

Final Report

Stormwater Management Plan Update

Prepared for the:



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TABLE OF CONTENTS

	<u>Page</u>
1. INTRODUCTION AND BACKGROUND	1-1
1.1 Introduction	1-1
1.2 Background	1-1
2. SUMMARY / OBJECTIVE	2-1
3. HYDROLOGIC / HYDRAULIC MODELING METHODOLOGY	3-1
3.1 Hydrologic / Hydraulic Model	3-1
3.2 Curve Numbers and Soils	3-1
3.3 Time-Of-Concentration	3-3
3.4 Rainfall	3-3
3.5 Runoff Routing	3-3
4. STORMWATER MANAGEMENT ZONES	4-1
4.1 Riparian Zone (Zone R)	4-1
4.1.1 Zone Determination Methodology	4-1
4.1.2 Development Standard	4-2
4.2 Developed/Urban Zone with Drainage Problems (Zone D1)	4-2
4.2.1 Zone Determination Methodology	4-2
4.2.2 Development Standard	4-2
4.3 Developed/Urban Zone without Drainage Problems (Zone D2)	4-2
4.3.1 Zone Determination Methodology	4-2
4.3.2 Development Standard	4-2
4.4 Future Development Zone Contributing to a Regional Pond (Zone U1)	4-3
4.4.1 Zone Determination Methodology	4-3
4.4.2 Development Standard	4-3
4.5 Future Development Zone w/ On-site Stormwater Facilities (Zone U2)	4-3
4.5.1 Zone Determination Methodology	4-3
4.5.2 Development Standard	4-3
4.6 Flow Chart for Guiding Development Projects	4-4
4.7 Relevant City Stormwater Management Ordinances	4-5
4.7.1 Section 28.05(01)	4-5
4.7.2 Section 28.06(01)	4-5
4.7.3 Section 28.06(02)	4-6
4.7.4 Section 28.06(03)	4-7
4.7.5 Section 28.06(04)	4-8
4.8 Updates to the City Stormwater Ordinance (Chapter 28)	4-8
5. DEVELOPED/URBAN ZONE WITH DRAINAGE PROBLEMS	5-1

5.1 Analysis Methodology.....5-1

 5.1.1 Zone Determination5-1

 5.1.2 Hydrologic / Hydraulic Modeling5-1

 5.1.3 Drainage Improvement Alternatives Standard.....5-1

5.2 Problem Area Analysis and Alternatives Development5-1

 5.2.1 Drainage Problem A – Basin LR07 (Ash Avenue / Elder Drive)5-3

 5.2.2 Drainage Problem B – Basin LR03 (Waldo Blvd. –
 Between 11th and 12th Street)5-6

 5.2.3 Drainage Problem C – Basin LR03 (Waldo Blvd. –
 6th Street and Little Manitowoc River).....5-9

 5.2.4 Drainage Problem D – Basin LR01 (Shorewood Blvd/Fenway Terrace)5-10

 5.2.5 Drainage Problem E– Basin R22 (36th Street / Custer Street)5-14

 5.2.6 Drainage Problem F – Basin L14 (30th Street / Division Street).....5-16

 5.2.7 Drainage Problem G – Basin L14 (Dewey St. and the railroad overpass)...5-17

 5.2.8 Drainage Problem H – Basin L14 (Expo Drive / Calumet Avenue).....5-21

 5.2.9 Drainage Problem I – Basin SC (Northeast Corner of Calumet Ave. / Silver St.
 Intersection).....5-21

6. FUTURE DEVELOPMENT ZONE CONTRIBUTING TO A REGIONAL POND.....6-1

 6.1 Analysis Methodology.....6-1

 6.1.1 Zone Determination6-1

 6.1.2 Regional Pond Implementation.....6-1

 6.1.3 Hydrologic / Hydraulic Modeling6-2

 6.1.4 Regional Pond Sizing Standard.....6-2

 6.2 Regional Pond Analysis.....6-3

 6.2.1 Regional Pond 1 – Basin SC026-3

 6.2.2 Regional Pond 2 – Basin SC046-5

 6.2.3 Regional Pond 3 – Basins SC and SC04.....6-7

 6.2.4 Regional Pond 4 – Basin SC046-9

 6.2.5 Regional Pond 5 – Basin SC036-11

 6.2.6 Regional Pond 6 – Basin R50x.....6-13

 6.2.7 Regional Pond 7 – Basin R52x.....6-15

 6.2.8 Regional Pond 8 – Basins R54x, R59, and R616-17

 6.2.9 Regional Pond 9 – Basin R63.....6-19

 6.2.10 Regional Pond 10 – Basin LR17x.....6-21

 6.2.11 Regional Pond 11 – Basins LR 17 and LR17x.....6-23

 6.2.12 Regional Pond 12 – Basin LR26x.....6-25

 6.2.13 Regional Pond 13 – Basins LR21x, LR22x, LR19x, and LRx6-27

 6.2.14 Regional Pond 14 – Basin LR13x.....6-29

 6.2.15 Regional Pond 15 – Basin LR27x.....6-31

Between



6.2.16 Regional Pond 16 – Basin LR27x 6-33
 6.2.17 Regional Pond 17 – Basin LR27 6-35
 6.2.18 Regional Pond 18 – Basin L33x 6-37
 7. CAPITAL IMPROVEMENT PLAN UPDATE 7-1

LIST OF TABLES

<u>Table</u>	<u>Page</u>
3-1 DCIA Percentages.....	3-2
3-2 Pervious Open Space CNS	3-3
3-3 Design Rainfall Events	3-3
4-1 Recommended Design Storms.....	4-9
5-1 Unit Prices For Items Used In Construction Cost Estimates	5-3
5-2 Peak Water Surface Elevations Drainage Problem Area A.....	5-3
5-3A Design/Construction Cost Estimate Drainage Problem Area A (Alternative 1).....	5-3
5-3B Design/Construction Cost Estimate Drainage Problem Area A (Alternative 2).....	5-4
5-3C Design/Construction Cost Estimate Drainage Problem Area A (Alternative 3).....	5-5
5-4A Design/Construction Cost Estimate Drainage Problem Area B (Alternative 1).....	5-7
5-4B Design/Construction Cost Estimate Drainage Problem Area B (Alternative 2).....	5-8
5-5 Design/Construction Cost Estimate Drainage Problem Area A (Alternative 1).....	5-9
5-6 Peak Water Surface Elevations Drainage Problem Area D.....	5-10
5-7A Design/Construction Cost Estimate Drainage Problem Area D (Alternative 1)	5-11
5-7B Design/Construction Cost Estimate Drainage Problem Area D (Alternative 2)	5-12
5-8A Design/Construction Cost Estimate Drainage Problem Area E (Alternative 1).....	5-14
5-8B Design/Construction Cost Estimate Drainage Problem Area E (Alternative 2).....	5-15
5-9 Design/Construction Cost Estimate Drainage Problem Area F (Alternative 1).....	5-16
5-10 Peak Water Surface Elevations Drainage Problem Area G.....	5-18
5-11A Design/Construction Cost Estimate Drainage Problem Area G (Alternative 1)	5-18
5-11B Design/Construction Cost Estimate Drainage Problem Area G (Alternative 2)	5-19
5-11C Design/Construction Cost Estimate Drainage Problem Area G (Alternative 3)	5-20
6-1 Regional Pond Water Surface Area Requirements.....	6-3
6-2A Regional Pond 1 Analysis Summary	6-4
6-2B Design/Construction Cost Estimate Regional Pond 1.....	6-5
6-3A Regional Pond 2 Analysis Summary	6-6
6-3B Design/Construction Cost Estimate Regional Pond 2.....	6-7
6-4A Regional Pond 3 Analysis Summary	6-8
6-4B Design/Construction Cost Estimate Regional Pond 3.....	6-9
6-5A Regional Pond 4 Analysis Summary	6-10
6-5B Design/Construction Cost Estimate Regional Pond 4.....	6-11
6-6A Regional Pond 5 Analysis Summary	6-12
6-6B Design/Construction Cost Estimate Regional Pond 5.....	6-13
6-7A Regional Pond 6 Analysis Summary	6-14
6-7B Design/Construction Cost Estimate Regional Pond 6.....	6-15
6-8A Regional Pond 7 Analysis Summary	6-16
6-8B Design/Construction Cost Estimate Regional Pond 7.....	6-17
6-9A Regional Pond 8 Analysis Summary	6-18
6-9B Design/Construction Cost Estimate Regional Pond 8.....	6-19
6-10A Regional Pond 9 Analysis Summary	6-20



6-10B Design/Construction Cost Estimate Regional Pond 9..... 6-21

6-11A Regional Pond 10 Analysis Summary..... 6-22

6-11B Design/Construction Cost Estimate Regional Pond 10..... 6-23

6-12A Regional Pond 11 Analysis Summary..... 6-24

6-12B Design/Construction Cost Estimate Regional Pond 11..... 6-25

6-13A Regional Pond 12 Analysis Summary..... 6-26

6-13B Design/Construction Cost Estimate Regional Pond 12..... 6-27

6-14A Regional Pond 13 Analysis Summary..... 6-28

6-14B Design/Construction Cost Estimate Regional Pond 13..... 6-29

6-15A Regional Pond 14 Analysis Summary..... 6-30

6-15B Design/Construction Cost Estimate Regional Pond 14..... 6-31

6-16A Regional Pond 15 Analysis Summary..... 6-32

6-16B Design/Construction Cost Estimate Regional Pond 15..... 6-33

6-17A Regional Pond 16 Analysis Summary..... 6-34

6-17B Design/Construction Cost Estimate Regional Pond 16..... 6-35

6-18A Regional Pond 17 Analysis Summary..... 6-36

6-18B Design/Construction Cost Estimate Regional Pond 17..... 6-37

6-19A Regional Pond 18 Analysis Summary..... 6-38

6-19B Design/Construction Cost Estimate Regional Pond 18..... 6-39

7-1 10-Year Capital Improvement Plan and Maintenance Costs 7-2

LIST OF FIGURES

<u>Figure</u>	<u>Follows Page</u>
1-1 Overview	1-2
4-1 Stormwater Management Zones.....	4-1
5-1 Drainage Problem Area A.....	5-2
5-2 Drainage Problem Area B.....	5-5
5-3 Drainage Problem Area C.....	5-8
5-4 Drainage Problem Area D.....	5-9
5-5 Drainage Problem Area E.....	5-13
5-6 Drainage Problem Area F.....	5-15
5-7 Drainage Problem Area G.....	5-16
6-1 Proposed Regional Ponds South Section.....	6-3
6-2 Proposed Regional Ponds West Section.....	6-8
6-3 Proposed Regional Ponds Northwest Section.....	6-14
6-4 Proposed Regional Ponds Northeast Section.....	6-22

1. INTRODUCTION AND BACKGROUND

1.1 Introduction

Whether we realize it or not, we all contribute to the problems of stormwater runoff. Changing the natural landscape with the addition of each home, building, factory and roadway, increases the volume of runoff as well as the rate that stormwater runs off the land. Leopold (1968) estimated that the runoff volume from a moderately developed watershed would increase 50 percent over “natural” conditions for the same amount of rainfall. Development also decreases that time for stormwater runoff to reach the stream by as much as 50 percent, which in combination with greater runoff volumes increase the peak runoff rate by 200 to 500 percent.

Increased impervious area reduces the amount of rainfall soaking into the ground to replenish the groundwater. Therefore, many small streams fed by groundwater begin to “dry up” as their watershed becomes developed (Schueler, 1987). This results in streams becoming more “flashy” (i.e. little flow during dry periods but rushing torrents during rain events).

Even if peaks are controlled to predevelopment rates, the frequency at which a particular discharge will occur also increases. Studies show that a peak discharge that under “natural “ conditions occurred on average every two years is now occurring annually and a flood event that use to occur on average every 100-years now has a recurrence interval of somewhere between five to 10 years.

Further, pollutants generated by urban development are washed off with every rainfall degrading water quality and reducing the number and diversity of organisms in the stream. The US-EPA estimates that non-point source (NPS) pollution is responsible for approximately 40 percent of the Nation's water quality problems. This can cost communities more to remove the pollutants that stormwater washes into the streams and places greater limits on waste treatments facilities.

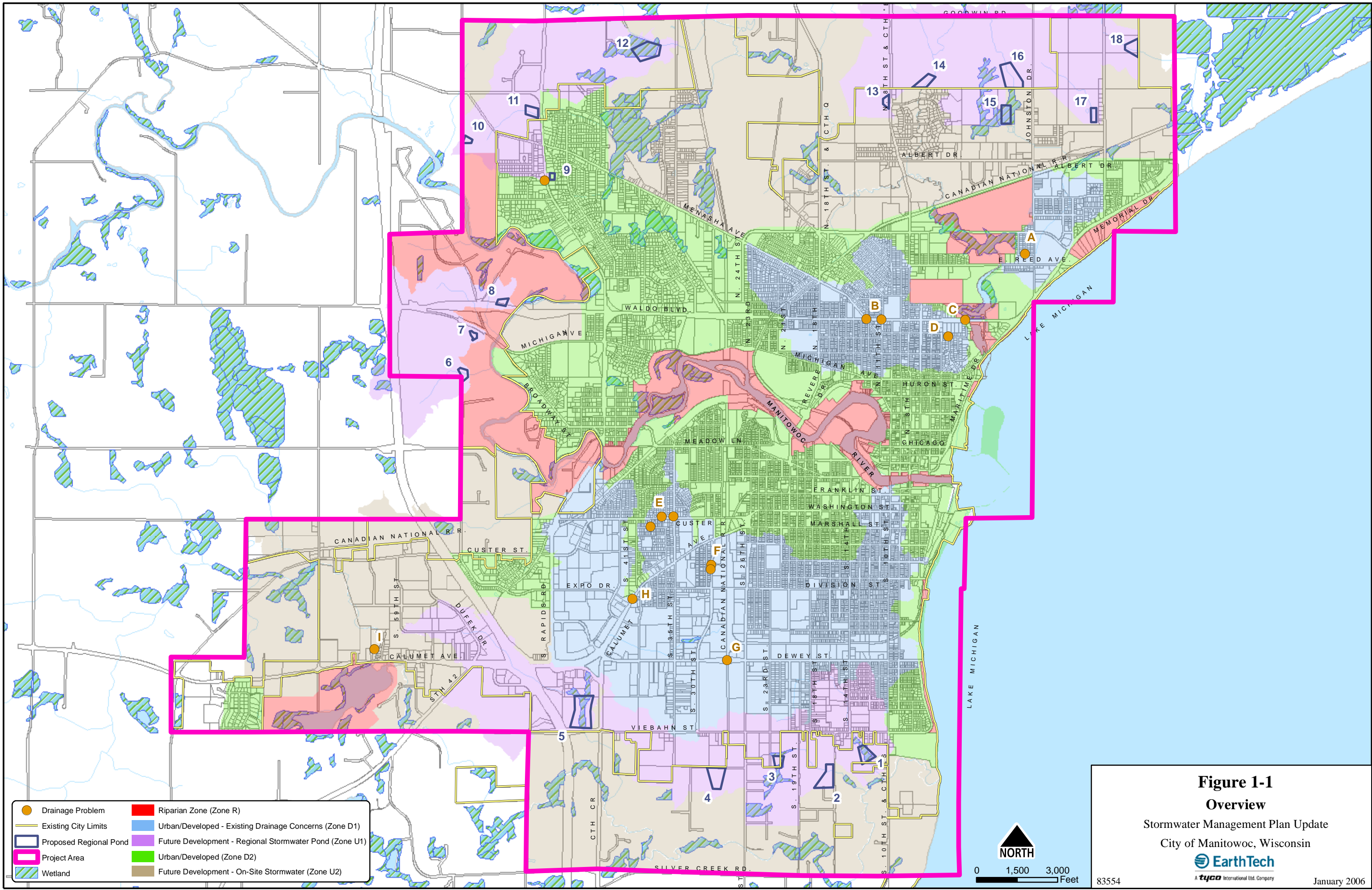
Without proper management, stormwater can limit the availability of clean water that will be needed for future growth. The problems created by not properly managing stormwater detract from the quality of life in our communities and creates problems that will carry over to future generations. This report is an element of the City's continued efforts to address stormwater management.

1.2 Background

In 2000, the City completed a city-wide Stormwater Management Plan to address the control and management of stormwater quantity and quality throughout the City. That report focused on stormwater quality modeling, some general quantity (drainage) modeling, and descriptions of proposed best management practices (BMPs), and a capital improvement plan (CIP) to implement the BMPs. That report did not specifically quantify the level to which pollutants would be reduced, and did not recommend specific corrections to identified drainage problems. Subsequent to that report, the Wisconsin Department of Natural Resources (WDNR) developed specific regulations relating to stormwater management. The WDNR regulations impact stormwater management in the City in two ways. **First, as a permitted municipality under Phase 2 of the NR 216 municipal stormwater rules, the City will have to meet specific nonpoint pollutant reduction goals. Second, development projects within the City will have to meet NR 216 rules for construction erosion control and post-construction performance standards established under NR 151. Pollutant reduction requirements for permitted municipalities, as listed in NR 151, are as follows:**

- By March 10, 2008, achieve an annual reduction of 20-percent in total suspended solids in runoff that enters waters of the state as compared to no controls.
- By March 10, 2013, achieve an annual reduction of 40-percent in total suspended solids in runoff that enters waters of the state as compared to no controls.

This **update** of the City's Stormwater Management Plan is a response to those regulations. The update addresses existing stormwater management issues, and identifying performance standards that are and will be required for continued development/redevelopment within the City and in future growth areas. This includes 1) developing potential mitigation measures for existing drainage problems, 2) identifying locations of potential future regional stormwater pond locations, and 3) developing zone-specific stormwater regulations relating to development and redevelopment. The project area includes the existing City limits and areas that may potentially be annexed into the City in the future (Figure 1-1).



- Drainage Problem
- Existing City Limits
- Proposed Regional Pond
- Project Area
- Wetland
- Riparian Zone (Zone R)
- Urban/Developed - Existing Drainage Concerns (Zone D1)
- Future Development - Regional Stormwater Pond (Zone U1)
- Urban/Developed (Zone D2)
- Future Development - On-Site Stormwater (Zone U2)

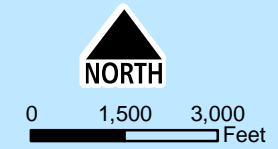



Figure 1-1
Overview
Stormwater Management Plan Update
City of Manitowoc, Wisconsin


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83554 January 2006

2. SUMMARY / OBJECTIVE

This updated plan is intended to assist in accomplishing the following goals:

- Perform hydrologic and hydraulic modeling analysis required to establish stormwater management zones,
- Develop conceptual alternatives for improving existing drainage problems,
- Locate and size potential future regional stormwater ponds,
- Create stormwater zones with zone-specific design standards,
- Support in obtaining the WDNR NR 216 Municipal Stormwater Permit,
- Promote public education of stormwater,
- Update the City's Capital Improvement Plan (CIP) as it relates to stormwater management, and
- Describe possible funding mechanisms that could be used to finance the required stormwater practices.

3. HYDROLOGIC / HYDRAULIC MODELING METHODOLOGY

3.1 Hydrologic / Hydraulic Model

To estimate the extent of existing drainage problems and to size stormwater management facilities, the hydrologic/hydraulic (H/H) computer model XP-SWMM[®], developed by XP Software, Inc., was selected for this analysis. This computer model is a private vendor model that is based on the Environmental Protection Agency's Stormwater Management Model (SWMM). The XP-SWMM[®] hydraulic model uses the St. Venant equations for gradually varied one-dimensional flow. The model can simulate dendritic and looped systems with backwater effects. This makes XP-SWMM[®] well suited to model the project area because of the potential of interconnections and multi-directional flow paths. XP-SWMM[®] can also model storage devices, such as detention ponds, with staged outlet structures.

In the hydrologic module of the model (RUNOFF), a hydrograph is developed for each basin, describing the rate of stormwater runoff from a basin over time during and after the storm event. XP-SWMM[®] allows the user to use a variety of methods to develop hydrographs. To comply with the City's proposed stormwater ordinance, the methods described in the United States Department of Agriculture – Natural Resources Conservation Services (formerly the Soil Conservation Service) Technical Release 55 (TR-55), "Urban Hydrology for Small Watersheds" were used to develop hydrographs.

3.2 Curve Numbers and Soils

The volume of runoff will be less than the total volume of rainfall that falls on the basin because of various factors, the most important being infiltration into the soil. Infiltration into the soil is reduced when an area is made impervious by paving over, building on, or compacting the soil. Soils are classified into one of four hydrologic soils groups (A, B, C, and D). "A" soils have the highest capacity to infiltrate rainwater while "D" soils have the least capacity.

TR-55 estimates the amount of stormwater infiltration using the runoff curve number (CN) method. A CN ranges from 0 to 100 and is based on soils, plant cover, the amount of impervious areas, interception, antecedent moisture conditions and surface storage. A CN was calculated for each basin. Impervious area for existing conditions was estimated based on land use maps from the Bay Lakes Regional Planning Commission. City Zoning Maps were used to estimate impervious area for future conditions. The estimated DCIA percentages for land use (existing conditions) and zoning (future conditions) are listed in Table 3-1. Soil characteristics were derived from information from the Natural Resource Conservation Service (NRCS) digital soils maps. The CN for a particular basin was estimated based on the percentage of pervious/open space and the percent of directly connected impervious area (DCIA) within that basin.

**TABLE 3-1
 DCIA PERCENTAGES**

Existing Zoning	Percent DCIA		Future Land Use (Zoning Code)	Percent DCIA
Airport	25		B-1	30
Commercial	70		B-2	30
Industrial	65		B-3	65
Institutional	30		B-4	70
Park	5		C-1	70
PUD	17		I-1	65
Residential	17		I-2	70
Rural	5		P-1	5
			R-1	8
			R-2	13
			R-3	13
			R-4	17
			R-5	17
			R-6	29
			R-7	30

When sizing regional stormwater ponds, the pervious/open space CNs were determined for two different conditions, to take into account the compaction that can take place during land disturbance activities (Table 3-2). The regional stormwater ponds were sized to match future developed condition peak flows for the 2-year and 100-year storm to pre-developed peak flows.

**TABLE 3-2
 PERVIOUS/OPEN SPACE CNs**

LAND USE CONDITION		
Hydrologic Soil Group	Pre-developed	Developed
A	30	49
B	58	69
C	71	79
D	78	84

3.3 Time-Of-Concentration

A time-of-concentration (T_c) was also calculated for each basin. The time of concentration is the time for runoff to travel from the hydraulically most distant point of the basin to a point of interest within the basin (TR-55, 1986). T_c 's were determined for both pre-developed and developed conditions. A list of T_c 's and supporting data can be found in Appendix A.

3.4 Rainfall

Rainfall events are described by their depth, duration, distribution, and probability of exceedance. As typically used with TR-55 in Wisconsin, a 24-hour storm duration with a Type II distribution was used in this analysis. In the Type II distribution, most of the rainfall occurs in a sharp peak in the middle of the event. The use of this storm duration and distribution is consistent with the WDNR NR 151 performance standards. The probability of exceedance is the probability that a rainfall event greater to or equal to a certain depth and duration will occur in a given year. Table 3-3 lists the 24-hour rainfall depths for each probability of exceedance used in the analysis. These depths were estimated from rainfall maps developed by the National Weather Service Technical Paper 40 (TP-40).

**TABLE 3-3
 DESIGN RAINFALL EVENTS**

Annual Exceedance Probability (Return Frequency)	24-hour Rainfall (in)
50% (2-year)	2.4
10% (10-year)	3.7
1% (100-year)	5.0

3.5 Runoff Routing

XP SWMM's hydraulic module called EXTRAN routes the flow through the storm sewers, ditches, swale and ponds that make up the City's stormwater conveyance system.

4. STORMWATER MANAGEMENT ZONES

One of the components of stormwater management considers how land development and increases in impervious surfaces can create or aggravate drainage and flooding problems. In response to this concern, municipalities, including the City of Manitowoc, have developed ordinances that require development to control the quantity of stormwater being released from the site. This requirement is appropriate for the majority of the City. This section focuses on the development of zones that contain specific stormwater management requirements to address effective stormwater best management practices (BMPs), guide development projects, and help prevent unnecessary measures for development and redevelopment areas. Each zone has a unique performance standard, with some being more stringent than others. Zones with new development also have more stringent water quality standards to compensate for developed portions of the City where it may not be economically feasible to treat stormwater runoff.

Stormwater Management Zones are a function of location, topography, state of development (urban, rural, etc), and sensitivity to existing and potential drainage problems. The zones were established based on a review of existing drainage problem areas, land use, and hydrologic/hydraulic modeling. These zones are summarized as follows:

- Riparian Zone (Zone R)
- Developed/Urban Zone with known drainage problems (Zone D1)
- Developed/Urban Zone without known drainage problems (Zone D2)
- Future Development Zone contributing to a proposed regional pond (Zone U1)
- Future Development Zone with on-site stormwater management facilities (Zone U2)

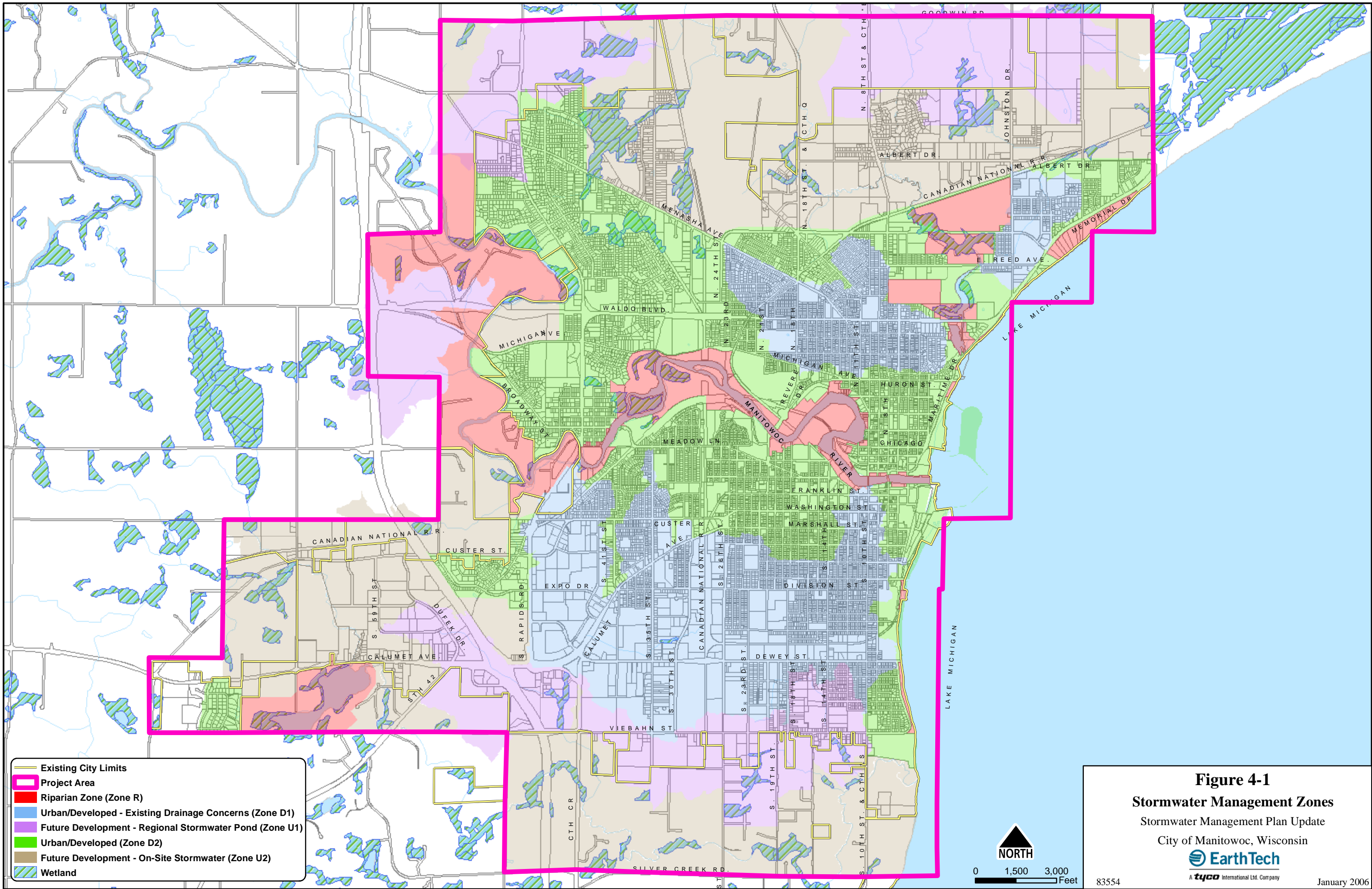
The following sub-sections describe the zones in more detail, including the methodology in determining the zone and the specific stormwater management requirements for each zone as it relates to development and redevelopment.

4.1 Riparian Zone (Zone R)

4.1.1 Zone Determination Methodology

For certain portions of the City directly adjacent to large water bodies, the increase in quantity discharged into the large water body would have a negligible effect and would likely not cause additional drainage or flooding problems. These areas within the City are referred to as the Riparian Zone (Zone R).

Zone R is defined as parcels of land within the City that do not contribute any stormwater runoff to the municipal separate storm sewer system, and drain directly into Lake Michigan or the estuary areas of the Manitowoc and Little Manitowoc Rivers. The estuary areas of these rivers are estimated as starting at the river's confluence with Lake Michigan upstream to Rapids Road for the Manitowoc River and the Canadian/Northwest railroad bridge for the Little Manitowoc River. To determine which parcels met this definition, topographic maps, parcel maps, and City storm sewer maps were analyzed. The Riparian Zone is shown in Figure 4-1.



- Existing City Limits
- Project Area
- Riparian Zone (Zone R)
- Urban/Developed - Existing Drainage Concerns (Zone D1)
- Future Development - Regional Stormwater Pond (Zone U1)
- Urban/Developed (Zone D2)
- Future Development - On-Site Stormwater (Zone U2)
- Wetland

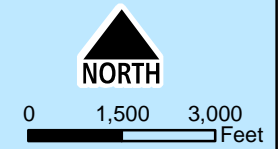



Figure 4-1
Stormwater Management Zones
 Stormwater Management Plan Update
 City of Manitowoc, Wisconsin


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83554 January 2006

L:\work\83554\ArcGis\mxd_doc\reportfigures\Figure4-1_ZoneMap.mxd

4.1.2 Development Standard

Because of the negligible impact of increased runoff quantities generated from development within Zone R, the primary focus of stormwater performance standards for development within this zone is stormwater quality. Development within this zone will need to meet the stormwater quality standards set forth in section 28.06(02) of the City's ordinances and post-construction performance standards as described by NR 151. The only quantity related standard for development within this zone is the requirement to show that any increases in stormwater runoff would be safely conveyed to the receiving water body.

4.2 Developed/Urban Zone with Drainage Problems (Zone D1)

4.2.1 Zone Determination Methodology

The Developed/Urban Zone with Drainage Problems (Zone D1) is comprised of the drainage basins that contribute to each drainage problem area.

Known drainage problem areas were identified during the development of this update to the stormwater management plan. Previously developed drainage basin maps were used to determine which drainage basins were associated with each problem area. In addition, some drainage basins previously identified in the 2000 Stormwater Management Plan that may have drainage limitations based on storm sewer modeling are also included in this zone. Zone D1 is shown on Figure 4-1.

Data from the City's storm sewer system maps and topographic maps were incorporated into the hydrologic/hydraulic model for assessment of the drainage system in the vicinity of the problem. A hydrologic/hydraulic model was used to analyze what types of improvements could be made to mitigate the drainage problems. Specific locations and description of improvements are discussed further in Section 5 of this report.

4.2.2 Development Standard

This zone is sensitive to added development and/or additional impervious areas, because of the existing drainage problems. Because of the sensitivity, no increase in stormwater runoff would be allowed, as set forth in section 28.06(01) of the City's ordinances. Furthermore, development within this zone will need to meet the stormwater quality standards set forth in section 28.06(02) and post-construction performance standards as listed under NR 151.

4.3 Developed/Urban Zone without Drainage Problems (Zone D2)

4.3.1 Zone Determination Methodology

The areas within this zone (Zone D2) include portions of the City that are already developed, and do not have any known or anticipated drainage problems. The zone is shown on Figure 4-1.

4.3.2 Development Standard

A stormwater management standard for development was created for this zone based on a minimum performance standard to meet the non-agricultural performance standards listed in NR 151. Because there are no known drainage problems, the quantity control standard could be less restrictive than the

current City stormwater ordinance. This standard would state that there would be no increase in peak flows above existing conditions.

4.4 Future Development Zone Contributing to a Regional Pond (Zone U1)

4.4.1 Zone Determination Methodology

Regional detention ponds centralize stormwater management for large segments of the community. By doing this, fewer larger facilities can be provided instead of numerous smaller facilities. By having fewer facilities, the long-term maintenance of infrastructure can be reduced. The locations are based on topography, available open space, and the ability to store and treat stormwater runoff for significant drainage areas. Specific locations and sizes of regional ponds are discussed further in Section 6.

The Future Development Zone Contributing to a Regional Pond is comprised of the drainage basins that contribute to proposed regional ponds. The number and location of ponds can change based on the actual development patterns and timing of development within the City and Project Area, as more site specific information becomes available. These zone areas are shown on Figure 4-1.

4.4.2 Development Standard

This zone can be characterized as being for the most part undeveloped. Therefore, it is sensitive to the added impervious area associated with development. However, stormwater management within this zone can be centralized into a few large facilities. Because of the sensitivity, no increase in the peak runoff rate (quantity) stormwater runoff would be allowed, as set forth in section 28.06(01) of the City's ordinances. Development within this zone will also need to meet the stormwater quality standards set forth in section 28.06(02) and post-construction performance standards as listed under NR 151. The regional ponds would be designed to meet these performance criteria. Furthermore, any major conveyance system from new development to a regional pond would have to safely convey the post-development 100-year storm without causing erosion or drainage problems.

4.5 Future Development Zone with On-site Stormwater Management Facilities (Zone U2)

4.5.1 Zone Determination Methodology

In the remaining undeveloped areas it was determined that it was not feasible to provide a regional facility. Therefore, stormwater management facilities will be required for each individual development project. The Future Development Zone with On-site Stormwater Management Facilities is comprised of the drainage basins of undeveloped areas that do not contribute to proposed regional ponds. These zone areas are shown on Figure 4-1.

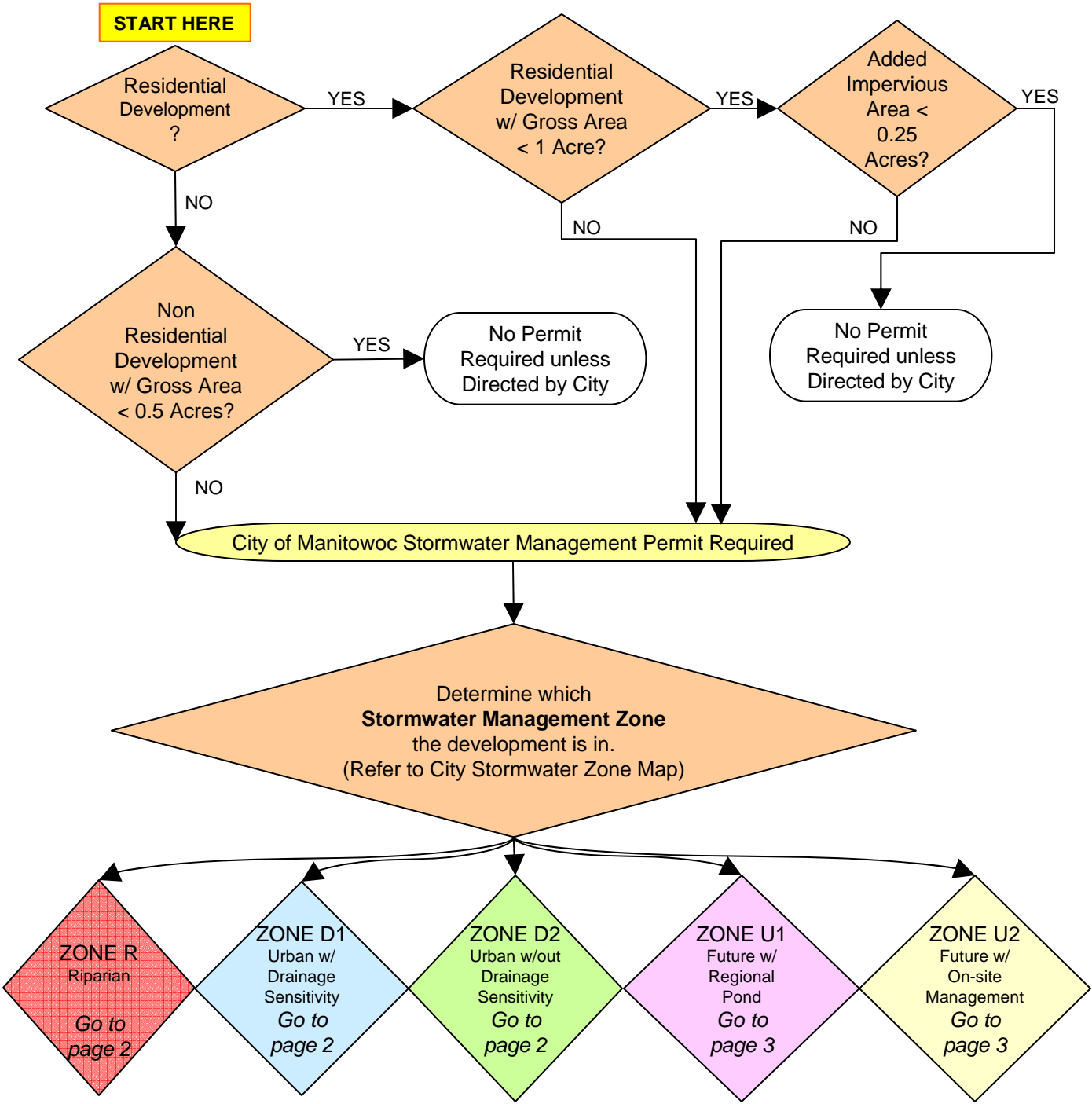
4.5.2 Development Standard

This zone is sensitive to added development because the vast majority of the zone is undeveloped and developing the zone without proper stormwater management would negatively impact receiving water bodies. On-site stormwater management facilities would be designed to provide no increase in the peak stormwater runoff rate, as set forth in section 28.06(01) of the City's ordinances. Furthermore, development within this zone will need to meet the stormwater quality standards set forth in section 28.06(02) and post-construction performance standards as listed under NR 151.

4.6 Flow Chart for Guiding Development Projects

The following pages present a flow chart and description of requirements that developers can use as a guide to help them determine the necessary stormwater management measures for proposed development projects.

City of Manitowoc Stormwater Management Permit Application Flow Chart



FOR PROJECTS LOCATED IN ZONE R (RIPARIAN ZONE)

Projects in this zone are directly adjacent to receiving water bodies that have a large capacity to receive and convey stormwater runoff. Because of the negligible impact of increased runoff quantities generated from development within the Riparian Zone, the primary focus of stormwater management within this zone is stormwater quality.

Specifically, development within this zone needs to meet:

- The stormwater quality standards set forth in section 28.06(02) of the City's ordinances and
- The post-construction performance standards as described by the Wisconsin Department of Natural Resources Administrative Code NR 151.
- It also must be demonstrated that any increases in stormwater runoff flows would be safely conveyed to the receiving water body.

FOR PROJECTS LOCATED IN ZONE D1 (URBAN/DEVELOPED ZONE with DRAINAGE SENSITIVITY)

This zone is sensitive to added development and/or additional impervious areas because of existing and/or potential drainage problems. Because of the sensitivity, no increase in stormwater runoff rates are allowed. Furthermore, development within this zone needs to meet the stormwater quality standards set forth in section 28.06(02) and post-construction performance standards as listed under NR 151.

Specifically, development within this zone needs to meet:

- The stormwater quantity standards set forth in section 28.06(01) of the City's ordinances,
- The stormwater quality standards set forth in section 28.06(02) of the City's ordinances, and
- The post-construction performance standards as described by the Wisconsin Department of Natural Resources Administrative Code NR 151.

FOR PROJECTS LOCATED IN ZONE D2 (URBAN/DEVELOPED ZONE without DRAINAGE PROBLEMS)

There are no known or anticipated drainage problems in this zone. With this standard there would be no increase in stormwater runoff rates above existing conditions. Because of the negligible impact of increased runoff quantities generated from development within this zone, the primary focus of stormwater management within this zone is stormwater quality.

Specifically, development within this zone will need to meet:

- A revision to the stormwater quantity standards set forth in section 28.06(01)(a) of the City's ordinances. For this zone, the following is applicable:
 - No development in the City shall increase peak flow rates of stormwater runoff from that which would have resulted from the same storm occurring over the site with the land in its **existing** conditions for design rainfall events with recurrence intervals of two (2), ten (10), and one hundred (100) years.
- The stormwater quality standards set forth in section 28.06(02) of the City's ordinances, and
- The post-construction performance standards as described by the Wisconsin Department of Natural Resources Administrative Code NR 151.

FOR PROJECTS LOCATED IN

ZONE U1 (FUTURE DEVELOPMENT CONTRIBUTING TO A REGIONAL POND)

Stormwater management within this zone is centralized into City owned and operated facilities that serve multiple areas and parcels. City owned facilities are sized and designed to meet the City and DNR stormwater regulations. Development projects within this zone are required to contribute financially to the construction of regional ponds, as determined by the Director of Public Works.

Specifically, development within this zone needs to:

- Develop a site-specific drainage plan that properly connects into the regional stormwater drainage/conveyance system (consult with the Director of Public Works).

FOR PROJECTS LOCATED IN

ZONE U2 (FUTURE DEVELOPMENT – ON-SITE STORMWATER MANAGEMENT)

This zone is largely undeveloped. Developing the zone without proper stormwater management can negatively impact receiving water bodies. Development projects within this zone are required to provide on-site stormwater management facilities. These facilities are to be designed to provide no increase in the peak stormwater runoff rate, and meet water quality requirements prior to leaving the site.

Specifically, development within this zone needs to meet:

- The stormwater quantity standards set forth in section 28.06(01) of the City's ordinances,
- The stormwater quality standards set forth in section 28.06(02) of the City's ordinances, and
- The post-construction performance standards as described by the Wisconsin Department of Natural Resources Administrative Code NR 151.

4.7 Relevant City Stormwater Management Ordinances

The following sections of the City's Stormwater Management Ordinance (Chapter 28) were referred to in sections 4.1, 4.2, 4.4, 4.5 and 6.1 of this report.

4.7.1 Section 28.05(01)

APPLICABILITY - This ordinance applies to land development activities which meet the following applicability criteria.

- a. residential land development with a gross aggregate area of one (1) acre or more;
- b. residential land development with a gross aggregate area less than one (1) acre, if there are at least 0.25 acres of impervious surfaces;
- c. land development, other than a residential land development, with a gross aggregate area of 0.5 acres or more; or
- d. in the opinion of the Administering Authority, is likely to result in stormwater runoff which causes undue channel erosion, increases water pollution, or which endangers downstream property or public safety.

4.7.2 Section 28.06(01)

STORMWATER DISCHARGE QUANTITY - Unless otherwise provided for in this ordinance, all land development activities subject to this ordinance shall establish on-site management practices to control the peak flow rates of stormwater discharged from a site as described in this ordinance. Infiltration of stormwater runoff from driveways, sidewalks, rooftops, parking lots, and landscaped areas shall be incorporated to the maximum extent practical to provide volume control in addition to control of peak flows. On-site management practices shall be used to meet the following minimum performance standards:

- a. No development in the City shall increase peak flow rates of stormwater runoff from that which would have resulted from the same storm occurring over the site with the land in its predevelopment conditions for design rainfall events with recurrence intervals of two (2), ten (10), and one hundred (100) years.
- b. All stormwater conveyance systems within a proposed development, and receiving surface runoff from a proposed development, shall be designed to completely contain peak storm flows as described in section 28.06(1)(b)(1) and (2) of this ordinance. Calculations for determining peak flows for conveyance system sizing shall be based on the existing or future proposed land use conditions for off-site areas (which ever results in the highest peak flows), and the future proposed land use conditions for the on-site areas:

1. For open channel conveyance systems the peak flow from the twenty-five (25) year, storm shall be completely contained within a channels bottom and banks.
 2. For storm sewer pipes, the peak flow from the ten (10) year storm, shall be completely contained within the pipes with no surcharging or pressurized flow. There shall be incorporated into the design, above ground emergency flow for the one hundred (100) year storm. Easements shall be granted to the City for emergency flow paths that are not wholly contained in the public right-of-way (ROW).
- c. Determination of peak flow rates and volume of runoff for purposes of meeting the requirements of section 28.06(1)(a) and (b) of this ordinance shall be computed by procedures based on the principals and procedures approved by the Director of Public Works, and on file at the Engineering Department.
 - d. More stringent discharge limits may be required at the discretion of the Director of Public Works for reasons such as, but not limited to, insufficient downstream system capacity, potential erosion of stream channels, or impacts on flood stages.
 - e. All point discharges will be restricted to public drainage systems (including storm sewers and ditches) or to waters of the State. The applicant is responsible to obtain, from adjacent property owners, any easements or other necessary approvals regarding the flow of water from the proposed development onto private lands.
 - f. Increases or decreases in the hydrology of natural wetlands shall be minimized to the fullest extent practical. Where such changes are proposed, the impact of the proposal on wetlands shall be assessed and meet the requirements of Wis. Admin. Code, Chapter NR 103.

4.7.3 Section 28.06(02)

STORMWATER DISCHARGE QUALITY - After January 1, 2004, and unless otherwise provided for in this ordinance, all land development activities subject to Section 28.05 (1) A, C, and D of this ordinance shall establish on-site management practices to control the quality of stormwater discharge from a site. The following on-site management practices shall be used to meet the following minimum standards:

- a. Stormwater management measures shall be designed to remove, on an average annual basis, a minimum of eighty (80) percent of the total suspended solids load from a proposed on-site development when compared to a proposed on-site development without stormwater management measures.
- b. Stormwater management measures on redevelopment sites shall be designed to remove, on an average annual basis, a minimum of forty (40) percent of the total suspended solids load from a proposed on-site development when compared to a proposed onsite development without stormwater management measures.

- c. Discharge of urban stormwater pollutants to natural wetlands shall have pre-treatment and vegetative buffers, unless otherwise exempted by the Director of Public Works. Where pre-treatment meets the standards described herein, the impacts of the proposal on wetland functional values shall be assessed using a method acceptable to the Director of Public Works. Significant changes to wetland functional values due to stormwater pollutant loads shall be avoided.
- d. Stormwater discharges shall have pre-treatment prior to infiltration, to prolong maintenance of the infiltration practice and to prevent discharge of stormwater pollutants at concentrations that will exceed groundwater preventive action limits or enforcement standards established by the Department of Natural Resources in Wis. Admin. Code Chapter NR 140. Stormwater infiltration is prohibited under the following circumstances:
 - 1. Stormwater is generated from highly contaminated source areas at manufacturing industrial sites;
 - 2. Stormwater is carried in a conveyance system that also carries contaminated, non-stormwater discharges; or
 - 3. Stormwater is generated from active construction sites.
- e. Stormwater ponds and infiltration devices shall not be located closer to water supply wells than indicated below, without prior written approval by the Director of Public Works:
 - 1. One hundred (100) feet from a non-public water supply well;
 - 2. One thousand, two hundred (1,200) feet from a City water supply well;
 - 3. the boundary of a recharge area to a well identified in a wellhead area protection plan, if it exists.
- f. More or less stringent treatment limits may be required at the discretion of the Director of Public Works.

4.7.4 Section 28.06(03)

EXCEPTIONS - The Director of Public Works may waive the minimum requirements for on-site stormwater management practices established in section 28.06(1) and (2) of this ordinance upon written request of the applicant, provided that at least one (1) of the following conditions applies:

- a. Alternative minimum requirements for on-site management of stormwater discharges have been established in a stormwater management plan that has been approved by the Director of Public Works.
- b. Provisions are made to manage stormwater by an off-site facility. This requires that an off-site facility is in place, is fully functional, and is designed and adequately sized to provide a level of stormwater control that is equal to or greater than that which would be afforded by on-site practices meeting the requirements of this ordinance,

and has a legally obligated applicant responsible for long-term operation and maintenance of the stormwater practice.

- c. The Director of Public Works finds that meeting the minimum onsite management requirements is not feasible due to site restrictions. The Director of Public Works shall not use financial hardship as the sole criteria in determining feasibility.

4.7.5 Section 28.06(04)

FEE IN LIEU OF ON-SITE STORMWATER MANAGEMENT PRACTICES - Where the Director of Public Works waives all or part of the minimum on-site stormwater management requirements under section 28.06(3)(c) of this ordinance, or where the waiver is based on the provision of adequate stormwater facilities provided by the City downstream of the proposed development, as provided for under section 28.06(3)(b) of this ordinance, the applicant shall be required to pay a fee, or alternative consideration, in an amount determined by the Director of Public Works. In setting the fee for land development projects, the City shall consider an equitable distribution of the cost of land, engineering design, construction, and maintenance. The minimum fee shall be 7.5 cents (\$0.75) per square foot of impervious area of the improvement contemplated. Partial detention will be credited towards the fee, if approved by the Director of Public Works.

4.8 Updates to the City Stormwater Ordinance (Chapter 28)

Because Chapter 28 of the City's ordinances was written before the promulgation of NR 216 permitting requirements and the promulgation of the performance standards listed under NR 151, some updates in this ordinance may be required. These include the following:

- 1) Throughout the ordinance, reference to meeting the WDNR NR 216 construction, and post-construction requirements should be made.
- 2) Throughout the ordinance, reference to meeting the post-construction performance standards listed in NR 151 for stormwater runoff quality and infiltration standards.
- 3) Under the definition of "Best Management Practices" in Section 28.04, the Wisconsin Best Management Practice Handbook is referred to. In conjunction with the NR 216 standards, the WDNR now has their approved Best Management Practices, and related technical standards listed on their webpage at www.dnr.state.wi.us/org/water/wm/nps/stormwater/techstds.htm.
- 4) Under the definition of "Design Rainfall Event" in Section 28.04, there is no rainfall depth or rainfall distribution type listed for the various recurrence intervals discussed in other sections of the ordinance. A standard for these should be developed. It is suggested that rainfall depths and distributions that were used in the latest analysis discussed in the City of Manitowoc Stormwater Management Plan Update, 2005, be adopted as the standard for the City (Table 4-1).

**TABLE 4-1
RECOMMENDED DESIGN STORMS
(TYPE II DISTRIBUTIONS)**

Annual Exceedance Probability	24-hour rainfall (in)
50% (2-year)	2.4
10% (10-year)	3.7
1% (100-year)	5.0

- 5) Consideration should be made to update the last two (2) sentences in Section 28.06(04) of the City Ordinances to read as follows:
The minimum fee shall be set by Common Council resolution. Partial detention will be credited towards the fee, if approved by the Director of Public Works.
- 6) The current fee in lieu of on-site stormwater management practices listed in Section 28.06(04) of the City Ordinances is \$0.75 per square foot of impervious area. A statistical review of the costs for the regional ponds (2006) yields a range of \$0.10 to \$0.50 per square foot of impervious area, with an average of \$0.28. An exercise was also performed on a typical thirty (30) acre residential development (6.0 acres of impervious cover). It is anticipated that a wet detention pond for this size development would cost approximately \$60,000, or \$0.22 per square foot of impervious area. These costs include a \$20,000 / acre land cost, but do not include maintenance costs or additional City administrative efforts.