The average elevation of the aquifer is 850 feet above sea level and is characterized by Mt. Simon and Hinckley Sandstones. The Eau Claire Formation confines the aquifer from above. Above this, the Franconia-Ironton-Galesville Aquifer is at approximately 900 feet above sea level. It is composed of the Franconia Formation and Ironton and Galesville Sandstones. The St. Lawrence Formation confines this aquifer in most areas.

Groundwater quality can be affected by a variety of land use types. The identification of areas susceptible to groundwater contamination is difficult due to the character (permeability and thickness) of the surficial material, depth to the piezometric surface, precipitation amount and duration, and other components of aquifer recharge. See section 2.14 for further discussion on groundwater contamination.

A DNR Water Appropriation Permit is required for all users withdrawing more than 10,000 gallons of water per day or 1 million gallons per year. There are active DNR Water Appropriation Permits in the City of Independence. The permittees and the locations of the appropriations are shown on Figure 2-7

2.8 Soils

The United States Department of Agriculture, Soil Conservation Service published the Soil Survey of Hennepin County in 1974. The survey lists soils found in Hennepin County along with their general characteristics and limitations on land use and development. The Soil Survey should be referenced for soils identifications and associated limitations on specific development sites. Figure 2-4 shows the soil associations occupying the City.

The City contains three soil associations. The Erin-Kilkenny-Peaty Muck Association is located in the central and northeast portion of the City and occupies the largest area of the three associations. This association is characterized by rolling to hilly relief with major soil conditions consisting of clay loam, heavy clay and peat. The clay soils are found on gentle to steep slopes, are well drained and generally suited for urban development. Heavy clay is, for the most part, a subsoil condition and is also conducive for development. Peat soils located in low-lying areas have high moisture capacity and are generally poorly drained. Peat soils are a limiting factor for development.

The Lester-Peaty Muck Association, located in the southern and southwestern portions of Independence, is characterized by undulating relief with major soil conditions consisting of black loam, clay loam and peat. The black and clay loams are suited for urban development.

The third association, Hayden-Cordova Peaty Muck, is located in the northwest part of the City and is the smallest in area of the three groups. The terrain is basically undulating to rolling. The soil conditions generally consist of brown loam, clay loam and light clay loam. Many of the soils in this association are poorly drained, and wet areas are often intermingled closely with better-drained soils. The sporadic wetness and poor drainage of the soil must be a consideration for any development. Peat soils severely restrict development because of their wetness and location.

2.9 Native Vegetation

Independence is in the central deciduous forest region. Oak woodland and maple-basswood forests were the most common vegetation types in the area. The maple-basswood forest included

a mix of elm, basswood, sugar maple, bur oak, ironwood, northern red oak, and aspen. The oak woodland was dominated by a mix of aspen, red oak, bur oak, and white oak.

The woodland that has not been cleared for crops is similar to what existed before settlement and occurs as scattered small tracts. Wooded areas are now very much in demand for homesites.

2.10 Land Use

The City of Independence is part of the Twin Cities Metropolitan area. The population growth trends for Independence and the surrounding communities are shown in the table below.

Table 2-11
Population and Growth Trends

Local Government	1980[a]	1990[a]	2000[b]	2010[b]	2020[b]	2030[b]
Independence	2,640	2,822	3,236	4,000	4,480	4,900
Greenfield	1,391	1,450	2,544	3,190	4,050	4,300
Medina	2,623	3,096	4,005	5,800	9,200	12,700
Maple Plain	1,421	2,005	2,088	2,550	2,570	2,600
Orono	6,845	7,285	7,538	8,300	9,500	9,800
Minnetrista	3,236	3,439	4,358	6,600	9,400	13,300

a. U.S. Census Bureau, 2000 Census of Population and Housing, *Population and Housing Unit Counts* PHC-3-25, Minnesota, Washington, DC, 2003.
b. Metropolitan Council. 2008 Revised Forecasts www.metrocouncil.org/metroarea/rdfforecasts.pdf

2.10.1 Existing Land Use

Independence has assembled a Comprehensive Plan to coordinate future development. Land use in the City is a mixture of agriculture, residential and commercial uses. There is a large area in the northwest corner of the City, around Lake Rebecca, that is used for parks and recreation. Existing land use is discussed further in the Comprehensive Plan. An existing land use map, which is Figure 1 in the Comprehensive Plan, is included in Appendix C.

2.10.2 Future Land Use

Chapter 6 of the Comprehensive Plan – Land Use Guide Plan – identifies limited future rural residential development with the intent of protecting valued open space and rural character. The Guide Plan will function to define the relationship of natural resources and land use development decisions as well as coordinate with zoning laws and other regulations to provide logical, efficient and effective decision-making. The Guide Plan is also an intergovernmental document, coordinating the City's plans with regional, county and adjacent municipal planning activities. A figure showing the proposed future land use, which is Figure 7 in the Comprehensive Plan, is included in Appendix C.

Figure 2-8 shows the Metropolitan Urban Service Area (MUSA) Map. As shown much of the City is either permanent agricultural or permanent rural with small areas included within the 2010 MUSA.

2.11 Parks and Open Spaces

The most significant open space in Independence is the Lake Rebecca Park Reserve. The Park Reserve has an area of approximately 2,200 acres, of which approximately 1,300 acres are within Independence. The park reserve offers outdoor activities and opportunities for glimpses of wildlife. Lake Rebecca Park Reserve's gently rolling Big Woods landscape, with numerous wetland areas, provides a haven for wildlife. Facilities and amenities include a swimming beach, a boat launch, a fishing pier, picnic areas, hiking and biking trails and horse and dog trails.

Lake Independence is also a water-based recreation lake. The Baker Park Reserve is located on the east side of the lake in Medina and offers many of the same activities as the Lake Rebecca Park Reserve.

2.12 Fish and Wildlife Habitat

The water bodies and open spaces throughout the City provide habitat for fish and wildlife species including birds, mammals, and reptiles. Ducks and geese are present in large numbers at lakes, wetlands and open water areas. Vegetative cover in the undeveloped open areas support many mammalian species such as deer, raccoon, squirrels, chipmunks, and rabbits. The numerous wetlands in Independence provide habitat for a variety of aquatic species including snakes, turtles and frogs. Figure 2-9 shows the land cover types within Independence as classified by the Minnesota Land Cover Classification System (MLCCS).

2.13 Unique Features and Scenic Areas

The MnDNR Natural Heritage and Nongame Wildlife Program maintains a database of rare plant and animal species and significant natural features. Figure 2-10 includes the natural communities and regional parks within Independence. Additional information can be found in the MCWD and PSCWMC Plans.

2.14 Pollutant Sources

The Minnesota Pollution Control Agency maintains up-to-date data on potential sources of groundwater contamination including: sanitary landfills, dumps, hazardous waste sites, registered underground and above ground storage tank sites, feedlots, abandoned wells, and permitted wastewater discharges. This information is available through the 14 databases maintained by the Minnesota Pollution Control Agency. The MPCA Pollutant sites are shown on Figure 2-11.

The County Atlas-Regional Assessment Program exists to develop County Geologic Atlases and Hydrogeologic Assessments. It is a joint program of the MnDNR-Division of Waters and the Minnesota Geological Survey. The County Atlas-Regional Assessment Program prepares map-based reports of counties and multicounty regions to convey geologic and hydrogeologic information and interpretations to governmental units at all levels, but particularly to local governments. This information and these interpretations contribute to sound planning and management of the state's land and water resources.

The program created a "Sensitivity of Ground Water Systems to Pollution" map for Hennepin County in 1989. Susceptibility of the water table was rated based on the depth of the water table and the vertical conductivity of geologic materials. Rating groundwater susceptibility can be based on the ability of geologic material to 1) absorb and hold contaminants; 2) transform contaminants into benign substances; 3) dilute contaminants to levels below some standard; and 4) control the rate that contaminated water flows to or through aquifers. High susceptibility does not indicate that water quality has been or will become degraded; low susceptibility does not guarantee that groundwater will remain pristine. Rather, it indicates the areas at a greater risk of contamination due to high soil permeability and shallow groundwater.

A majority of the water table in Independence has a low susceptibility to pollution, but the areas near Pioneer, Painter and Robina Creeks and the South Fork Crow River have a medium to very high susceptibility.

The City of Independence does not have a municipal water supply system, therefore the City has no need for a Well Head Protection Plan.

2.15 Water Resources Related Agreements

Independence has entered into a water resource related agreement with the Pioneer-Sarah Creek Watershed Management Commission. A copy of the Joint Powers Agreement is included in Appendix A.

2.16 Comprehensive Plan

The City's 2030 Comprehensive Plan was adopted by the City Council on June 29, 2010. The following sections relate to protecting the City's water resources.

- Environment
- Community Participation and Issues
- Policy Plan
- Land Use Guide Plan
- Community Facilities
- Implementation

Section 4.0, of the Comprehensive Plan discusses the residents desire to preserve and enhance the City's lakes. This section also discusses the City's TMDL's waste load reductions and the ISTS maintenance inspections and reporting program.

Section 5.0 of the Comprehensive Plan outlines the goals to preserve water resources by adopting an ordinance regulating the development of shoreland in the City. This ordinance was adopted by the City Council on May 26, 2009. The shoreland ordinance protects water bodies, in part, by requiring setbacks for structures and limiting the removal of natural vegetation. The Stormwater Pollution Prevention Program, which was adopted on May 2006 and amended July 2008 to include TMDL requirements, is also discussed in this section of the plan.

Section 7 of the Comprehensive Plan discusses the City's approach to hooking up failing septic systems to a centralized wastewater collection system around Lake Sarah and Lake Independence.

3.0 Management Strategies and Problem Areas

This section presents the process and information used to develop the management plan strategies for wetlands, water quality and water quantity. Section 3.4 discusses the known problem areas within the City.

3.1 Wetland Protection

This section describes the process that was used to develop a wetland management strategy. The objective of this process is to provide no net loss of wetland functions and values. Impacts to wetlands include not only direct impacts such as filling and drainage, but also indirect impacts from stormwater inputs. This process is based largely on the state guidance document "Stormwater and Wetlands: Planning and Evaluation Guidelines for Addressing Potential Impacts of Urban Stormwater and Snowmelt Runoff on Wetlands" (State of Minnesota, Stormwater Advisory Group, June 1997).

3.1.1 Wetland Susceptibility to Stormwater Input

Stormwater runoff carries soil particles, nutrients, and contaminants, which can change the ecological balance of the receiving water body. Changes in the volume or rate of stormwater entering or discharging from the water body can also change the ecological balance. Change in the ecological balance of a wetland often results in changes in the water quality, changes in animal and fish habitat, replacement of native vegetation with invasive and tolerant plant species, and/or other impacts to the wetland's functions and values.

The state guidance document developed a methodology for determining the susceptibility of wetlands to degradation by stormwater input. This methodology relates wetland type to a level of susceptibility as shown in Table 3-1. Wetlands such as bogs and fens can be easily degraded by changes in the stormwater inflows and are designated as highly susceptible. On the other hand, floodplain forests can tolerate relatively significant changes in the chemical and physical characteristics of stormwater inflow without degradation and are therefore slightly susceptible. Commonly observed shallow marshes and wet meadows dominated by cattail and reed canary grass (respectively) have a moderate susceptibility to stormwater fluctuations.

3.1.2 Wetland Management Standards

Wetland management standards were developed to determine how and when stormwater should be routed through a wetland to minimize potential impacts. These standards, shown in Table 3-2, were largely based on the state guidance document. These standards determine tolerable hydrologic change in terms of bounce (difference between the peak flood elevation and the wetland elevation), inundation period (time that floodwaters temporarily stored in the wetland exceed the wetland elevation), and runout control (elevation of the outlet).

These standards provide guidance for the management of stormwater to minimize wetland impacts. It is assumed that wetland impacts will be minimized and existing wetland functions and values will be maintained if the proposed management system and criteria meet the

management standards shown in Table 3-2. Specific requirements designed to implement the City's wetland management strategies are outlined in Section 5.1.

3.1.3 Wetland Management Classification

A wetland function and value assessment will be required for all waters proposed to receive new stormwater discharges from private development or City initiated projects unless a management class has already been designated for the receiving water. The latest version of the "Minnesota Routine Assessment Method for Evaluating Wetland Functions" shall be used to assess receiving waters. The City may require, not only the water body directly receiving the discharge, but all downstream water bodies to be assessed. The assessment shall be completed by qualified wetland personnel who specialize in such work. Developers will be responsible for submitting the assessment for private projects. The assessments will be subjected to review and approval by the City's water resource staff.

The function and value assessment will be used to assign the wetlands into one of four categories – Preserve, Manage 1, 2, or 3. The flowchart shown on Figure 3-3 will be used with the function and value assessment to assign the wetlands into one of the four categories. The City's water resource staff will be responsible for assigning the wetlands into categories.

The MCWD has designated a management classification for all wetlands in their jurisdiction that are greater than one-quarter acre in size. Figure 3-1 shows the wetland management classifications for wetlands in the MCWD.

Table 3-1
Susceptibility of Wetlands to Degradation by Stormwater Impacts

Exceptionally Susceptible Wetland Types:[1]	Highly Susceptible Wetland Types:[2]	Moderately Susceptible Wetland Types:[3]	Least Susceptible Wetland Types:[4]
Sedge Meadows	Shrub-carrs[a]	Floodplain Forests[a]	Gravel Pits
Open Bogs	Alder Thickets[b]	Fresh (Wet) Meadows[b]	Cultivated Hydric Soils
Coniferous Bogs	Fresh (Wet) Meadows[c,e]	Shallow Marshes[c]	Dredged Material/Fill Material Disposal Sites
Calcareous Fens	Shallow Marshes[d,c]	Deep Marshes[c]	
Low Prairies	Deep Marshes[d,c]		
Lowland Hardwood Swamps			
Seasonally Flooded Basins			

1. Special consideration must be given to avoid altering these wetland types. Inundation must be avoided. Water chemistry changes due to alteration by stormwater impacts can also cause adverse impacts. Note: All scientific and natural areas and pristine wetland should be considered in this category regardless of wetland type.
2. a., b., c. Can tolerate inundation from 6 inches to 12 inches for short periods of time. May be completely dry in drought or late summer conditions. d. Can tolerate +12 inches inundation, but adversely impacted by sediment and/or nutrient loading and prolonged high water levels. e. Some exceptions.
3. a. Can tolerate annual inundation of 1 to 6 feet or more, possibly more than once/year. b. Fresh meadows that are dominated by reed canary grass. c. Shallow marshes dominated by reed canary grass, cattail, giant reed, or purple loostrife.
4. These wetlands are usually so degraded that input of urban stormwater may not have adverse impacts.

Notes: There will always be exceptions of the general categories listed above. Use best professional judgment. Appendix A of the State Guidance Document contains a more complete description of wetland characteristics under each category. Pristine wetlands are those that show little disturbance from human activity.

Source: "Planning and Evaluation Guideline for Addressing Potential Impacts of Urban Stormwater and Snowmelt Runoff on Wetlands" State of Minnesota, Stormwater Advisory Group, June 1997.

Table 3-2
Wetland Management Standards According to Management Class

Standard	Management Class			
	Preserve	**Manage 1**	**Manage 2**	**Manage 3**
Bounce (10-year)	Existing	Existing plus 0.5 feet	Existing plus 1 feet	No limit
Inundation Period[2] (1 & 2-year)	Existing	Existing plus 1 day	Existing plus 2 days	Existing plus 7 days
Inundation Period[2] (10-year)	Existing	Existing plus 7 days	Existing plus 14 days	Existing plus 21 days
Runout Control[1]	No change, maintain existing hydrology	No change, maintain existing hydrology	0 to 1 feet above existing outlet	0 to 4 feet above existing runout
Stormwater Treatment	Upstream sediment and nutrient pretreatment required to maintain background loading rates	Upstream sediment and nutrient pretreatment required to maintain background loading rates	Remove sediment from new inflows	Remove sediment from new inflows
Buffer Width[3]	35 feet	25 feet	20 feet	20 feet

[1] If currently landlocked, new outlet should be above delineated wetland elevation.

[2] Inundation period is defined as the proposed peak storage divided by the average discharge (S/Q).

[3] Buffers are unmowed, naturalized strips of vegetation around the wetland perimeter. Buffers shall be provided during development or redevelopment.

3.2 Water Quality

Within the four major watersheds of the City of Independence, there are hundreds of water bodies ranging in size from lakes to small stormwater detention basins. Nonpoint pollution associated with stormwater runoff creates adverse impacts; the degree of impact depends on the water body's natural ability to remove, absorb, or process the pollutants through chemical, physical, or biological processes. Poor water quality usually indicates a situation where the resource receives more nutrients, or other pollutants, than can be processed naturally. Planning for water quality protection is necessary to preserve the beneficial uses of existing water bodies, as well as to evaluate wetland impacts as described in Section 3.1.

Water quality protection will also be achieved through implementation of the City's Stormwater Pollution Prevention Program (SWPPP) as discussed in Section 1.2.4.

3.3 Water Quantity

The flood and rate control portion of the planning consisted of estimating the 100-year flood elevation and discharge rate for each watershed. This section discusses the flood insurance study and the City's flood and rate control process.

3.3.1 Flood Insurance Study

A Flood Insurance Study (FIS) of the City of Independence was completed in January 1983 by the Federal Emergency Management Agency (FEMA). The FIS maps indicate the boundaries for 100-year levels. The study did not determine the actual flood elevations except for the profiles along Robina Creek and Pioneer Creek. The 100-year flood elevations reported for the two creeks were used in the plan.

3.3.2 Flood Protection Level

Storm drainage systems are typically designed to pass a flood of a designated magnitude called the design flood. The design flood generally balances the cost of flood damages with the cost of the storm drainage system to achieve an overall minimum public cost. Watersheds in Independence are classified as requiring protection for either the 1 or 10 percent chance flood based on expected flood damages. Storm drainage systems that serve as the outlet for areas where flood damage is likely to occur must safely pass the critical-duration 1 percent chance flood. Storm drainage systems for areas where no significant flood damage or disruption of infrastructure is likely to occur must safely pass the critical-duration 10 percent chance flood.

3.3.3 Hydrologic Model

Simulating the stormwater system using a hydrologic model is important in determining the adequacy of the existing system and to provide guidance in designing systems to handle surface runoff for ultimate development conditions. A hydrologic model simulates the rainfall-runoff process so that runoff rates and volumes from design storms can be estimated for different stormwater configurations and land use conditions.

As rain falls on the watershed, several different processes move the water from the ground surface to one of three ultimate destinations. Initially water is stored in depressions and on the surface of the ground, and begins to infiltrate into the soil. As rainfall continues, the storage capacity of these depressions is exceeded and the excess water begins to runoff into gutters, swales, ditches and storm sewers. In Independence, these conveyance paths lead to county and public ditches, creeks or to one of the many lakes, ponds and wetlands in the City.

The amount of rain and the time over which the rain occurs influence the amount of runoff and the rate at which the runoff travels from the watershed. In addition to the rainfall conditions, the physical characteristics of the watershed also determine the volume of water that leaves the watershed as runoff, and the resulting flood levels in the ponds, wetlands and lakes in the watershed.

The storm drainage system for Independence was analyzed for the 1 percent chance flood for existing and proposed (ultimate development) conditions. The 1 percent chance flood is used to design storm drainage systems that serve as the outlet for areas where significant flood damage is likely to occur.

The drainage divides within the PSCWMC were determined using:

- Four USGS Maps: Delano – 1981, Mound – 1993, Rockford – 1981, Watertown – 1993
- Field Surveyed pipes and water levels

The drainage divides within the MCWD were copied from the MCWD Comprehensive Water Resources Management Plan.

HydroCAD was used as the hydrologic model to simulate flow through the storm drainage systems in Independence. This computer model creates a hydrograph for each watershed. The model then routes these hydrographs through storage areas (such as wetlands, lakes, and detention ponds) and conveyance systems (storm sewers and ditches) and combines them with hydrographs from other subwatersheds. The hydrologic model estimates both the peak rate of runoff and the volume of runoff. The peak rate of runoff is the primary factor in determining storm sewer sizes. The volume of runoff is the primary factor in the design and evaluation of stormwater storage areas and in the assessment of hydrologic impacts to wetlands. A more detailed discussion about the HydroCAD Model is given in Section 9.0.

3.3.4 Rate Control and Flood Storage

Independence has vast amounts of stormwater storage available in its wetlands and lakes. This storage was used in the development of the ultimate conditions hydrologic model for the City. The storage areas were estimated from the USGS topographic maps and the elevations were based on field surveys of existing water levels and pipe inverts.

The ultimate pipes were designed to take advantage of the large storage areas while maintaining the overall discharge rate leaving the City borders.

3.3.5 Flood Control

Flood control has been directed primarily at the management of flood levels which include the protection of structures and the safety of the residents of the City.

3.3.5.1 Flood Protection Standards

It is common practice in stormwater management to provide a safety factor against flooding. This factor of safety is typically represented as a vertical separation distance between the peak flood elevation and the flood damage elevation. This vertical separation is called the "freeboard." Section 5.2 presents the freeboard values that will be used for the City.

3.3.5.2 Flood Control System

The flood control system in Independence consists of the wetlands, ponds and lakes for storage of runoff, the roadways, storm sewers, ditches and streams for conveyance of water from the watershed, and the management of the water in the system. Normal levels, flood levels, flood storage, peak discharges and proposed storm sewer pipe sizes for each watershed are tabulated in the tables in Section 6.

3.4 Problem Areas

An assessment of the known problem areas and concerns within the City has been developed by the MCWD and the PSCWMC and is presented in their respective Watershed Management Plans. The following sections summarize the information in these plans.

3.4.1 Pioneer-Sarah Creek Watershed Management Commission

The following problems and concerns have been identified in the PSCWMC Plan.

3.4.1.1 Lake, Stream, and Wetland Water Quality Concerns

The water quality of Lake Independence, Lake Rebecca, Lake Sarah and Haughey Lake has been identified as a concern. A phosphorus Total Maximum Daily Load (TMDL) study for Lake Independence was approved in 2007. Lake Sarah, Lake Rebecca and the South Fork Crow River are listed on the MPCA's Impaired Waters List. These impaired waters in relation to Independence are shown on Figure 2-1. A summary of the TMDL information for the impaired waters is shown on Table 3-3.

Table 3-3
TMDL Information

Reach	Year Identified	Lake or River ID	Affected Use	Pollutant or Stressor	TMDL Target Start	TMDL Target Completion Date	Year TMDL Plan Approved
South Fork Crow River	2002, 2004 and 2006	07010205-508	Aquatic Life and Recreation	Fecal Coliform, Fish Bioassessments, and Turbidity	2008	2014-2015	n/a
Lake Independence	2002	27-0176-00	Aquatic Recreation	Nutrient/Eutrophication Biological Indicators	n/a	n/a	2007
Lake Sarah (West Bay)	2006	27-0191-01	Aquatic Recreation	Nutrient/Eutrophication Biological Indicators	2007	2012	n/a
Lake Sarah (East Bay)	2006	27-0191-02	Aquatic Recreation	Nutrient/Eutrophication Biological Indicators	2007	2012	n/a
Lake Rebecca	2008	27-0192-00	Aquatic Recreation	Nutrient/Eutrophication Biological Indicators	2008	2010	n/a

A statewide mercury TMDL study was approved in 2007 for Lake Independence and the reaches shown in Table 3-3.

Water quality impacts associated with residential pollution, hobby farms, feedlots, and development have been identified as a concern.

Corrective Actions:

The City shall implement the water quality policies and standards outlined within this plan through development plan review in an effort to address water quality concerns within the City.

The recommendations in the TMDL studies will be incorporated into this plan.

The City shall implement an educational program targeted at educating the public, City staff, and elected officials about water quality.

3.4.1.2 Flooding, Stormwater Rate Control, and Water Quantity Concerns

The high water elevations of Lake Independence, Lake Sarah, and Lake Haughey have been identified as a concern. A contributing factor to the high water levels is from increased rates and volumes of stormwater runoff as a result of an increase in impervious surface area due to development.

The maintenance of private drainageways (i.e. private ditches or draintile) has been identified as a concern.

Rates and volumes of stormwater runoff associated with the culverts north and south of the railroad at County Line Road between the Cities of Delano and Independence has been identified as a concern. The location of these culverts is shown on Figure 3-2 as issues 1 and 2.

Corrective Actions:

The City shall implement the water quantity policies and standards outlined within this plan through development plan review in an effort to address flooding and increased flow rate and volume concerns within the City.

The City will be responsible to address private drainage system maintenance for systems solely within the City. For private drainage systems that cross municipal boundaries, the PSCWMC will coordinate with the member communities and landowners to address the issue.

The City will cooperate with the City of Delano and the PSCWMC to study the rate and volume control issue associated with the railroad culverts at County Line Road. The City has completed a preliminary drainage study of the Urban Commercial Area. Figure 1 in Appendix D shows the study area that was analyzed. An XP-SWMM model was used for the routing analysis. The study area was divided into four subwatersheds. Subwatersheds 2 and 3 are within the City of Independence and subwatersheds 1 and 4 are within the City of Delano. In general, the drainage is from east to west.

As previously indicated, there are concerns regarding the culverts north and south of the railroad crossing at County Line Road. It appears that the culvert north of the railroad tracks does not drain any of the proposed Urban Commercial area therefore this pipe was not included in the analysis. The north portion of the Urban Commercial area, which is in subwatershed 3, drains to Delano through a 30 inch RCP. The south portion of the Urban Commercial area, which is in subwatershed 2, drains to Delano through a 15 inch CMP.

To review the impact of the Urban Commercial area on the City of Delano, the immediate downstream watersheds, numbers 1 and 4, were included in the analysis. The existing conditions were compared to a scenario that would require restriction of the outlets from subwatersheds 2 and 3. A summary of the results is shown in Table 3-4:

Table 3-4
Drainage Study Summary
Urban Commercial Area

	Existing Conditions – 100 year[1]			**Proposed Conditions – 100 year[1]**		
Subwatershed	**HWL**	**Q**	**Storage**	**HWL**	**Q**	**Storage**
1	954.3	3.3	4.6	953.7	3.0	3.2
2	955.3	4.9	14.8	955.6	2.9	17.6
3	958.6	62.1	13.3	959.4	23.2	18.9
4	952.2	16.8	46.2	951.9	15.2	39.8

[1] Q is the discharge in cfs and storage is on Acre-Feet.

As the results show, by requiring restrictions of the outlets from subwatersheds 2 and 3, the hydrologic conditions of the watersheds in Delano will not only be maintained, but will be improved. The XP-SWMM results are included in Appendix D.

A detailed drainage review will be required prior to approval of any preliminary plats within the Urban Commercial area. The study has been identified on Table 5-3 of this plan.

3.4.1.3 Impacts of Stormwater Quality on Fish and Wildlife Resources

Impacts to fish and wildlife resources have been identified, including decreased floristic diversity and impacted wildlife habitat, as a result of stormwater.

Corrective Actions:

The City shall implement the water quality standards outlined within this plan through development plan review in an effort to address water quality impacts on fish and wildlife resources.

3.4.1.4 Impacts of Soil Erosion on Water Quality and Water Quantity

Construction site erosion has been identified as a concern.

Erosion along the banks of Lake Independence, Pioneer Creek, and Lake Sarah has been identified as a concern.

Erosion caused by commercial, hobby farm and agricultural/farming activities has been identified as a concern.

Corrective Actions:

The City shall implement the standards outlined within this plan through development plan review to address erosion issues within the City.

The City shall develop erosion and sedimentation ordinances that conform to this plan's policies and standards.

The City will be responsible for enforcement of these ordinances.

The City shall create developer's guidelines based on the goals, policies, and standards outlined in this plan.

3.4.2 Minnehaha Creek Watershed District

The following problems and concerns have been identified in the MCWD Plan.

3.4.2.1 Water Quality

Painter Creek has total phosphorus and TSS concentrations that exceed the MPCA's ecoregion guidelines. Phosphorus loads in Painter Creek increase upstream to downstream and dissolved oxygen can fall below the state standards during low flows.

MCWD has identified two potential regional ponds within Independence. The regional ponds will help reduce the phosphorus loading and peak flows to Painter Creek. The potential regional pond locations are shown on Figure 3-2.

As required by MCWD, Independence must reduce phosphorus loads to Painter Creek by 79 pounds per year.

Corrective Action:

The City shall implement the policies and standards outlined in this plan through plan review in an effort to address water quality concerns within the Painter Creek Subwatershed. The City will also work cooperatively with the MCWD on proposed district projects and will implement the strategies outlined in Section 5.2.5.3.

3.4.2.2 Water Quantity

There are two locations within the City that are predicted to overtop during a 100-year storm event. The two locations are one private driveway off of Ingerson Road and the low spot south of County Road 6 on Ingerson Road. These two locations are shown on Figure 3-2 as issues 3 and 4.

MCWD has identified three culvert crossings within the City that have higher velocities than desired which may result in erosion at the outlet. The crossings are on County Road 6. The locations are shown on Figure 3-2 as issues 5, 6 and 7.

Corrective Action:

The flooding issues were discussed with City Staff and they were not identified as a threat to life or property; therefore they were not examined any further. If projects occur in these areas, the flood potential will be reviewed at that time.

The potential erosion issue at the culvert on Ingerson Road was reviewed further. There are some slight to moderate erosion issues at the outlet of this culvert. This item has been added to the Capital Improvement Program. The City also reviewed the culvert crossings on County Road 6. These crossings have minor to no erosion issues. It is assumed that these crossings will be inspected on a routine basis by the County as part of their MS4 permit requirements.

3.4.2.3 Groundwater

As discussed in Section 2.14, the MnDNR and the Minnesota Geological Survey have developed a map that identifies the susceptibility of the water table to pollution. There are a number of areas in the City that have been identified as highly or very highly susceptible to aquifer impacts.

Corrective Action:

The City shall implement the groundwater policies and standards outlined within this plan through development plan review in an effort to protect existing groundwater quality. Given the proposed

low density development planned for Independence, the potential for groundwater impacts is considered low.

3.4.2.4 Wetlands

There are potential wetland restoration areas within Independence. Wetland restoration may help reduce the phosphorus loading and peak flows to Painter Creek. Three potential wetland restoration areas are shown on Figure 3-2. These wetland restorations are proposed projects by the MCWD. The City will cooperate with the MCWD during the implementation stage of these projects.

4.0 Goals and Policies

This section presents the goals and policies developed for the management of water resources within Independence. Goals and policies are provided for wetlands, water quality, water quantity, erosion control, groundwater, public ditch system, recreation, fish and wildlife management, enhancement of public participation, information and education, floodplains, abstraction/filtration, shorelines and streambanks. Goals propose the desired end and policies provide the means to achieve the goals. Section 5.0 provides more specific detail on how the goals and policies will be implemented.

4.1 Wetlands

Goal: Preserve, create and restore wetland resources and maximize the benefits and functionality of wetlands to the City.

Policy 1:
Act as the Local Government Unit responsible for administration of the Wetland Conservation Act within the boundaries of the Pioneer Sarah Creek Watershed Management Organization.

Policy 2:
The Minnehaha Creek Watershed District will act as the Local Government Unit responsible for administration of the Wetland Conservation Act within their District boundaries.

Policy 3:
Manage wetlands consistent with this plan and state and federal wetland regulations.

Policy 4:
Encourage restoration of degraded wetlands in Key Conservation Areas (Figure 5-1) to improve vegetative diversity and ecological integrity, with priority given to wetlands where restoration could improve management classification to at least a Manage 1. Restore other wetlands as opportunities arise.

Policy 5:
Regulate wetland impacts commensurate with the quality of the wetland as determined by the management classifications identified in the function and value assessment.

Policy 6:
Encourage establishment and maintenance of buffer areas around wetlands, lakes, and streambanks.

Policy 7:
Require submittal of a functions and values assessment for all proposed wetland impacts requiring a permit, unless a management class has already been designated for the

impacted wetland; mitigation of all fill in Preserve category wetlands; and specifying by management classification stormwater discharge pretreatment, buffer, inundation period, and other wetland standards.

Policy 8:
Maintain a current inventory of wetland location, size, function and value, and management classification.

4.2 Water Quality

Goal 1: Preserve, maintain and improve aesthetic, physical, chemical and biological composition of surface waters and groundwater within the City.

Goal 2: Achieve an annual load reduction of 79 pounds of phosphorus in the Painter Creek Watershed.

Goal 3: Achieve an annual load reduction of 541 pounds of phosphorus in the Lake Independence Watershed.

Policy1:
Manage stormwater consistent with the water quality standards outlined in this plan. In all cases, stormwater will be managed to meet or exceed MCWD and WMC standards. The MCWD will continue to implement and permit their rules within their District boundaries.

Policy 2:
The City will continues to educate Independence residents about household BMPs to protect the City's water resources.

Policy 3:
Maintain, operate, and clean structural BMPs such as sedimentation and detention structures as needed to preserve the initial intended performance.

Policy 4:
The City shall review the progress and policies related to TMDL's as they become available.

Policy 5:
The City will amend this surface water management plan to incorporate completed TMDL studies.

Policy 6:
The City will use the findings of the TMDL studies to guide development review.

Policy 7:
The City will provide the MCWD and WMC annual reports regarding TMDL implementation progress.

Policy 8:
Promote the general application of BMP's across the City.

Policy 9:
All individual developments shall be designed so as to preserve and enhance existing topography, water bodies, natural vegetation, permanent wetlands, wildlife areas and other natural amenities.

Policy 10:
The City's natural drainage network of wetlands and streams shall be maintained and protected to provide a natural stormwater system for runoff storage, filtration and maximum groundwater recharge.

4.3 Water Quantity

Goal 1: Maintain or reduce existing flows from drainage within the City to decrease the negative effects of stormwater runoff and bounce from existing and proposed development as well as provide low flow augmentation to surface waters.

Goal 2: Reduce volume of stormwater runoff from new development and redevelopment and maintain or reduce existing water volumes discharged in the Painter Creek Watershed.

Policy 1:
The City will promote preservation of the retention capacities of the lakes, streams, wetlands and ditches of the present drainage system in order to control rates of runoff and potential flooding.

Policy 2:
The City will encourage infiltration of precipitation and runoff where feasible and practical.

Policy 3:
Detention facility design will include access for maintenance of the outlet structure and to the facility in general.

Policy 4:
Provide a positive overflow from all stormwater ponds and wetlands for landlocked basins. Outlets will be installed under the 100-year flood elevation only if there is a demonstrated threat to public structures or safety.

Policy 5:
Require low floors of new structures to be built to have 2 feet of freeboard protection for the critical duration 1 percent chance flood. Low floors of new structures adjacent to landlocked basins shall be elevated a minimum of 2 feet above the elevation of two consecutive 1 percent chance storms and low openings shall be 1 foot above the 10-day snowmelt as outlined in this plan.

Policy 6:
Review development and redevelopment proposals for consistency with this plan.

Policy 7:
Correct existing flooding problems within available funding constraints by upgrading the storm drainage system or implementing flood protection improvements.

Policy 8:
Trunk storm drainage systems that serve as the outlet for areas where flooding of structures or where significant flood damage is likely to occur will typically be designed to meet freeboard protection standards for the critical duration 1 percent chance flood. The design shall be based on a hydrograph method for appropriate rainfall and snowmelt events. The design shall be based on proposed ultimate land use. The design shall consider potential flood, wetland, and water quality impacts to upstream and downstream areas.

Policy 9:
Trunk storm drainage systems for areas where no significant flood damage or disruption of infrastructure is to occur shall be designed to safely convey the critical duration 10 percent chance flood. The design shall be based on proposed ultimate land use. The design shall consider potential flood, wetland, and water quality impacts to upstream and downstream areas.

Policy 10:
Manage the rate and volume of runoff in general accordance with the stormwater management criteria presented in this plan.

Policy 11:
Provide emergency overflows for storm drainage systems where possible.

Policy 12:
Maintain, clean, and replace storm drainage systems as needed to preserve the initial design capacity.

Policy 13:
Promote regional stormwater retention systems for stormwater rate control when it is reasonable and practical to do so. The City supports on-site retention systems when regional systems are not reasonable and practical.

Policy 14:
Encourage the development and maintenance of depressional storage within the City.

Policy 15:
Encourage abstraction of the first one inch of rainfall on new permitted development and redevelopment.

Policy 16:
Development shall not decrease the runoff time for a 100-year event of the critical duration for a subwaterhsed.

4.4 Erosion Control

Goal: Control temporary sources of sediment resulting from land disturbance and identify, minimize and correct the effects of sedimentation from erosion-prone and sediment source areas.

Policy 1:
Require development and redevelopment to implement construction site erosion and sediment control practices consistent with the City's Sediment and Erosion Control Ordinance, the NPDES General Construction Permit, the Minnesota Stormwater Manual and the MCWD Rule B: Erosion Control. The MCWD will continue to implement and permit their rules within their District boundaries.

Policy 2:
Inspect construction sites and provide enforcement for conformance to the site's approved erosion and sediment control plans.

Policy 3:
The City will encourage the preservation of natural vegetation.

Policy 4:
Evaluate the need to provide erosion control or energy dissipation measures at culverts with high velocities to prevent erosion and downstream sediment transport.

Policy 5:
Work cooperatively with adjacent property owners to prevent erosion and sediment transport and stabilize streambanks as necessary.

Policy 6:
Diversion, retention, and treatment of wastes from feed lots and stables shall be required to conform to Minnesota Pollution Control Agency's regulations for agricultural waters.

4.5 Groundwater

Goal: Protect and maintain existing groundwater flow, promote groundwater recharge and improve groundwater quality and aquifer protection.

Policy 1:
Cooperate with the Minnesota Department of Health to ensure that abandoned wells are properly sealed.

Policy 2:
Encourage pretreatment of stormwater discharge to wetlands or infiltration areas in the areas of high aquifer sensitivity.

Policy 3:
Encourage the use of low impact development techniques that minimize new impervious surfaces and provides for increased infiltration.

Policy 4:
Encourage groundwater infiltration and recharge where feasible and practical.

Policy 5:
Require developers to identify existing drain tile lines on property proposed for development.

Policy 6:
Encourage abstraction of the first one inch of rainfall on new permitted development and redevelopment in Type A and B soils.

Policy 7:
Require an additional level of analysis and review of permitted development and redevelopment where there is a potential to adversely impact groundwater connected to a surface water feature.

4.6 Public Ditch System

Goal: Maintain public ditch systems within the City as required under statutory jurisdiction.

Policy 1:
The City shall maintain public water management structures between waters and wetlands, and regional detention basins.

Policy 2:
Except for Painter Creek, the public ditch systems within the City shall be managed by Hennepin County, which is the public ditch authority. Painter Creek will be managed by the Minnehaha Creek Watershed District.

4.7 Recreation, Fish and Wildlife Management

Goal 1: To protect and enhance fish and wildlife habitat areas, significant open spaces and natural areas.

Goal 2: Promote the recreational use, where appropriate, of surface waters within the City by providing recreation opportunities for residents by promoting the use and enjoyment of water resources with the intent of increasing the livability and quality of life within the City.

Policy 1:
The City shall encourage fish and wildlife habitat protection and enhancement opportunities as part of surface water management practices.

Policy 2:
The City will work with and support to the maximum extent practical the efforts of the MCWD and WMC in promoting public enjoyment and protecting fish, wildlife, and recreational resource values in the City.

4.8 Enhancement of Public Participation, Information and Education

Goal 1: Educate and inform the public on pertinent water resource management issues and increase public participation in water management activities.

Goal 2: Solicit input from the general public with the intent that polices, projects and programs will address local community values and goals as well as protect historic and cultural values regarding water resources; strive to manage expectations; and base decisions on an educated public.

Policy 1:
Implement the Stormwater Pollution Prevention Program adopted May 2006, amended July 2008 to include TMDL requirements.

Policy 2:
Develop and distribute targeted written material to stakeholder groups (e.g., residents, agricultural property owners, developers) explaining the need for natural resource conservation and low impact development approaches to reduce phosphorus and other pollutant loading and providing strategies that each stakeholder group can employ to assist in meeting the City's goals.

4.9 Floodplains

Goal: Reduce the severity and frequency of flooding and high water by preserving and increasing the existing water storage capacity below 100-year flood elevations on all waterbodies within the City.

Policy 1:
Manage activities within the floodplain in accordance with the City's ordinance and state and federal regulations.

Policy 2:
The City shall discourage encroachment into the floodplain/fringe that will reduce storage capacity unless the storage volume is mitigated.

Policy 3:
The City shall prohibit encroachment into the floodway.

4.10 Low Impact Development

Goal: Promote low impact development strategies where feasible for the purpose of improving water quality, increasing groundwater recharge, and decreasing runoff volumes throughout the City.

Policy 1:
Encourage abstraction of the first one inch of rainfall on new permitted development and redevelopment.

Policy 2:
Promote reforestation and revegitation with native plants to increase infiltration.

Policy 3:
Encourage the use of low impact development techniques that minimize new impervious surface and provides for increased infiltration.

Policy 4:
Develop ordinances to enforce buffer requirements outlined in this plan.

4.11 Shorelines and Streambanks

Goal: Preserves the natural appearance of shoreline areas and minimize degradation of surface water quality, which can result from dredging operations.

Policy 1:
Manage activities within the shoreland districts in accordance with the City ordinance and state and federal regulations.

Policy 2:
Promote native vegetation over structural stabilization in City policies, regulations, and programs.

Policy 3:

Work cooperatively with adjacent property owners to prevent erosion and sediment transport and stabilize streambanks as necessary.

5.0 Plan Implementation

To uphold the goals and policies of this Plan, the City will review all proposed developments and improvements. Approvals for BMPs relating to water quality, wetland protection, and erosion and sediment control and water quantity will be required for all developments, land disturbances, and other applications that require permitting by City Ordinance.

The City has established the following regulatory controls and criteria relating to its policies. These controls and criteria apply to the management of: wetlands, water quantity and quality, floodplains, shorelands, recreation, open space and wildlife, groundwater, soil erosion and sedimentation control, education and municipal operations. While these controls and criteria relate to one of the policy areas, it should be noted that they are interrelated and may serve multiple purposes.

The criteria, as a minimum, establish the degree of performance necessary to achieve improvements in water quantity and quality management. These criteria are not intended to dictate or preempt the design process, but rather provide a guide to proper development. Section 8 outlines the development submittals required for the City to complete the engineering review for proposed developments.

5.1 Wetlands

As discussed in Section 3.0, the City's strategy for managing wetlands will be guided by designating wetlands into management classes.

5.1.1 Wetland Alterations

Wetland alteration will continue to be permitted and enforced through state and federal agencies. These regulatory programs are well established and agency personnel are trained to make qualitative judgments regarding wetland values. The City will continue to administer the Wetland Conservation Act within the boundaries of the Pioneer Sarah Creek Watershed Management Organization. The Minnehaha Creek Watershed District will administer the Wetland Conservation Act within their District boundary.

5.1.2 Field Delineation

Any proposed development will require a field delineation by a qualified individual using accepted methodology. The functions and values of identified wetlands shall also be analyzed according to Section 3.1.3. The City's water resource staff will use the information described in Section 3.1.3 to determine the wetland's management class.

5.1.3 Wetland Excavation

Wetland excavation shall be in accordance with the requirements of the Wetland Conservation Act and all other local, state and federal agencies.

5.1.4 Wetland Fill

Any filling shall not cause the total natural flood storage capacity of the wetland to fall below the projected volume that the wetland would hold following a 24-hour duration, 1 percent (100-year) frequency rainfall over the fully developed drainage area.

Fill material shall not be placed below the Ordinary High Water (OHW) level of state public waters and public waters wetlands without obtaining appropriate permits from the Army Corps of Engineers, Minnesota Department of Natural Resources, and the City as required. Fill material may only be placed within the wetland limit if there are not conflicts with floodplain management policies and, if federal, state and City permits as may be required are obtained.

5.1.5 Stormwater Runoff

Stormwater runoff into wetlands shall conform to the requirements listed in Table 3-2.

5.1.6 Sequencing Procedures

When a proposed wetland alteration(s) involves excavation, filling, or stormwater runoff, the City will determine the applicability of the 1991 Minnesota Wetland Conservation Act, as amended. Project proposers must follow the sequencing procedures described in Minnesota Rules, Chapter 8420 – Wetland Conservation.

5.1.7 Wetland Buffers

Wetland buffers are unmowed areas adjacent to wetlands, lakes, and streams that contain non-invasive vegetation, preferably dense native vegetation. Buffers filter pollutants before they can enter the water body, reduce erosion, protect vegetation diversity and wildlife habitat, and minimize human impacts to the water body. Buffers are required around all wetlands, lakes, and streams for all new development, with the width dependent on the management class. Minimum buffer widths are shown in Table 3-2.

5.1.7.1 Buffer Easements

A conservation easement (preferred), or functional equivalent such as a drainage and utility easement or outlot, is encouraged on the wetland and buffer.

5.1.7.2 Use of Existing Vegetation as the Buffer

The existing vegetation is acceptable for a buffer and must not be disturbed if:

1. It is continuous, dense perennials (can be trees and shrubs with 60% canopy cover), and

2. <30% invasive plant species, and

3. Not disturbed or mowed within the last 5 years, and

4. Topography does not channelize runoff.

5.1.7.3 Buffer Monuments

Buffers shall be adequately marked with signage at maximum 200 foot spacing. Signs should be erected before occupation of new developments. Signs can be waived where the City deems they would serve no practical purpose.

5.1.7.4 Buffer Requirements for Mitigation Wetlands

Mitigation wetlands must have equal or better functions and values than the wetlands they replace. Buffers are required around mitigation wetlands. The buffer width must be the larger of the buffer required for:

1. the impacted wetland being replaced, or

2. if mitigation is an expansion of an existing wetland with higher classifications then meet that wetland's buffer requirement.

5.1.7.5 Buffer Maintenance

The functionality and aesthetic qualities of the buffer depend on maintenance. The following summarizes the buffer maintenance requirements:

- During the first two full growing seasons the applicant must replant any vegetation that does not survive.
- After the first two full growing seasons the buffer must be reseeded if the buffer changes at any time through human intervention and activities.
- The City may require an escrow for buffer establishment and maintenance.
- A legally binding and enforceable maintenance plan clarifying responsible parties is required for all buffer areas.

5.2 Water Quantity and Quality Management

The following prescribe the design criteria for water quality and quantity assessment.

5.2.1 General Hydrology

Hydrologic analysis of stormwater runoff for the planning and design of flows in storm sewers, ditches, streams and channels to lakes, detention basins, and wetlands shall be made using generally accepted hydrograph methods.

Determination of total runoff volume should follow the USDA-SCS curve number method which incorporates land use and hydrologic soil groups. Specific step-by-step process can be found in the Soil Conservation Service (SCS) publication National Engineering Handbook: Chapter 4, SCS Hydrology (1972), and Hydrology Guide for Minnesota (1992). Peak runoff rates should be

determined through the use of the SCS method incorporating "time of concentration" for both pre and post development conditions.

The developed runoff hydrograph should then be routed through the drainage area, that is, mathematically the peaks and volumes are followed as they move in a wave progressively downstream.

"Design Storms" or storm volumes for hydrologic analyses shall be based upon Hershfield, D.M., 1961, Rainfall Frequency Atlas of the United States for Durations of 30 minutes to 24 hours and Return Periods from 1 to 100 years, Technical Publication Number 40 (TP-40) along with the supplementary documents entitled: Vinha, K., J. A. Sventek and G.L. Oberts, 1995: Precipitation Frequency Analysis for the Twin Cities Metropolitan Area, Metropolitan Council, Publication Number 32-95-009 and Fredrick, R.H., 1977, Five-to-Six-Minute Precipitation Frequency for the Eastern United States, NOAA Technical Memorandum NWS HYDRO-35, Office of Hydrology, Silver Spring, Maryland.

The rational method may be used to determine peak runoff rates for primary systems. Construction of a hydrograph should be undertaken which characterizes the movement of surface water as a function of time and precipitation.

5.2.2 Rainfall

Usually the standard 24-hour SCS rainfall distribution will be used to calculate the peak discharge rates and levels from developments. The following minimum rainfall and snowmelt values shall be used in calculations for the City of Independence:

Event	Rainfall (inches)
1 year, 24 hour	2.4
2 year, 24 hour	2.8
10 year, 24 hour	4.2
25 year, 24 hour	4.7
50 year, 24 hour	5.3
100 year, 24 hour	5.9
100 year, 2 day	7.0
100 year, 4 day	8.1
100 year, 10 day snowmelt	7.2 inches of runoff

5.2.3 Curve Numbers

Table 8-1 in Section 8 lists the minimum allowable Curve Numbers (CN) which shall be used for design. Hydrologic soil groups shall be determined based upon the Soil Survey for Hennepin County, Minnesota as published by the United States Department of Agriculture Soil Conservation Service in Cooperation with Minnesota Agricultural Experiment Station.

5.2.4 Flood Protection

Consistent with state and federal regulations, Independence requires that the level of flood protection along all ditches, detention basins, lakes, streams and wetlands be established based upon the 1 percent (100-year frequency) flood. Land use within floodplains shall be regulated in accordance with City ordinance and state floodplain zoning regulations.
The following freeboard values are required for the City of Independence:

• Landlocked Basins (no outlet)	2.0 feet	(Established high water, see 5.2.5.9)
• Non-Landlocked Basins	2.0 feet	(100-year frequency)

5.2.5 Stormwater Basin Design

It is the policy of the City of Independence to require development to control urban stormwater quantity and quality through a management approach of detention and infiltration basins. Detention and infiltration basins, whether on-site or regional in nature, shall be designed to incorporate all requirements of the National Pollution Discharge Elimination System Application for General Stormwater Permits for Construction Activity (MN R100001) and the following:

5.2.5.1 Infiltration Basins

New development will be encouraged to infiltrate the first one inch of runoff from the impervious areas created by new project where there are A and B soils. Infiltration techniques will not be allowed in stormwater hotspots. Potential stormwater hotspots are defined as a land use or activity that produces higher concentrations of trace metals, hydrocarbons, or pollutants not normally found in stormwater. Examples include fueling stations, vehicle service or washing areas, vehicle fleet storage areas, and facilities that generate or store hazardous materials. Infiltration basins shall be construction and designed in accordance with Chapter 12-INF Volume 2 of the 2005 Minnesota Stormwater Manual, Version 1.0 with the following additional requirements:

1. Construction of an approved pre-treatment system shall be required prior to discharging to the infiltration basin. Pre-treatment is defined as any Best Management Practice that (a) removes settleable or particulate matter and (b) removes oil and grease to a level that they do not interfere with infiltration performance.

2. Exit velocities from the pre-treatment system shall be less than 3 feet per second for the 100-year storm event and flows shall be evenly distributed across the width of the outlet.

3. A minimum of three soil borings or pits shall be submitted with the design to verify soil types and infiltration capacity characteristics and to determine the depth to restrictive soil layers and groundwater. The depth of the soil borings or pits shall be a minimum of five feet below the bottom elevation of the proposed infiltration practice. Soil boring reports shall be conducted by a qualified geotechnical professional.

4. The bottom of the infiltration practice must be at least three feet from the seasonal high ground water table.

5. Infiltration practices shall not have standing water longer than 48 hours following each storm event.

5.2.5.2 Sediment Removal

Where infiltration basins are not possible, a permanent pool ("dead storage") volume shall be provided below the normal water elevation, which shall be greater than or equal to the runoff from a 2.5 inch rainfall over the entire contributing drainage area assuming full development. In no case should the dead storage be less than 1,800 cubic feet of storage below the outlet pipe for each acre that drains to the basin. The permanent pool average depth (basin volume/basin area) shall be greater than 3 feet with maximum depth of 8 feet.

5.2.5.3 Phosphorus Loading Reduction

Facilities shall be designed to reduce phosphorus loading at down gradient site boundaries such that there is no net increase in pollutant loads as a result of development.

These standards can be achieved through the use of ponding, Low Impact Development techniques, reduction in impervious surfaces, or other Best Management Practices deemed reasonable by the City. The City will consider a variance or flexibility to this standard if impacts to other natural resources are demonstrated. Independence will consider the implementation of this standard on regional/drainage area basis if this standard is deemed impractical on a site-by-site basis.

As required by the Minnehaha Creek Watershed District Independence is required to reduce phosphorus loads in its discharge to Painter Creek. Independence's phosphorus reduction strategy consists of the following components:

- Pasture Management
- Implementation of Post Construction Stormwater Management
- Street Sweeping
- Painter Creek Stormwater Improvement Projects

Pasture Management

This strategy would include the following steps:

1. Determine locations and approximate phosphorus loads of livestock operators, including horse owners, within the Painter Creek Watershed.

2. Determine if the operators are in compliance with City ordinance and State feedlot regulations.

3. Work with landowners, the Minnesota Pollution Control Agency, the Minnesota Extension Service and MCWD to implement BMP strategies. BMP strategies for pasture/feedlot management could include riparian buffers, fencing off sensitive areas, fortified stream crossings, pasture rotation, feed management, proper manure storage and other projects that will improve water quality by reducing erosion and phosphorus release.

MinnFARM was used to evaluate four existing livestock operations. It was determined that these operations had a phosphorus loading of 6-23 pounds per year based on their proximity to the tributary, buffers, quality of pasture and other factors. Using the BMP strategies discussed above it was estimated that an average reduction of 6 pounds of phosphorus per year per operation could be achieved. There are numerous livestock operations within the Painter Creek Watershed that the City could work with. Assuming the City would be successful with implementing the BMP Strategies on 8 operations this strategy would reduce the phosphorus load to Painter Creek **48 pounds per year**.

Implementation of Post Construction Stormwater Management

As shown on Figure 5-2, there is approximately 1,200 acres of existing Farm Land, excluding Ag Preserve, within the Painter Creek Subwatershed. It is anticipated that at least 5 percent or 60 acres of this property will develop into Rural Residential in the next 5 to 15 years. With the implementation of the stormwater basin requirements outlined in Section 5.2.5 it is conservatively estimated that at least 40 percent of the phosphorus will be removed from the Rural Residential land use.

Also, there will be a load reduction in phosphorus by converting the land use from Farm to Rural Residential. Assuming a phosphorus load of 2 pounds per acre per year for Farm/Pasture and 0.3 pounds per acre per year for Rural Residential it is anticipated that implementation of the post construction stormwater strategies will reduce the phosphorus load to Painter Creek by 112 pounds per year.

- (60 acres) (2 lbs/acre/yr) – (60 acres) (0.30 lbs/acre/yr) (40%) = **112 pounds per year**

Street Sweeping

The City of Independence has a total of 8.25 miles of street within the Painter Creek Subwatershed. The City will sweep these streets once per year after snowmelt. This will remove organic debris and sediment prior to reaching water bodies and further reduce phosphorus loadings.

Painter Creek Stormwater Improvement Projects

The MCWD has identified 7 potential stormwater improvement projects within the Painter Creek Watershed. These projects are identified on Table 5-3 as projects 30 through 36. The City will work cooperatively with the MCWD to identify project partners and other funding sources

during the feasibility study stage of these projects. The City may contribute financially toward these projects to meet their phosphorus load reduction obligations for Painter Creek.

5.2.5.4 Emergency Spillway

An emergency spillway (emergency outlet) adequate to control the critical one percent frequency/duration rainfall event (usually 100-year, 24-hour).

5.2.5.5 Basin Side Slopes

Basin side slopes above the normal water level should be no steeper than 4:1 and preferably flatter. Provide a basin shelf with a minimum width of 10 feet and a slope of 10:1 starting at the normal water level. Side slopes below the basin shelf shall be no steeper than 3:1 and preferably flatter.

5.2.5.6 Length to Width Ratio

To prevent short-circuiting, the distance between major inlets and the normal outlet shall be maximized.

5.2.5.7 Flood Storage

To protect downstream channels and structures the following flood control criteria are required for basin design:

1. A flood pool ("live storage") volume above the normal elevation shall be adequate so that the peak discharge rates from the 2-year, 10-year, and 100-year frequency, critical duration storms (usually the 24-hour) are no greater than predevelopment basin watershed conditions.

2. Dead storage volume may not be utilized as live storage.

5.2.5.8 Skimming Structures

Skimming structures shall be utilized to remove floating debris for a 2-year storm event for each basin. Skimming structures shall be shown on the plans.

5.2.5.9 For Areas without Formal Outlets (i.e. Landlocked Areas)

Landlocked depressions that presently do not have a defined outlet and do not typically overflow may only be allowed a positive outlet provided downstream impacts are addressed and the plan is approved by the City. Where a positive outlet is not constructed the following shall apply:

The minimum building elevation (low floor) shall be set two (2) feet above the level resulting from two concurrent 100-year rainfall events. The starting elevation of the pond/waterbody prior to the runoff event shall be established by one of the following:

1. Existing Ordinary High Water level established by the Minnesota Department of Natural Resources;
2. Local observation well records, as approved by the City; or
3. Mottled soil.

All areas below the established high water level shall be contained within a drainage and utility easement.

Landlocked areas shall also be analyzed for the 100 year 10 day snowmelt event. The analysis shall consider a minimum of 7.2 inches of runoff. The minimum building opening shall be set a minimum of 1 foot above the 100 year 10 day snowmelt elevation.

Outletting landlocked areas below the 100-year flood elevations is only permitted in cases of demonstrated threat to public structures or safety.

5.2.5.10 Stormwater Discharge

Discharge must be made to a receiving stream, a ditch, another pond or an approved discharge route as shown in this Water Management Plan. All outlet structures shall have outlet erosion control devices.

5.2.5.11 Storm Sewer

A. Storm sewer sizing shall be based upon the 10 year storm event. Inlet capacities and roadway spread at each inlet shall be determined. Storm sewer inlets shall be spaced to insure that not more than half the travel lane is inundated during the 10 year storm event. Manning's equation shall be utilized to determine the flow in the street at each catchbasin for verification of actual spread. Additionally, grate inlet capacities shall be verified at the maximum allowable depth of flow (low point) to verify that the proposed grates will pass the 10 year flows. When appropriate, by-pass flows shall be considered in calculations.

B. Storm sewer systems shall also meet the following requirements:

1. Maintain a minimum velocity of 3 fps for 10-year storm event.

2. Maintain a minimum cover of 2 feet from top of pipe to top of casting or flow line elevation.

3. Maintain a minimum of 3 feet of final cover over corrugated high density polyethylene (HDPE) pipe.

4. Maintain a minimum of 1.5 feet of final cover over RCP in areas not used for vehicle traffic.

5. Storm sewer inverts, which outlet to detention basins, shall be placed at the normal level of the basin. Storm sewers may be submerged a maximum of half the pipe diameter below the basin normal level if approved by the City Engineer.

5.2.5.12 Stormwater Facility Easements

The City will require that all stormwater facilities be within a drainage and utility easement or outlot.

5.2.6 Lake Independence Phosphorus Total Maximum Daily Load (TMDL)

Lake Independence is an 851-acre lake located in the Pioneer-Sarah Creek Watershed on the east side of the City of Independence. Lake Independence and its surrounding drainage area contains portions of three municipalities; Independence, Medina, and Loretto. As with many lakes in the Twin Cities metropolitan area, Lake Independence is used heavily for recreation and is prized for its aesthetic value by homeowners. Over the past several decades, the lake has experienced degraded water quality that has reduced the lake's recreational and aesthetic value. In 2002, the lake was added to the Minnesota 303(d) impaired waters list for impaired acquatic recreation as a result of mean summer phosphorus values that exceeded the 40 ppb phosphorus standard for Class 2 recreation waters. A total maximum daily load (TMDL) study for Lake Independence was approved on February 23, 2007. The requirements of the study are incorporated into the Water Management Plan by reference.

The current estimated phosphorus load to Lake Independence based upon field monitoring and computer model results is 2,381 pounds per year assuming normal annual precipitation. To reach the goal of 36 ppb for in-lake phosphorus concentration, the model predicts that the annual phosphorus load to the lake would need to be reduced to 1,300 lbs/year. This translates to a total reduction of 1,081 lbs/year, or a 45% reduction from the current total annual phosphorus load estimate of 2,381 lbs/year.

5.2.6.1 TMDL Implementation Plan

The TMDL implementation plan focuses on reducing the movement of phosphorus from the watershed area into Lake Independence. As previously indicated, a reduction of 45% (1,081 lbs/year) in the current nutrient loading to the lake is necessary to achieve the adopted water quality goal of 36 ppb.

The stakeholder group agreed that the reductions (872 lbs/year) from each identified phosphorus source summarized in Table 5-1 could be achieved. In addition, internal loading is predicted to decrease by 209 lbs/year as external loading is reduced.

Table 5-1
Summary of Proposed Annual Loading Reductions, in pounds, by Source for Individual Municipalities

Phosphorus Source	Municipality			Total Reduction
	Independence	Loretto	Medina	
Agricultural Cropland	187	0	97	284
Animal Waste	260	0	110	370
Urban Development	80	0	66	146
Failing Individual Sewage	6	0	2	8

Treatment Systems				
Goose Removal	8	0	3	11
Loretto Sewage Treatment Facility	0	53	0	53
Total	541	53	278	872

5.2.6.1.1 Agricultural Cropland

The committee agreed that establishment of buffer strips along drainage ditches, streams, and wetlands would significantly reduce nutrient runoff from agricultural cropland in the watershed. Areas with the greatest erosion potential and proximity to sediment and nutrient conveyance systems will be targeted for buffer zone establishment. Buffer establishment will be on a voluntary basis.

5.2.6.1.2 Animal Waste

The committee agreed that improved management of animal waste in the watershed would significantly reduce the phosphorus load to Lake Independence. Reduction of phosphorus runoff from existing feedlots will require improved manure storage, improved land application practices, and better pasture management. In addition, because of high animal density at some sites and existing high soil fertility, land application of manure may not be practical. Thus, proper management of feedlots will require removal of manure from the watershed.

In the event that voluntary implementation of manure management plans does not occur on the majority of feedlots, Independence will revise existing Conditional Use Permits or Zoning Ordinances to require compliance. In cooperation with the Pioneer-Sarah Creek Watershed Management Commission, Three Rivers Park District, and Hennepin County Environmental Services (HCES), Independence will develop a manure hauling and disposal service to assist landowners with manure management.

5.2.6.1.3 Urban Development

The stakeholder committee agreed that improved management of urban runoff, particularly from lakeshore properties would reduce nutrient loading to Lake Independence. Urban runoff management will include the following components; installation of rain gardens, street sweeping, removal of leaf litter from streets, installation of shoreline buffers, and stabilization of eroding lake shore.

Rain garden installation will be coordinated by the Lake Independence Citizens Association (LICA). LICA members will contact homeowners to determine interest in rain garden construction. HCES will assist LICA with rain garden design and will apply for grant monies to design and construct demonstration sites for homeowners to view.

Shoreline stabilization on Lake Independence will be coordinated by LICA with technical assistance from HCES. Three Rivers Park District staff inventoried the Lake Independence shoreline to develop priority rankings to determine where initial stabilization efforts should focus. Over 2,000 feet of the lake shoreline is experiencing significant erosion.

Street sweeping in areas immediately adjacent to Lake Independence will be completed by Independence. Street sweeping will focus on springtime removal of debris accumulated during the winter, and during leaf drop in the fall. In addition to street sweeping, removal of leaf litter from lakeshore lawns and streets adjacent to Lake Independence will be coordinated by LICA. Installation of shoreline buffers will be coordinated by LICA with technical assistance from HCES. Three Rivers Park District inventoried the lake shoreline to determine where lawns currently extend to the waters edge along the lake. These areas will be targeted by LICA.

5.2.6.1.4 Failing Individual Sewage Treatment Systems (ISTS's)

Reduction of loading from ISTS's will be achieved through increased inspections of septic systems by the City of Independence, requiring remediation of failing systems, and more frequent pump-out of all septic system tanks. These requirements will conform to Minnesota State standards for ISTS's (R. Ch. 7020).

5.2.6.1.5 Goose Removal

A reduction in phosphorus loading will be achieved by reducing the resident goose population. Three Rivers Park District, Medina, and Independence will develop a cooperative program to capture and remove geese from the lake in late summer when the birds are flightless. LICA will assist in obtaining permission to enter private property to collect geese.

5.2.6.2 Reasonable Assurance for BMP Implementation

Implementation of the BMP's necessary to achieve the total maximum daily load phosphorus targets will be the responsibility of the Cities of Independence, Loretto, and Medina. These municipalities have the constitutional authority to adopt and enforce ordinances requiring compliance with the target phosphorus load reductions discussed in the TMDL report.

5.3 Water Quality Monitoring Program

The City will continue to cooperate with the MCWD and WMC with regards to water quality monitoring, modeling, and planning to protect priority resources. The PSCWMC has developed the following water quality goals for streams within Independence

Table 5-2
Water Quality Goals

Stream	Total Nitrogen (g/m^3)	Total Suspended Solids (g/m^3)	Total Phosphorus (mg/m^3)
Pioneer Creek	3	25	500
Robina Creek	3	25	500

Goals are flow-weighted annual average concentrations.

5.4 Floodplains and Shoreland Management

Various levels of government are involved in regulation of surface water, wetlands and floodplain. As previously discussed, the MnDNR has inventoried and classified water bodies and wetlands in the State of Minnesota. The "protected waters and wetlands" program identifies water bodies and wetlands that require DNR permits for activities like draining, filling, dredging, and diverting of water. The MnDNR *Shoreland Management Program* has also established a classification system for lakes greater than 10 acres in size and rivers with a drainage area two square miles or greater. Floodplain and shoreland areas are governed by the City's floodplain and shoreland ordinance, which regulate activities adjacent to water bodies classified by the Minnesota DNR. A plan review is required for development or redevelopment if any part of the development is within or affects a 100-year floodplain.

5.5 Recreation, Open Space and Wildlife Management

Through development review the City shall encourage protection and/or preservation of wetlands and uplands that provide habitat for fish and wildlife.

5.6 Groundwater Management

The City of Independence contains natural characteristics which result in low to very high sensitivity for groundwater contamination. This Plan contains policies and criteria which will guide land use development to protect existing groundwater quality.

5.6.1 Well Abandonment

The City will continue to, in cooperation with Hennepin County, educate residents regarding the land use control practices and proper well abandonment procedures in accordance with Minnesota Rules, Section 4725.2700.

5.6.2 Individual Sewage Treatment Systems

A principal risk of direct contamination of groundwater comes from sewage from individual sewage treatment systems. Independence will insure protection of local groundwater through implementation of its ordinances regarding private on-site sewer systems. Wetlands, floodplain and shoreland areas also serve as important areas of groundwater recharge. Strategies to protect these areas were described in the previous sections.

5.7 Soil Erosion and Sediment Control

The control of erosion and sedimentation remains important to maintaining water quality in the City. Of paramount importance to the maintenance of water quality in the City is the proper enforcement of erosion and sediment controls. Enforcement will involve indirect and direct approaches.

5.7.1 Indirect Approach

The indirect approach includes incentives within the ordinance such as the requirement for a performance bond equal to or greater than the estimated cost of the work to be performed and civil penalties.

5.7.2 Direct Approach

The direct approach involves the inspection and enforcement of the sediment control elements in this Plan to insure compliance with the principles and standards. The inspection and enforcement will be undertaken by the City or its representative.

5.7.3 Conservation Principles

For applicable urban land disturbance activities, the developer shall prepare and implement an erosion and sediment control plan. The Plan shall include the necessary erosion and sediment control practices, implementation schedule and other necessary items to conform to the General Stormwater Permit for Construction Activity (MN R100001) and City ordinance.

5.8 Low Impact Development

A majority of the City of Independent's proposed zoning is Rural Residential. The nature of this land use will likely reduce impacts of stormwater, as development occurs, given that much of Independence is currently farmed.

Low impact development techniques that Independence will focus on as outlined in this plan include:

- Wetland Buffers – Section 5.1.7
- Infiltration Basins – Section 5.2.5.1
- Recreation, Open Space and Wildlife Management – Section 5.5
- Land Conservation – Section 5.9

5.9 Stormwater System Maintenance Plan

The Stormwater System Maintenance Plan has been developed to assure that the system of stormwater retention/treatment basins and stormwater conveyance systems are adequately inspected and maintained to assure that they meet their design functions. Outlined below are the inspection and maintenance activities the City intends to implement:

1. All City stormwater retention, infiltration, and treatment basins and outlets will be inspected, in accordance with BMP 6b-3 of the SWPPP, to determine if the basin's retention and treatment characteristics are adequate.

2. Portions of the City's storm sewer system will be inspected on a rotating basis in accordance with BMP 6b-7 of the SWPPP.

3. Urban streets will be swept once annually in all areas and twice annually in priority areas. Priority areas are those that drain directly to high public use water bodies and/or high quality wetlands without pretreatment of stormwater runoff.

4. All public sump catch basins, sump manholes, skimmer structures and other settling or filter devices will be cleaned and inspected every year.

The City is currently evaluating and will further refine the maintenance plan in accordance with the SWPPP. This item is specifically outlined in BMP Nos. 6a-1 to 6b-7.

5.10 Land Conservation

As shown on Figure 5-1, the City contains Key Conservation Areas, including high-value wetlands and uplands. The conservation of these areas will improve the characteristics of the aquatic ecosystem and the water quality within the watershed as well as areas downstream. Strategies to protect the ecological and hydrological values of these areas may include land use regulation; acquisition and management; and property owner education regarding land management strategies to maintain ecological integrity.

5.11 Stormwater Pollution Prevention Program

In addition to design guidelines and strategies previously presented the City will implement its SWPPP. Implementation of the SWPPP will assist in maintaining or improving existing water quality through implementation of public and employee education and participation programs, illicit discharge and detection programs and improved municipal operations.

5.12 Program Financing

5.12.1 Capital Improvements Program and Stormwater Maintenance

In the next 5 years the City will focus on their education program, development of program implementation procedures, and capital improvement projects through the land development permitting process and working cooperatively with land owners and local associations such as the lake associations to cost share on relevant projects. Table 5-3 provides an estimate of expenses and funding sources to implement the strategies outlined in this plan. The table also identifies potential funding sources.

5.12.2 Funding Sources

The City currently has a Tax District established for Pioneer-Sarah Creek Watershed area. The district was established by Ordinance 2003-04. A copy of the Ordinance is included as Appendix E of this plan. Over 85 percent of Independence is within the Pioneer-Sarah Creek Watershed; therefore this district will fund a majority of the proposed stormwater improvements and maintenance activities. At this time the City does not plan to establish any other Tax Districts or stormwater utility fees. Routine maintenance items such as culvert repair and street sweeping, which are performed by the City's public works department has been and will remain part of the general fund budget.

The City will actively pursue grant opportunities to fund proposed projects. Some of the grant programs the City will track are as follows:

1. Clean Water Revolving Fund

   The Clean Water Revolving Fund (CWRF) is a low interest loan program that is administered by the Public Facilities Authority (PFA). To be eligible, the City must first apply for placement on the Project Priority List (PPL) and then on the Intended Use Plan (IUP). This involves preparation of a preliminary plan siting the needs and benefits of the project(s) in a feasibility report. The project(s) are then rated and ranked based on points assigned through the rating process. Following the ranking process to get the project onto the PPL, a letter from the City is required to move the project(s) forward to the IUP. Generally, only the higher ranking projects are funded through this process

   Over the past two annual funding cycles, federal law has required that a portion of the CWRF financing be reserved for green infrastructure. This program, titled "Green Project Reserve" includes loan forgiveness for qualifying projects. These projects would include those projects that provide for a definable environmental benefit and/or reduced maintenance activities or costs.

2. Clean Water Fund

   The 2008 amendment to the state constitution increased the sales tax rate by three-eighths of one percent, and, approximately 33% of that is dedicated to the Clean Water Fund (CWF). Local Government Units (LGUs) are eligible to apply for competitive grants from the Board of Soil and Water Resources (BWSR) and receive up to 75% of project costs in grant dollars for eligible projects. BWSR has created several programs to disperse the Clean Water Funds appropriated. Cities are only eligible to apply for the BWSR Shoreland Improvement Grants and BWSR Restoration Technical Assistance Grants. The City will need to work cooperatively with the Watershed Organizations when making application for the BWSR grants.

3. Clean Water Partnership / Section 319 Grants

Clean Water Partnership / Section 319 grants are eligible to projects that address nonpoint-source pollution. Eligible implementation projects are those that are identified by a comprehensive assessment and planning process in the watershed or around the water body of concern. The projects must be categorized as either protection or restoration. Protection projects focus on protecting a water body that is currently meeting state water quality standards for a particular pollutant.

5.12.3 Levy Limit Constraints

Current State Statutes do not provide for levy limits therefore levy limit constrains will not be an issue in regards to financing stormwater activities.

5.12.4 Effect on Other City Funds and Households

As previously discussed the City has an established Taxing District that covers the Pioneer-Sarah Creek Watershed area. The City also already has established budget items that are financed through the general fund for routine maintenance items. It is anticipated that the City will continue to levy $65,000 - $80,000 per year to the Pioneer-Sarah Creek Watershed Taxing District. These funds will be used for annual expenses and capital projects. With these funds and others as indentified on Table 5-3 the City does not anticipate that this program will have a significant impact on other City Funds in the next 5 years.

The City of Independence has approximately 1,300 households. Over the next 5 years the City will spend approximately $85,000 per year on the activities outlined in Table 5-3. In the next 5 years it is anticipated that this program will cost each household within the City approximately $65 per year.

5.13 Ordinance Updates

The City will need to revise and expand their existing ordinances to enforce the goals and policies of this plan. The Ordinance will be needed to enforce rate control, volume control, and water quality provisions through the techniques outlined in this plan.

6.0 Watershed Data Tables

As discussed, the City of Independence has been divided into four watersheds. South Fork Crow River, Sarah Creek, Pioneer Creek and Painter Creek. This section contains data tables that present pertinent information to each subwatershed. The tables are as follows:

Table 6-1: South Fork Crow River and Sarah Creek Watershed Data
Table 6-2: Pioneer Creek Watershed Data
Table 6-3 Painter Creek Watershed Data

Table Abbreviations

OC = Open Channel
CMP = Corrugated Metal Pipe
RCP = Reinforced Concrete Pipe
INA = Information Not Available
NA = Not Applicable

7.0 Plan Amendments

This plan will be reviewed at five to ten-year intervals to determine whether updates are required to meet changing legal or physical conditions. Amendments may be either minor or major.

Minor amendments are amendments that do not change the goals, policies, management strategies, and management processes. Minor amendments include, but are not limited to the following:

- Updates to the storm drainage system based on construction or to correct errors or omissions.
- Changes to watershed divides provided they do not affect major watershed divides.
- Minor amendments as defined by Minn. Rules 8410.0020, Subp. 10 which reads as follows:
  ". . . items such as recodification of the plan, revision of a procedure meant to streamline administration of the plan, clarification of the intent of a policy, the inclusion of additional data not requiring interpretation, or any other action that will not adversely affect a local unit of government or diminish a water management organizations' ability to achieve the plan's goals or implementation program."

Minor amendments will be submitted to the affected WD or WMC as required by respective WD or WMC policy.

Major amendments will include:

- Modifications to the watershed divides or storm drainage system that change the projected rates and volume of flow.
- Modifications to the goals and policies.
- Major amendments, when required, will involve the same steps as approval of the original document.

Amendments will also be required within two years of the adoption of a watershed plan by a Watershed District or Watershed Management Organization, consistent with Minn. Rules 8410-0160.

8.0 Development Submittal Requirements

8.1 Purpose and Intent

This section of the plan is intended to provide Developer's Engineers with a standardized format for submittal of drainage plans and calculations and wetland delineation and mitigation reports to the City for review. A standardized format will provide the following:

- Reduce preparation time for submittals by providing direct guidelines for Developer's Engineers to follow.
- Reduce review time required by the City by insuring that a complete and comprehensive drainage plan and calculations are submitted.
- Insure that the City will receive the best possible protection of its resources, which could be adversely affected by inadequate stormwater management planning.

8.2 General Requirements – Grading, Drainage, and Erosion Control Plan

Grading, Drainage, and Erosion Control Plans shall be provided by the Developer in accordance with the City Code. Several items critical to the review of the drainage system must be adequately depicted on the plan by the Developer's Engineer. The following key elements must be depicted on the plan:

8.2.1 Topography

Existing and proposed contours at a minimum of 2-foot intervals. A 1-foot contour interval or proposed spot elevations shall be used where conditions dictate. The determination of contour interval shall be made based upon clarity and readability of the plans.

8.2.2 Stormwater Basins

Basin locations as depicted by the proposed contours. Normal level and 100 year flood water levels shall be depicted on the plan for each basin. Detention basins are required at each outfall point from the proposed plat. Perimeter berm elevation and width shall be clearly labeled on plan sheets.

Permanent detention basins may be utilized as construction detention basins, provided they are cleaned after permanent erosion control measures are established. Design features of the detention ponds shall be as described in this Plan.

8.2.3 Erosion Control Features

Locations of silt fence, bale barriers, wood fiber blanket, rock construction entrances, storm drain inlet protection, outlet projection, riprap, temporary seeding, permanent seeding, sod, mulch, or other erosion control features proposed to be implemented for the project.

8.2.4 Wetland Delineation

Show the field delineated boundaries of all public waters and wetlands.

8.2.5 Storm Sewer Facilities

Storm sewer facilities, when utilized, shall be adequately depicted on the drawings. At a minimum, the following must be shown on the plan:

1. Storm sewer pipe size, length, grade and type of material between each structure.

2. Catchbasin and manhole structural data including size, flow line or rim elevations and invert elevations. A typical section depicting each different type of catchbasin or manhole used shall be shown on the drawing. Type of casting utilized shall be referenced for each catchbasin or manhole.

3. A typical curb section for urban design streets shall be shown on the drawing.

4. If ditch sections are used, a typical section shall be shown on the drawing depicting bottom width and side slopes of the ditch.

5. Details of skimming structures proposed.

8.3 Storm Drainage System Submittal Requirements

The stormwater drainage report shall be comprised of the following sections to provide the City Engineer with adequate base information for which to review the report. The following data must be included in the report:

Title Page. The title page shall list the project name, project location, date prepared, and preparer's name, title, and company.

Table of Contents. The table of contents must provide a description of the major categories of the report and also list each hydrograph and reservoir report presented in the report.

Summary. The summary must provide descriptions of items critical to the review of the entire report. Assumptions and results of the calculations shall be included in the summary:

A. Pre-Development Site Conditions (Existing)
    1. Total site area
    2. Delineation of sub-drainage areas, as appropriate.
    3. For each drainage area, or sub-drainage area, provide the following information:
        a. Area in acres.
        b. Curve number (with justification)
        c. Time of Concentration (with justification)
        d. Runoff rate and runoff volume

B. Post-Development Site Conditions (Proposed)
   1. Total site area
   2. Delineation of sub-drainage areas, as appropriate.
   3. For each drainage area, or sub-drainage area, provide the following information:
      a. Area in acres
      b. Curve number (with justification)
      c. Time of Concentration (with justification)
      d. Runoff rate and runoff volume

C. Comparison of pre-development to post-development runoff rates and volumes.

D. Summary of nutrient removal on site.

E. Discussion of temporary and permanent erosion control measures utilized.

F. A discussion of the storm sewer system, if applicable, to include a summary of flows to each catchbasin and the depth of water over each catchbasin during the ten year event.

Drainage maps: Drainage maps depicting pre-development and post-development conditions. The maps may be 22"x34" plans, but shall also be provided on 11"x17" reductions. The plans shall delineate drainage area and sub-drainage area boundaries. All areas shall be labeled and referenced to those presented in the report.

Computer Printouts: Drainage maps of all hydrograph and reservoir files shall be included at the back of the report for reference.

8.4 Wetland Delineation and Replacement

8.4.1 Wetland Delineation

When a regulated use or activity is proposed on a property which is within a wetland or wetland buffer area, a wetland delineation and report is required. The applicant shall provide a wetland report prepared by a qualified Wetland Specialist. The wetland report shall include the following:

1. Vicinity map;
2. A copy of a National Wetland Inventory Map identifying the wetlands on or adjacent to the site;
3. A site map setting forth all of the following:
   a. Surveyed wetland boundaries based upon delineation;
   b. Site boundary property lines and roads;
   c. Internal property lines, rights-of-way, easements, etc.;
   d. Existing physical features of the site including buildings, fences, and other structures, roads, parking lots, utilities, water bodies, etc.;
   e. Contours at the smallest readily available intervals, preferably at 2-foot intervals;
   f. Hydrologic mapping showing patterns of surface water movement and know subsurface water movement into, through, and out of the site area.

g. Location of all test holes and vegetation sample sites, numbered to correspond with flagging in the field and field data sheets.

4. A report which discusses the following:
   a. Location information (legal description, parcel number and address);
   b. Delineation. The wetland boundaries on the site established by the delineation shall be staked and flagged in the field. If the wetland extends outside the site, the delineation report shall discuss all wetland areas within 150 feet of the site, but need only delineate those wetland boundaries within the site;
   c. General site conditions including topography, acreage, and surface areas of all wetlands identified;
   d. Hydrological analysis, including topography, of existing surface and known significant sub-surface flows into and out of the subject wetland(s);
   e. Analysis of functional values of existing wetlands, including vegetative, faunal, and hydrologic conditions;
5. A summary of proposed activity and potential impacts to the wetland(s);
6. Site plan of proposed activity, including location of all parcels, tracts, easement, roads, structures, and other modifications to the existing site. The location of all wetlands and buffers shall be identified on the site plan.

8.4.2 Wetland Replacement

When wetland impacts cannot be avoided, the applicant shall prepare a Wetland Replacement Plan. The Wetland Replacement Plan components shall conform to the requirements of Minnesota Rules 8420.0530.

8.4.3 Wetland Functions and Values Assessment

A wetland functions and values assessment shall be provided in accordance with Section 3.1.3.

8.5 Wetland Review

The applicant must submit copies of all required information including the preliminary plat to the appropriate Watershed Organization for review and approval. The two Watershed Organizations within the City include Minnehaha Creek Watershed District and the Pioneer-Sarah Watershed Management Organization.

Table 8-1
City of Independence Minimum Runoff Curve Numbers

Cover Description	Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	**A**	**B**	**C**	**D**
Fully developed urban areas (vegetation established)				
Open space (lawns, parks, golf courses, cemeteries, etc.				
Grass Cover > 75%	39	61	74	80
Grass Cover < 75%	49	65	77	82
Impervious areas:				
Paved parking lots, roofs, driveways, etc. (excluding right-of-way)	98	98	98	98
Streets and roads:				
Paved; curbs and storm sewers (excluding right-of-way)	98	98	98	98
Paved; open ditches (including right-of-way)	83	89	92	93
Gravel (including right-of-way)	76	85	89	91
Dirt (including right-of-way)	72	82	87	89
Water Surface:	100	100	100	100
Urban Districts:				
Commercial and business	NA[1]	92	94	95
Industrial	NA[1]	88	91	93
Residential districts by average lot size:				
1/8 acre of less (town houses)	NA[1]	85	90	92
1/4 acre	NA[1]	75	83	87
1/3 acre	NA[1]	72	81	86
1/2 acre	NA[1]	70	80	85
1 acre	59	68	79	84
2 acres and greater	55	65	77	82
Developing Urban Areas				
Newly graded areas (pervious areas only, no vegetation)	77	86	91	94
Undeveloped areas				
Agricultural land (all current uses)	55	65	77	82
Pasture, grassland, or range – continuous forage for grazing	49	65	77	82
Meadow – continuous grass, protected from grazing and generally mowed for hay	30	58	71	78
Brush – brush-weed-grass mixture with brush the major element	35	56	70	77
Woods – grass combination (orchard or tree farm)	43	65	76	82
Woods	36	60	73	79

[1]Use of Type A soil is not allowed for this hydrologic condition.

9.0 Hydrologic/Hydraulic Models

9.1 General Overview

The need for stormwater modeling has increased as new construction changes the usage of the surrounding land. For example, replacing a stand of trees with a parking lot has a dramatic effect on runoff, greatly increasing its total volume and the rate of runoff. The potential for erosion and flooding is increased in areas downstream of construction. To prevent such damage, the runoff must be predicted before construction so that suitable steps can be taken to handle the runoff in a safe and effective manner.

HydroCAD, a hydrologic computer modeling program, was used for this management plan. Hydraulic evaluations of pipes, ditches, and other structures were performed using standard engineering procedures and are not discussed. The Flood Insurance Study for Pioneer and Robina Creeks was adopted by this plan and was not restudied.

To determine the critical flood levels for each subwatershed, runoff volumes from pervious and impervious areas were determined for storms with durations varying between one and four days and a snowmelt runoff event with a duration of ten days.

9.2 Hydrologic Model (HydroCAD)

Stormwater modeling and drainage design techniques can be divided into two basic groups:

1) Steady-state (constant flow) methods, such as the Rational Method as applied to storm sewer pipe networks.
2) Hydrograph generation and routing procedures designed to simulate the time varying nature of actual runoff.

Although HydroCAD can be used for steady-state designs, it is designed primarily as a hydrograph generation and routing program. It is based primarily on hydrology techniques developed by the Soil Conservation Service (SCS) combined with standard hydraulics calculations. For any given storm these techniques are used to generate hydrographs throughout a watershed.

9.2.1 Runoff Volumes

The volume and rate of runoff from a subwatershed are affected by the runoff curve number (CN). The soil group classification and antecedent soil moisture condition have an effect on the CN.

The soil group classification used for this study is Group B. Soil Group B contains shallow, sandy loams. The antecedent soil moisture condition (AMC) is a measure of how much rain falls five days before a 24-hour storm. For this study, AMC II was used. The total 5 day antecedent

rainfall, for AMC II, is 0.5-1.1" during the dormant season and 1.4 – 2.1" during the growing season. From this information a CN, which indicates the percentage of runoff from a subwatershed, can be determined. For this study, the CN's range from 50-100. With the CN and the rainfall distribution and duration information, the runoff from each subwatershed can be determined using the SCS TR-20 method.

9.2.2 Rainfall Distribution and Duration

Design storm characteristics must be determined for the model. This requires determining both the amount of precipitation and the intensity distribution of the precipitation. Technical Paper Numbers 40 and 49, and Hydro-35 published by the National Weather Service are used to determine the amount of precipitation.

Two separate rainfall intensity distributions were used for this study. The 1 day duration uses a SCS Type II distribution, which is used for the continental U.S. east of the Sierra Nevada and Cascade Mountains in California, Oregon, and Washington. The Type II distribution is based on the generalized rainfall depth-duration frequency relationships shown in technical publications of the Weather Bureau. The rainfall intensity distribution for the 2-day and 4-day storm durations was developed from F.A. Huff's fourth quartile, 50 percent probability hyetograph. This hyetograph is discussed in Huff's paper, "Time Distribution of Rainfall in Heavy Storms", published in Water Resources Research, Fourth Quarter, 1967.

9.2.3 Flood Elevations

After the hydrographs are created for each subwatershed, they are routed through storage areas (wetlands, lakes, detention ponds, etc.) and conveyance systems (storm sewers and ditches) and combined with other hydrographs at junctions with other subwatersheds. Specific characteristics of the water body and its outlet are input into the elevation-flood storage-discharge relationship used in the routing through each water body.

The storm duration that is critical for a watershed is dependent on the watershed size and slope, the volume of storage available in the system, and the outlet capacity. The critical duration is determined by routing several different duration storms of a given frequency and determining which duration produces the greatest peak discharge or flood elevation. A small watershed with little available storage will have a critical storm of shorter duration than a large watershed with abundant storage.

The elevations reported in this plan have been derived using limited topographic information and shall not be used for the purpose of establishing flood protection standards of new or existing structures. As development/building applications are submitted, the applicants will be required to further investigate the drainage patterns in accordance with Section 8.0 to more accurately determine flood elevations.

10.0 Glossary

1 Percent Chance Flood: The flood event that has an annual probability of being equaled or exceeded in any given year of 1 percent. This flood is the result of the critical duration 1 percent chance storm falling on the watershed. This is also commonly called the "100-year" flood.

10 Percent Chance Flood: The flood event that has an annual probability of being equaled or exceeded in any given year of 10 percent. This flood is the result of the critical duration 10 percent chance storm falling on the watershed. This is also commonly called the "10-year" flood.

100-Year Storms: Rainstorms of varying duration (e.g. 2-, 6-, 24-hour) and intensities (inches per hour) expected to recur on the average of once every one hundred years (1% frequency probability).

Abstraction: Retention on site through infiltration, evapotranspiration, or capture and reuse.

Acre-Foot: A measurement of water volume that is equal to 1 foot of water covering an area of 1 acre.

Algae: Simple rootless plants that grow in bodies of water in relative proportion to the amount of nutrients available. Algal blooms, or sudden growth spurts, can affect water quality adversely.

Aquifer: Saturated permeable geologic unit(s) that can transmit significant quantities of water under ordinary hydraulic gradients.

Bedrock Aquifer: One or more saturated geologic units composed of sedimentary, metamorphic, or origineous rock that can transmit significant quantities of water under ordinary hydraulic gradients.

Best Management Practices (BMPs): Practices that can be used to control urban nonpoint source pollution.

BMP Fingerprinting: A series of techniques used to manage stormwater to minimize impacts to wetlands, forest, and sensitive stream reaches. Techniques include bypassing flow around a wetland and discharge of stormwater to a pretreatment pond around or adjacent to the wetland.

Bounce: The vertical elevation difference between the peak flood elevation and the wetland elevation.

Buffer: An upland area adjacent to a wetland, lake, or stream that is covered with natural vegetation that experiences little to no human impact such as mowing. The buffer begins at the delineated wetland edge or top of bank of a stream.

County Ditch: An open channel to conduct the flow of water. (Minnesota Statutes, section 103E.005, Subd. 8).

Design Storm: A rainfall event of specific return frequency and duration (e.g., a storm with a 2-year frequency of occurrence and 24-hour duration) that is used to calculate the runoff volume and peak discharge rate.

Detention: The temporary storage of storm runoff used to control the peak discharge rates, and which provides gravity settling of pollutants.

Detention Pond: An impoundment that is normally dry but is used to store water runoff until it is released from the structure. Used to reduce the peak discharge from stormwater runoff.

Detention Time: The amount of time a parcel of water actually is present. Theoretical detention time for a runoff event is the average time parcels of water reside in the basin over the period of release.

Ditch Repair: To restore all or part of a drainage system, as nearly as practicable, to the same condition as when originally constructed and subsequently improved.

- Resloping of ditches, leveling and reseeding of waste banks, if necessary, to prevent further deterioration;
- Realignment of original construction, if necessary, and to restore the effectiveness of the system or prevent the drainage of a wetland;
- Routine operations that may be required to remove obstructions and maintain the efficiency of the drainage system;
- Restoration or enhancement of wetlands; and
- Wetland replacement under Minnesota Statutes, section 103G.222.

Erosion: Wearing away of the lands or structures by running water, glaciers, wind, and waves.

Eutrophication: The natural or artificial process of nutrient enrichment whereby a water body becomes filled with aquatic plants and low in oxygen content.

Evapotranspiration: Water evaporated and transpired from soil and plant surfaces.

Feedlot: An area where livestock are fattened for market.

Flood Fringe: The portion of the floodplain outside of the floodway.

Flood Profile: A graph of a longitudinal plot of water surface elevations of a flood event along a reach of a stream or river.

Floodplain: Lowland area adjoining water bodies which are susceptible to inundation of water during a flood.

Floodway: The channel of a watercourse and those portions of the adjoining floodplain which are reasonably required to carry and discharge the 100-year flood.

Freeboard: A factor of safety above a certain flood level. This typically is defined as the vertical separation (feet) between the design flood level (e.g., 1 percent chance flood elevation) and the lowest floor of a structure or the top of an embankment. Freeboard compensates for the many unknown factors (e.g., waves, ice, debris, etc.) that may increase flood levels beyond the calculated level.

Geology: The science which treats the origin, history, and structure of the earth, as recorded in the rocks; together with the forces and processes now operating to modify rocks.

Glacial Drift: Material which was deposited by glaciers.

Greenway: A linear open space established along either a natural corridor such as a riverfront, stream, valley, or ridgeline, or overland along a railroad right-of-way converted to recreational use, a canal, scenic road or bicycle passage. An open space connector linking parks, nature

reserves, cultural features, or historic sites with each other and with populated areas. Locally certain strip or linear parks designated as parkway or greenbelt.

Groundwater: Water underneath the ground surface that is under positive pressure.

Hydric Soils: Soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part.

Hydrograph: A graph showing variation in the water depth or discharge in a stream or channel, over time, at a specified point of interest.

Hydrology: The applied science concerned with the waters of the earth in all its states – their occurrences, distribution, and circulation through the unending hydrologic cycle of: precipitation; consequent runoff, stream flow, infiltration, and storage; eventual evaporation; and reprecipitation.

Impervious Area: Impermeable surfaces, such as pavement or rooftops, which prevent the infiltration of water into the soil.

Infiltration: The entrance of water into the soil or other porous material through the interstices or pores of a soil or other porous medium.

Inundation Period: Time that flood waters temporarily stored in the wetland exceed the wetland elevation. Difference between the peak flood elevation and the wetland elevation.

Invert Elevation: The vertical elevation of a pipe or orifice in a pond which defines the water level.

Judicial Ditch: A public drainage system established under Chapter 106 of the Minnesota Statutes and under the jurisdiction of the district court or a watershed management organization.

Landlocked Lake or Basin: Area which has an outlet that is significantly higher than the normal water level of the lake, pond, or wetland.

Lateral Ditch: Any open channel or storm sewer drainage construction by branch or extension, or a system of branches and extensions, or a drain that connects or provides an outlet to property with an established drainage system (Minnesota Statutes, section 103E.005, subdivision 15). Lateral includes only those facilities which are connected to the Anoka County Ditch system as identified in the Anoka County Public Ditch Inventory dated January 1992.

Level of Protection: The amount of secondary stormwater runoff capacity required to avoid flood damage and provide for public safety.

Level of Service: The amount of primary stormwater runoff capacity required to avoid unusual hardship or significant interference with normal public activities (transportation, sanitary, or utilities).

Management Strategy: The specific physical, legal or administrative actions recommended or implemented based upon the established criteria and will achieve the policies and goals.

Nationwide Urban Runoff Program (NURP): A study initiated by the EPA in 1978 to develop a consistent database and set of recommendations to be used to make planning decisions about nonpoint pollution issues. This study included 28 projects across the United States that were completed independently under the direction of the EPA. This study has been used extensively in both the characterization of stormwater quality, and as a guide to implementation of management alternatives for stormwater treatment. The most often cited management option

derived from this study is a detention basin referred to as a NURP pond. The NURP study provided recommendations for the size and shape of detention ponds to provide pollutant removal efficiency.

No Net Loss: No reduction in the area and value of a wetland from existing conditions.

Nonpoint Source Pollution: Pollution from any source other than any discernible, confined and discrete conveyances, including but not limited to surface runoff from agricultural, silvicultural, mining, construction, subsurface disposal and urban activities.

Normal Level: For basins, that water elevation maintained by a natural or man-made outlet.

Nutrients: Fertilizer, particularly phosphorous and nitrogen (the two most common components that run off in sediment).

On-Site Detention: A method of temporarily storing stormwater runoff at a development site in the form of wet or dry basins. While the primary objective is water quality control, significant reduction in outflow conveyor overloading is accomplished for high intensity, short duration storm events. This method is employed on developments when the regional detention basin approach is not available, usually due to site location of either facility.

Ordinary High Water (OHW) Level: The boundary of public waters and wetlands, and shall be an elevation delineating the highest water level which has been maintained for a sufficient period of time to leave evidence upon the landscape, commonly that point where the natural vegetation changes from predominantly aquatic to predominantly terrestrial. For watercourses, the ordinary high water level is the elevation of the top of the bank of the channel. For reservoirs and flowages, the ordinary high water level is the operating elevation of the normal summer pool.

Peak Discharge: The maximum instantaneous rate of flow during a storm, usually in reference to a specific design storm event.

Percolation: Movement of water through soil layers of material.

Permeability: A characteristic of soil that enables water to move downward through the profile. Measured in inches per hour.

Policies: The plans or course of action to be followed in achieving the goals.

Post-Disturbance Condition: The state of a site following crop or development establishment in which source and/or structural control measures have been implemented resulting in erosion and sedimentation control achieving soil loss limits.

Precipitation: The total measurable supply of water of all forms of falling moisture, including dew, rain, mist, snow, hail, and sleet; usually expressed as depth of liquid water on a horizontal surface in a day, month, or year, and designated as daily, monthly, or annual precipitation.

Primary Capacity: The volume and/or rate of stormwater runoff defined as that level of service provided by the primary system.

Primary System: The primary system conveys runoff from the more frequent events such as the 2 to 10-year events. In general, the system is composed of swales, ditches, gutters, and storm sewers.

Public Waters: Any waters as defined in Minnesota Statutes, section 105.37, subdivisions 14 and 15.

Reach: Longitudinal segments of a stream defined by natural or manmade restrictions. In an urban area the segments of the stream between two consecutive road crossings could typically constitute a reach.

Recharge: Replenishment of the groundwater system by natural or artificial means.

Recurrence Interval: The average interval of time, based on a statistical analysis of actual or representative stream flow records, which can be expected to elapse between floods equal to or greater than a specified stage or discharge. The recurrence interval is generally expressed in years.

Regional Detention Basin: A natural pond or wetland area, often modified by man, in which a minimum and permanent water level is maintained. During periods of stormwater runoff of various durations, the basin receives additional water, stores it temporarily, and releases it at a controlled rate(s). In addition to runoff flow equalization in reducing existing flooding problems, the basin serves pollutants from existing as well as planned development.

Retention: The holding of runoff in a basin without release except by means of evaporation, infiltration, or emergency bypass.

Retention Facility: A permanent natural or manmade structure that provides for the storage of stormwater runoff by means of a permanent pool of water.

Riparian: A relatively narrow strip of land that borders a stream or river, often coincides with the maximum water surface elevation of the 100-year storm.

Runoff: That portion of the precipitation which is not absorbed by the deep strata but finds its way into the surface water system after meeting the demands of evapotranspiration.

Secchi Disc: A circular plate, used to measure the transparency or clarity of water by noting the greatest depth at which it can be visually detected. Its primary use is in the study of lakes.

Secondary Capacity: The volume and/or rate of stormwater runoff in excess of the primary capacity and defined as that level of protection provided by the secondary system.

Secondary System: The system is composed of all the pathways that runoff takes when the capacity of the primary system is exceeded and in general is composed of streets, swales, ditches, storm sewers, detention basins, creeks, streams and rivers.

Sediment: Solid matter carried by water, sewage, or other liquids.

Shoreland: Land located within the following distances from public water: 1,000 feet from the ordinary high water level of a lake, pond, or flowage; and 300 feet from a rive or stream, or the landward extent of a floodplain designated by ordinances on a river or stream, whichever is greater.

Soil Association: A group of soils geographically associated in a characteristic repeating pattern defined and delineated as a single map unit.

Source Control: The application of erosion techniques including but not limited to: mulching, seeding, sodding, and greenbelts.

Stormwater Runoff: The flow on the surface of the ground, resulting from precipitation in the form of rainfall or snowmelt.

Structural Control: The application of construction erosion techniques including but not limited to: sediment basins, silt fences, debris dams, dikes, terracing, riprap and diversions.

Swale: A natural depression or wide shallow ditch used to temporarily store, route, or filter runoff.

Time of Concentration: The time required for surface runoff from the most remote part of a drainage basin to reach the basin outlet.

Transpiration: The process by which plants dissipate water into the atmosphere from leaves and other surfaces.

Universal Soil Loss Equation: A method developed by the Agricultural Research Service, USDA, and used by Soil and Water Conservation Districts to estimate the average annual soil erosion based on rainfall, soil erodibility, slope of the land, length of slope, vegetative cover, and erosion control practices.

Water Bodies: Natural and man-made depressions and stormwater conveyance and storage facilities including wetlands, lakes, ponds, streams and rivers.

Watershed: A geographical area which collects precipitation and provides runoff to a particular collector such as a stream, lake, or marsh.

Wetland: Transitional land between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have a predominance of hydric soils, be inundated or saturated with water at a frequency and duration to support a prevalence of hydrophytic vegetation typically adapted for life in saturated soil conditions, and under normal circumstances, supports a prevalence of hydrophytic vegetation.

Wetland Bank: System of identifying wetlands restored or created for replacement credit, providing for, and facilitating and tracking the exchange of wetland banking credits for projects that require replacement plans or wetland mitigation.

Worst-case Soil Loss Condition: The state of a site which is denuded and rough grade contours could create the greatest potential soil loss (e.g., a site in which all of the vegetative cover is removed, the existing or interim grades are not stabilized and could result in significant soil loss).