Executive Summary
City of New Berlin Storm Water Management Plan

Introduction

Storm water management is a critical municipal responsibility. The effectiveness and efficiency of storm water management have a direct impact on public health and safety, storm water system planning, surface water quality, environmental habitat, and future development. The City of New Berlin and the Wisconsin Department of Natural Resources (WDNR) have joined in a cooperative effort to prepare a Storm Water Management Master Plan for the City of New Berlin. This report presents a summary of the storm water management plan prepared for the City of New Berlin. The development and preparation of the plan have been funded by a local assistance grant received by the City of New Berlin from the WDNR. The Storm Water Management Plan is intended to assist in the implementation of the *Nonpoint Source Control Plan for the Root River, Menomonee River, Upper Fox River, and Muskego-Wind Lakes Priority Watershed Projects*. The City of New Berlin was recently designated for municipal storm water discharge permitting under NR216 of the Wisconsin Administrative Code by the WDNR.

The purpose of the Plan is to identify an approach for the City of New Berlin to:

- control storm water drainage and flooding in the primary drainage system within the study area,
- improve the water quality of storm water runoff from urban non-point sources, and
- meet the municipal permitting application and compliance requirements.

The primary tasks conducted as part of preparing the storm water management master plan include:

- Establishing project objectives to guide the development of the Storm Water Management Plan.
- Establishing a storm water advisory group
- Providing guidance regarding the WDNR municipal storm water permit regulations.
- Inventorying existing conditions related to the drainage system and land use.
- Conducting the hydrologic-hydraulic analysis.
- Conducting a citywide culvert capacity analysis.

- Conducting the water quality analysis.
- Developing storm water management options to mitigate major flooding problems, provide sufficient storm water flow capacity, and reduce pollutant loadings.
- Reviewing plans prepared by others for specific areas within the city of New Berlin.
- Evaluating potential regional storage areas.
- Developing a recommended storm water management plan which addresses flood control, water quality improvement, development guidelines, operation and maintenance practices, development of a storm water management ordinance, and plan implementation.

Objectives and Criteria

Objectives and criteria guide the development of the Storm Water Management Master Plan. The objectives and criteria developed for the City of New Berlin Storm Water Management Master Plan are compatible with the Nonpoint Source Control Plans prepared for the Root River, Menomonee River, Upper Fox River, and Muskego-Wind Lakes Priority Watersheds and address local issues and concerns. The objectives are listed in Table ES-1.

Table ES-1: City of New Berlin Storm Water Management Master Plan Objectives

Objective #1	Provide water quality suitable to support the designated potential recreational and biological uses of the streams.
Objective #2	Provide storm water drainage and flood control facilities to prevent flood damages to property, prevent health and safety hazards, and prevent drainage-related nuisance and inconvenience.
Objective #3	Develop a storm water management system that effectively serves both existing and anticipated future land uses at the lowest practicable cost.
Objective #4	Reduce erosion and sedimentation from construction of new development and agricultural activities.
Objective #5	Protect environmentally sensitive areas that provide significant surface water quantity or quality benefits.

Project Setting

The project area incorporates approximately 37 square miles of land including the entire City of New Berlin in Waukesha County, Wisconsin. The study area is generally bordered by College Avenue to the south, by Springdale Road to the west, by Greenfield Avenue to the north, and by 124th Street to the east as shown on Figure 1-1.

Land use within the study area effects both the quantity and quality of storm water runoff. Imperviousness, materials exposed to storm water, and traffic patterns are a few examples of land use characteristics which affect the hydraulics and potential pollutant loading from an area. The city is developed in urban and rural land uses. The future land use, based on the City of New Berlin Zoning Map, indicates that about 59 percent of the current agricultural lands will be developed into urban land uses. A breakdown of the existing and future land uses is shown on Figures ES-1 and ES-2.

Figure ES-1: Existing Land Use within the New Berlin Study Area

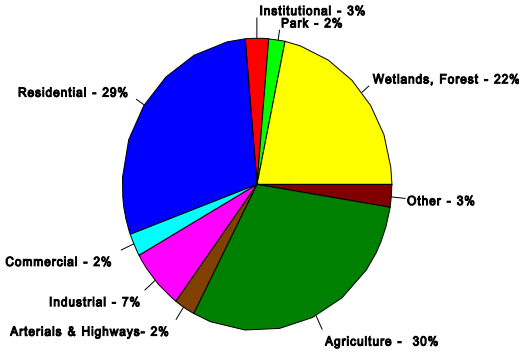
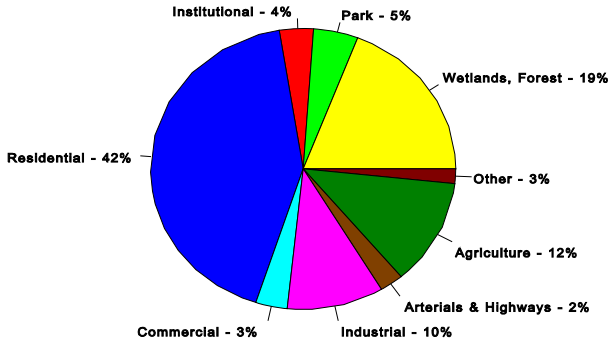


Figure ES-2: Future Land Use within the New Berlin Study Area



Storm Water Management System

Storm water runoff from the area is conveyed by a network of drainage ditches, storm sewers, culverts, and streams. A majority of the study area is drained by drainage ditch and culvert systems.

Culverts

Culverts are a major conveyance element in the City of New Berlin storm water management system. Information regarding about 1,400 culverts was obtained during a citywide field inventory. The inventory included documentation of:

- the shape, dimensions, length, and construction material of the culvert,
- the upstream and downstream invert elevations,
- the presence of debris or obstructions,
- the culvert end condition, and
- the structural condition of each culvert.

Information collected in the field inventory was used to identify blocked culverts and also used in the citywide culvert capacity analysis. Culverts which are significantly

undersized or obstructed reduce the efficiency of the storm water drainage system and may cause flooding.

Streambanks

Streambank erosion is responsible for the delivery of hundreds of tons of sediment to receiving streams annually. In order to reduce the sediment loading, existing and potential streambank erosion areas must be identified and repaired. Approximately 34 miles of channel were evaluated using field techniques developed by the U.S. Department of Agriculture. Nine stability indicators of the upper and lower bank areas of the stream channel were evaluated and classified as excellent, good, fair, or poor. The inventory of the streambank conditions indicated that:

- # Of the streambanks inventoried, the overall reach condition of 19.8 miles, or 59 percent, is classified good; 13.4 miles, or 40 percent, is classified fair; and 0.2 miles, or 1 percent, is classified poor.

- # Bank rock content is classified poor for 88 percent of the stream. This indicates that 20 miles of streambank have less than 30 percent rock in the bank and is a reflection of the overall geology of the area.

- # Vegetative bank protection, debris jam potential, and landform slope are the most common indicators, other than bank rock content, to be rated fair or poor.
  - < 9.5 miles, or 29 percent, of the streambanks have less then 70 percent plant density.
  - < 8.7 miles, or 26 percent, of the streambanks have the quantity and size materials present for the potential to create a flow deflection or debris jam.
  - < 7.2 miles, or 22 percent, of the streambanks have a slope steeper than 40 percent.

- # Evidence of mass wasting (severe slope failure) was generally not observed in the streambanks inventoried.

- # The Upper Root River, Poplar Creek, Calhoun Creek, and Underwood Creek subwatersheds have the greatest percentage of streambanks showing significant signs of erosion, streambanks with an overall classification of fair or poor.

- # The Deer Creek, Tess Corners Creek, and Mill Creek subwatersheds have the greatest percentage of streambanks in good overall condition. Poplar Creek and Deer Creek subwatersheds have the most miles of streambank in good overall condition.

Drainage Ditches

Drainage ditches convey storm water runoff to the receiving streams throughout a majority of the City of New Berlin storm water management system. The drainage ditches were visually evaluated based on location, shape, lining, erosion,

sedimentation, vegetation, trash, and standing water. The evaluation identified 32 areas of drainage ditch experiencing erosion, sedimentation, standing water, or debris buildup. Erosion, sedimentation, standing water, and debris buildup within the drainage ditches may significantly reduce the efficiency of the storm water management system.

Storm Water Management System Analysis

A computer analysis of the Primary Storm Water Management System in the City of New Berlin was conducted. The objectives of this analysis were to:

- evaluate the capacity and performance of major drainage structures,
- determine the extent of floodplain areas,
- assess the magnitude of future increases in flows and flood elevations due to future development areas, and
- identify existing and possible future capacity problems.

The system analysis consisted of the following tasks:

- Definition of the Primary Storm Water Management System
- Assembly of watershed surface runoff data
- Preparation of hydrologic model information
- Assembly of conveyance system data
- Formulation of the hydraulic model

The hydraulic analysis models were run using the 2-, 10-, 25-, and 100-year recurrence interval storm event runoff flows as input. The models were run under both existing land use and future land use conditions. The results of the hydraulic analysis consist of the flow rate, velocity, and depth at each location considered in the hydraulic model. This information can be used to identify areas of high flood level, channel and culvert capacity shortfalls, and areas of high erosion potential. Road overtopping was detected at 31 locations in the model including 16 locations where overtopping occurs in the 10-year event or less.

Differences between existing and future land use flows are shown in Table ES-2 for selected locations in each subwatershed. Flow increases are greatest in the Calhoun Creek, Deer Creek, and Poplar Creek subwatersheds, while flow increases are the smallest in the Underwood Creek and Upper Root River subwatersheds. The flow increases are typically due to future development within the subwatershed.

Table ES-2: Existing and Future Land Use Flows at Selected Locations

Location	Existing Flow (cfs)	Future Flow (cfs)	Percent Change (%)
Upper Root River at 124th Street	650	700	8
Deer Creek at Rogers Drive	1,250	1,522	22
Deer Creek at Moorland Road	534	579	8
Deer Creek at National Avenue	489	547	12
Calhoun Creek at City Limit	620	635	11
Calhoun Creek at upstream of Racine Drive	290	310	17
Calhoun Creek at upstream of Calhoun Road	300	320	22
Underwood Creek at Meadow Lane	380	400	6
Poplar Creek at Cleveland Avenue	114	136	19

Water Quality Analysis

A water quality analysis was conducted to estimate the amount of pollutants that are discharged into the major streams within New Berlin via storm water runoff. The results of the water quality analysis can be used to target appropriate best management practices to effectively reduce the pollutant loadings in critical areas.

The water quality model, a unit-area loading model, is based in part on the Source Loading and Management Model (SLAMM) developed by the WDNR. The analysis is based on:

- the study area land use,
- pollutant loading rates for each land use category based on SLAMM, research results, and professional judgement, and
- existing practices, such as the use of drainage swales.

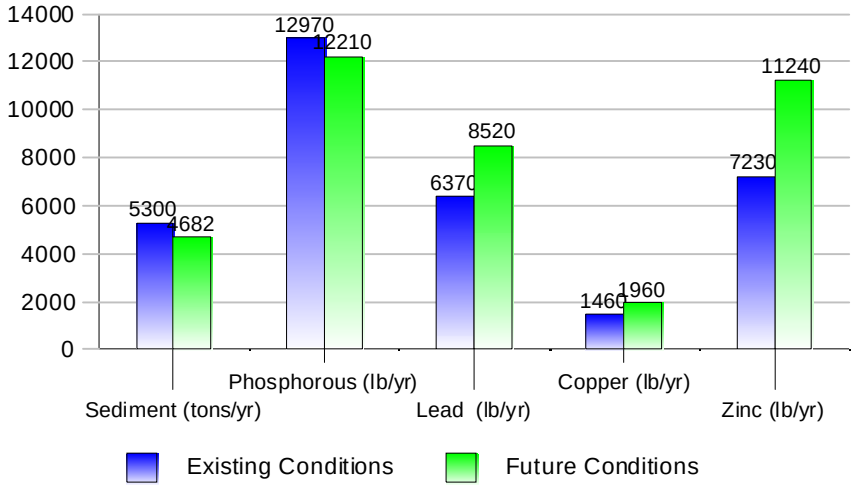
The analysis was conducted for sediment, phosphorous, copper, lead, and zinc, which are typically associated with urban storm water runoff and often cause water quality problems in urban streams. Urban stream water quality problems typically include decreased water clarity, sedimentation, excessive algal growth, and water toxicity.

The estimated annual pollutant loadings under existing and future land use conditions from the water quality analysis are shown on Figure ES-3.

The analysis indicated that:

- Agricultural and residential land use account for 49 and 44 percent of the total sediment loading under existing and future land use conditions, respectively.
- Extractive land use accounts for more than 20 percent of the total sediment loading under existing and future conditions.
- Agricultural and park land uses account for 57 and 46 percent of the phosphorous loading under existing and future conditions.

Figure ES-3: Total Annual Pollutant Loadings



- Commercial, industrial, and highway land use account for 46 to 78 percent of the total metals loadings under existing and future conditions, respectively.
- The total sediment and phosphorous loading are reduced by 12 and 6 percent, respectively from existing to future conditions, while the metal loadings are increased by more than 30 percent due to development of agricultural lands.

A separate industrial pollutant loading analysis was conducted to further evaluate the amount of pollutants discharged to storm water runoff from industries within the City of New Berlin. The results can then be used to identify those industries that have the greatest potential for contributing significant storm water pollutant loadings and to identify appropriate best management practices for those industries. The analysis indicates that five of the industrial categories, fabricated metal products, transportation equipment, electronics, land transportation, and printing and publishing, contribute over one-half of the total industrial loading of all pollutants. The industrial facilities in these five categories occupy approximately 350 acres, or over 80 percent of the industrial areas evaluated. Based on the total loading calculated by the industrial water quality analysis:

- A majority of the industrial metals loading is contributed by fabricated metal products, transportation equipment, electronics, land transportation, and printing and publishing facilities.
- A majority of the industrial sediment loading is contributed by Timber Products and Land Transportation facilities.

- A majority of the industrial nutrient loading is contributed by transportation equipment and land transportation facilities.

Problem Areas

The analysis conducted as part of this storm water management master plan identified potential problem areas related to flooding and drainage, streambank stability, culvert capacity, and water quality. The problems identified are described in the following paragraphs.

Flooding and Drainage Problem Areas

Flooding and drainage areas were reported by City of New Berlin residents and representatives. In order to evaluate the flooding problems, a priority system was developed to differentiate varying degrees of problem severity. Priorities are based upon two factors: the cost-effectiveness of the project and whether storm water management improvements can adequately solve the problem. Primary problems encompass both factors. Seven primary problems were identified from the reported problems. The primary problems are presented in Table ES-3.

Table ES-3 Summary of Primary Flooding and Drainage Problem Areas

Problem Area Designation	General Location	Description of Problem
UNDERWOOD1	Underwood Creek at Meadow Lane	Along Meadow Lane between 128th and 124th Street, the South Branch of Underwood Creek is enclosed in a rectangular storm sewer. There are numerous reports of house, yard, and street flooding associated with this enclosed channel.
UNDERWOOD 2a	Underwood Creek near Elm Grove Road	This problem involves overbank flooding of yards and homes along a reach of the South Branch of Underwood Creek beginning about 500 feet upstream of Arcadian Drive. The primary cause of the problem is that the properties are in or very close to the 100-year floodplain.
UNDERWOOD 2b	Gatewood Park	This residential area, east of Sunny Slope Road and South of Greenfield Avenue, experiences extensive yard and basement flooding due to slow drainage of the neighborhood and adjacent cemetery. The cause of the problem is mild roadside ditch slopes and inadequate outlet capacity under Sunny Slope Road.
ROOT1	Upper Root River-130th Block of Park Avenue	One residence experiences flooding along Park Avenue due to inadequately sized downstream culvert at Graham Street. Also, inadequate drainage ditch capacity exists between Elm Grove Road and Honey Lane south to the golf course.
ROOT2	Upper Root River – 132nd Street to Lagoon Road along Cleveland Avenue	Approximately 15 homes are within the floodplain in the area bounded by Cleveland Avenue, National Avenue, 124th Street, and 132nd Street. Road flooding occurs on Lagoon Road north of Cleveland Avenue. A private bridge at 128th Street and Cleveland Avenue has been washed out.
ROOT3	Upper Root River -	A structure located adjacent to a tributary of the Upper Root River near Grange Avenue

Table ES-3 Summary of Primary Flooding and Drainage Problem Areas

Problem Area Designation	General Location	Description of Problem
	LaSalle Drive and Grange Avenue	experiences flooding. The problem is caused by inadequate culvert capacity downstream at St. Mary's Drive.
ROOT4	Upper Root River - Honey Lane	Yard flooding and erosion are experienced by several residences along a tributary to the Upper Root River and also drainage problems along the railroad tracks north of Honey Lane near Elm Grove Road. The problem is due to inadequate drainage capacity and culvert capacity.
DEER1	Deer Creek - Buena Park	Six residences along 168th Street experience structural flooding. Several additional residences experience yard and basement flooding. The problem stems from backup from inadequate culverts, ditch capacity, and lot grading. The general area slope is very flat. In addition, most homes have sump pump discharge into the ditch. Lawn clippings and yard waste contribute to culvert blockage.

Thirteen storm water flooding problems were identified as minor. The New Berlin Storm Water Management Master Plan does not provide conceptual engineering solutions to minor system problems.

Culvert Capacity Problem Areas

The hydrologic and hydraulic computer modeling included a capacity analysis of 73 road crossings culverts in the primary storm water management system. The analysis indicates that 32 of the primary culverts have capacity deficiencies. Capacity deficiencies within the primary system are defined by the following criteria: overtopping of a main arterial in the 100-year storm, insufficient flow capacity for the 100-year storm, or excessive backwater behind a culvert in a developed area. Approximately 41 percent of the primary culverts with capacity deficiencies are located within the Upper Root River subwatershed.

Secondary culverts were analyzed as part of the citywide culvert capacity analysis. The analysis indicates that 83 culverts have culvert deficiencies. Capacity deficiency within the secondary system is defined as not being able to pass the 10-year storm.

Drainage Ditch Problem Areas

The drainage ditch inspection identified 32 problem areas. A problem area is defined as a location where erosion, sedimentation, debris accumulation, or standing water were observed. About 65 percent of the drainage ditch problem areas are located in the Deer Creek and Upper Root River subwatersheds.

Streambank Problem Areas

The streambank inventory classified approximately 14 miles of channel as fair or poor based on the US Department of Agriculture/Phankuch method. A majority of the

miles of streambanks rated as fair or poor are located in the Poplar Creek, Calhoun Creek, and Upper Root River subwatersheds.

Water Quality Problem Areas

Based on the annual pollutant loadings generated by the analysis, critical land uses, land uses which contribute a majority of the storm water pollutants, were identified. Critical land uses for sediment include agriculture, extractive, and residential land use; critical land uses for phosphorous include agriculture, residential, and park land uses, and critical land uses for metal include highway/arterial, commercial, and industrial land uses. Based on an overall consideration of the pollutant loadings, areas which are significant contributors of pollutants within New Berlin are identified and presented on Table ES-4.

Table ES-4: Significant Storm Water Pollutant Contributor Areas

Area	Contributing Land Use	Pollutants of Concern
Critical Land Use Areas throughout the City of New Berlin	Industrial, agricultural, residential, highways and arterials, and developing and redeveloping areas	Various
Rock Freeway	Highway	Metals
Industrial Park	Industrial and commercial areas	Metals
6C010 - Northwest area of Poplar Creek subwatershed	Industrial and agricultural areas	Metals, Phosphorous, Sediment
5A020 - Southeast area of Tess Corners Creek subwatershed	Agricultural and commercial areas	Sediment, Phosphorous, Metals
4C010 - Northern area of Calhoun Creek subwatershed	Residential, highway, and agricultural areas	Metals, Phosphorous Sediment
7D010 & Various - Northern area of Mill Creek subwatershed	Extractive	Sediment

The industrial analysis further evaluated the pollutant loadings from industries within New Berlin. Based on the analysis, the industries with the greatest potential for contributing significant storm water pollutant loadings are fabricated metal product manufacturers; transportation equipment manufacturers; land transportation facilities(warehouses and trucking facilities); electronic, electrical, photographic and optical facilities, and printing and publishing industries. Extractive industries are also considered a potential significant contributor based on the study area analysis.

Regional Detention Evaluation

The purpose of regional detention is to mitigate the cumulative impacts of existing and future development in an area. Regional detention is often proposed because it is perceived to be more effective at controlling flood peaks than constructing individual storage ponds at numerous sites. Presumably, a regional detention facility is also more cost effective than individual basins because of the economy of scale associated with building one large pond.

Sites evaluated for potential regional detention are located in the Poplar Creek and Tess Corners Creek Watersheds. The site locations and relative sizes are :

- Site RD-1 is located just north of College Avenue on the northeast side of Tess Corners Creek. This site will hold 240 acre-feet of water which will reduce the existing landuse 100-year peak flow by 100 cfs and reduce the future conditions peak flow by as much as 300 cfs. The detention facility would have a design depth of about 7 feet and cover an area of 38 to 40 acres.

- Site RD-2 is located just east of Calhoun Road, on the east side of Poplar Creek and south of Coffee Road. This site would be designed to hold 51 acre-feet of water which will reduce the future conditions 100-year peak flow by as much as 80 cfs. The detention facility would have a design depth of about 4.4 feet and cover an area of 20 acres.

- Site RD-3 is located on the west side of Poplar Creek, just south of Coffee Road. This site would be designed to hold 200 acre-feet of water which will reduce the future conditions 100-year peak flow by as much as 260 cfs. The detention facility would have a design depth of about 7.7 feet and cover an area of 45 acres.

- Site RD-4 is located on the east side of Calhoun Road, just north of Coffee Road. This site would be designed to hold 236 acre-feet of water which will reduce the future conditions 100-year peak flow by as much as 240 cfs. The detention facility would have a design depth of about 5.9 feet and cover an area of 67 acres.

The site locations are shown on the Recommended Plan Map presented in Appendix A of this report.

These regional sites will help prevent future flooding problems due to development and may reduce flooding problems that already exist.

Regional detention sites recommended in the Stormwater Management Plan for the Deer Creek Watershed prepared by Bonestroo Rosne Anderlick & Associates in 1993 and in the Westridge Storm Water Management Plan prepared by Ruekert /Mielke in 1995 have been incorporated into this report. The recommendations presented in the reports prepared by others were not analyzed as part of this Plan. The location of these storage locations recommended by others are presented in Appendix I.

Recommended Plan

The recommended plan includes a variety of structural and non-structural measures which will effectively and efficiently meet the goals and objectives of this plan, reduce flooding and drainage problems, and improve the quality of storm water runoff. The elements of the drainage and flood control plan, the water quality improvement plan, and the regional detention opportunities are presented on Tables ES-5, ES-6, and ES-7 respectively. The recommended plan also includes adoption and enforcement of a storm water management ordinance to prevent new flooding areas from occurring and reduce pollutant loadings from new development areas.

The estimated capital cost of the recommended plan is $4,681,000. The estimated annual operation and maintenance cost is $537,000. The estimated costs are for planning purposes only and do not include land acquisition, construction site erosion control, unknown environmental constraints, legal fees, or utility relocation costs.

The recommended plan provides a 100-year level of protection from flooding and drainage problems when feasible and results in a reduction in the total annual pollutant loading of 37 percent of sediment, 26 percent of phosphorous, and 7 percent of lead.

Table ES-5: Selected Drainage and Flood Control Plan

Problem Number	Problem Summary	Selected Alternative	Level of Protection	Capital Cost	Annual Operations and Maintenance Cost
UNDERWOOD 1	Along Meadow Lane between 128th and 124th Streets, the South Branch of Underwood Creek is enclosed in a storm sewer. Overflow of the box culvert entrance at 124th Street and Meadow Lane floods basements and backyards. There are numerous reports of house, yard, and street flooding associated with this enclosed channel.	Reduce flow with upstream storage recommended as part of UNDERWOOD 2a, increase conveyance capacity of the storm sewer entrance, including a sloped trash rack which is less susceptible to debris clogging.	100 year	$50,000-$100,000	$8,000
UNDERWOOD 2a	Overbank flooding of yards and homes along the South Branch of Underwood Creek beginning about 500 feet upstream of Arcadian Drive. Flooding southwest of the intersection of Elm Grove Road and Meadow Lane.	30 acre-foot storage facility located north of Greenfield Avenue in the City of Brookfield. Also provides necessary storage for Problem UNDERWOOD 1.	100 year	$790,000	$10,000
UNDERWOOD 2b	Yard, street, and basement flooding in the Gatewood Park neighborhood.	Additional 60-inch storm sewer to serve Gatewood Park area.	25 year[1]	$400,000	$1,000
ROOT 1	One residence experiences flooding along Park Avenue near Elm Grove Road. Yard flooding and erosion in backyards on the north side of Park Avenue.	Installation of a new culvert at Graham Street and channel expansion between Graham Street and Elm Grove Road.	25 year[1]	$101,000	$1,000
ROOT 2	15 homes are within the floodplain in the area bounded by Cleveland Avenue, National Avenue, 124th Street, and 132nd Street. Road flooding on	Online detention storage at four locations in the area and floodplain lowering.	100 year	$2,500,000	$10,000

Table ES-5: Selected Drainage and Flood Control Plan

Problem Number	Problem Summary	Selected Alternative	Level of Protection	Capital Cost	Annual Operations and Maintenance Cost
	Lagoon Road north of Cleveland Avenue. Washout of private bridge at 128th Street and Cleveland Avenue				
ROOT 3	House flooding upstream of Grange Avenue near Francis Avenue.	Replace culverts at St. Mary=s Drive and lower floodplain south of Grange Avenue.	100 year	$350,000	$1,000
ROOT 4	Yard flooding and erosion near Honey Lane and Elm Grove Road. Flooding of one residence and several yards east of the intersection at Elm Grove Road and Honey Lane.	Regrade roadside and railroad ditches in the area.	10 year[1]	$30,000	---
DEER 1	Six residences experience structural flooding along 168th Street in the Buena Park neighborhood south of Greenfield Avenue. The flooding is caused by inadequate drainage. Sump pumps discharge to the drainage ditch and lawn clippings and yard waste contribute to culvert blockage.	Reconstruct ditches with some segments of storm sewer from Fullerton Avenue to Roosevelt Avenue. Also redirect sump pumps to lawn areas rather than direct discharge to the drainage ditches. Clean debris from ditches and culverts.	10 year[1]	$180,000	$2,000
Various	Minor System Flooding Problems- Upper Root River subwatershed: < Parkwood Lane Storm Sewer Capacity Calhoun Creek subwatershed: < Sediment and debris blockage at Sovereign Dr. Poplar Creek subwatershed:	To be determined	to be determined	to be determined	to be determined

Table ES-5: Selected Drainage and Flood Control Plan

Problem Number	Problem Summary	Selected Alternative	Level of Protection	Capital Cost	Annual Operations and Maintenance Cost
	< Minor erosion on Poplar Creek between Calhoun Road and Victor Road < Drainage easement backup at 157th Street and Monterey Drive. < Insufficient ditch storage at 158th Street and Santa Rosa Boulevard < Sediment and debris blockage at Calhoun Road and Salentive Drive Underwood Creek subwatershed: < Insufficient drainage from Highland Memorial Park < Lack of storm water conveyance at Gatewood Drive and Clover Knoll Place < Inadequate culvert capacity at Kostner Lane and C & NW Railroad < Sediment and debris blockage of Sunny Slope Road culvert < Surcharging manhole at 13000 block of Greenfield Avenue. < Insufficient ditch storage at 124th Street and Prospect Drive. Deer Creek: Inadequate local drainage in backyards between 164th and 168th Street and Roosevelt Avenue.				

Table ES-5: Selected Drainage and Flood Control Plan

Problem Number	Problem Summary	Selected Alternative	Level of Protection	Capital Cost	Annual Operations and Maintenance Cost
Citywide	Undersized culverts	Replace designated culverts	---	---	$50,000
Citywide	Drainage ditch problem locations	Repair ditch areas to improve the conveyance efficiency	---	---	$25,000
			Drainage and Flood Control Total	$4,426,000[2]	$108,000[2]

Notes: [1] an alternative to achieve 100-year level of protection was not considered economically feasible.

[2] these costs do not include alternatives to address minor system flooding problems.

These estimated costs are for planning purposes only and do not include land acquisition, construction site erosion control, unknown environmental constraints, legal fees, or utility relocation costs.

Table ES-6: Selected Water Quality Control Measures

Source Control Measure	Description	Estimated Reduction of Total Annual Load	Comments	Capital Cost	Annual Operations & Maintenance Costs
Source Control Measures					
Develop in Accordance	The change from existing to future land use, based on the zoning map.	sediment 12% phosphorous 6%	As new areas are developed, the land use will transform from agricultural to urban. Sediment	---	---

Table ES-6: Selected Water Quality Control Measures

Source Control Measure	Description	Estimated Reduction of Total Annual Load	Comments	Capital Cost	Annual Operations & Maintenance Costs
with the Zoning Map		lead -34%	and phosphorous loading will be reduced. However, due to the more urban land use, the metals loading is expected to increase.		
Adopt & Enforce Storm Water Ordinance	The draft storm water ordinance requires new development to provide storm water quality improvement.	sediment 9% phosphorous 5% lead 14%	The storage and water quality requirements will be essential in eliminating new flooding or water quality problems caused by urban development.	---	$10,000
Industrial Best Management Practices	Industries regulated by NR216 are required to implement best management practices. Additionally, industries which are potential significant pollutant contributors should implement applicable suggested best management practices.	sediment 4% phosphorous 0.3% lead 3%	To ensure we achieve the estimated pollutant reduction, routine monitoring/reporting may be necessary.	Cost incurred by industries	Cost incurred by industries
Roadway Pavement Sweeping	Arterials and Industrial Park Area: Seasonal sweeping program (weekly from April through May, bi-weekly June through August, monthly from September through November and during March)	sediment 1% phosphorous 0.5% lead 3%	--	---	$125,000
Ice Management Practices	Implement improved salt distribution methods, train personnel involved with salt distribution	variable	Ice management should involve a policy decision on the part of the common council regarding the frequency, level, and extent of deicing.	Minimal	Minimal
Catch Basin	Clean catch basins twice per year / install catch	sediment	--	$5,000 per	$70/yr./catch

Table ES-6: Selected Water Quality Control Measures

Source Control Measure	Description	Estimated Reduction of Total Annual Load	Comments	Capital Cost	Annual Operations & Maintenance Costs
Cleaning / Retrofit	basins in new development or redeveloping areas which will be serviced by storm sewer.	0.04 tons/acre drained lead 0.05 lbs./ acre drained		new catch basin installed	basin cleaned *(assume 200 basins cleaned /yr. for cost estimate)*
Landscape Practices	Implement environmentally friendly landscape practices in institutional yards, park areas, school yards, city building yards, and vegetated median strips.	sediment 0.4% phosphorous 2% lead 2%	Examples of environmentally friendly practices include increased turf height, reduced weed control, replacement of turf with low maintenance ground cover or perennials, and reduced fertilizer application.	Minimal	Minimal
Snow Storage Practices	Locate snow storage areas in a well-vegetated area at least 200 feet from a drainage way or storm sewer inlet.	variable	Implementation of this practice provides the snow melt an opportunity to filter though the vegetated area which will remove a portion of the pollutant loading.	Minimal	Minimal
Erosion Control Ordinance	Increase the construction site inspection program, and train inspectors on erosion control techniques.	variable	--	Minimal	Minimal
Agricultural Practices	Encourage use of Agricultural BMPs such as conservation tillage and adopt a shoreline management ordinance.	sediment 6.5% phosphorous 7% lead 0.1%	County may be primarily responsible for implementation of agricultural practices.	Cost incurred by farmers	Cost incurred by farmers

Table ES-6: Selected Water Quality Control Measures

Source Control Measure	Description	Estimated Reduction of Total Annual Load	Comments	Capital Cost	Annual Operations & Maintenance Costs
Streambank Stabilization	Stabilize key streambanks as identified in Section 7 *(about 1.2 miles per year)*	variable	Streambank stabilization measures may include: vegetation, erosion protection, and debris removal in designated areas.	---	$250,000
Public Education and Information Program	Provide information to the general public and industries on the Storm Water Management Master Plan	variable	Topics may include: Lawn care, pet waste handling, other best management practices, as well as the NR216 requirements. May utilize newsletters, newspaper articles, school programs, cable TV and use of preprinted materials and videos.	Variable	Variable
Treatment Measures					
Water Quality Detention Basin	Construct a water quality detention basin west of Kelly Lake.	sediment 2% phosphorous 1.5% lead 3%	--	to be determined	to be determined
Retrofit Wetland	Retrofit three prior converted wetlands into storm water treatment wetlands for highway runoff. Locations: north of I-43 west of Calhoun Road, north of I-43 west of Moorland Road, and south of I-43 east of Moorland Road.	sediment 2% phosphorous 3% lead 15%	--	$75,000	$10,000
Retrofit Wetland	Retrofit one prior converted wetland within Basin 5A020 south of National Avenue and east of	sediment 1% phosphorous 1%	Will collect runoff from agricultural and residential land use areas.	$165,000	$10,000

Table ES-6: Selected Water Quality Control Measures

Source Control Measure	Description	Estimated Reduction of Total Annual Load	Comments	Capital Cost	Annual Operations & Maintenance Costs
	Moorland Road.	lead 0.5%			
Retrofit Wetland	Retrofit one prior converted wetland within Basin 3A060 north of College Avenue, west of Sunny Slope Road, and east of Small Road	sediment 0.2% phosphorous 0.1% lead 0.9%	Will collect runoff from commercial land use area.	$15,000	$10,000
			Water Quality Control Measures Total	$255,000*	$429,000

* cost for installation of new catch basins not included.

Note: These estimated costs are for planning purposes only and do not include land acquisition, construction site erosion control, unknown environmental constraints, legal fees, or utility relocation costs.

Table ES-7: Potential Regional Detention Sites

Pond Number	Location	Approximate Drainage Area (acres)	Volume (acre-feet)	Capital Cost
RD-1	Northeast side of Tess Corners Creek, North of College Avenue	1570	260	$2,651,000 [1]
RD-2	East of Calhoun Road, south of Coffee Road	260	51	$1,712,130 [1]
RD-3	West side of Poplar Creek, south of Coffee Road	2,150	200	$8,430,030 [1]
RD-4	East of Calhoun Road, north of Coffee Road	370	236	$13,504,870 [1]
Regional ponds recommended in the Stormwater Management Plan for the Deer Creek Subwatershed prepared by Bonestroo Rosene Anderlick & Associates [2]				

Table ES-7: Potential Regional Detention Sites

Pond Number	Location	Approximate Drainage Area (acres)	Volume (acre-feet)	Capital Cost
NP-1	NW & NE1/4 of Section 3	not available	1,64.3	$971,000
CP-1	NW1/4 of Section 11	not available	0.3	not available
CP-2	NW1/4 of Section 11	not available	11.9	not available
CP-3	NE1/4 of Section 10	not available	24.1	not available
CP-4	SW1/4 of Section 3	not available	9.9	$244,000
CP-5	SW1/4 of Section 3	not available	10.3	$171,000
CP-6	SW1/4 of Section 3	not available	45.8	$180,000
CP-7	SE1/4 of Section 3	not available	50.5	not available
CR-2		not available	not available	$10,000
CR-3		not available	not available	$26,000
SCP-1	SW1/4 of Section 11	not available	0.4	$74,000
SCP-2	SW1/4 of Section 11	not available	2.2	$24,000
SCP-3	SW1/4 of Section 11	not available	1.2	$37,000
SCP-4	SW1/4 of Section 11	not available	5.3	$144,000
SCP-5	SW1/4 of Section 11	not available	4.8	not available
SCP-6	SW1/4 of Section 11	not available	34.9	$466,000

Table ES-7: Potential Regional Detention Sites

Pond Number	Location	Approximate Drainage Area (acres)	Volume (acre-feet)	Capital Cost
SCP-7	SE1/4 of Section 10	not available	5.4	$32,000
SCP-8	SE1/4 of Section 10	not available	8.8	$50,000
CR-1	SE1/4 of Section 10	not available	25.1	$10,000
SP-1	SW1/4 of Section 23	not available	11.2	$4,000
SP-2	N1/2 of Section 23 & S1/2 of Section 14	not available	90.9	$516,000
SP-3	SW1/4 of Section 14	not available	10.3	$41,000
SP-4	SE1/4 of Section 14	not available	13	$54,000
SP-5	SW1/4 of Section 14	not available	4.4	$535,000
CR-4	Section 11,14,&23	not available	7.5	$26,000
Regional ponds recommended in the Westridge Stormwater Management Plan prepared by Ruekert/Mielke [2]				
G3	NE1/4 of Section 34	not available	18.5	not available
H1/2	SW1/4 of Section 23	58.5	3.61	not available
H1/4	NW1/4 of Section 26	68	6.92	not available
H1/5	NW1/4 of Section 26	90.4	3.34	not available
H1/6	NE1/4 of Section 27	27.9	3.54	not available
H2/1	SE1/4 of Section 27	87.6	5.01	not available

Table ES-7: Potential Regional Detention Sites

Pond Number	Location	Approximate Drainage Area (acres)	Volume (acre-feet)	Capital Cost
H2/3	SW1/4 of Section 26	not available	3.00	not available
H3/2	NE1/4 of Section 27	not available	7.08	not available
H3/3	SW1/4 of Section 27	not available	13.32	not available
H3/4	NE1/4 of Section 27	not available	3.10	not available

Note:

1 - These costs are for planning purposes only and do not include land acquisition, construction site erosion control, unknown environmental constraints, legal fees, or utility relocation costs which may be associated with the plan.

2 - The recommendations presented in reports prepared by others were analyzed as part of this plan. The costs listed in this table have not been updated. The plans should be referred to far additional information.