Water and Natural Resources Management Plan

2018-2027

Prepared for the
City of Lakeville

January 2019

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Certifications

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer in the under the Laws of the State of Minnesota.

Sterling G. Williams, Jr.
PE #: 47642

January 17, 2019
Date

Acronyms

Acronym	Description
AIS	Aquatic Invasive Species
BDWMO	Black Dog Watershed Management Organization
BMP	Best Management Practice
BWSR	Minnesota Board of Water and Soil Resources
CAMP	Citizen Assisted Monitoring Program
CFS	Cubic Feet per Second
CWA	Clean Water Act
DEM	Digital Elevation Model
DWSMA	Drinking Water Supply Management Area
EDA	Environmental Data Access (MPCA)
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FIS	Flood Insurance Study
HSG	Hydrologic Soil Group
LA	Load Allocation
LGU	Local Governmental Unit
LID	Low Impact Development
LiDAR	Light Detection and Ranging
LOMA	Letter of Map Amendment
MCM	Minimum Control Measure
MDH	Minnesota Department of Health
MGS	Minnesota Geological Survey
MIDS	Minimal Impact Design Standards
MNDNR	Minnesota Department of Natural Resources
MnDOT	Minnesota Department of Transportation
MnRAM	Minnesota Routine Assessment Method
MPCA	Minnesota Pollution Control Agency
MRCC	Midwestern Regional Climate Center
MS4	Municipal Separate Storm Sewer System
MSP	Minneapolis/St. Paul International Airport
NCHF	North Central Hardwood Forest
NFIP	National Flood Insurance Program
NHIS	Natural Heritage Information System
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NWI	National Wetland Inventory

OHWL	Ordinary High Water Level
P8	Program for Predicting Polluting Particle Passage through Pits, Puddles and Ponds
PWI	Public Waters Inventory
SCS	Soil Conservation Service
SFHA	Special Flood Hazard Area
SSTS	Subsurface Sewage Treatment Systems
SSURGO	Soil Survey Geographic Dataset
SWCD	Soil and Water Conservation District
SWPPP	Storm Water Pollution Prevention Program
TAC	Technical Advisory Committee
TIS	Terrestrial Invasive Species
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
TSS	Total Suspended Solids
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
VIC	Voluntary Investigation and Cleanup
VRWJPO	Vermillion River Watershed Joint Powers Organization
WCA	Wetland Conservation Act
WCBP	Western Corn Belt Plains
WHEP	Wetland Health Evaluation Program
WHPP	Wellhead Protection Plan
WLA	Waste Load Allocation
WMO	Watershed Management Organization
WNRMP	Water and Natural Resources Management Plan
WRAPS	Watershed Restoration and Protection Strategy
WWTP	Wastewater Treatment Plant

Executive Summary

The City of Lakeville Water and Natural Resources Management Plan (WNRMP or Plan) provides a guide to managing stormwater, surface water, and natural resources throughout the City. The WNRMP provides data and other background information on resources, assesses City-wide and site-specific issues, sets goals and policies, and establishes an implementation program. The WNRMP is organized into four major sections, summarized as follows:

Section 1 – Introduction

Section 1.0 summarizes the City of Lakeville's location, development history, and describes the purpose of the WNRMP. The City's 2018-2027 WNRMP is the third iteration of the City's local water management plan and replaces the City's 2008 Water Resources Management Plan (2008 WRMP). The purposes of the WNRMP aligns with those purposes given in Minnesota Statute 103B.201 requirements for metropolitan water management programs, including to:

- Protect, preserve, and use natural surface and groundwater storage and retention systems;
- Minimize public capital expenditures needed to correct flooding and water quality problems;
- Identify and plan for means to effectively protect and improve surface and groundwater quality;
- Establish more uniform local policies and official controls for surface and groundwater management;
- Prevent erosion of soil into surface water systems;
- Promote groundwater recharge;
- Protect and enhance fish and wildlife habitat and water recreational facilities; and
- Secure the other benefits associated with proper management of surface and ground water.

This WNRMP was developed in accordance with the requirements of Minnesota Statutes 103B.235 and Minnesota Rules Chapter 8410, and consistent with the guidance from the Metropolitan Council, the Black Dog Watershed Management Organization (BDWMO), and the Vermillion River Watershed Joint Powers Organization (VRWJPO).

Section 2 – Resource Goal Areas

Section 2.0 identifies a number of stormwater and natural resource issues facing the City and outlines goals, policies, and implementation items to address these issues. This section is organized according to the major resource areas:

Resource Goal Area	Specific Issues
Surface water quality	• Stormwater runoff water quality • Excessive erosion and sedimentation • Impaired waters and TMDLs
Water quantity and flood risk	• Floodplain management • Intercommunity drainage • Areas of localized flooding
Wetlands, shorelands, and upland natural areas	• Wetland and shoreland buffers • Aquatic invasive species • South Creek trout stream • Upland natural resource management
Groundwater	• Groundwater conservation • Groundwater quality and wellhead protection • Groundwater-surface water interaction

Each resource goal area includes a brief discussion of the implementation programs and practices planned to address the issues. Specific, prioritized implementation tasks are included in the City's overall implementation table presented in Table 4-1 and Table 4-2 of Section 4.0.

Section 3 – Water and Natural Resources Inventory

Section 3.0 contains information about the physical resources in the City that affect, or are affected by, the City's stormwater and surface water management activities, including:

- Climate and precipitation;
- Topography;
- Land use;
- Soils;
- Geology and groundwater;
- Surface waters (lakes, streams, and wetlands);
- Water quality monitoring and classifications;
- Drainage districts;
- Water quantity modeling and flood insurance studies;
- Natural communities and rare features;
- Fish and wildlife habitat;
- Recreational areas; and
- Potential pollutant sources.

Information included in the water and natural resources inventory is presented as text, tables, and figures. A key update to the land and water resources inventory includes the 2013 publication of updated data on

extreme precipitation events commonly used in the design of flood control systems. Other changes include revisions to hydrologic soil group delineations, land use data, and the MPCA's impaired waters list.

Section 4 – Implementation Program

Section 4.0 provides a framework for protecting, preserving, and managing the City's surface water resources and stormwater management system. The City's implementation program includes prioritized actions related to:

- NPDES permit requirements;
- Stormwater system operation and maintenance;
- Natural resource management program;
- Education and public involvement;
- Ordinances and official controls; and
- Projects and capital improvements.

The implementation program includes the roles of the =BDWMO and the VRWJPO with respect to water resource management and activities performed in cooperation with the City.

Many of the City's stormwater and surface water management activities are tied to the implementation of the City's MS4 permit and associated SWPPP; Section 4.0 outlines a framework for a future natural resource inventory and management program. The implementation program is presented in Table 4-1 and Table 4-2 organized as follows:

- Table 4-1 Implementation Program – Capital Improvements
- Table 4-2 Implementation Program – Programs, Studies, and Official Controls

1.0 Introduction

1.1 Location and Development History

Lakeville is located within Dakota County in the southeast corner of the Twin Cities metropolitan area, 20 miles south of downtown Minneapolis and St. Paul. Lakeville is bordered on the north by the Cities of Apple Valley and Burnsville, on the east by the City of Farmington and Empire Township, on the south by the Townships of Eureka and New Market, and on the west by Credit River Township.

The City lies within two major watersheds, the Black Dog watershed (tributary to the Minnesota River) and the Vermillion River watershed (tributary to the Mississippi River). These watersheds are managed respectively by the BDWMO and the VRWJPO. These watershed management organizations and their coordination with the City are described in greater detail in Section 4.3.

The northwest corner of the City is located within the jurisdiction of the BDWMO, with the remainder of the City within the jurisdiction of the VRWJPO. These watersheds cross political boundaries; therefore, cooperation between communities within the watershed is necessary to effectively manage the resources within each watershed.

At one time Lakeville was a rural community that serviced surrounding agricultural activities. In recent years, its convenient access to the metropolitan area has stimulated both residential, commercial, and industrial growth. Located between urban and rural service areas, Lakeville maintains a historic downtown neighborhood and other mature residential areas, while areas of the City continue to develop. The population of Lakeville in 2016 was approximately 61,000. Continued growth is expected, with a population of 83,500 anticipated by 2040. More information regarding population and growth is available in the City's 2040 Comprehensive Plan. Low density residential land use is the predominant land use (Section 3.3). Significant park and recreation areas exist throughout the City, as well as commercial, industrial, and institutional development.

1.2 Purpose and Scope

This water and natural resource management plan (WNRMP) provides the City of Lakeville with a comprehensive guide to managing water and other natural resources throughout the City and replaces the 2008 Lakeville Water Resources Management Plan (2008 WRMP).

Several changes have occurred since the 2008 WRMP that are addressed by this update, including, but not limited to:

- Changes in current and anticipated land use;
- Modifications to the City's stormwater system;
- Publication of updated precipitation frequency data (Atlas 14);
- Updates to the BDWMO and VRWJPO watershed management plans;
- Updates to the MPCA's MS4 general permit;

- Evolving public and government attitudes, perceptions, and awareness regarding surface water quality management; and
- Completion of several TMDL studies for waters that receive drainage from the City.

The WNRMP is a local water management plan prepared in accordance with Minnesota Statute 103B.235 and Minnesota Rules 8410, guidance from the Metropolitan Council, and the watershed management organizations with jurisdiction in the City, including the BDWMO and the VRWJPO. The purpose of this WNRMP includes those purposes given in Minnesota Statute 103B.201 for metropolitan water management programs. According to statute, the purposes of these water management programs are to:

- Protect, preserve, and use natural surface and groundwater storage and retention systems;
- Minimize public capital expenditures needed to correct flooding and water quality problems;
- Identify and plan for means to effectively protect and improve surface and groundwater quality;
- Establish more uniform local policies and official controls for surface and groundwater management;
- Prevent erosion of soil into surface water systems;
- Promote groundwater recharge;
- Protect and enhance fish and wildlife habitat and water recreational facilities; and
- Secure the other benefits associated with proper management of surface and ground water.

1.3 Water Resource Agreements

The City of Lakeville has entered into the following water resource management related agreements:

1. Joint Powers Agreement establishing the BDWMO. The original joint powers agreement between the member cities (including Lakeville) went into effect in 1985. A revised joint powers agreement was developed and signed in 1999, and again in 2010.

2. A Joint Powers Agreement with the City of Burnsville, dated January 3, 1992 relating to three issues: (1) quarterly potable water usage, (2) Maple Island Sanitary Sewer Lift Station charges, and (3) payment for the Crystal Lake Outlet construction.

3. A Joint Powers Agreement with the City of Burnsville, dated March 17, 1980 relating to the Crystal Lake Overflow System.

4. A Joint Powers Agreement with the City of Burnsville, dated September 6, 1983 relating to storm controls in an area adjacent to a common border between the cities of Lakeville and Burnsville in the vicinity of I-35 northbound and 160th Street.

In addition to the specific agreements listed above, the City continues to require owners of private stormwater facilities to enter into maintenance agreements with the City to ensure that those facilities continue to function as originally intended (Section 4.2.1).

1.4 WNRMP Update, Amendment, and Reporting

The WNRMP is intended to guide the City's water resource management activities through the year 2028, or until superseded by adoption and approval of a subsequent local water management plan. The City will begin the process of updating this WNRMP one to two years before its expiration date in coordination with the City's comprehensive planning process and the requirements of applicable Minnesota laws and rules, the BDWMO, and the VRWJPO.

The City may amend the WRNMP prior to the scheduled WRNMP update. However, this WNRMP remains in effect until an updated WRNMP is adopted by the City. Any significant changes to this WRNMP must be approved by the affected WMO(s). Minor changes to this WRNMP will not require WMO approval and can be made by City staff and supplied to the WMOs. The City considers minor changes to be those that do not modify the goals, policies, standards, or commitments identified in the WRNMP. Examples of minor changes include:

- Inclusion of updated hydrologic modeling results and mapping, as long as the changes do not significantly affect the rate or quality of intercommunity stormwater runoff.
- Inclusion of new/updated water quality monitoring data.
- Minor changes to the City's implementation program, such as added projects, schedule changes, and revised cost estimates, as long as there are no intercommunity impacts of such changes and the changes are consistent the goals and policies in the WRNMP.

If it is unclear whether a proposed WRNMP change is minor or not, the City will bring the issue to the WMOs for their determination. The amendment procedure for the WRNMP is presented below:

- **Request for Amendment** – If the amendment is not proposed by City staff, a written request for plan amendment must be submitted to City staff. The request shall outline the need for the amendment and additional materials City staff will need to consider reviewing the amendment.
- **Staff Review of Amendment** – City staff will make a decision as to the validity of the request and either:
    - Reject the amendment;
    - Accept the amendment as a minor issue, with minor issues collectively added to the plan at a later date; or
    - Accept the amendment as a major issue, with major issues requiring an immediate amendment.

  In acting on an amendment request, City staff shall recommend to City Council whether or not a public hearing is warranted.
- **Council Consideration** – The amendment and the need for a public hearing shall be considered at a regular or special Council meeting. Staff recommendations should be considered before decisions on appropriate action(s) are made.

- **Public Hearing and Council** – This step allows for public input based on public interest. Council shall determine when the public hearing should occur in the process. Based on the public hearing, the City Council could approve the amendment.
- **Watershed Organization Review and Approval** – The City shall submit the proposed amendment to the affected WMOs. The City shall also submit the proposed WRNMP amendment to the Metropolitan Council and Dakota County. The review process for a WRNMP amendment is the same as for the original WRNMP —the WMOs have 60 days to review and comment on the proposed WRNMP amendment.
- **Council Adoption** – Following approval by the watershed organizations, the City Council may adopt the amended WRNMP. Prior to the adoption, an additional public hearing may be held to review the plan changes and notify the appropriate stakeholders.

2.0 Resource Goal Areas

2.1 Surface Water Quality

2.1.1 Goal

Preserve and enhance surface water quality.

2.1.2 Issues

2.1.2.1 Nutrient and Pollutant Loading

Stormwater runoff, when not adequately treated, is a major contributor of pollutants to most waterbodies. As urbanization increases and other land use changes occur in the City, inputs (i.e., loading) from untreated stormwater runoff can far exceed the natural inputs to waterbodies. Untreated stormwater runoff collects and conveys pollutants from impervious areas and land uses (e.g., development, redevelopment), including pollutants such as chlorides, oil, grease, chemicals, metals, litter, and pathogens (e.g., *E. coli* and fecal coliform), which can impact water quality.

For lakes, ponds, streams, and wetlands, phosphorous is typically the pollutant of major concern in stormwater runoff. Land use changes resulting in increased imperviousness or land disturbance (e.g., construction) typically result in increased amounts of phosphorus and sediment carried in stormwater runoff. In addition to watershed sources (e.g., stormwater runoff, grass clippings, pet waste), other possibly significant sources of phosphorus include atmospheric deposition, internal loading (e.g., release from anoxic sediments, algae die-off, aquatic plant die-back, and fish disturbed sediment), and non-functioning SSTS.

As phosphorus and other pollutant loading increases, it is likely that water quality degradation will accelerate, resulting in negative consequences, such as profuse algae growth or algal blooms. Algal blooms and high concentrations of pollutants such as chloride can interfere with ecological functions as well as recreational and aesthetic uses of water bodies. Water quality treatment practices implemented or required by the City at the time of development and redevelopment are critical to minimize water quality impacts from phosphorus and other pollutant loading.

2.1.2.2 Erosion and Sedimentation

Sediment is also a major contributor to water quality degradation. Stormwater runoff from streets, parking lots, and other impervious surfaces carries suspended and dissolved solids consisting of fine particles of soil, dust, and dirt. Although erosion and sedimentation are natural processes, they are often accelerated by human activities, including construction activities. Regardless of its source, sediment deposition decreases water depth, degrades water quality, smothers fish and wildlife habitat, and degrades aesthetics.

Sediment deposition can also impact the function of stormwater infrastructure by wholly or partially block culverts, manholes, and other stormwater facilities, causing flooding. Sediment deposition in detention

basins and wetlands also reduces the storage volume capacity, resulting in higher flood levels and/or reducing the amount of water quality treatment provided. As erosion and sedimentation increase, the City's public stormwater management facilities require more frequent maintenance, repair, and/or modification to ensure they will function as designed. Maintenance agreements with owners of private stormwater management infrastructure are needed to ensure private systems also perform as intended (Section 4.2.1).

Monitoring the stormwater system, including inspection of sediment build-up in stormwater basins is critical to minimize life cycle costs and maintain public safety (Section 4.2.3). The City is aware of existing erosion and sedimentation problems at stormwater basins and basin inlets.

2.1.2.3 Impaired Waters and Total Maximum Daily Loads (TMDLs)

The federal Clean Water Act (CWA) requires states to adopt water quality standards to protect the nation's waters. In Minnesota, these responsibilities are administered by the MPCA. Minnesota water quality standards designate beneficial uses for each waterbody and establish water quality criteria that must be met to support its designated use(s). The MPCA identifies and establishes priority rankings for "impaired waters" that do not meet the water quality standards. The list of impaired waters (303(d)) list, is updated by the MPCA in even numbered years.

The MPCA performs TMDL studies to evaluate impaired waters. A TMDL is a threshold calculation of the amount of a pollutant that a waterbody can receive and still meet state water quality standards. A TMDL establishes the pollutant loading capacity within a waterbody and develops an allocation scheme amongst the various contributors, which include point sources, non-point sources and natural background, as well as a margin of safety. A WRAPS is similar to a TMDL but typically addresses a larger number of water resources, including waterbodies that are not impaired, and does not necessarily include wasteload allocations for all waterbodies studied. Data and action items from TMDLs have been used in developing the prioritized implementation items included in this WNRMP (Table 4-1 and Table 4-2).

Impaired waters partially or fully within the City of Lakeville (as of 2018) include:

- East Lake
- North Creek
- South Creek
- Middle Creek

Crystal Lake, Lake Marion, and Orchard Lake are listed as impaired for aquatic consumption due to mercury in fish tissue; these impairments are addressed by the Minnesota Statewide Mercury TMDL (MPCA, 2007). Crystal Lake and Lee Lake were previously listed as impaired due to excess nutrients, but were delisted in 2018 due to improved water quality. Impairments of North, South, and Middle Creek are addressed by the *Vermillion River Watershed TMDL Report* (MPCA, 2015). A TMDL for East Lake is scheduled to be completed by 2022. Additional information is included in Table 3-3.

2.1.3 Policies

The following policies support the City's goal to protect and enhance surface water quality and are required per the City's MS4 permit responsibilities, WMO requirements, and/or state law:

1. The City addresses negative water quality impacts (including, but not limited to thermal pollution) of construction activities through implementation of the City's project review and permit program, City code, and other City official controls.

2. The City reviews proposed projects for compliance with the applicable BDWMO and VRWJPO standards, including: Stormwater Management Standards, Construction Erosion Control, Post Construction Water Quality Criteria, and Runoff Temperature Control Criteria. Watershed management organization performance standards and requirements are available at: www.blackdogwmo.org and www.vermillionriverwatershed.org

3. The City requires development to comply with and follow applicable best management practices (BMPs) for erosion and sedimentation control and post-construction water quality as specified in the MPCA's NPDES Construction Stormwater General Permit and the Minnesota Stormwater Manual, available at: http://stormwater.pca.state.mn.us/index.php/Main_Page.

4. The City cooperates with local WMOs in the management of Lakeville waterbodies, including East Lake, Valley Lake, and Lake Marion (in the VRWJPO) and the following BDWMO strategic waterbodies: Crystal Lake, Orchard Lake, and Kingsley Lake.

5. The City will provide water quality pretreatment for new, redesigned, or replaced outlets to Orchard Lake and Kinglsey Lake, consistent with BDWMO policy. The City encourages water quality pretreatment of stormwater runoff upstream of stormwater system inlets and all receiving waters.

6. The City reports water quality data, survey results, and management activities (proposed or performed) for City waterbodies to the BDWMO, VRWJPO, or other relevant entities.

7. The City will track contaminant load reduction achieved by implemented BMPs through monitoring and/or modeling and use this information to inform water resource management decisions.

8. The City manages its winter road management practices (e.g., de-icing) to reduce negative environmental impacts while maintaining public safety. The City will consider management strategies resulting from the MPCA's Twin Cities Metro Chloride TMDL, including staff trainings.

The following policies support the City's goal to protect and enhance surface water quality and are adopted at the discretion of the City:

9. The City encourages implementation of BMPs to improve surface water quality beyond the minimum required by applicable regulatory controls.

10. The City will work with the MPCA, WMOs, and other agencies to participate in TMDL studies and/or WRAPS study for water bodies located in or downstream of the City, including, but not limited to those included on the 303(d) list.

11. The City collaborates with the Dakota County SWCD, federal, state, and local programs to cost share for water quality improvement projects throughout the City. The City actively pursues grants and legislature funding, where appropriate.

12. The City will use water quality modeling of major subwatersheds to diagnose potential problems and prioritize solutions, where appropriate.

13. The City monitors the water quality of surface waters located within the City, in cooperation with watershed management organizations, the MPCA, and others agencies, including participation in citizen volunteer monitoring efforts such as CAMP.

14. The City evaluates monitoring data for trends and use available data to inform water resource management activities.

15. The City monitors emerging technologies for protecting the trout streams, including reducing thermal impacts to streams from stormwater runoff and considers application of emerging technology, as appropriate.

16. The City implements the South Creek Management Plan.

17. The City will maintain an inventory of known erosion issues and address erosion problems in the City of Lakeville as resources and opportunities allow.

2.1.4 Implementation

The City seeks to protect and enhance surface water quality of its waterbodies through a range of practices and programs, including:

- Implementation of regulatory controls, including:
    - MS4 Permit
    - Stormwater collection and conveyance system operation and maintenance
    - TMDLs
    - City ordinances, design standards, and official controls
- Partner with WMOs
- Monitoring and assessments
- Education and public involvement

- Capital improvement projects

These practices and programs are described in greater detail in Section 4.0. Aspects specifically related to protecting and enhancing surface water quality are described in the following sections.

2.1.4.1 Municipal Separate Storm Sewer System (MS4) Permit and Storm Water Pollution Prevention Plan (SWPPP)

In its enforcement of the federal CWA and related NPDES, the MPCA administers the MS4 permit program. Subject to this program, the City is required to maintain an MS4 permit from the MPCA for managing non-point source stormwater. The MS4 permit addresses how the City will regulate and improve stormwater discharges. The permit must include a SWPPP addressing all of the requirements of the permit.

The Lakeville manages the MS4 permit renewal process, including identifying issues and developing implementation measures to address the issues. Lakeville's NPDES SWPPP addresses six minimum control measures, including:

1. Public outreach and education;
2. Public participation/involvement;
3. Illicit discharge detection and elimination;
4. Construction site runoff control;
5. Post-construction runoff control; and
6. Pollution prevention/good housekeeping.

The City continuously implements BMPs required in the NPDES permit. If a BMP is not in place, the SWPPP identifies the City's plan to address the issue. The MPCA is in the process of issuing a new NPDES MS4 General Permit, expected in 2018. The 2018 update is expected to include additional requirements tracking performance of water quality ponds and other stormwater management BMPs.

2.1.4.2 Stormwater System Operations and Maintenance

The City is responsible for inspecting and maintaining its public stormwater collection and conveyance system. Proper maintenance ensures the stormwater system continues to provide the intended functions, including water quality benefits. The City regularly inspects and maintains key components of the system.

The City inspects stormwater management basins and facilities to identify issues that may impact water quality functions. Excessive sediment, debris, and unwanted vegetation can significantly reduce stormwater detention and pollutant removal capacity. The City uses inspection data and available model results to prioritize basin maintenance needs.

Drainage swales are susceptible to erosion that, if not addressed, can impair system function, degrade downstream water quality, and potentially result in loss of property. Inspection of drainage swales is a part of the City's annual inspection process.

The City of has an active street sweeping program. The City brush or vacuum sweeps public streets a minimum of twice per year in an effort to reduce the amount of sediment, pollutants, and trash from reaching the storm sewer system and surface waters – once in the spring following snowmelt, and once in the fall after leaf fall. Areas directly tributary to lakes are prioritized for street sweeping. Sweepings are taken to a dedicated soil storage area.

Owners of private stormwater facilities are responsible for facility maintenance consistent with the original performance design standards. Owners of private stormwater facilities must provide the City with a maintenance plan as part of the project SWPPP; the maintenance plan defines who will perform the inspection, maintenance, the type of maintenance, and the maintenance intervals.

2.1.4.3 Total Maximum Daily Loads

The City partners with the MPCA and WMOs in the development and implementation of TMDL studies. The City implements projects and practices to address waste load allocations assigned to the City through approved TMDL studies (Section 2.1.2.3). Activities related to TMDL implementation are included in the City's SWPPP, (Appendix B), and the City regularly reports progress towards meeting applicable waste load allocation goals.

The City will consider the management strategies resulting from the MPCA's *Twin Cities Metro Chloride TMDL* (MPCA, 2016), including staff trainings, in efforts to optimize its winter road management practices (e.g., de-icing) to reduce negative environmental impacts while maintaining public safety.

2.1.4.4 Ordinances, Design Standards, and Official Controls

The City protects water quality through ordinances, design standards, and official controls. These official controls are enforced through the City's project review and permitting program. The ordinances, standards, and official controls are consistent with applicable WMO and State requirements. The City may need to revise its performance standards to achieve higher levels of water quality treatment in the future in response to changing WMO, state, or federal requirements or to address impaired waters issues.

City regulations and land use controls directly related to surface water quality include the following ordinances and resource management plans (as amended):

- City Code Title 10 – Subdivisions, Chapter 4: Design Standards, including:
    - Erosion and Sediment Control (Lakeville City Code, Section 10-4-5)
    - Storm Drainage (Lakeville City Code, Section 10-4-6)
    - Protected Areas (Lakeville City Code, Section 10-4-7)
    - Wetlands and Watercourses (Lakeville City Code, Section 10-4-8)
    - Tree Preservation (Lakeville City Code, Section 10-4-11)
- City Code Title 11 – Zoning
- The South Creek Management Plan (2000, as amended)

Design standards applicable to new development and redevelopment are summarized in Table 4-3. *Note that the design standards included in Table 4-3 may not include all applicable design standards and do not replace design or performance standards required by the MPCA, BDWMO, VRWJPO, or other entities, as applicable.*

To ensure compliance with City ordinances, design standards, and official controls, the City reviews proposed projects and issues permits and/or approvals for land-disturbing projects (including developments). The City's regulatory and project review process is described in Section 4.7. In addition, the VRWJPO may review projects meeting specific triggers for compliance with WMO stormwater management criteria and other performance standards. The BDWMO may review projects at the request of the City.

Opportunities for incorporating additional water quality treatment in developed areas exist primarily through redevelopment activities or public improvement projects. The City is proactive in using regulatory controls at its disposal to ensure that opportunities presented by redevelopment to improve stormwater systems and implement the policies of the WNRMP are not lost.

2.1.4.5 Partnerships with Watershed Management Organizations and Other Agencies

The BDWMO and VRWJPO perform roles and responsibilities related to protecting and enhancing water quality in accordance with the authority specified in Minnesota Statutes 103B. The MPCA, MDNR, and Dakota County SWCD also perform roles to address water quality issues. In many instances, there are opportunities for the City to partner with the WMOs and other agencies to achieve common objectives. Such opportunities may include, but are not limited to:

- Educational programs;
- Natural resource inventories and monitoring;
- TMDL and WRAPS studies and implementation; and
- Capital improvements.

The roles and responsibilities of the WMOs within the City are described in greater detail in Section 4.3.

2.1.4.6 Monitoring and Assessment

The City partners with WMOs and other agencies to monitor the water quality of waterbodies within the City. Example programs include:

- BDWMO water quality and habitat monitoring;
- Wetland Health Evaluation Program (WHEP); and
- Metropolitan Council's Citizen Assisted Monitoring Program (CAMP).

Water quality data is publically available. The City uses available data in its water and natural resource management decisions.

2.1.4.7 Education and Public Involvement

The City performs education and civic engagement activities that promote surface water quality within the City. Key topics include, but are not limited to:

- Water conservation and reuse;
- Non-point source pollution and best practices for pollution prevention (e.g. pet waste disposal);
- Native plants and terrestrial and aquatic invasive species;
- Low impact development (LID) practices;
- Water quality in lakes and streams;
- Construction regulation and guidance;
- Illicit discharges and hazardous waste disposal;
- Infiltration, filtration, and groundwater protection;
- Erosion control;
- Vegetated buffers and shoreline management;
- Composting and yard waste management; and
- Methods for water quality improvement for residents (e.g., rainwater gardens, lawn maintenance).

The City promotes alternative uses for unwanted materials by providing information on recycling options, services, and programs within and outside the community, including drop-off sites for household hazardous waste to increase awareness of illicit discharge issues.

The City also works collaboratively with the Dakota County SWCD, BDWMO, and VRWJPO to distribute water quality educational materials and promote/support water quality outreach programs. Programs include, but are not limited to:

- Landscaping for Clean Water workshops (Dakota County SWCD),
- Volunteer stream monitoring (VRWJPO)
- Citizen Assisted Lake Monitoring Program (Metropolitan Council),

Information on the City's education and public involvement program is included in Section 4.5.

2.1.4.8 Capital Improvement Program

The City addresses water quality issues through the construction of capital improvements including stormwater basins, infiltration basins, and other BMPs. Capital improvements planned during the life of this WNRMP are summarized in Table 4-1.

2.2 Water Quantity and Flood Risk

2.2.1 Goals

Manage the rate and volume of surface water runoff entering rivers, streams, lakes, and wetlands within the City.

Reduce the risk and impact of floods on the environment, public health, and infrastructure.

2.2.2 Issues

2.2.2.1 Floodplain Management and Flood Insurance Studies

FEMA publishes an FIS for Dakota County that maps the floodplains in the City (Section 3.9.1). The FIS, together with the City's floodplain ordinance, allows the City to participate in the federal government's NFIP. Homeowners with structures within mapped FEMA-designated 1% special flood hazard area (SFHA) are federally required to purchase flood insurance. In some cases, structures within the mapped FEMA SFHA may not be physically located in the SFHA; in these cases, residents must obtain a LOMA from FEMA to waive the flood insurance requirement.

Based on hydrologic and hydraulic modeling, the City has determined 1% flood elevations (i.e., elevations corresponding to a storm with a 1% chance of occurring in any year) for many water bodies that are not mapped in the FEMA FIS. The City manages activities within the floodplains of these water bodies through its permit/approval processes, its floodplain ordinance, and this WNRMP. City-modeled 1% flood elevations and associated inundation areas may differ from the SFHA shown in the FIS (Zone A) due to differences in input data, level of detail, and other factors. The City's FIS became effective December 2, 2011. Thus, the FEMA-mapped SFHA within the City were established prior to the publication of NOAA's Atlas 14 precipitation data (Section 3.1).

As development and redevelopment occur within the City, appropriate rate and volume controls and development standards are necessary to avoid creating future or exacerbating existing flooding issues. The BDWMO and VRWJPO have established rate and/or volume control performance standards applicable to those areas of the City within their respective jurisdictions. The City has adopted rate and volume control performance standards consistent with WMO requirements (Table 4-3).

2.2.2.2 Intercommunity Drainage and Flow Rates

There are areas of the City where stormwater runoff enters from other communities or is discharged to other communities. It is necessary to manage intercommunity flow rates to prevent increases beyond the capacity of downstream stormwater management systems. Regulation or resolution of intercommunity drainage is often a responsibility of WMOs. Within the VRWJPO and BDWMO, the City is required to maintain existing intercommunity flow rates unless otherwise specified by an agreement. In some cases, reduction of intercommunity flow rates below existing conditions may be necessary to resolve existing flooding issues located outside of the City.

2.2.2.3 Areas of Localized Flooding

High-water levels (i.e., flooding) presents a threat to public health and safety and can result in significant economic impacts, including but not limited to:

- Damage to structures, utilities, and transportation facilities;
- Flood fighting and post-flood cleanup costs; and
- Business and property losses.

Flooding may cause other environmental damages that are harder to quantify, including the following:

- Shoreline erosion;
- Increased pollution due to the inundation of hazardous materials;
- Destruction of riparian habitats and vegetation such as grass, shrubs, trees, etc.; and
- Alterations to the mix and diversity of wildlife species as a result of inundation of habitats.

Areas of existing localized flooding have been identified within the City through observation and hydrologic and hydraulic modeling (Appendix A). Most of these areas are low priority due to the low risk to health and property. The City plans to address these areas as opportunities allow (e.g., pavement management programs, redevelopment opportunities, and coordination with other City or WMO projects). The results of hydrologic and hydraulic modeling performed by the VRWJPO and City have also identified areas with potential flooding issues. Complete hydrologic and hydraulic model results are presented in Appendix A.

The City will prioritize existing and potential local flood risk issues to be addressed during the life of this WNRMP. The City will also use the results of hydrologic and hydraulic modeling in municipal planning efforts to avoid creating or exacerbating flooding issues with future actions. The City will update the model annually to reflect new development, redevelopment, and capital improvements.

2.2.3 Policies

The following policies support the City's goals to manage stormwater runoff rates and reduce the risk and impact of flooding and are required per the City's MS4 permit responsibilities, WMO requirements, and/or state law:

18. The City minimizes downstream stormwater impacts of runoff from land-disturbing activities including new development, redevelopment, and road construction through the implementation of the City's design performance standards, ordinances, and other regulatory controls.

19. The City requires all new development and redevelopment projects, where feasible, to provide for the infiltration of 1.0 inch of runoff from new and redeveloped impervious surface (consistent with the MPCA NPDES general construction stormwater permit, see Section 4.7.1); in the South Creek drainage district, the infiltration requirement is increased to 1.5 inches.

20. The City requires that all applicable development and redevelopment activities, including City projects, meet applicable BDWMO and VRWJPO requirements for rate control and volume control based on Atlas 14 precipitation data (see Section 3.1). Watershed management organization performance standards and requirements are available at: www.blackdogwmo.org and www.vermillionriverwatershed.org.

21. The City requires "no net loss" of floodplain by requiring compensatory storage between the normal water level and the water level corresponding to an event with 1%chance of annual occurrence for filling within the flood fringe. Filling or other floodplain alternation may be authorized by the City if it is shown that the filling or alteration, together with the alteration or filling of all other land on the affected reach of the waterbody to the same degree of encroachment as proposed by the applicant, will not cause high water or aggravate flooding on other land and will not unduly restrict flood flows.

22. The City maintains floodplain zoning regulations that are consistent with Dakota County water resource plans and ordinances and applicable state and WMO requirements.

23. The City restricts peak outflow from the Orchard Lake outlet to no more than 65 cfs for the critical (4 day) runoff event with 1% chance of annual occurrence.

24. The City considers long duration events, such as multiple-year wet cycles and high runoff volume events (e.g., snowmelt events that last for many weeks) when establishing high water elevations and the need for outlets from landlocked basins.

25. The City considers the effects of water level fluctuations on trees, vegetation, and erosion when establishing flood levels for landlocked basins.

26. The City encourages outlets from landlocked basins only when such outlets are consistent with State and Federal regulations, and the downstream, riparian, and habitat impacts of such outlets have been analyzed and no detrimental impacts result.

The following policies support the City's goals to manage stormwater runoff rates and reduce the risk and impact of flooding and are adopted at the discretion of the City:

27. For new and significantly redeveloped structures, the City requires the following minimum building elevations:

Structure Type	Water Bodies with Piped Outlets	Water Bodies without Piped Outlets	Creeks or Water Bodies within the Floodplain Zoning District	Subsurface Stormwater Management BMPs
Habitable Buildings	Low floor must be minimum of 3 feet above the outlet elevation and 1 foot above the regulatory flood elevation (2 feet above the regional (1%) flood elevation).	Low floor must be a minimum of 5 feet above the regional (1%) flood elevation.	Low floor must be 1 foot above the regulatory flood elevation (2 feet above the regional (1%) flood elevation).	Low floor must be a minimum of 3 feet above the regional (1%) flood elevation.
Underground Parking Structures	Low opening must be a minimum of 3 feet above the regional (1%) flood elevation.	Low opening must be a minimum of 5 feet above the regional (1%) flood elevation.	Low floor must be 1 foot above the regulatory flood elevation.	Low opening must be a minimum of 3 feet above the regional (1%) flood elevation or one foot above the emergency overflow elevation.
Roadways	Roadways shall have a minimum of 1-foot of freeboard above the regional (1%) flood elevation when adjacent to water bodies with piped outlets designed to store the 1% rainfall event. **OR** 1 foot above the regulatory flood elevation when adjacent to creek or other water bodies within the Floodplain Zoning District.			

Note: The lowest floor and HVAC facilities of new or significantly redeveloped habitable structures and underground parking facilities must be at least 3 feet above the seasonal high groundwater elevations for the area; groundwater elevation data may be derived from piezometer data, soil boring data showing mottled or hydric soils, or other sources approved by the City Engineer.

Note: The low opening of all structures must be at least 1 foot about the emergency overflow elevation.

28. The City requires developers to map all unmapped inundation areas corresponding to the 1% flood elevation to established Zone AE as part of the permit application process.

29. The City requires developers to provide as-built drawings of all basins and designated emergency overflows, and requires a surveyor's certified drawing showing the elevations of the low floors, low openings, and below the floor HVAC facilities in conformance with the City's minimum building elevation requirements for such features.

30. Developers and builders must grant the City permanent public drainage and utility easements and easements for maintenance access and over emergency overflow routes during development and/or building permit processes.

31. The City will implement its development review process and floodplain ordinance to preserve the natural function of the floodplain as a floodwater storage area from encroachment. The City will pursue opportunities to maximize upstream floodwater storage.

32. The City encourages developers to reduce runoff rates for new development and redevelopment beyond minimum requirements.

33. The City encourages infiltration in appropriate floodplain areas through increased vegetated areas and reduced impervious surfaces.

34. The City encourages the use of water reuse to reduce stormwater runoff volume and rate, where possible.

35. The City seeks opportunities to retrofit existing developments and sites under re-development with low-impact development techniques, in partnership with other units of government.

36. The City will identify areas of known or estimated flooding and evaluate options to address these areas prioritizing public safety.

37. The City will consider fully developed conditions when planning and design stormwater detention facilities, with the goal of accommodating runoff without increase in flow rates at watershed outlets.

38. The City will consider planning for outlets to landlocked basins, as needed, to minimize water level fluctuation and flood damage.

39. The City allows diversion of surface water runoff across watershed boundaries if such action is demonstrated to have no adverse impacts.

40. The City participates in the National Flood Insurance Program (NFIP).

41. The City will cooperate and coordinate with the Dakota County's FEMA floodplain mapping updates, as needed.

2.2.4 Implementation

The City seeks to manage stormwater runoff and reduce the risk and impact of flooding through a range of practices and programs, including:

- Stormwater system maintenance and operations;

- Coordination with WMOs;
- Monitoring and assessments (hydrologic and hydraulic modeling);
- Education and public involvement;
- Ordinances, design standards, and official controls; and
- Capital improvements.

These programs are described in greater detail in Section 4.0 of this WNRMP. Aspects of the above programs specifically related to managing water quantity are described in the following sections.

2.2.4.1 Stormwater System Operations and Maintenance

The City is responsible for inspecting and maintaining its public stormwater collection and conveyance system. Proper maintenance ensures the stormwater system continues to provide the intended functions, including stormwater conveyance and flood risk reduction. The City regularly inspects and maintains key components of the system.

The City inspects stormwater management basins to identify issues that may affect the conveyance and storage capacity of the system. Excessive sediment build-up, collected debris, and unwanted vegetation, if not addressed, can significantly reduce stormwater detention and conveyance functions. The City uses inspection data and available model results to prioritize basin maintenance needs.

Owners of private stormwater facilities are responsible for facility maintenance consistent with the original performance design standards. Owners of private stormwater facilities must provide the City with a maintenance plan as part of the project SWPPP; the maintenance plan defines who will perform the inspection and maintenance, the type of maintenance, and the maintenance intervals.

2.2.4.2 Partnerships with Watershed Management Organizations

The BDWMO and VRWJPO perform roles and responsibilities related to managing stormwater runoff and reducing the risk and impact of flooding in accordance with the authority specified in Minnesota Statutes 103B. The MDNR, MnDOT, and Dakota County SWCD also perform roles to address stormwater management and water quantity issues. In many instances, there are opportunities for the City to partner with the WMOs and other agencies to achieve common objectives. Such opportunities may include, but are not limited to:

- Educational programs;
- Hydrologic and hydraulic modeling and other assessments;
- Coordination/resolution of intercommunity flow issues; and
- Capital improvements to address flood risk.

The roles and responsibilities of the WMOs within the City are described in greater detail in Section 4.3.

2.2.4.3 Monitoring and Assessment

The City monitors and models stormwater runoff and flood risk issues within the City. The City inspects stormwater conveyance and detention facilities to maintain their intended functions consistent with the City's MS4 permit (Section 2.2.4.1). The City maintains an inventory of stormwater basins and prioritize management activities accordingly. The City updated hydrologic and hydraulic modeling in 2014 and again in 2018; results are presented in Appendix A. The City will update hydrologic and hydraulic modeling annually to incorporate new development, redevelopment, and capital improvements. The City will use model results, as needed, to assess proposed development and redevelopment activity and to evaluate areas of potential flood risk. The City will partner with the BDWMO and VRWJPO in these efforts, as opportunities allow.

2.2.4.4 Education and Public Involvement

The City supports education and civic engagement activities to promote stormwater runoff reduction and flood risk reduction within the City. Key topics include, but are not limited to:

- Stormwater runoff;
- Residential rainwater gardens;
- Low impact development (LID) practices; and
- Inflow and infiltration.

The City also works collaboratively with the Dakota County SWCD, BDWMO, and VRWJPO to distribute educational materials and promote/support outreach programs that address water quantity and flood risk issues. Information on the City's education and public involvement program is included in Section 4.5.

2.2.4.5 Ordinances, Design Standards, and Official Controls

The City manages stormwater runoff and flood risk through ordinances, design standards, and official controls. These official controls are enforced through the City's project review and permitting program. The City requires implementation of best management practices (BMPs) to limit stormwater runoff rates and volumes from development and redevelopment projects. The City also defines minimum building elevations to minimize the potential for flooding of new or significantly redeveloped structures. The ordinances, standards, and official controls are consistent with applicable WMO and State requirements. The City may need to revise its performance standards in the future in response to changing WMO, State, or Federal requirements.

City regulations and land use controls directly related to water quantity and flood risk include the following ordinances and resource management plans (as amended):

- City Code Title 10 – Subdivisions, Chapter 4: Design Standards, including:
    - Storm Drainage (Lakeville City Code, Section 10-4-6)
    - Protected Areas (Lakeville City Code, Section 10-4-7)
    - Wetlands and Watercourses (Lakeville City Code, Section 10-4-8)

- City Code Title 11 – Zoning, including:
    - Shoreland Overlay District (Lakeville City Code, Section 11-102)
    - Floodplain Overlay District (Lakeville City Code, Section 11-101)
- The South Creek Management Plan (2000, as amended)

Design standards applicable to new development and redevelopment are summarized in Table 4-3. *Note that the design standards included in Table 4-3 may not include all applicable design standards and do not replace design or performance standards required by the MPCA, BDWMO, VRWJPO, or other entities, as applicable.*

To ensure compliance with City ordinances, design standards, and official controls, the City reviews proposed projects and issues permits and/or approvals for land-disturbing projects (including developments). The City's regulatory and project review process is described in Section 4.7. In addition, the VRWJPO may review projects meeting specific triggers for compliance with WMO stormwater management criteria and other performance standards. The BDWMO may review projects at the request of the City.

Opportunities for incorporating additional water quantity and flood risk management benefits in developed areas exist primarily through redevelopment activities or public improvement projects. The City is proactive in using regulatory controls at its disposal to ensure that opportunities presented by redevelopment to improve stormwater systems and implement the policies of the WNRMP are not lost.

2.2.4.6 Capital Improvement Program

The City addresses water quantity and flood risk issues through the construction of capital improvements including stormwater basins, infiltration basins, and other BMPs. Capital improvements planned during the life of this WNRMP are summarized in Table 4-1.

2.3 Wetlands, Shorelands, and Upland Natural Areas

2.3.1 Goals

Maintain and enhance the quantity, quality, and biological diversity of wetlands, shorelands, and upland natural areas within the City.

Develop or improve recreational, wildlife, and open space areas in conjunction with water resource management projects.

2.3.2 Issues

2.3.2.1 Wetlands, Shorelands, and Buffers

Diverse wetland systems and shoreland areas are critical components of a healthy hydrologic system and positively affect soil health, groundwater and surface water quality and quantity, wildlife, fisheries, aesthetics, and recreation. Development of land and other human activities can affect the hydrologic and ecological functions of wetlands and shoreland areas. Degraded water quality in wetlands can pass on to downstream waters, contributing to degradation of additional resources. The City serves as the local governmental unit (LGU) responsible for locally administering the Wetland Conservation Act (WCA, Minnesota Rule 8420).

Many of the hydrologic, water quality, and habitat benefits achieved by wetland and shoreland areas are directly attributable to, or dependent on, the presence of buffers. Buffers are upland, vegetated areas located adjacent to wetlands and shoreland areas. Vegetation reduces sheet and rill erosion by obstructing runoff flow, thereby decreasing water velocities and allowing infiltration. Vegetation also binds sediment and other insoluble pollutants from runoff. Buffers have habitat benefits; native plants provide the best food and shelter for native wildlife, fish, and amphibians.

Establishing buffers in developed areas may be difficult, as existing structures may be located within the desired buffer area. Redevelopment offers an opportunity to establish buffers in developed areas. The City enforces vegetated buffer requirements that are consistent with the requirements of the BDWMO and VRWJPO (Table 4-3).

2.3.2.2 Aquatic Invasive Species (AIS)

Aquatic invasive species (AIS) is a term given to invasive species of plants, animals, or microorganisms that inhabit lakes, wetlands, rivers, or streams and overrun or inhibit the growth of native species. AIS are also described in Minnesota Statutes Chapter 84D.01. AIS pose a threat to natural resources and local economies that depend on natural resources.

AIS identified in the City include:

- Curlyleaf pondweed – Crystal Lake, Kingsley Lake, Lee Lake, Lake Marion, Orchard Lake;
- Eurasian watermilfoil – Crystal Lake, Lake Marion, Orchard Lake, Valley Lake;

- Yellow Iris – Kingsley Lake;
- Zebra mussels – Lake Marion; and
- Common carp – Lake Marion.

Curlyleaf pondweed is of special water quality concern due to its potential as a source of internal phosphorus loading due to the timing of its life cycle. Curlyleaf pondweed grows rapidly early in the growing season, displacing native species, before dying back in mid-summer, releasing phosphorus when conditions are favorable for algal growth.

At the state level, management of AIS is the responsibility of the MDNR. The MDNR maintains a list of infested waters on its website. Dakota County receives funding from the Minnesota Department of Revenue to prevent the introduction or limit the spread of invasive species within the County through a grant program. County staff work with cities and lake associations to identify and fund AIS management strategies. Dakota County has also developed a 2016-2020 AIS management plan. The City partners with the MDNR, WMOs, and County to address the impacts of AIS at the local level. More information about AIS is available from the MDNR and Dakota County at:

- www.dnr.state.mn.us/invasives/aquatic/index.html; and
- www.co.dakota.mn.us/Environment/WaterResources/AIS/Pages/default.aspx

2.3.2.3 Terrestrial Invasive Species (TIS)

Terrestrial invasive species (TIS) are invasive species of plants that inhabit upland areas and overrun or inhibit the growth of native species. TIS present in the City include:

- Buckthorn;
- Garlic mustard;
- Japanese knotweed; and
- Exotic honeysuckles.

As with AIS, TIS are managed at the state level by the MDNR, which provides educational material and TIS management guidance for a range of audiences. A complete list of TIS present in Minnesota is available from the MDNR website at:

- www.dnr.state.mn.us/invasives/terrestrialplants/index.html

2.3.2.4 Upland Natural Area Preservation

In addition to surface water and wetland features, the City contains significant upland natural resources, including woodlands, prairie, and other features. Natural areas provide significant benefits to the community and local ecology. Natural areas promote community quality of life, provide critical wildlife habitat, collect and infiltrate stormwater runoff, and can offset heat island impacts of urbanization.

Many of the natural resources within the City have been lost, reduced, or degraded over the course of the City's development. The City enforces local and state-mandated regulatory controls (e.g., zoning ordinance, tree preservation ordinance, shoreland ordinance) to promote the preservation of natural areas. Identification and inventory of existing natural resources allows targeted actions to prevent further natural resource loss. Restoration opportunities may also exist to expand or enhance the benefits provided by natural resource areas.

Much of the land in the City is privately owned, limiting the opportunity for the City to implement natural resource management strategies. Programs to encourage or incentivize natural resource management practices on private property may provide opportunities on these lands. Similarly, public education and outreach efforts may enhance community capacity for natural resource stewardship.

2.3.3 Policies

The following policies support the City's goal to protect, enhance, and restore wetland, shoreland, and upland natural areas, and are required per the City's MS4 permit responsibilities, WMO requirements, and/or state law:

42. The City serves as the LGU for administering the WCA (Minnesota Rule 8420). The City will inform potential developers of MDNR public waters and Corps Section 404 permit programs.

43. The City requires that wetland impacts resulting from land-disturbing activities be avoided, minimized, or mitigated (in that order) consistent with the requirements of the WCA, City zoning ordinance, and applicable WMO rules.

44. The City implements its development review process to ensure that development and redevelopment activity that may potentially impact wetland or habitat areas are consisted with the requirements of the South Creek Management Plan, City ordinances, WMO requirements, and the WCA. The City considers sensitive habitats and communities, and rare species in its review.

45. The City enforces buffer standards for wetlands, lakes, and streams at least as stringent as those required by WMOs. Minimum buffer widths are determined according to wetland classification and are described in the VRWJPO standards (2016, as amended).
46. The City limits allowable water level fluctuation (bounce) in wetlands, where feasible, according to wetland management classification as follows:
    a. Preserve: maintain existing conditions for the 50% (2-year) event
    b. Manage 1: maintain existing conditions for the 50% (2-year) event + 0.5 feet
    c. Manage 2: maintain existing conditions for the 50% (2-year) event + 1.0 foot
    d. Manage 3: no limit

The following policies support the City's goal to protect, enhance, and restore wetland, shoreland, and upland natural areas and are adopted at the discretion of the City:

47. The City identifies and pursues wetland restoration opportunities within the City as resources and opportunities allow.

48. The City protects existing wetlands (by requiring outlots through the development process) and fish and wildlife habitat areas and promotes the development of additional habitat areas.

49. The City requires development plans to consider impacts on local natural resources and corresponding receiving waters, consistent with City ordinance and project permitting requirements. Best management practices designed to minimize natural resource impacts must be identified as part of the development approval process.

50. The City requires that developers minimize impacts and restore, to the extent practical, native vegetation during and after construction projects adjacent to wetlands, water bodies, and buffers.

51. The City identifies and pursues opportunities to preserve, restore and enhance upland natural areas, shoreland, and wetland environments wherever possible.

52. The City will inventory high priority natural areas to assist in evaluating development proposals.

53. The City partners with the MDNR, WMOs, Dakota County, and other agencies in efforts to monitor and manage AIS and TIS.

54. The City considers environmentally sensitive natural resource areas when making land use management decisions.

55. The City requires that fragmentation of natural areas and corridors be avoided.

56. The City collaborates with other agencies and organizations to develop or enhance wildlife habitat corridors that connect open space, stream corridors, lake buffers, wetland buffers and stormwater management facilities.

57. The City cooperates with WMOs, Dakota County, and the Dakota County SWCD to identify, rank, and map disturbed shoreline areas at lakes and streams.

58. The City identifies stream corridor reaches for streambank erosion reduction projects, and restores damaged stream banks at priority locations, taking advantage of partnerships and cost-sharing whenever possible.

59. The City participates in the Wetland Health Evaluation Program (WHEP).

60. The City seeks opportunities to create and preserve access to public waters, where appropriate.

61. The City promotes the use of native vegetation for local government projects and private development open spaces.

62. The City supports the connection and enhancement of open spaces, outdoor recreational amenities, and cultural resources whenever possible. The City seeks opportunities to enhance open space and recreational opportunities in conjunction with water quality, flood risk reduction, or other improvements.

63. The City will consider unique site conditions, energy dissipation potential, preservation of natural features or processes, habitat, and aesthetics when designing shoreline stabilization measures.

64. The City will cooperate with the VRWJPO and other entities in activities regarding river corridor access and protection.

2.3.4 Implementation

The City seeks to protect, enhance, and restore wetland, shoreland, and upland natural areas through a range of practices and programs, including:

- Stormwater system maintenance and operations;
- Coordination with WMOs and Dakota County;
- Monitoring and assessment;
- Education and public involvement;
- Natural resource management program;
- Ordinances, design standards, and official controls; and
- Capital improvements.

These programs are described in greater detail in Section 4.0 of this WNRMP. Aspects of the above programs related to wetland, shoreland, and upland natural areas are described in the following sections.

2.3.4.1 Stormwater System Operations and Maintenance

The City is responsible for inspecting and maintaining its public stormwater collection and conveyance system. Proper maintenance ensures the stormwater system continues to provide the intended functions, which may include secondary habitat benefits (e.g., stormwater basins, rainwater gardens). The City regularly inspects and maintains key components of the system.

The City inspects stormwater management basins to identify issues that may affect the intended function of the system. Excessive sediment build-up, collected debris, and unwanted vegetation, if not addressed, can significantly reduce ecological and habitat benefits achieved by the system. The City uses inspection data and available model results to prioritize basin maintenance needs.

Owners of private stormwater facilities are responsible for facility maintenance consistent with the original performance design standards. Owners of private stormwater facilities must provide the City with a maintenance plan as part of the project SWPPP; the maintenance plan defines who will perform the inspection and maintenance, the type of maintenance, and the maintenance intervals.

Owners of private stormwater facilities are responsible for facility maintenance consistent with the original performance design standards. Owners of private stormwater facilities must provide the City with a maintenance plan as part of the project SWPPP; the maintenance plan defines who will perform the maintenance, the type of maintenance, and the maintenance intervals.

2.3.4.2 Partnerships with Watershed Management Organizations and Dakota County

The BDWMO and VRWJPO perform roles and responsibilities related to protecting, enhancing, and restoring wetland, shoreland, and upland natural areas in accordance with the authority specified in Minnesota Statutes 103B. Dakota County also manages natural resources and implements a grant program to address AIS. The MDNR, Dakota County SWCD and other agencies also served wetland and shoreland management roles. In many instances, there are opportunities for the City to partner with the BDWMO, VRWJPO, Dakota County, and others to achieve common objectives. Such opportunities may include, but are not limited to:

- Educational programs;
- Water quality and habitat monitoring;
- AIS and TIS management activities;
- Natural resource inventories and assessments; and
- Capital improvements to address wetland, shoreland, and upland natural area issues.

The roles and responsibilities of the WMOs within the City are described in greater detail in Section 4.3.

2.3.4.3 Monitoring and Assessment

The City continues to cooperate with watershed management organizations and state agencies to inventory and monitor wetland, shoreland, and upland natural areas within the City. This includes support for or participation in:

- BDWMO habitat monitoring of Crystal, Kingsley, and Orchard Lakes;
- Wetland Health Evaluation Program (WHEP); and
- Dakota County/MDNR AIS and TIS monitoring efforts.

The City maintains an inventory of wetland areas within the City and continues to inventory, classify, and assess the functions and values of wetlands on an as-needed basis. The City continues to require wetland delineations for proposed development and redevelopment projects.

The City plans to develop a natural resource inventory developed from publically available datasets and site-specific surveys. The inventory will serve as a foundation for the City's expanded Natural Resource Management Program (Section 2.3.4.4 and Section 4.4).

2.3.4.4 Natural Resource Management Program

The City of Lakeville looks to continue and expand its natural resource management program. City management activities may include:

- Protection of woodlands, especially larger tracts of pre-settlement and/or high quality woodland ecosystems. This could include varying degrees of urban forest management, depending on resources.
- Management of prairie communities. Activities within this concept may include:
    - Identification and management of larger prairie tracts, in an attempt to enhance the ecological functions of prairies;
    - Planting of prairie strips and patches in public areas where mowed grass is not necessary;
    - Providing materials (hard copy and/or online) to homeowners to assist them in introducing prairie plants in their yards; and
    - Developing natural alternatives to turf landscaping.
- Natural Resource Inventory based on publically available data sets or site specific surveys;
- Enhancing connectivity of remnant natural areas (i.e., natural resource corridors).
- Wildlife habitat enhancements, including constructed habitats from natural materials for a range of small mammals, birds, or other species.
- Promoting pollinators.
- Creek restoration activities.

The City uses its education and public involvement program to build community interest and engagement for natural resource stewardship. The City may also consider the feasibility of creating or supporting programs to incentivize natural resource management practices on private property. Grant funding from watershed management organizations or Dakota County SWCD may be available to promote such programs.

As part of ongoing natural resource management activities, the City plans to evaluate wetlands and former wetland areas to identify and prioritize wetland restoration and enhancement opportunities. Wetland restoration priorities may consider estimated ease of hydrologic restoration, quality/size of existing buffer, public/private ownership, and existing vegetation quality. Generally, priority sites for wetland restoration and enhancement are those that have experienced minor alterations in hydrology or have high floral diversity and large buffer areas.

2.3.4.5 Education and Public Involvement

The City supports education and civic engagement activities to promote the protection, enhancement, and restoration of wetland, shoreland, and upland natural areas through increased public awareness and engagement. The City's education and public involvement program is closely tied with, but not limited to, the City's implementation of its NPDES MS4 permit. The City develops and distributes articles and information regarding water, wetland, shoreland, and upland natural area issues, including, but not limited to:

- Management of AIS and TIS;
- Vegetated buffers and shoreline management;
- Habitant enhancement and pollinator promotion; and
- Residential rainwater gardens.

The City works collaboratively with the Dakota SWCD, BDWMO, and VRWJPO in distributing water quality educational materials and promoting/supporting outreach programs with habitat and ecological benefits, including:

- Landscaping for Clean Water workshops (Dakota SWCD)
- Volunteer stream monitoring (VRWJPO)
- Wetland Health Evaluation Program (Dakota SWCD)

Information on the City's education and public involvement program is included in Section 4.5.

2.3.4.6 Ordinances, Design Standards, and Official Controls

The City protects wetlands, shorelands, and upland natural areas through ordinances, design standards, and official controls. These official controls are enforced through the City's project review and permitting program. The ordinances, standards, and official controls are consistent with applicable WMO and State requirements. The City may need to revise its performance standards in the future in response to changing WMO, State, or Federal requirements.

City regulations and land use controls directly related to protecting wetlands, shorelands, and upland natural areas include the following ordinances and resource management plans (as amended):

- City Code Title 10 – Subdivisions, Chapter 4: Design Standards, including:
    - Storm Drainage (Lakeville City Code, Section 10-4-6)
    - Protected Areas (Lakeville City Code, Section 10-4-7)
    - Wetlands and Watercourses (Lakeville City Code, Section 10-4-8)
- City Code Title 11 – Zoning, including:
    - Shoreland Overlay District (Lakeville City Code, Section 11-102)
    - Floodplain Overlay District (Lakeville City Code, Section 11-101)
- The South Creek Management Plan (2000, as amended)

The City serves as the LGU responsible for administering the WCA. As the LGU, the City's role includes requiring and verifying that all projects impacting wetlands meet the requirements of the WCA. The City's performance standards related to wetland and shoreland impacts are consistent with applicable WMO requirements.

Design standards applicable to new development and redevelopment are summarized in Table 4-3. *Note that the design standards included in Table 4-3 may not include all applicable design standards and do not*

replace design or performance standards required by the MPCA, BDWMO, VRWJPO, or other entities, as applicable.

To ensure compliance with City ordinances, design standards, and official controls, the City reviews proposed projects and issues permits and/or approvals for land-disturbing projects (including developments). The City's regulatory and project review process is described in Section 4.7. In addition, the VRWJPO may review projects meeting specific triggers for compliance with WMO criteria and performance standards. The BDWMO may review projects at the request of the City.

2.3.4.7 Capital Improvement Program

The City may address issues related to wetlands, shorelands, and upland natural areas through the construction of capital improvements (e.g., restoration projects). Restoration projects are often coordinated with construction or renewal of stormwater management infrastructure. Capital improvements planned during the life of this WNRMP are summarized in Table 4-1.

2.4 Groundwater

2.4.1 Goal

Protect groundwater quality and quantity to preserve it for sustainable and beneficial purposes.

2.4.2 Issues

2.4.2.1 Groundwater Sustainability and Recharge

Groundwater is a valuable resource that must be protected from contamination and conserved for sustainable use. The City obtains its drinking water from wells extending into the Prairie du Chien-Jordan and St. Peter bedrock aquifers (Section 3.5.1). Increased population in the Twin Cities metropolitan area has put increased pressure on these aquifers. In addition, development results in larger impervious areas and more compacted soils, thus decreasing opportunities for infiltration and recharge.

Infiltration of stormwater runoff provides opportunities for groundwater recharge. However, infiltration may have negative consequences in areas with vulnerable groundwater resources (Section 2.4.2.2).

Voluntary conservation practices may significantly reduce the consumptive use of groundwater and promote groundwater sustainability. Examples include the use of low-flow plumbing fixtures, "smart" irrigating systems, rainwater capture, and water reuse.

2.4.2.2 Groundwater Quality and Wellhead Protection

Maintaining clean, safe groundwater supplies is critical to human and environmental health. Groundwater can be contaminated by commercial and industrial waste disposal, landfills, leaking underground storage tanks, subsurface sewage treatment systems (SSTS), accidental spills, feedlots, and fertilizer/pesticide applications. In some areas of the City, the Prairie du Chien-Jordan aquifer has a high sensitivity to

contamination due to the local geological setting and provides a relatively low level of protection (MGS, 1990).

Due to the sensitivity of the bedrock aquifer to contamination, infiltration practices must be implemented with consideration of guidance provided by the MPCA in its NPDES General Construction Stormwater permit (2013, as amended) and the MDH's *Evaluating Proposed Stormwater Infiltration Projects in Vulnerable Wellhead Protection Areas* (2007).

The MDH administers and enforces the Minnesota Water Well Code through its wellhead protection program. This program regulates the installation of new wells, and is intended to prevent contaminants from entering the recharge zones of public well supplies. As part of this program, cities that pump groundwater to supply their residents with drinking water are required to prepare WHPPs.

The City maintains a current WHPP, most recently updated in 2014.

2.4.2.3 Groundwater-Surface Water Interaction

The interaction of groundwater and surface water can have negative consequences on either resource. Contaminated groundwater discharged to surface waters may have a direct impact on surface water quality and/or habitat. Declines in groundwater levels may result in decreased water levels in lakes, which may limit recreational use, reduce habitat areas, and result in increased growth of aquatic plants including invasive species (via an increased littoral zone). These impacts are difficult to estimate due to the difficulty in quantifying the exchange of water between surface waters and groundwater.

2.4.3 Policies

The following policies support the City's goal to protect and conserve groundwater, and are required per the City's MS4 permit responsibilities, WMO requirements, and/or state law:

65. The City will continue to implement and update, as necessary, the City of Lakeville Wellhead Protection Plan.

66. The City requires that stormwater infiltration and filtration practices be designed and implemented consistent with the requirements of the NPDES Construction Stormwater General Permit (2013, as amended) and guidance provided in the Minnesota Department of Health's Evaluating Proposed Stormwater Infiltration Projects in Vulnerable Wellhead Protection Areas (MDH, 2007).

The following policies support the City's goal to protect and conserve groundwater and are adopted at the discretion of the City:

67. The City considers impacts to groundwater and potential groundwater-surface water interaction in the design and review of proposed projects to promote the conservation of groundwater quantity and quality.

68. The City continues to work with the Dakota County Health Department in ensuring that abandoned wells are properly sealed according to the Minnesota Department of Health Well Code.

69. The City considers impacts to base flow of the Vermillion River and its tributaries, and other potential groundwater-surface water interactions, in the design and review of proposed projects.

70. The City minimizes discharges of fecal coliform bacteria, nitrate, and other pollutants to groundwater and surface waters of the City through the enforcement of City code and development review process.

71. The City cooperates with the County's efforts to inventory non-functioning SSTS (septic systems) and jointly prioritize areas for SSTS upgrades.

72. The City uses the Dakota County Well Management database, and other available groundwater data, in plan and permit reviews, as needed.

73. The City will collaborate with local and state agencies, as opportunities allow, in groundwater management planning efforts to gain a better understanding of groundwater-surface water interaction and develop management strategies that consider the protection of both resources. The role of the City may include:

    - Collaboration with state and local agencies to identify data gaps and attempt to fill those gaps by providing groundwater, surface water, and stream monitoring data;
    - Coordination with appropriate local and state agencies to estimate thresholds for sustainable aquifer use;
    - Cooperation with appropriate local and state agencies to periodically assess the vulnerability of groundwater used for drinking water supplies; and
    - Coordination with appropriate local and state agencies to develop and utilize tools to assess impacts of groundwater use (e.g., groundwater modeling).

2.4.4 Implementation

The City seeks to protect and conserve groundwater through a range of practices and programs, including:

- Coordination with WMOs and Dakota County;
- Monitoring and assessments;
- Education and public involvement;
- Ordinances, design standards, and official controls; and
- Capital improvements.

These programs are described in greater detail in Section 4.0 of this WNRMP. Aspects of the above programs related to protecting and conserving groundwater are described in the following sections.

2.4.4.1 Partnerships with Watershed Management Organizations and Other Agencies

The BDWMO and VRWJPO performs roles and responsibilities related to protecting and conserving groundwater resources in accordance with the authority specified in Minnesota Statutes 103B. The MDNR, MHD, and other organizations also perform roles related to the protection and management of groundwater resources. In many instances, there are opportunities for the City to cooperate with the WMOs and other agencies to achieve common objectives. Such opportunities may include, but are not limited to:

- Coordination of educational programs;
- Collaboration with WMOs and/or state and local agencies to identify and fill data gaps;
- Cooperation with WMOs and/or state agencies to periodically assess the vulnerability of groundwater used for drinking water supplies;
- Coordination with appropriate local and state agencies to develop and utilize tools to assess surface water and groundwater impacts (e.g., groundwater modeling); and
- WMO review of updates to the City's WHPP.

The roles and responsibilities of the WMOs within the City are described in greater detail in Section 4.3.

2.4.4.2 Monitoring and Assessment

The City will continue to cooperate with WMOs and State agencies to support or perform monitoring and assessment of groundwater resources. This includes support for or participation in:

- Monitoring of temperature and flow in tributaries to the Vermillion River; and
- Assessment of groundwater resources performed as part of the City's WHPP.

The City's WHPP delineates DWSMAs for the City's municipal groundwater wells and assesses the water supply's susceptibility to contamination from activities on the land surface. The DWSMA represents the boundaries of the recharge area to the well and is the area to be protected and managed by the wellhead protection plan. The City's DWSMAs are presented in the City's WHPP.

Future monitoring and assessment efforts could include assessment of groundwater-surface water interaction within the City and other collaborative monitoring efforts between the City, Dakota County, and WMOs.

2.4.4.3 Education and Public Involvement

The City supports education and civic engagement activities to promote the protection and conservation of groundwater through increased public awareness and engagement. The City's education and public involvement program is closely tied with, but not limited to, the City's implementation of its NPDES MS4

permit. The City develops and distributes articles and information regarding groundwater issues, including, but not limited to:

- Infiltration and groundwater recharge practices;
- Wellhead protection;
- Water conservation and reuse; and
- Pollution prevention.

The City also works collaboratively with the Dakota County SWCD, BDWMO, and VRWJPO in distributing water quality educational materials and promoting/supporting outreach programs that promote groundwater protection and conservation, including:

- Landscaping for Clean Water workshops (Dakota SWCD).

Information on the City's education and public involvement program is included in Section 4.5.

2.4.4.4 Ordinances, Design Standards, and Official Controls

The City protects and conserves groundwater resources ordinances, design standards, and official controls. These official controls are enforced through the City's project review and permitting program. The City's Wellhead Protection Plan addresses groundwater issues directly, while City ordinances generally address groundwater protection indirectly through appropriate management of stormwater runoff. The City may need to revise its performance standards in the future in response to changing WMO, State, or Federal requirements.

City regulations and land use controls that impact groundwater include the following ordinances and resource management plans (as amended):

- Wellhead Protection Plan
- City Code Title 10 – Subdivisions, Chapter 4: Design Standards, including:
    - Storm Drainage (Lakeville City Code, Section 10-4-6)
    - Protected Areas (Lakeville City Code, Section 10-4-7)
- City Code Title 11 – Zoning
- The South Creek Management Plan (2000, as amended)

Design standards applicable to new development and redevelopment are summarized in Table 4-3. *Note that the design standards included in Table 4-3 may not include all applicable design standards and do not replace design or performance standards required by the MPCA, BDWMO, VRWJPO, or other entities, as applicable.*

The City's WHPP delineates drinking water supply management areas (DWSMA) for the City's municipal groundwater wells, assesses the water supply's susceptibility to contamination from activities on the land surface, and establishes management programs, such as identification and sealing of abandoned wells,

and education/public awareness programs. If the City determines that a proposed infiltration/discharge may potentially cause adverse effects to the local drinking water supply, the City will prohibit the construction of the infiltration area or incorporate the necessary BMPs to reduce the identified pollutant(s) prior to infiltrating into the highly vulnerable portions of the DWSMA.

To ensure compliance with City ordinances, design standards, and official controls, the City reviews proposed projects and issues permits and/or approvals for land-disturbing projects (including developments). The City's regulatory and project review process are described in Section 4.7. In addition, the VRWJPO may review projects meeting specific triggers for compliance with WMO criteria and performance standards. The BDWMO may review projects at the request of the City.

2.4.4.5 Capital Improvement Program

The City addresses water and natural resource management issues through the construction of capital improvements including stormwater basins, infiltration basins, and other BMPs. Capital improvements planned during the life of this WNRMP are summarized in Table 4-1. The City will also seek opportunities to incorporate benefits for groundwater resources into planned water quality, flood risk reduction, or other projects. The City may also support the MDNR, WMOs, or other entities in performing studies, research, or pilot projects to address groundwater issues.

3.0 Water and Natural Resources Inventory

3.1 Climate and Precipitation

Lakeville has a humid continental climate, characterized by moderate precipitation, wide daily temperature variations, large seasonal variations in temperature, warm humid summers, and cold winters with moderate snowfall.

Average total annual precipitation at the Minneapolis-St. Paul International Airport (MSP) station is 30.6 inches. The mean monthly precipitation varies from 4.3 inches in August to 0.9 inches in January. From May to September, growing season months, the average rainfall is 19.0 inches or about 62 percent of the average annual precipitation. Average annual lake evaporation is about 31 inches. Average annual snowfall is 54.4 inches at the MSP station. Average climate data from the MSP station is available from the MDNR at: https://www.dnr.state.mn.us/climate/historical/annual.html

Average weather imposes little strain on the typical drainage system. Extremes of precipitation and snowmelt are important for design of stormwater management and flood risk reduction systems. The NOAA has data on extreme precipitation events that can be used to aid in the design of stormwater management and flood risk reduction systems.

NOAA published Atlas 14, Volume 8, in 2013. Atlas 14 is the primary source of information regarding rainfall in the region. Atlas 14 supersedes publications TP-40 and TP-49 issued by the National Weather Bureau (now the National Weather Service) in 1961 and 1964. Improvements in Atlas 14 precipitation estimates include denser data networks, longer (and more recent) periods of record, application of regional frequency analysis, and new techniques in spatial interpolation and mapping. Atlas 14 provides estimates of precipitation depth (i.e., total rainfall, in inches) and intensity (i.e., depth of rainfall over a specified period) for durations from 5 minutes up to 60 days.

Runoff from spring snowmelt is significant in this region but is not provided in Atlas 14. The Soil Conservation Service's (now the Natural Resources Conservation Service) National Engineering Handbook, Hydrology, Section 4, presents maps of regional runoff volume. Table 3-1 lists selected precipitation and runoff events used for design purposes.

It is important to note that the frequency (also called recurrence interval or return period) of a given storm event is a function of probability. The recurrence interval or return period describes the average time between events of a given magnitude expected over extremely long periods of time. The inverse of the recurrence interval is the probability of a given event occurring in any single year (e.g., a 100 year event has a 1% chance of occurring in any single year). The return period implies nothing about the actual time sequence of the event. For example, two 100 year events could occur in consecutive years, or even within a single year.

Table 3-1 Selected Rainfall and Snowmelt Runoff Events

Type	Percent chance of occurring in a given year	Depth (inches) during 24 hour event	Depth (inches) during 4 day event	Depth (inches) during 10 day event
Rainfall	50% annual occurrence	2.80	3.70	4.91
	20% annual occurrence	3.48	4.41	5.86
	10% annual occurrence	4.16	5.12	6.70
	4% annual occurrence	5.28	6.28	7.95
	2% annual occurrence	6.29	7.31	8.97
	1% annual occurrence	7.41	8.45	10.1
Snowmelt[1]	10% annual occurrence	--	--	4.7
	4% annual occurrence	--	--	5.7
	2% annual occurrence	--	--	6.4
	1% annual occurrence	--	--	7.1

Source: NOAA Atlas 14 – Volume 8. Station: Farmington 3NW (21-2737). Hydrology Guide for Minnesota (USDA Soil Conservation Service – NRCS)

[1] Snowmelt depth reported as liquid water.

Even with wide variations in climate conditions, climatologists have found four significant climate trends in the Upper Midwest (NOAA, 2013):

- Warmer winters;
- Higher minimum temperatures;
- Higher dew points; and
- Changes in precipitation trends – more rainfall is coming from heavy thunderstorm events and increased snowfall.

According to NOAA's 2013 assessment of climate trends for the Midwest (NOAA, 2013), annual and summer precipitation amounts in the Midwest are trending upward, as is the frequency of high intensity storms. Higher intensity precipitation events typically produce more runoff than lower intensity events with similar total precipitation amounts; higher rainfall intensities are more likely to overwhelm the capacity of the land surface to infiltrate and attenuate runoff. Precipitation records in the Twin Cities area show that the average annual precipitation has increased (Minnesota Climatology Working Group, 2016).

Additional climate information can be obtained from a number of sources, such as the following:

- For climate information about the Twin Cities metropolitan area: http://www.dnr.state.mn.us/climate/twin_cities/index.html
- Local data available from the Midwestern Regional Climate Center: http://mrcc.isws.illinois.edu/CLIMATE/

- For a wide range of Minnesota climate information: http://www.nws.noaa.gov/climate/index.php?wfo=mpx

3.2 Topography, Watersheds, and Drainage Patterns

The City's topography is a result of its geologic history and generally includes three geologic features (or landforms):

- Glacial moraines (termination points of a glacial advance) cover large areas in the north and west of the City. This landform, also called knob and kettle topography, is characterized by rolling to hilly terrain interspersed with poorly drained depressions that form many deep wetlands and lakes.
- Outwash plains extend from northwest to southeast across the City. Outwash plains were created as water from the melting glaciers reworked the debris carried by the glaciers. Outwash plains contain some of the richest gravel deposits in the metropolitan area.
- Upland terrain located in the center of the City is separated from the highlands in the southwest by a low-lying area which includes Lake Marion and drains to the southeast into South Creek and eventually the Vermillion River.

Topography within the City is presented in Figure 3-1. Elevations within the City range from a maximum of about 1,200 feet to a minimum of about 900 feet (MDNR LiDAR, 2011).

Urbanization of the City over time has altered the local topography of the watershed. With these land alterations, drainage patterns have become more defined. The City is subdivided into two major watersheds: the Black Dog watershed (tributary to the Minnesota River) and the Vermillion River watershed (tributary to the Mississippi River). These major watersheds fall under the jurisdictions of the BDWMO and VRWJPO, respectively. The legal boundaries of these WMOs are shown in Figure 3-1. Within these two major watersheds there are six drainage districts, including:

- Crystal Lake drainage district;
- Farmington Outlet drainage district;
- Lake Marion drainage district;
- North Creek drainage district;
- Orchard Lake drainage district; and
- South Creek drainage district.

The six drainage districts are described in greater detail in 3.8. The City has further subdivided its drainage area into smaller subwatershed areas for the purposes of stormwater and surface water management and planning activities (e.g., water quality and water quantity modeling). These subwatersheds are presented in the figures included in Appendix A.

3.3 Land Use

The City contains diverse areas of residential neighborhoods, commercial and industrial developments, and park and recreation facilities. Current land use information is presented in Figure 3-2. Estimated future land use for the year 2040 is presented in Figure 3-3. More detailed information about current and future land use can be found in the City's Comprehensive Plan.

Changes in land use are expected to be modest over the life of this Plan. Continued development of undeveloped areas shown in Figure 3-2 is expected, as is a limited amount of redevelopment in older areas of the City. Redevelopment with or without land use changes may provide opportunities to implement a variety of stormwater BMPs to improve water quality, reduce the risk of flooding, provide habitat, or achieve other benefits. The City encourages the use of environmentally beneficial practices with redevelopment, where opportunities allow.

3.4 Soils

Soil composition, slope, and land management practices determine the impact of soils on water resource issues by affecting the rate and volume of stormwater runoff. The shape and stability of aggregates of soil particles influence the permeability, infiltration rate, and erodibility (i.e., potential for erosion) of soils. Slope is important in determining stormwater runoff rates and susceptibility to erosion.

Infiltration capacities of soils affect the amount of direct runoff resulting from rainfall. Higher infiltration rates lower the potential for runoff from the land, as more precipitation is able to enter the soil. Conversely, soils with low infiltration rates produce high runoff volumes and high peak discharge rates, as most or all of the rainfall moves as overland flow.

The NRCS has established four HSGs. These groups are:

- Group A Low runoff potential—high infiltration rate
- Group B Moderate infiltration rate
- Group C Slow infiltration rate
- Group D High runoff potential—very slow infiltration rate

Combined with land use, the HSG classifications (A through D) may be used to estimate the amount of runoff that will occur over a given area for a particular rainfall amount. As land is developed for urban use, much of the soil is covered with impervious surfaces, and soils in the remaining areas are significantly disturbed and altered. Development often results in consolidation of the soil and tends to reduce infiltration capacity of otherwise permeable soils, resulting in significantly greater amounts of runoff.

There are many different soil types within each hydrologic group. Lakeville soils generally consist of well-drained soils formed in loamy and sandy glacial till and outwash. HSGs present within the City are shown in Figure 3-4. Group C soils are concentrated in the western portion of the City while Group B soils occupy much of the eastern part of the City. Group D soils are frequently mixed with Group B soils where swales

occur, especially along South Creek, North Creek, and channels in the Farmington Outlet drainage district. HSG classifications data provided by the NRCS are approximate. For proposed projects incorporating infiltration of stormwater runoff, soils should be evaluated for suitability on a site-by-site basis.

The most recent information from the NRCS soil survey is available online at: https://websoilsurvey.nrcs.usda.gov/app/

Additional information about soil types and distributions within the City is available from the *Soil Survey of Dakota County, Minnesota* (NRCS, as amended).

3.5 Geology and Groundwater Resources

The City is located in the southwestern portion of a bowl-like bedrock structure underlying the Minneapolis-St. Paul metropolitan area (called the Twin Cities basin), which has a gentle slope to the southeast. The bedrock is overlain by a layer of glacial drift which varies from over 300 feet thick in the southwestern part of the City and to less than 50 feet in the northeastern part of the City. Generally, there is no uniform relationship between the existing surface topography and the bedrock structure. The bedrock underlying Lakeville includes the Platteville and Glenwood formation in the north, St. Peter sandstone in the northeast, and Prairie du Chien formation in the southern and eastern parts of the City.

The surficial geology present near or at the land surface is a product of glaciation that occurred approximately 10,000 years ago and left areas of glacial moraines (the termination point of a glacial advance) and outwash plains (formed by melting glacier). Deposits from the superior lobe include moraines of glacial till characterized by reddish-brown sandy loam, cobbles, and boulders in the central and western parts of the City, and outwash plains comprised of gravel and sand in the eastern and southeastern part of the City.

3.5.1 Bedrock Aquifers

Dakota County is underlain by six major bedrock aquifers: (1) Platteville Limestone, (2) St. Peter Sandstone, (3) Prairie du Chien-Jordan, (4) St. Lawrence-Franconia Dolomite, (5) Wonewoc Sandstone (formerly Ironton-Galesville Sandstones), and (6) Mt. Simon-Hinckley Sandstones. In addition, there are numerous aquifers in the glacial drift.

The City uses groundwater for its municipal water supplies, primarily from the Prairie du Chien-Jordan and St. Peter aquifers. Most of the City's municipal wells draw water from the Prairie du Chien-Jordan aquifer. The Prairie du Chien-Jordan aquifer is confined in most areas, has high yields, and is continuous through most of the City. Private wells in central and northeast parts of the City typically utilize the St. Peter sandstone. The St. Peter aquifer varies between confined and unconfined conditions depending on location.

3.5.2 Surficial Aquifers

Surficial aquifers are water-bearing layers of sediment, usually sand and gravel, which lie close to the ground surface. Some private domestic wells remain in the City and draw water from these aquifers. Since the surficial aquifers are more susceptible to pollution, they are generally not used for municipal or public supply wells. The depth of the water table varies across the watershed, but is on the order of tens of feet.

Recharge to the surficial aquifers is primarily through the downward percolation of local precipitation. The basins, lakes, wetlands, and streams scattered throughout the City recharge the groundwater. Some of these waterbodies are landlocked and their only outlet is to the groundwater; some landlocked lakes may be perched above the regional level of the shallow groundwater in the watershed. Some surficial aquifers may also be recharged during periods of high stream stage. Surficial aquifers may discharge to local lakes, streams or to the underlying bedrock.

3.5.3 Wellhead Protection Areas

The increased population in the Twin Cities metropolitan area has put increased pressure on groundwater quantity and quality. The MDH is responsible for the protection of groundwater quality and aims to prevent contaminants from entering the recharge zones of public water supply wells through its wellhead protection program. This includes the development of WHPPs and guidance to limit potential for groundwater contamination. Wellhead protection efforts may restrict or prevent the use of certain stormwater BMPs within these areas to prevent possibly contaminated stormwater from reaching groundwater supplies. The City maintains a WHPP consistent with MDH requirements (Section 4.7.2). Figure 3-5 shows the delineated wellhead protection areas within and around the City.

3.6 Surface Waters

3.6.1 MDNR Public Waters

The MDNR designates certain water resources as public waters to indicate those lakes, wetlands, and watercourses over which the MDNR has regulatory jurisdiction. By statute, the definition of public waters includes "public waters," "public waters wetlands," and "public watercourses." The collection of public waters and public waters wetlands designated by the MDNR is generally referred to as the public waters inventory, or PWI.

Public waters are all basins and watercourses that meet the criteria set forth in Minnesota Statutes, Section 103G.005, subd. 15 that are identified on public water inventory maps and lists authorized by Minnesota Statutes, Section 103G.201. Public waters wetlands include all Type 3, Type 4, and Type 5 wetlands, as defined in U.S. Fish and Wildlife Service Circular No. 39, 1971 edition that are 10 acres or more in size in unincorporated areas or 2.5 acres or more in size in incorporated areas (see Minnesota Statutes Section 103G.005, subd. 15a and 17b). A MDNR permit is required for work within designated public waters.

The MDNR uses county-scale maps to show the general location of the public waters and public waters wetlands under its regulatory jurisdiction. These maps are commonly known as PWI maps. PWI maps also show public waters watercourses and public ditches. The regulatory boundary of these waters and wetlands is called OHWL. The PWI maps and lists are available on the MDNR's website at: http://www.dnr.state.mn.us/waters/watermgmt_section/pwi/maps.html

Figure 3-6 shows the waters, wetlands, and streams listed on the MDNR PWI located in the City. There are nine designated and numbered public waters lakes within the City, including the following:

- Crystal Lake (MDNR ID 19-0027);
- Horseshoe Lake (MDNR ID 19-0032);
- Kingsley Lake (MDNR ID 19-0030);
- Lee Lake (MDNR ID 19-0029);
- Lake Marion (MDNR ID 19-0026);
- Orchard Lake (MDNR ID 19-0031);
- Unnamed Lake (MDNR ID 19-00397);
- Unnamed Lake (MDNR ID 19-00397); and
- Unnamed Lake (MDNR ID 19-00397).

3.6.2 BDWMO Strategic Waterbodies and Waterbody Classification

The 2012 BDWMO Plan classifies certain waterbodies as BDWMO strategic waterbodies based on criteria including intercommunity drainage area, regional recreational or natural resource significance, and other factors (Section 3.1.4 of the 2012 BDWMO Plan). The BDWMO manages strategic water bodies to prevent water quality degradation by assigning action levels to these water bodies based on recent water quality data. BDWMO strategic waterbodies within or adjacent to the City include:

- Crystal Lake,
- Kingsley Lake; and
- Orchard Lake.

The BDWMO further classifies waterbodies as "Category I" through "Category IV" based on existing and future intended uses (Section 3.1.5 of the 2012 BDWMO Plan). Category I includes waterbodies used for direct contact recreational activity (i.e., swimming) and include Crystal and Orchard Lakes. Kingsley Lake is classified as Category II for non-contact recreational use (e.g., boating).

3.6.3 Lakes

Major lakes in the City include the six named MDNR public waters lakes identified in Section 3.6.1 as well as Valley Lake and East Lake, which are classified as MDNR public waters wetlands. Detailed information regarding lake outlets and elevation is included in the stormwater system analysis included as Appendix

Additional information is available from the MDNR Lakefinder website at: https://www.dnr.state.mn.us/lakefind/index.html

3.6.3.1 Crystal Lake

Crystal Lake is approximately 300 acres in area. Most of that area lies within the City of Burnsville, but approximately 9 acres of area and a half mile of shoreline are located within the City of Lakeville. The cumulative tributary watershed within the City is approximately 1,500 acres (including the area tributary to Lee Lake). The lake outlet is located at the northwest end of the lake in the City of Burnsville and consists of a box weir with an overflow elevation of 933.7 feet NAVD88. The ordinary high water level (OHW) for the lake is listed by the MDNR Lakefinder website as 934.5 ft NGVD29 (934.7 ft NAVD88). The lake has an average depth of 10 feet and a maximum depth of 35 feet. The lake is a major recreational resource for the area. A public beach and public boat landing in the City of Burnsville provide opportunities for swimming, fishing, water skiing and aesthetic viewing. Crystal Lake is a BDWMO Category I strategic water body (Section 3.6.2) and is classified as a deep lake by the MPCA. The Dakota County FIS (see Section 3.9.1) includes Crystal Lake within the mapped Zone AE floodplain and identifies the 1% floodplain elevation as 936 feet NAVD88 (i.e., the RFPE is 937 feet NAVD88).

3.6.3.2 Kingsley Lake

Kingsley Lake is approximately 40 acres in area and drains a watershed of approximately 180 acres. The lake surface area grows to nearly 80 acres when the adjacent wetland area is included. Kingsley Lake has a maximum depth of 13 feet. The lake is shallow enough that aquatic plants could grow over the entire lake bed so the entire lake is littoral area. The lake drains into Orchard Lake by a culvert located at the OHW of 978.5 feet NGVD29 (978.7 feet NAVD88).

The lake provides canoeing opportunities for lake residents. Aesthetic and wildlife viewing are also popular recreational uses of the lake. A private camp is also located on the lake. Kingsley Lake is a BDWMO Category II strategic water body (Section 3.6.2) and is considered a shallow lake by the MPCA. The Dakota County FIS (see Section 3.9.1) includes Kingsley Lake within the mapped Zone A floodplain (i.e., inundation areas are mapped but an elevation is not listed).

3.6.3.3 Lee Lake

Lee Lake is approximately 22 acres in area with a tributary watershed of 313 acres. The average depth of the lake is 7 feet and the maximum depth is about 15 feet. The lake is surrounded by privately owned property. Lee Lake is located within the BDWMO but is not classified as a strategic waterbody by the BDWMO. The lake is classified as a shallow lake by the MPCA.

Originally, Lee Lake was landlocked and experienced high flood levels until 1993 when a gated outlet to Crystal Lake was constructed. The Lee Lake outlet is located on the east side of the lake and is a stop log weir at the OHW (elevation 948.5 feet NGVD29) followed by a 36 inch gated structure (at an elevation of 947.2 feet NAVD88). Water levels in Lee Lake are typically below the outlet elevation. The Dakota County

FIS (see Section 3.9.1) includes Lee Lake within the mapped Zone A floodplain (i.e., inundation areas are mapped but an elevation is not listed).

3.6.3.4 Lake Marion

Lake Marion is the largest lake in the City with an area of approximately 600 acres and a tributary watershed of approximately 5,000 acres (about 8 square miles). Lake Marion has a maximum depth of about 21 feet. Lake Marion is bounded by several parks and private residences and includes public boat access, a beach, and two fishing piers. The OHW for the lake is listed by the MDNR Lakefinder website as 983.1 ft NGVD29 (983.3 ft NAVD88). Lake Marion outlets into a channel which joins South Creek (locally known as the North Branch of South Creek) before leaving the City. The Dakota County FIS (see Section 3.9.1) includes Lake Marion within the mapped Zone AE floodplain and identifies the 1% floodplain elevation as 985 feet NAVD88 (i.e., the RFPE is 986 feet NAVD88).

3.6.3.5 Orchard Lake

Orchard Lake is located in the northwest corner of the City. It has an area of about 240 acres and a tributary watershed of approximately 1,900 acres (about 3 square miles). It is the deepest lake in the City, with a maximum depth of 33 feet; the average depth is about 10 feet. The lake outlet is located on the west shore and discharges toward Credit River through Murphy Hanrehan Park Reserve. The OHW for the lake is listed by the MDNR Lakefinder website as 977.6 ft NGVD29 (977.8 ft NAVD88).

The lake is used primarily for fishing, but swimming, boating, and aesthetic and wildlife viewing are also popular recreational uses of the lake. Three City parks—a public boat access on the south shore (Orchard Lake Park), one public beach on the west shore (Orchard Lake Beach), and Wayside Park—are located on Orchard Lake. Orchard Lake is a BDWMO Category I strategic water body and is classified as a deep lake by the MPCA. The Dakota County FIS (see Section 3.9.1) includes Orchard Lake within the mapped Zone A floodplain (i.e., inundation areas are mapped but an elevation is not listed).

3.6.3.6 Horseshoe Lake

Horseshoe Lake is approximately 12 acres in area and is split into east and west halves by a rail line. The lake is located in the far northwest part of the City on the border with the City of Burnsville within the Orchard Lake drainage district (Section 3.8.1). The total tributary area to the lake is approximately 140 acres. Approximately seven acres of the lake, including the south half of both east and west halves, is located within the City. The lake is surrounded by residential and undeveloped land and is without public access. The lake drains north through the City of Burnsville to the Credit River.

3.6.3.7 Valley Lake (Public Water Wetland)

Valley Lake is approximately 8 acres in area and with a maximum depth of 10 feet. Valley Lake receives flow from a 117-acre tributary watershed located in the North Creek drainage district and is located within the VRWJPO (Section 3.8.3). Valley Lake outlets to the south toward North Creek. This is a human-created lake located entirely within Valley Lake Park; the park has a swimming beach and fishing pier. Valley Lake is classified as a public water wetland by the MDNR (Section 3.6.1). The Dakota County FIS (see

Section 3.9.1) includes Valley Lake within the mapped Zone AE floodplain and identifies the 1% floodplain elevation as 936 feet NAVD88 (i.e., the RFPE is 937 feet NAVD88).

3.6.3.8 East Lake (Public Water Wetland)

East Lake is 41 acres in areas and is located in the North Creek drainage district within the VRWJPO (Section 3.8.3). East Lake is located within East Lake Community Park, which includes walking paths and a footbridge crossing a narrow portion of the East Lake. Valley Lake outlets to the south toward North Creek. East Lake is classified as a shallow lake by the MPCA, and is included on the list of impaired waters (Section 3.7.2.1). East Lake is classified as a public water wetland by the MDNR (Section 3.6.1). The Dakota County FIS (see Section 3.9.1) includes East Lake within the mapped Zone AE floodplain but the base flood elevation is not listed.

3.6.4 Wetlands

Wetlands fill a number of roles in the landscape, including improving water quality, and providing floodwater retention. They are also a critical habitat component for many species of wildlife and often contribute significantly to the aesthetics of an area. Nationally, the U.S. Fish and Wildlife Service (USFWS) is responsible for mapping wetlands across the country, including those in Lakeville. The USFWS identifies and delineates wetlands, produces detailed maps on the characteristics and extent of wetlands, and maintains a national wetlands database as part of the National Wetland Inventory (NWI). The NWI is primarily based on aerial photo-interpretation. As a result, the NWI may not include all wetlands, and ground conditions may differ from mapped wetlands. The NWI is periodically updated based on available imagery (last updated within the City in 2011).

The NWI identified approximately 450 wetlands within the City; NWI wetlands are presented in Figure 3-7. The City also inventoried, classified, and assessed approximately 350 wetlands during its 1999/2000 inventory. The City's inventory and assessment methodology is based on the Minnesota Routine Assessment Method (MnRAM) for evaluating wetlands. Additionally, the BDWMO, VRWJPO, and Dakota SWCD have performed wetland inventories of various extents.

The City adopted buffer standards and management strategies for wetlands according to their management classifications and consistent with the requirements of the BDWMO and VRWJPO (see Section 4.7.4).

3.6.5 Streams

The City contains over 50 miles of public water watercourses (see Figure 3-6). These streams are located in the North Creek, Farmington Outlet, Lake Marion, and South Creek drainage districts (see Section 3.8). Several intermittent streams drain to Lake Marion from the uplands located to the northeast and southwest of the lake.

In the North Creek drainage district, North Creek flows from west to east for approximately six miles before entering the City of Farmington. Along that path, various intermittent streams enter from the

north and south, including discharge from Valley Lake. Several intermittent streams drain west from the central uplands east towards the City of Farmington in the Farmington Outlet drainage district. These parallel-flowing channels are all considered part of Middle Creek and merge in Farmington before discharging to the Vermillion River.

3.6.5.1 South Creek

In the South Creek drainage district, there are five channels that drain from west to east into the City of Farmington (Section 3.8.6). The South Creek watershed within the City covers approximately 5,050 acres (3.9 square miles). The watershed is mostly developed and includes the Airlake Industrial Park (about 1,300 acres) and approximately 2400 acres of residential development). All channels of South Creek lie within the Vermillion River Watershed and fall under the jurisdiction of the VRWJPO.

The MDNR has designated portions of all five branches of South Creek in the City as trout streams. The viability of trout stream habitat is dependent on temperature and turbidity, which are dependent on watershed conditions. Land use practices may present challenges for the health of trout streams. In developed areas, untreated stormwater runoff can carry pollutants and warm the stream beyond what's healthy for trout. In developing areas, the loss of perennial vegetation and land disturbing activity can increase runoff, raise temperatures, and deposit excess sediment.

To minimize potential negative impacts of land use in trout stream habitat within and downstream of the City, the City developed the *South Creek Management Plan* (Lakeville, 2000, as amended). The South Creek Management Plan establishes additional requirements and BMP recommendations for development and redevelopment activities located in the South Creek watershed (Section 4.7.3)

More information about trout streams in southern Minnesota is available from the MDNR at: https://www.dnr.state.mn.us/fishing/trout_streams/southeastern.html

3.7 Water Quality

3.7.1 Water Quality Monitoring

The City monitors, or cooperates with other state and local entities to monitor the water quality of lakes, streams, and wetlands located within the City. Past and present water quality monitoring programs occurring in the City include:

- Citizen Assisted Monitoring Program (CAMP) – Metropolitan Council: https://metrocouncil.org/Wastewater-Water/Services/Water-Quality-Management/Lake-Monitoring-Analysis.aspx
- Citizen Lake Monitoring Program (CLMP) – MPCA: https://www.pca.state.mn.us/water/lake-monitoring-0
- Wetland Health Evaluation Program (WHEP): http://www.mnwhep.org/
- Vermillion River Watch – Dakota SWCD:

http://www.dakotaswcd.org/vr_watch.html

- City lake water quality monitoring

Data collected through various water quality monitoring programs is available from the MPCA's Environmental Data Access database at: https://www.pca.state.mn.us/quick-links/eda-surface-water-data

3.7.2 MPCA Water Quality Classifications

The federal CWA requires states to adopt water quality standards to protect the nation's waters. To that end, the MPCA developed criteria for Minnesota lakes and streams to establish water quality goals and determine appropriate uses of the lakes and streams, as outlined in the guidance document Guidance Manual for Assessing the Quality of Minnesota Surface Waters for Determination of Impairment: 305(b) Report and 303(d) List (MPCA, 2016).

As part of establishing water quality goals, the MPCA classifies lakes according to depth and ecoregion. The MPCA defines shallow lakes as those having a maximum depth of 15 feet or less or a littoral area (area of lake 15 feet deep or less) of 80 percent or more, while deep lakes include those lakes with a maximum depth above 15 feet and a littoral area of less than 80 percent. Ecoregions are areas of relative uniformity characterized by distinctive regional ecological factors, including land use, soils, topography and potential natural vegetation (MPCA, 1997). Because these factors, combined with depth, affect the water quality that may be reasonable obtained in a specific lake, the MPCA eutrophication criteria for Minnesota lakes vary by ecoregion and depth of the lake.

The City is located within two MPCA ecoregions, including the North Central Hardwood Forest (NCHF) ecoregion in the western part of the City and the Western Corn Belt Plains (WCBP) ecoregion in the east. All of the MNDR public waters lakes in the City are located within the NCHF ecoregion. Valley Lake, which is classified by the MDNR as a public water wetland, is located within the WCBP ecoregion. The MPCA's delineation of stream ecoregions differs from the delineation of ecoregions for lakes described above. The City includes two stream ecoregions: the central stream ecoregion (coinciding with the NCHF ecoregion) and the south stream ecoregion (coinciding with the WCBP ecoregion).

MPCA eutrophication water quality standards applicable to deep lakes, shallow lakes, and streams within the NCHF (central stream) and WCBP (south stream) ecoregions are summarized in Table 3-2. The MPCA also established water quality standards for parameters in addition to those presented in Table 3-2; these standards are published in Minnesota Rules 7050 and are applicable to lakes, ponds, and streams. Standards for several parameters included in Minnesota Rules 7050 vary according to the MPCA-determined designated use of the waterbody (e.g., drinking water, industrial use).

Table 3-2 MPCA Water Quality Standards

Waterbody Name	MPCA Ecoregion	MPCA Waterbody Type	Total Phosphorus (ug/L)	Chlorophyll a (ug/L)	Secchi Depth (m)	Chloride (mg/L)	*E. coli* (#/100mL)	Total Suspended Solids (mg/L)
Crystal Lake	NCHF	Deep Lake[1]	40	14	1.4	230	126[2]	
Orchard Lake	NCHF	Deep Lake[1]	40	14	1.4	230	126[2]	
Lake Marion	NCHF	Deep Lake[1]	40	14	1.4	230	126[2]	
Kingsley Lake	NCHF	Shallow Lake[1]	60	20	1.0	230	126[2]	--
Lee Lake	NCHF	Shallow Lake[1]	60	20	1.0	230	126[2]	--
Horseshoe	NCHF	Shallow Lake[1]	60	20	1.0	230	126[2]	--
East Lake	WCBP	Shallow Lake[1]	90	30	0.7	230	126[2]	
Valley Lake	WCBP	Shallow Lake[1]	90	30	0.7	230	126[2]	--
North Creek	South	Stream (Class 2B)	150	35	--	230	126[2]	65
Middle Creek	South	Stream (Class 2B)	150	35	--	230	126[2]	65
South Creek	South	Stream (Class 2A)	150	35	--	230	126[2]	10

Note: standards presented above are summer average values calculated from June through September (except for *E.coli* and Total Suspended Solids, for which the standard applies from April 1 through October 31). MN Rule 7050.0220 includes water quality standards for additional parameters.

(1) Classification as deep or shallow is based on MPCA shallow/deep classification; shallow lakes have a maximum depth of less than 15 feet or littoral area greater than 80% of the total lake surface area.

(2) 126 organisms per 100 mL as a geometric mean of not less than five samples within any month, nor shall more than 10% of all samples within a month exceed 1,260 organisms per 100 mL.

3.7.2.1 MPCA Impaired Waters

In compliance with Section 303(d) of the CWA, the MPCA identifies and establishes priority rankings for waters that do not meet the water quality standards. The list of impaired waters, sometimes called the 303(d) list, is updated by the MPCA every 2 years. Waterbodies located within and downstream of the City are listed on the MPCA impaired waters (303(d)) list for a variety of impairments. Impaired waters located

within the City are listed summarized in Table 3-3 and shown on Figure 3-8. Waterbodies on the impaired waters list are required to have an assessment completed that addresses the causes and sources of the impairment. This process is known as a TMDL analysis. TMDLs applicable to Lakeville are noted in the footnotes of Table 3-3. Downstream of the City, the Vermillion River is impaired for aquatic life due to turbidity/total suspended solids. The *Vermillion River Watershed Restoration and Protection Strategies* (WRAPS) report (MPCA, 2015) includes the City in an "assist as needed" role.

Table 3-3 Summary of Impaired Waters within the City of Lakeville

Waterbody	Impaired Use	Pollutant or Stressor	Year Listed	TMDL Study Target Start	TMDL Study Target Completion	TMDL Study Approved
Crystal Lake	Aquatic Recreation	Nutrients/ Eutrophication	2002	Delisted as of 2018 [1,2]		
	Aquatic Consumption	Mercury in Fish Tissue	2004			2007[3]
East Lake	Aquatic Recreation	Nutrients/ Eutrophication	2012	2018	2022	--
Lee Lake	Aquatic Recreation	Nutrients/ Eutrophication	2002	Delisted as of 2018 [1,2]		
Lake Marion	Aquatic Consumption	Mercury in Fish Tissue	2004	--	--	2007[3]
Orchard Lake	Aquatic Consumption	Mercury in Fish Tissue	2004	--	--	2007[3]
Headwaters to unnamed Creek "*North Creek*" (070400001-542)	Aquatic Recreation	Fecal Coliform	2008	--	--	2015[4]
Unnamed creek to Vermillion R. "*South Creek*" (070400001-527)	Aquatic Recreation	Fecal Coliform	2008	--	--	2015[4]
	Aquatic Life	Fisheries Bioassessments	2018	--	--	--[5]
	Aquatic Life	Macroinvertebrate Bioassessments	2018	--	--	--[5]
Headwaters to unnamed Creek *"Middle Creek"* (070400001-546)	Aquatic Recreation	*Escherichia coli*	2010	--	--	2015[4]
Headwaters to unnamed Creek *"Middle Creek"* (070400001-548)	Aquatic Recreation	*Escherichia coli*	2010	--	--	2015[4]

Source: draft 2018 Impaired Waters List

(1) Addressed by the *Crystal, Keller, and Lee Lakes Nutrient Impairment and Total Maximum Daily Load Report and Earley Lake Water Quality Assessment* (MPCA, 2011).
(2) Delisted per the draft 2018 Impaired Waters 303(d) list.
(3) Addressed by the *Minnesota Statewide Mercury TMDL* (MPCA, 2007).
(4) Addressed by the *Vermillion River Watershed TMDL Report* (MPCA, 2015).
(5) Addressed by the Vermillion River WRAPS Report (MPCA, 2015, as amended)

3.8 Drainage Districts

The City is divided into six drainage districts split among the two major watersheds (see Figure 3-9). This section summarizes the six drainage districts, which include:

- Orchard Lake drainage district
- Crystal Lake drainage district
- North Creek drainage district
- Farmington Outlet drainage district
- Lake Marion drainage district
- South Creek drainage district

3.8.1 Orchard Lake Drainage District

The Orchard Lake District encompasses approximately 2,500 acres within the jurisdiction of the BDWMO. Major lakes in the district include Kingsley Lake and Orchard Lake, both of which lie entirely within the City. Orchard Lake has an area of about 240 acres and a tributary watershed of approximately 3 square miles. The lake is used for recreation and has a swimming beach and concrete boat launch. Kingsley Lake, which is wetland-like in character, has an open water area of about 40 acres. Kingsley Lake has a tributary watershed area of 190 acres. The lake drains into Orchard Lake by a culvert located at the OHW of 978.5 feet NGVD29.

Approximately 420 acres of this district are not tributary to Orchard Lake, but drain north and west to other municipalities (about 200 acres drains north into Burnsville, while about 220 acres is tributary to Credit River Township). Horseshoe Lake is a small lake located in this area; Horseshoe Lake is located on the boundary with the City of Burnsville, and outflow drains north towards Burnsville.

3.8.2 Crystal Lake Drainage District

The Crystal Lake drainage district has a drainage area of approximately 1,500 acres along the northern boundary of the City. Runoff from an additional 140 acres in the Buck Hill development in the City of Burnsville is also tributary to this drainage district. This drainage district is located within the BDWMO.

Approximately 290 acres within the district (and another 20 acres from Burnsville) are tributary to Lee Lake. Lee Lake is about 22 acres in size and has a maximum depth of about 15 feet. A gated outlet directs outflow from large events from Lee Lake to the east under I-35 and eventually leading to Crystal Lake.

3.8.3 North Creek Drainage District

The North Creek drainage district includes approximately 5,640 acres that drain to North Creek, a tributary of the Vermillion River. This drainage district is located within the jurisdiction of the VRWJPO. North Creek has two branches: the West Branch and the Main Branch. The West Branch of North Creek is a perennial stream fed by groundwater discharge during dry weather, and the Main Branch has more

intermittent flow. The West Branch of North Creek begins in the western portion of the district, between Highview Avenue and Ipava Avenue, and flows east. The West Branch roughly divides the district west to east before entering the City of Farmington east of Pilot Knob Road. The Main Branch begins in Apple Valley and flows south through Lakeville, joining the West Branch about one half mile downstream from Pilot Knob Road. The watershed of the Main Branch includes approximately 6,000 acres of the City of Apple Valley, extending as far as Alimagnet Lake. The City of Apple Valley constructed a 60-inch storm sewer to convey Main Branch flow from a stormwater pond north of 160th Street West to East Lake, located east of Pilot Knob Road. The sewer follows the pre-existing channel alignment.

A small created lake, with a swimming beach and fishing pier, named Valley Lake, is located in the north-central part of the North Creek district and drains to North Creek. Valley Lake is approximately 8 acres in size and with a maximum depth of 10 feet. East Lake, located east of Pilot Knob Road, also drains to North Creek.

3.8.4 Farmington Outlet Drainage District

The Farmington Outlet drainage district includes approximately 3,400 acres within the Vermillion River Watershed. There are no large surface water bodies within this district. Drainage from the Farmington Outlet District flows east in existing channels through the City of Farmington into the Middle Creek portion of the Vermillion River.

Drainage from this district flows through three main channels. Drainage from west of Dodd Boulevard is collected in the northern channel and flows east. The central channel collects runoff from areas adjacent to 190th Street, and flows east. Runoff from areas between 195th and 200th Street is collected in the southern channel and flows east. Several intermittent streams drain west from the central uplands east towards Farmington in the Farmington Outlet District. These parallel-flowing channels are all considered part of Middle Creek and merge in Farmington before discharging to the Vermillion River.

3.8.5 Lake Marion Drainage District

The Lake Marion watershed occupies a transitional zone within the City between the rolling hills, hardwood forests, and abundant wetlands of the northwestern part of the City and the level outwash landforms of eastern and southern Lakeville. The Lake Marion drainage district drains to the Vermillion River via South Creek (Section 3.8.6) and is located within the VRWJPO. The drainage district includes approximately 4,770 acres within the City of Lakeville; another 200 acres in Credit River Township are tributary to the district.

Lake Marion is the largest lake in the City of Lakeville with an area of about 600 acres and a maximum depth of 21 feet. Lake Marion is bounded by several parks and includes a public boat access, beach, and two fishing piers. Lake Marion outlets into a channel which joins South Creek (regionally known as the North Branch of South Creek) before leaving the City. Several intermittent streams drain to Lake Marion from the uplands located to the northeast and southwest of the lake.

3.8.6 South Creek Drainage District

The South Creek drainage district includes approximately 6,400 acres within the City of Lakeville and is located within the jurisdiction of the VRWJPO. Portions of South Creek in this drainage district are designated as trout stream by the MDNR. There are five main channels within this district (Figure 3-6):

- **South Branch of South Creek** – The main channel includes two short reaches (referred to by the City as the South Branch of South Creek) located in the far southern portion of the City. The South Branch begins west of I-35 in New Market Township before briefly entering Lakeville west of Dodd Boulevard. The South Branch again enters the City near Cedar Avenue and flows east through Airlake Industrial Park.
- **North Branch of South Creek** – The North Branch refers to the channel that begins north of 192nd Street between Dodd Boulevard and Kenwood Trail and continues approximately four miles to the southeast, eventually flowing into the West Branch of South Creek just south of 202nd Street between Hamburg Avenue and Cedar Avenue.
- **Marion Branch of South Creek** – The outlet from Lake Marion forms the Marion Branch of South Creek. The outlet from Lake Marion is located 1 foot below the OHWL of 983.1 feet NAVD88. The Marion Branch is approximately 2 miles long and meets the West Branch south of 210th Street.
- **West Branch of South Creek** – The West Branch begins west of I-35 and flows east. The Marion Branch and North Branch join the West Branch before the creek exits the City into the City of Farmington south of Lakeville Boulevard.
- **East Branch of South Creek** – The East Branch begins near the intersection of Hamburg Avenue and 200th Street and flows southeast. The East Branch enters the City of Farmington before joining the West Branch.

3.9 Water Quantity and Flooding

The City seeks to manage the quantity of water and reduce the risk of flooding within the City. The City limits and regulates development within floodplain areas through its ordinances and policies (Section 2.2.3), performs studies and projects to identify and address areas of potential flood risk, and participates in the NFIP.

3.9.1 Flood Insurance Studies

FEMA maps floodplains of basins and streams to create community FIS and FIRMs. There is an FIS for Dakota County that includes the City. It should be noted that the current FIS in Lakeville is based on analysis performed using older, TP-40 precipitation data versus the newer, Atlas 14 precipitation data (Section 3.1). The FEMA-delineated floodplain within the City is shown in Figure 3-10.

FIRMs , together with the City's floodplain ordinance, allow the City to participate in the federal government's NFIP. Homeowners with structures located in the FEMA-designated special flood hazard area (SFHA) are required to purchase flood insurance. In some cases, homes within the mapped FEMA-designated SFHA may actually not be in the floodplain. In order to waive the mandatory Federal

flood insurance requirements for their homes, residents must remove their homes from the FEMA-designated floodplain by obtaining LOMA through an established FEMA process.

3.9.2 Water Quantity Modeling

Water quantity modeling is necessary to establish flood levels and determine floodplain extents, design hydraulic structures adequate to meet their intended functions, and assess hydraulic impacts of projects proposed by developers, the City, and the WMOs. In 2015, the City completed hydrologic and hydraulic modeling using XP-SWMM software for the City, including areas within both the BDWMO and VRWJPO. This modeling incorporates Atlas 14 precipitation data (Section 3.1).

The City will use the XP-SWMM model to assess hydrologic and hydraulic impacts of potential projects and prioritize flood risk reduction efforts. The XP-SWMM model and results are described in greater detail in the text, tables, and figures included in Appendix A.

3.10 Natural Communities and Rare Features

Pre-settlement vegetation data (around the year 1895) is available from the MDNR. Pre-settlement vegetation in the eastern half of the City was primarily prairie, while the western half of the City was covered primarily by oak openings and barrens. Oak openings occurred on rich, dry-mesic to mesic soils and were dominated by grasses, forbs, brush, and scattered large trees of mostly bur and white oak. Oak openings had less grass and more forbs and woody shrubs than prairie, but more grass and fewer forbs than forests. Isolated areas of wet prairie occurred in the far northeastern corner of the City, along the Farmington-Lakeville border north of South Creek, and around Orchard Lake and Lake Marion.

Natural vegetation in the City has been altered over time by agricultural development and urbanization. The Minnesota County Biological Survey (1997) identifies areas of natural communities remaining in the City, including oak woodland and brushland located in Ritter Farm Park, west of I-35 and Lake Marion. Through the implementation of this Plan, the City plans to expand its natural resource management activities to further preserve and enhance natural areas serving fishery and wildlife habitat functions (Section 4.4).

The MDNR maintains a database of rare plant and animal species and significant natural features, known as the NHIS. The purpose of the database is to foster better understanding and conservation of these features. The database indicates that there are several notable natural features found within the City. These include plant species, plant communities as well as the Blandings and Wood Turtle, both of which are listed as threatened by the State of Minnesota. The specific locations of rare species are not publically available to promote conservation.

More information is available from the MDNR's NHIS website at:
http://www.dnr.state.mn.us/nhnrp/nhis.html

3.11 Fish and Wildlife Habitat

Several lakes within the City are stocked by the MDNR and/or contain large or notable fish populations:

- Crystal Lake is managed by the MDNR as a pan-fish lake and is stocked with tiger muskellunge in even-numbered years;
- Orchard Lake is stocked by the MDNR with walleye annually and tiger muskellunge in even-numbered years;
- Lake Marion is stocked by the MDNR with walleye annually;
- Valley Lake is stocked annually by the MDNR with bluegill and channel catfish; and
- Sections of South Creek have been designated as trout streams by the MDNR.

In addition to fish stocking, the MDNR has performed fisheries surveys on several lakes in Lakeville. Fishery surveys have been performed on East Lake, Valley Lake, and Lee Lake by the City. Additional information about fish stocking and surveys is available through the MDNR Lakefinder website: http://www.dnr.state.mn.us/lakefind/index.html

The MDNR designated an area of the main branch of South Creek as trout stream in 1988. The MDNR designated additional branches of South Creek as trout streams in 1996. Every year, the MDNR performs trout survey along the restored stretches of South Creek on the east and west sides of Cedar Avenue in the Airlake Industrial Park area of Lakeville. The survey is conducted to obtain a population estimate and other baseline data. Portions of South Creek were listed by the MPCA as impaired for aquatic life due to fish bioassessments in 2018 (see Table 3-3 and Figure 3-8). More information about trout streams in this area is available from the MDNR at: https://www.dnr.state.mn.us/fishing/trout_streams/southeastern.html

There are no county- or state-protected wildlife habitat areas within the City. In some locations, the City has established conservation easements to create an area of protection where important natural areas have been preserved. Conservation easements protect water quality, vegetation, and wildlife habitat, but the property remains in private ownership. The City plans to expand its natural resource management activities to further preserve and enhance natural areas serving fishery and wildlife habitat functions (Section 4.4).

3.12 Recreational Areas

The City's Parks and Recreation Department maintains a total of 62 community and neighborhood parks. City parks offer athletic fields, playgrounds, tennis courts, skating rinks, picnic areas, conservation areas, and nature areas. There are more than 100 miles of pedestrian and bike trails. Also available are cross-country ski trails, snowmobile trails, and equestrian trails.

There are public parks located along the shorelines of Lake Marion, Orchard Lake, and Valley Lake. These parks include three swimming beaches and public fishing areas. Public boat access is available at Lake Marion and Orchard Lake. More information about City parks, trails, and recreational facilities is available from the City's Parks and Recreation department website at: http://LakevilleMN.gov

3.13 Potential Pollutant Sources

There are permitted sites, hazardous waste generators, and contaminated sites within the City. The MPCA maintains a state-wide database of these sites, which includes permitted sites (air, industrial stormwater, construction stormwater, and wastewater discharge), hazardous waste generating sites, leak sites, petroleum brownfields, tank sites, unpermitted dump sites, and sites enrolled in the Voluntary Investigation and Cleanup (VIC) program. This information is available online through the MPCA's What's In My Neighborhood program, and is presented in Figure 3-11. The location of these potentially contaminated or hazardous waste sites should be considered as sites are redeveloped and BMPs are implemented. The presence of soil contamination at many of these sites, if not removed, may limit or prevent infiltration as a BMP option.

In contrast to sites with known hazards, non-point source pollution cannot be traced to a single source or pipe. Instead, pollutants are carried from land to water in stormwater runoff, agricultural runoff, or snowmelt runoff, in seepage through the soil, and in atmospheric transport. Discharge from stormwater pipes is considered a non-point source discharge as the pollutants coming from the pipe are generated across the watershed contributing to the pipe, not at a single location. Point sources frequently discharge continuously throughout the year, while non-point sources discharge in response to precipitation or snowmelt events. For most waterbodies, non-point source runoff, especially stormwater runoff, is the major contributor of pollutants if untreated.

Some private properties within the City are served by SSTS. Non-functioning SSTS may be a non-point source of pollutants, including bacteria. Improperly sited, installed or maintained systems may achieve inadequate treatment of sewage. In addition to the public health risks of untreated or inadequately treated sewage (e.g., contamination of wells), sewage contains the nutrient phosphorus, which if discharged into waterbodies can cause excessive algae and aquatic plant growth leading to degradation in water quality. The MPCA implements an SSTS regulatory program to manage the environmental and public health impacts of SSTS.

More information about potential pollutant sources is available from the MPCA website: http://www.pca.state.mn.us/index.php/data/wimn-whats-in-my-neighborhood/whats-in-my-neighborhood.html

SAVAGE
BURNSVILLE
APPLE VALLEY
ROSEMOUNT
LAKEVILLE
DAKOTA COUNTY
SCOTT COUNTY
FARMINGTON

County Boundary
Municipal Boundary
50-Foot Contour

Elevation (ft)
High : 1210
Low : 850

Elevation data from LiDAR data acquired through the Minnesota Elevation Mapping Project (Spring and Fall 2011).

N

2,000 0 2,000
Feet

950 2017 USDA NAIP Imagery via MnGeo

TOPOGRAPHY
Water and Natural Resources Management Plan
City of Lakeville

FIGURE 3-1

Barr Footer: ArcGIS 10.6, 2018-05-25 07:52 File: I:\Client\Lakeville\23191357 WRMP Update\Maps\Report\Figure 3-1 - Lakeville Topography.mxd User: RCS2

SAVAGE
BURNSVILLE
APPLE VALLEY
ROSEMOUNT
LAKEVILLE
DAKOTA COUNTY
SCOTT COUNTY
FARMINGTON

2017 USDA NAIP Imagery via MnGeo

County Boundary
Municipal Boundary

2016 Land Use (Metropolitan Council)

- Agricultural
- Airport
- Extractive
- Farmstead
- Golf Course
- Industrial and Utility
- Institutional
- Major Highway
- Manufactured Housing Parks
- Mixed Use Industrial
- Office
- Open Water
- Park, Recreational, or Preserve
- Retail and Other Commercial
- Seasonal/Vacation
- Single Family Detached
- Multifamily
- Single Family Attached
- Mixed Use Residential
- Undeveloped

2016 Generalized Land Use from the Metropolitan Council (04/22/2016). Acquired through the Minnesota Geospatial Commons.

N

2,000 0 2,000
Feet

2016 LAND USE
Water and Natural Resources Management Plan
City of Lakeville

FIGURE 3-2

Barr Footer: ArcGIS 10.6, 2018-05-25 07:56 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 3-2_Lakeville 2016 Land Use.mxd User: RCS2

SAVAGE
BURNSVILLE
APPLE VALLEY
ROSEMOUNT
LAKEVILLE
DAKOTA COUNTY
SCOTT COUNTY
FARMINGTON

County Boundary
Municipal Boundary

2040 Land Use (Lakeville)

- Airport
- Commercial
- Commercial Mixed Use
- Industrial
- Low Density Residential
- Low/Medium Density Residential
- Manufactured Housing
- Medium Density Residential
- Medium/High Density Residential
- High Density Residential
- Office Park
- Office/Residential Transition
- Parks
- Public and Quasi Public
- Restricted Development
- Rural Density Residential
- Special Plan Area
- Warehouse/Light Industrial
- Water
- Road

2040 Land Use from the City of Lakeville (06/05/2018).

N

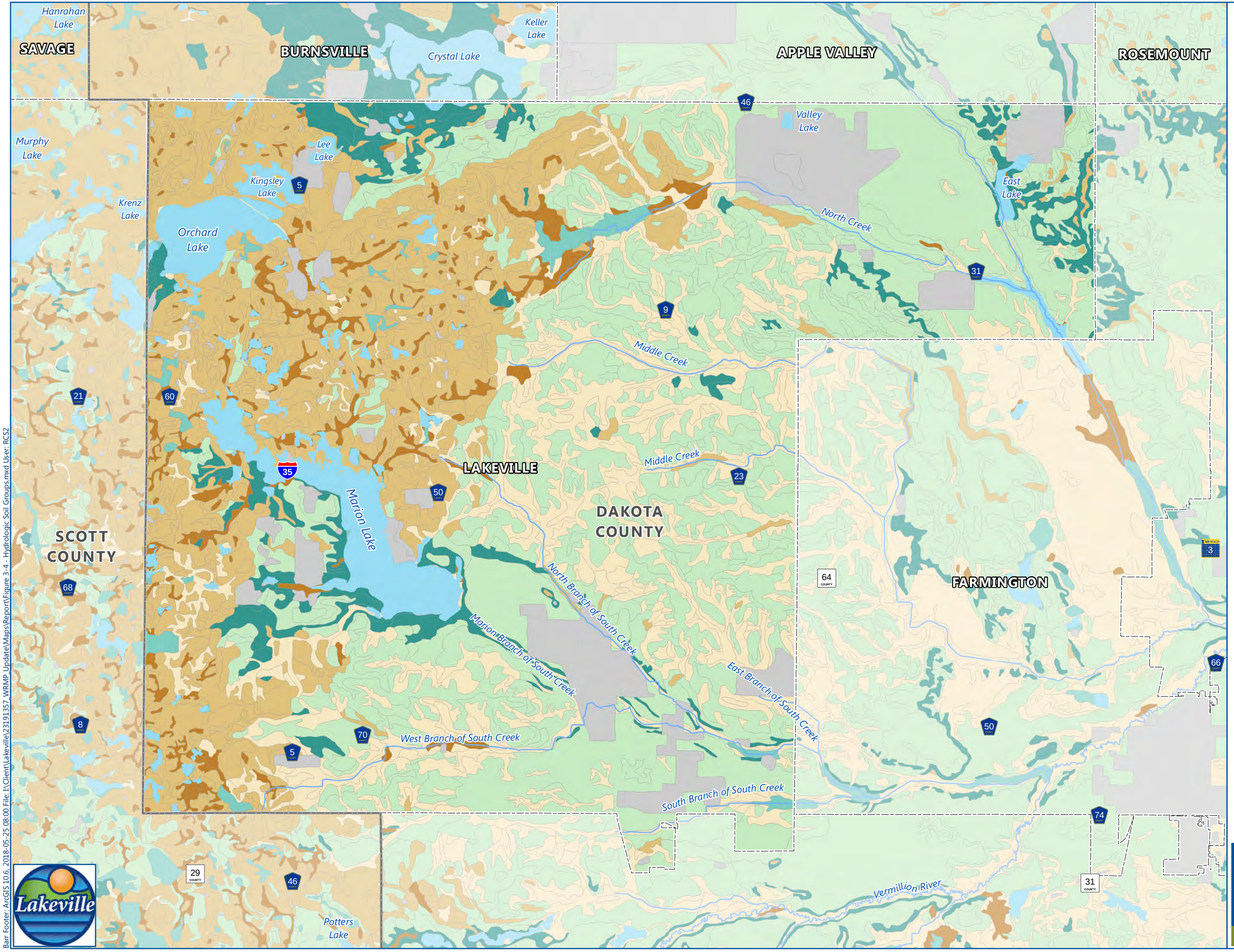
2,000 0 2,000
Feet

2017 USDA NAIP Imagery via MnGeo

2040 LAND USE
Water and Natural Resources Management Plan
City of Lakeville

FIGURE 3-3

Barr Footer: ArcGIS 10.6, 2018-06-05 14:41 File: \\barr.com\gis\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 3-3 - Lakeville 2040 Land Use.mxd User: EMA



County Boundary

Municipal Boundary

Public Water Inventory Watercourses

Public Water Inventory Basins

Hydrologic Soil Groups (HSG)

Undefined/Urban Soils

A - High Infiltration Rates

A/D - If drained, acts as HSG A. If undrained, acts as HSG D.

B - Moderate Infiltration Rates

B/D - If drained, acts as HSG B. If undrained, acts as HSG D.

C - Low Infiltration Rates

C/D - If drained, acts as HSG C. If undrained, acts as HSG D.

D - Very Low Infiltration Rates

Hydrologic Soil Groups (HSG) derived from Soil Survey Staff, NRCS, USDA. Soil Survey Geographic (SSURGO) Database. Available online at: http://sdmdataacess.nrcs.usda.gov/. Accessed

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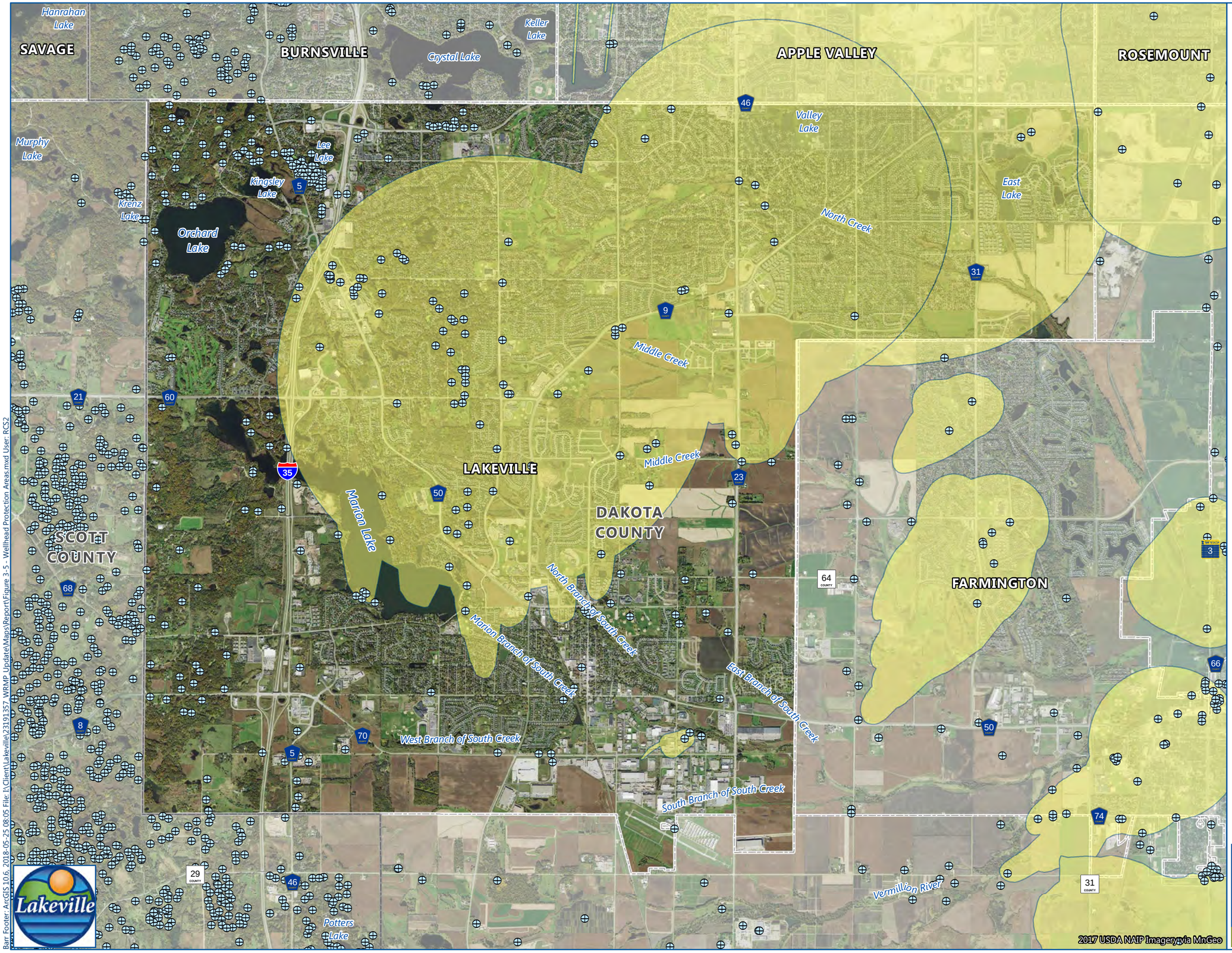
Feet

HYDROLOGIC SOIL GROUPS
Water and Natural Resources Management Plan
City of Lakeville

FIGURE 3-4

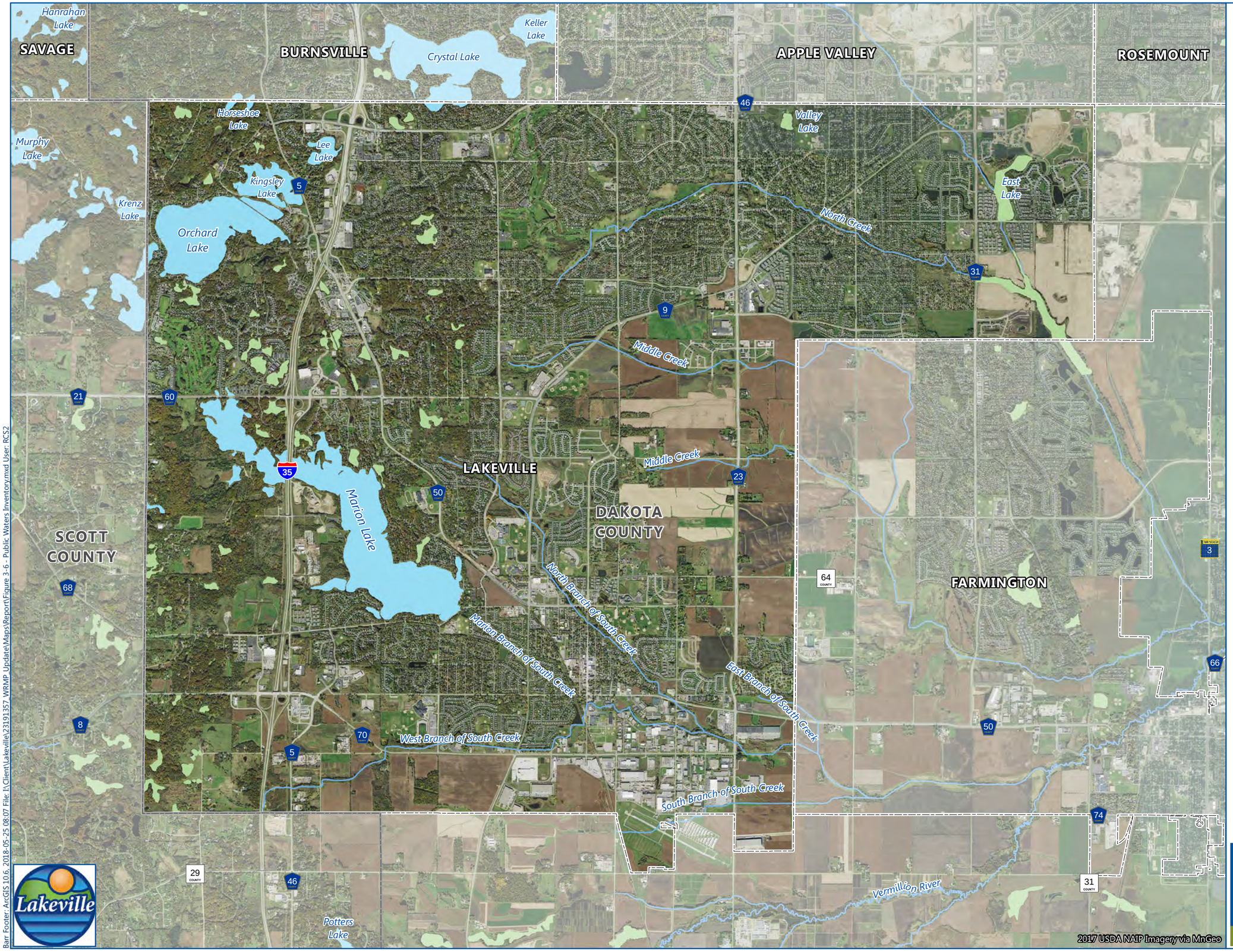
Barr Footer: ArcGIS 10.6, 2018-05-25 08:00 File: J:\Client\Lakeville\23191357 WRMP Update\Maps\Report\Figure 3-4 - Hydrologic Soil Groups.mxd User: RCS2



County Well Index developed by the Minnesota Geological Survey and the Minnesota Department of Health (MDH). Wellhead Protection Area (WHPA) is the MDH approved surface and subsurface area surrounding a well or well field that supplies a public water system, through which contaminants are likely to move toward and reach the well or well field (Minnesota Statutes, section 1031.005, subdivision 24). Accessed 5/3/2017.

WELLHEAD PROTECTION AREAS
Water and Natural Resources Management Plan
City of Lakeville

FIGURE 3-5



County Boundary
Municipal Boundary
Public Water Inventory Watercourses
Public Water Lakes
Public Water Wetlands

Public Water Inventory Basins and Watercourses from the Minnesota Department of Natural Resources (01/21/2016).

These are provisional data. Users are expected to contact the appropriate Area and Regional Hydrologist before taking any actions that may affect a regulated basin or watercourse.

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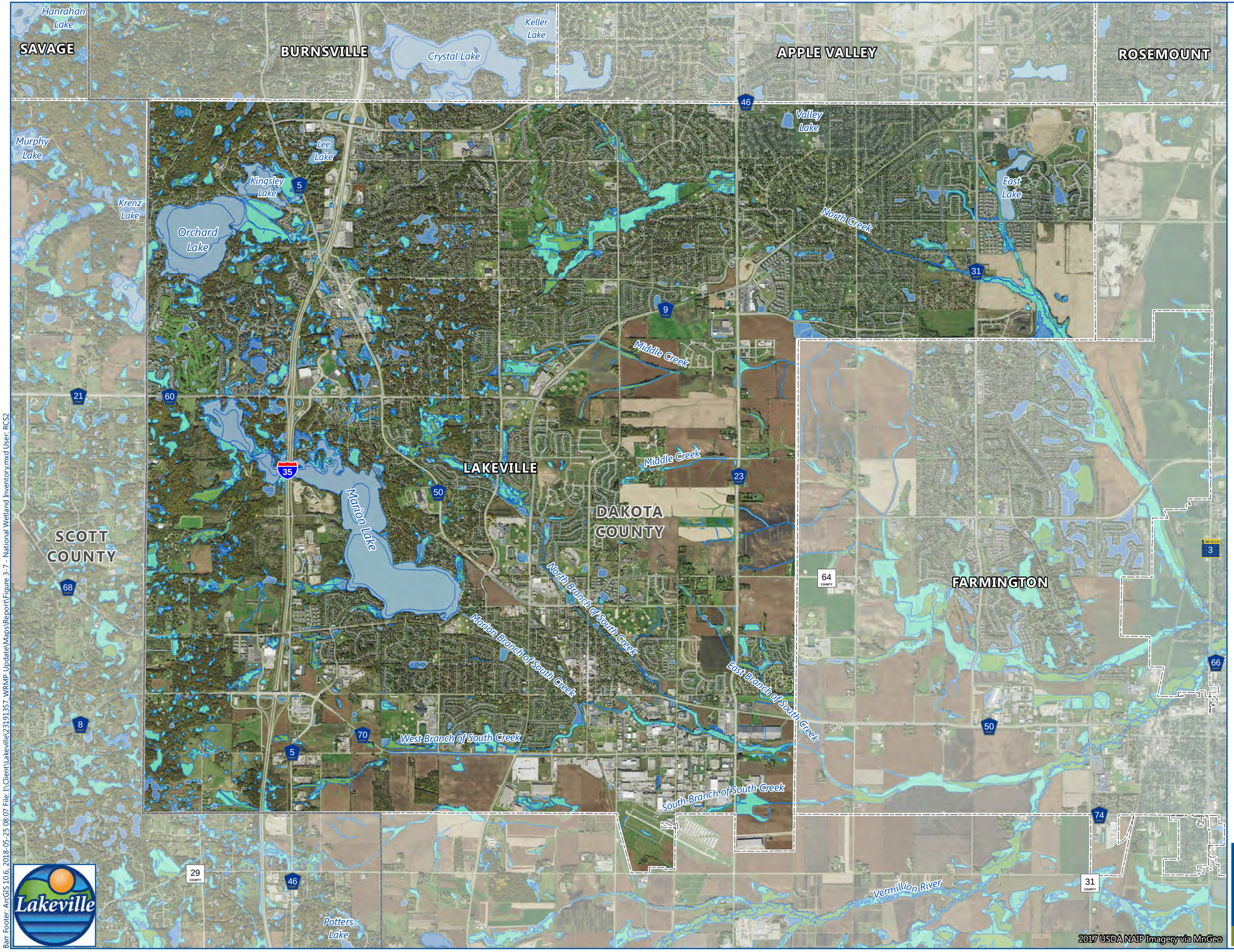
Feet

PUBLIC WATERS INVENTORY
Water and Natural Resources Management Plan
City of Lakeville

FIGURE 3-6

Barr Footer: ArcGIS 10.6, 2018-05-25 08:07 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 3-6 - Public Waters Inventory.mxd User: RCS2



County Boundary

Municipal Boundary

National Wetlands Inventory

- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond
- Lake
- Riverine

National Wetlands Inventory (NWI) wetlands from the Minnesota Department of Natural Resources NWI East Central Update (Study 2010 - 2013).

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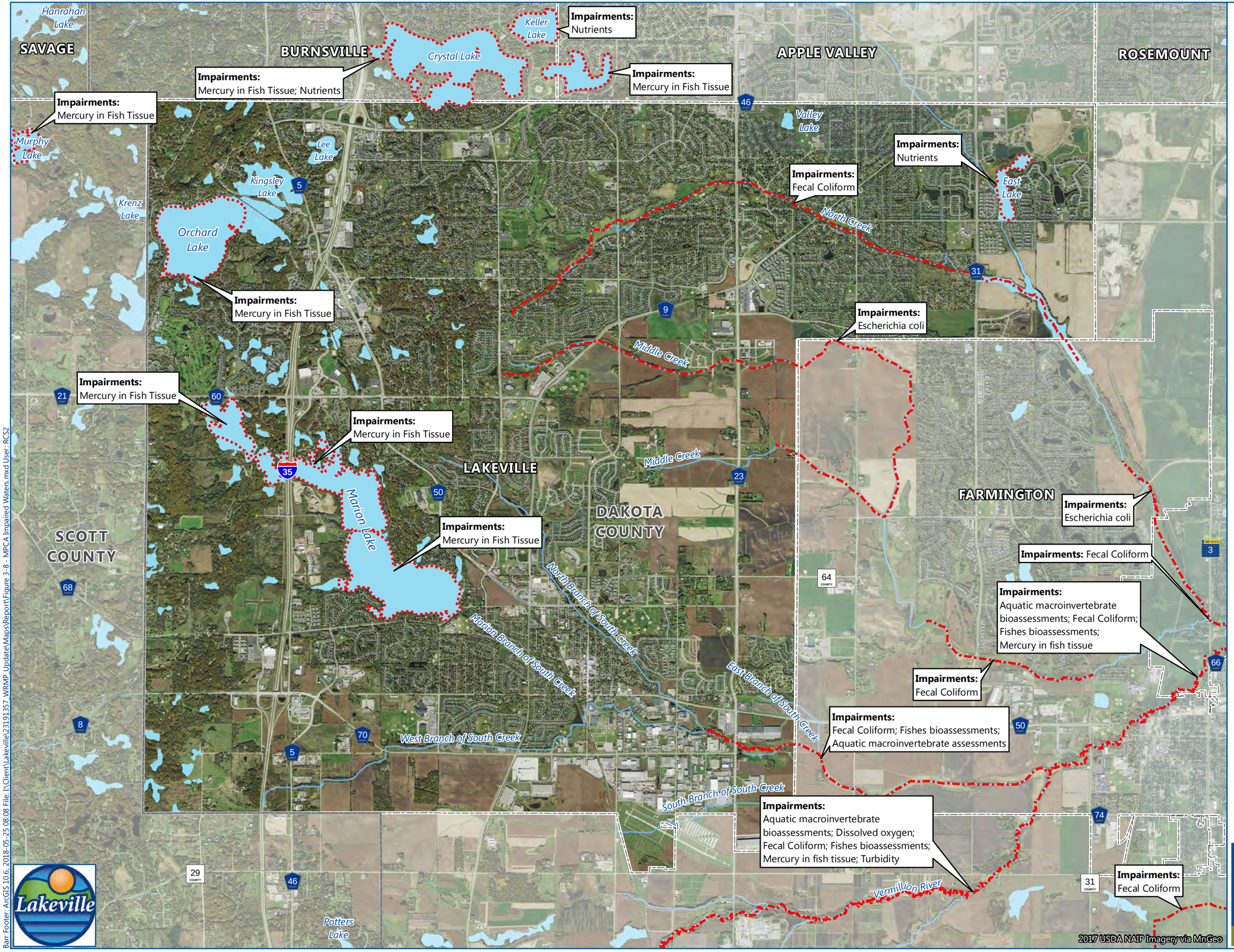
Feet

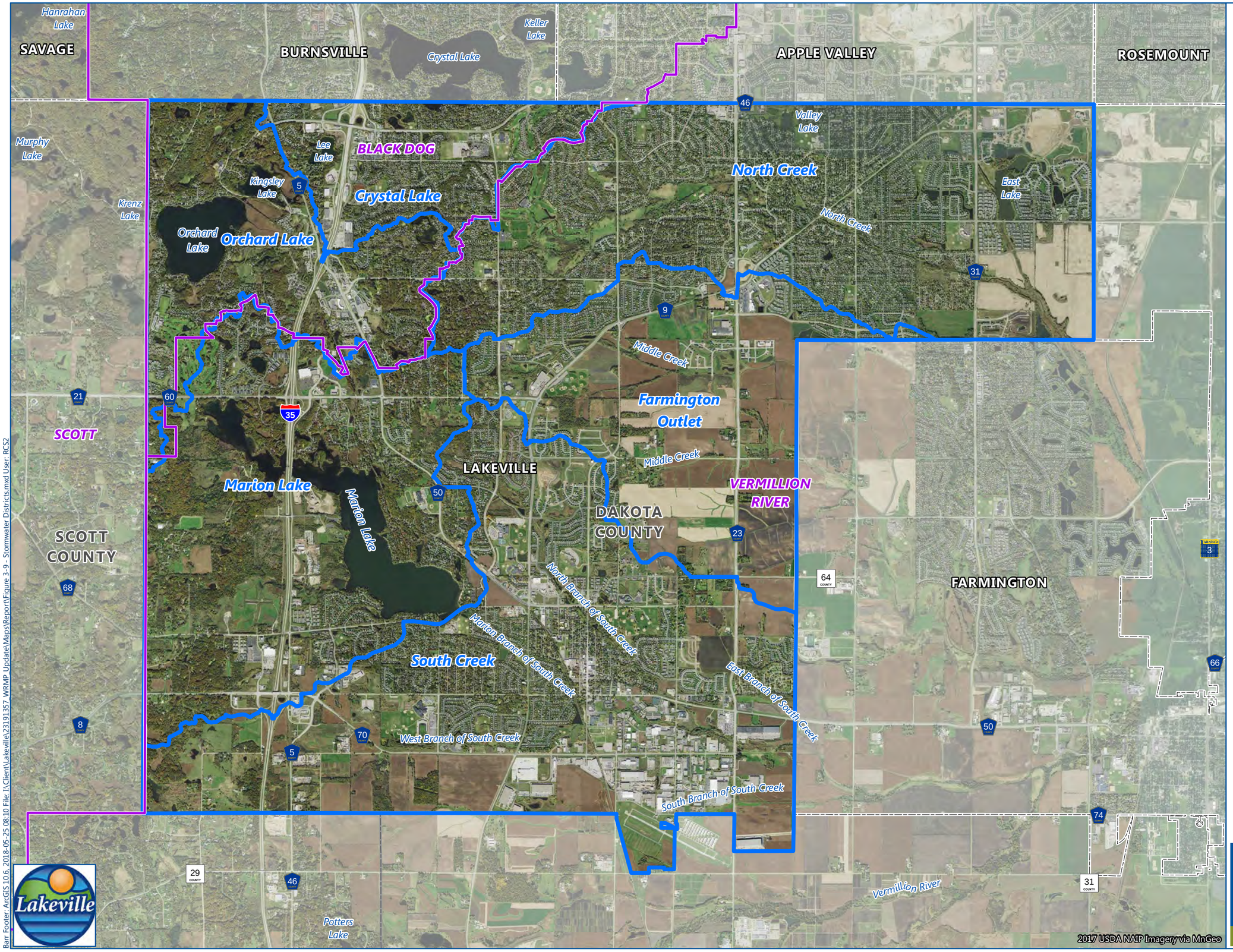
NATIONAL WETLANDS INVENTORY
Water and Natural Resources Management Plan
City of Lakeville

FIGURE 3-7

Barr Footer: ArcGIS 10.6, 2018-05-25 08:07 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 3-7 - National Wetland Inventory.mxd User: RCS2



Barr Footer: ArcGIS 10.6, 2018-05-25 08:08 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 3-8 - MPCA Impaired Waters.mxd User: RCS2



Watershed Management Districts and Organizations Boundaries

Stormwater Districts

County Boundary

Municipal Boundary

Stormwater Districts from the City of Lakeville.

Watershed Management Districts and Organizations Boundaries from the Minnesota Board of Water and Soil Resources (BWSR). This layer represents BWSR's most current information on watershed districts and WMOs in the State of MN. The dataset is NOT error free, and boundaries are frequently being updated and changed, so these should be used for reference only. Accessed 6/8/2015.

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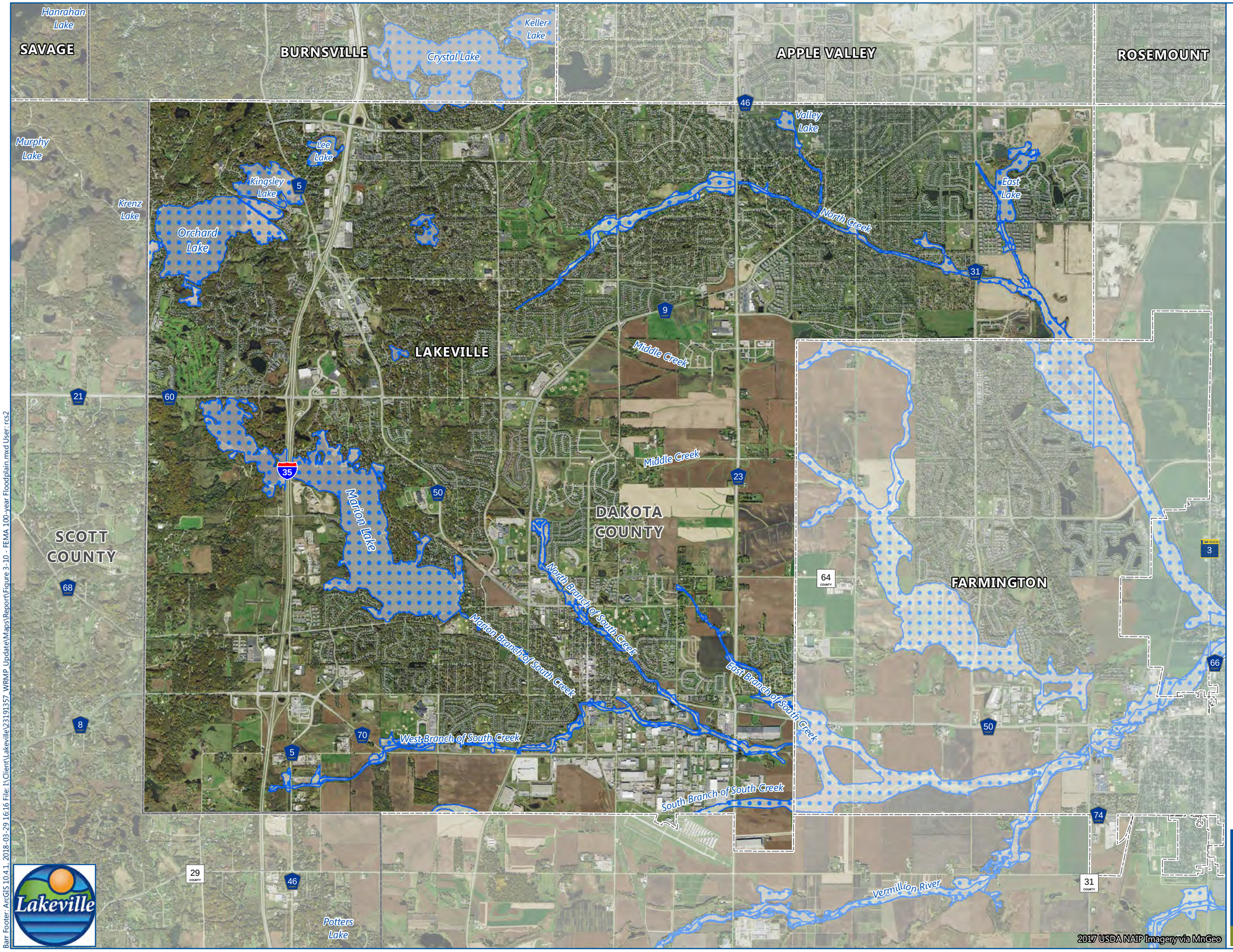
STORMWATER DISTRICTS
Water and Natural Resources Management Plan
City of Lakeville

FIGURE 3-9

Barr Footer: ArcGIS 10.6, 2018-05-25 08:10 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 3-9 - Stormwater Districts.mxd User: RCS2



County Boundary

Municipal Boundary

1% Annual Chance of Flooding

1% Annual Chance of Flood from the Federal Emergency Management Agency (FEMA) Flood Insurance Study for Dakota County, Minnesota (effective 12/2/2011, last updated 02/16/2016).

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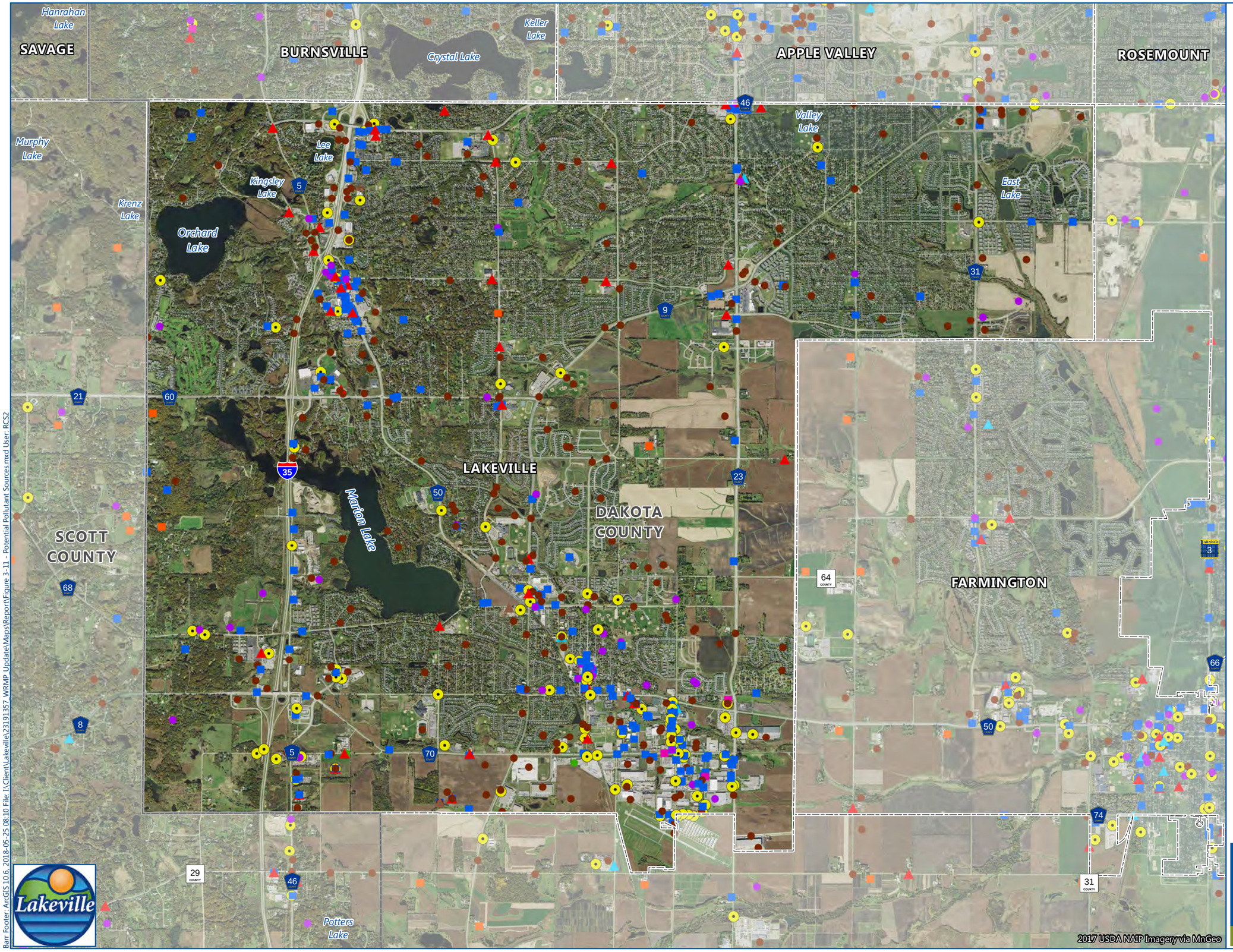
Feet

FEMA 1% SPECIAL FLOOD HAZARD AREA
Water and Natural Resources Management Plan
City of Lakeville

FIGURE 3-10

Barr Footer: ArcGIS 10.4.1, 2018-03-29 16:16 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 3-10 - FEMA 100-year Floodplain.mxd User: rcs2



County Boundary

Municipal Boundary

What's in my Neighborhood (MCPA)

- Multiple Programs
- Air Quality
- Feedlots
- Hazardous Waste
- Investigation and Cleanup
- Solid Waste
- Stormwater
- SSTS
- Tanks
- Water Quality

What's in my Neighborhood data developed by the Minnesota Pollution Control Agency. Accessed 1/17/2019.

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POTENTIAL POLLUTANT SOURCES
Water and Natural Resources Management Plan
City of Lakeville

FIGURE 3-11

Barr Footer: ArcGIS 10.6, 2018-05-25 08:10 File: I:\Client\Lakeville\23191357_WRMP_UpdateMaps\Report\Figure 3-11 - Potential Pollutant Sources.mxd User: RCS2

4.0 Implementation Program

This section describes the significant components of the City's WNRMP implementation program, including capital projects, ordinance implementation and official controls, NPDES MS4 permit, and operation and maintenance of the City's stormwater collection and conveyance system and natural resources. The implementation program for years 2018-2027 is presented at the end of this section in a series of tables, as follows:

- Table 4-1 Implementation Program – Capital Improvements
- Table 4-2 Implementation Program – Programs, Studies, and Official Controls

4.1 NPDES MS4 Permit

Under the U.S. EPA Stormwater NPDES Rules, the City is required to maintain an MS4 permit for managing non-point source stormwater. The City's permit includes a SWPPP addressing all requirements of the MS4 permit issued by the MPCA in 2013. The MPCA plans to reissue the MS4 general permit in Fall 2019, which may include additional requirement for Cities.

The SWPPP outlines the appropriate BMPs for the City to control or reduce pollutants in stormwater runoff to the maximum extent practicable. The City will accomplish this through the implementation of the BMPs outlined within its SWPPP. These BMPs are a combination of education, operation and maintenance, control techniques, system design and engineering methods, and other such provisions that are appropriate to meet the requirements of the NDPES permit.

BMPs have been prepared to address each of the six minimum control measures as outlined in the MS4 permit:

1. Public education and outreach on stormwater impacts;
2. Public participation/involvement;
3. Illicit discharge detection and elimination;
4. Construction site stormwater runoff control;
5. Post-construction stormwater management in new development and redevelopment; and
6. Pollution prevention/good housekeeping for municipal operations.

For each of these six MCMs, the City identified BMPs, along with measurable goals, an implementation schedule, and the persons responsible to complete each measure. In addition to addressing the six MCMs, the City's MS4 permit includes additional measures to protect trout streams.

Future MS4 general permit revisions, TMDL studies, or other studies (e.g., City modeling efforts) may result in the identification of new or expanded BMPs to address City MS4 permit requirements. The City will identify appropriate BMPs and add them to the City's implementation program and SWPPP, where appropriate.

Prior to June 30 of each year, the City submits an annual report to the MPCA. This annual report summarizes the following:

1. **Status of Compliance with Permit Conditions:** This includes an assessment of the appropriateness of the BMPs and the City's progress toward achieving the identified measurable goals for each of the minimum control measures. The assessment is based on results collected and analyzed, inspection findings, and public input received during the reporting period.
2. **Work Plan:** The work plan lists the stormwater activities that are planned to be undertaken in the next reporting cycle (i.e., the following year).
3. **Modifications to the SWPPP:** The annual report identifies any changes to BMPs or measurable goals for any of the minimum control measures.
4. **Notice of Coordinated Activities:** A notice is included in the annual report for any portions of the permit for which a government entity or organization outside of the MS4 is being utilized to fulfill any BMP contained in the SWPPP.

The City provides access to SWPPP document, annual reports, and other documentation that supports or describes the SWPPP for public review, upon request. At least once per year, the City must provide an opportunity for the public to provide input on the adequacy of the SWPPP; the City considers this input in updating and implementing the SWPPP.

The SWPPP BMP implementation program is incorporated into the City's overall stormwater implementation program presented in Table 4-2.

4.2 Stormwater System Operation and Maintenance

The City is responsible for maintaining its stormwater system. Proper maintenance will ensure that the stormwater system continues to function as designed and provides the intended benefits. The City's operation and maintenance program is closely tied with the City's implementation of its NPDES MS4 permit and is incorporated into Table 4-2.

The City's stormwater system includes not only pipes and constructed stormwater management basins, but also lakes, wetlands, ditches, swales, drainage ways, underground storage facilities, and other BMPs. Maintenance of the stormwater system also includes maintaining or restoring the ecological characteristics of the natural portions of the stormwater system. The City regularly inspects and maintains key components of the system. Key components include storm sewer and culvert inlets/outlets, overflow drainage swales, stormwater management basins, and riprap-protected banks.

MnDOT is responsible for maintaining road ditches and culverts along Interstate 35. Dakota County is responsible for maintaining road ditches and culverts along CSAHs and county roads.

4.2.1 Private Stormwater Facilities

Owners of private stormwater facilities are responsible for maintaining the facilities in proper condition, consistent with the original performance design standards. Responsibilities include removal and proper disposal of all settled materials from basins, sumps, grit chambers, and other devices, including settled solids. Owners of private stormwater facilities are required to provide the City with a maintenance agreement as part of the project permitting process; the maintenance agreement defines who will perform the maintenance, the type of maintenance, and the maintenance intervals, and reporting requirements.

4.2.2 Maintenance of Storm Sewer and Culvert Inlets

For safety reasons and to prevent pipe plugging, trash racks are typically installed on storm sewer and culvert inlets. These trash racks prevent people from entering the pipes and keep large debris from becoming lodged in the pipes. If not inspected and maintained, trash racks become plugged with debris such as branches, leaves, and other materials carried by storm flows. Even if partially plugged, flooding can occur. To address these issues, the City performs periodic removal of collected debris from system trash racks and inlets.

4.2.3 Maintenance of Basins

Stormwater basins provide flood risk reduction and water quality benefits. However, if accumulated sediments are not periodically removed, such basins can experience a significant loss in necessary stormwater detention and pollutant removal capacity. If not maintained, these facilities can become overgrown with unwanted vegetation that may further reduce performance and hinder access for periodic maintenance.

The City inspects stormwater storage basins and water quality treatment BMPs to identify excess sediment build-up, collected debris, and unwanted vegetation. The City uses inspection data and available model results to prioritize basin maintenance needs.

Overflow swales can turn into steep eroding channels if erosion problems are not addressed. Typical stabilization materials could include permanent geotextile erosion-control material or riprap accompanied by a properly designed filter material. Erosion problems are identified and addressed by the City's maintenance program.

In general, vegetation in existing basins is allowed to grow naturally on the side slopes of the basin and should not be mowed. This practice allows basins to act like natural wetland areas by providing nearby upland wildlife habitat.

4.2.4 Maintenance of Riprap and Filter Areas

Riprap and filter areas along banks, in overflow swales, or around storm sewer or culvert outlets, require periodic maintenance. Riprap is placed to prevent damage from erosion due to high flow velocities. If not

periodically maintained, significant erosion occurs, resulting in pipe damage, downstream sediment problems, and potential safety issues. The City performs maintenance as needed.

4.2.5 Adequacy of maintenance program

The City's operations and maintenance program is based on the Lakeville SWPPP and is adequate to meet the conditions of the City's NPDES Permit and to maintain an effective stormwater management system. The City will continue and expand upon its operation and maintenance activities to ensure the system functions as designed.

4.2.6 Street Sweeping

The City has an active street sweeping program. The City sweeps (brush or vacuum) public streets a minimum of twice per year in an effort to reduce the amount of sediment, pollutants, and trash from reaching the storm sewer system and surface waters – once in the spring following snowmelt, and once in the fall after leaf fall. Areas directly tributary to lakes are prioritized for street sweeping. Sweepings are taken to a dedicated soil storage area until tested and disposed.

4.3 Watershed Management Organization Roles and Responsibilities

The City is located within two WMOs: the VRWJPO and the BDWMO (Figure 3-9). Within their respective jurisdictions, each WMO performs roles and responsibilities in accordance with the authority specified in Minnesota Statutes 103B. This section summarizes the role of each WMO within the City.

4.3.1 Black Dog Watershed Management Organization

The BDWMO is a JPO including the cities of Apple Valley, Burnsville, Eagan, and Lakeville. As a JPO, the BDWMO relies on its member cities to achieve the BDWMO vision:

> ***Water resources and related ecosystems are managed to sustain their long-term health and aesthetic beauty in order to contribute to the well-being of the citizens within the watershed.***

The relationship between the BDWMO and its member cities, including Lakeville, is defined in part according to the BDWMO's guiding principles:

- Keep regulation at the local level—the BDWMO will not administer a permit program.
- Assist member communities with intercommunity floodplain and runoff planning and with mediation of water management disputes between communities.
- Monitor, classify and manage strategic water resources to meet their intended use. Strategic resources are waterbodies that have broad watershed significance.
- Monitor, evaluate and/or model stormwater runoff quality.
- Improve the quality of the stormwater runoff reaching the Minnesota River.
- Manage intercommunity stormwater runoff, flooding and other water quantity issues.
- Develop policies to be implemented by the cities to protect the BDWMO's water resources.

- Assess performance of the BDWMO and the member cities toward achieving the goals stated in this plan.
- Provide member cities with useful information about the BDWMO, its activities, and water resource management.
- Educate all watershed citizens and member cities in water resource issues and BDWMO activities.
- Assist member cities with funding water quality projects through grants and other funding available directly to watershed organizations.

The BDWMO's *2012 Watershed Management Plan* (BDWMO Plan) identifies roles and responsibilities for the BDWMO and its member cities among its policies (Section 4 of the BDWMO Plan). Key among these policies is the requirement that cities maintain a project review and permitting program with performance standards at least as stringent as those maintained by the BDWMO (and included in Section 4.9 of the BDWMO Plan). The City has developed this WNRMP to be consistent with the polies, requirements, and performance standards included in the BDWMO Plan.

The BDWMO Plan identifies five waterbodies as strategic waterbodies, including three in Lakeville. The BDWMO will classify, set action levels, monitor water quality, and track water quality trends for all strategic water resources, and will implement lake management actions (as needed) for those strategic water resources with intercommunity tributary watersheds, or as requested by the involved cities. Strategic waterbodies in the City include:

- Crystal Lake;
- Kingsley Lake; and
- Orchard Lake.

Applicable BDWMO water quality goals and action levels for strategic waterbodies are described in the BDWMO Plan (2012, as amended) and adopted by the City through this WNRMP.

The BDWMO will continue to cooperate with member cities in resolving water quality improvement project issues. Diagnostic-feasibility studies will be used to determine the needed water quality improvement projects and the estimated costs of the projects. The BDWMO will undertake a water quality improvement project only as a last resort. The BDWMO will involve the cities in the decision-making process, taking into account cost effectiveness and the cities' financial capability to fund water quality improvement projects. In accordance with the JPA, any member city may appeal cost allocation decisions made by the BDWMO.

The BDWMO reviews local water management plans for consistency with the BDWMO Plan per the authorities listed in Minnesota Statutes 103B. BDWMO requirements for local plans in addition to those specified in Minnesota Rules 8410, are identified in Section 4.7.5 of the BDWMO Plan.

The BDWMO will work with member cities to set reasonably attainable goals and measurable expectations and to assess the BDWMO's and each city's progress toward the agreed upon expectations. The BDWMO

expects the member cities to continue to share information with the BDWMO regarding monitoring and surveying of strategic waterbodies or MDNR public waters within the BDWMO and any management actions or projects performed for those waterbodies so that the BDWMO can compile an annual report.

Additional information, including the BDWMO implementation program and 2012 Watershed Management Plan, is available from the BDWMO website at: http://www.blackdogwmo.org/

4.3.2 Vermillion River Watershed Joint Powers Organization

The VRWJPO was formed through a JPA between Dakota and Scott counties in September 2002. The mission of the VRWJPO, adopted in May 2015, is to:

> ***Collaboratively providing education, science, and support to restore and protect the Vermillion River Watershed's natural resources for all who live, work, and play within its boundaries.***

To guide the VRWJPO in pursuit of its mission, the VRWJPO developed and adopted its *2016-2025 Vermillion River Watershed Management Plan* (VRWJPO Plan). Development of the VRWJPO included substantial stakeholder engagement to identify and prioritize issues within the watershed (Section 5 of the VRWJPO Plan). To address these issues, the VRWJPO Plan includes the following goals:

- Protect or restore water quality in lakes, streams, and wetlands.
- Protect and restore groundwater quality.
- Maintain a sustainable water supply.
- Address more intense fluctuations (up and down) in river flow rate and volume.
- Improve public awareness and stewardship of water resources.
- Improve watershed resilience to changing precipitation and temperature patterns.
- Protect or restore sensitive biological resources, such as plants, fish, insects, and wildlife.

Section 6 of the VRWJPO Plan includes objectives and actions to achieve the above goals. Many of these objectives and actions include collaborative efforts between the VRWJPO and its member cities, including Lakeville. Prominent among these are efforts to improve or maintain water quality. The VRWJPO also collaborates with municipalities to:

- Provide cost-share grants for cities and residents to implement water quality improvement projects (e.g., cost-share for projects to prevent impacts of excess nutrients on Lake Marion);
- Provide assistance to cities meeting MS4 permit requirements;
- Reduce barriers to implementing resource conservation practices; and
- Promote civic engagement and citizen-based action on water and natural resources issues.

The VRWJPO established performance standards for activities meeting specific triggers (VRWJPO Standards, 2010, as amended). The VRWJPO does not currently implement a permitting program in any communities where the local government unit satisfactorily maintains and implements project review and permitting programs. The VRWJPO instead requires member cities to maintain and implement project

review and permitting programs with performance standards at least as stringent as those defined in the VRWJPO Standards (2010, as amended). The City developed this WNRMP with the intent to be consistent with the VRWJPO Plan and VRWJPO Standards.

As part of the VRWJPO Plan, the VRWJPO established a ten year implementation plan; the implementation plan is subdivided into management plans for each of the VRWJPO's major subwatersheds. In addition to collaborative, watershed-wide activities, the subwatershed implementation plan identifies the following specific projects that may possibly be located within the City:

- Stormwater storage in the headwaters of North Creek (North Creek Subwatershed);
- Stormwater retrofits near Pilot Knob Road (North Creek Subwatershed);
- BMP retrofits in Lakeville downstream of Marion Lake (South Creek Subwatershed); and
- Headwater stream ponds upstream of 195th Street (Middle Creek Subwatershed).

Consistent with Minnesota Statutes 103B, the VRWJPO reviews local water management plans for consistency with the VRWJPO Plan. Along with Minnesota Rules 8410, Figure 10.2.1 of the VRWJPO Plan identifies requirements for local plans.

Additional information about the VRWJPO, including the VRWJPO Plan and Standards, is available from the VRWJPO website at: http://www.vermillionriverwatershed.org/

4.3.3 Watershed Management Organization Cooperative Efforts and Funding

The City partners with the BDWMO and VRWJPO to varying degrees to address surface water management issues. These WMOs and the Dakota SWCD provide technical support and funding toward solving various water resource problems and completing water resource projects. These organizations have a long history of working successfully with the individual cities toward meeting shared goals. The City collaborates and contributes to these organizations and takes advantage of the available benefits. City staff participates as active members of WMO Technical Advisory Committees and participate in WMO programs and projects, as requested. Specific opportunities for collaboration include proposed projects included in the BDWMO and VRWJPO capital improvement programs. The City may also benefit by leveraging educational materials and opportunities developed by the WMOs to promote good watershed stewardship among its residents.

4.4 Natural Resource Management Program

Through the implementation of this WNRMP, the City looks to continue and expand its natural resource management program. City activities addressing natural resource management are included in Table 4-2. City management activities may include:

- Protection of wooded areas, especially larger tracts of woods. This could include varying degrees of urban forest management, depending on resources.
- Management of prairie communities. Activities within this concept may include:

    - Identification and management of larger prairie tracts, in an attempt to enhance the ecological functions of prairies;
    - Planting of prairie strips and patches in public areas where mowed grass is not necessary;
    - Providing materials (hard copy and/or online) to homeowners to assist them in introducing prairie plants in their yards; and
    - Developing natural alternatives to turf landscaping.
- Natural Resource Inventory based on publically available data sets or site specific surveys;
- Enhancing connectivity of remnant natural areas (i.e., natural resource corridors).
- Wildlife habitat enhancements, including constructed habitats from natural materials for a range of small mammals, birds, or other species.
- Promoting pollinators.
- Creek restoration activities.

The City will use its education and public involvement program to build community capacity for natural resource stewardship. Providing direction to Lakeville property owners on prairies, tree care, pollinator gardens, rain gardens, and other issues will promote behaviors that protect existing resources. The City may consider developing protocols for natural resource inventory or monitoring performed by volunteers ("citizen science") a means of gathering natural resource data.

The City may also consider the feasibility of creating or supporting programs to incentivize natural resource management practices on private property. Grant funding from WMOs or Dakota SWCD may be available to promote such programs.

Further identification of target areas and resources is necessary to develop feasible strategies and projects to preserve, restore, and enhance targeted resources or areas.

4.5 Education and Public Involvement Program

The City's education and public involvement program seeks to create an understanding of water resources issues within the City and increase community capacity to address those issues through appropriate stormwater and water resource practices. The City achieves this goal through a range of programs, outreach, and communications.

The City cooperates with WMOs and other applicable groups to develop and distribute information on stormwater and natural resource management topics including, but not limited to:.

- Water conservation and reuse;
- Non-point source pollution and best practices for pollution prevention (e.g. pet waste disposal);
- Native plants and terrestrial and aquatic invasive species;
- Low impact development (LID) practices;
- Water quality in lakes and streams;
- Construction regulation and guidance;

- Illicit discharges and hazardous waste disposal;
- Infiltration, filtration, and groundwater protection;
- Erosion control;
- Vegetated buffers and shoreline management;
- Composting and yard waste management; and
- Methods for water quality improvement for residents (e.g., rainwater gardens, lawn maintenance).

The City communicates stormwater and natural resource management information through:

- Workshops;
- Presentations;
- City website: lakevillemn.gov
- Newsletters;
- Targeted mailings; and
- Social media.

The City tailors its educational materials and communication strategies to target specific audiences (e.g., lakeshore residents, business owners) to promote behaviors with positive impact on water and natural resources (e.g., installing residential rainwater gardens, picking up pet waste).

The City promotes public awareness of the potential sources and negative effects of illicit non-stormwater discharges, as well as alternative uses for unwanted materials by providing information on recycling options, services, and programs within and outside the City, such as drop-off sites for household hazardous waste. The City will also review the current educational activities undertaken by its staff to identify, prevent and correct illicit discharges from daily public works activities and other general City operations.

The City provides opportunities for community involvement and collaboration with volunteer groups to address stormwater and natural resource management issues. The City works collaboratively with the Dakota SWCD, BDWMO, and VRWJPO in promoting and supporting outreach programs. Such programs have included, but are not limited to:

- Landscaping for Clean Water workshops (Dakota SWCD);
- Minnesota Envirothon (Dakota SWCD) ;
- Volunteer stream monitoring (VRWJPO);
- Citizen Assisted Lake Monitoring Program (Metropolitan Council); and
- Wetland Health Evaluation Program (Dakota County).

The City's website provides pages and links devoted to water resource related issues. The City website (lakevillemn.gov) contains relevant City management documents (e.g., this WNRMP), links to other agencies and technical resources, and local contact information for residents to request further information on specific stormwater topics or to report a stormwater related infraction.

The City periodically reviews its educational programs to keep this communication up to date and useful.

4.6 Funding Considerations

The City plans to continue to use the Environmental Resources Fee program (formerly the Storm Water Management Utility) to fund stormwater related activities including those described in this WNRMP. The City's Environmental Resources Fee revenue is generated by fees according to impervious surface coverage for non-single-family residential land use (single-family residential lots are assessed a quarterly fee per unit) The Environmental Resources Fee is the primary funding source for all water quality improvements related to this WNRMP and NPDES requirements. This program is periodically reviewed to determine its adequacy for funding the projects and programs needed.

Funding for construction of new stormwater management infrastructure is obtained by the City from connection charges and development fees. Funding for construction of new stormwater management infrastructure is collected on an area basis at the time of subdivision. The storm sewer charge is based on square footage of the parcel and proposed land use. The program is regularly updated based on an index of construction costs to account for inflation and other market forces.

Over the next several years, the City will be challenged with needing to replace an increasing amount of existing stormwater infrastructure that is at or beyond the end of its design life. Funding for capital improvements within the storm sewer system which serve the older portions of the City may be obtained through the Environmental Resources Fee, or other funding sources (yet to be identified). The City may seek cost-share opportunities and grants to fund future infrastructure replacement.

This Plan, along with its capital improvement and implementation programs, combined with the existing Environmental Resources Utility Fund, connection charges and development fees, and other funding sources gives the City adequate funding tools to maintain and expand public stormwater infrastructure.

4.7 Ordinances, Design Standards, and Official Controls

The City of Lakeville regulates the management of stormwater, surface water, and natural resources through this WNRMP, City ordinances, and other applicable regulatory programs. These are collectively referred to as "official controls," and include the following:

City regulations and land use controls include the following ordinances and resource management plans:

- City Code Title 10 (Subdivisions), Chapter 4: Design Standards, including:
    - Erosion and Sediment Control (Lakeville City Code, Section 10-4-5, as amended)
    - Storm Drainage (Lakeville City Code, Section 10-4-6, as amended)
    - Protected Areas (Lakeville City Code, Section 10-4-7, as amended)
    - Tree Preservation (Lakeville City Code, Section 10-4-11, as amended)
    - Wetlands and Watercourses (Lakeville City Code, Section 10-4-12, as amended)
- City Code Title 11 – Zoning, including:

    - Floodplain Overlay District (Lakeville City Code, Section 11-101, as amended)
    - Shoreland Overlay District (Lakeville City Code, Section 11-102, as amended)
- The South Creek Management Plan (2000, as amended)
- Wellhead Protection Plan (2014, as amended)

Design standards generally applicable to new development and redevelopment included in the above ordinances are summarized in Table 4-3. *Note that the design standards included in Table 4-3 may not include all applicable design standards and do not replace design or performance standards required by the MPCA, BDWMO, VRWJPO, or other entities, as applicable.*

The City ensures compliance with applicable performance standards through its project review and permitting program. The City requires permits and/or approvals for land-disturbing projects, including development, redevelopment, and linear projects. Planning applications must include a grading and drainage plan, an erosion control plan, a tree preservation plan and a wetland delineation, where applicable.

The City actively works with the BDWMO and the VRWJPO toward accomplishing common goals and adhering to the policies of these watershed organizations. The VRWJPO operates permit programs in municipalities that have not established official controls consistent with VRWJPO standards. The City intends to maintain permitting authority. The City seeks to maintain consistency with applicable BDWMO and VRWJPO requirements through the policies and implementation items included in this WNRMP, including any necessary updates to the City's official controls.

As part of implementing this WRNMP, the City will revise its official controls, as needed, to be consistent with the:

- Vermillion River Watershed Joint Powers Organization Watershed Standards (2016, as amended);
- Black Dog Watershed Management Organization Watershed Management Plan (2012, as amended); and
- City MS4 Permit.

4.7.1 NPDES Construction Stormwater Permit

In addition to meeting applicable City and applicable WMO permit requirements, owners and operators of construction sites disturbing one or more acres of land must obtain an NPDES Construction Stormwater Permit from the MPCA. Owners/operators of sites smaller than one acre that are a part of a larger common plan of development or sale that is one acre or more must also obtain permit coverage. A key permit requirement is the development and implementation of a Stormwater Pollution Prevention Plan that includes:

- Temporary erosion prevention and sediment control BMPs;
- Permanent erosion prevention and sediment control BMPs;
- Permanent stormwater management system; and

- Pollution prevention management measures.

More information is available from the MPCA website at: https://www.pca.state.mn.us/water/construction-stormwater

4.7.2 Wellhead Protection Plan

The MDH administers and enforces the Minnesota Water Well Code through its wellhead protection program. As part of this program, cities that pump groundwater to supply their residents with drinking water are required to prepare wellhead protection plans (WHPPs). The City maintains a current WHPP, most recently updated in 2014. The WHPP delineates drinking water supply management areas (DWSMA) for the City's municipal groundwater wells, assesses the water supply's susceptibility to contamination from activities on the land surface, and establishes management programs, such as identification and sealing of abandoned wells, and education/public awareness programs.

The City maintains its WHPP and performs the activities described. If the City determines that a proposed infiltration/discharge may potentially cause adverse effects to the local drinking water supply, the City will prohibit the construction of the infiltration area or incorporate the necessary BMPs to reduce the identified pollutant(s) prior to infiltrating into the vulnerable portions of the DWSMA.

4.7.3 South Creek Management Plan

The Lakeville South Creek Management Plan is a statement of City goals and management strategies combined with a set of BMP recommendations for the South Creek Stormwater District. The South Creek Management Plan was designed to preserve trout stream habitat within the City and minimize impacts to downstream areas designated as trout stream habitat.

The goals of the Lakeville South Creek Management Plan are:

- Preserve trout stream habitat within the City;
- Minimize impact to downstream areas designated as trout stream habitat;
- Map out a coherent, long term management strategy for trout habitat preservation;
- Focus limited resources in the most effective direction;
- Create a guide for surface water design aspects of development;
- Identify key educational areas;
- Improve the quality, functionality, and biological diversity of the South Creek fishery;
- Continue the growth of the Airlake Industrial Park; and
- Integrate the trout stream corridor with City green space and greenway amenities.

The South Creek Management Plan requires the following protective measures:

- Infiltration depressions for all new subdivisions and redevelopment within the South Creek Stormwater District with volume sufficient to infiltrate (within 72 hours) 1.5" of runoff over the impervious surface area for all current and future phases of development. Infiltration depressions

shall not be lined nor shall mining of native material be allowed before the basin is constructed. Re-vegetation on the infiltration areas bottoms shall consist in the majority of plant types which can tolerate inundated condition for periods of days and have root depths in excess of 18 inches.

- Site landscaping for all new subdivisions and redevelopment within the South Creek Stormwater District shall include planting of shade trees or shrubs of native species sufficient to shade the full reach of the trout stream channel or tributary flows adjacent to the subdivision. It is further recommended that specifications provide some level of shade for infiltration areas.
- Transfer of ownership to the City of a required buffer on either side of the stream centerline in newly subdivided areas and where practical in existing areas.

The Plan also outlines recommendations for a stream monitoring plan, educational project and emergency response plan. The Plan recommends the evaluation of the effectiveness of measures to maintain the cold water fishery.

Responsibility for implementing the South Creek Management Plan is assigned to Environmental Resources under the supervision of the City Engineer. Environmental Resources shall maintain the educational and monitoring programs and implement the management strategies outlined in the South Creek Management Plan. Environmental Resources shall also periodically review the success of the South Creek Management Plan in meeting its goals using monitoring or the functional assessment method outlined in the South Creek Management Plan.

More information is included in the South Creek Management Plan is and is available from the City at:. lakevillemn.gov/

4.7.4 Wetland Management

The City is the LGU responsible for administering the WCA within the City. This includes requiring and verifying that all projects impacting wetlands meet the requirements of the Minnesota WCA (Minnesota Rule 8420) and the City's wetland ordinance. The City requires an approved wetland delineation following USCAE 1987 Wetland Delineation Manual standards as part of proposed subdivision or redevelopment activities. The City also requires that proposed projects meet applicable wetland requirements of the BCWMO or VRWJPO.

4.8 Partnerships with Neighboring Cities

The City seeks opportunities to partner with neighboring cities to address intercommunity hydraulic and water quality issues. Examples of such activities include collaborative efforts with the City of Burnsville to improve water quality of Crystal Lake, and cooperative efforts with the City of Apple Valley to improve water quality in East Lake.

4.9 Redevelopment

Opportunities for updating and upgrading the City storm drainage system in developed areas exist primarily through redevelopment activities. As private and public properties redevelop, the City will implement the policies and programs of this WNRMP. The City proactively uses the regulatory controls at its disposal to ensure that opportunities presented by redevelopment to improve the stormwater systems and implement the policies of this WNRMP are not lost.

4.10 Low Impact Development Practices

Existing development, limited space, and poor site conditions (e.g., soil contamination, low infiltration capacity) throughout many areas of the City limit opportunities for additional stormwater management infrastructure. To mitigate the difficulty and expense of stormwater infrastructure to serve subdivision and redevelopment sites, the City fosters sustainable development and works to establish a balance between urban and natural systems. The City promotes the use of low impact development practices (e.g., green roofs, rain gardens, bioswales, pervious pavement, water reuse) throughout the City, where appropriate. These techniques promote water quality improvements and reduction of runoff volumes to receiving waters.

4.11 Coordination with Other City Programs

Coordinating stormwater and surface water management activities with other City programs presents an opportunity to increase operational efficiency, reduce costs, and limit the frequency and duration of disruptions to City services. The City's pavement management program, for example, may be coordinated with stormwater management activities so that potentially disruptive maintenance or improvements may be performed simultaneously with road maintenance, minimizing the number of closures. Similarly, water resource management projects may be coordinated with park improvements to maximize efficiency and minimize disruption.

4.12 Agricultural Land Conversion

Residential subdivision of agricultural land typically results in reduced loading of sediment to receiving waters. Lakeville still has areas of agricultural land that are expected to subdivide into residential neighborhoods. Along with the opportunity to apply stormwater BMPs with the subdivision, these projects will reduce the acreage of agricultural land acting as a source of sediment in stormwater runoff.

4.13 Capital Improvements and Implementation Priorities

The projects, programs, and activities related to the City's surface water and stormwater management responsibilities are summarized in Table 4-1 and Table 4-2. Many of the implementation items listed in Table 4-1 and Table 4-2 are required per the City's NPDES MS4 permit and incorporated into the City's SWPPP. These tasks will be addressed per the schedule presented in the SWPPP.

The City carries out its implementation program with the intent to achieve its goals while promoting efficiency and minimizing cost. Therefore, the City will seek opportunities to coordinate stormwater system repair and/or replacement with its Pavement Management Program, redevelopment opportunities, or other coordinated projects (e.g., park improvements, other utility upgrades). The City may also re-prioritize projects based on the availability of grant funding, cost-share opportunities, or availability of other funding sources that may reduce the City's financial responsibility.

Table 4-1 Implementation Program – Capital Improvements

ID	Project Description	Cost Estimate ($)*	Proposed Funding Source	Estimated Expenses by Year						Notes
				2019	2020	2021	2022	2023	2024-2028	
XX-02	New storm sewer infrastructure constructed in coordination with annual street reconstruction and collector road rehabilitiation.	$1,050,000	Storm sewer fund	$105,000	$105,000	$105,000	$105,000	$105,000	$525,000	
ER-4	Storm Water Conveyance System Expansion – Extension and construction of new infrastructure to serve areas of planned growth	$1,000,000	Storm sewer fund	$100,000	$100,000	$100,000	$100,000	$100,000	$500,000	
ER-5	Water quality best management practices – including partnerships (e.g., VRWJPO, BDWMO, DCSWCD)	$1,000,000	Environmental resources utility fund	$100,000	$100,000	$100,000	$100,000	$100,000	$500,000	
ER-6	Forestry – Annual maintenance program designed to manage, preserve and protect public woodland assets; Implement potential natural resource management projects and activities, including those based on results of natural resource management plan	$980,000	Environmental resources utility fund; grants	$80,000	$100,000	$100,000	$100,000	$100,000	$500,000	Based on results of management plan developed in task ER-5.1 in Table 4-2
CP15-12	Water Conservation/Water Reuse - in coordination with 202nd Street/CSAH 50 reconstruction project	Cost included in other budgets								Planned for 2019
CP19-06	South Creek Restoration (North/West Branches)- Stream realignment and restoration between Hamburg Avenue and Cedar Avenue	NA	VRWJPO							Planned for 2019-2020
CP19-07	Market Plaza Pavers Rehabilitation - Rehabilitation of existing pervious pavers designed to remove sediment and maintain storm sewer	$50,000	Environmental resources utility fund	$50,000						
CP19-08	James Jensen Storm Water Management - Floodplain management project to increase floodplain storage and reduce localized flooding impacts	$125,000	Storm sewer fund	$25,000	$100,000					

CP19-09:	Lake Marion Shoreline Restoration (Casperson Park)	$50,000	Environmental resources utility fund	$50,000						
VR-1	Stormwater retrofits near Pilot Knob Road to address water quality (North Creek Subwatershed)	NA	VRWJPO	Project to be implemented by the VRWJPO with cooperation from the City, as requested						From VRWJPO 2016 Plan – North Creek Subwatershed;
VR-2	Water quality BMP retrofits in Lakeville downstream of Lake Marion (South Creek Subwatershed)	NA	VRWJPO	Project to be implemented by the VRWJPO with cooperation from the City, as requested						From VRWJPO 2016 Plan – South Creek Subwatershed
VR-3	Projects in headwater stream basins upstream of 195th Street (Middle Creek Subwatershed)	NA	VRWJPO	Project to be implemented by the VRWJPO with cooperation from the City, as requested						From VRWJPO 2016 Plan – Middle Creek Subwatershed
VR-4	Stormwater storage in the headwaters of North Creek (North Creek Subwatershed)	NA	VRWJPO	Project to be implemented by the VRWJPO with cooperation from the City, as requested						From VRWJPO 2016 Plan – North Creek Subwatershed

* Costs presented in 2018 dollars for planning purposes.

Table 4-2 Implementation Program – Programs, Studies, and Official Controls

ID	Item Description	Cost Estimate ($)*	Proposed Funding Source	Estimated Expenses by Year						Notes
				2018	2019	2020	2021	2022	2023-2027	
OC-1	Implement the City development review, permitting, and inspection program	$800,000	Storm sewer fund	$80,000	$80,000	$80,000	$80,000	$80,000	$400,000	Addresses SWPPP MCMs 4 and 5
OC-2	Revise City stormwater management ordinance	$10,000	Environmental resources utility fund	$10,000						Update for consistency with policies in this WNRMP
OC-3	Revise City wetland management ordinance	$10,000	Environmental resources utility fund	$10,000						Update for consistency with VRWJPO Standards
ED-1	Perform education and public involvement activities per SWPPP	$250,000	Environmental resources utility fund	$25,000	$25,000	$25,000	$25,000	$25,000	$125,000	Addresses SWPPP MCM 1, 2 and 3; performed in coordination with WMOs
ER-2	Storm Water Infrastructure Maintenance – Perform maintenance activities for natural resources and stormwater infrastructure, including activities consistent with the City's SWPPP (e.g., pond cleanout, street sweeping)	$750,000	Environmental resources utility fund	$75,000	$75,000	$75,000	$75,000	$75,000	$375,000	Addresses SWPPP MCM 6
ER-3	Stormwater basin rehabilitation	$1,450,000	Environmental resources utility fund	$150,000	$150,000	$150,000	$150,000	$150,000	$750,000	
ER-1.1	Lake Management – Implement ongoing lake and water resource assessment activities (e.g., water quality monitoring)	$650,000	Environmental resources utility fund	$65,000	$65,000	$65,000	$65,000	$65,000	$325,000	
ER-1.2	Lake Management – Implement ongoing lake and water resource treatment activities (e.g., aquatic vegetation management)	$500,000	Environmental resources utility fund	$50,000	$50,000	$50,000	$50,000	$50,000	$250,000	
ER-6.1	Develop more detailed natural resource inventory and management plan and carry out identified strategies	NA	Environmental resources utility fund	Costs included in Item NR-6 in Table 4-1						Plan would identify resources and areas to be managed and identify potential implementation projects

ID	Item Description	Cost Estimate ($)*	Proposed Funding Source	Estimated Expenses by Year						Notes
				2018	2019	2020	2021	2022	2023-2027	
ER-5.1	Develop City wide water quality model	$40,000	Environmental resources utility fund		$40,000					Will inform practices implement as part of Item NR-5 in Table 4-1
NR-7	Coordinate with the MPCA, BDWMO, and VRWJPO as necessary in the development of TMDL and/or WRAPS studies and implementation plans, as needed	$100,000	Environmental resources utility fund						$100,000	
NR-8	Update City-wide hydrologic and hydraulic modeling (including annual updates)	$150,000	Environmental resources utility fund	$10,000	$75,000	$75,000	$10,000	$10,000	$10,000	
NR-8.1	Use update hydrologic and hydraulic modeling to re-evaluate potential issues identified in prior stormwater system analysis (see Appendix A)	$20,000	Environmental resources utility fund				$20,000			Including potential outlet in subwatershed CL-021, flooding in CL-056, and potential pumping in subwatersheds OL-093, OL-094, and OL-105
NR-9	Coordinate with MDNR, County, and WMOs in collaborative efforts to address groundwater issues	$20,000	Environmental resources utility fund	$2,000	$2,000	$2,000	$2,000	$2,000	$10,000	As opportunities arise
NR-10	Update the City WNRMP ahead of 2050 comprehensive plan update	$50,000	Environmental resources utility fund						$50,000	

* Costs presented in 2018 dollars for planning purposes.

Table 4-3 Summary of City of Lakeville Design Standards

Category	Performance Standards	Source/Driver[1]
Stormwater Rate Control	- New development and redevelopment projects shall not increase the runoff rate for 1-year, 10-year (10% chance), and 100-year (1% chance) critical duration storm events	BDWMO Plan Section 4.9.1 VRWJPO Standards 8.3.C
Stormwater Volume Control	- New subdivision and redevelopment projects must provide for the infiltration of 1.0 inch of runoff from new and redeveloped impervious surface (1.5 inches in the South Creek drainage district) - New subdivision and redevelopment projects creating one or more acres of new impervious surface must not increase in the runoff volume for the 2-year 24-hour storm above 2005 conditions.	NPDES Construction Stormwater General Permit Lakeville South Creek Management Plan VRWJPO Standards 8.3.D BDWMO Plan (Policy 4.9.1-2 and 4.9.1-17)
Erosion and Sediment Control	- BMPs consistent with NPDES Construction Stormwater General Permit - BMPs implemented consistent with guidance from MN Stormwater Manual	NPDES Construction Stormwater General Permit VRWJPO Standards 7.3
Stormwater Quality	- BMPs consistent with NPDES Construction Stormwater General Permit - BMPs implemented consistent with guidance from MN Stormwater Manual - No net increase in the temperature of the discharge for the 2-year 24-hour event (or there is zero discharge in the 2-year, 24-hour event)	NPDES Construction Stormwater General Permit VRWJPO Standards 8.3.A
Stream and Wetland Buffers	- Buffers are required adjacent to wetlands according to management classification: **Preserve:** 50 ft average (30 ft minimum) **Manage 1:** 40 ft average (30 ft minimum) **Manage 2:** 30 ft average (25 ft minimum) **Manage 3:** 25 ft average (16.5 ft minimum	VRWJPO Standards 6.3.G

<table>
<tr><td>Stream and Wetland Buffers (continued)</td><td>- Buffers are required adjacent to watercourses according to VRWJPO management classification:
Conservation corridor: 150 ft average (100 ft minimum)
Principal connector: 100 ft average (65 ft minimum)
Principal connector (trout stream): 100 ft minimum
Tributary connector: 50 ft average (35 ft minimum)</td><td>VRWJPO Standards 6.3.H and Map 1 (Watercourse Classifcations)</td></tr>
<tr><td>Flood Risk Reduction</td><td>- Land disturbing activity shall result in no net loss of floodplain

- For new and significantly redeveloped structures, the City requires minimum building elevations varying by type of structure and adjacent waterbody or stormwater facility, as follows:
<table>
<tr><th>Structure Type</th><th>Water Bodies with Piped Outlets</th><th>Water Bodies without Piped Outlets</th><th>Creeks or Water Bodies within the Floodplain Zoning District</th><th>Subsurface Stormwater Management BMPs</th></tr>
<tr><td>Habitable Buildings</td><td>Low floor must be minimum of 3 feet above the outlet elevation and 1 foot above the regulatory flood elevation (2 feet above the regional (1%) flood elevation).</td><td>Low floor must be a minimum of 5 feet above the regional (1%) flood elevation.</td><td>Low floor must be 1 foot above the regulatory flood elevation (2 feet above the regional (1%) flood elevation).</td><td>Low floor must be a minimum of 3 feet above the regional (1%) flood elevation.</td></tr>
<tr><td>Underground Parking Structures</td><td>Low opening must be a minimum of 3 feet above the regional (1%) flood elevation.</td><td>Low opening must be a minimum of 5 feet above the regional (1%) flood elevation.</td><td>Low floor must be 1 foot above the regulatory flood elevation.</td><td>Low opening must be a minimum of 3 feet above the regional (1%) flood elevation or one foot above the emergency overflow elevation.</td></tr>
<tr><td>Roadways</td><td colspan="4">Roadways shall have a minimum of 1-foot of freeboard above the regional (1%) flood elevation when adjacent to water bodies with piped outlets designed to store the 1% rainfall event.
OR
1 foot above the regulatory flood elevation when adjacent to creek or other water bodies within the Floodplain Zoning District.</td></tr>
</table>
Note: The lowest floor and HVAC facilities of new or significantly redeveloped habitable structures and underground parking facilities must be at least 3 feet above the seasonal high groundwater elevations for the area; groundwater elevation data may be derived from piezometer data, soil boring data showing mottled or hydric soils, or other sources approved by the City Engineer.
Note: The low opening of all structures must be at least 1 foot about the emergency overflow elevation.</td><td>VRWJPO Standards 4.3.A</td></tr>
</table>

(1) Note that City performance standards presented above may exceed the minimum standard required by the BDWMO, VRWJPO, MPCA, or other regulatory agencies. Examples include volume control requirements in the South Creek watershed and minimum building elevations.

5.0 References

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Appendices

Appendix A

Stormwater System Analysis

Appendix A Stormwater System District Analysis

The 1995 Lakeville Stormwater Management Plan included the development of a citywide hydrologic model and water quality modeling for the watersheds. Since that time, significant development and other changes have occurred requiring updates to the modeling. In 2009, the Vermillion River Watershed Joint Powers Organization (VRWJPO) developed a Vermillion River watershed-wide model to guide community discharge rates and runoff volume at municipal boundaries throughout the entire VRWJPO. The VRWJPO hydrologic model was calibrated to select storm event measurements collected between 2000 and 2004 at monitoring stations throughout the watershed. In 2014, the City of Lakeville, in partnership with the VRWJPO, enhanced the model to simulate the trunk stormwater system within the City. The City of Lakeville also developed a model for the Orchard Lake and Crystal Lake districts following the same methodology and using the same calibrated hydrologic parameters that were used to develop the model for the rest of the city. In 2018, the City updated the model to include development within the City that occurred since 2014.

The City's 1995 Plan included a summary of water quality modeling results. However, with all the development, changes in land use, and detailed water quality assessments that have occurred within the City since the early 1990s, water quality modeling completed for previous plans is no longer applicable. Instead the City relies on more recent studies and requirements from local watersheds, state, and federal agencies when making decisions related to water quality including the MPCA MS4 Permit, MPCA Construction Permit, Black Dog Watershed Management Organization Rules and Standards, and VRWJPO Rules and Standards.

A.1 Crystal Lake District

The Crystal Lake District has an area of approximately 1,465 acres within the City of Lakeville along the northern boundary of the City. It extends from Kenwood Trail on the west to Highview Avenue on the east, between 175th Street and the boundary with the City of Burnsville. The majority of Crystal Lake and the watershed contributing runoff to Crystal Lake lie within the City of Burnsville in the Black Dog Watershed Management Organization (BDWMO). Lakeville is a member of this Watershed Management Organization. Discharge from Crystal Lake flows to the Minnesota River.

The watershed divides within the City of Lakeville in the Crystal Lake District are shown on Figure A.1.1. The storm sewer network and additional details regarding the drainage system within the Crystal Lake watershed are shown on Figure A.1.2.

This entire district is tributary to Crystal Lake. Runoff from approximately 238 acres within the district flows into Lee Lake. In 1992 the City constructed an outlet to direct outflow from the lake to the east under Interstate 35 (I-35).

Runoff flows to Crystal Lake through three locations:

- the pond in Oak Shores Park, north of 162nd Street, between Jamaica Avenue and Oak Curve (CL-021) (Outlets in bay near Burnsville)
- the drainage swale in Oak Shores Park just east of Jamaica Avenue, between 161st Street and Oak Shore Drive (Outlets north of Oak Shore Drive, west of Jacquard Avenue)
- the storm sewer along County Road 46 (162nd Street), west of the Apple Valley water tower is routed to Bluebill Bay Pond which is located in subwatershed CL-046, south of Bluebill Bay Road and west of Inglewood Drive.

Runoff from approximately 138 acres in the Buck Hill development in the City of Burnsville (Subwatershed CL-007) flows through the City of Lakeville, Crystal Lake District watershed, and into Crystal Lake.

Within the City of Lakeville, nearly all of the Crystal Lake District is developed. Most of the watershed is single-family residential. The land adjacent to Interstate 35 is primarily commercial.

A.1.1 Flood Protection

For each subwatershed and storage pond, peak runoff rates, flood levels, flood discharges, and storage volumes were calculated using the XP-SWMM model. The results of the modeling are shown in the following tables:

No monitoring data were available within the subwatershed for model calibration. Therefore, the XP-SWMM model was developed using the calibrated parameters defined in *Vermillion River Watershed Hydrologic Study of Existing Conditions* (Barr 2009).

A.1.2 Subwatershed Pond Descriptions

The subwatersheds described in this section have unique characteristics.

Crystal Lake District

CL-020a - Crystal Lake: The majority of Crystal Lake and the subwatershed draining to Crystal Lake, lie within the City of Burnsville. A complete hydrologic analysis of Crystal Lake was not completed as a part of this plan.

CL-003, CL-004, and CL-021: The ponds in these watersheds are located in Oak Shores Park. The ponds are three connected basins, which act as one pond during high water levels. The 100-year flood level is 948.7 which inundates portions of Oak Shores Park. When maintenance is completed on Oak Shore Drive and South Oak Shore Drive the outlet from the pond in CL-021 could be evaluated to identify a way to lower flood levels in the pond.

CL-012 and CL-013: Subwatersheds CL-012 and CL-013 include ponds within the Crystal Ridge Estates development. The existing outlet from pond CL-013 is a 48-inch RCP that discharges under 163rd Street. The outlet from pond CL-012 is two 28-inch RCPs that discharge under 162nd Street (County Road 46) to Pond CL-004.

CL-033: The swale in subwatershed CL-033 is connected to the storm sewer system. During rainfall events larger than the 2-year event stormwater from the storm sewer on 167th Street outlets into the swale and is stored in the swale during the rainfall event until there is capacity in the downstream storm sewer system and the swale drains. During rainfall events a portion of the park is inundated. The 100-year flood elevation is approximately 1012.3.

CL-004, CL-005, CL-013, CL-014, CL-027, and CL-029a: These subwatersheds border Interstate 35 on the west. To provide a factor of safety and eliminate flooding of downstream ponds, the overall imperviousness for the commercial areas in these subwatersheds are restricted to 70 percent rather than 80 percent as is required in remainder of the city. The City has restricted imperviousness on new developments since 1994.

CL-029b, CL-030a and CL-030b, and CL-030c, : To provide a factor of safety and eliminate flooding of downstream ponds, the overall imperviousness for the high density residential area in these subwatersheds was restricted to 50 percent and the imperviousness for the commercial areas was restricted to 70 percent. The City has restricted imperviousness on new developments since 1994.

CL-015 - Lee Lake: Lee Lake has an existing gated outlet that was installed in 1992. The historical water level of the lake has varied, but the City considers the long-term normal water level to be elevation 946.1. Using this as a starting elevation for the analysis, the existing 100-year flood level is elevation 951.4 for the 4-day rainfall event (assuming the lake is landlocked). However, as with any landlocked lake, this will vary and can increase. It should be recognized that this flood elevation is very dependent on the operation of the outlet gate and the starting water surface elevation in the lake.

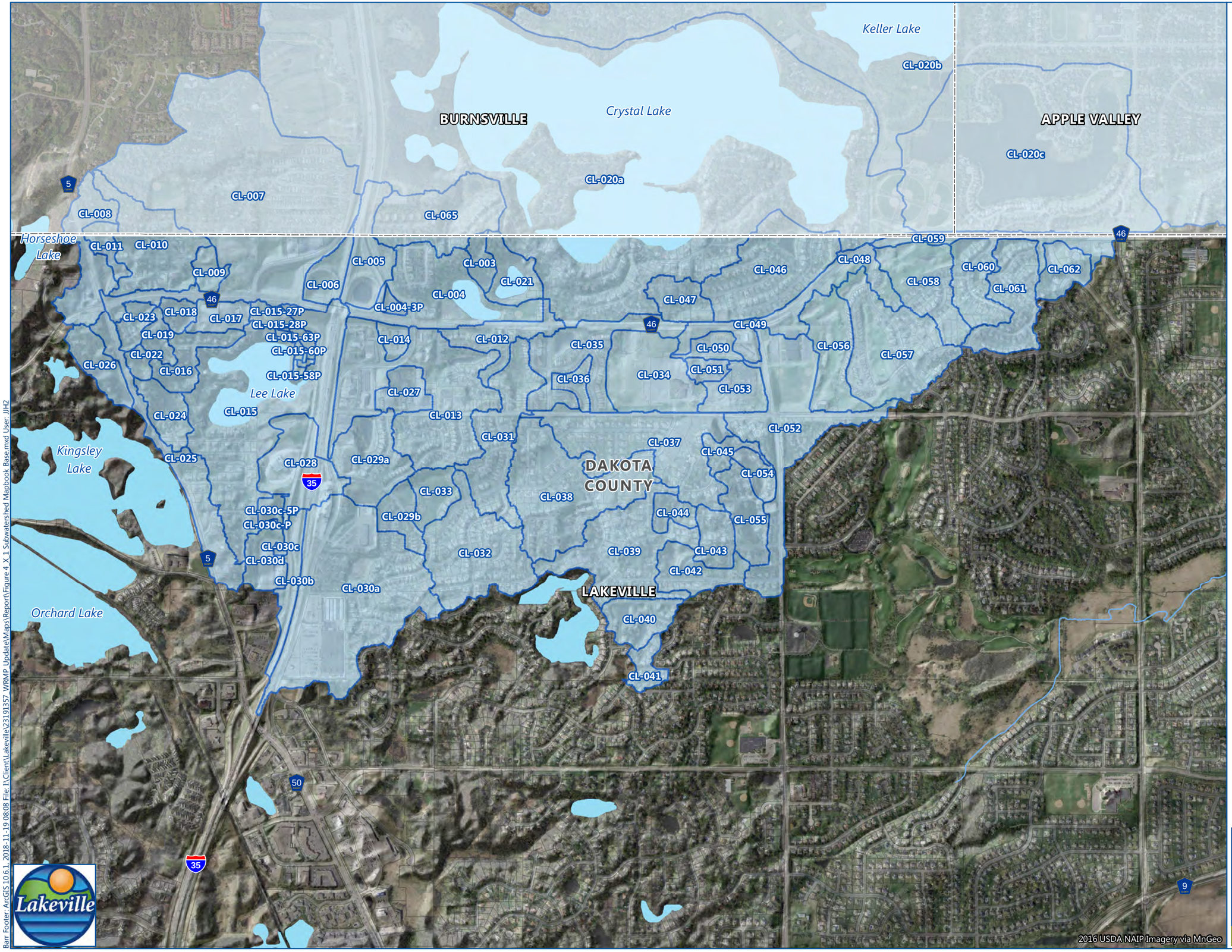
CL-056: Runoff from upstream subwatersheds enters CL-056, where flow is then directed through an existing 24-inch RCP under County Road 46 to subwatershed CL-046. The existing conditions 100-year flood level of Pond CL-056 overtops the existing County Road 46 by approximately 1.3 feet.

A majority of this subwatershed is within the Crystal Lake Golf Club development. The normal water surface elevation for Pond CL-056 was based on plans for the Crystal Lake Golf Club, which includes a berm around the pond at elevation of 970 to prevent water from flowing towards County Road 46. Based on available LiDAR data the top of berm is approximately elevation 968.3. However, the water surface elevation in the pond, based on available LiDAR data, is also 5-feet below the normal water surface elevation shown on the plans. In the future, if there are flooding concerns in this area the normal water level of the pond could be lowered or the berm could be raised.

CL-060: This entire subwatershed is located within the Hypointe Crossing development. Outflow from the pond is routed through the storm sewer along County Road 46.

CL-061: This entire subwatershed is located within the Hypointe Crossing development. Outflow from the pond flows through an existing storm sewer to subwatershed CL-060.

CL-062: Until 1992, runoff from this subwatershed flowed along the County Road 46 drainage ditch to subwatershed CL-061. After 1992 drainage from CL-062 is routed through the storm sewer along County Road 46 to Crystal Lake.



County Boundary
Municipal Boundary
Parcel Boundary
Subwatersheds
Public Water Inventory Watercourses
Public Water Inventory Basins

Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

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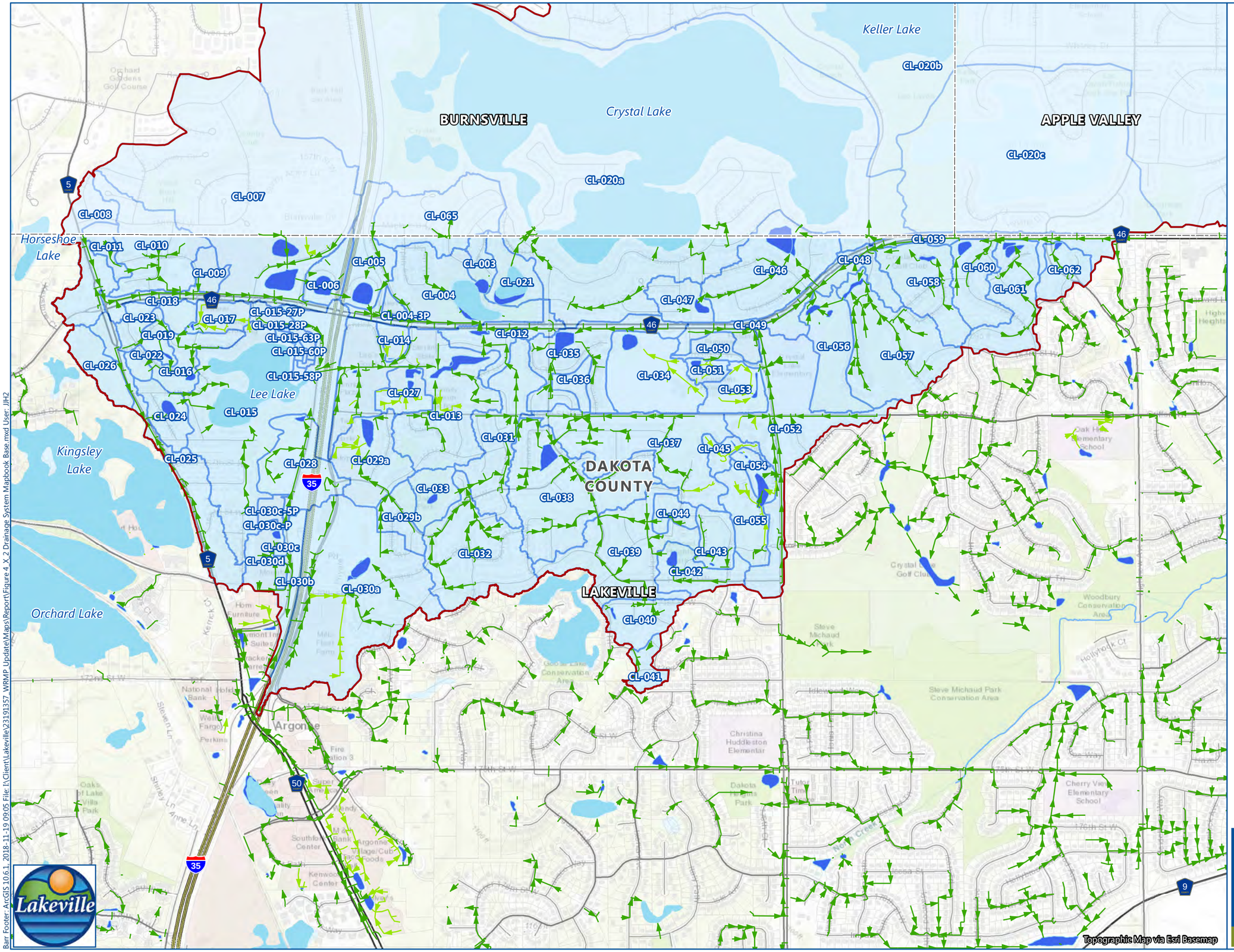
Feet

CRYSTAL LAKE SUBWATERSHEDS
Water and Natural Resources Management Plan
City of Lakeville

FIGURE A.1.1

Barr Footer: ArcGIS 10.6.1, 2018-11-19 08:08 File: J:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure-A_X_1_Subwatershed Mapbook Base.mxd User: JH2



County Boundary
Municipal Boundary
Parcel Boundary

Pipes

Storm Main
Private Storm Main
Subwatersheds
Major Subwatersheds
Existing Pond
Public Water Inventory Watercourses
Public Water Inventory Basins

Major Watersheds, Ponds and Pipe data from the City of Lakeville. Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

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1,000 0 1,000

Feet

CRYSTAL LAKE
DRAINAGE SYSTEM
Water and Natural Resources
Management Plan
City of Lakeville

FIGURE A.1.2

Barr Footer: ArcGIS 10.6.1, 2018-11-19 09:05 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 4_X_2 Drainage System Mapbook Base.mxd User: JH2

TABLE A.1.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION	MINIMUM INFILTRATION	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
CL-003	5.9	17.88	262	0.100	0.351	0.014	0.171	0.060	1.59	0.22	0.00110
CL-004	42.2	40.51	794	0.071	0.242	0.014	0.160	0.060	1.33	0.17	0.00110
CL-004-3P	2.0	69.90	166	0.088	0.249	0.014	0.170	0.060	1.30	0.18	0.00110
CL-005	19.8	48.96	504	0.074	0.226	0.014	0.191	0.060	1.10	0.15	0.00110
CL-006	10.2	54.17	355	0.095	0.220	0.014	0.194	0.060	1.34	0.18	0.00110
CL-007	177.5	28.83	1460	0.098	0.310	0.014	0.172	0.060	1.40	0.19	0.00110
CL-008	24.3	20.87	482	0.102	0.322	0.014	0.171	0.060	1.17	0.16	0.00110
CL-009	5.7	12.48	308	0.094	0.272	0.014	0.177	0.060	1.57	0.20	0.00110
CL-010	34.0	17.60	535	0.097	0.359	0.014	0.171	0.060	1.22	0.16	0.00110
CL-011	6.4	22.89	273	0.095	0.351	0.014	0.170	0.060	1.07	0.12	0.00110
CL-012	15.4	23.29	503	0.067	0.339	0.014	0.168	0.060	1.26	0.17	0.00110
CL-013	71.8	43.06	892	0.090	0.278	0.014	0.172	0.060	1.22	0.17	0.00110
CL-014	4.4	69.67	304	0.081	0.191	0.014	0.176	0.060	1.06	0.15	0.00110
CL-015	101.2	42.70	1113	0.092	0.233	0.014	0.160	0.060	1.15	0.16	0.00110
CL-015-27P	4.0	70.00	194	0.072	0.278	0.014	0.180	0.060	1.67	0.23	0.00110
CL-015-28P	0.4	70.00	46	0.071	0.254	0.014	0.170	0.060	1.67	0.23	0.00110
CL-015-58P	0.8	33.80	196	0.120	0.251	0.014	0.170	0.060	1.67	0.23	0.00110
CL-015-60P	0.8	66.20	242	0.029	0.251	0.014	0.170	0.060	1.01	0.14	0.00110
CL-015-63P	0.9	64.20	134	0.069	0.251	0.014	0.170	0.060	1.41	0.19	0.00110
CL-015-66P	0.2	16.60	101	0.215	0.251	0.014	0.170	0.060	1.67	0.23	0.00110
CL-015-74P	0.9	82.20	107	0.054	0.251	0.014	0.170	0.060	1.67	0.23	0.00110
CL-015-75P	0.5	83.40	103	0.033	0.251	0.014	0.170	0.060	1.00	0.14	0.00110
CL-015-76P	0.9	95.30	140	0.023	0.251	0.014	0.170	0.060	1.00	0.14	0.00110
CL-015-77P	0.2	90.00	144	0.064	0.251	0.014	0.170	0.060	1.00	0.14	0.00110
CL-015-78P	0.5	90.00	83	0.115	0.251	0.014	0.170	0.060	1.00	0.14	0.00110
CL-016	13.3	19.73	630	0.115	0.374	0.014	0.169	0.060	1.00	0.13	0.00110
CL-017	8.5	12.32	396	0.051	0.287	0.014	0.179	0.060	1.27	0.17	0.00110
CL-018	4.9	11.66	294	0.145	0.300	0.014	0.177	0.060	1.00	0.14	0.00110
CL-019	5.6	20.49	327	0.135	0.379	0.014	0.169	0.060	1.00	0.14	0.00110
CL-020a	659.0	55.82	3007	0.075	0.229	0.014	0.132	0.060	1.46	0.19	0.00110
CL-020b	1450.1	27.23	3347	0.056	0.331	0.014	0.167	0.060	1.01	0.14	0.00120
CL-020c	185.3	47.62	2348	0.074	0.258	0.014	0.138	0.060	1.00	0.14	0.00110
CL-021	13.3	38.29	483	0.101	0.291	0.014	0.148	0.060	1.49	0.20	0.00110
CL-022	3.6	20.57	263	0.125	0.380	0.014	0.169	0.060	0.87	0.11	0.00110
CL-023	6.3	20.58	444	0.099	0.380	0.014	0.169	0.060	0.92	0.12	0.00110
CL-024	11.8	18.50	500	0.125	0.358	0.014	0.171	0.060	1.00	0.13	0.00110
CL-025	29.3	18.58	556	0.108	0.362	0.014	0.170	0.060	0.99	0.14	0.00110
CL-026	12.7	11.25	316	0.156	0.282	0.014	0.177	0.060	0.91	0.12	0.00110
CL-027	10.1	56.73	545	0.095	0.238	0.014	0.172	0.060	1.66	0.23	0.00110
CL-028	27.6	40.24	786	0.081	0.239	0.014	0.180	0.060	1.00	0.14	0.00110
CL-029a	25.4	17.01	605	0.098	0.315	0.014	0.174	0.060	1.18	0.16	0.00110
CL-029b	10.2	18.37	419	0.045	0.346	0.014	0.171	0.060	1.00	0.14	0.00110
CL-030a	99.3	40.60	1555	0.068	0.278	0.014	0.175	0.060	1.00	0.14	0.00110
CL-030b	11.1	56.16	292	0.062	0.215	0.014	0.192	0.060	1.00	0.14	0.00110
CL-030c	0.7	74.24	130	0.084	0.249	0.014	0.170	0.060	1.00	0.14	0.00110

TABLE A.1.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION	MINIMUM INFILTRATION	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
CL-030c-5P	3.6	72.00	394	0.102	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
CL-030c-P	0.5	0.00	85	0.063	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
CL-030d	11.1	51.75	685	0.100	0.261	0.014	0.170	0.060	1.00	0.14	0.00110
CL-031	33.4	22.25	470	0.093	0.351	0.014	0.167	0.060	1.22	0.17	0.00110
CL-032	44.0	20.32	923	0.084	0.377	0.014	0.169	0.060	1.01	0.14	0.00110
CL-033	10.9	13.06	509	0.060	0.301	0.014	0.175	0.060	1.18	0.16	0.00110
CL-034	32.6	18.53	697	0.063	0.266	0.014	0.174	0.060	1.14	0.16	0.00110
CL-035	32.2	26.90	706	0.064	0.252	0.014	0.163	0.060	1.17	0.16	0.00110
CL-036	5.2	29.53	253	0.120	0.241	0.014	0.161	0.060	1.07	0.15	0.00110
CL-037	52.9	21.99	888	0.115	0.360	0.014	0.168	0.060	1.01	0.14	0.00110
CL-038	57.2	21.28	839	0.110	0.365	0.014	0.168	0.060	1.08	0.14	0.00110
CL-039	43.6	20.18	1113	0.103	0.375	0.014	0.169	0.060	1.02	0.13	0.00110
CL-040	13.9	19.83	376	0.100	0.372	0.014	0.169	0.060	0.96	0.12	0.00110
CL-041	6.6	20.17	313	0.091	0.375	0.014	0.169	0.060	1.00	0.11	0.00110
CL-042	15.0	18.31	433	0.086	0.358	0.014	0.171	0.060	0.93	0.13	0.00110
CL-043	10.4	16.27	485	0.092	0.349	0.014	0.172	0.060	1.00	0.14	0.00110
CL-044	6.4	20.58	391	0.101	0.380	0.014	0.169	0.060	1.00	0.13	0.00110
CL-045	5.9	31.69	309	0.113	0.243	0.014	0.159	0.060	1.00	0.14	0.00110
CL-046	44.2	19.41	835	0.070	0.367	0.014	0.170	0.060	1.28	0.18	0.00110
CL-047	11.5	21.23	332	0.085	0.357	0.014	0.169	0.060	1.19	0.16	0.00110
CL-048	18.9	14.64	871	0.075	0.271	0.014	0.159	0.060	1.21	0.17	0.00110
CL-049	9.0	53.56	279	0.048	0.215	0.014	0.173	0.060	1.00	0.14	0.00110
CL-050	6.2	35.68	263	0.065	0.238	0.014	0.174	0.060	1.00	0.14	0.00110
CL-051	4.4	34.30	424	0.063	0.247	0.014	0.169	0.060	1.00	0.14	0.00110
CL-052	56.7	27.86	557	0.093	0.295	0.014	0.167	0.060	1.03	0.14	0.00110
CL-053	13.0	33.66	475	0.103	0.253	0.014	0.169	0.060	1.00	0.14	0.00110
CL-054	6.6	31.44	310	0.175	0.237	0.014	0.159	0.060	1.00	0.14	0.00110
CL-055	16.1	22.11	583	0.136	0.299	0.014	0.167	0.060	1.00	0.14	0.00110
CL-056	24.3	10.70	437	0.089	0.241	0.014	0.155	0.060	1.03	0.14	0.00110
CL-057	46.6	18.29	848	0.103	0.301	0.014	0.161	0.060	1.00	0.14	0.00110
CL-058	26.5	13.04	662	0.100	0.314	0.014	0.161	0.060	1.00	0.14	0.00110
CL-059	5.8	11.41	141	0.048	0.264	0.014	0.162	0.060	1.00	0.14	0.00110
CL-060	28.6	21.42	631	0.099	0.355	0.014	0.169	0.060	1.00	0.14	0.00110
CL-061	26.3	20.52	378	0.099	0.379	0.014	0.169	0.060	1.00	0.12	0.00110
CL-062	11.2	19.99	464	0.089	0.374	0.014	0.169	0.060	1.00	0.14	0.00110
CL-065	35.5	25.18	597	0.101	0.307	0.014	0.165	0.060	1.49	0.20	0.00110

TABLE A.1.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
CL-003	5.9	1.0	6	1.3	8	2.4	15	4.4	27	5.5	33
CL-004	42.2	1.5	66	1.9	83	3.1	147	5.2	241	6.3	288
CL-004-3P	2.0	2.3	7	2.6	8	4.0	13	6.1	20	7.2	23
CL-005	19.8	1.8	39	2.1	49	3.4	87	5.5	139	6.6	164
CL-006	10.2	1.9	24	2.2	30	3.5	53	5.6	83	6.7	97
CL-007	177.5	1.1	171	1.4	216	2.5	381	4.5	631	5.6	762
CL-008	24.3	1.1	24	1.4	31	2.6	56	4.6	97	5.7	118
CL-009	5.7	0.9	5	1.2	7	2.4	16	4.4	28	5.4	34
CL-010	34.0	0.9	27	1.2	35	2.4	63	4.4	109	5.5	133
CL-011	6.4	1.3	8	1.6	11	3.0	20	5.0	34	6.1	40
CL-012	15.4	1.1	18	1.4	22	2.7	41	4.7	70	5.8	84
CL-013	71.8	1.6	104	1.9	131	3.1	231	5.2	379	6.3	452
CL-014	4.4	2.3	15	2.6	18	4.0	30	6.1	45	7.3	51
CL-015	101.2	1.6	142	1.9	181	3.2	321	5.3	530	6.4	634
CL-015-27P	4.0	2.2	11	2.5	14	3.9	24	6.0	37	7.1	43
CL-015-28P	0.4	2.2	1	2.6	2	3.9	3	6.0	4	7.1	5
CL-015-58P	0.8	1.5	2	1.8	3	3.0	5	5.0	8	6.1	9
CL-015-60P	0.8	2.2	3	2.6	3	3.9	5	6.1	8	7.2	9
CL-015-63P	0.9	2.1	3	2.5	4	3.8	6	5.9	9	7.0	10
CL-015-66P	0.2	1.1	1	1.4	1	2.6	1	4.5	2	5.6	2
CL-015-74P	0.9	2.5	3	2.8	4	4.2	6	6.4	9	7.5	11
CL-015-75P	0.5	2.6	2	2.9	2	4.3	4	6.5	5	7.6	6
CL-015-76P	0.9	2.8	3	3.1	4	4.6	6	6.8	9	7.9	11
CL-015-77P	0.2	2.7	1	3.1	1	4.5	2	6.7	2	7.8	3
CL-015-78P	0.5	2.7	2	3.0	2	4.5	4	6.7	5	7.8	6
CL-016	13.3	1.3	16	1.6	21	2.9	41	4.9	69	6.0	83
CL-017	8.5	0.9	7	1.2	9	2.4	18	4.4	34	5.5	42
CL-018	4.9	1.1	5	1.4	7	2.7	16	4.7	27	5.8	32
CL-019	5.6	1.3	8	1.6	10	2.9	19	4.9	32	6.0	38
CL-020a	659.0	1.8	715	2.1	903	3.4	1620	5.4	2732	6.5	3305
CL-020b	1450.1	0.9	722	1.1	912	2.1	1624	3.9	2738	5.0	3316
CL-020c	185.3	1.8	283	2.1	358	3.4	634	5.5	1032	6.6	1230
CL-021	13.3	1.5	24	1.8	31	3.1	54	5.1	88	6.2	104
CL-022	3.6	1.3	5	1.7	7	3.0	13	5.1	22	6.1	26
CL-023	6.3	1.3	9	1.6	11	2.9	22	5.0	36	6.1	43
CL-024	11.8	1.2	14	1.5	18	2.8	34	4.9	59	6.0	71
CL-025	29.3	1.1	27	1.4	34	2.6	62	4.7	106	5.8	129
CL-026	12.7	1.1	10	1.4	14	2.7	28	4.7	50	5.8	62
CL-027	10.1	1.9	27	2.3	34	3.6	58	5.6	90	6.7	104
CL-028	27.6	1.6	50	2.0	63	3.3	112	5.4	181	6.5	214
CL-029a	25.4	1.0	23	1.3	29	2.5	55	4.5	98	5.6	120
CL-029b	10.2	1.1	10	1.4	13	2.7	24	4.7	42	5.8	51
CL-030a	99.3	1.6	144	1.9	181	3.2	321	5.3	525	6.4	626
CL-030b	11.1	2.0	24	2.3	30	3.7	52	5.8	83	6.9	98
CL-030c	0.7	2.4	3	2.7	3	4.1	5	6.3	8	7.4	9
CL-030c-5P	3.6	2.3	13	2.7	16	4.1	26	6.2	38	7.3	43
CL-030c-P	0.5	0.9	1	1.2	1	2.4	2	4.5	3	5.5	4

TABLE A.1.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
CL-030d	11.1	1.9	30	2.3	37	3.6	63	5.7	97	6.8	112
CL-031	33.4	1.0	31	1.3	39	2.5	70	4.5	118	5.6	142
CL-032	44.0	1.1	42	1.4	53	2.7	96	4.7	164	5.8	198
CL-033	10.9	1.0	9	1.3	12	2.5	25	4.5	46	5.6	56
CL-034	32.6	1.0	29	1.3	38	2.6	70	4.6	123	5.7	150
CL-035	32.2	1.2	39	1.5	49	2.8	89	4.8	151	5.9	182
CL-036	5.2	1.5	9	1.8	12	3.1	22	5.1	36	6.2	42
CL-037	52.9	1.1	53	1.4	67	2.7	121	4.7	204	5.8	247
CL-038	57.2	1.1	54	1.4	68	2.6	121	4.7	205	5.8	248
CL-039	43.6	1.2	45	1.5	57	2.8	105	4.8	180	5.9	218
CL-040	13.9	1.2	15	1.5	19	2.8	34	4.9	58	6.0	71
CL-041	6.6	1.3	8	1.6	10	2.9	20	5.0	33	6.1	40
CL-042	15.0	1.2	15	1.5	19	2.8	35	4.8	61	5.9	74
CL-043	10.4	1.1	11	1.4	14	2.7	28	4.8	49	5.8	59
CL-044	6.4	1.3	8	1.6	11	2.9	21	5.0	35	6.1	42
CL-045	5.9	1.5	11	1.8	14	3.2	26	5.2	42	6.3	49
CL-046	44.2	1.0	38	1.2	48	2.4	86	4.4	148	5.5	181
CL-047	11.5	1.1	12	1.4	16	2.6	28	4.7	49	5.8	59
CL-048	18.9	1.0	19	1.3	25	2.6	50	4.6	90	5.7	109
CL-049	9.0	1.9	19	2.3	24	3.6	42	5.7	66	6.8	78
CL-050	6.2	1.6	11	1.9	14	3.2	26	5.3	41	6.4	49
CL-051	4.4	1.6	10	1.9	12	3.2	22	5.3	34	6.4	40
CL-052	56.7	1.2	57	1.5	72	2.8	129	4.8	214	5.9	258
CL-053	13.0	1.5	23	1.9	29	3.2	52	5.2	85	6.3	100
CL-054	6.6	1.5	13	1.8	17	3.2	30	5.2	48	6.3	57
CL-055	16.1	1.3	21	1.6	28	2.9	52	4.9	88	6.0	105
CL-056	24.3	0.9	16	1.2	21	2.5	42	4.5	77	5.6	95
CL-057	46.6	1.1	43	1.4	55	2.7	101	4.7	175	5.8	213
CL-058	26.5	1.0	21	1.3	27	2.6	53	4.6	95	5.7	117
CL-059	5.8	0.9	4	1.2	5	2.5	10	4.5	18	5.6	22
CL-060	28.6	1.2	30	1.5	38	2.7	68	4.8	117	5.9	141
CL-061	26.3	1.1	24	1.4	30	2.7	53	4.7	90	5.8	108
CL-062	11.2	1.2	13	1.5	16	2.8	31	4.8	53	5.9	64
CL-065	35.5	1.1	39	1.4	49	2.6	87	4.5	147	5.6	178

TABLE A.1.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
CL-003	Multiple Links*	936.6	941.1	111	941.9	140	944.3	231	947.3	437	948.7	618
CL-004	Multiple Links*	937.2	941.1	106	941.9	138	944.3	266	947.3	544	948.7	781
CL-005	L-CL-414	968.9	971.2	13	971.5	14	972.3	15	973.4	17	973.9	18
CL-006	L-CL-413	971.0	972.5	7	972.8	8	973.6	9	974.9	11	975.6	11
CL-007	L-CL-412	971.8	977.7	5	979.2	6	985.0	7	992.3	9	994.4	10
CL-008	Multiple Links*	1026.9	1028.7	6	1029.3	7	1031.4	8	1032.8	32	1033.0	50
CL-009	L-CL-400	996.9	997.9	3	998.1	4	999.2	4	1000.4	6	1000.9	6
CL-010	L-CL-398	993.7	995.4	6	995.8	8	997.6	14	1001.5	20	1003.6	20
CL-011	Multiple Links*	1024.4	1026.0	4	1026.4	5	1027.8	7	1029.4	31	1029.6	55
CL-012	Multiple Links*	937.9	941.6	98	942.1	120	944.6	204	947.3	448	948.7	671
CL-013	Multiple Links*	943.0	945.8	45	946.2	54	948.0	78	950.9	91	951.5	149
CL-014	L-CL-580	949.4	951.5	11	951.9	12	953.1	16	954.4	19	955.1	17
CL-015	N/A	946.1	947.4	0	947.7	0	948.8	0	950.5	0	951.4	0
CL-016	Multiple Links*	962.7	965.6	10	966.6	12	969.6	26	969.8	50	969.9	64
CL-017	Multiple Links*	991.7	992.0	4	992.1	6	992.5	11	993.5	12	993.7	22
CL-018	Multiple Links*	991.7	992.0	2	992.1	2	992.5	5	993.5	6	993.7	7
CL-019	Multiple Links*	988.1	989.7	3	990.4	4	992.8	5	995.6	6	996.0	14
CL-020a	L-CL-654	933.5	934.3	20	934.5	26	935.1	38	936.2	42	936.8	44
CL-020b	L-CL-649	933.5	935.1	22	935.5	30	936.8	70	938.8	147	939.8	182
CL-020c	N/A	930.0	930.4	0	930.5	0	930.8	0	931.3	0	931.5	0
CL-021	Multiple Links*	936.3	941.1	42	941.9	43	944.3	48	947.3	53	948.7	55
CL-022	L-CL-438	1008.0	1008.6	1	1008.7	1	1009.2	3	1009.9	3	1010.3	4
CL-023	L-CL-429	1021.8	1022.6	2	1022.7	3	1023.4	4	1024.5	6	1025.0	7
CL-024	Multiple Links*	964.0	965.8	5	966.3	6	968.4	7	969.5	41	969.6	63
CL-025	L-CL-462	977.0	979.3	26	979.9	34	985.1	59	988.1	67	988.7	68
CL-026	L-CL-460	1000.4	1001.2	2	1001.4	2	1002.2	4	1003.4	6	1004.0	7
CL-027	L-CL-586	944.3	947.0	12	947.4	12	949.2	12	952.3	9	953.0	9
CL-028	Multiple Links*	981.9	984.9	7	985.3	12	985.6	55	986.0	146	986.0	188
CL-029a	L-CL-567	970.9	973.7	34	974.0	39	974.9	56	976.8	66	977.7	70
CL-029b	L-CL558a	1004.7	1005.8	10	1009.5	12	1010.6	13	1012.0	13	1012.3	13
CL-030a	L-CL-554	998.7	1002.2	33	1002.9	35	1005.6	44	1008.4	50	1009.5	52
CL-030b	L-CL-554i	1003.3	1004.9	19	1005.1	23	1005.8	34	1008.6	36	1009.6	33
CL-030c	Multiple Links*	1006.9	1008.5	6	1008.8	7	1009.7	9	1011.6	12	1011.7	26
CL-031	Multiple Links*	946.5	948.1	19	948.2	24	949.7	39	953.4	29	954.7	32
CL-032	Multiple Links*	1010.5	1016.7	41	1017.6	52	1018.5	100	1018.8	169	1019.0	203
CL-033	Multiple Links*	1008.6	1010.2	5	1010.4	7	1011.3	12	1012.0	42	1012.3	48
CL-034	L-CL-601	969.7	970.7	3	971.0	4	972.3	6	974.5	9	975.6	10
CL-035	Multiple Links*	958.4	962.7	30	963.7	35	965.3	106	965.5	187	965.5	218
CL-036	Multiple Links*	969.2	972.7	64	973.3	80	974.4	147	974.9	272	975.4	443
CL-037	Multiple Links*	985.8	988.9	62	989.3	78	991.3	134	993.6	255	993.9	426
CL-038	Multiple Links*	991.9	994.3	25	995.2	29	999.2	39	1000.3	153	1000.4	132
CL-039	Multiple Links*	1025.8	1029.5	53	1031.8	69	1032.0	145	1032.1	223	1032.2	264

TABLE A.1.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
CL-040	L-CL-492	1095.5	1096.2	1	1096.3	2	1096.9	4	1097.7	5	1098.2	6
CL-041	Multiple Links*	1101.2	1102.0	4	1102.2	6	1102.9	12	1103.1	26	1103.2	36
CL-042	L-CL-515	1087.8	1088.8	3	1089.1	4	1090.1	8	1091.8	9	1092.7	9
CL-043	Multiple Links*	1103.7	1104.8	6	1105.0	8	1106.2	13	1107.4	39	1107.5	51
CL-044	Multiple Links*	1081.9	1084.2	8	1085.7	10	1087.1	13	1087.4	30	1087.5	37
CL-045	Multiple Links*	1072.6	1073.2	11	1073.2	14	1073.5	26	1075.7	41	1076.5	48
CL-046	Multiple Links*	933.8	939.8	37	941.4	43	942.6	226	943.0	493	943.1	640
CL-047	L-CL-606	953.9	955.0	5	955.2	7	955.9	13	957.0	21	957.8	22
CL-048	L-CL-318	947.7	949.8	126	950.2	158	956.2	244	959.3	262	959.9	259
CL-049	Multiple Links*	966.9	968.3	29	968.6	36	973.8	56	974.3	84	974.4	96
CL-050	L-CL-354	977.4	979.4	11	979.5	13	980.3	18	981.9	21	982.7	22
CL-051	L-CL-349	989.4	990.0	1	990.1	1	990.6	3	991.2	5	991.6	5
CL-052	Multiple Links*	967.9	970.6	62	971.2	78	974.1	199	974.2	267	974.3	310
CL-053	Multiple Links*	989.4	991.0	7	991.3	9	992.2	13	993.5	18	993.8	35
CL-054	L-CL-329	1069.0	1071.0	3	1071.4	3	1073.2	4	1075.7	5	1076.5	6
CL-055	L-CL-327	1078.7	1080.6	2	1081.1	2	1082.7	6	1085.0	8	1086.0	8
CL-056	Multiple Links*	967.0	968.3	21	968.7	29	969.0	70	969.2	168	969.3	223
CL-057	Multiple Links*	972.0	973.1	17	973.4	22	974.6	44	975.0	109	975.1	145
CL-058	Multiple Links*	954.5	956.2	11	956.7	15	959.1	37	961.0	84	961.0	107
CL-059	Multiple Links*	952.1	954.0	28	954.3	37	958.4	63	961.0	300	961.0	371
CL-060	Multiple Links*	973.4	975.5	17	975.8	22	977.8	34	978.3	105	978.4	127
CL-061	Multiple Links*	974.5	975.9	10	976.3	12	978.7	17	982.0	30	982.7	38
CL-062	Multiple Links*	988.3	989.8	4	990.3	5	991.7	17	991.8	41	991.9	61
CL-065	L-CL-387	938.0	939.5	6	939.9	7	941.8	12	945.1	15	946.5	16

*Discharge rates reported are the sum of peak flow rates of all downstream conduits

A.2 ORCHARD LAKE DISTRICT

The Orchard Lake District has its south end approximately at 185th Street (County Road 60) and extends north to the boundary with the City of Burnsville, and westerly from Ipava Avenue to the boundary with Credit River Township. The district lies within the Credit River Watershed, which is managed by the BDWMO. Drainage from the Orchard Lake District flows into Credit River, which discharges to the Minnesota River. Kingsley and Orchard Lakes are the major lakes in the district and lie entirely within the boundaries of the City of Lakeville. Two smaller lakes, Horseshoe and Goose Lakes, are also located in this district. Horseshoe Lake is located on the boundary with the City of Burnsville, and outflow drains north.

The watershed divides of the Orchard Lake District are shown on Figure A.2.1. The storm sewer network and additional details regarding the drainage system within the Orchard Lake watershed are shown on Figure A.2.2.

Most of this district is tributary to Orchard Lake, the largest surface water feature in the district. The outlet from the lake is to the west into Credit River Township through Murphy Hanrehan Park Reserve. Within the City of Lakeville, an area of approximately 2,040 acres is tributary to Orchard Lake. Part of Credit River Township (roughly 140 acres) is also tributary to Orchard Lake and runoff from this area flows through Lakeville in the southwestern portion of the watershed.

Approximately 590 acres analyzed as part of this district do not drain to Orchard Lake, but north and west to other municipalities. Runoff from approximately 285 acres within this district flows north into the City of Burnsville. Runoff from approximately 305 acres within the district flows west into the Credit River Township.

The Orchard Lake District is largely developed with residential areas. Some commercial areas occupy the land in close proximity to Interstate 35. Remaining areas consist of mainly rural forest areas and public parks. The landforms in the northwestern part of Lakeville are nearly level to very steep and are comprised of unconsolidated clay, sand and gravel deposited as glacial moraines.

A.2.1 Flood Protection

For each subwatershed and storage pond, peak runoff rates, flood levels, flood discharges, and storage volumes were calculated using the XP-SWMM model. The results of the modeling are shown in the following tables:

Table A.2.1	Hydrologic Parameters - Existing Conditions—(subwatershed data)
Table A.2.2	Hydrologic Results - Existing Conditions—(peak flow rates from subwatersheds)
Table A.2.3	Hydraulic Results - Existing Conditions—(peak discharges and elevations)

No monitoring data was available within the subwatershed for calibration. Therefore the XP-SWMM model was developed using the calibrated parameters defined in *Vermillion River Watershed Hydrologic Study of Existing Conditions* (Barr 2009).

A.2.2 Subwatershed Pond Descriptions

For proposed conditions, runoff from Credit River Township that flows into the southwestern subwatersheds is assumed to remain at the existing flow rates. The subwatersheds described in this section have unique characteristics.

OL-001 (Orchard Lake): The outlet for Orchard Lake is located at Orchard Lake Beach on the west side of the lake. The control for Orchard Lake is a 16-foot concrete weir structure at approximate elevation 977.0. There is a 72-inch equivalent reinforced concrete arch pipe (RCPA) just downstream of the concrete weir structure at elevation 973.2. The MDNR has determined the OHWL of Orchard Lake to be elevation 977.6. City building permits require the low floor to be at or above elevation 980.6 (3 feet above the OHWL).

The 100-year flood level on the lake is elevation 979.1 (2.1 feet above the weir) for existing conditions, with a 100-year peak discharge of 146 cfs for the 4-day event. Currently, portions of this watershed are outside the 2030 urban service area for sanitary sewer and so the minimum lot size for new residential development in this area is 10 acres and it is expected that full urban development is many years away.

It is the policy of the BDWMO to require that post-development discharges be no greater than existing discharges. To maintain the existing 100-year peak discharge, the outlet structure may need to be restricted prior to ultimate development of the watershed or peak discharge rates and runoff volume will be reduced when future development occurs.

For the critical event 4-day rainfall, ponding which empties in 24 hours may not fully mitigate critical event flows. However, the City has installed additional detention in the lake's watershed, and as part of the implementation of the MPCA MS4 Permit, a 1.0-inch infiltration standard. Future modeling efforts will examine the impact from the application of a 1.0-inch infiltration requirement for new development. The City will use the results of the future model effort to meet the BDWMO requirement for discharge from Orchard Lake. The City will implement rate control requirements on a project-by-project basis as

development occurs.

OL-082: Historic water levels for the pond in this subwatershed correspond closely to Orchard Lake water levels, although no existing outlet had been located under the railroad tracks. The MDNR has determined the OHWL to be elevation 978.4.

OL-017: The pond located north of the Brackett's Townhomes development has a variable elevation control outlet. The actual flood levels will be dependent on the control elevation at the time of the storm event. A majority of the area in this subwatershed is located in a golf course.

OL-011a: The outlet of subwatershed OL-011a is a 36-inch RCP culvert that was installed as part of the County Road 60 improvements.

OL-030: Runoff from approximately 507 acres is tributary to the pond in OL-030. Prior to 2004 the only outlet was a small agriculture drain tile. In 2004 an outlet structure was constructed to maintain a normal water level of 888 within the pond, which was assumed to be the starting water surface elevation in the model. The computed 100-year water surface elevation overtops 172nd Street by approximately 0.6 foot. However, past flood levels in this pond have been low, which indicate that the pond may be a groundwater recharge area. If a lower starting water surface elevation is used in the analysis 172nd Street may not overtop during the 100-year event.

OL-052: The existing outlet pipe is several feet above the actual water level noted in the past. However, the model assumes the starting water surface elevation in the pond is equal to the elevation of the outlet pipe. The 100-year flood level appears below the elevation of the existing homes adjacent to the pond based on available 2011 LiDAR data.

OL-081: Based on City records, there is no existing outlet under the adjacent railroad tracks. A 36-inch RCP outlet, which is the same diameter as upstream culverts, was assumed to provide drainage under the adjacent railroad tracks.

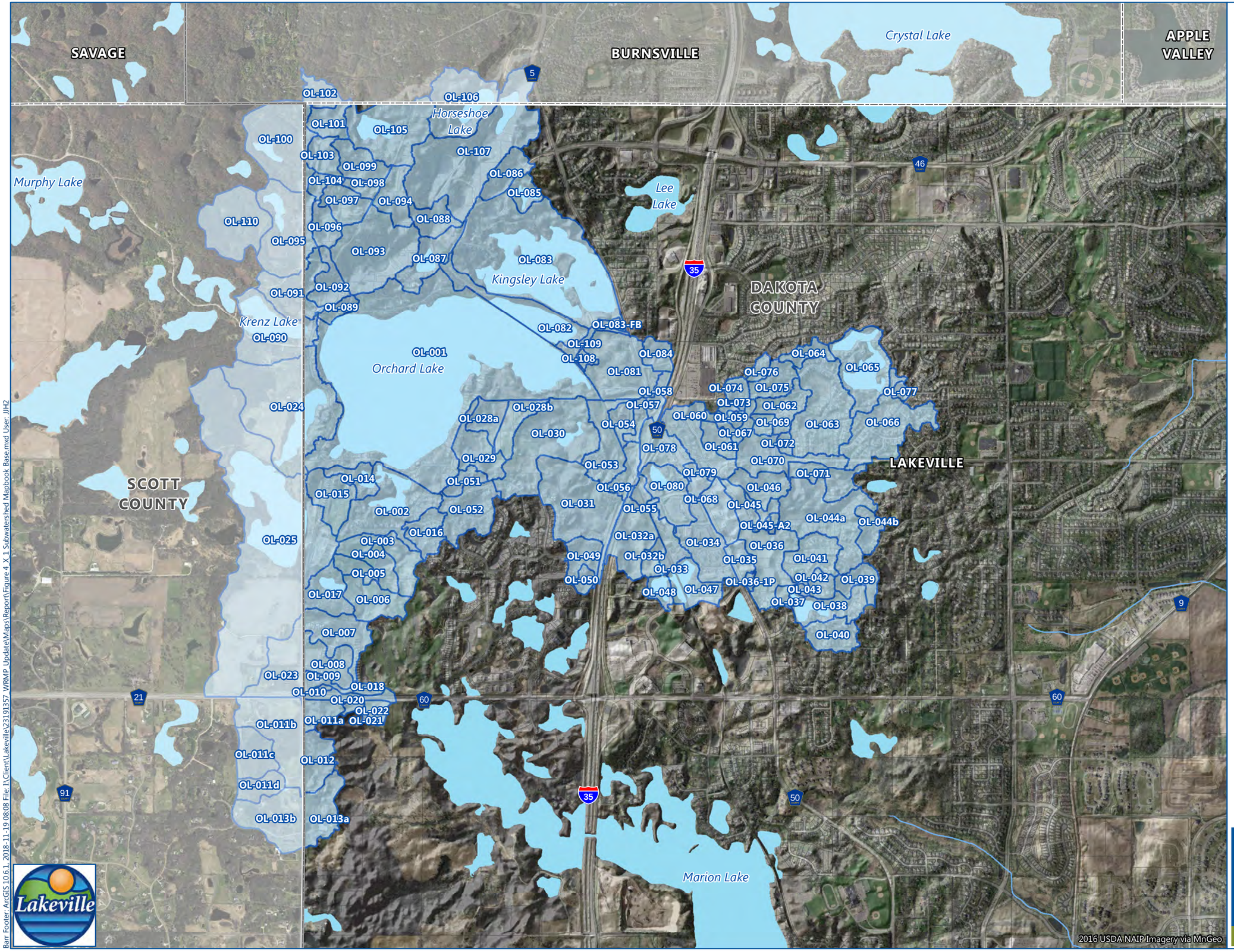
OL-083 (Kingsley Lake): The MDNR has determined the OHWL of Kingsley Lake to be elevation 978.5, which is 0.9 foot above the OHWL for Orchard Lake. Old construction plans show that an outlet was constructed from Kingsley Lake under Klamath Trail. In 1994 an outlet was installed 0.5 feet above the OHWL of 978.5 to direct high flows to Orchard Lake. The outlet elevation was constructed at 981.2, which was the assumed starting water surface elevation for the lake. City building permits require the low floor to be a minimum of 3 feet above the outlet from the Lake or 984.2.

OL-087 and OL-088: The ponds in subwatershed OL-087 and upstream drainage area in OL-088 are currently landlocked. If an outlet is installed in the future, it should be designed to operate in such a way as to minimize discharge volume to Orchard Lake.

OL-093 and OL-094: The pond in subwatershed OL-093 and upstream drainage area in OL-094 are currently landlocked. The normal water level of this pond is lower than any adjacent lakes or ponds. During periods of high water, it may be necessary to temporarily pump water from OL-093 to Orchard Lake. As with OL-087, the volume pumped to Orchard Lake should be minimized.

OL-107: This subwatershed and Horseshoe Lake are located on the boundary with the City of Burnsville. Drainage from OL-107 flows north through the City of Burnsville and into Credit River.

OL-105: Pond OL-105 is landlocked. The 100-year flood level is approximately 6-feet below the overflow elevation. During periods of high water, it may be necessary to temporarily pump water from OL-105 north to the City of Burnsville, after the peak has past downstream. It may be desirable to install an outlet in the future at the OHWL to control the flood level during periods of high water.



County Boundary
Municipal Boundary
Parcel Boundary
Subwatersheds
Public Water Inventory Watercourses
Public Water Inventory Basins

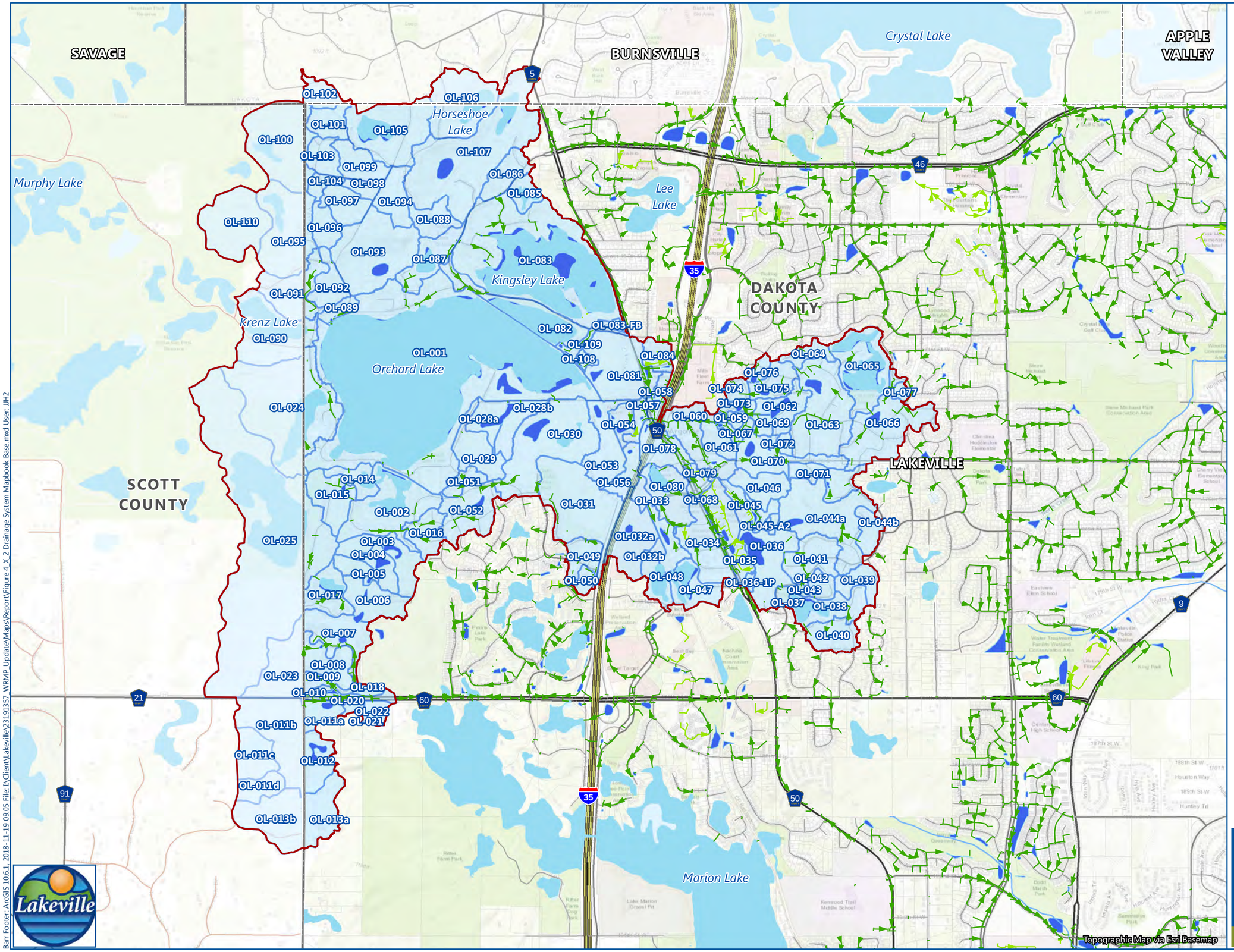
Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

1,000 0 1,000
Feet

ORCHARD LAKE
SUBWATERSHEDS
Water and Natural Resources
Management Plan
City of Lakeville

FIGURE A.2.1

Barr Footer: ArcGIS 10.6.1, 2018-11-19 08:08 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 4_X_1 Subwatershed Mapbook Base.mxd User: JJH2



County Boundary
Municipal Boundary
Parcel Boundary

Pipes

Storm Main
Private Storm Main
Subwatersheds
Major Subwatersheds
Existing Pond
Public Water Inventory Watercourses
Public Water Inventory Basins

Major Watersheds, Ponds and Pipe data from the City of Lakeville. Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

ORCHARD LAKE
DRAINAGE SYSTEM
Water and Natural Resources
Management Plan
City of Lakeville

FIGURE A.2.2

Barr Footer: ArcGIS 10.6.1, 2018-11-19 09:05 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 4_X_2 Drainage System Mapbook Base.mxd User: JJH2

TABLE A.2.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION	MINIMUM INFILTRATION	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
OL-001	389.5	66.10	2488	0.038	0.200	0.014	0.117	0.060	0.90	0.10	0.00110
OL-002	48.4	12.20	584	0.097	0.319	0.014	0.172	0.060	1.11	0.11	0.00110
OL-003	23.4	8.00	596	0.099	0.269	0.014	0.156	0.060	0.98	0.13	0.00110
OL-004	11.4	4.80	476	0.079	0.241	0.014	0.153	0.060	1.00	0.10	0.00110
OL-005	7.7	4.80	360	0.080	0.241	0.014	0.153	0.060	1.00	0.12	0.00110
OL-006	22.4	4.50	623	0.088	0.240	0.014	0.153	0.060	1.00	0.10	0.00110
OL-007	25.7	3.60	694	0.077	0.278	0.014	0.179	0.060	1.17	0.10	0.00110
OL-008	19.1	5.30	648	0.076	0.285	0.014	0.181	0.060	1.31	0.07	0.00110
OL-009	6.5	5.50	234	0.072	0.279	0.014	0.176	0.060	1.00	0.13	0.00110
OL-010	1.7	3.50	164	0.121	0.272	0.014	0.173	0.060	1.00	0.13	0.00110
OL-011a	10.3	7.60	306	0.158	0.290	0.014	0.177	0.060	1.00	0.12	0.00110
OL-011b	43.1	5.20	817	0.121	0.294	0.014	0.183	0.060	1.00	0.12	0.00110
OL-011c	18.7	19.80	633	0.102	0.266	0.014	0.165	0.060	1.00	0.13	0.00110
OL-011d	11.7	6.70	503	0.089	0.287	0.014	0.178	0.060	1.00	0.12	0.00110
OL-012	17.3	6.20	430	0.130	0.283	0.014	0.176	0.060	1.24	0.09	0.00110
OL-013a	22.1	7.60	428	0.103	0.291	0.014	0.188	0.060	1.04	0.11	0.00110
OL-013b	34.8	8.80	774	0.090	0.307	0.014	0.176	0.060	1.00	0.11	0.00110
OL-014	11.1	8.20	360	0.109	0.285	0.014	0.172	0.060	1.40	0.15	0.00110
OL-015	22.0	5.20	608	0.076	0.251	0.014	0.162	0.060	1.32	0.18	0.00110
OL-016	14.6	18.90	489	0.107	0.368	0.014	0.170	0.060	1.11	0.12	0.00110
OL-017	19.6	1.70	692	0.078	0.238	0.014	0.157	0.060	1.00	0.13	0.00110
OL-018	2.7	5.30	162	0.109	0.254	0.014	0.161	0.060	1.00	0.12	0.00110
OL-020	8.1	5.70	240	0.070	0.273	0.014	0.172	0.060	1.01	0.11	0.00110
OL-021	3.7	7.20	290	0.102	0.287	0.014	0.177	0.060	1.17	0.09	0.00110
OL-022	5.3	7.70	385	0.084	0.290	0.014	0.177	0.060	1.00	0.09	0.00110
OL-023	30.3	3.30	537	0.108	0.288	0.014	0.185	0.060	1.02	0.13	0.00110
OL-024	98.2	10.00	1049	0.092	0.300	0.014	0.178	0.060	1.22	0.13	0.00110
OL-025	241.3	21.50	1831	0.075	0.256	0.014	0.166	0.060	1.10	0.12	0.00110
OL-028a	12.9	8.30	457	0.074	0.301	0.014	0.178	0.060	1.14	0.11	0.00110
OL-028b	14.5	6.50	525	0.090	0.302	0.014	0.183	0.060	1.09	0.12	0.00110
OL-029	21.7	10.60	639	0.094	0.323	0.014	0.178	0.060	1.04	0.13	0.00110
OL-030	63.6	9.60	919	0.104	0.302	0.014	0.176	0.060	0.97	0.11	0.00110
OL-031	58.2	17.40	575	0.121	0.289	0.014	0.176	0.060	0.99	0.11	0.00110
OL-032a	29.2	16.60	638	0.094	0.269	0.014	0.181	0.060	0.96	0.10	0.00110
OL-032b	7.3	6.50	274	0.118	0.282	0.014	0.178	0.060	0.87	0.08	0.00110
OL-033	12.9	15.60	289	0.093	0.255	0.014	0.170	0.060	1.00	0.10	0.00110
OL-034	30.0	25.70	584	0.059	0.221	0.014	0.165	0.060	1.00	0.10	0.00110
OL-035	8.6	7.73	388	0.119	0.281	0.014	0.180	0.060	1.01	0.12	0.00110
OL-036	33.6	13.59	613	0.096	0.275	0.014	0.180	0.060	1.23	0.09	0.00110
OL-036-1P	1.9	64.90	260	0.141	0.280	0.014	0.180	0.060	1.12	0.12	0.00110
OL-036A	3.4	8.50	188	0.109	0.281	0.014	0.180	0.060	1.00	0.14	0.00110
OL-036B	0.8	6.80	73	0.136	0.282	0.014	0.180	0.060	1.00	0.11	0.00110
OL-037	3.1	12.10	216	0.109	0.292	0.014	0.176	0.060	1.00	0.14	0.00110
OL-038	22.0	40.60	603	0.100	0.299	0.014	0.146	0.060	1.00	0.13	0.00110
OL-039	11.9	17.60	321	0.084	0.351	0.014	0.171	0.060	0.86	0.11	0.00110

TABLE A.2.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION	MINIMUM INFILTRATION	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
OL-040	16.6	20.60	509	0.082	0.380	0.014	0.169	0.060	0.90	0.12	0.00110
OL-041	22.8	17.70	583	0.111	0.359	0.014	0.168	0.060	1.04	0.12	0.00110
OL-042	7.4	17.40	264	0.106	0.351	0.014	0.171	0.060	1.11	0.12	0.00110
OL-043	1.6	10.50	174	0.067	0.279	0.014	0.177	0.060	1.00	0.14	0.00110
OL-044a	52.5	14.60	768	0.125	0.338	0.014	0.172	0.060	1.03	0.12	0.00110
OL-044b	10.3	20.60	399	0.067	0.380	0.014	0.169	0.060	1.00	0.12	0.00110
OL-045	8.8	43.95	290	0.106	0.265	0.014	0.180	0.060	1.00	0.13	0.00110
OL-045-A1	0.3	60.90	149	0.120	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
OL-045-A2	1.0	60.90	114	0.059	0.277	0.014	0.170	0.060	1.00	0.14	0.00110
OL-045-B1	1.7	39.20	227	0.127	0.279	0.014	0.170	0.060	1.00	0.14	0.00110
OL-046	16.1	13.20	592	0.100	0.328	0.014	0.174	0.060	1.00	0.12	0.00110
OL-047	19.1	30.50	538	0.094	0.220	0.014	0.144	0.060	1.00	0.13	0.00110
OL-048	7.4	7.20	394	0.105	0.286	0.014	0.177	0.060	1.00	0.10	0.00110
OL-049	13.2	16.70	503	0.093	0.315	0.014	0.175	0.060	1.00	0.13	0.00110
OL-050	5.0	7.50	330	0.128	0.279	0.014	0.178	0.060	1.00	0.14	0.00110
OL-051	7.7	20.50	305	0.111	0.379	0.014	0.169	0.060	1.00	0.14	0.00110
OL-052	28.6	20.60	704	0.110	0.380	0.014	0.169	0.060	1.00	0.13	0.00110
OL-053	25.6	25.30	450	0.087	0.271	0.014	0.173	0.060	1.46	0.06	0.00110
OL-054	8.4	52.30	348	0.095	0.220	0.014	0.174	0.060	1.19	0.10	0.00110
OL-055	4.5	18.30	276	0.104	0.266	0.014	0.182	0.060	1.04	0.13	0.00110
OL-056	11.3	41.30	288	0.113	0.246	0.014	0.179	0.060	1.35	0.08	0.00110
OL-057	5.9	56.60	276	0.070	0.210	0.014	0.179	0.060	1.08	0.12	0.00110
OL-058	7.2	62.70	248	0.062	0.201	0.014	0.185	0.060	1.00	0.14	0.00110
OL-059	2.8	6.50	251	0.069	0.282	0.014	0.178	0.060	1.00	0.13	0.00110
OL-060	29.6	34.10	452	0.070	0.244	0.014	0.176	0.060	1.00	0.11	0.00110
OL-061	9.9	10.90	344	0.076	0.305	0.014	0.175	0.060	1.00	0.09	0.00110
OL-062	16.2	18.60	450	0.101	0.366	0.014	0.170	0.060	1.00	0.11	0.00110
OL-063	52.9	19.60	957	0.097	0.370	0.014	0.170	0.060	1.06	0.12	0.00110
OL-064	8.3	20.60	315	0.096	0.380	0.014	0.169	0.060	0.90	0.12	0.00110
OL-065	40.1	51.00	682	0.076	0.263	0.014	0.134	0.060	1.00	0.12	0.00110
OL-066	45.6	19.60	888	0.083	0.370	0.014	0.170	0.060	0.98	0.12	0.00110
OL-067	8.7	7.20	265	0.074	0.287	0.014	0.177	0.060	1.00	0.11	0.00110
OL-068	16.8	56.30	596	0.034	0.203	0.014	0.174	0.060	0.97	0.12	0.00110
OL-069	4.7	12.20	295	0.077	0.321	0.014	0.174	0.060	1.00	0.11	0.00110
OL-070	26.4	15.00	393	0.094	0.341	0.014	0.172	0.060	1.11	0.12	0.00110
OL-071	17.5	15.00	340	0.118	0.341	0.014	0.173	0.060	0.91	0.12	0.00110
OL-072	3.3	18.40	325	0.082	0.365	0.014	0.170	0.060	1.07	0.12	0.00110
OL-073	1.5	6.70	141	0.113	0.283	0.014	0.178	0.060	0.63	0.07	0.00110
OL-074	5.8	20.00	360	0.085	0.375	0.014	0.169	0.060	0.92	0.12	0.00110
OL-075	14.4	20.60	420	0.109	0.380	0.014	0.169	0.060	1.09	0.12	0.00110
OL-076	4.6	20.60	306	0.109	0.380	0.014	0.169	0.060	1.00	0.14	0.00110
OL-077	2.9	13.60	284	0.106	0.306	0.014	0.175	0.060	1.31	0.08	0.00110
OL-078	20.6	58.10	510	0.083	0.209	0.014	0.185	0.060	1.00	0.14	0.00110
OL-079	6.89	67.40	362	0.036	0.194	0.014	0.173	0.060	1.00	0.13	0.00110
OL-080	24.15	70.60	458	0.051	0.187	0.014	0.163	0.060	1.07	0.09	0.00110

TABLE A.2.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION	MINIMUM INFILTRATION	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
OL-081	43.68	17.37	673	0.076	0.276	0.014	0.180	0.060	1.03	0.11	0.00110
OL-082	33.72	11.40	533	0.080	0.289	0.014	0.175	0.060	0.66	0.08	0.00110
OL-083	155.67	60.85	1901	0.081	0.191	0.014	0.120	0.060	0.83	0.11	0.00110
OL-083-FB	1.1	67.80	247	0.034	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
OL-083-RP1	0.05	76.70	29	0.039	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
OL-083-RP2	0.13	36.30	92	0.015	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
OL-083-UG	0.92	89.10	224	0.053	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
OL-084	9.53	62.90	369	0.050	0.198	0.014	0.174	0.060	1.00	0.14	0.00110
OL-085	9.22	11.60	406	0.138	0.308	0.014	0.175	0.060	1.00	0.14	0.00110
OL-086	14.96	10.70	467	0.150	0.307	0.014	0.175	0.060	0.97	0.13	0.00110
OL-087	21.82	20.10	631	0.109	0.308	0.014	0.172	0.060	1.11	0.12	0.00110
OL-088	13.86	14.90	531	0.142	0.289	0.014	0.174	0.060	1.07	0.13	0.00110
OL-089	6.45	19.20	372	0.189	0.368	0.014	0.170	0.060	0.95	0.13	0.00110
OL-090	45.39	40.80	1140	0.113	0.260	0.014	0.144	0.060	1.00	0.14	0.00110
OL-091	28.72	13.30	670	0.146	0.329	0.014	0.174	0.060	1.06	0.13	0.00110
OL-092	14	13.60	381	0.174	0.331	0.014	0.173	0.060	0.95	0.13	0.00110
OL-093	57.35	14.70	1087	0.200	0.286	0.014	0.170	0.060	1.00	0.14	0.00110
OL-094	16.82	11.70	393	0.137	0.318	0.014	0.175	0.060	0.97	0.13	0.00110
OL-095	48.59	25.80	802	0.142	0.263	0.014	0.160	0.060	1.00	0.14	0.00110
OL-096	11.32	8.70	615	0.122	0.299	0.014	0.176	0.060	0.90	0.12	0.00110
OL-097	16.01	13.70	668	0.112	0.333	0.014	0.173	0.060	0.98	0.13	0.00110
OL-098	5.63	13.30	239	0.102	0.329	0.014	0.174	0.060	1.03	0.13	0.00110
OL-099	17.03	12.90	483	0.120	0.326	0.014	0.174	0.060	1.03	0.13	0.00110
OL-100	53.64	17.30	1235	0.137	0.274	0.014	0.170	0.060	1.03	0.12	0.00110
OL-101	13.33	10.20	393	0.155	0.308	0.014	0.175	0.060	0.97	0.13	0.00110
OL-102	10.37	8.50	570	0.111	0.296	0.014	0.177	0.060	0.95	0.13	0.00110
OL-103	12.39	12.20	432	0.158	0.321	0.014	0.174	0.060	1.00	0.14	0.00110
OL-104	5.79	17.90	248	0.167	0.361	0.014	0.171	0.060	0.91	0.12	0.00110
OL-105	48.28	24.90	813	0.117	0.302	0.014	0.161	0.060	0.96	0.13	0.00110
OL-106	41.83	23.00	896	0.178	0.272	0.014	0.161	0.060	1.00	0.14	0.00110
OL-107	100.89	17.60	1410	0.198	0.291	0.014	0.168	0.060	1.00	0.13	0.00110
OL-108	2.7	1.20	192	0.083	0.244	0.014	0.162	0.060	1.00	0.14	0.00110
OL-109	5.95	18.04	226	0.059	0.267	0.014	0.180	0.060	0.93	0.13	0.00110
OL-110	41.96	11.00	960	0.148	0.279	0.014	0.177	0.060	1.04	0.13	0.00110

TABLE A.2.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
OL-001	389.5	2.2	474	2.5	601	3.9	1082	6.1	1807	7.2	2181
OL-002	48.4	0.9	29	1.2	38	2.5	70	4.5	124	5.6	153
OL-003	23.4	1.0	15	1.3	20	2.5	42	4.6	79	5.6	98
OL-004	11.4	1.1	8	1.4	11	2.7	25	4.8	46	5.8	56
OL-005	7.7	1.0	6	1.3	8	2.6	18	4.7	33	5.7	40
OL-006	22.4	1.0	13	1.3	18	2.7	40	4.7	75	5.8	93
OL-007	25.7	0.9	12	1.2	17	2.6	38	4.6	72	5.7	90
OL-008	19.1	1.2	12	1.5	16	2.8	35	4.9	64	6.0	80
OL-009	6.5	0.9	4	1.2	5	2.5	11	4.5	22	5.6	27
OL-010	1.7	1.0	2	1.3	3	2.6	6	4.6	10	5.7	12
OL-011a	10.3	1.0	7	1.3	10	2.6	22	4.7	40	5.7	49
OL-011b	43.1	0.8	19	1.1	26	2.4	57	4.4	113	5.5	142
OL-011c	18.7	1.3	23	1.6	29	2.9	56	4.9	95	6.0	114
OL-011d	11.7	1.0	8	1.3	11	2.6	25	4.7	47	5.7	57
OL-012	17.3	1.0	10	1.4	14	2.7	31	4.7	58	5.8	72
OL-013a	22.1	1.0	12	1.3	16	2.6	33	4.6	62	5.7	78
OL-013b	34.8	1.0	20	1.3	27	2.6	56	4.6	104	5.7	129
OL-014	11.1	0.9	7	1.2	10	2.4	22	4.4	41	5.5	51
OL-015	22.0	0.7	10	1.0	14	2.2	32	4.1	65	5.2	83
OL-016	14.6	1.2	16	1.5	20	2.8	38	4.9	65	6.0	79
OL-017	19.6	0.9	11	1.2	16	2.4	35	4.4	67	5.5	83
OL-018	2.7	1.0	3	1.4	4	2.7	8	4.7	14	5.8	17
OL-020	8.1	0.9	4	1.3	6	2.6	13	4.6	25	5.7	31
OL-021	3.7	1.2	4	1.5	6	2.8	12	4.9	20	6.0	24
OL-022	5.3	1.2	5	1.5	8	2.8	16	4.9	27	6.0	33
OL-023	30.3	0.8	10	1.1	15	2.3	36	4.3	71	5.4	89
OL-024	98.2	0.8	50	1.1	64	2.3	121	4.3	218	5.4	270
OL-025	241.3	1.1	186	1.4	235	2.6	424	4.6	715	5.7	867
OL-028a	12.9	1.0	9	1.3	12	2.6	25	4.7	46	5.7	56
OL-028b	14.5	0.9	9	1.3	12	2.5	27	4.6	51	5.6	64
OL-029	21.7	1.0	15	1.3	20	2.5	41	4.6	76	5.7	94
OL-030	63.6	1.0	35	1.3	46	2.6	91	4.6	166	5.7	206
OL-031	58.2	1.1	45	1.4	57	2.7	105	4.7	179	5.8	218
OL-032a	29.2	1.2	27	1.5	35	2.8	67	4.9	117	6.0	142
OL-032b	7.3	1.2	6	1.5	8	2.9	17	4.9	30	6.0	37
OL-033	12.9	1.2	12	1.5	15	2.9	30	4.9	52	6.0	63
OL-034	30.0	1.4	36	1.7	45	3.1	83	5.2	139	6.3	166
OL-035	8.6	1.0	7	1.3	10	2.6	22	4.7	39	5.8	47
OL-036	33.6	1.2	26	1.5	34	2.8	66	4.9	115	6.0	141
OL-036-1P	1.9	2.2	7	2.6	8	4.0	13	6.1	19	7.2	22
OL-036A	3.4	1.0	3	1.3	4	2.6	9	4.6	17	5.7	20
OL-036B	0.8	1.1	1	1.4	1	2.8	3	4.8	5	5.9	6
OL-037	3.1	1.1	4	1.4	5	2.7	10	4.7	17	5.8	21
OL-038	22.0	1.7	40	2.0	51	3.3	89	5.4	142	6.5	167
OL-039	11.9	1.2	11	1.5	15	2.8	27	4.9	47	6.0	57
OL-040	16.6	1.2	18	1.5	23	2.8	42	4.9	71	6.0	86
OL-041	22.8	1.1	22	1.5	28	2.7	53	4.8	91	5.9	111

TABLE A.2.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
OL-042	7.4	1.2	8	1.5	10	2.8	19	4.9	33	6.0	40
OL-043	1.6	1.1	2	1.4	3	2.7	6	4.7	10	5.8	12
OL-044a	52.5	1.0	39	1.3	50	2.6	93	4.7	163	5.7	200
OL-044b	10.3	1.2	11	1.5	15	2.8	27	4.9	46	6.0	55
OL-045	8.8	1.8	18	2.1	23	3.4	40	5.5	63	6.6	74
OL-045-A1	0.3	2.1	1	2.5	1	3.8	2	6.0	3	7.1	4
OL-045-A2	1.0	2.1	3	2.5	4	3.8	6	6.0	10	7.1	11
OL-045-B1	1.7	1.7	5	2.0	6	3.4	10	5.4	15	6.6	18
OL-046	16.1	1.1	14	1.4	19	2.7	38	4.8	68	5.9	83
OL-047	19.1	1.5	30	1.8	39	3.1	70	5.2	114	6.3	136
OL-048	7.4	1.1	7	1.4	9	2.8	20	4.8	35	5.9	42
OL-049	13.2	1.2	14	1.5	18	2.8	35	4.8	61	5.9	73
OL-050	5.0	1.0	5	1.3	7	2.6	15	4.6	27	5.7	32
OL-051	7.7	1.2	9	1.5	12	2.8	22	4.9	38	5.9	45
OL-052	28.6	1.2	30	1.5	38	2.8	69	4.8	118	5.9	143
OL-053	25.6	1.6	31	1.9	40	3.3	71	5.4	116	6.5	139
OL-054	8.4	2.0	21	2.3	27	3.7	46	5.8	70	6.9	82
OL-055	4.5	1.2	6	1.6	8	2.9	16	4.9	27	6.0	32
OL-056	11.3	1.8	22	2.2	28	3.6	48	5.7	77	6.8	90
OL-057	5.9	2.0	15	2.4	19	3.7	33	5.9	51	7.0	59
OL-058	7.2	2.1	18	2.5	23	3.8	39	6.0	61	7.1	71
OL-059	2.8	1.0	3	1.3	4	2.6	8	4.6	15	5.7	18
OL-060	29.6	1.5	39	1.8	49	3.2	89	5.2	146	6.3	175
OL-061	9.9	1.2	8	1.5	11	2.9	21	4.9	38	6.0	46
OL-062	16.2	1.2	16	1.5	21	2.9	39	4.9	67	6.0	81
OL-063	52.9	1.1	49	1.4	62	2.7	112	4.7	190	5.8	231
OL-064	8.3	1.3	10	1.6	12	2.9	23	4.9	39	6.0	47
OL-065	40.1	1.9	72	2.2	91	3.6	159	5.7	255	6.8	302
OL-066	45.6	1.1	42	1.5	54	2.7	97	4.8	165	5.9	199
OL-067	8.7	1.0	5	1.3	7	2.6	15	4.7	28	5.7	35
OL-068	16.8	2.0	37	2.3	46	3.7	81	5.8	128	6.9	150
OL-069	4.7	1.2	5	1.5	7	2.8	13	4.9	23	6.0	28
OL-070	26.4	1.0	19	1.3	25	2.6	45	4.6	79	5.7	96
OL-071	17.5	1.1	14	1.4	18	2.6	34	4.7	61	5.8	74
OL-072	3.3	1.3	5	1.6	6	2.9	12	5.0	20	6.0	24
OL-073	1.5	1.3	2	1.6	3	3.0	5	5.0	9	6.1	11
OL-074	5.8	1.3	7	1.6	10	2.9	19	5.0	31	6.0	38
OL-075	14.4	1.2	16	1.5	20	2.8	37	4.9	63	6.0	76
OL-076	4.6	1.3	6	1.6	8	2.9	16	4.9	26	6.0	32
OL-077	2.9	1.3	4	1.7	6	3.0	11	5.1	18	6.2	22
OL-078	20.6	2.0	46	2.4	59	3.7	102	5.8	161	6.9	189
OL-079	6.9	2.2	19	2.6	24	4.0	41	6.1	62	7.2	72
OL-080	24.2	2.3	53	2.7	67	4.1	116	6.2	184	7.4	216
OL-081	43.7	1.1	36	1.4	46	2.7	86	4.8	148	5.8	180
OL-082	33.7	1.1	22	1.5	28	2.8	55	4.9	96	5.9	118
OL-083	155.7	2.1	287	2.5	363	3.9	646	6.0	1037	7.1	1227
OL-083-FB	1.1	2.3	4	2.6	5	4.0	8	6.1	11	7.2	13

TABLE A.2.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
OL-083-RP1	0.1	2.4	0	2.8	0	4.2	0	6.3	1	7.5	1
OL-083-RP2	0.1	1.7	0	2.0	1	3.3	1	5.4	1	6.5	1
OL-083-UG	0.9	2.7	4	3.0	5	4.4	7	6.6	10	7.8	12
OL-084	9.5	2.1	24	2.5	31	3.8	52	6.0	81	7.1	95
OL-085	9.2	1.1	9	1.4	12	2.6	25	4.7	44	5.7	53
OL-086	15.0	1.0	12	1.3	16	2.6	34	4.6	61	5.7	75
OL-087	21.8	1.2	25	1.6	32	2.9	60	4.9	102	6.0	123
OL-088	13.9	1.2	15	1.5	20	2.8	40	4.8	69	5.9	83
OL-089	6.5	1.3	9	1.6	12	2.9	23	4.9	38	6.0	46
OL-090	45.4	1.7	84	2.0	106	3.3	186	5.4	299	6.5	352
OL-091	28.7	1.1	23	1.4	30	2.6	60	4.7	108	5.8	132
OL-092	14.0	1.1	12	1.4	16	2.7	33	4.7	58	5.8	71
OL-093	57.4	1.1	50	1.4	66	2.6	129	4.7	230	5.7	281
OL-094	16.8	1.0	12	1.3	16	2.6	33	4.6	60	5.7	74
OL-095	48.6	1.3	59	1.6	75	2.9	137	4.9	231	6.0	277
OL-096	11.3	1.1	11	1.4	15	2.7	31	4.7	55	5.8	67
OL-097	16.0	1.1	15	1.4	20	2.7	41	4.7	72	5.8	88
OL-098	5.6	1.1	5	1.4	7	2.7	14	4.7	25	5.8	30
OL-099	17.0	1.0	14	1.3	18	2.6	37	4.7	66	5.7	81
OL-100	53.6	1.2	54	1.5	70	2.8	135	4.8	235	5.9	285
OL-101	13.3	1.0	10	1.3	14	2.6	29	4.6	53	5.7	65
OL-102	10.4	1.0	9	1.3	13	2.6	28	4.7	50	5.7	60
OL-103	12.4	1.0	11	1.4	15	2.6	30	4.7	55	5.7	67
OL-104	5.8	1.2	7	1.6	9	2.9	18	4.9	30	6.0	36
OL-105	48.3	1.3	55	1.6	70	2.9	126	4.9	212	6.0	255
OL-106	41.8	1.3	52	1.6	67	2.9	124	4.9	210	6.0	252
OL-107	100.9	1.1	92	1.4	118	2.7	221	4.7	385	5.8	469
OL-108	2.7	0.9	2	1.2	3	2.4	7	4.5	13	5.5	16
OL-109	6.0	1.2	6	1.5	8	2.8	16	4.8	27	5.9	33
OL-110	42.0	1.0	32	1.3	42	2.6	86	4.6	157	5.7	194

TABLE A.2.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
OL-001	L-OL-118	977.1	977.6	24	977.7	30	978.2	63	978.8	118	979.1	146
OL-002	Multiple Links*	975.4	977.7	13	977.8	17	978.3	38	979.2	61	979.6	67
OL-003	L-OL-146	981.1	982.6	13	982.8	15	983.8	31	984.9	45	985.5	47
OL-004	Multiple Links*	981.1	982.8	13	983.0	15	983.9	40	984.9	59	985.5	65
OL-005	Multiple Links*	981.1	983.1	15	983.5	17	984.1	43	985.0	89	985.5	118
OL-006	Multiple Links*	981.1	983.7	15	984.1	20	984.4	40	985.0	73	985.5	95
OL-007	L-OL-141	985.4	988.2	17	988.5	19	989.7	24	990.9	28	991.4	30
OL-008	L-OL-140	990.2	993.9	12	994.4	13	996.3	16	998.8	20	999.9	21
OL-009	Multiple Links*	994.2	995.1	2	995.4	2	996.4	4	998.8	9	999.9	14
OL-010	Multiple Links*	995.0	997.0	41	997.6	58	999.0	112	1003.7	194	1005.0	241
OL-011a	Multiple Links*	999.3	1001.6	38	1002.1	54	1004.1	107	1005.7	278	1005.9	384
OL-011b	Multiple Links*	1008.9	1011.0	14	1011.4	19	1013.4	31	1014.4	95	1014.5	130
OL-011c	L-OL-649	1047.6	1048.2	0	1048.3	0	1049.1	0	1050.6	0	1051.4	0
OL-011d	L-OL-653	1069.4	1072.0	0	1072.4	0	1073.3	2	1073.7	11	1073.8	18
OL-012	L-OL-128a	1017.6	1022.0	25	1022.2	37	1022.7	87	1023.0	176	1023.1	218
OL-013a	L-OL-127	1033.2	1033.8	21	1034.0	29	1034.3	70	1034.6	135	1034.8	167
OL-013b	L-OL-648	1069.0	1069.7	17	1069.9	22	1070.3	46	1070.9	85	1071.1	105
OL-014	L-OL-154	977.3	978.2	5	978.4	8	978.8	24	979.3	60	979.6	84
OL-015	Multiple Links*	979.0	980.5	6	981.0	8	981.6	29	981.9	61	982.0	78
OL-016	L-OL-150	985.8	986.4	2	986.6	3	987.2	6	988.0	11	988.5	12
OL-017	L-OL-142	986.9	987.3	1	987.4	1	987.9	3	988.8	5	989.3	5
OL-018	L-OL-136	994.8	995.5	2	995.7	3	996.4	9	998.8	17	999.9	21
OL-020	Multiple Links*	996.1	997.6	4	998.1	5	999.9	6	1003.7	158	1005.0	237
OL-021	Multiple Links*	1000.9	1001.5	1	1001.9	2	1002.9	5	1003.3	10	1003.4	13
OL-022	L-OL-134	999.0	1001.8	1	1001.9	2	1002.4	4	1003.0	9	1003.4	13
OL-023	Multiple Links*	995.3	996.9	10	997.4	14	999.3	29	1000.4	68	1000.4	88
OL-024	Multiple Links*	970.8	971.4	46	971.7	49	972.3	81	973.0	140	973.4	161
OL-025	Multiple Links*	969.3	970.0	45	970.1	55	970.8	83	971.6	154	972.0	192
OL-028a	L-OL-173	978.0	979.3	3	979.5	3	980.2	5	981.1	6	981.5	7
OL-028b	Multiple Links*	978.4	980.4	4	980.7	5	981.5	11	981.7	35	981.7	47
OL-029	L-OL-172	980.1	981.9	0	982.2	0	983.2	0	984.6	0	985.3	0
OL-030	Multiple Links*	988.2	990.1	67	990.2	78	991.2	97	993.1	113	993.2	129
OL-031	L-OL-178	995.7	998.7	62	999.1	69	1000.8	92	1002.8	115	1003.6	123
OL-032a	L-OL-180a	1021.1	1024.4	53	1024.7	59	1026.0	83	1029.3	109	1029.9	113
OL-032b	L-OL-647	1032.2	1033.7	0	1033.9	0	1034.5	0	1035.3	0	1035.7	0
OL-033	Multiple Links*	1025.9	1029.4	52	1029.7	59	1031.1	86	1035.0	260	1035.3	395
OL-034	Multiple Links*	1030.9	1034.3	52	1034.7	59	1036.0	84	1037.5	273	1037.9	395
OL-035	Multiple Links*	1038.0	1041.7	17	1042.2	25	1042.6	43	1042.9	42	1043.2	52
OL-036	Multiple Links*	1044.2	1045.9	41	1046.4	45	1047.5	96	1048.1	229	1048.3	340
OL-037	L-OL-197b	1088.1	1088.9	2	1089.0	3	1093.2	13	1096.8	46	1096.9	72
OL-038	Multiple Links*	1100.1	1100.7	1	1100.9	2	1101.1	18	1101.3	51	1101.4	71
OL-039	L-OL-213	1126.1	1127.7	0	1127.8	1	1128.0	8	1128.2	25	1128.3	34

TABLE A.2.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
OL-040	L-OL-193	1102.3	1103.4	4	1103.6	5	1104.4	9	1105.6	10	1106.1	11
OL-041	L-OL-210a	1059.7	1063.6	7	1063.7	13	1063.9	40	1064.1	89	1064.3	115
OL-042	Multiple Links*	1105.8	1106.6	2	1106.6	3	1106.8	10	1106.9	24	1106.9	31
OL-043	L-OL-200	1106.4	1106.6	1	1106.7	1	1106.9	1	1107.2	2	1107.3	2
OL-044a	L-OL-216	1059.7	1060.4	38	1060.5	49	1060.8	91	1061.2	159	1061.4	194
OL-044b	L-OL-216a	1122.1	1122.6	1	1122.7	1	1123.2	3	1124.0	5	1124.4	6
OL-045	Multiple Links*	1045.0	1046.6	5	1047.0	5	1048.0	8	1049.7	20	1050.1	44
OL-046	L-OL-214	1053.1	1054.6	0	1054.8	0	1055.4	1	1055.7	16	1055.8	27
OL-047	L-OL-181	1040.4	1041.1	2	1041.2	2	1041.6	3	1042.3	5	1042.6	6
OL-048	L-OL-179	1047.4	1048.8	0	1049.0	0	1049.4	0	1050.0	0	1050.3	0
OL-049	Multiple Links*	1030.1	1030.1	5	1030.1	5	1030.1	5	1030.8	11	1031.1	21
OL-050	L-OL-174	1036.4	1036.7	3	1036.8	5	1037.5	5	1038.1	9	1038.4	10
OL-051	L-OL-156	997.2	998.0	1	998.2	2	999.3	3	1000.8	3	1001.5	4
OL-052	L-OL-160	997.2	997.9	2	998.1	3	998.8	7	1000.0	9	1000.7	10
OL-053	Multiple Links*	989.6	992.6	94	993.2	121	995.4	215	997.9	305	998.3	473
OL-054	Multiple Links*	996.9	998.5	79	998.9	101	1000.2	180	1001.5	258	1003.7	438
OL-055	L-OL-626	1025.3	1025.6	6	1025.6	8	1025.7	15	1026.4	116	1026.7	236
OL-056	L-OL-229	1008.7	1011.2	11	1011.3	16	1011.6	40	1012.1	121	1012.7	251
OL-057	L-OL-226	1002.5	1004.7	61	1005.1	76	1006.3	131	1007.4	200	1007.8	218
OL-058	Multiple Links*	1004.0	1005.5	9	1005.8	11	1007.0	17	1008.8	22	1010.2	25
OL-059	L-OL-256	1033.5	1034.4	23	1034.4	28	1034.6	37	1034.8	48	1035.0	53
OL-060	Multiple Links*	1006.5	1008.8	53	1009.6	68	1013.8	116	1015.0	195	1015.0	250
OL-061	Multiple Links*	1019.1	1020.5	8	1020.8	11	1021.8	21	1022.5	37	1022.8	55
OL-062	L-OL-252	1038.5	1041.9	8	1042.1	9	1042.8	13	1044.1	23	1045.5	29
OL-063	Multiple Links*	1058.8	1060.3	4	1060.6	5	1061.7	5	1062.9	26	1063.1	55
OL-064	Multiple Links*	1075.8	1077.5	4	1077.7	5	1078.0	12	1078.1	26	1078.2	35
OL-065	L-OL-245	1082.6	1083.1	1	1083.2	1	1083.7	1	1084.5	2	1084.8	2
OL-066	L-OL-242	1094.5	1095.9	8	1096.2	11	1097.5	16	1099.6	19	1100.5	20
OL-067	L-OL-279a	1031.0	1031.6	3	1031.9	4	1033.0	7	1034.1	18	1034.1	27
OL-068	Multiple Links*	1034.8	1037.3	7	1037.6	9	1039.6	16	1041.9	52	1042.3	116
OL-069	Multiple Links*	1037.2	1038.9	7	1039.2	8	1040.5	11	1042.8	19	1043.8	19
OL-070	Multiple Links*	1038.3	1039.4	6	1039.7	8	1041.1	11	1042.8	26	1043.8	28
OL-071	Multiple Links*	1068.3	1072.0	13	1072.1	18	1072.2	33	1072.3	57	1072.4	70
OL-072	L-OL-274	1060.7	1061.2	1	1061.3	1	1061.7	2	1062.2	4	1062.5	4
OL-073	Multiple Links*	1040.7	1042.3	8	1042.6	10	1043.9	14	1045.2	18	1045.3	21
OL-074	Multiple Links*	1042.5	1043.7	8	1043.9	10	1044.5	18	1046.1	22	1046.5	23
OL-075	L-OL-286	1047.9	1049.3	6	1049.6	8	1050.7	13	1051.8	17	1052.3	18
OL-076	L-OL-285	1058.0	1058.3	2	1058.3	3	1058.5	7	1058.6	15	1058.7	19
OL-077	L-OL-237	1108.1	1108.3	1	1108.3	1	1108.6	3	1108.8	3	1109.0	3
OL-078	L-OL-225	1002.5	1007.0	17	1007.7	22	1009.8	27	1011.7	29	1012.3	29
OL-079	Multiple Links*	1033.7	1036.3	14	1036.7	19	1038.4	25	1038.8	62	1038.9	80
OL-080	L-OL-217	1028.0	1029.5	2	1029.7	3	1030.5	3	1031.5	4	1032.0	4

TABLE A.2.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
OL-081	Multiple Links*	982.1	984.1	20	984.4	25	985.5	42	986.5	63	987.1	166
OL-082	L-OL-477o	978.1	979.9	2	979.9	3	979.9	4	980.0	14	980.3	62
OL-083	Multiple Links*	981.2	981.5	4	981.6	4	981.8	5	982.2	5	982.4	5
OL-084	Multiple Links*	1004.6	1007.1	7	1007.6	7	1009.2	9	1009.8	25	1009.9	40
OL-085	L-OL-473	1026.5	1027.1	0	1027.2	0	1027.6	0	1028.1	0	1028.4	0
OL-086	L-OL-478	1027.1	1028.5	4	1028.8	6	1030.5	8	1032.7	10	1033.6	11
OL-087	L-OL-617	998.7	999.9	0	1000.0	0	1000.6	0	1001.4	0	1001.9	0
OL-088	L-OL-113	1007.5	1009.6	0	1009.8	0	1010.8	0	1012.2	0	1012.8	0
OL-089	Multiple Links*	976.5	978.5	3	978.8	3	979.3	10	979.5	25	979.5	35
OL-090	L-OL-126	957.0	957.5	0	957.5	0	957.9	0	958.5	0	958.7	0
OL-091	L-OL-125	958.5	960.5	0	960.7	0	961.7	0	963.1	0	963.8	0
OL-092	Multiple Links*	975.7	977.4	0	977.7	0	979.1	0	981.0	0	981.9	0
OL-093	L-OL-112	928.2	933.2	4	934.2	7	937.3	22	940.6	48	942.0	60
OL-094	L-OL-112	1039.2	1041.9	4	1041.9	7	1042.2	22	1042.6	48	1042.7	60
OL-095	L-OL-108	988.9	990.1	0	990.3	0	991.0	0	991.8	1	992.1	12
OL-096	L-OL-107	1012.2	1013.5	0	1013.7	0	1015.4	0	1018.5	0	1020.2	0
OL-097	L-OL-106	1029.4	1031.5	0	1031.9	0	1032.2	11	1032.5	38	1032.6	55
OL-098	L-OL-105	1051.5	1053.6	0	1053.9	0	1055.4	0	1056.3	5	1056.5	10
OL-099	L-OL-104	1049.5	1053.1	0	1053.7	0	1055.4	0	1056.8	2	1057.5	3
OL-100	L-OL-103	982.0	983.6	0	984.1	0	986.0	0	988.4	0	989.5	0
OL-101	L-OL-102	1015.7	1017.9	1	1018.0	3	1018.3	16	1018.6	40	1018.7	52
OL-102	L-OL-101	1033.0	1034.3	0	1034.5	0	1035.2	0	1036.1	0	1036.6	0
OL-103	L-OL-114	1027.5	1028.8	0	1029.2	0	1030.4	0	1032.1	0	1032.8	0
OL-104	L-OL-115	1023.3	1025.5	0	1025.6	0	1025.8	6	1026.0	17	1026.1	23
OL-105	L-OL-109	0.0	1037.2	0	1037.5	0	1038.4	0	1039.8	0	1040.5	0
OL-106	L-OL-111	0.0	987.7	0	987.9	0	988.8	0	990.0	0	990.6	0
OL-107	L-OL-110	0.0	987.7	0	987.9	1	988.8	1	990.1	2	990.7	2
OL-108	Multiple Links*	0.0	984.5	1	984.7	1	985.2	4	985.4	10	985.4	14
OL-109	Multiple Links*	0.0	980.3	2	980.5	3	981.1	6	981.8	15	982.1	107
OL-110	L-OL-652	0.0	976.5	0	977.1	0	978.9	0	981.0	0	982.2	0

*Discharge rates reported are the sum of peak flow rates of all downstream conduits

A.3 LAKE MARION DISTRICT

The total area of the Lake Marion District, including the lake water surface area, is 5,066 acres, 4,838 of which lie within the City of Lakeville. The remaining 228 acres lie in Credit River Township in Scott County. The district extends approximately from 210th Street in the south to Lake Villa Golf Estates in the north and from Dodd Boulevard in the east to Credit River Township in the west. The Lake Marion watershed occupies a transitional zone within the City between the rolling hills, hardwood forests, and abundant wetlands of the northwestern part of the City and the level outwash landforms of eastern and southern Lakeville. The district lies within the Vermillion River Watershed, which is managed by the VRWJPO.

At present, the area to the west of Lake Marion contains rural area with single-family housing. The area to the north and east of Lake Marion is more developed with residential uses. The corridor along Interstate 35 contains some commercial business at County Road 60 and County Road 70.

The watershed divides of the Lake Marion District are shown on Figure A.3.1. The storm sewer network and additional details regarding the drainage system within the Lake Marion watershed are shown on Figure A.3.2.

Stormwater enters Lake Marion at various points. The largest tributaries enter at the southwest corner of the lake, via Subwatersheds ML-092 and ML-088. Many smaller inflows are scattered around the perimeter of the lake. Subwatersheds ML-042, ML-045, and ML-046 are comprised largely of park land; drainage from these areas is presently uncontrolled. For proposed conditions, it was assumed that this would remain a natural area.

The maximum depth of the lake is about 23 feet at the center of the east bay. The middle bay is shallower, while the west bay is shallowest. The mean depths of the east, middle and west basins are approximately 15, 8, and 5 feet, respectively. These depths are all relative to the outlet elevation of 982.1 (1 foot below the OHWL). The lake is seldom at this elevation so the depths will generally be less than these.

Lake Marion is relatively shallow. Because of this, it is susceptible to intermittent mixing during summer. Most lakes tend to stratify during open water periods due to temperature differences in the water column. This tends to isolate the surface waters (epilimnion) from the deeper waters which are cooler and often become rich in nutrients released from the bottom. Shallow lakes tend to stratify weakly and mix intermittently during the course of a summer because they are not deep enough to remain stratified. Exposure to winds, or the "fetch" of a lake, is also a factor in mixing. Lake Marion appears to have the longest fetch of any lake in the City, and the three basins of the lake lie along a northwest-to-southeast line that is slightly longer than 1 mile.

The *Dakota County Geologic Atlas* (Balaban and Hobbs, 1990) noted that Lake Marion has

fluctuated up to 13 feet. A 1993 well study found that the lake level is controlled more by surface water inflows rather than groundwater level fluctuation. Spring time levels may fluctuate with infiltration from the drift aquifer, but the effect is seasonal. Lake Marion has a gated outlet at the southeast end of the lake; during occasional periods of high water overflow occurs through the structure to a channel and storm sewer system to downtown Lakeville, following the path of the natural outlet of the lake.

A.3.1 Flood Protection

Lake Marion outflow is controlled by an outlet control structure and 30-inch culvert, which were installed in 1985. The structure consists of a 4-foot by 6-foot reinforced concrete box weir, with an overflow elevation of 982.1. The 30-inch culvert has an invert elevation of 980.8, and is controlled with a sluice gate. For the existing conditions analysis, outflow entered City storm sewer in downtown Lakeville, and flowed to the east through Airlake Industrial Park, via natural drainage. A storm sewer system was constructed in 1994 that directs the outflow from Lake Marion southeast along Dodd Boulevard and 210th Street to the West Branch of South Creek.

The outlet structure is necessary because the construction of 202nd Street/Icalee Path blocked the natural overflow of the lake. This was not a problem until the early 1980s, when the lake level began to rise significantly. The lake reached a record elevation of 984.7 in 1984. Flooding of City streets and the threat to area homes prompted the City to seek permission from the MDNR to install the outlet. The outlet was used in September 1992, when Lake Marion reached an elevation of 982.6 following heavy rains. It was again used in 1993, and remained in use throughout much of the summer. Lake Marion reached a peak elevation of 984.5 in July 1993. During this period, it was discovered that the outlet was operating at approximately one-half the anticipated capacity. Reasons for this include high tailwater elevations and high inlet losses.

The 100-year flood level on Lake Marion was previously determined to be 984.6 (FIS December, 2011). A frequency distribution using average water surface elevations for the years 1946 through 1990 confirms the FIS elevation.

The peak 100-year elevation of Lake Marion, as computed with XP-SWMM (985.3). Unlike most other lakes, Lake Marion is semi-landlocked and is often below the outlet level. Making an assumption that the lake is already at the outlet level prior to the extreme rainfall, which is the approach taken in the XP-SWMM model, is a conservative assumption.

For each subwatershed and storage pond, peak runoff rates, flood levels, flood discharges, and storage volumes were calculated using the XP-SWMM model. The results of the modeling are shown in the following tables:

Table A.3.1 Hydrologic Parameters - Existing Conditions—

A.3.2 Subwatershed Pond Descriptions

For proposed conditions, it is assumed that future land use within Credit River Township in the western subwatersheds of the Lake Marion District will remain unchanged from 2005 conditions. Following is a brief discussion of those subwatersheds for which alterations are proposed, or which have unique features.

ML-085: This is a wetland area which is controlled by a 30-inch outlet. If unaltered, this pond will overtop Keokuk Avenue during the 2-year flood event under future development conditions. It is assumed that at the time of future development the road crossing will be evaluated to prevent overtopping and maintain existing discharge rates.

ML-086: There are several small wetland areas in this subwatershed. Runoff eventually drains under County Road 70 to Subwatershed ML-085, via a 24-inch culvert.

ML-052: Approximately 87 acres of this subwatershed lie within the City of Lakeville; the remaining 105 acres lie within Credit River Township. This subwatershed contains a large amount of wetland area. The subwatershed drains towards Credit River Township. Flow is then discharged through a culvert across County Road 70 and through a drainage channel, before flowing back into Lakeville in subwatershed ML-057.

ML-065: This subwatershed is divided into two basins: a large upper pond and a smaller lower pond. The upper pond receives the majority of the runoff from the subwatershed, and discharges to the lower pond via a culvert of unknown dimensions. The lower pond is 10 feet lower in elevation than the upper pond. The lower pond discharges to Subwatershed ML-092, but will backflow to the upper pond if the water level exceeds elevation 1003. It is anticipated that a similar scenario will exist during future conditions. When the Shiely mining area is developed, runoff from the southern portion of ML-065 may be diverted to a new pond in the southern portion of the subwatershed.

ML-061: This area is included in the Shiely Post-Mining Grading Plan, but the plan does not include a pond at this location.

ML-045: This subwatershed is located almost entirely within Ritter Farm Park.. It is assumed that at the time of future development the road crossing will be evaluated to prevent overtopping and maintain existing discharge rates. Wetland #960 is adjacent to the pond within this

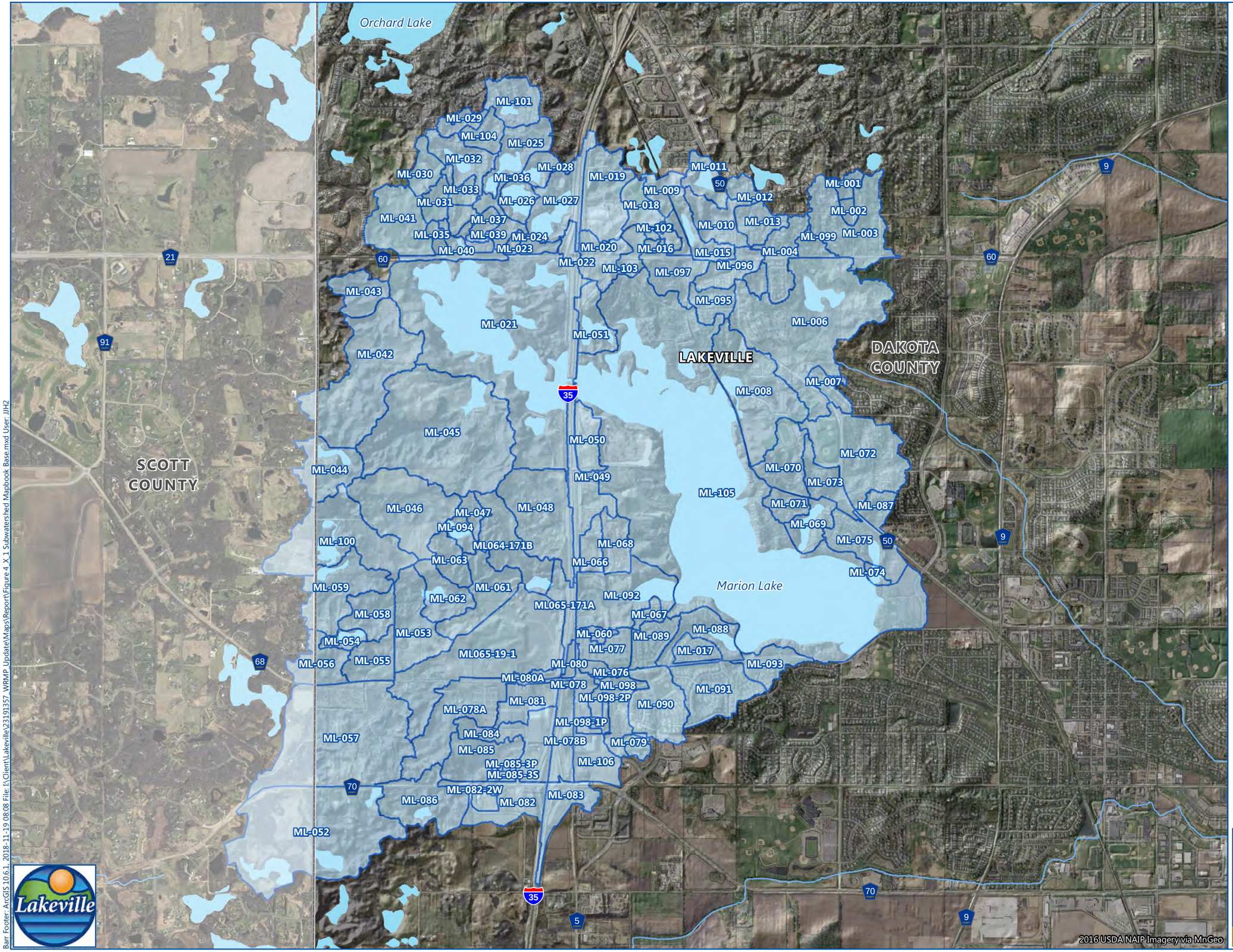
subwatershed; the City wetland inventory notes that it has good potential for increasing floodwater storage.

ML-006: Construction of an outlet structure is considered for an existing wetland to create additional storage volume for future conditions. Controlling outflow will reduce the potential for overtopping of Kenwood Trail.

ML-069: The pond in this subwatershed will overtop 199th Street and Upper 196th Way by approximately 1.0 feet during the 100-year flood event. Preventing the overtopping would require raising the roadway to create more flood storage volume, and installing a larger outlet.

ML-072: All runoff is directed into an existing pond upstream of Kenwood Trail. The storage volume of this pond maybe increased as development occurs to reduce the peak discharge to ML-073.

ML-074: The pond in ML-074 presently has no constructed outlet. The overflow is a berm which separates the pond from Lake Marion. It may be desirable to provide a culvert structure or weir-type overflow structure to prevent erosion of the berm.



County Boundary
Municipal Boundary
Parcel Boundary
Subwatersheds
Public Water Inventory Watercourses
Public Water Inventory Basins

Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

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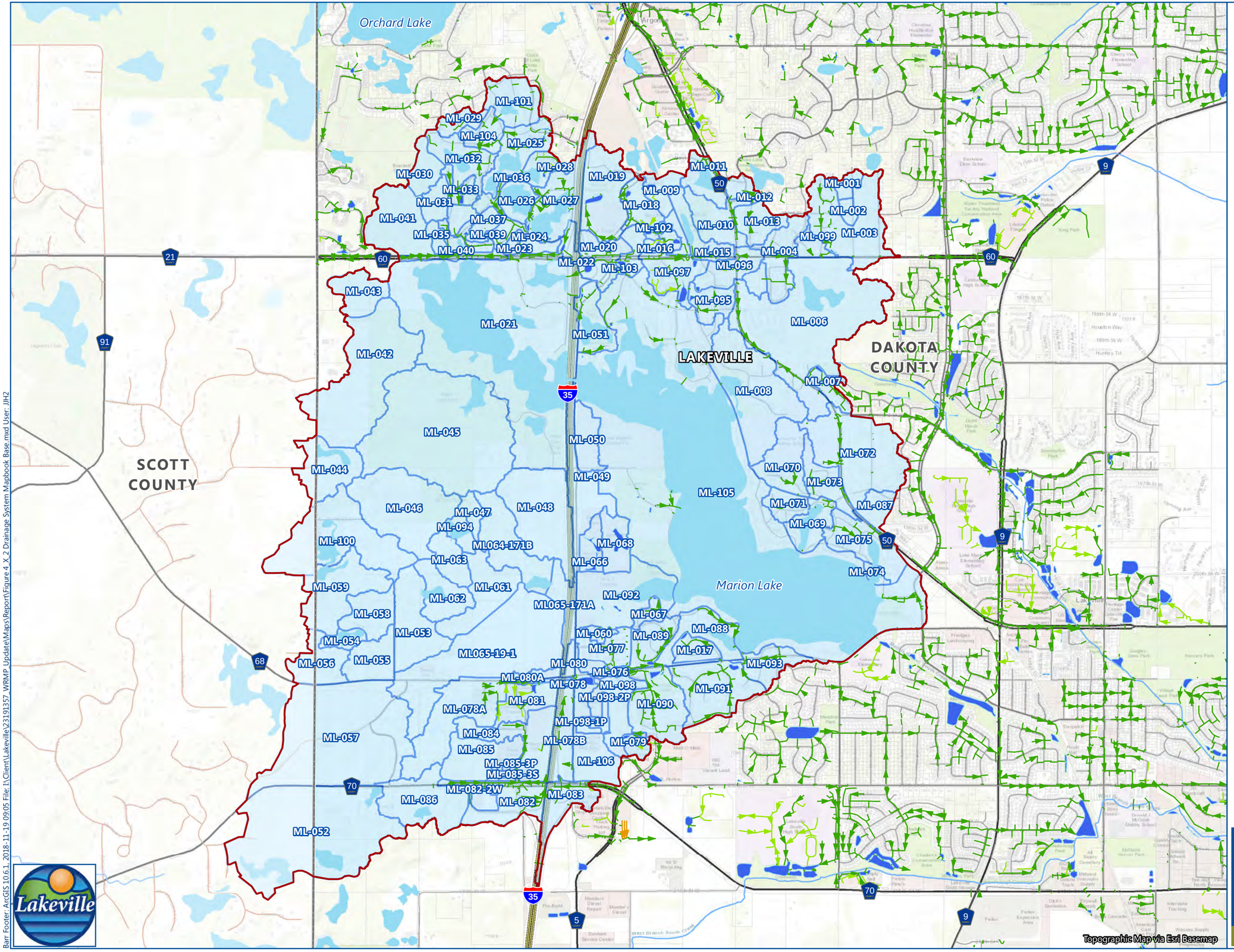
Feet

MARION LAKE SUBWATERSHEDS
Water and Natural Resources Management Plan
City of Lakeville

FIGURE A.3.1

Barr Footer: ArcGIS 10.6.1, 2018-11-19 08:08 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 4_X.1 Subwatershed Mapbook Base.mxd User: JJH2



County Boundary
Municipal Boundary
Parcel Boundary

Pipes

Storm Main
Private Storm Main
Drain Tile

Subwatersheds
Major Subwatersheds
Existing Pond
Public Water Inventory Watercourses
Public Water Inventory Basins

Major Watersheds, Ponds and Pipe data from the City of Lakeville. Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

1,000 0 1,000
Feet

Topographic Map via Esri Basemap

MARION LAKE
DRAINAGE SYSTEM
Water and Natural Resources
Management Plan
City of Lakeville

FIGURE A.3.2

Barr Footer: ArcGIS 10.6.1, 2018-11-19 09:05 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 4_X_2 Drainage System Mapbook Base.mxd User: JJH2

TABLE A.3.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION RATE	MINIMUM INFILTRATION RATE	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
ML-001	8.1	10.40	473	0.100	0.272	0.014	0.170	0.060	0.52	0.19	0.00110
ML-002	5.3	37.00	280	0.099	0.270	0.014	0.169	0.060	0.43	0.23	0.00110
ML-003	71.4	17.00	1164	0.063	0.272	0.014	0.171	0.060	0.50	0.20	0.00110
ML-004	33.3	29.30	640	0.057	0.270	0.014	0.169	0.060	1.00	0.22	0.00110
ML-005	7.5	22.10	512	0.058	0.275	0.014	0.174	0.060	1.00	0.23	0.00110
ML-006	182.3	8.90	1557	0.075	0.278	0.014	0.176	0.060	0.62	0.16	0.00110
ML-007	13.3	27.60	400	0.089	0.272	0.014	0.171	0.060	1.00	0.23	0.00110
ML-008	94.4	11.60	1385	0.122	0.263	0.014	0.169	0.060	0.53	0.20	0.00110
ML-009	14.7	10.20	507	0.128	0.282	0.014	0.178	0.060	0.43	0.19	0.00110
ML-010	30.5	24.80	657	0.114	0.258	0.014	0.166	0.060	1.00	0.20	0.00110
ML-011	21.5	25.10	684	0.101	0.258	0.014	0.165	0.060	0.48	0.17	0.00110
ML-012	10.3	27.00	415	0.089	0.273	0.014	0.171	0.060	1.00	0.20	0.00110
ML-013	20.9	13.40	417	0.081	0.272	0.014	0.170	0.060	0.92	0.20	0.00110
ML-014	6.5	5.17	364	0.182	0.282	0.014	0.180	0.060	1.02	0.13	0.00110
ML-015	23.0	15.90	574	0.114	0.260	0.014	0.167	0.060	0.46	0.21	0.00110
ML-016	8.4	5.50	349	0.100	0.282	0.014	0.180	0.060	1.00	0.11	0.00110
ML-017	14.6	23.20	400	0.044	0.270	0.014	0.169	0.060	1.21	0.25	0.00110
ML-018	19.2	21.30	477	0.068	0.277	0.014	0.178	0.060	0.41	0.21	0.00110
ML-019	53.2	40.20	839	0.093	0.236	0.014	0.175	0.060	0.46	0.18	0.00110
ML-020	28.4	47.90	806	0.102	0.225	0.014	0.185	0.060	1.00	0.22	0.00110
ML-021	374.7	40.50	2361	0.077	0.220	0.014	0.146	0.060	0.71	0.22	0.00110
ML-022	8.1	49.60	370	0.098	0.222	0.014	0.193	0.060	0.44	0.19	0.00110
ML-023	4.7	18.50	267	0.079	0.282	0.014	0.178	0.060	0.45	0.17	0.00110
ML-024	7.7	16.10	281	0.058	0.280	0.014	0.177	0.060	1.00	0.17	0.00110
ML-025	35.4	21.10	625	0.086	0.244	0.014	0.155	0.060	0.83	0.18	0.00110
ML-026	17.0	34.20	663	0.057	0.191	0.014	0.124	0.060	0.40	0.13	0.00110
ML-027	50.1	33.10	668	0.090	0.258	0.014	0.179	0.060	0.47	0.17	0.00110
ML-028	15.2	16.00	489	0.084	0.280	0.014	0.177	0.060	0.86	0.19	0.00110
ML-029	11.6	21.80	395	0.100	0.270	0.014	0.169	0.060	1.00	0.20	0.00110
ML-030	17.8	6.10	546	0.079	0.242	0.014	0.153	0.060	1.00	0.23	0.00110
ML-031	13.5	2.20	479	0.093	0.244	0.014	0.156	0.060	0.43	0.23	0.00110
ML-032	31.0	17.80	631	0.102	0.254	0.014	0.161	0.060	0.43	0.20	0.00110
ML-033	11.4	21.40	476	0.088	0.275	0.014	0.174	0.060	1.00	0.18	0.00110
ML-034	8.8	30.00	378	0.107	0.275	0.014	0.175	0.060	0.43	0.19	0.00110
ML-035	6.8	1.20	254	0.099	0.244	0.014	0.156	0.060	0.39	0.22	0.00110
ML-036	16.3	32.00	832	0.059	0.279	0.014	0.176	0.060	0.55	0.23	0.00110
ML-037	9.9	3.40	346	0.094	0.279	0.014	0.176	0.060	1.00	0.23	0.00110
ML-038	6.9	35.40	285	0.083	0.281	0.014	0.177	0.060	0.40	0.23	0.00110
ML-039	0.8	0.00	140	0.073	0.282	0.014	0.178	0.060	0.33	0.23	0.00110
ML-040	16.5	30.00	359	0.089	0.268	0.014	0.171	0.060	0.39	0.20	0.00110
ML-041	51.7	0.00	949	0.075	0.241	0.014	0.154	0.060	1.00	0.17	0.00110
ML-042	124.6	0.60	957	0.093	0.269	0.014	0.180	0.060	1.01	0.18	0.00110
ML-043	26.6	0.60	570	0.090	0.281	0.014	0.177	0.060	1.00	0.19	0.00110
ML-044	41.3	17.80	840	0.099	0.277	0.014	0.176	0.060	1.00	0.20	0.00110
ML-045	207.9	2.60	1521	0.095	0.278	0.014	0.177	0.060	0.68	0.22	0.00110

TABLE A.3.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION RATE	MINIMUM INFILTRATION RATE	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
ML-046	86.6	0.80	1017	0.054	0.251	0.014	0.185	0.060	0.51	0.18	0.00110
ML-047	10.3	0.00	313	0.063	0.280	0.014	0.177	0.060	0.90	0.20	0.00110
ML-048	78.9	4.10	1227	0.091	0.273	0.014	0.179	0.060	0.52	0.24	0.00110
ML-049	41.3	38.60	357	0.094	0.246	0.014	0.183	0.060	0.43	0.25	0.00110
ML-050	21.9	5.70	425	0.096	0.270	0.014	0.177	0.060	0.41	0.24	0.00110
ML-051	27.9	40.20	648	0.099	0.239	0.014	0.163	0.060	0.96	0.17	0.00110
ML-052	192.3	2.60	1581	0.091	0.263	0.014	0.175	0.060	0.61	0.19	0.00110
ML-053	50.6	2.70	835	0.072	0.268	0.014	0.174	0.060	1.00	0.14	0.00110
ML-054	9.6	25.80	432	0.087	0.280	0.014	0.176	0.060	0.77	0.16	0.00110
ML-055	28.5	1.70	643	0.086	0.266	0.014	0.179	0.060	1.00	0.15	0.00110
ML-056	30.4	7.90	800	0.076	0.275	0.014	0.173	0.060	1.00	0.19	0.00110
ML-057	184.8	6.00	1993	0.073	0.264	0.014	0.181	0.060	0.65	0.14	0.00110
ML-058	28.5	0.50	515	0.087	0.280	0.014	0.177	0.060	1.00	0.15	0.00110
ML-059	57.6	2.50	754	0.065	0.278	0.014	0.177	0.060	0.47	0.16	0.00110
ML-060	4.5	22.10	376	0.056	0.276	0.014	0.176	0.060	1.50	0.34	0.00110
ML-061	44.4	0.00	871	0.102	0.259	0.014	0.170	0.060	1.06	0.14	0.00110
ML-062	29.8	0.70	534	0.087	0.271	0.014	0.180	0.060	0.43	0.13	0.00110
ML-063	20.9	0.70	663	0.093	0.278	0.014	0.179	0.060	1.00	0.16	0.00110
ML-066	15.4	26.30	550	0.096	0.271	0.014	0.176	0.060	1.00	0.23	0.00110
ML-067	7.4	24.10	263	0.061	0.270	0.014	0.169	0.060	0.41	0.28	0.00110
ML-068	22.4	80.50	663	0.100	0.249	0.014	0.172	0.060	1.00	0.23	0.00110
ML-069	24.1	41.10	560	0.074	0.233	0.014	0.148	0.060	0.45	0.22	0.00110
ML-070	37.8	13.80	610	0.106	0.256	0.014	0.169	0.060	0.43	0.22	0.00110
ML-071	15.2	18.80	461	0.080	0.270	0.014	0.169	0.060	0.41	0.19	0.00110
ML-072	90.0	17.50	1535	0.066	0.268	0.014	0.172	0.060	1.00	0.19	0.00110
ML-073	24.4	26.50	485	0.102	0.268	0.014	0.171	0.060	0.48	0.21	0.00110
ML-074	5.4	44.40	484	0.046	0.278	0.014	0.175	0.060	0.68	0.16	0.00110
ML-075	40.8	31.60	803	0.052	0.256	0.014	0.174	0.060	1.22	0.27	0.00110
ML-076	5.3	15.90	217	0.048	0.280	0.014	0.177	0.060	0.39	0.24	0.00110
ML-077	23.6	21.80	387	0.074	0.249	0.014	0.164	0.060	0.41	0.24	0.00110
ML-078	1.2	20.80	145	0.215	0.243	0.014	0.190	0.060	1.00	0.11	0.00110
ML-078A	71.2	12.00	636	0.076	0.278	0.014	0.180	0.060	1.00	0.13	0.00110
ML-078B	27.7	43.08	413	0.080	0.248	0.014	0.190	0.060	1.00	0.06	0.00110
ML-079	7.8	34.50	339	0.060	0.253	0.014	0.174	0.060	1.00	0.21	0.00110
ML-080	4.8	32.16	221	0.104	0.223	0.014	0.190	0.060	1.00	0.14	0.00110
ML-080A	4.7	19.17	227	0.105	0.265	0.014	0.180	0.060	1.00	0.14	0.00110
ML-081	25.8	47.82	615	0.060	0.266	0.014	0.180	0.060	1.18	0.14	0.00110
ML-082	38.6	15.40	952	0.074	0.250	0.014	0.190	0.060	1.00	0.12	0.00110
ML-082-1W	0.3	0.00	58	0.087	0.282	0.014	0.180	0.060	1.00	0.03	0.00110
ML-082-2W	0.4	0.00	71	0.091	0.279	0.014	0.170	0.060	1.00	0.08	0.00110
ML-083	28.7	56.40	394	0.071	0.221	0.014	0.185	0.060	0.40	0.23	0.00110
ML-084	47.4	18.62	807	0.060	0.266	0.014	0.180	0.060	1.14	0.11	0.00110
ML-085	38.4	1.30	598	0.065	0.275	0.014	0.180	0.060	1.02	0.10	0.00110
ML-085-1P	0.9	70.88	146	0.041	0.282	0.014	0.180	0.060	1.00	0.06	0.00110
ML-085-3P	1.2	62.76	131	0.035	0.282	0.014	0.180	0.060	1.00	0.05	0.00110

TABLE A.3.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION RATE	MINIMUM INFILTRATION RATE	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
ML-085-3S	1.2	69.03	193	0.026	0.282	0.014	0.180	0.060	1.00	0.05	0.00110
ML-085-7P	2.8	79.40	364	0.071	0.282	0.014	0.180	0.060	1.00	0.12	0.00110
ML-086	56.0	4.20	891	0.091	0.280	0.014	0.177	0.060	0.96	0.20	0.00110
ML-087	14.3	14.24	414	0.091	0.274	0.014	0.170	0.060	1.00	0.14	0.00110
ML-088	33.3	23.00	530	0.097	0.273	0.014	0.171	0.060	0.47	0.27	0.00110
ML-089	24.3	28.20	764	0.046	0.270	0.014	0.169	0.060	0.51	0.28	0.00110
ML-090	53.5	25.60	820	0.090	0.268	0.014	0.171	0.060	0.46	0.19	0.00110
ML-091	54.5	24.40	710	0.094	0.270	0.014	0.169	0.060	1.06	0.23	0.00110
ML-092	70.8	33.30	907	0.100	0.248	0.014	0.165	0.060	1.21	0.25	0.00110
ML-093	23.9	33.70	735	0.066	0.270	0.014	0.169	0.060	0.47	0.25	0.00110
ML-094	11.1	26.60	337	0.070	0.243	0.014	0.155	0.060	0.95	0.17	0.00110
ML-095	18.9	20.60	452	0.091	0.257	0.014	0.167	0.060	0.41	0.22	0.00110
ML-096	23.6	30.50	404	0.093	0.261	0.014	0.174	0.060	0.40	0.23	0.00110
ML-097	31.8	30.53	522	0.081	0.267	0.014	0.180	0.060	1.06	0.10	0.00110
ML-098	33.4	6.26	528	0.066	0.272	0.014	0.180	0.060	1.00	0.09	0.00110
ML-098-1P	4.8	51.02	349	0.065	0.282	0.014	0.180	0.060	1.00	0.13	0.00110
ML-098-2P	4.9	73.06	630	0.081	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
ML-099	10.2	26.90	391	0.073	0.270	0.014	0.169	0.060	0.42	0.23	0.00110
ML-100	96.5	4.70	732	0.061	0.260	0.014	0.179	0.060	0.48	0.16	0.00110
ML-101	32.0	17.20	860	0.110	0.270	0.014	0.169	0.060	0.47	0.21	0.00110
ML-102	3.5	9.69	415	0.090	0.282	0.014	0.180	0.060	1.00	0.12	0.00110
ML-103	13.6	36.91	757	0.058	0.273	0.014	0.180	0.060	0.95	0.11	0.00110
ML-104	16.9	34.40	493	0.086	0.270	0.014	0.169	0.060	0.41	0.22	0.00110
ML-105	817.9	61.40	2775	0.048	0.180	0.014	0.121	0.060	0.77	0.24	0.00110
ML-106	42.2	26.86	467	0.056	0.251	0.014	0.180	0.060	1.00	0.10	0.00110
ML064-171B	50.7	6.62	643	0.096	0.282	0.014	0.180	0.060	1.13	0.16	0.00110
ML065-171A	20.2	18.85	521	0.093	0.247	0.014	0.190	0.060	1.35	0.15	0.00110
ML065-19-1	147.0	1.57	1027	0.072	0.267	0.014	0.170	0.060	1.04	0.14	0.00110
ML082-100P	6.7	64.42	424	0.057	0.250	0.014	0.180	0.060	1.00	0.13	0.00110
ML082-150I	0.8	0.00	190	0.086	0.229	0.014	0.190	0.060	1.00	0.14	0.00110

TABLE A.3.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
ML-001	8.1	1.0	8	1.3	10	2.5	23	4.4	41	5.5	50
ML-002	5.3	1.6	10	1.9	13	3.2	23	5.2	38	6.2	45
ML-003	71.4	0.9	55	1.2	70	2.4	129	4.3	226	5.4	278
ML-004	33.3	1.3	39	1.6	50	2.8	88	4.7	148	5.8	179
ML-005	7.5	1.2	10	1.5	13	2.7	25	4.6	43	5.7	52
ML-006	182.3	0.7	77	0.9	98	2.0	184	4.0	334	5.1	418
ML-007	13.3	1.3	18	1.6	23	2.8	41	4.7	70	5.8	84
ML-008	94.4	0.8	59	1.1	76	2.2	149	4.2	277	5.2	346
ML-009	14.7	0.9	11	1.2	15	2.4	32	4.4	61	5.4	75
ML-010	30.5	1.3	36	1.5	47	2.8	86	4.8	146	5.8	177
ML-011	21.5	1.4	29	1.7	37	2.9	69	4.9	116	6.0	140
ML-012	10.3	1.4	15	1.7	19	2.9	35	4.9	59	6.0	71
ML-013	20.9	0.9	15	1.1	19	2.3	37	4.3	67	5.3	84
ML-014	6.5	1.0	6	1.3	9	2.6	19	4.6	34	5.7	41
ML-015	23.0	1.0	21	1.3	27	2.5	53	4.4	95	5.5	117
ML-016	8.4	1.0	6	1.4	8	2.7	18	4.7	34	5.8	41
ML-017	14.6	1.1	15	1.3	19	2.5	35	4.4	60	5.5	74
ML-018	19.2	1.1	19	1.4	25	2.6	46	4.5	80	5.6	97
ML-019	53.2	1.7	81	2.0	102	3.3	182	5.3	300	6.4	358
ML-020	28.4	1.9	58	2.2	74	3.5	130	5.5	209	6.6	246
ML-021	374.7	1.6	391	1.8	497	3.0	896	5.0	1496	6.1	1810
ML-022	8.1	2.0	19	2.3	24	3.6	43	5.7	67	6.8	78
ML-023	4.7	1.2	6	1.5	8	2.7	15	4.8	26	5.9	31
ML-024	7.7	1.1	7	1.4	9	2.6	18	4.6	32	5.7	39
ML-025	35.4	1.2	35	1.4	45	2.7	83	4.7	144	5.7	175
ML-026	17.0	1.8	31	2.1	40	3.4	71	5.5	113	6.6	133
ML-027	50.1	1.5	63	1.8	79	3.0	141	5.1	235	6.2	283
ML-028	15.2	1.0	14	1.3	18	2.5	36	4.5	64	5.6	79
ML-029	11.6	1.2	14	1.5	18	2.7	34	4.7	59	5.8	71
ML-030	17.8	0.7	9	1.0	13	2.1	29	4.0	58	5.0	73
ML-031	13.5	0.6	7	0.9	10	2.0	23	3.9	45	5.0	57
ML-032	31.0	1.0	29	1.3	37	2.5	69	4.5	123	5.6	151
ML-033	11.4	1.2	14	1.5	18	2.8	35	4.8	60	5.9	73
ML-034	8.8	1.5	14	1.8	18	3.0	33	5.1	55	6.2	66
ML-035	6.8	0.6	4	0.9	5	2.0	12	3.9	24	5.0	30
ML-036	16.3	1.4	26	1.7	33	3.0	61	4.9	101	6.0	120
ML-037	9.9	0.6	4	0.9	6	2.0	15	3.9	30	4.9	39
ML-038	6.9	1.5	12	1.8	15	3.1	27	5.1	44	6.2	52
ML-039	0.8	0.7	1	1.0	1	2.1	3	4.0	5	5.0	6
ML-040	16.5	1.4	22	1.7	28	2.9	50	4.9	84	6.0	100
ML-041	51.7	0.6	16	0.8	23	2.0	55	3.9	115	5.0	147
ML-042	124.6	0.4	18	0.6	26	1.6	70	3.5	156	4.5	206
ML-043	26.6	0.5	8	0.8	12	1.9	30	3.9	62	4.9	79
ML-044	41.3	1.0	37	1.3	47	2.5	89	4.4	157	5.5	193
ML-045	207.9	0.3	35	0.5	47	1.5	108	3.2	243	4.3	323
ML-046	86.6	0.4	15	0.6	22	1.7	57	3.6	125	4.6	164
ML-047	10.3	0.5	3	0.8	5	1.9	13	3.9	26	4.9	33

TABLE A.3.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
ML-048	78.9	0.5	22	0.7	31	1.7	71	3.6	151	4.6	196
ML-049	41.3	1.5	49	1.7	62	2.9	110	4.8	181	5.9	219
ML-050	21.9	0.6	8	0.8	12	1.9	26	3.7	52	4.8	68
ML-051	27.9	1.7	49	2.1	62	3.3	109	5.4	177	6.5	210
ML-052	192.3	0.4	35	0.7	48	1.7	118	3.6	259	4.6	339
ML-053	50.6	0.7	14	1.0	21	2.2	51	4.2	103	5.3	132
ML-054	9.6	1.4	14	1.7	18	3.0	33	5.0	56	6.1	67
ML-055	28.5	0.7	10	1.0	15	2.2	36	4.2	72	5.3	91
ML-056	30.4	0.8	16	1.0	22	2.2	47	4.2	91	5.2	115
ML-057	184.8	0.7	65	1.0	85	2.2	173	4.2	333	5.2	422
ML-058	28.5	0.6	8	0.9	12	2.1	30	4.1	61	5.1	78
ML-059	57.6	0.6	12	0.8	18	2.0	44	3.9	93	5.0	121
ML-060	4.5	1.1	6	1.3	7	2.4	15	4.3	26	5.2	32
ML-061	44.4	0.7	16	1.0	23	2.2	56	4.2	110	5.3	139
ML-062	29.8	0.7	9	1.0	13	2.2	33	4.2	66	5.3	84
ML-063	20.9	0.7	9	1.0	14	2.2	32	4.2	63	5.2	79
ML-066	15.4	1.3	21	1.6	27	2.8	50	4.7	84	5.8	102
ML-067	7.4	1.1	9	1.4	11	2.5	21	4.4	35	5.5	43
ML-068	22.4	2.8	65	3.1	82	4.5	138	6.6	210	7.7	244
ML-069	24.1	1.7	40	2.0	51	3.3	91	5.3	148	6.4	176
ML-070	37.8	0.8	27	1.1	35	2.2	66	4.2	121	5.2	150
ML-071	15.2	1.1	15	1.4	20	2.6	38	4.6	67	5.7	82
ML-072	90.0	1.0	73	1.2	92	2.4	170	4.4	299	5.4	368
ML-073	24.4	1.3	29	1.5	37	2.8	67	4.7	114	5.8	138
ML-074	5.4	1.9	12	2.2	16	3.5	28	5.6	43	6.7	50
ML-075	40.8	1.3	50	1.5	63	2.7	112	4.6	187	5.7	226
ML-076	5.3	0.9	5	1.2	6	2.3	12	4.2	21	5.3	26
ML-077	23.6	1.0	22	1.3	28	2.4	51	4.3	89	5.4	109
ML-078	1.2	1.5	3	1.8	4	3.2	6	5.2	10	6.3	12
ML-078A	71.2	0.9	39	1.2	49	2.4	91	4.4	159	5.5	196
ML-078B	27.7	2.1	44	2.4	56	3.8	99	5.9	159	7.0	189
ML-079	7.8	1.5	13	1.8	16	3.1	30	5.1	49	6.2	58
ML-080	4.8	1.6	9	2.0	11	3.3	21	5.4	33	6.4	39
ML-080A	4.7	1.3	6	1.6	8	2.9	16	5.0	27	6.1	32
ML-081	25.8	2.0	47	2.3	59	3.6	104	5.7	168	6.8	198
ML-082	38.6	1.2	34	1.5	44	2.8	87	4.8	153	5.9	186
ML-082-1W	0.3	1.6	1	2.0	1	3.3	1	5.4	2	6.5	2
ML-082-2W	0.4	1.1	1	1.5	1	2.8	2	4.9	3	5.9	3
ML-083	28.7	2.1	49	2.4	62	3.7	110	5.7	180	6.8	214
ML-084	47.4	1.2	41	1.5	53	2.8	97	4.9	167	6.0	203
ML-085	38.4	0.8	11	1.1	15	2.4	37	4.5	74	5.5	94
ML-085-1P	0.9	2.7	3	3.1	4	4.5	6	6.6	9	7.8	10
ML-085-3P	1.2	2.6	4	2.9	5	4.3	8	6.5	11	7.6	13
ML-085-3S	1.2	2.7	4	3.0	5	4.4	8	6.6	12	7.7	14
ML-085-7P	2.8	2.8	11	3.2	13	4.6	21	6.7	30	7.9	35
ML-086	56.0	0.6	17	0.8	23	1.9	53	3.8	112	4.9	144
ML-087	14.3	1.1	13	1.4	17	2.7	33	4.8	59	5.8	71

TABLE A.3.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
ML-088	33.3	1.0	33	1.3	42	2.4	75	4.3	128	5.3	158
ML-089	24.3	1.2	30	1.5	38	2.6	69	4.5	116	5.6	141
ML-090	53.5	1.2	58	1.5	73	2.7	131	4.7	223	5.8	270
ML-091	54.5	1.1	54	1.4	68	2.5	122	4.4	206	5.5	251
ML-092	70.8	1.4	88	1.6	111	2.8	197	4.8	329	5.8	397
ML-093	23.9	1.4	35	1.7	45	2.9	81	4.9	134	6.0	161
ML-094	11.1	1.4	15	1.7	19	2.9	35	5.0	59	6.1	70
ML-095	18.9	1.1	19	1.4	25	2.6	47	4.5	82	5.6	100
ML-096	23.6	1.3	30	1.6	37	2.8	67	4.8	112	5.8	136
ML-097	31.8	1.6	41	1.9	52	3.3	93	5.4	152	6.5	182
ML-098	33.4	1.0	14	1.3	19	2.6	40	4.7	75	5.7	94
ML-098-1P	4.8	2.1	12	2.5	16	3.8	26	5.9	40	7.0	47
ML-098-2P	4.9	2.7	18	3.0	22	4.4	35	6.5	51	7.7	59
ML-099	10.2	1.3	14	1.6	18	2.8	33	4.8	56	5.8	67
ML-100	96.5	0.5	24	0.7	32	1.8	63	3.7	123	4.8	157
ML-101	32.0	1.0	31	1.3	40	2.5	77	4.5	138	5.6	168
ML-102	3.5	1.2	5	1.5	7	2.8	14	4.9	23	6.0	27
ML-103	13.6	1.8	27	2.1	34	3.5	60	5.6	95	6.7	111
ML-104	16.9	1.5	26	1.8	33	3.0	60	5.0	99	6.1	118
ML-105	817.9	2.2	730	2.5	930	3.7	1710	5.7	2892	6.8	3509
ML-106	42.2	1.4	41	1.8	52	3.1	94	5.2	157	6.3	189
ML064-171B	50.7	0.7	20	1.0	27	2.2	54	4.2	105	5.2	134
ML065-171A	20.2	1.2	21	1.5	27	2.8	52	4.8	91	5.9	110
ML065-19-1	147.0	0.5	21	0.7	30	1.8	78	3.8	170	4.8	223
ML082-100P	6.7	2.4	20	2.8	25	4.2	41	6.3	62	7.4	72
ML082-150I	0.8	0.9	1	1.2	2	2.5	4	4.5	6	5.6	7

TABLE A.3.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
ML-001	L-LSC-001	1111.3	1113.6	7	1114.9	9	1117.6	13	1118.9	15	1119.4	15
ML-002	Multiple Links*	1109.4	1109.5	9	1109.5	13	1109.6	24	1109.6	36	1109.7	41
ML-003	Multiple Links*	1080.8	1083.5	27	1083.6	40	1083.9	101	1084.2	185	1084.3	231
ML-004	Multiple Links*	1072.0	1072.0	32	1072.1	40	1072.3	70	1072.5	119	1072.6	148
ML-005	L-LSC-012	1083.3	1083.7	1	1083.8	1	1084.1	2	1084.6	3	1084.9	3
ML-006	L-LSC-680	1003.5	1009.1	37	1010.6	41	1015.2	91	1015.6	448	1015.7	658
ML-007	Multiple Links*	1030.9	1033.4	6	1033.7	6	1034.5	17	1034.8	42	1035.0	59
ML-008	Multiple Links*	982.1	983.0	45	983.3	52	984.6	75	989.7	144	991.8	164
ML-009	L-LSC-041	1044.6	1051.9	0	1053.3	0	1056.9	5	1057.1	35	1057.2	52
ML-010	Multiple Links*	1035.6	1036.3	35	1036.4	44	1036.6	80	1036.8	135	1036.9	163
ML-011	L-LSC-026	1055.1	1060.3	0	1060.4	0	1061.0	0	1061.7	0	1062.1	0
ML-012	L-LSC-023	1074.5	1075.4	3	1075.6	4	1076.4	4	1077.5	5	1078.1	5
ML-013	L-LSC-020	1062.4	1064.2	7	1064.7	9	1067.0	13	1070.3	18	1071.9	20
ML-014	Multiple Links*	1016.2	1018.6	17	1018.8	20	1020.5	30	1026.1	51	1031.4	81
ML-015	Multiple Links*	1023.2	1027.0	12	1027.6	13	1029.6	16	1031.9	33	1032.2	77
ML-016	L-LSC-034	1047.4	1050.6	2	1051.4	2	1052.7	6	1054.9	8	1055.9	10
ML-017	Multiple Links*	996.3	996.7	8	996.7	11	997.0	22	997.4	40	997.8	44
ML-018	Multiple Links*	1042.9	1048.8	14	1049.1	14	1050.7	16	1054.0	17	1055.4	18
ML-019	L-LSC-847	1026.7	1028.4	0	1028.7	0	1029.9	0	1031.3	6	1031.5	21
ML-020	L-LSC-671	1002.6	1005.9	16	1006.5	17	1008.4	21	1011.0	25	1012.4	27
ML-021	L-LSC-099	982.1	982.7	118	982.9	137	983.6	197	984.7	292	985.3	342
ML-022	L-LSC-054	1000.4	1001.9	3	1002.2	3	1003.4	4	1005.0	5	1005.8	5
ML-023	Multiple Links*	990.1	991.9	17	992.0	19	992.6	27	993.2	38	993.6	44
ML-024	Multiple Links*	993.5	995.4	15	995.5	17	996.0	23	996.6	32	996.9	35
ML-025	Multiple Links*	1013.5	1014.1	0	1014.2	0	1014.7	5	1015.0	19	1015.1	29
ML-026	Multiple Links*	1006.9	1007.5	0	1007.7	0	1008.4	0	1008.8	1	1009.2	2
ML-027	Multiple Links*	998.3	1000.0	10	1000.1	11	1000.6	17	1001.3	23	1001.8	26
ML-028	Multiple Links*	1018.0	1018.4	6	1018.5	7	1019.2	9	1020.0	7	1020.3	7
ML-029	L-LSC-060	1001.9	1002.5	1	1002.7	2	1003.4	3	1004.4	4	1004.9	3
ML-030	Multiple Links*	1000.2	1001.8	0	1002.2	0	1003.6	0	1005.6	0	1006.4	0
ML-031	L-LSC-102	993.8	996.5	0	996.9	0	998.7	0	1000.0	2	1000.6	2
ML-032	L-LSC-086	996.8	997.8	3	998.0	5	999.0	7	1000.5	8	1001.1	9
ML-033	Multiple Links*	995.0	995.9	2	996.1	3	996.9	5	998.3	8	998.5	18
ML-034	Multiple Links*	994.7	995.7	4	995.9	5	996.6	10	997.6	13	998.0	30
ML-035	L-LSC-101	983.9	984.3	1	984.4	2	984.8	4	985.4	8	985.6	11
ML-036	Multiple Links*	996.0	999.9	4	1000.1	5	1000.8	14	1001.2	44	1001.5	62
ML-037	Multiple Links*	990.5	991.9	5	992.1	6	993.2	9	995.5	14	996.5	16
ML-038	Multiple Links*	990.5	992.1	5	992.4	5	993.7	7	995.7	10	996.7	10
ML-039	Multiple Links*	994.4	998.8	3	999.2	4	1000.1	8	1001.2	27	1001.5	41
ML-040	Multiple Links*	982.1	982.7	20	982.9	25	983.6	44	984.7	76	985.3	83
ML-041	L-LSC-669	987.2	989.8	6	990.5	6	993.0	8	995.3	10	996.1	11
ML-042	L-LSC-105	998.4	999.1	21	999.3	32	999.9	84	1000.5	194	1000.8	258

TABLE A.3.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
ML-043	L-LSC-104	998.9	999.2	4	999.4	6	999.9	17	1000.4	38	1000.7	51
ML-044	L-LSC-107	1094.7	1100.0	6	1100.2	9	1100.5	24	1101.0	57	1101.2	77
ML-045	Multiple Links*	987.6	989.4	5	989.8	23	992.2	36	995.9	41	997.7	44
ML-046	L-LSC-122	1045.5	1046.9	13	1047.0	20	1047.6	54	1048.2	122	1048.5	160
ML-047	L-LSC-121	1046.1	1046.9	2	1047.0	3	1047.6	9	1048.2	20	1048.4	26
ML-048	L-LSC-173	991.2	991.6	15	991.7	22	992.1	54	992.5	109	992.7	155
ML-049	L-LSC-168	985.7	986.3	43	986.4	54	986.6	92	986.9	150	987.0	180
ML-050	L-LSC-636	984.5	984.8	7	984.9	10	985.1	24	985.4	50	985.5	64
ML-051	L-LSC-231	986.4	986.8	1	986.8	2	987.1	2	987.6	4	987.8	5
ML-052	Multiple Links*	1090.7	1093.5	25	1094.2	33	1097.0	56	1100.9	80	1102.6	89
ML-053	L-LSC-115	1039.8	1040.6	51	1040.6	58	1040.9	134	1041.3	329	1041.5	439
ML-054	Multiple Links*	1097.5	1099.0	0	1099.1	0	1099.5	0	1100.1	0	1100.4	0
ML-055	Multiple Links*	1067.9	1071.6	41	1072.0	43	1072.8	49	1073.8	56	1074.2	63
ML-056	L-LSC-127	1077.2	1077.4	7	1077.5	10	1077.6	27	1077.9	58	1078.0	79
ML-057	L-LSC-129	1067.9	1072.4	25	1072.9	33	1074.0	56	1075.4	80	1076.1	89
ML-058	L-LSC-111	1056.2	1060.6	0	1061.5	0	1062.1	66	1062.5	209	1062.7	289
ML-059	L-LSC-110	1062.2	1062.8	10	1063.0	15	1063.3	42	1063.6	92	1063.8	119
ML-060	Multiple Links*	1023.3	1024.3	2	1024.5	2	1025.3	4	1026.5	9	1026.6	14
ML-061	L-LSC-124	1006.0	1007.4	81	1007.6	105	1008.2	209	1009.2	481	1009.6	660
ML-062	L-LSC-114	1030.2	1031.0	66	1031.1	83	1031.4	157	1032.0	416	1032.3	563
ML-063	L-LSC-116	1030.1	1031.0	9	1031.1	13	1031.4	32	1032.0	62	1032.3	86
ML064-171B	Link5582	1001.5	1002.2	103	1002.3	134	1002.7	275	1003.4	634	1004.5	844
ML065-171A	Multiple Links*	988.1	991.9	109	992.4	143	994.1	297	1000.9	609	1004.5	726
ML-066	L-LSC-170	1024.3	1026.5	0	1026.7	0	1027.6	0	1027.7	23	1027.8	42
ML-067	Multiple Links*	984.0	985.5	3	986.0	4	986.3	9	987.6	13	988.5	13
ML-068	L-LSC-169	1016.8	1017.3	46	1017.4	57	1017.5	103	1017.6	157	1017.7	184
ML-069	Multiple Links*	982.1	983.5	24	983.8	34	984.8	65	985.9	174	986.2	251
ML-070	L-LSC-242	983.8	985.6	20	985.9	25	987.0	46	988.7	82	989.8	97
ML-071	Multiple Links*	982.5	983.6	17	983.9	22	984.8	48	985.9	114	986.3	700
ML-072	Multiple Links*	997.9	1000.7	56	1001.4	72	1004.0	114	1006.4	202	1006.5	274
ML-073	Multiple Links*	987.3	992.4	50	993.3	53	997.4	65	999.0	209	999.1	304
ML-074	L-LSC-637	982.1	982.7	11	982.9	14	983.6	21	984.7	35	985.3	91
ML-075	Multiple Links*	982.1	982.7	11	982.9	14	983.6	22	984.8	46	985.3	100
ML-076	L-LSC-183	1023.8	1024.2	2	1024.3	2	1024.8	5	1025.4	9	1025.8	11
ML-077	Multiple Links*	1023.6	1024.2	8	1024.3	11	1024.6	28	1024.8	62	1024.9	82
ML-078	Multiple Links*	1024.5	1028.2	34	1028.3	43	1029.0	120	1030.3	228	1031.0	288
ML-079	L-LSC-196	1068.6	1069.3	4	1069.4	6	1069.7	15	1069.9	30	1070.1	38
ML-080	Multiple Links*	1030.6	1032.2	7	1032.9	9	1034.9	17	1035.1	28	1035.2	33
ML-081	Multiple Links*	1027.5	1033.2	20	1033.9	32	1035.5	70	1037.7	103	1038.1	118
ML-082	L-LSC-678	1073.5	1078.9	7	1079.3	8	1080.7	8	1082.9	10	1084.2	10
ML-083	L-LSC-134	1074.5	1081.0	10	1081.3	11	1082.4	16	1084.1	21	1085.0	22
ML-084	L-LSC-146	1034.8	1035.5	57	1035.6	69	1035.9	137	1038.6	1144	1039.1	1294

TABLE A.3.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
ML-085	Multiple Links*	1054.6	1058.2	24	1058.8	40	1058.9	76	1059.0	128	1059.1	159
ML-086	Multiple Links*	1090.6	1096.7	15	1098.8	21	1103.5	33	1106.6	78	1106.9	117
ML-087	L-LSC-250	989.0	989.6	10	989.7	13	991.3	25	992.3	43	992.7	52
ML-088	Multiple Links*	982.1	982.7	98	982.9	130	983.6	254	984.7	604	985.3	758
ML-089	L-LSC-192	1008.0	1010.0	15	1010.5	20	1013.2	40	1016.4	50	1017.2	53
ML-090	Multiple Links*	1012.0	1014.1	76	1014.7	98	1017.6	241	1018.0	576	1018.1	734
ML-091	Multiple Links*	988.0	991.4	7	992.3	8	995.8	12	996.9	79	997.1	129
ML-092	Multiple Links*	983.4	985.5	55	986.0	55	986.3	284	986.5	702	986.6	853
ML-093	Multiple Links*	982.8	986.5	13	987.0	19	987.4	52	987.9	114	988.3	192
ML-094	L-LSC-120	1057.5	1060.4	0	1060.6	0	1060.9	3	1061.0	15	1061.1	21
ML-095	Multiple Links*	1010.5	1013.1	19	1014.1	25	1017.1	33	1019.7	40	1020.9	46
ML-096	Multiple Links*	1017.0	1020.6	12	1020.8	18	1021.2	45	1021.6	89	1021.7	110
ML-097	Multiple Links*	1008.9	1012.3	26	1012.9	29	1014.2	63	1014.7	123	1014.8	151
ML-098	Multiple Links*	1013.4	1016.1	71	1016.6	91	1019.3	176	1020.9	432	1021.0	550
ML-099	L-LSC-651	1072.8	1076.8	38	1076.9	55	1077.1	129	1077.2	240	1077.3	295
ML-100	L-LSC-112	1055.8	1060.6	9	1061.5	11	1062.1	33	1062.5	98	1062.7	135
ML-101	L-LSC-059	1009.5	1010.5	3	1010.8	4	1011.6	8	1012.8	11	1013.5	12
ML-102	L-LSC-608	1058.7	1059.7	2	1059.9	3	1060.4	4	1061.1	5	1061.4	6
ML-103	Multiple Links*	1040.7	1045.3	13	1045.7	14	1047.0	16	1048.8	19	1049.2	32
ML-104	L-LSC-067	998.7	999.5	8	999.8	10	1000.6	19	1001.6	27	1002.3	30
ML-105	Multiple Links*	982.1	982.7	21	982.9	24	983.6	31	984.7	40	985.3	79
ML-106	L-LSC-048	1027.1	1028.2	57	1028.2	72	1028.5	156	1028.9	327	1029.0	412

*Discharge rates reported are the sum of peak flow rates of all downstream conduits

A.4 NORTH CREEK DISTRICT

The total area of the North Creek watershed at the Lakeville-Farmington border is approximately 14,800 acres, 5,880 of which lie within the City of Lakeville. Of the remaining area, 380 acres lie within the City of Farmington and 8,540 acres lie within the City of Apple Valley. The district is located in the portion of the City of Lakeville lying generally north of 180th Street. The district lies within the Vermillion River Watershed, which is managed by the VRWJPO.

The North Creek District is comprised largely of level outwash landforms, with fewer wetlands and forest than the western portion of the City. The district is drained by North Creek, a tributary of the Vermillion River. The creek has two branches. The West Branch of North Creek is a perennial stream fed by groundwater discharge during dry weather. The Main Branch is more intermittent in flow.

The West Branch of North Creek begins in the western portion of the district, between Highview and Ipava Avenue, and flows east. The West Branch roughly divides the district west to east before entering the City of Farmington east of Pilot Knob Road.

The Main Branch extends north into Apple Valley. The watershed of the Main Branch includes a significant portion of the City of Apple Valley, extending as far as Alimagnet Lake. The Main Branch joins the West Branch in Section 12, about one-half mile downstream from Pilot Knob Road. The City of Apple Valley has constructed a 60-inch storm sewer to convey Main Branch flow from a 10-acre stormwater pond north of County Road 46 to NCL-78, located east of Pilot Knob Road.

The western part of the North Creek District is developed primarily in residential uses. The eastern portion is a mix of residential and agricultural uses.

The subwatershed divides of the North Creek District are shown on Figure A.4.1. The drainage system is shown in greater detail on Figure A.4.2. North Creek does not provide the direct or indirect body contact recreation that many lakes would provide.

The beneficial uses of North Creek are not as obvious as the uses of lakes but the Creek is still a significant resource to the neighborhoods through which it flows. Probably the most significant use of the creek will be as an aesthetic and wildlife resource as well as a greenway corridor. The Lakeville Park Plan and Dakota County Greenway Plan envision a system of parks and trails along North Creek forming a linear park within natural areas. Additional parks are planned as development progresses along the corridor. The entire North Creek park system will be connected to the creek.

A.4.1 Flood Protection

The flood profile of North Creek is primarily controlled by the size of culverts at major road crossings. These include, Highview Avenue, Cedar Avenue, Dodd Boulevard, Flagstaff Avenue, and Pilot Knob Road.

For each subwatershed and storage pond, peak runoff rates, flood levels, flood discharges, and storage volumes were calculated using the XP-SWMM model. The results of the modeling are shown in the tables. Information is described as follows:

Table A.4.1	Hydrologic Parameters - Existing Conditions—(subwatershed data)
Table A.4.2	Hydrologic Results - Existing Conditions—(peak flow rates from subwatersheds)
Table A.4.3	Hydraulic Results - Existing Conditions—(peak discharges and elevations)

The XP-SWMM model was developed using the calibrated parameters defined in *Vermillion River Watershed Hydrologic Study of Existing Conditions* (Barr 2009). The calibration parameters were developed by comparing simulation results to measurements at gages on North Creek upstream and downstream of the confluence with Middle Creek.

A.4.2 Subwatershed Pond Descriptions

For proposed conditions, it is assumed that runoff from Apple Valley (NCreek-24 and NCreek-25), which flow into subwatershed NCL-78, will conform to the rates shown in the Apple Valley Surface Water Management Plan and documented in the *Vermillion River Watershed Hydrologic Study of Existing Conditions* (Barr 2009). Following is a brief description of subwatersheds for which future alterations maybe considered, or which have unique features.

NCL-79: This subwatershed is part of the proposed Nordic Square Development. Based on existing end-use plans, there will be seven proposed ponds within this subwatershed.

NCreek-24: Cobblestone Lake in Apple Valley (NCreek-24) has a pumped outlet that is designed to operate in an extreme event. This discharge would be routed via force main to NCL-78. Probably due to high infiltration rates in Cobblestone Lake, the pump has never been operated except for testing and maintenance since it was installed in 2001.

NCL-78: Water enters this Lakeville subwatershed from Apple Valley Pond WVR-443 (NCreek-25) and flows to NCL-78. By mutual agreement between Apple Valley and Lakeville, this subwatershed will receive a 100-year peak flow of 80 cfs from Apple Valley under fully

developed conditions. For modeling it was assumed that 77 cfs would flow for all of the runoff events. The City of Apple Valley has constructed a NURP/stormwater pond north of County Road 46 with a 60-inch storm sewer outlet that conveys flow to NCL-78.

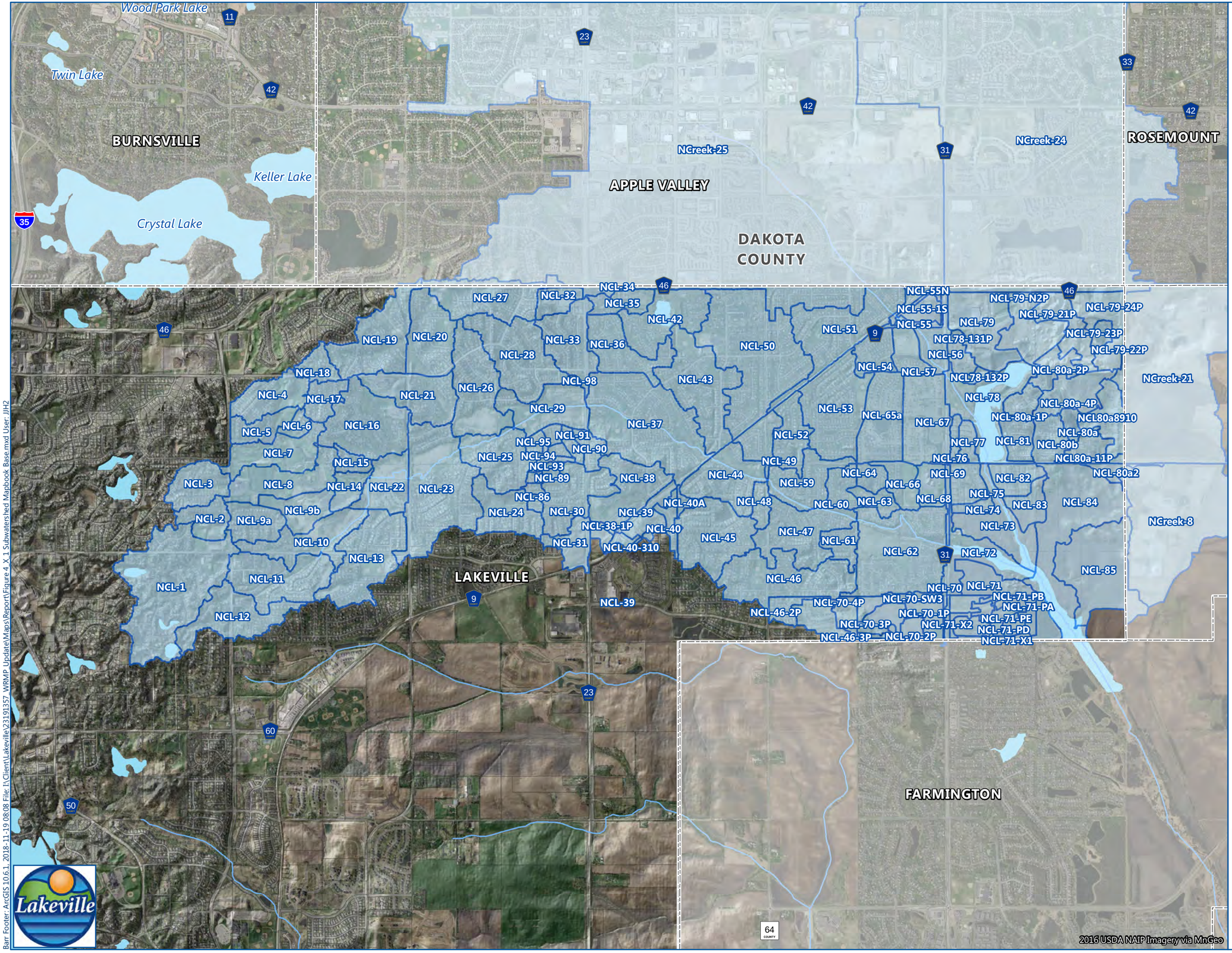
NCL-42: This watershed contains Valley Lake. When County Road 46 was re-constructed runoff from Apple Valley was rerouted away from Valley Lake to Apple Valley Pond WVR-443 (NCreek-25). From there the water travels back into Lakeville to NCL-78.

NCL-27, NCL-32, and NCL-34: Runoff from these subwatersheds drain north, across 160th Street into Apple Valley, where it travels through Apple Valley pond WVR-P50 and eventually to WVR-443 (NCreek-25). From there the water travels back into Lakeville to NCL-78.

NCL-7 and NCL-8: These subwatersheds reflect the drainage plan of the Crystal Lake Golf Course. Subwatershed NCL-8 may contain a fen, which is being protected.

NCL-22: This watershed is along North Creek upstream of Highview Avenue. The outlets are two box culverts below Highview Avenue. The 100-year flood elevation in NCL-22 is 983.7 which overtops Highview Avenue by approximately 1.4-feet. It is assumed that at the time maintenance to Highview Avenue is complete, alternatives to prevent Highview Avenue from overtopping will be considered.

NCL-29: This watershed is along North Creek upstream of Cedar Avenue. There are two culverts below Cedar Avenue. The 100-year flood elevation in NCL-29 is approximately 949.5 which overtops Cedar Avenue by approximately 1.5-feet. It is assumed that at the time maintenance to Cedar Avenue is complete, alternatives to prevent Cedar Avenue from overtopping will be considered.



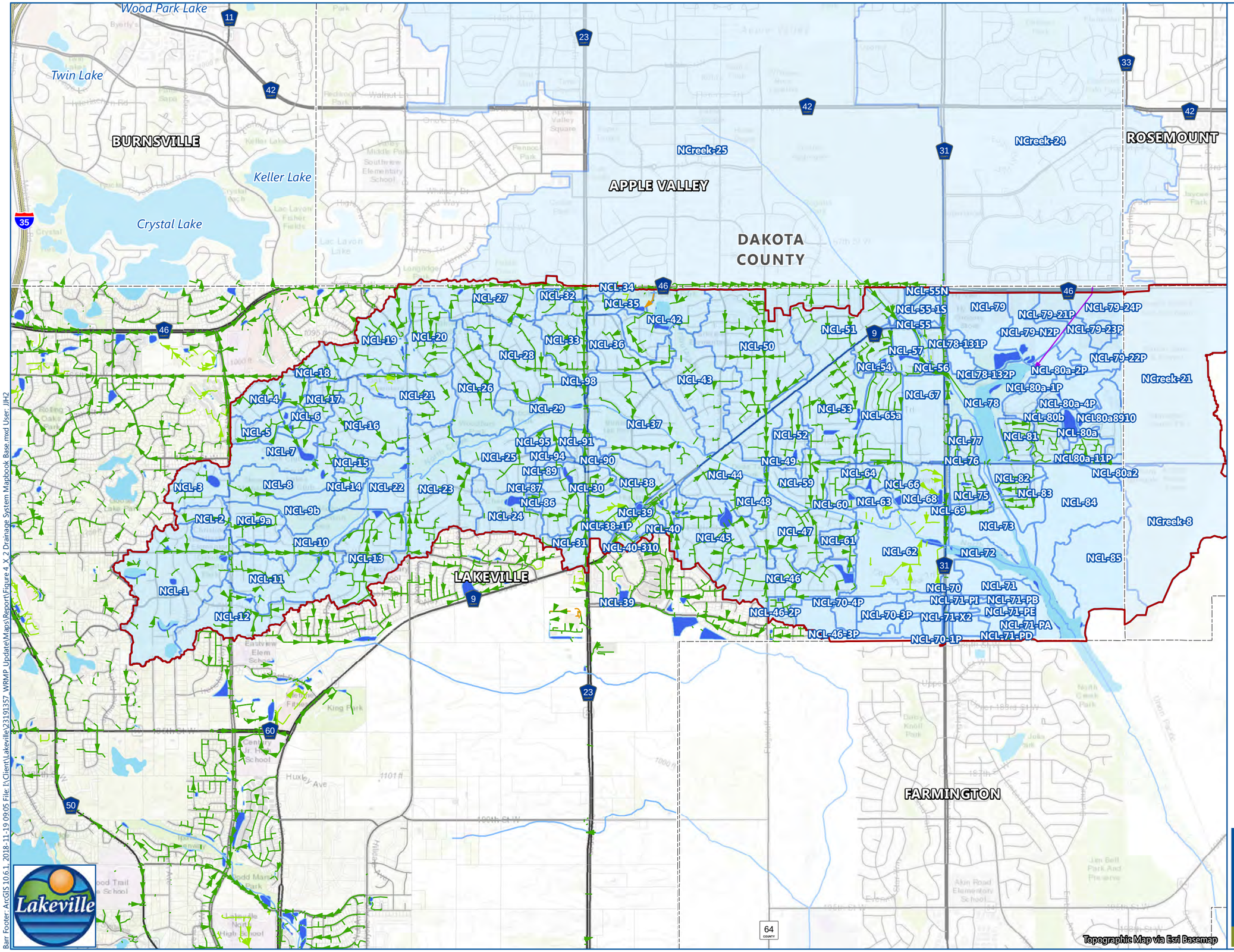
County Boundary
Municipal Boundary
Parcel Boundary
Subwatersheds
Public Water Inventory Watercourses
Public Water Inventory Basins

Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

1,000 0 1,000
Feet

NORTH CREEK SUBWATERSHEDS
Water and Natural Resources Management Plan
City of Lakeville

FIGURE A.4.1



County Boundary
Municipal Boundary
Parcel Boundary

Pipes

Forcemain
Storm Main
Private Storm Main
Drain Tile

Subwatersheds
Major Subwatersheds
Existing Pond
Public Water Inventory Watercourses
Public Water Inventory Basins

Major Watersheds, Ponds and Pipe data from the City of Lakeville. Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

N

1,000 0 1,000
Feet

NORTH CREEK
DRAINAGE SYSTEM
Water and Natural Resources
Management Plan
City of Lakeville

FIGURE A.4.2

Barr Footer: ArcGIS 10.6.1 2018-11-19 09:05 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 4_X_2 Drainage System Mapbook Base.mxd User: JH2

TABLE A.4.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION	MINIMUM INFILTRATION	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
NCL-1	197.7	24.20	1364	0.068	0.352	0.014	0.167	0.060	0.99	0.13	0.00110
NCL-10	66.2	17.60	653	0.049	0.334	0.014	0.173	0.060	1.13	0.08	0.00110
NCL-11	87.1	19.90	1110	0.071	0.333	0.014	0.171	0.060	1.11	0.12	0.00110
NCL-12	74.9	18.60	908	0.076	0.362	0.014	0.171	0.060	1.03	0.14	0.00110
NCL-13	99.3	25.60	1342	0.058	0.353	0.014	0.169	0.060	1.01	0.14	0.00110
NCL-14	20.9	2.60	503	0.070	0.270	0.014	0.165	0.060	1.53	0.03	0.00110
NCL-15	14.2	24.10	442	0.082	0.368	0.014	0.170	0.060	1.00	0.14	0.00110
NCL-16	97.1	20.60	1249	0.071	0.352	0.014	0.171	0.060	1.00	0.11	0.00110
NCL-17	25.4	25.50	566	0.047	0.380	0.014	0.169	0.060	1.00	0.09	0.00110
NCL-18	20.9	30.20	487	0.051	0.378	0.014	0.169	0.060	1.00	0.12	0.00110
NCL-19	91.5	23.10	1292	0.077	0.359	0.014	0.171	0.060	1.00	0.12	0.00110
NCL-2	31.1	24.40	730	0.052	0.342	0.014	0.169	0.060	0.96	0.13	0.00110
NCL-20	70.1	19.50	889	0.070	0.346	0.014	0.173	0.060	1.00	0.13	0.00110
NCL-21	68.7	26.40	694	0.073	0.328	0.014	0.170	0.060	1.00	0.12	0.00110
NCL-22	48.4	5.80	865	0.043	0.298	0.014	0.182	0.060	1.32	0.05	0.00110
NCL-23	149.4	21.80	1455	0.059	0.352	0.014	0.171	0.060	1.11	0.10	0.00110
NCL-24	53.3	25.20	1028	0.055	0.364	0.014	0.170	0.060	1.00	0.13	0.00110
NCL-25	67.7	16.90	1103	0.067	0.344	0.014	0.171	0.060	1.13	0.09	0.00110
NCL-26	90.9	19.00	989	0.055	0.350	0.014	0.171	0.060	1.07	0.11	0.00110
NCL-27	80.0	31.80	731	0.061	0.346	0.014	0.171	0.060	1.00	0.12	0.00110
NCL-28	97.1	23.10	1058	0.068	0.376	0.014	0.169	0.060	1.00	0.11	0.00110
NCL-29	64.2	12.60	987	0.043	0.300	0.014	0.172	0.060	1.12	0.09	0.00110
NCL-3	45.1	24.10	694	0.058	0.379	0.014	0.169	0.060	0.90	0.11	0.00110
NCL-30	67.1	28.70	966	0.062	0.375	0.014	0.169	0.060	1.00	0.11	0.00110
NCL-31	30.6	25.82	584	0.061	0.238	0.014	0.180	0.060	1.00	0.13	0.00110
NCL-32	21.4	54.70	516	0.092	0.231	0.014	0.172	0.060	1.00	0.14	0.00110
NCL-33	63.2	42.30	746	0.053	0.356	0.014	0.169	0.060	1.00	0.13	0.00110
NCL-34	8.0	82.70	355	0.027	0.182	0.014	0.173	0.060	1.00	0.14	0.00110
NCL-35	26.3	25.80	766	0.032	0.275	0.014	0.174	0.060	1.00	0.14	0.00110
NCL-36	60.7	26.10	681	0.024	0.380	0.014	0.169	0.060	1.00	0.14	0.00110
NCL-37	179.0	21.20	1504	0.048	0.353	0.014	0.171	0.060	1.00	0.14	0.00110
NCL-38	67.6	24.76	1129	0.055	0.266	0.014	0.170	0.060	1.00	0.12	0.00110
NCL-38-1P	1.0	0.00	104	0.057	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
NCL-38-3P	7.1	68.78	449	0.061	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
NCL-38-4P	0.8	0.00	97	0.083	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
NCL-39	25.3	33.17	726	0.065	0.279	0.014	0.180	0.060	1.00	0.13	0.00110
NCL-4	50.2	16.00	732	0.064	0.334	0.014	0.164	0.060	1.00	0.14	0.00110
NCL-40	16.8	29.89	640	0.055	0.272	0.014	0.180	0.060	1.00	0.13	0.00110
NCL-40-310	6.6	41.26	367	0.060	0.277	0.014	0.180	0.060	1.00	0.14	0.00110
NCL-40A	5.9	23.94	330	0.062	0.273	0.014	0.170	0.060	1.00	0.09	0.00110
NCL-42	74.5	23.50	1587	0.024	0.322	0.014	0.162	0.060	1.00	0.14	0.00110
NCL-43	105.1	21.20	988	0.035	0.360	0.014	0.170	0.060	1.00	0.14	0.00110
NCL-44	70.1	21.70	837	0.057	0.359	0.014	0.171	0.060	1.01	0.13	0.00110
NCL-45	89.6	26.16	1215	0.059	0.273	0.014	0.170	0.060	1.06	0.11	0.00110
NCL-46	105.1	19.80	1180	0.055	0.273	0.014	0.170	0.060	1.06	0.15	0.00110
NCL-46-2P	15.8	30.00	562	0.046	0.220	0.014	0.190	0.060	1.00	0.14	0.00110
NCL-46-3P	27.3	30.00	795	0.032	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
NCL-47	83.2	25.70	1141	0.050	0.376	0.014	0.169	0.060	1.16	0.16	0.00110

TABLE A.4.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION	MINIMUM INFILTRATION	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
NCL-48	14.3	29.20	383	0.049	0.358	0.014	0.171	0.060	1.00	0.14	0.00110
NCL-49	30.9	31.20	504	0.027	0.360	0.014	0.170	0.060	1.00	0.14	0.00110
NCL-5	29.2	28.20	493	0.067	0.325	0.014	0.163	0.060	1.07	0.13	0.00110
NCL-50	193.2	25.70	1629	0.021	0.350	0.014	0.169	0.060	1.00	0.14	0.00110
NCL-51	103.7	24.76	1031	0.033	0.272	0.014	0.170	0.060	1.00	0.14	0.00110
NCL-52	41.6	24.60	567	0.034	0.380	0.014	0.169	0.060	1.00	0.14	0.00110
NCL-53	106.3	22.40	1313	0.036	0.367	0.014	0.172	0.060	1.00	0.14	0.00110
NCL-54	30.6	0.70	930	0.015	0.213	0.014	0.200	0.060	1.00	0.14	0.00110
NCL-55	6.9	20.02	307	0.056	0.212	0.014	0.200	0.060	1.02	0.14	0.00110
NCL-55-1B	0.7	0.00	165	0.062	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
NCL-55-1P	1.5	79.92	219	0.047	0.221	0.014	0.190	0.060	1.00	0.14	0.00110
NCL-55-1S	15.7	50.77	718	0.061	0.220	0.014	0.190	0.060	1.18	0.16	0.00110
NCL-55-4S	3.4	17.54	274	0.062	0.216	0.014	0.200	0.060	1.28	0.18	0.00110
NCL-55N	7.2	22.49	243	0.049	0.258	0.014	0.180	0.060	1.03	0.14	0.00110
NCL-56	30.3	6.88	482	0.056	0.209	0.014	0.190	0.060	1.03	0.14	0.00110
NCL-57	26.1	0.00	623	0.014	0.300	0.014	0.197	0.060	1.00	0.14	0.00110
NCL-59	55.1	23.60	863	0.048	0.369	0.014	0.170	0.060	1.00	0.14	0.00110
NCL-6	10.6	9.10	522	0.079	0.318	0.014	0.162	0.060	1.00	0.08	0.00110
NCL-60	24.0	27.90	635	0.040	0.375	0.014	0.169	0.060	1.00	0.14	0.00110
NCL-61	22.5	25.60	533	0.031	0.377	0.014	0.169	0.060	1.00	0.14	0.00110
NCL-62	151.3	24.39	1561	0.026	0.251	0.014	0.170	0.060	1.01	0.12	0.00110
NCL-63	16.8	11.00	498	0.029	0.295	0.014	0.172	0.060	1.16	0.11	0.00110
NCL-64	15.3	21.10	598	0.040	0.368	0.014	0.170	0.060	1.00	0.14	0.00110
NCL-65a	71.7	0.00	1541	0.011	0.300	0.014	0.197	0.060	1.00	0.14	0.00110
NCL-66	28.0	13.00	677	0.026	0.306	0.014	0.170	0.060	1.00	0.14	0.00110
NCL-67	80.5	3.20	1136	0.012	0.297	0.014	0.195	0.060	1.00	0.14	0.00110
NCL-68	23.9	35.88	481	0.039	0.250	0.014	0.170	0.060	1.00	0.14	0.00110
NCL-69	6.1	70.81	260	0.052	0.244	0.014	0.170	0.060	1.00	0.13	0.00110
NCL-7	58.4	10.40	728	0.063	0.263	0.014	0.157	0.060	1.02	0.08	0.00110
NCL-70	2.9	17.01	146	0.033	0.231	0.014	0.180	0.060	1.00	0.14	0.00110
NCL-70-1P	25.5	46.03	919	0.022	0.232	0.014	0.190	0.060	1.04	0.14	0.00110
NCL-70-2P	14.0	46.19	460	0.038	0.227	0.014	0.190	0.060	1.06	0.15	0.00110
NCL-70-3P	22.6	40.51	653	0.050	0.229	0.014	0.190	0.060	1.09	0.15	0.00110
NCL-70-4P	18.5	0.00	804	0.082	0.212	0.014	0.200	0.060	1.12	0.15	0.00110
NCL-70-SW1	11.3	0.00	286	0.043	0.224	0.014	0.190	0.060	1.08	0.15	0.00110
NCL-70-SW2	2.8	0.00	136	0.013	0.219	0.014	0.190	0.060	1.00	0.14	0.00110
NCL-70-SW3	4.2	0.00	214	0.019	0.222	0.014	0.180	0.060	1.00	0.14	0.00110
NCL-71	53.9	0.08	831	0.019	0.201	0.014	0.170	0.060	1.00	0.13	0.00110
NCL-71-PA	9.3	0.00	593	0.016	0.212	0.014	0.200	0.060	1.00	0.13	0.00110
NCL-71-PB	6.6	0.00	293	0.012	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
NCL-71-PC	2.7	0.00	165	0.015	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
NCL-71-PD	7.8	0.00	430	0.013	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
NCL-71-PE	11.6	0.00	604	0.013	0.212	0.014	0.200	0.060	1.00	0.13	0.00110
NCL-71-PF	5.0	0.00	344	0.014	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
NCL-71-PG	13.0	0.00	620	0.017	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
NCL-71-PH	3.5	0.00	174	0.019	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
NCL-71-PI	10.1	0.00	499	0.015	0.233	0.014	0.180	0.060	1.00	0.14	0.00110
NCL-71-X1	2.4	0.00	128	0.031	0.219	0.014	0.190	0.060	1.00	0.06	0.00110

TABLE A.4.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION	MINIMUM INFILTRATION	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
NCL-71-X2	7.2	10.15	148	0.045	0.225	0.014	0.190	0.060	1.00	0.14	0.00110
NCL-72	52.2	5.21	618	0.032	0.243	0.014	0.190	0.060	1.06	0.10	0.00110
NCL-73	64.3	2.40	704	0.025	0.231	0.014	0.190	0.060	1.04	0.11	0.00110
NCL-74	9.8	22.70	279	0.042	0.274	0.014	0.179	0.060	1.00	0.13	0.00110
NCL-75	26.9	24.30	761	0.045	0.253	0.014	0.172	0.060	1.00	0.14	0.00110
NCL-76	9.9	31.90	250	0.037	0.253	0.014	0.173	0.060	1.00	0.14	0.00110
NCL-77	13.5	28.40	388	0.028	0.257	0.014	0.173	0.060	1.00	0.14	0.00110
NCL-78	93.7	44.27	1039	0.055	0.203	0.014	0.140	0.060	1.33	0.12	0.00110
NCL-79	76.9	0.00	832	0.108	0.159	0.014	0.140	0.060	1.27	0.17	0.00110
NCL-79-21P	45.5	0.00	1199	0.136	0.139	0.014	0.130	0.060	1.00	0.14	0.00110
NCL-79-22P	15.3	0.00	805	0.071	0.139	0.014	0.130	0.060	1.12	0.15	0.00110
NCL-79-23P	9.8	0.00	549	0.054	0.139	0.014	0.130	0.060	1.00	0.14	0.00110
NCL-79-24P	35.9	27.03	872	0.100	0.139	0.014	0.130	0.060	1.10	0.15	0.00110
NCL-79-N2P	54.7	0.00	1054	0.081	0.138	0.014	0.130	0.060	1.00	0.14	0.00110
NCL-8	66.3	14.00	855	0.047	0.276	0.014	0.168	0.060	1.10	0.09	0.00110
NCL-80a	10.0	0.00	426	0.074	0.168	0.014	0.150	0.060	1.19	0.16	0.00110
NCL-80a-1P	18.4	36.20	701	0.053	0.212	0.014	0.200	0.060	1.17	0.16	0.00110
NCL-80a-2P	25.6	35.97	959	0.159	0.159	0.014	0.150	0.060	1.00	0.14	0.00110
NCL-80a-4P	45.2	25.29	1018	0.069	0.186	0.014	0.180	0.060	1.06	0.15	0.00110
NCL-80a2	10.9	9.34	497	0.054	0.200	0.014	0.190	0.060	1.28	0.18	0.00110
NCL-80b	30.4	38.00	521	0.066	0.211	0.014	0.180	0.060	1.34	0.18	0.00110
NCL-81	24.8	1.95	1110	0.054	0.218	0.014	0.200	0.060	1.29	0.18	0.00110
NCL-82	28.4	23.10	600	0.046	0.255	0.014	0.174	0.060	1.06	0.15	0.00110
NCL-83	25.1	8.40	545	0.037	0.293	0.014	0.191	0.060	1.05	0.15	0.00110
NCL-84	154.1	1.14	1592	0.034	0.223	0.014	0.190	0.060	1.24	0.14	0.00110
NCL-85	122.3	0.20	1391	0.028	0.294	0.014	0.195	0.060	1.11	0.15	0.00110
NCL-86	4.9	27.50	391	0.066	0.380	0.014	0.169	0.060	1.00	0.09	0.00110
NCL-87	4.3	32.00	276	0.044	0.380	0.014	0.169	0.060	1.00	0.13	0.00110
NCL-88	3.7	31.20	289	0.050	0.380	0.014	0.169	0.060	1.00	0.13	0.00110
NCL-89	5.0	32.30	276	0.062	0.380	0.014	0.169	0.060	1.00	0.10	0.00110
NCL-90	15.6	50.10	492	0.063	0.277	0.014	0.169	0.060	1.03	0.14	0.00110
NCL-91	9.4	26.70	372	0.055	0.340	0.014	0.170	0.060	1.20	0.17	0.00110
NCL-92	6.7	25.40	449	0.028	0.341	0.014	0.170	0.060	1.05	0.11	0.00110
NCL-93	2.5	18.70	250	0.082	0.380	0.014	0.169	0.060	1.00	0.10	0.00110
NCL-94	5.9	33.00	380	0.075	0.373	0.014	0.169	0.060	1.00	0.12	0.00110
NCL-95	7.1	20.60	435	0.049	0.318	0.014	0.170	0.060	1.15	0.03	0.00110
NCL-96	4.7	14.60	345	0.053	0.322	0.014	0.170	0.060	1.10	0.10	0.00110
NCL-97	1.1	42.10	148	0.053	0.358	0.014	0.169	0.060	1.00	0.07	0.00110
NCL-98	1.9	20.30	234	0.047	0.273	0.014	0.169	0.060	1.00	0.09	0.00110
NCL-9a	38.4	24.00	717	0.059	0.367	0.014	0.170	0.060	1.00	0.13	0.00110
NCL-9b	38.0	3.80	725	0.040	0.280	0.014	0.176	0.060	1.40	0.05	0.00110
NCL78-131P	18.0	36.59	622	0.050	0.224	0.014	0.190	0.060	1.15	0.16	0.00110
NCL78-132P	5.1	0.00	282	0.106	0.279	0.014	0.180	0.060	1.31	0.18	0.00110
NCL80a-11P	25.8	37.48	435	0.047	0.224	0.014	0.190	0.060	1.20	0.17	0.00110
NCL80a8910	40.1	36.59	735	0.066	0.211	0.014	0.200	0.060	1.29	0.18	0.00110

TABLE A.4.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
NCL-1	197.7	1.1	151.7	1.4	191	2.6	338	4.6	557	5.7	670
NCL-10	66.2	1.2	45	1.6	57	2.9	102	4.9	170	6.0	205
NCL-11	87.1	1.2	73	1.5	92	2.8	164	4.8	276	5.9	334
NCL-12	74.9	1.1	58	1.3	73	2.6	130	4.6	219	5.6	266
NCL-13	99.3	1.3	96	1.6	121	2.8	213	4.8	353	5.9	424
NCL-14	20.9	1.5	12	1.9	16	3.3	32	5.4	57	6.5	70
NCL-15	14.2	1.4	17	1.7	22	3.0	39	5.0	66	6.1	79
NCL-16	97.1	1.2	83	1.5	104	2.8	186	4.8	310	5.9	375
NCL-17	25.4	1.5	28	1.8	35	3.1	62	5.2	102	6.3	122
NCL-18	20.9	1.5	26	1.8	33	3.2	58	5.2	95	6.3	113
NCL-19	91.5	1.3	88	1.6	110	2.9	196	4.9	325	6.0	392
NCL-2	31.1	1.3	34	1.7	43	3.0	76	5.0	127	6.1	153
NCL-20	70.1	1.1	57	1.4	72	2.6	127	4.7	215	5.7	260
NCL-21	68.7	1.3	65	1.6	82	2.9	145	4.9	240	6.0	288
NCL-22	48.4	1.3	21	1.6	27	3.0	54	5.0	100	6.1	125
NCL-23	149.4	1.2	119	1.5	149	2.8	265	4.8	438	5.9	527
NCL-24	53.3	1.3	56	1.6	71	2.9	125	5.0	207	6.0	249
NCL-25	67.7	1.2	54	1.6	69	2.9	125	5.0	212	6.0	257
NCL-26	90.9	1.1	67	1.4	85	2.7	151	4.7	251	5.8	303
NCL-27	80.0	1.4	79	1.7	100	3.0	177	5.0	290	6.1	348
NCL-28	97.1	1.2	84	1.5	106	2.8	187	4.8	308	5.9	370
NCL-29	64.2	1.1	40	1.5	51	2.8	94	4.8	163	5.9	200
NCL-3	45.1	1.3	44	1.6	55	2.9	97	5.0	160	6.1	192
NCL-30	67.1	1.4	73	1.7	91	3.0	160	5.1	263	6.2	314
NCL-31	30.6	1.4	35	1.7	45	3.0	81	5.1	137	6.2	165
NCL-32	21.4	2.2	47	2.5	59	3.9	102	6.0	161	7.1	189
NCL-33	63.2	1.7	80	2.1	101	3.4	178	5.4	289	6.5	346
NCL-34	8.0	2.9	23	3.2	29	4.6	48	6.8	73	7.9	85
NCL-35	26.3	1.4	30	1.7	38	3.0	69	5.0	116	6.1	140
NCL-36	60.7	1.2	48	1.4	60	2.6	106	4.6	174	5.7	209
NCL-37	179.0	1.0	127	1.3	160	2.5	281	4.4	466	5.5	562
NCL-38	67.6	1.4	71	1.7	90	3.0	162	5.1	271	6.2	327
NCL-38-1P	1.0	0.9	1	1.2	1	2.4	3	4.4	5	5.5	6
NCL-38-3P	7.1	2.5	21	2.9	27	4.3	44	6.4	67	7.5	77
NCL-38-4P	0.8	0.9	1	1.2	1	2.5	3	4.5	5	5.5	5
NCL-39	25.3	1.6	38	2.0	48	3.3	87	5.4	142	6.4	169
NCL-4	50.2	1.0	36	1.3	46	2.5	83	4.6	143	5.6	175
NCL-40	16.8	1.6	25	1.9	32	3.2	58	5.3	95	6.4	113
NCL-40-310	6.6	1.9	14	2.2	17	3.5	30	5.6	48	6.7	56
NCL-40A	5.9	1.6	9	1.9	12	3.3	21	5.4	35	6.5	41
NCL-42	74.5	1.2	69	1.5	87	2.8	154	4.8	258	5.9	312
NCL-43	105.1	1.0	73	1.3	92	2.4	162	4.4	268	5.5	323
NCL-44	70.1	1.1	58	1.4	73	2.6	129	4.7	215	5.7	259
NCL-45	89.6	1.4	92	1.7	116	3.0	209	5.1	347	6.2	418
NCL-46	105.1	1.1	82	1.4	104	2.6	186	4.6	316	5.7	385
NCL-46-2P	15.8	1.5	23	1.9	30	3.2	54	5.2	90	6.3	107
NCL-46-3P	27.3	1.5	36	1.8	46	3.1	84	5.2	140	6.3	168

TABLE A.4.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
NCL-47	83.2	1.2	78	1.5	99	2.7	172	4.7	284	5.7	342
NCL-48	14.3	1.4	18	1.8	23	3.0	40	5.1	66	6.2	79
NCL-49	30.9	1.4	32	1.7	40	2.9	71	5.0	116	6.1	139
NCL-5	29.2	1.4	33	1.7	42	3.0	75	5.1	124	6.2	148
NCL-50	193.2	1.1	132	1.4	167	2.5	296	4.4	489	5.5	589
NCL-51	103.7	1.2	82	1.5	104	2.7	186	4.7	311	5.8	376
NCL-52	41.6	1.2	36	1.5	45	2.7	79	4.7	130	5.8	157
NCL-53	106.3	1.1	84	1.4	106	2.6	187	4.6	309	5.6	372
NCL-54	30.6	0.6	8	0.9	12	2.1	30	4.1	63	5.2	80
NCL-55	6.9	1.3	9	1.6	11	2.9	22	5.0	37	6.0	45
NCL-55-1B	0.7	0.9	1	1.2	2	2.5	3	4.5	5	5.6	6
NCL-55-1P	1.5	2.8	6	3.2	7	4.6	11	6.7	16	7.8	18
NCL-55-1S	15.7	2.1	36	2.4	46	3.7	80	5.8	126	6.9	147
NCL-55-4S	3.4	1.2	5	1.5	6	2.7	13	4.8	22	5.8	26
NCL-55N	7.2	1.3	8	1.6	11	2.9	20	5.0	34	6.0	41
NCL-56	30.3	0.8	13	1.1	18	2.3	38	4.3	74	5.4	93
NCL-57	26.1	0.5	4	0.7	6	1.9	17	3.8	36	4.9	47
NCL-59	55.1	1.2	51	1.5	64	2.7	113	4.8	187	5.8	226
NCL-6	10.6	1.3	9	1.6	13	3.0	26	5.0	45	6.1	55
NCL-60	24.0	1.4	28	1.7	35	3.0	62	5.0	103	6.1	124
NCL-61	22.5	1.3	23	1.6	29	2.8	52	4.9	85	6.0	103
NCL-62	151.3	1.2	117	1.5	148	2.8	267	4.8	447	5.9	541
NCL-63	16.8	1.1	11	1.4	14	2.7	27	4.7	49	5.8	60
NCL-64	15.3	1.3	16	1.6	21	2.8	38	4.9	64	6.0	77
NCL-65a	71.7	0.4	10	0.7	14	1.8	38	3.7	84	4.8	111
NCL-66	28.0	1.0	18	1.2	23	2.5	43	4.5	75	5.6	93
NCL-67	80.5	0.5	14	0.7	19	1.7	38	3.6	76	4.7	101
NCL-68	23.9	1.6	32	1.9	41	3.2	72	5.3	119	6.4	143
NCL-69	6.1	2.6	17	2.9	21	4.3	36	6.5	55	7.6	64
NCL-7	58.4	1.1	33	1.4	42	2.8	81	4.8	143	5.9	176
NCL-70	2.9	1.2	3	1.5	4	2.8	8	4.9	14	5.9	17
NCL-70-1P	25.5	1.9	44	2.2	56	3.6	100	5.7	162	6.8	191
NCL-70-2P	14.0	1.9	26	2.3	33	3.6	58	5.7	94	6.8	111
NCL-70-3P	22.6	1.8	38	2.1	49	3.4	87	5.5	141	6.6	168
NCL-70-4P	18.5	0.8	12	1.0	17	2.3	39	4.3	74	5.3	91
NCL-70-SW1	11.3	0.6	4	0.9	5	2.1	14	4.1	27	5.2	35
NCL-70-SW2	2.8	0.7	1	1.0	1	2.2	4	4.2	7	5.3	9
NCL-70-SW3	4.2	0.7	2	1.0	3	2.3	6	4.3	12	5.4	15
NCL-71	53.9	0.6	11	0.8	15	2.0	39	4.0	81	5.1	105
NCL-71-PA	9.3	0.8	5	1.1	7	2.4	16	4.4	30	5.4	37
NCL-71-PB	6.6	0.7	2	1.0	3	2.2	8	4.2	16	5.3	20
NCL-71-PC	2.7	0.7	1	1.0	2	2.3	4	4.3	8	5.4	10
NCL-71-PD	7.8	0.7	3	1.0	5	2.2	11	4.3	22	5.3	27
NCL-71-PE	11.6	0.7	5	1.0	7	2.3	16	4.3	31	5.4	39
NCL-71-PF	5.0	0.8	2	1.0	4	2.3	8	4.3	16	5.4	20
NCL-71-PG	13.0	0.7	5	1.0	8	2.3	19	4.3	36	5.3	45
NCL-71-PH	3.5	0.7	1	1.0	2	2.3	5	4.3	10	5.3	13

TABLE A.4.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
NCL-71-PI	10.1	0.7	4	1.0	5	2.2	13	4.2	26	5.3	33
NCL-71-X1	2.4	1.2	2	1.5	2	2.9	5	4.9	9	6.0	11
NCL-71-X2	7.2	0.9	4	1.2	6	2.5	11	4.5	21	5.6	26
NCL-72	52.2	0.8	16	1.1	21	2.3	42	4.3	81	5.4	102
NCL-73	64.3	0.6	11	0.9	15	2.1	38	4.1	81	5.2	105
NCL-74	9.8	1.3	11	1.6	14	2.9	25	5.0	42	6.0	51
NCL-75	26.9	1.4	31	1.7	40	3.0	73	5.0	124	6.1	149
NCL-76	9.9	1.5	13	1.9	17	3.2	30	5.2	49	6.3	59
NCL-77	13.5	1.4	16	1.8	21	3.0	37	5.1	62	6.2	75
NCL-78	93.7	1.9	126	2.2	160	3.5	289	5.6	476	6.7	570
NCL-79	76.9	0.6	25	0.9	36	2.0	87	4.0	179	5.0	227
NCL-79-21P	45.5	0.9	37	1.2	51	2.5	111	4.5	200	5.5	244
NCL-79-22P	15.3	0.9	15	1.2	21	2.4	45	4.4	78	5.5	95
NCL-79-23P	9.8	0.9	10	1.2	13	2.5	28	4.5	49	5.6	59
NCL-79-24P	35.9	1.5	56	1.8	73	3.1	135	5.2	222	6.3	264
NCL-79-N2P	54.7	0.8	31	1.1	43	2.4	96	4.4	180	5.5	224
NCL-8	66.3	1.1	43	1.5	55	2.8	101	4.8	173	5.9	212
NCL-80a	10.0	0.8	7	1.1	10	2.3	23	4.3	43	5.4	53
NCL-80a-1P	18.4	1.7	31	2.0	40	3.3	73	5.3	119	6.4	141
NCL-80a-2P	25.6	1.8	57	2.1	73	3.4	129	5.5	201	6.6	236
NCL-80a-4P	45.2	1.4	56	1.7	73	3.0	136	5.0	231	6.1	277
NCL-80a2	10.9	0.9	9	1.2	12	2.4	26	4.4	49	5.5	60
NCL-80b	30.4	1.6	44	1.9	55	3.2	99	5.2	165	6.3	198
NCL-81	24.8	0.7	13	1.0	19	2.2	45	4.2	89	5.2	111
NCL-82	28.4	1.3	29	1.6	37	2.8	68	4.9	115	6.0	140
NCL-83	25.1	0.8	12	1.1	15	2.3	31	4.3	58	5.4	73
NCL-84	154.1	0.5	24	0.7	35	1.9	92	3.8	200	4.8	261
NCL-85	122.3	0.4	14	0.6	21	1.7	57	3.6	128	4.6	170
NCL-86	4.9	1.7	8	2.0	11	3.4	19	5.4	31	6.5	37
NCL-87	4.3	1.6	7	2.0	9	3.3	16	5.4	26	6.5	30
NCL-88	3.7	1.6	6	1.9	8	3.3	14	5.3	23	6.4	28
NCL-89	5.0	1.7	8	2.0	11	3.4	19	5.5	31	6.6	36
NCL-90	15.6	2.1	32	2.4	40	3.7	70	5.8	111	6.9	131
NCL-91	9.4	1.4	12	1.7	16	2.9	28	5.0	47	6.1	57
NCL-92	6.7	1.5	9	1.8	12	3.2	22	5.2	36	6.3	43
NCL-93	2.5	1.5	4	1.8	5	3.1	9	5.2	15	6.3	18
NCL-94	5.9	1.7	11	2.0	14	3.4	24	5.5	39	6.6	46
NCL-95	7.1	1.9	11	2.3	14	3.7	24	5.8	38	6.9	46
NCL-96	4.7	1.3	5	1.6	7	3.0	14	5.1	24	6.1	29
NCL-97	1.1	2.1	3	2.5	4	3.8	6	6.0	9	7.1	11
NCL-98	1.9	1.5	3	1.9	4	3.2	8	5.3	13	6.4	15
NCL-9a	38.4	1.3	39	1.6	49	2.9	87	4.9	145	6.0	174
NCL-9b	38.0	1.3	14	1.6	19	3.0	40	5.1	76	6.2	96
NCL78-131P	18.0	1.7	30	2.0	38	3.3	69	5.3	112	6.4	133
NCL78-132P	5.1	0.7	3	1.0	5	2.2	11	4.2	21	5.2	26
NCL80a-11P	25.8	1.6	34	1.9	44	3.2	78	5.2	130	6.3	156
NCL80a8910	40.1	1.6	57	1.9	73	3.2	131	5.2	218	6.3	261

TABLE A.4.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
NCL-1	Multiple Links*	1063.0	1070.1	9	1071.5	10	1075.2	46	1076.2	175	1076.5	252
NCL-2	LNCRK-255	1085.0	1087.4	13	1087.7	16	1089.3	23	1091.1	29	1091.7	31
NCL-3	Multiple Links*	1081.6	1085.1	25	1085.4	40	1086.2	78	1086.4	135	1086.5	164
NCL-4	Multiple Links*	1031.0	1033.2	26	1033.7	31	1035.2	70	1035.4	192	1035.5	222
NCL-5	Multiple Links*	1021.0	1023.9	31	1024.7	35	1027.4	70	1027.9	233	1028.0	292
NCL-6	Multiple Links*	1019.0	1021.8	33	1022.3	37	1023.4	78	1024.3	258	1024.5	329
NCL-7	LNCRK-168	1012.0	1014.7	6	1015.2	8	1016.4	17	1017.3	22	1017.6	23
NCL-8	LNCRK-31	998.0	998.9	47	999.0	61	999.3	125	1000.1	401	1000.4	537
NCL-9a	LNCRK-272	1035.9	1036.5	36	1036.5	46	1036.7	81	1036.8	135	1036.8	163
NCL-9b	LNCRK-214	988.6	991.6	88	991.9	112	993.0	226	994.7	525	995.4	700
NCL-10	L-1156	991.4	997.0	77	997.6	105	998.0	245	998.3	467	998.4	593
NCL-11	L-1154	1025.8	1028.2	44	1028.5	56	1029.7	112	1032.4	264	1032.7	347
NCL-12	LNCRK-265	1060.5	1062.6	13	1063.1	18	1064.6	46	1065.1	124	1065.3	169
NCL-13	LNCRK-249	996.0	997.1	80	997.6	100	998.0	170	998.4	282	998.5	344
NCL-14	LNCRK-2426	983.2	984.0	178	984.1	229	984.5	518	984.9	998	985.2	1341
NCL-15	LNCRK-273	991.3	991.7	10	991.7	14	991.9	28	992.1	51	992.2	63
NCL-16	LNCRK-278	981.9	983.1	57	983.2	73	983.7	137	984.2	238	984.4	291
NCL-17	Multiple Links*	1046.2	1047.6	22	1047.8	28	1051.8	41	1054.1	50	1054.9	53
NCL-18	Multiple Links*	1051.6	1052.9	21	1053.1	26	1057.0	40	1061.8	47	1062.8	54
NCL-19	Multiple Links*	997.9	1001.7	65	1002.0	74	1003.1	102	1005.1	125	1005.9	153
NCL-20	LNCRK-276	987.4	989.6	64	990.0	80	991.1	138	992.9	183	993.9	204
NCL-21	Multiple Links*	968.0	971.3	78	971.7	95	973.5	150	975.7	210	976.0	262
NCL-22	LNCRK-244	974.3	979.4	174	979.9	212	982.1	367	983.5	1125	983.7	1548
NCL-23	LNCRK-245	960.9	963.4	190	963.5	235	963.8	417	964.6	1247	964.9	1719
NCL-24	Multiple Links*	1007.5	1008.9	7	1009.2	9	1010.4	19	1011.5	68	1011.6	99
NCL-25	L-1147	947.1	954.1	248	954.5	311	954.9	664	955.7	1577	955.9	2076
NCL-26	LNCRK-241	953.3	954.4	93	954.5	111	954.8	201	955.6	453	955.7	422
NCL-27	Multiple Links*	944.1	952.4	75	954.0	80	956.7	99	957.1	253	957.2	305
NCL-28	Multiple Links*	944.8	948.2	71	948.9	88	952.3	151	954.8	244	955.1	295
NCL-29	L-1136	939.0	945.1	229	945.9	288	948.5	560	949.2	1771	949.5	2594
NCL-30	Multiple Links*	969.5	972.5	28	973.2	35	975.4	108	975.7	225	975.8	293
NCL-31	LNCRK-103	996.3	997.7	29	997.9	36	1002.6	55	1004.2	58	1004.9	60
NCL-32	Multiple Links*	949.1	953.6	28	954.0	28	955.3	29	956.5	31	956.8	43
NCL-33	Multiple Links*	940.5	945.1	73	945.9	90	948.5	153	949.3	224	949.6	235
NCL-34	Multiple Links*	936.0	938.7	0	938.8	0	939.0	0	939.5	0	939.5	0
NCL-35	Multiple Links*	936.9	938.8	19	939.1	24	939.9	46	940.1	93	940.7	113
NCL-36	Multiple Links*	934.3	937.4	43	937.9	53	939.9	85	942.2	112	942.6	129
NCL-37	L-1128	930.4	934.1	239	934.7	300	936.3	566	940.3	1415	941.4	1891
NCL-38	Multiple Links*	975.9	978.3	14	978.9	16	981.7	20	982.7	110	982.8	174
NCL-39	Multiple Links*	970.0	974.3	22	975.5	23	977.5	40	978.1	166	978.4	255
NCL-40	Multiple Links*	964.1	966.3	14	966.7	17	967.2	19	967.9	28	968.3	43
NCL-42	LNCRK-227	934.5	935.6	4	935.9	5	936.9	8	939.7	164	940.7	275

TABLE A.4.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
NCL-43	L-1130	928.0	933.5	241	934.4	302	936.1	573	940.2	1289	941.3	1493
NCL-44	Multiple Links*	925.4	932.4	264	933.4	330	933.8	625	934.3	1478	934.4	1740
NCL-45	Multiple Links*	942.0	944.5	24	945.0	30	946.8	57	948.1	270	948.6	413
NCL-46	Multiple Links*	923.6	925.3	11	925.7	14	927.4	25	930.3	38	931.1	65
NCL-47	Multiple Links*	921.6	923.9	15	924.3	18	925.8	36	928.7	66	930.2	100
NCL-48	Multiple Links*	928.2	929.9	14	930.6	18	933.8	31	934.4	54	934.5	65
NCL-49	Multiple Links*	925.1	929.8	110	930.3	124	931.1	151	933.1	187	933.4	239
NCL-50	LNCRK-224	927.2	933.4	93	934.6	101	936.0	112	937.1	116	937.5	123
NCL-51	Multiple Links*	926.5	928.4	48	928.6	59	929.3	99	930.3	146	930.8	168
NCL-52	LNCRK-168	924.8	926.1	6	926.3	8	927.4	17	929.6	22	930.5	23
NCL-53	LNCRK-262	924.8	926.2	7	926.5	10	927.8	16	929.3	19	929.7	29
NCL-54	LNCRK-290	924.3	927.1	9	928.1	11	930.4	15	931.2	16	931.5	16
NCL-55	LNCRK-220	925.0	926.8	24	927.1	29	927.8	53	929.1	88	929.8	103
NCL-56	LNCRK-221	922.9	925.2	31	925.6	39	927.3	54	929.0	67	929.7	70
NCL-57	LNCRK-296	924.0	925.2	12	925.6	16	927.3	28	929.0	46	929.7	56
NCL-59	Multiple Links*	921.3	923.9	11	924.3	15	925.8	25	928.7	76	930.2	216
NCL-60	LNCRK-254	922.0	922.3	17	922.4	22	922.5	43	922.8	76	923.5	93
NCL-61	Multiple Links*	920.3	921.9	20	922.1	25	923.0	44	926.3	84	926.9	126
NCL-62	Multiple Links*	915.6	918.7	96	919.1	120	920.4	229	923.0	478	923.6	528
NCL-63	LNCRK-257	916.5	919.4	8	919.8	9	921.1	25	922.8	61	923.6	74
NCL-64	LNCRK-263	920.5	920.9	9	920.9	12	921.1	19	922.8	38	923.5	49
NCL-65a	LNCRK-286	922.0	924.8	5	925.0	9	925.6	21	926.3	27	926.7	33
NCL-66	LNCRK-261	919.5	920.2	5	920.3	8	921.1	21	922.8	42	923.6	52
NCL-67	LNCRK-287	924.5	924.9	8	925.0	11	925.5	28	926.3	37	926.7	46
NCL-68	LNCRK-184	918.5	919.6	4	919.8	5	920.6	7	922.5	9	922.7	9
NCL-69	LNCRK-188	917.4	918.7	13	919.1	17	920.4	29	922.8	44	923.1	51
NCL-70-1P	Multiple Links*	915.7	916.6	13	916.9	17	917.8	35	919.0	105	919.2	156
NCL-71	LNCRK-271	911.6	913.5	15	913.8	18	914.5	33	915.7	100	915.9	101
NCL-72	L-1125	914.0	917.2	297	917.4	376	918.2	727	919.1	1497	919.4	1697
NCL-73	LNCRK-314	914.9	917.2	70	917.4	81	918.2	96	919.1	152	919.4	203
NCL-74	Multiple Links*	917.0	918.2	3	918.4	3	919.2	4	920.6	5	921.0	9
NCL-75	LNCRK-189	918.5	920.1	3	920.5	4	921.7	5	922.8	5	923.2	6
NCL-76	Multiple Links*	918.2	919.9	12	920.2	16	920.4	30	921.0	43	921.5	50
NCL-77	Multiple Links*	917.8	919.9	19	920.2	24	920.4	43	920.7	68	921.2	80
NCL-78	L-1171	917.3	919.9	70	920.2	81	920.4	96	920.7	110	920.9	116
NCL-79	Multiple Links*	916.8	917.9	0	918.3	0	920.3	1	922.3	2	923.0	37
NCL-79-23P	Link6034	914.0	915.3	0	915.7	0	917.0	0	919.1	1	920.2	4
NCL-80a-4P	Multiple Links*	914.3	916.3	4	916.6	9	916.9	51	918.8	142	919.8	191
NCL-80b	Multiple Links*	915.0	916.5	10	917.0	12	918.6	22	920.1	76	920.3	109
NCL-81	LNCRK-195	918.8	920.4	5	920.9	6	922.3	8	923.7	10	924.3	10
NCL-82	Multiple Links*	918.5	920.1	6	920.3	12	920.8	37	920.9	91	920.9	116
NCL-83	Multiple Links*	918.0	919.5	6	920.0	7	921.4	15	921.6	50	921.7	65

TABLE A.4.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
NCL-84	L-1584	910.1	912.4	303	912.7	390	913.5	795	914.2	1622	914.4	1895
NCL-85	LNCRK-316	912.0	913.1	42	913.3	62	914.0	155	915.2	344	915.4	453
NCL-86	Multiple Links*	1002.7	1003.7	11	1003.8	12	1005.6	21	1007.3	83	1007.5	117
NCL-87	Multiple Links*	1001.1	1002.6	16	1002.7	19	1004.3	29	1006.6	104	1006.7	141
NCL-88	Multiple Links*	997.0	998.9	21	999.3	25	1002.2	35	1006.3	65	1006.5	92
NCL-89	Multiple Links*	973.8	974.9	28	975.1	33	978.5	48	978.6	82	978.7	125
NCL-90	LNCRK-506	960.6	961.4	11	961.5	14	962.0	24	962.7	28	963.2	28
NCL-91	LNCRK-500	948.4	949.6	10	949.8	12	953.3	22	955.8	26	956.5	28
NCL-92	Multiple Links*	946.5	950.1	71	950.5	78	954.3	154	955.6	329	956.0	419
NCL-93	Multiple Links*	963.0	965.2	45	967.4	79	967.8	153	968.2	289	968.5	368
NCL-94	Multiple Links*	958.9	961.5	52	965.8	59	966.4	135	966.8	284	966.9	369
NCL-95	Multiple Links*	950.8	953.4	11	955.1	12	956.3	25	956.4	41	956.5	48
NCL-96	Multiple Links*	951.2	954.8	55	956.7	64	957.3	157	957.9	317	958.1	407
NCL-97	Multiple Links*	953.9	954.4	2	955.6	3	957.9	4	959.0	7	959.1	8

*Discharge rates reported are the sum of peak flow rates of all downstream conduits

A.5 SOUTH CREEK DISTRICT

The South Creek District extends from the southern boundary of the City northward to between 215th Street and 185th Street. The district lies within the Vermillion River Watershed, which is managed by the VRWJPO. Drainage from the South Creek District flows into the Vermillion River, which discharges to the Mississippi River.

Runoff from the majority of this district flows in channels to the Vermillion River. Runoff from 76 acres in the southwest corner of the City flows to the southwest, into the Credit River Township. This area also eventually discharges to the Vermillion River.

There are three main channels within this district that outlet to the east into the City of Farmington. The main channel is South Creek, which exits the City through Subwatershed SC-173. The other two channels exit the City just north and south of the main channel, the South Branch of South Creek (i.e., Tributary 1 to South Creek) through Subwatershed SC-204 and the East Branch of South Creek through Subwatershed SC-175.

Runoff from approximately 7,940 acres (not including tributary area to Lake Marion) is tributary to the South Creek channel. North Branch of South Creek begins north of 192nd Street between Dodd Boulevard and Kenwood Trail. North Branch of South Creek then flows to the southeast, past the Lakeville North High School and City Hall, and flows just east of the downtown area between Aronson Park and Upper 206th Street. A long section adjacent to Upper 206th Street was improved in 1988 by the City to reduce flooding. The West Branch begins west of I-35 near the City boundary with New Market Township. The West Branch flows through Airlake Industrial Park and joins North Branch of South Creek just south of County Highway 50 between Hamburg Avenue and Cedar Avenue. The Marion Branch of South Creek directs the outflow from Lake Marion to the southeast and enters the West Branch south of Highway 50, west of Holyoke Avenue.

The South Creek District is primarily residential, industrial, and agricultural or open fields. The watershed divides of the South Creek District are shown on Figure A.5.1. The drainage system is shown in greater detail on Figure A.5.2.

A.5.1 Flood Protection

For each subwatershed and storage pond, peak runoff rates, flood levels, flood discharges, and storage volumes were calculated using the XP-SWMM model. The results of the modeling are shown in the following tables:

Table A.5.1 Hydrologic Parameters - Existing Conditions—(subwatershed data)

A.5.2 Subwatershed Pond Descriptions

The subwatersheds described in the following sections have unique characteristics or significant alterations that could be considered at the time of future development occurs.

SC-173: The section of South Creek located in this subwatershed has been designated by the MDNR as a trout stream.. A roadway that would cross South Creek at this location is planned. Culverts installed under the road would be sized to store large storm events and control the rate of release.

SC-182: The section of South Creek located in this subwatershed has been designated by the MDNR as a trout stream.

SC-187: SC-187 is located southwest of 215th Street near the Lakeville municipal boarder. The existing 100-year flood level overtops 215th Street by 1.8 foot.

When future development occurs additional storage in the watershed may be considered to prevent 215th Street from overtopping.

SC-038: The existing overflow for Pond SC-27-1 is to the north in the drainage swale west of I-35. Overflow in this swale drains to pond SC-037.

Construction of a pond may be considered in this subwatershed when future development occurs to reduce the peak flow rates downstream.

SC-001: SC-001 is a low area located between I-35 and Keokuk Avenue. When future development occurs a pond may be considered west of Keokuk Avenue, to reduce the 100-year peak flow rate. Keokuk Avenue is currently a gravel road and may also be raised by at least 1 foot when future development occurs.

SC-118: Outflow from Lake Marion enters this subwatershed, which is the upstream end of the Marion Branch of South Creek. Prior to 1994, the Marion Branch flowed east through a channel and storm sewer system through downtown to the confluence with the West Branch of South Creek in Subwatershed SC-183. The high flows through the downtown storm sewer system placed portions of the downtown area in the floodplain. In 1994, a new storm sewer system was

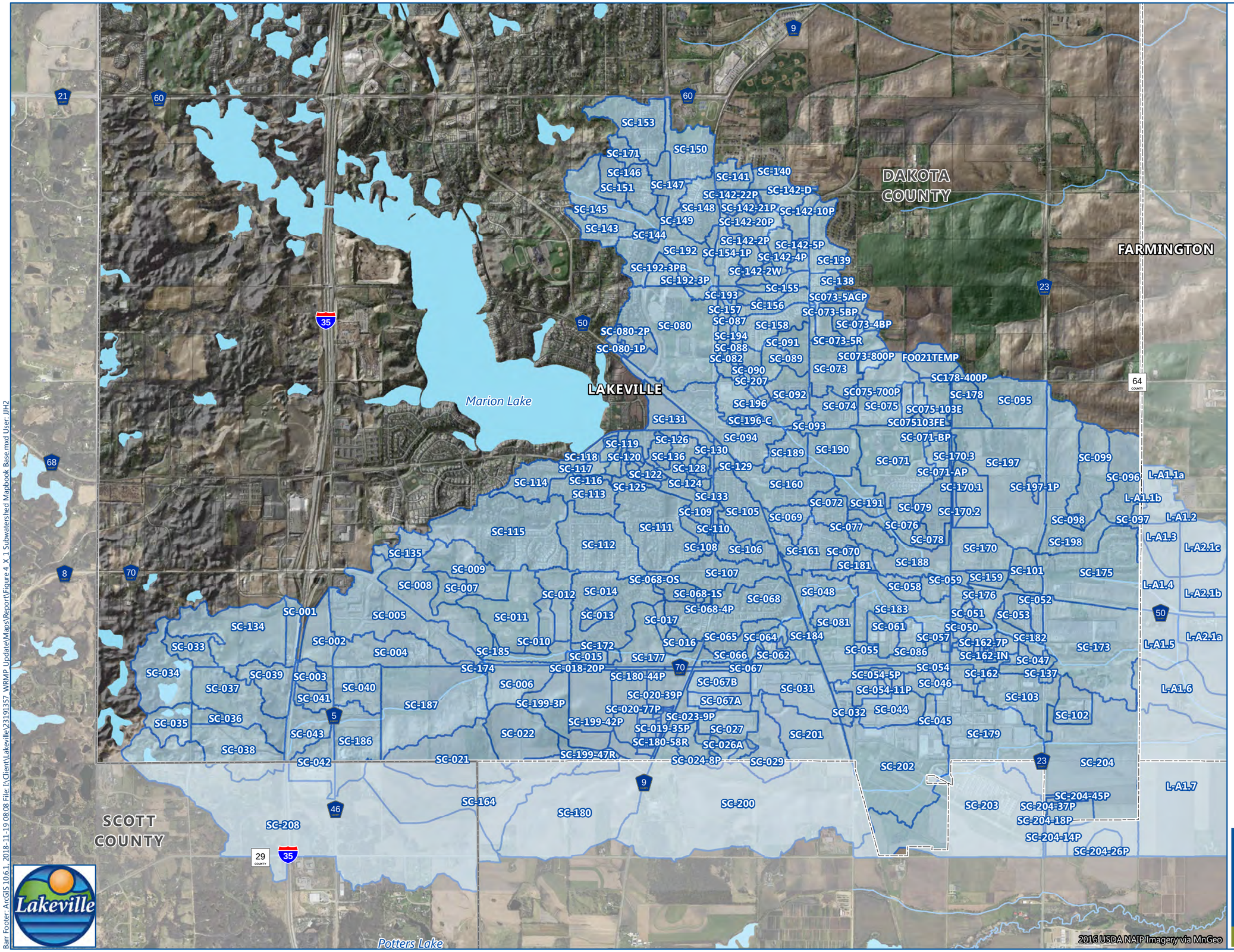
constructed that routes the Marion Branch flow south along Dodd Boulevard and east along 210th Street to Subwatershed SC-068.

The outflow from Lake Marion was simulated based on inflow to the lake from upstream tributary area. The City completed a LOMR in 2014 to modify the FIRM to reflect the developed conditions downstream of Lake Marion.

SC-131: A pond maybe considered in this subwatershed to reduce downstream discharge at the time of future development.

SC-095: At the time future development occurs, additional storage maybe required upstream of 202nd Street to reduce peak flow rates. The existing cattle pass under 202nd Street maybe replaced.

SC-178: At the time future development occurs, additional storage maybe required at 202nd Street, to reduce peak flow rates, and the outlet under 202nd Street may be replaced with an outlet structure from a future pond.



County Boundary
Municipal Boundary
Parcel Boundary
Subwatersheds
Public Water Inventory Watercourses
Public Water Inventory Basins

Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

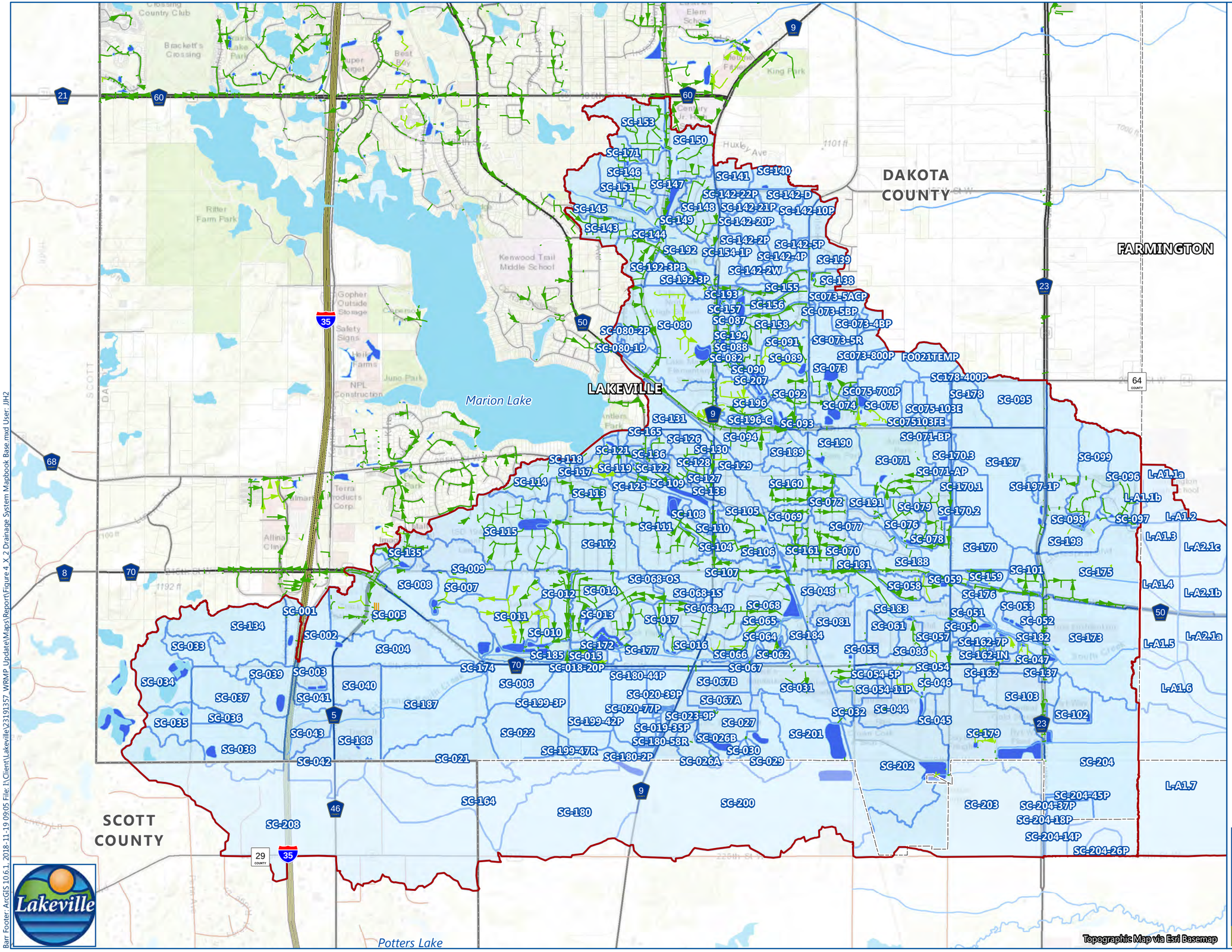
N

1,000 0 1,000
Feet

SOUTH CREEK
SUBWATERSHEDS
Water and Natural Resources
Management Plan
City of Lakeville

FIGURE A.5.1

Barr Footer: ArcGIS 10.6.1, 2018-11-19 08:08 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 4_X_1 Subwatersheds Mapbook Base.mxd User: JH2



County Boundary
Municipal Boundary
Parcel Boundary

Pipes

Storm Main
Private Storm Main
Drain Tile
Subwatersheds
Major Subwatersheds
Existing Pond
Public Water Inventory Watercourses
Public Water Inventory Basins

Major Watersheds, Ponds and Pipe data from the City of Lakeville. Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

1,000 0 1,000
Feet

SOUTH CREEK
DRAINAGE SYSTEM
Water and Natural Resources
Management Plan
City of Lakeville

FIGURE A.5.2

Topographic Map via Esri Basemap

Barr Footer: ArcGIS 10.6.1, 2018-11-19 09:05 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure 4_X_2 Drainage System Mapbook Base.mxd User: JH2

TABLE A.5.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION RATE	MINIMUM INFILTRATION RATE	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
SC-001	15.8	9.80	324	0.057	0.217	0.014	0.194	0.060	1.00	0.23	0.00110
SC-002	31.8	4.60	628	0.054	0.277	0.014	0.178	0.060	0.44	0.22	0.00110
SC-003	12.7	38.20	416	0.052	0.269	0.014	0.179	0.060	1.00	0.22	0.00110
SC-004	57.2	17.10	546	0.035	0.222	0.014	0.187	0.060	0.44	0.20	0.00110
SC-005	105.5	14.90	731	0.040	0.230	0.014	0.182	0.060	1.02	0.23	0.00110
SC-006	39.5	1.17	499	0.050	0.222	0.014	0.190	0.060	1.02	0.12	0.00110
SC-007	15.5	1.00	396	0.078	0.233	0.014	0.191	0.060	0.40	0.23	0.00110
SC-008	66.8	2.20	609	0.051	0.236	0.014	0.188	0.060	1.00	0.20	0.00110
SC-009	51.1	7.40	617	0.070	0.256	0.014	0.183	0.060	0.44	0.19	0.00110
SC-010	17.1	50.40	916	0.025	0.256	0.014	0.171	0.060	1.00	0.21	0.00110
SC-011	66.4	9.70	767	0.043	0.254	0.014	0.171	0.060	1.00	0.22	0.00110
SC-012	29.8	75.90	443	0.047	0.251	0.014	0.170	0.060	1.00	0.19	0.00110
SC-013	9.4	19.70	290	0.041	0.279	0.014	0.176	0.060	0.39	0.16	0.00110
SC-014	78.0	18.00	805	0.049	0.280	0.014	0.177	0.060	0.48	0.14	0.00110
SC-015	16.0	23.10	199	0.028	0.279	0.014	0.178	0.060	1.00	0.11	0.00110
SC-016	10.2	27.40	240	0.061	0.272	0.014	0.171	0.060	0.37	0.20	0.00110
SC-017	6.6	5.28	336	0.069	0.281	0.014	0.180	0.060	1.00	0.14	0.00110
SC-017A	1.2	0.00	112	0.050	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
SC-018-20P	1.0	0.00	101	0.049	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-018-21P	0.8	0.00	81	0.051	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-018-22P	1.0	22.45	76	0.047	0.212	0.014	0.200	0.060	1.00	0.03	0.00110
SC-018-23P	2.7	28.12	84	0.057	0.212	0.014	0.200	0.060	1.00	0.09	0.00110
SC-018-24P	1.8	39.07	90	0.051	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-019-34P	2.6	0.00	330	0.019	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-019-35P	2.6	0.00	361	0.027	0.232	0.014	0.180	0.060	1.00	0.14	0.00110
SC-019-36P	0.5	0.00	83	0.014	0.258	0.014	0.170	0.060	1.00	0.14	0.00110
SC-019-41P	0.2	0.00	71	0.051	0.262	0.014	0.170	0.060	1.00	0.14	0.00110
SC-019-43P	0.5	0.00	95	0.013	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-019-48P	0.4	48.89	150	0.020	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-019-49P	0.6	41.90	198	0.038	0.260	0.014	0.170	0.060	1.00	0.14	0.00110
SC-019-63P	0.5	90.85	100	0.016	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-019-73P	0.6	92.70	152	0.013	0.236	0.014	0.180	0.060	1.00	0.14	0.00110
SC-019-76P	2.7	100.00	189	0.020	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-019-82P	0.4	92.76	113	0.010	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-019-83P	0.3	94.92	70	0.018	0.239	0.014	0.180	0.060	1.00	0.14	0.00110
SC-019-84P	0.1	100.00	60	0.012	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-020-39P	24.0	72.77	543	0.032	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-020-60P	0.1	0.00	64	0.021	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-020-77P	1.2	48.33	146	0.026	0.218	0.014	0.190	0.060	1.00	0.14	0.00110
SC-021	92.0	0.10	1149	0.050	0.224	0.014	0.193	0.060	0.51	0.21	0.00110
SC-022	57.9	0.00	884	0.065	0.229	0.014	0.192	0.060	1.00	0.22	0.00110
SC-023-9IN	0.6	0.00	149	0.023	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-023-9P	5.9	85.00	236	0.030	0.239	0.014	0.180	0.060	1.00	0.14	0.00110
SC-024-8IN	0.9	0.00	143	0.022	0.216	0.014	0.200	0.060	1.00	0.14	0.00110
SC-024-8P	15.0	0.00	479	0.020	0.213	0.014	0.200	0.060	1.00	0.14	0.00110

TABLE A.5.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION RATE	MINIMUM INFILTRATION RATE	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
SC-025	10.2	85.00	459	0.022	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-026A	14.9	0.00	338	0.036	0.250	0.014	0.190	0.060	0.83	0.11	0.00110
SC-026B	1.2	0.00	156	0.081	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
SC-026C	6.8	72.00	242	0.034	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-027	26.5	0.00	658	0.031	0.213	0.014	0.200	0.060	1.00	0.14	0.00110
SC-028	1.1	0.00	185	0.022	0.228	0.014	0.192	0.060	1.00	0.23	0.00110
SC-029	39.8	2.70	946	0.020	0.226	0.014	0.190	0.060	1.00	0.12	0.00110
SC-030	4.6	0.00	189	0.017	0.214	0.014	0.196	0.060	1.00	0.23	0.00110
SC-031	61.7	44.71	728	0.025	0.234	0.014	0.180	0.060	1.00	0.14	0.00110
SC-032	10.3	60.30	313	0.029	0.242	0.014	0.171	0.060	0.39	0.23	0.00110
SC-033	22.5	18.00	463	0.065	0.282	0.014	0.178	0.060	0.41	0.16	0.00110
SC-034	62.3	4.50	658	0.070	0.282	0.014	0.178	0.060	1.00	0.16	0.00110
SC-035	25.3	12.70	565	0.068	0.277	0.014	0.175	0.060	1.00	0.18	0.00110
SC-036	9.1	0.90	294	0.066	0.220	0.014	0.193	0.060	1.00	0.19	0.00110
SC-037	66.1	0.90	610	0.053	0.250	0.014	0.185	0.060	0.46	0.15	0.00110
SC-038	64.2	0.80	826	0.057	0.263	0.014	0.181	0.060	1.00	0.14	0.00110
SC-039	34.9	8.40	662	0.065	0.271	0.014	0.179	0.060	0.43	0.16	0.00110
SC-040	34.4	38.80	739	0.045	0.257	0.014	0.174	0.060	0.45	0.16	0.00110
SC-041	18.6	9.90	539	0.046	0.276	0.014	0.179	0.060	1.00	0.16	0.00110
SC-042	30.8	37.20	397	0.061	0.276	0.014	0.178	0.060	0.41	0.20	0.00110
SC-043	33.6	12.50	503	0.051	0.263	0.014	0.183	0.060	1.00	0.14	0.00110
SC-044	34.6	78.64	673	0.034	0.245	0.014	0.170	0.060	1.00	0.14	0.00110
SC-045	6.8	35.00	356	0.051	0.249	0.014	0.172	0.060	1.00	0.23	0.00110
SC-046	13.8	17.54	384	0.021	0.266	0.014	0.180	0.060	1.00	0.14	0.00110
SC-046-1P	3.4	81.93	207	0.033	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
SC-046-2P	0.3	0.00	78	0.045	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
SC-047	5.0	6.50	349	0.039	0.277	0.014	0.177	0.060	0.51	0.23	0.00110
SC-048	39.7	35.10	646	0.044	0.252	0.014	0.170	0.060	1.00	0.23	0.00110
SC-049	0.8	60.40	82	0.074	0.245	0.014	0.171	0.060	0.44	0.23	0.00110
SC-050	3.6	72.60	203	0.034	0.251	0.014	0.172	0.060	1.00	0.20	0.00110
SC-051	6.1	24.80	234	0.032	0.275	0.014	0.177	0.060	1.00	0.20	0.00110
SC-052	8.9	88.90	280	0.033	0.183	0.014	0.173	0.060	0.39	0.23	0.00110
SC-053	16.0	50.20	496	0.040	0.216	0.014	0.175	0.060	1.00	0.23	0.00110
SC-054	12.5	50.70	193	0.044	0.264	0.014	0.180	0.060	1.00	0.14	0.00110
SC-054-11P	3.6	65.99	279	0.030	0.226	0.014	0.190	0.060	1.00	0.14	0.00110
SC-054-14P	13.5	65.99	638	0.038	0.231	0.014	0.180	0.060	1.00	0.14	0.00110
SC-054-5P	7.5	36.06	283	0.027	0.262	0.014	0.180	0.060	1.00	0.14	0.00110
SC-055	26.8	58.20	367	0.045	0.246	0.014	0.171	0.060	1.00	0.23	0.00110
SC-056	1.4	83.20	108	0.032	0.243	0.014	0.171	0.060	1.00	0.23	0.00110
SC-057	6.7	44.30	292	0.030	0.251	0.014	0.173	0.060	0.42	0.23	0.00110
SC-058	15.0	57.40	413	0.048	0.239	0.014	0.172	0.060	1.00	0.23	0.00110
SC-059	12.6	43.50	532	0.038	0.246	0.014	0.170	0.060	0.46	0.22	0.00110
SC-060	4.6	23.20	326	0.036	0.274	0.014	0.174	0.060	1.00	0.23	0.00110
SC-061	17.5	44.20	546	0.049	0.254	0.014	0.173	0.060	1.00	0.23	0.00110
SC-062	12.4	6.20	547	0.025	0.217	0.014	0.190	0.060	1.00	0.14	0.00110

TABLE A.5.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION RATE	MINIMUM INFILTRATION RATE	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
SC-063	1.2	0.70	124	0.037	0.215	0.014	0.196	0.060	0.58	0.23	0.00110
SC-064	11.8	3.57	226	0.038	0.268	0.014	0.180	0.060	1.00	0.13	0.00110
SC-065	20.1	21.70	302	0.036	0.282	0.014	0.178	0.060	0.39	0.23	0.00110
SC-066	9.6	13.48	236	0.046	0.279	0.014	0.180	0.060	1.00	0.07	0.00110
SC-067	4.1	0.51	103	0.046	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-067_2	3.8	60.31	118	0.028	0.271	0.014	0.170	0.060	1.00	0.12	0.00110
SC-067A	18.3	72.00	354	0.023	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-067B	23.7	72.00	520	0.029	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-068	88.4	29.52	867	0.054	0.264	0.014	0.170	0.060	1.00	0.14	0.00110
SC-068-1S	1.9	30.00	146	0.060	0.280	0.014	0.180	0.060	1.00	0.11	0.00110
SC-068-2S	1.5	25.00	193	0.071	0.281	0.014	0.180	0.060	1.00	0.11	0.00110
SC-068-4P	1.4	0.00	117	0.067	0.275	0.014	0.170	0.060	1.00	0.06	0.00110
SC-068-OS	13.6	0.00	424	0.070	0.278	0.014	0.170	0.060	1.00	0.13	0.00110
SC-069	20.9	74.50	570	0.022	0.227	0.014	0.171	0.060	0.43	0.23	0.00110
SC-070	8.6	9.70	372	0.022	0.279	0.014	0.177	0.060	1.00	0.23	0.00110
SC-071	86.3	10.25	892	0.044	0.274	0.014	0.180	0.060	1.00	0.13	0.00110
SC-071-AP	16.5	25.77	817	0.076	0.278	0.014	0.180	0.060	1.00	0.11	0.00110
SC-071-BP	1.0	6.96	200	0.064	0.279	0.014	0.180	0.060	1.00	0.10	0.00110
SC-072	20.3	39.20	589	0.020	0.260	0.014	0.169	0.060	0.43	0.23	0.00110
SC-073	46.7	7.26	937	0.082	0.269	0.014	0.180	0.060	1.00	0.08	0.00110
SC-073-4AP	6.2	21.10	455	0.067	0.218	0.014	0.200	0.060	1.00	0.14	0.00110
SC-073-4BP	1.8	5.71	268	0.086	0.280	0.014	0.180	0.060	1.00	0.13	0.00110
SC-073-5BP	9.6	42.56	718	0.082	0.227	0.014	0.190	0.060	1.00	0.14	0.00110
SC-073-5EP	0.9	50.55	114	0.072	0.282	0.014	0.180	0.060	1.00	0.08	0.00110
SC-073-5R	17.5	0.00	507	0.074	0.260	0.014	0.180	0.060	1.00	0.09	0.00110
SC-074	28.3	27.35	704	0.045	0.255	0.014	0.170	0.060	1.00	0.09	0.00110
SC-075	26.3	0.00	728	0.050	0.213	0.014	0.200	0.060	1.00	0.10	0.00110
SC-076	20.1	23.20	714	0.043	0.271	0.014	0.170	0.060	1.00	0.20	0.00110
SC-077	19.5	27.50	456	0.026	0.270	0.014	0.169	0.060	1.00	0.23	0.00110
SC-078	9.0	23.26	386	0.035	0.260	0.014	0.170	0.060	1.00	0.14	0.00110
SC-079	32.5	18.14	826	0.050	0.256	0.014	0.170	0.060	1.00	0.12	0.00110
SC-080	138.1	34.93	1473	0.054	0.251	0.014	0.170	0.060	1.00	0.13	0.00110
SC-080-1P	5.1	32.87	292	0.058	0.242	0.014	0.180	0.060	1.00	0.14	0.00110
SC-080-2P	8.1	27.50	373	0.071	0.231	0.014	0.190	0.060	1.00	0.14	0.00110
SC-080-3P	4.5	39.18	331	0.056	0.220	0.014	0.190	0.060	1.00	0.14	0.00110
SC-080-4P	0.2	0.00	68	0.055	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-081	49.0	26.06	823	0.033	0.259	0.014	0.170	0.060	1.00	0.14	0.00110
SC-082	7.4	26.54	317	0.037	0.281	0.014	0.180	0.060	1.00	0.12	0.00110
SC-083	3.3	42.40	396	0.052	0.270	0.014	0.169	0.060	1.00	0.23	0.00110
SC-084	2.4	9.60	255	0.074	0.352	0.014	0.171	0.060	1.00	0.23	0.00110
SC-085	1.9	3.70	231	0.078	0.275	0.014	0.174	0.060	1.00	0.23	0.00110
SC-086	13.5	56.50	369	0.038	0.252	0.014	0.173	0.060	1.00	0.22	0.00110
SC-087	6.9	24.58	308	0.018	0.282	0.014	0.180	0.060	1.00	0.13	0.00110
SC-088	0.6	0.00	101	0.037	0.282	0.014	0.178	0.060	1.00	0.06	0.00110
SC-089	14.0	19.60	400	0.070	0.255	0.014	0.171	0.060	1.00	0.23	0.00110

TABLE A.5.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION RATE	MINIMUM INFILTRATION RATE	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
SC-090	10.1	22.10	345	0.060	0.282	0.014	0.178	0.060	1.00	0.40	0.00110
SC-091	21.7	28.30	508	0.074	0.255	0.014	0.171	0.060	1.00	0.16	0.00110
SC-092	23.8	30.60	609	0.060	0.251	0.014	0.168	0.060	1.00	0.22	0.00110
SC-093	9.5	55.70	372	0.037	0.253	0.014	0.169	0.060	0.42	0.23	0.00110
SC-094	73.2	47.84	1155	0.030	0.255	0.014	0.170	0.060	1.01	0.14	0.00110
SC-095	57.2	3.20	956	0.058	0.264	0.014	0.180	0.060	1.00	0.17	0.00110
SC-096	50.4	6.50	592	0.053	0.233	0.014	0.190	0.060	1.00	0.20	0.00110
SC-097	4.3	12.90	271	0.060	0.267	0.014	0.182	0.060	0.46	0.23	0.00110
SC-098	2.9	16.50	129	0.048	0.276	0.014	0.174	0.060	0.37	0.15	0.00110
SC-099	51.7	10.60	601	0.054	0.248	0.014	0.185	0.060	1.00	0.18	0.00110
SC-101	20.2	21.90	552	0.051	0.219	0.014	0.184	0.060	1.00	0.20	0.00110
SC-102	24.6	51.80	488	0.038	0.245	0.014	0.182	0.060	0.41	0.23	0.00110
SC-103	55.6	53.10	744	0.032	0.241	0.014	0.174	0.060	1.00	0.23	0.00110
SC-104	4.0	42.90	141	0.062	0.270	0.014	0.169	0.060	1.00	0.23	0.00110
SC-105	46.4	25.30	594	0.042	0.270	0.014	0.169	0.060	0.44	0.23	0.00110
SC-106	27.5	21.40	425	0.053	0.271	0.014	0.170	0.060	1.00	0.23	0.00110
SC-107	51.2	26.21	618	0.058	0.274	0.014	0.170	0.060	1.00	0.12	0.00110
SC-108	11.6	30.60	318	0.053	0.270	0.014	0.169	0.060	0.39	0.23	0.00110
SC-109	19.6	24.10	516	0.060	0.251	0.014	0.160	0.060	1.00	0.23	0.00110
SC-110	1.2	81.70	70	0.084	0.276	0.014	0.174	0.060	1.00	0.23	0.00110
SC-111	89.0	21.10	1274	0.054	0.271	0.014	0.170	0.060	0.52	0.22	0.00110
SC-112	73.5	22.80	1150	0.052	0.270	0.014	0.169	0.060	1.00	0.21	0.00110
SC-113	33.9	30.40	618	0.024	0.270	0.014	0.169	0.060	1.00	0.23	0.00110
SC-114	31.3	23.00	510	0.052	0.270	0.014	0.169	0.060	1.00	0.23	0.00110
SC-115	132.8	20.50	1272	0.075	0.271	0.014	0.171	0.060	0.55	0.16	0.00110
SC-116	3.0	8.40	159	0.027	0.264	0.014	0.169	0.060	1.00	0.23	0.00110
SC-117	8.3	61.10	328	0.029	0.247	0.014	0.169	0.060	1.00	0.23	0.00110
SC-118	9.5	42.10	265	0.058	0.253	0.014	0.169	0.060	1.00	0.23	0.00110
SC-119	8.2	6.00	446	0.031	0.260	0.014	0.170	0.060	1.00	0.23	0.00110
SC-120	2.8	41.60	192	0.046	0.271	0.014	0.170	0.060	1.00	0.23	0.00110
SC-121	5.9	2.30	287	0.053	0.250	0.014	0.169	0.060	1.00	0.23	0.00110
SC-122	5.4	14.30	228	0.074	0.272	0.014	0.171	0.060	1.00	0.23	0.00110
SC-123	2.4	4.90	157	0.042	0.270	0.014	0.169	0.060	0.46	0.23	0.00110
SC-124	7.9	30.40	480	0.041	0.270	0.014	0.169	0.060	1.00	0.23	0.00110
SC-125	4.8	4.00	202	0.032	0.270	0.014	0.169	0.060	1.00	0.23	0.00110
SC-126	15.5	54.80	359	0.046	0.226	0.014	0.171	0.060	1.00	0.23	0.00110
SC-127	5.0	29.60	233	0.038	0.270	0.014	0.169	0.060	1.00	0.23	0.00110
SC-128	2.7	21.60	264	0.032	0.270	0.014	0.169	0.060	1.00	0.23	0.00110
SC-129	8.0	30.20	278	0.041	0.252	0.014	0.171	0.060	1.00	0.23	0.00110
SC-130	8.1	65.10	202	0.037	0.236	0.014	0.171	0.060	1.00	0.23	0.00110
SC-131	27.2	3.50	408	0.015	0.216	0.014	0.195	0.060	1.00	0.23	0.00110
SC-132	3.6	3.20	198	0.049	0.270	0.014	0.169	0.060	1.00	0.23	0.00110
SC-133	3.9	46.50	255	0.051	0.271	0.014	0.170	0.060	1.00	0.23	0.00110
SC-134	96.3	1.60	867	0.061	0.261	0.014	0.183	0.060	1.00	0.22	0.00110
SC-135	23.3	56.90	732	0.039	0.244	0.014	0.173	0.060	1.00	0.23	0.00110

TABLE A.5.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION RATE	MINIMUM INFILTRATION RATE	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
SC-136	9.4	25.50	330	0.033	0.259	0.014	0.169	0.060	1.00	0.23	0.00110
SC-137	13.4	48.60	321	0.048	0.257	0.014	0.175	0.060	0.40	0.21	0.00110
SC-138	11.8	6.12	450	0.072	0.225	0.014	0.190	0.060	1.00	0.12	0.00110
SC-138-1AP	2.4	35.86	270	0.078	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-139	32.1	0.00	534	0.056	0.300	0.014	0.197	0.060	1.00	0.17	0.00110
SC-140	15.0	38.00	737	0.050	0.214	0.014	0.200	0.060	1.00	0.14	0.00110
SC-141	17.0	29.46	584	0.044	0.216	0.014	0.190	0.060	1.00	0.14	0.00110
SC-142-10P	15.7	29.70	429	0.064	0.212	0.014	0.200	0.060	1.00	0.11	0.00110
SC-142-1W	7.1	0.00	400	0.030	0.212	0.014	0.200	0.060	1.00	0.02	0.00110
SC-142-20P	26.7	40.11	834	0.079	0.227	0.014	0.190	0.060	1.00	0.10	0.00110
SC-142-21P	4.7	32.70	308	0.092	0.246	0.014	0.190	0.060	1.00	0.09	0.00110
SC-142-22P	7.2	33.32	453	0.057	0.214	0.014	0.200	0.060	1.00	0.14	0.00110
SC-142-2P	10.6	41.24	548	0.082	0.217	0.014	0.200	0.060	1.00	0.07	0.00110
SC-142-2W	5.7	0.00	285	0.059	0.212	0.014	0.200	0.060	1.00	0.04	0.00110
SC-142-4P	18.8	35.99	573	0.066	0.214	0.014	0.200	0.060	1.00	0.07	0.00110
SC-142-5P	8.3	0.00	353	0.049	0.212	0.014	0.200	0.060	1.00	0.03	0.00110
SC-142-7P	3.6	19.09	241	0.038	0.249	0.014	0.190	0.060	1.00	0.02	0.00110
SC-142-D	18.9	0.00	537	0.064	0.230	0.014	0.190	0.060	1.00	0.13	0.00110
SC-143	24.2	24.40	465	0.079	0.272	0.014	0.170	0.060	0.41	0.22	0.00110
SC-144	3.9	14.40	171	0.076	0.274	0.014	0.173	0.060	0.39	0.20	0.00110
SC-145	46.2	5.10	503	0.061	0.278	0.014	0.176	0.060	0.45	0.12	0.00110
SC-146	22.7	23.50	584	0.089	0.271	0.014	0.170	0.060	1.00	0.19	0.00110
SC-147	22.8	29.00	456	0.069	0.265	0.014	0.169	0.060	0.41	0.16	0.00110
SC-148	37.9	28.40	661	0.086	0.266	0.014	0.170	0.060	0.44	0.20	0.00110
SC-149	1.5	34.80	223	0.064	0.258	0.014	0.167	0.060	1.00	0.11	0.00110
SC-150	43.1	20.90	805	0.066	0.250	0.014	0.166	0.060	1.00	0.17	0.00110
SC-151	19.0	11.30	400	0.062	0.277	0.014	0.175	0.060	1.00	0.17	0.00110
SC-152	5.4	31.70	310	0.084	0.272	0.014	0.171	0.060	1.00	0.07	0.00110
SC-153	54.6	17.00	764	0.050	0.273	0.014	0.173	0.060	0.46	0.23	0.00110
SC-154	3.6	11.40	189	0.025	0.269	0.014	0.180	0.060	1.00	0.04	0.00110
SC-154-1P	27.1	30.60	553	0.086	0.234	0.014	0.190	0.060	1.00	0.11	0.00110
SC-155	15.5	18.10	240	0.045	0.285	0.014	0.181	0.060	1.00	0.09	0.00110
SC-156	17.8	17.60	357	0.055	0.282	0.014	0.178	0.060	1.00	0.14	0.00110
SC-157	3.8	8.10	180	0.018	0.282	0.014	0.178	0.060	1.00	0.20	0.00110
SC-158	32.6	22.60	538	0.069	0.280	0.014	0.178	0.060	1.00	0.19	0.00110
SC-159	10.9	13.50	337	0.055	0.259	0.014	0.170	0.060	0.40	0.23	0.00110
SC-160	51.0	36.10	1006	0.019	0.262	0.014	0.169	0.060	1.00	0.23	0.00110
SC-161	45.6	57.30	831	0.026	0.238	0.014	0.170	0.060	0.46	0.23	0.00110
SC-162	14.3	72.62	345	0.041	0.242	0.014	0.170	0.060	1.00	0.14	0.00110
SC-162-1	3.5	60.68	255	0.059	0.268	0.014	0.180	0.060	1.00	0.14	0.00110
SC-162-2	0.8	73.01	114	0.078	0.229	0.014	0.160	0.060	1.00	0.14	0.00110
SC-162-3	1.0	54.42	153	0.043	0.227	0.014	0.170	0.060	1.00	0.14	0.00110
SC-162-7P	2.6	53.58	227	0.046	0.251	0.014	0.170	0.060	1.00	0.14	0.00110
SC-162-ADS	1.1	100.00	168	0.046	0.275	0.014	0.180	0.060	1.00	0.14	0.00110
SC-162-IN	1.0	80.00	182	0.041	0.248	0.014	0.170	0.060	1.00	0.14	0.00110

TABLE A.5.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION RATE	MINIMUM INFILTRATION RATE	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
SC-163	8.3	46.00	351	0.039	0.254	0.014	0.170	0.060	1.00	0.14	0.00110
SC-164	134.2	1.50	888	0.041	0.258	0.014	0.181	0.060	1.00	0.20	0.00110
SC-165	8.8	34.40	565	0.040	0.269	0.014	0.169	0.060	1.00	0.23	0.00110
SC-167	3.1	4.70	283	0.081	0.272	0.014	0.171	0.060	1.00	0.23	0.00110
SC-169	10.5	78.90	533	0.032	0.243	0.014	0.171	0.060	1.00	0.23	0.00110
SC-170	41.9	0.26	771	0.040	0.215	0.014	0.200	0.060	1.00	0.13	0.00110
SC-170.1	33.9	35.92	818	0.054	0.220	0.014	0.190	0.060	1.00	0.11	0.00110
SC-170.2	3.7	35.92	145	0.039	0.212	0.014	0.200	0.060	1.00	0.11	0.00110
SC-170.3	3.7	20.26	279	0.064	0.254	0.014	0.180	0.060	1.00	0.14	0.00110
SC-171	11.1	19.30	430	0.052	0.275	0.014	0.173	0.060	1.00	0.15	0.00110
SC-172	7.7	2.30	210	0.025	0.271	0.014	0.176	0.060	1.00	0.03	0.00110
SC-173	139.9	15.00	1132	0.042	0.241	0.014	0.185	0.060	1.00	0.19	0.00110
SC-174	2.0	13.40	151	0.041	0.282	0.014	0.178	0.060	0.48	0.04	0.00110
SC-175	107.0	21.90	1313	0.039	0.221	0.014	0.178	0.060	1.00	0.18	0.00110
SC-176	40.8	24.50	663	0.048	0.256	0.014	0.180	0.060	1.00	0.11	0.00110
SC-177	48.2	13.36	608	0.041	0.275	0.014	0.180	0.060	1.08	0.05	0.00110
SC-178	25.3	5.44	517	0.056	0.280	0.014	0.180	0.060	1.00	0.11	0.00110
SC-179	117.5	49.80	973	0.027	0.235	0.014	0.179	0.060	1.00	0.21	0.00110
SC-180	167.3	0.73	1288	0.048	0.224	0.014	0.190	0.060	1.00	0.13	0.00110
SC-180-2P	8.8	41.35	624	0.013	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-180-44P	37.0	78.32	1245	0.025	0.212	0.014	0.200	0.060	1.00	0.13	0.00110
SC-180-45P	0.7	76.16	143	0.029	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-180-53P	0.4	100.00	67	0.025	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-180-58R	2.1	33.59	75	0.045	0.221	0.014	0.190	0.060	1.00	0.14	0.00110
SC-180-62P	0.4	100.00	68	0.026	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-180-64P	2.8	100.00	193	0.018	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-180-65P	0.4	100.00	72	0.024	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-180-68P	0.4	100.00	94	0.023	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-180-69P	0.4	100.00	102	0.014	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-180-78P	0.4	94.04	63	0.012	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-180-79P	2.1	58.55	386	0.010	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-180-80P	0.3	92.47	42	0.014	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-181	14.1	37.30	456	0.028	0.235	0.014	0.168	0.060	0.42	0.23	0.00110
SC-182	16.8	27.90	436	0.060	0.273	0.014	0.178	0.060	1.00	0.14	0.00110
SC-183	61.3	44.20	588	0.050	0.258	0.014	0.174	0.060	1.00	0.20	0.00110
SC-184	18.7	8.70	496	0.032	0.249	0.014	0.177	0.060	0.42	0.23	0.00110
SC-185	18.4	4.50	299	0.034	0.279	0.014	0.177	0.060	1.00	0.06	0.00110
SC-186	56.4	24.50	822	0.057	0.265	0.014	0.174	0.060	1.00	0.13	0.00110
SC-187	130.1	1.10	1224	0.046	0.225	0.014	0.193	0.060	1.00	0.19	0.00110
SC-188	47.3	21.10	565	0.041	0.247	0.014	0.176	0.060	1.00	0.21	0.00110
SC-189	23.8	15.00	569	0.035	0.260	0.014	0.169	0.060	1.00	0.23	0.00110
SC-190	40.9	14.70	807	0.043	0.276	0.014	0.175	0.060	0.46	0.23	0.00110
SC-191	24.0	10.60	529	0.058	0.273	0.014	0.173	0.060	0.42	0.21	0.00110
SC-192	70.2	22.50	879	0.064	0.274	0.014	0.170	0.060	1.00	0.07	0.00110
SC-192-3P	4.2	40.15	408	0.122	0.282	0.014	0.180	0.060	1.00	0.11	0.00110

TABLE A.5.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION RATE	MINIMUM INFILTRATION RATE	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
SC-192-3PB	14.4	42.37	452	0.088	0.282	0.014	0.180	0.060	1.00	0.12	0.00110
SC-193	7.0	0.00	216	0.023	0.282	0.014	0.178	0.060	1.00	0.07	0.00110
SC-194	4.9	1.40	265	0.037	0.282	0.014	0.178	0.060	1.00	0.09	0.00110
SC-195	2.6	51.10	355	0.097	0.260	0.014	0.171	0.060	1.00	0.23	0.00110
SC-196	37.8	31.26	1074	0.038	0.274	0.014	0.180	0.060	1.00	0.14	0.00110
SC-196-A	0.6	84.78	152	0.060	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
SC-196-B	1.7	78.00	214	0.027	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
SC-196-C	3.7	0.00	196	0.032	0.282	0.014	0.180	0.060	1.16	0.16	0.00110
SC-197	137.2	2.25	1629	0.047	0.223	0.014	0.190	0.060	1.00	0.11	0.00110
SC-197-1P	4.1	39.31	326	0.038	0.212	0.014	0.200	0.060	1.00	0.06	0.00110
SC-198	97.9	11.10	762	0.050	0.244	0.014	0.182	0.060	1.00	0.18	0.00110
SC-199-3P	45.9	0.00	1177	0.051	0.238	0.014	0.190	0.060	1.00	0.14	0.00110
SC-199-42P	48.7	77.34	1108	0.027	0.213	0.014	0.200	0.060	1.00	0.13	0.00110
SC-199-47R	21.7	0.00	413	0.030	0.246	0.014	0.190	0.060	1.00	0.07	0.00110
SC-200	335.6	1.60	1670	0.046	0.227	0.014	0.191	0.060	1.00	0.17	0.00110
SC-201	60.0	0.50	891	0.020	0.216	0.014	0.190	0.060	0.47	0.23	0.00110
SC-202	136.5	21.30	1396	0.032	0.234	0.014	0.170	0.060	1.00	0.21	0.00110
SC-203	214.9	0.30	1077	0.030	0.227	0.014	0.175	0.060	0.61	0.22	0.00110
SC-204	186.5	0.13	1701	0.015	0.213	0.014	0.200	0.060	1.06	0.10	0.00110
SC-204-14P	31.6	42.89	787	0.011	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-204-18P	4.7	31.96	180	0.028	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-204-26P	14.7	2.39	518	0.017	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-204-37P	1.5	69.48	184	0.008	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-204-38P	1.4	68.12	172	0.008	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-204-45P	1.0	67.25	151	0.008	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
SC-206	4.2	80.70	353	0.055	0.231	0.014	0.168	0.060	1.00	0.23	0.00110
SC-207	2.8	5.60	141	0.036	0.280	0.014	0.178	0.060	1.00	0.20	0.00110
SC-208	445.8	9.20	1288	0.063	0.221	0.014	0.194	0.060	0.88	0.24	0.00110
SC073-211P	9.7	6.09	278	0.089	0.253	0.014	0.180	0.060	1.00	0.12	0.00110
SC073-5ACP	13.2	32.12	932	0.077	0.243	0.014	0.190	0.060	1.00	0.14	0.00110
SC073-800P	8.4	28.28	429	0.086	0.212	0.014	0.200	0.060	1.00	0.10	0.00110
SC075-103E	14.2	30.00	841	0.078	0.226	0.014	0.190	0.060	1.00	0.11	0.00110
SC075-103W	8.8	30.00	534	0.075	0.223	0.014	0.190	0.060	1.00	0.10	0.00110
SC075-700P	26.3	28.03	611	0.081	0.212	0.014	0.200	0.060	1.00	0.12	0.00110
SC075103FE	1.7	25.00	205	0.084	0.212	0.014	0.200	0.060	1.00	0.12	0.00110
SC075103FW	0.5	25.00	109	0.105	0.261	0.014	0.180	0.060	1.00	0.14	0.00110
SC142-WL9P	4.3	5.56	154	0.029	0.212	0.014	0.200	0.060	1.00	0.02	0.00110
SC178-400P	4.8	0.00	262	0.071	0.268	0.014	0.170	0.060	1.00	0.12	0.00110
SC178104NS	14.5	31.65	588	0.053	0.233	0.014	0.190	0.060	1.00	0.12	0.00110
CD12-5a	502.1	19.40	2790	0.100	0.240	0.014	0.170	0.060	4.09	0.24	0.00110
CD12-5b	63.5	16.00	902	0.115	0.260	0.014	0.160	0.060	3.36	0.25	0.00110
CD12-5c	235.6	24.70	1892	0.082	0.250	0.014	0.170	0.060	4.18	0.23	0.00110

TABLE A.5.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
SC-001	15.8	0.7	9	1.0	11	2.1	24	4.0	45	5.0	57
SC-002	31.8	0.5	10	0.8	13	1.8	30	3.7	62	4.8	80
SC-003	12.7	1.6	21	1.9	26	3.1	46	5.1	76	6.2	91
SC-004	57.2	0.8	35	1.0	45	2.1	81	4.0	140	5.1	172
SC-005	105.5	0.7	54	0.9	69	1.8	124	3.6	212	4.7	261
SC-006	39.5	0.7	9	0.9	13	2.2	33	4.2	67	5.2	87
SC-007	15.5	0.5	5	0.7	8	1.8	20	3.7	41	4.8	52
SC-008	66.8	0.4	10	0.6	14	1.6	37	3.4	84	4.5	111
SC-009	51.1	0.6	20	0.9	27	2.0	53	3.9	102	5.0	129
SC-010	17.1	2.0	35	2.3	45	3.6	78	5.6	125	6.7	147
SC-011	66.4	0.6	30	0.8	38	1.9	71	3.7	128	4.7	161
SC-012	29.8	2.6	57	3.0	73	4.4	129	6.5	208	7.6	246
SC-013	9.4	1.2	9	1.5	12	2.7	22	4.8	38	5.8	46
SC-014	78.0	1.0	54	1.3	69	2.5	123	4.5	209	5.5	255
SC-015	16.0	1.2	13	1.5	16	2.8	29	4.9	49	5.9	59
SC-016	10.2	1.3	12	1.6	16	2.8	28	4.8	47	5.9	57
SC-017	6.6	0.9	4	1.2	6	2.5	14	4.5	26	5.6	32
SC-017A	1.2	0.9	1	1.2	1	2.4	3	4.4	5	5.5	7
SC-018-20P	1.0	0.9	1	1.2	1	2.4	3	4.4	5	5.5	6
SC-018-21P	0.8	0.9	1	1.2	1	2.4	2	4.4	4	5.5	5
SC-018-22P	1.0	1.9	2	2.3	2	3.7	4	5.8	6	6.9	8
SC-018-23P	2.7	1.6	4	2.0	5	3.3	9	5.4	15	6.5	18
SC-018-24P	1.8	1.8	3	2.1	4	3.4	8	5.5	13	6.6	15
SC-019-34P	2.6	0.8	2	1.1	3	2.4	7	4.4	12	5.5	15
SC-019-35P	2.6	0.9	2	1.2	3	2.4	8	4.5	13	5.5	16
SC-019-36P	0.5	0.9	0	1.2	1	2.4	1	4.4	2	5.5	3
SC-019-41P	0.2	1.0	0	1.3	0	2.5	1	4.5	1	5.6	2
SC-019-43P	0.5	0.9	0	1.2	1	2.4	1	4.4	3	5.5	3
SC-019-48P	0.4	2.1	1	2.4	2	3.8	3	5.9	4	7.0	5
SC-019-49P	0.6	1.9	2	2.3	2	3.6	4	5.7	6	6.8	7
SC-019-63P	0.5	3.1	2	3.4	2	4.8	4	7.0	5	8.1	6
SC-019-73P	0.6	3.1	2	3.5	3	4.9	4	7.1	6	8.2	7
SC-019-76P	2.7	3.3	9	3.6	11	5.1	18	7.3	26	8.4	31
SC-019-82P	0.4	3.1	2	3.5	2	4.9	3	7.1	5	8.2	5
SC-019-83P	0.3	3.2	1	3.5	1	4.9	2	7.1	3	8.3	4
SC-019-84P	0.1	3.3	0	3.6	1	5.1	1	7.3	1	8.4	1
SC-020-39P	24.0	2.6	50	3.0	64	4.3	112	6.5	179	7.6	211
SC-020-60P	0.1	0.9	0	1.2	0	2.5	1	4.5	1	5.6	1
SC-020-77P	1.2	2.1	3	2.4	4	3.7	7	5.8	10	6.9	12
SC-021	92.0	0.4	16	0.6	24	1.6	64	3.5	140	4.5	183
SC-022	57.9	0.4	12	0.6	19	1.7	49	3.5	107	4.6	140
SC-023-9IN	0.6	0.9	1	1.2	1	2.5	2	4.5	4	5.6	5
SC-023-9P	5.9	2.9	16	3.3	21	4.7	35	6.8	53	8.0	62
SC-024-8IN	0.9	0.9	1	1.2	1	2.4	3	4.4	5	5.5	6
SC-024-8P	15.0	0.7	5	0.9	7	2.2	17	4.2	34	5.2	44
SC-025	10.2	2.9	28	3.3	36	4.7	60	6.8	92	8.0	107
SC-026A	14.9	0.8	4	1.0	6	2.3	15	4.4	31	5.4	40

TABLE A.5.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
SC-026B	1.2	0.9	1	1.2	2	2.5	4	4.5	7	5.6	8
SC-026C	6.8	2.6	17	2.9	22	4.3	37	6.5	58	7.6	67
SC-027	26.5	0.6	8	0.9	12	2.2	29	4.2	60	5.2	76
SC-028	1.1	0.6	1	0.9	1	2.0	3	3.9	6	5.0	7
SC-029	39.8	0.8	11	1.0	16	2.3	38	4.3	77	5.4	99
SC-030	4.6	0.4	1	0.7	2	1.7	5	3.6	11	4.6	14
SC-031	61.7	1.8	71	2.1	90	3.4	162	5.5	270	6.6	325
SC-032	10.3	2.2	21	2.5	26	3.8	46	5.9	74	7.0	87
SC-033	22.5	1.1	20	1.4	25	2.6	46	4.6	81	5.7	99
SC-034	62.3	0.6	17	0.8	22	1.9	46	3.9	93	4.9	120
SC-035	25.3	0.9	18	1.2	23	2.4	44	4.4	81	5.4	101
SC-036	9.1	0.6	4	0.9	6	2.1	14	4.0	28	5.1	35
SC-037	66.1	0.4	10	0.7	15	1.8	38	3.7	84	4.8	111
SC-038	64.2	0.6	13	0.8	19	2.0	49	4.0	102	5.0	131
SC-039	34.9	0.8	17	1.1	23	2.3	47	4.3	89	5.3	112
SC-040	34.4	1.7	50	2.0	64	3.3	113	5.4	185	6.5	221
SC-041	18.6	0.9	11	1.2	15	2.4	30	4.4	56	5.4	70
SC-042	30.8	1.5	38	1.8	48	3.0	85	5.0	140	6.1	168
SC-043	33.6	0.9	20	1.2	26	2.4	49	4.4	88	5.5	109
SC-044	34.6	2.8	72	3.1	91	4.5	160	6.6	255	7.8	300
SC-045	6.8	1.5	12	1.8	15	3.1	27	5.1	44	6.1	53
SC-046	13.8	1.1	11	1.4	14	2.7	26	4.7	46	5.8	56
SC-046-1P	3.4	2.8	11	3.2	13	4.6	22	6.8	33	7.9	38
SC-046-2P	0.3	0.9	0	1.2	1	2.5	1	4.5	2	5.6	2
SC-047	5.0	0.7	3	1.0	4	2.1	10	4.0	19	5.1	24
SC-048	39.7	1.4	48	1.7	61	2.9	109	4.9	180	5.9	217
SC-049	0.8	2.3	3	2.6	3	3.9	5	6.0	8	7.1	9
SC-050	3.6	2.6	10	2.9	13	4.3	22	6.4	33	7.5	38
SC-051	6.1	1.2	7	1.5	9	2.7	16	4.7	28	5.8	34
SC-052	8.9	3.0	24	3.3	30	4.7	51	6.9	79	8.0	92
SC-053	16.0	1.9	30	2.2	38	3.5	68	5.6	110	6.6	130
SC-054	12.5	2.0	19	2.3	24	3.7	43	5.8	70	6.9	84
SC-054-11P	3.6	2.5	11	2.8	13	4.2	22	6.3	34	7.4	39
SC-054-14P	13.5	2.5	36	2.8	45	4.2	76	6.3	117	7.4	136
SC-054-5P	7.5	1.7	11	2.0	15	3.3	26	5.4	42	6.5	50
SC-055	26.8	2.1	42	2.4	53	3.7	95	5.8	156	6.9	186
SC-056	1.4	2.8	5	3.2	6	4.6	9	6.7	14	7.8	16
SC-057	6.7	1.8	12	2.1	15	3.3	27	5.3	44	6.4	52
SC-058	15.0	2.1	31	2.4	39	3.7	68	5.8	108	6.9	128
SC-059	12.6	1.8	23	2.1	30	3.3	52	5.4	85	6.5	100
SC-060	4.6	1.2	6	1.5	8	2.7	15	4.6	25	5.7	31
SC-061	17.5	1.8	31	2.1	39	3.3	69	5.3	112	6.4	133
SC-062	12.4	0.9	7	1.2	9	2.5	21	4.5	41	5.6	51
SC-063	1.2	0.6	1	0.9	1	2.0	3	3.9	6	5.0	7
SC-064	11.8	0.7	3	1.0	5	2.2	11	4.2	22	5.3	28
SC-065	20.1	1.0	16	1.2	21	2.3	37	4.2	62	5.2	76
SC-066	9.6	1.4	8	1.7	10	3.0	19	5.1	32	6.2	39

TABLE A.5.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
SC-067	4.1	0.7	1	1.0	2	2.2	5	4.2	10	5.3	13
SC-067_2	3.8	2.3	8	2.7	10	4.0	17	6.2	27	7.3	32
SC-067A	18.3	2.6	33	2.9	42	4.3	76	6.4	122	7.6	145
SC-067B	23.7	2.6	48	2.9	61	4.3	107	6.5	172	7.6	203
SC-068	88.4	1.4	86	1.7	108	2.9	194	5.0	323	6.1	389
SC-068-1S	1.9	1.7	4	2.0	5	3.3	8	5.4	13	6.5	15
SC-068-2S	1.5	1.6	3	1.9	4	3.3	7	5.3	11	6.4	13
SC-068-4P	1.4	1.2	1	1.6	2	2.9	4	5.0	7	6.1	8
SC-068-OS	13.6	0.8	6	1.1	8	2.3	20	4.4	38	5.4	48
SC-069	20.9	2.6	44	2.9	55	4.3	97	6.4	155	7.5	183
SC-070	8.6	0.7	5	1.0	6	2.1	13	4.0	25	5.0	31
SC-071	86.3	0.8	40	1.1	51	2.3	95	4.2	169	5.3	209
SC-071-AP	16.5	1.6	25	1.9	33	3.2	61	5.3	99	6.4	117
SC-071-BP	1.0	1.2	2	1.5	2	2.9	4	4.9	7	6.0	8
SC-072	20.3	1.6	28	1.8	36	3.1	63	5.1	104	6.1	125
SC-073	46.7	1.2	26	1.5	35	2.8	73	4.9	134	6.0	166
SC-073-4AP	6.2	1.4	10	1.7	13	3.0	25	5.0	41	6.1	48
SC-073-4BP	1.8	1.1	3	1.4	4	2.7	7	4.7	12	5.8	14
SC-073-5BP	9.6	1.9	23	2.2	30	3.6	52	5.7	80	6.8	93
SC-073-5EP	0.9	2.2	3	2.6	3	4.0	6	6.1	8	7.2	10
SC-073-5R	17.5	0.9	8	1.3	12	2.6	28	4.6	51	5.7	63
SC-074	28.3	1.6	35	1.9	45	3.3	82	5.3	135	6.4	161
SC-075	26.3	0.9	12	1.2	17	2.5	40	4.6	74	5.6	93
SC-076	20.1	1.2	23	1.5	29	2.7	54	4.7	92	5.8	112
SC-077	19.5	1.2	21	1.5	26	2.6	46	4.6	78	5.6	94
SC-078	9.0	1.4	11	1.7	14	3.0	26	5.0	44	6.1	53
SC-079	32.5	1.2	31	1.5	39	2.8	74	4.9	128	6.0	156
SC-080	138.1	1.6	154	1.9	195	3.2	350	5.3	580	6.3	697
SC-080-1P	5.1	1.7	9	2.0	12	3.3	22	5.4	35	6.5	41
SC-080-2P	8.1	1.5	13	1.8	16	3.1	30	5.2	50	6.3	60
SC-080-3P	4.5	1.8	10	2.2	13	3.5	22	5.6	35	6.7	41
SC-080-4P	0.2	0.9	0	1.2	1	2.5	1	4.5	2	5.6	2
SC-081	49.0	1.3	48	1.6	61	2.9	110	4.9	185	6.0	223
SC-082	7.4	1.5	10	1.8	13	3.1	23	5.2	38	6.3	46
SC-083	3.3	1.8	8	2.1	10	3.4	18	5.4	28	6.5	32
SC-084	2.4	0.9	2	1.2	3	2.3	7	4.2	13	5.3	15
SC-085	1.9	0.8	2	1.0	3	2.2	6	4.1	11	5.1	13
SC-086	13.5	2.1	26	2.4	33	3.7	58	5.8	93	6.9	110
SC-087	6.9	1.4	8	1.7	10	3.0	18	5.0	31	6.1	37
SC-088	0.6	1.3	1	1.6	1	3.0	2	5.0	3	6.1	4
SC-089	14.0	1.0	14	1.3	18	2.5	34	4.4	60	5.5	74
SC-090	10.1	0.9	10	1.1	13	2.1	24	3.9	43	4.9	53
SC-091	21.7	1.4	28	1.7	36	3.0	65	5.0	109	6.1	130
SC-092	23.8	1.4	32	1.7	40	2.9	73	4.9	122	5.9	147
SC-093	9.5	2.1	20	2.4	26	3.7	45	5.8	71	6.9	83
SC-094	73.2	1.9	102	2.2	129	3.6	230	5.6	378	6.7	452
SC-095	57.2	0.6	15	0.9	21	2.0	51	4.0	108	5.0	139

TABLE A.5.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
SC-096	50.4	0.5	18	0.8	23	1.8	46	3.7	90	4.8	115
SC-097	4.3	0.9	4	1.2	5	2.4	11	4.3	21	5.4	26
SC-098	2.9	1.2	3	1.5	4	2.7	7	4.8	13	5.9	16
SC-099	51.7	0.7	26	1.0	33	2.1	62	4.1	114	5.1	142
SC-101	20.2	1.2	21	1.4	28	2.6	52	4.6	91	5.7	110
SC-102	24.6	1.9	40	2.2	51	3.5	90	5.5	147	6.6	175
SC-103	55.6	1.9	77	2.2	97	3.5	174	5.5	287	6.6	345
SC-104	4.0	1.7	7	2.0	9	3.3	16	5.3	26	6.4	31
SC-105	46.4	1.1	41	1.3	52	2.4	93	4.3	156	5.4	189
SC-106	27.5	1.0	24	1.2	30	2.4	54	4.3	93	5.3	113
SC-107	51.2	1.3	50	1.6	63	2.9	113	5.0	189	6.1	228
SC-108	11.6	1.3	15	1.6	19	2.8	35	4.8	58	5.9	70
SC-109	19.6	1.2	22	1.4	28	2.6	52	4.6	89	5.6	108
SC-110	1.2	2.8	4	3.2	5	4.5	8	6.7	12	7.8	14
SC-111	89.0	1.0	75	1.2	95	2.4	171	4.3	291	5.3	356
SC-112	73.5	1.1	67	1.3	85	2.5	153	4.4	260	5.5	316
SC-113	33.9	1.2	35	1.5	44	2.6	79	4.6	131	5.7	158
SC-114	31.3	1.0	29	1.3	37	2.4	66	4.4	112	5.4	137
SC-115	132.8	1.1	105	1.3	133	2.5	238	4.5	405	5.6	493
SC-116	3.0	0.7	2	1.0	2	2.1	5	4.0	10	5.1	13
SC-117	8.3	2.2	18	2.6	23	3.9	40	5.9	64	7.0	75
SC-118	9.5	1.7	16	2.0	20	3.2	36	5.3	59	6.3	70
SC-119	8.2	0.7	4	0.9	6	2.1	13	4.0	27	5.0	34
SC-120	2.8	1.7	6	2.0	7	3.3	13	5.3	21	6.4	24
SC-121	5.9	0.6	3	0.9	4	2.0	10	3.9	20	4.9	25
SC-122	5.4	0.9	5	1.2	6	2.4	13	4.3	24	5.4	29
SC-123	2.4	0.7	1	1.0	2	2.1	5	4.0	9	5.1	11
SC-124	7.9	1.4	12	1.7	16	2.9	29	4.9	48	6.0	57
SC-125	4.8	0.6	2	0.8	3	1.9	6	3.8	12	4.9	16
SC-126	15.5	2.0	29	2.4	37	3.6	65	5.7	104	6.8	124
SC-127	5.0	1.4	7	1.6	9	2.9	16	4.8	27	5.9	33
SC-128	2.7	1.2	4	1.5	5	2.7	9	4.6	16	5.7	19
SC-129	8.0	1.3	11	1.6	14	2.8	25	4.8	42	5.9	51
SC-130	8.1	2.3	17	2.7	21	4.0	37	6.1	59	7.2	70
SC-131	27.2	0.4	5	0.5	7	1.5	15	3.2	33	4.3	44
SC-132	3.6	0.6	2	0.9	3	2.0	6	3.9	12	5.0	15
SC-133	3.9	1.9	9	2.2	11	3.4	19	5.5	30	6.6	35
SC-134	96.3	0.3	12	0.5	19	1.4	51	3.2	114	4.2	153
SC-135	23.3	2.1	48	2.4	60	3.7	105	5.8	169	6.9	199
SC-136	9.4	1.2	11	1.5	14	2.7	25	4.6	43	5.7	53
SC-137	13.4	1.9	23	2.2	30	3.5	52	5.5	84	6.6	100
SC-138	11.8	1.0	8	1.3	11	2.6	25	4.7	47	5.7	58
SC-138-1AP	2.4	1.8	6	2.1	8	3.4	13	5.5	20	6.6	24
SC-139	32.1	0.4	6	0.7	9	1.8	24	3.7	52	4.8	68
SC-140	15.0	1.8	29	2.1	37	3.4	66	5.5	105	6.6	124
SC-141	17.0	1.5	24	1.8	31	3.1	57	5.2	95	6.3	114
SC-142-10P	15.7	1.6	23	1.9	29	3.2	53	5.3	88	6.4	105

TABLE A.5.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
SC-142-1W	7.1	1.7	6	2.1	8	3.4	16	5.5	27	6.7	33
SC-142-20P	26.7	1.9	51	2.2	64	3.6	114	5.7	182	6.8	214
SC-142-21P	4.7	1.8	10	2.1	13	3.5	22	5.6	35	6.7	41
SC-142-22P	7.2	1.7	14	2.0	18	3.3	32	5.4	52	6.5	61
SC-142-2P	10.6	2.0	25	2.4	31	3.8	54	5.9	83	7.0	97
SC-142-2W	5.7	1.4	5	1.8	7	3.2	14	5.2	24	6.3	29
SC-142-4P	18.8	1.9	33	2.2	42	3.6	75	5.7	120	6.8	142
SC-142-5P	8.3	1.5	7	1.8	9	3.2	18	5.3	31	6.4	38
SC-142-7P	3.6	2.1	6	2.4	7	3.8	13	5.9	20	7.1	24
SC-142-D	18.9	0.8	8	1.0	12	2.3	28	4.3	54	5.4	68
SC-143	24.2	1.2	26	1.4	33	2.6	60	4.6	102	5.7	124
SC-144	3.9	1.0	4	1.3	5	2.5	10	4.5	18	5.5	22
SC-145	46.2	0.7	14	1.0	19	2.2	39	4.2	74	5.3	94
SC-146	22.7	1.2	26	1.5	34	2.7	62	4.8	107	5.8	129
SC-147	22.8	1.4	28	1.7	36	3.0	64	5.0	108	6.1	130
SC-148	37.9	1.3	45	1.6	57	2.8	103	4.8	173	5.9	209
SC-149	1.5	1.8	4	2.2	5	3.5	8	5.6	13	6.7	15
SC-150	43.1	1.2	42	1.4	53	2.7	97	4.7	168	5.8	205
SC-151	19.0	0.9	12	1.1	15	2.3	30	4.3	56	5.4	69
SC-152	5.4	1.8	11	2.2	14	3.6	24	5.7	37	6.8	44
SC-153	54.6	0.8	39	1.1	49	2.2	89	4.1	154	5.1	189
SC-154	3.6	1.6	3	1.9	4	3.3	8	5.4	14	6.5	17
SC-154-1P	27.1	1.6	38	1.9	48	3.3	87	5.3	144	6.4	172
SC-155	15.5	1.3	12	1.6	16	2.9	29	5.0	49	6.0	59
SC-156	17.8	1.1	15	1.4	19	2.7	35	4.7	62	5.8	75
SC-157	3.8	0.7	2	1.0	3	2.1	5	4.1	11	5.2	13
SC-158	32.6	1.1	31	1.4	40	2.6	72	4.6	122	5.6	149
SC-159	10.9	0.9	8	1.1	11	2.3	21	4.2	39	5.2	49
SC-160	51.0	1.4	58	1.7	74	2.9	131	4.8	217	5.9	261
SC-161	45.6	2.1	72	2.4	91	3.7	162	5.7	265	6.8	317
SC-162	14.3	2.6	32	3.0	41	4.3	71	6.5	111	7.6	131
SC-162-1	3.5	2.3	10	2.7	13	4.0	21	6.2	32	7.3	37
SC-162-2	0.8	2.7	3	3.0	4	4.4	6	6.5	9	7.7	10
SC-162-3	1.0	2.2	3	2.6	4	3.9	7	6.0	10	7.1	11
SC-162-7P	2.6	2.2	7	2.5	9	3.9	15	6.0	23	7.1	27
SC-162-ADS	1.1	3.3	4	3.6	5	5.1	8	7.3	12	8.4	14
SC-162-IN	1.0	2.8	4	3.2	5	4.6	8	6.7	11	7.9	13
SC-163	8.3	2.0	17	2.3	21	3.6	37	5.7	58	6.8	69
SC-164	134.2	0.3	14	0.4	19	1.3	49	3.1	115	4.1	155
SC-165	8.8	1.5	15	1.8	19	3.1	35	5.0	57	6.1	68
SC-167	3.1	0.8	2	1.0	4	2.2	9	4.1	16	5.1	20
SC-169	10.5	2.7	30	3.1	38	4.4	64	6.6	97	7.7	113
SC-170	41.9	0.6	11	0.9	17	2.1	41	4.1	85	5.2	109
SC-170.1	33.9	1.7	52	2.1	66	3.4	119	5.5	195	6.6	231
SC-170.2	3.7	1.8	6	2.1	8	3.4	15	5.5	23	6.6	28
SC-170.3	3.7	1.4	5	1.7	7	3.0	14	5.0	23	6.1	28
SC-171	11.1	1.2	12	1.6	15	2.8	29	4.9	51	5.9	62

TABLE A.5.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
SC-172	7.7	1.5	3	1.9	4	3.2	9	5.3	17	6.4	21
SC-173	139.9	0.8	77	1.0	97	2.0	176	3.9	304	5.0	374
SC-174	2.0	1.7	3	2.1	3	3.4	6	5.5	10	6.6	12
SC-175	107.0	1.1	87	1.3	111	2.5	200	4.5	344	5.6	420
SC-176	40.8	1.4	41	1.7	52	3.0	95	5.1	160	6.2	192
SC-177	48.2	1.4	31	1.8	39	3.1	72	5.2	122	6.3	148
SC-178	25.3	0.9	10	1.2	14	2.5	30	4.5	58	5.6	74
SC-179	117.5	1.8	123	2.1	155	3.3	281	5.3	471	6.4	570
SC-180	167.3	0.5	24	0.8	36	1.9	93	3.9	202	4.9	265
SC-180-2P	8.8	1.8	16	2.2	21	3.5	37	5.6	60	6.7	71
SC-180-44P	37.0	2.8	90	3.1	114	4.5	197	6.7	307	7.8	360
SC-180-45P	0.7	2.7	3	3.1	3	4.5	5	6.6	8	7.7	9
SC-180-53P	0.4	3.3	2	3.6	2	5.1	3	7.3	5	8.4	5
SC-180-58R	2.1	1.6	3	2.0	4	3.3	8	5.3	13	6.4	15
SC-180-62P	0.4	3.3	2	3.6	2	5.1	3	7.3	5	8.4	5
SC-180-64P	2.8	3.3	9	3.6	11	5.1	18	7.3	27	8.4	32
SC-180-65P	0.4	3.3	2	3.6	2	5.1	3	7.3	4	8.4	5
SC-180-68P	0.4	3.3	2	3.6	2	5.1	3	7.3	5	8.4	5
SC-180-69P	0.4	3.3	2	3.6	2	5.1	3	7.3	5	8.4	5
SC-180-78P	0.4	3.1	2	3.5	2	4.9	3	7.1	5	8.2	5
SC-180-79P	2.1	2.3	6	2.6	8	4.0	13	6.1	19	7.2	23
SC-180-80P	0.3	3.1	1	3.5	1	4.9	2	7.1	3	8.2	4
SC-181	14.1	1.5	21	1.8	26	3.1	47	5.1	78	6.1	93
SC-182	16.8	1.5	22	1.8	27	3.1	50	5.1	83	6.2	99
SC-183	61.3	1.7	73	2.0	92	3.2	165	5.2	273	6.3	328
SC-184	18.7	0.7	9	0.9	12	2.0	25	3.9	47	4.9	60
SC-185	18.4	1.1	6	1.4	8	2.8	17	4.8	32	5.9	40
SC-186	56.4	1.3	56	1.6	71	2.9	128	5.0	215	6.1	260
SC-187	130.1	0.4	18	0.6	28	1.6	74	3.5	166	4.5	219
SC-188	47.3	1.0	37	1.2	47	2.3	84	4.3	143	5.3	174
SC-189	23.8	0.8	17	1.1	22	2.2	41	4.1	73	5.2	91
SC-190	40.9	0.8	28	1.0	36	2.1	66	4.0	117	5.1	145
SC-191	24.0	0.8	14	1.0	18	2.2	36	4.1	67	5.1	85
SC-192	70.2	1.5	66	1.8	84	3.2	151	5.3	251	6.4	302
SC-192-3P	4.2	1.9	11	2.3	14	3.6	24	5.7	36	6.8	42
SC-192-3PB	14.4	1.9	28	2.2	35	3.6	62	5.7	98	6.8	115
SC-193	7.0	1.0	2	1.3	3	2.6	8	4.7	15	5.7	19
SC-194	4.9	1.0	3	1.4	4	2.7	9	4.7	16	5.8	20
SC-195	2.6	2.0	8	2.4	10	3.6	17	5.7	25	6.8	29
SC-196	37.8	1.5	50	1.8	64	3.1	114	5.2	189	6.3	227
SC-196-A	0.6	2.9	2	3.3	3	4.7	4	6.9	6	8.0	7
SC-196-B	1.7	2.8	6	3.1	7	4.5	12	6.7	17	7.8	20
SC-196-C	3.7	0.7	2	1.0	2	2.1	6	4.1	11	5.2	14
SC-197	137.2	0.7	32	1.0	45	2.3	111	4.3	226	5.4	291
SC-197-1P	4.1	2.0	10	2.4	12	3.8	21	5.9	32	7.0	38
SC-198	97.9	0.7	45	0.9	57	1.9	104	3.8	183	4.9	227
SC-199-3P	45.9	0.7	16	1.0	23	2.2	58	4.2	115	5.3	144

TABLE A.5.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
SC-199-42P	48.7	2.7	103	3.1	130	4.5	229	6.6	364	7.7	429
SC-199-47R	21.7	1.0	6	1.3	9	2.6	20	4.7	40	5.8	51
SC-200	335.6	0.3	35	0.5	48	1.4	117	3.2	275	4.2	369
SC-201	60.0	0.3	8	0.5	12	1.4	34	3.2	76	4.2	102
SC-202	136.5	0.9	98	1.2	124	2.3	222	4.1	377	5.2	461
SC-203	214.9	0.2	13	0.3	20	1.0	57	2.6	136	3.5	185
SC-204	186.5	0.5	22	0.8	31	2.0	80	3.9	176	5.0	232
SC-204-14P	31.6	1.8	41	2.1	52	3.4	94	5.5	155	6.6	187
SC-204-18P	4.7	1.6	7	1.9	9	3.2	16	5.3	27	6.4	32
SC-204-26P	14.7	0.7	5	1.0	7	2.2	18	4.3	35	5.3	44
SC-204-37P	1.5	2.5	4	2.9	5	4.3	9	6.4	14	7.5	16
SC-204-38P	1.4	2.5	4	2.9	5	4.2	9	6.4	13	7.5	15
SC-204-45P	1.0	2.5	3	2.8	4	4.2	6	6.3	10	7.5	11
SC-206	4.2	2.8	15	3.1	18	4.5	29	6.6	44	7.8	50
SC-207	2.8	0.7	1	1.0	2	2.2	4	4.1	9	5.2	11
SC-208	445.8	0.4	133	0.5	169	1.3	305	2.9	523	3.8	646
SC073-211P	9.7	1.0	6	1.3	8	2.6	17	4.6	33	5.7	41
SC073-5ACP	13.2	1.7	26	2.0	33	3.3	61	5.4	97	6.5	113
SC073-800P	8.4	1.6	15	2.0	20	3.3	36	5.4	57	6.5	68
SC075-103E	14.2	1.7	27	2.0	34	3.3	63	5.4	100	6.5	117
SC075-103W	8.8	1.7	17	2.0	22	3.4	39	5.5	62	6.6	73
SC075-700P	26.3	1.5	36	1.8	46	3.2	85	5.3	141	6.3	169
SC075103FE	1.7	1.6	4	1.9	5	3.2	9	5.3	13	6.4	16
SC075103FW	0.5	1.5	1	1.9	2	3.2	3	5.2	4	6.3	5
SC142-WL9P	4.3	1.9	3	2.2	4	3.6	8	5.7	14	6.8	18
SC178-400P	4.8	0.9	3	1.2	5	2.5	10	4.5	19	5.6	23
SC178104NS	14.5	1.6	24	2.0	30	3.3	55	5.4	89	6.5	105
CD12-5a	502.1	0.8	327	1.0	413	2.0	743	3.8	1259	4.8	1536
CD12-5b	63.5	0.8	48	1.1	61	2.2	115	4.0	203	5.1	252
CD12-5c	235.6	1.0	197	1.3	249	2.4	446	4.2	750	5.3	911

TABLE A.5.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
SC-001	L-LSC-143	1087.4	1089.2	18	1089.5	23	1091.2	53	1093.6	81	1095.5	90
SC-002	L-LSC-145	1068.8	1071.3	22	1072.0	29	1073.3	62	1073.4	102	1073.4	121
SC-003	L-LSC-163	1072.6	1073.2	5	1073.2	6	1073.5	17	1073.8	35	1073.9	45
SC-004	Multiple Links*	1021.7	1022.7	41	1022.9	59	1023.2	113	1023.4	168	1023.6	228
SC-005	Multiple Links*	1019.0	1022.7	39	1022.9	40	1023.2	76	1023.4	192	1023.5	258
SC-006	Multiple Links*	1004.5	1005.2	9	1005.4	13	1008.2	26	1009.0	67	1009.2	83
SC-007	Multiple Links*	1044.5	1044.7	2	1044.8	4	1045.4	7	1046.7	12	1047.2	16
SC-008	L-LSC-201	1016.0	1017.0	36	1017.0	43	1017.6	71	1018.1	112	1018.3	145
SC-009	L-LSC-206	1014.7	1016.4	16	1016.6	21	1017.9	44	1023.0	89	1025.1	113
SC-010	Multiple Links*	1004.0	1006.4	85	1006.9	107	1008.1	154	1009.1	183	1009.5	194
SC-011	Multiple Links*	1013.5	1014.5	10	1014.8	14	1016.1	35	1018.5	59	1019.1	119
SC-012	Multiple Links*	1007.7	1010.8	54	1011.3	68	1012.8	116	1014.9	171	1015.5	189
SC-013	L-LSC-407	1005.8	1006.5	1	1006.7	2	1007.4	4	1008.7	5	1009.3	5
SC-014	Multiple Links*	1002.8	1003.5	6	1003.9	7	1004.9	19	1005.2	79	1005.3	115
SC-015	L-LSC-706	1002.4	1002.9	4	1003.0	5	1003.5	12	1004.6	26	1005.4	32
SC-016	L-LSC-414	995.7	996.3	2	996.4	3	996.7	10	997.1	22	997.2	29
SC-017	Multiple Links*	998.3	1001.4	4	1001.7	5	1002.8	8	1004.3	11	1005.1	12
SC-021	L-LSC-217	1010.1	1010.6	15	1010.7	23	1010.9	63	1011.6	138	1011.8	181
SC-022	L-LSC-218	997.5	1002.0	12	1002.0	19	1002.1	49	1002.3	106	1002.3	139
SC-024-8P	Multiple Links*	972.0	973.7	5	973.9	6	974.2	15	974.6	47	974.8	67
SC-025	L-LSC-692	982.4	983.7	22	983.7	28	983.8	46	983.9	69	983.9	80
SC-026A	Multiple Links*	971.0	972.0	14	972.0	18	972.3	37	972.9	98	973.1	124
SC-027	Multiple Links*	970.1	970.7	3	970.9	5	971.7	6	972.3	25	972.6	36
SC-028	Multiple Links*	970.0	970.7	0	970.9	0	971.7	4	971.9	19	971.9	26
SC-029	L-LSC-643	965.6	966.1	19	966.1	25	966.3	65	966.9	161	967.7	206
SC-030	L-LSC-427	971.0	971.4	14	971.5	18	971.8	39	972.3	102	972.5	128
SC-031	L-LSC-526	960.6	962.5	73	962.8	92	965.0	162	966.9	264	967.7	317
SC-032	L-LSC-525	961.5	962.9	10	963.0	12	965.0	20	966.8	31	967.6	34
SC-033	L-LSC-150	1115.2	1115.6	14	1115.6	18	1115.8	34	1116.0	63	1116.0	78
SC-034	L-LSC-153	1115.9	1116.0	0	1116.0	0	1116.2	0	1116.6	0	1116.8	1
SC-035	L-LSC-284	1119.9	1121.2	0	1121.4	0	1122.1	0	1122.9	0	1123.2	0
SC-036	L-LSC-285	1109.6	1109.8	0	1109.9	0	1110.4	0	1111.2	0	1111.6	0
SC-037	LLSC155.OC	1080.6	1093.5	0	1094.3	0	1095.5	17	1095.7	69	1095.7	98
SC-038	Multiple Links*	1092.9	1093.5	13	1093.7	19	1095.1	49	1095.3	102	1095.4	131
SC-039	L-LSC-289	1086.7	1087.4	4	1087.6	5	1088.4	11	1089.5	21	1090.0	25
SC-040	L-LSC-162	1047.4	1047.7	32	1047.7	41	1048.2	77	1049.1	136	1049.5	167
SC-041	L-LSC-164	1062.6	1063.9	175	1063.9	138	1065.3	99	1066.8	161	1067.6	178
SC-042	L-LSC-157	1060.8	1063.8	45	1063.9	53	1065.3	88	1066.8	129	1067.6	143
SC-043	L-LSC-160	1063.1	1063.8	20	1064.0	21	1065.3	36	1066.8	53	1067.6	60
SC-044	Multiple Links*	950.6	952.9	14	953.3	16	954.4	22	955.9	25	956.4	30
SC-045	L-LSC-597	950.0	952.3	12	952.6	13	953.3	17	954.2	20	954.6	22
SC-046	Multiple Links*	950.5	952.9	4	953.3	5	954.4	8	955.9	16	956.4	18

TABLE A.5.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
SC-047	Multiple Links*	940.5	940.9	3	941.0	3	941.6	3	942.6	5	943.1	6
SC-048	L-LSC-726	953.7	956.5	200	956.7	255	957.1	443	958.0	984	958.3	1207
SC-049	L523.OC3	944.5	946.3	3	946.4	4	946.4	8	947.4	11	947.8	12
SC-050	LSC522.OC	941.1	943.6	4	943.8	4	944.4	9	945.2	17	945.5	22
SC-051	LSC051.OC	941.0	941.9	0	942.1	0	942.7	0	943.0	5	943.1	10
SC-052	Multiple Links*	934.8	937.1	6	937.5	6	938.8	8	940.7	9	941.7	10
SC-053	Multiple Links*	940.4	941.3	4	941.4	4	942.1	9	943.2	13	943.7	19
SC-054	L-LSC-049	950.1	952.1	10	952.3	12	953.2	14	953.7	28	953.8	40
SC-055	Multiple Links*	950.4	952.0	34	952.3	41	953.1	58	953.9	67	954.2	84
SC-056	L-LSC-593	949.8	950.2	3	950.3	4	950.5	7	950.9	9	951.0	9
SC-057	Multiple Links*	947.6	950.7	6	950.7	11	950.7	21	950.8	36	950.8	43
SC-058	L-LSC-563	949.7	951.0	9	951.3	11	952.1	20	953.4	27	954.2	28
SC-059	Multiple Links*	946.1	947.1	13	947.6	14	948.4	28	952.1	239	952.4	655
SC-060	Multiple Links*	951.2	951.6	4	951.7	5	952.0	8	952.8	10	953.2	12
SC-061	Multiple Links*	953.4	955.3	22	955.6	26	956.2	40	956.9	48	957.2	51
SC-062	Multiple Links*	967.7	969.2	0	969.7	0	970.6	3	971.7	6	972.3	12
SC-063	L-LSC-619	967.1	969.2	0	969.7	0	970.6	0	971.7	0	972.2	0
SC-064	L-LSC-725	966.0	967.7	155	967.8	205	968.2	436	968.5	784	968.6	955
SC-065	Multiple Links*	966.3	966.9	5	967.0	6	967.6	10	968.6	17	969.2	22
SC-066	L-LSC-723	974.6	976.6	154	976.9	203	977.5	436	978.0	776	978.2	940
SC-067	Multiple Links*	974.3	976.6	1	976.9	4	977.5	2	979.2	141	979.6	317
SC-068	L-LSC-638	961.7	962.4	37	962.5	49	963.8	112	964.6	234	964.8	307
SC-069	Multiple Links*	961.8	962.8	41	963.0	51	965.4	86	968.1	126	968.7	189
SC-070	L-LSC-842	956.0	956.3	15	956.4	19	957.2	37	958.8	88	959.2	144
SC-071	Multiple Links*	957.4	959.3	15	960.2	17	963.9	23	965.8	93	965.9	156
SC-072	Multiple Links*	959.7	961.5	24	961.9	30	964.6	48	965.8	48	966.1	45
SC-073	Multiple Links*	972.1	974.6	7	975.1	19	978.1	25	980.5	78	980.8	140
SC-074	Multiple Links*	970.7	972.1	15	972.3	27	972.6	53	974.5	93	975.6	135
SC-075	Multiple Links*	977.0	977.8	29	978.1	29	979.6	29	981.2	75	982.1	77
SC-076	Multiple Links*	956.0	957.0	11	957.3	14	958.6	18	958.9	62	959.9	229
SC-077	Multiple Links*	953.8	956.6	14	956.6	19	956.8	36	958.8	62	960.2	76
SC-078	Multiple Links*	956.0	957.7	11	957.9	15	958.6	29	958.9	58	959.9	63
SC-079	Multiple Links*	961.9	964.8	6	965.5	6	967.7	17	968.2	61	968.5	87
SC-080	Multiple Links*	980.3	982.8	23	983.3	31	985.6	36	986.8	174	987.1	230
SC-081	L-LSC-727	954.0	956.4	204	956.6	261	957.0	449	958.0	1006	958.2	1241
SC-082	Multiple Links*	978.4	979.0	21	979.2	21	979.5	26	979.7	40	980.1	47
SC-083	Multiple Links*	978.0	982.4	7	983.8	9	987.2	16	987.9	18	988.0	24
SC-084	Multiple Links*	976.6	980.0	4	980.3	6	981.2	12	982.2	19	982.3	27
SC-085	Multiple Links*	973.6	976.3	36	976.8	47	979.8	70	981.5	74	981.8	99
SC-086	Multiple Links*	947.9	949.7	11	949.9	13	950.8	22	952.1	26	952.6	30
SC-087	Multiple Links*	983.8	984.3	2	984.4	2	985.0	4	985.8	6	986.2	6
SC-088	Multiple Links*	980.0	982.5	2	982.6	2	983.1	4	984.3	8	984.5	11

TABLE A.5.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
SC-089	L-LSC-458	981.5	980.4	11	980.4	14	980.5	28	980.5	49	980.6	61
SC-090	Multiple Links*	965.0	976.0	0	977.1	2	978.1	3	979.7	224	980.1	478
SC-091	Multiple Links*	987.5	988.6	7	988.8	7	989.6	14	990.7	24	991.2	27
SC-092	Multiple Links*	966.5	968.4	29	968.7	36	970.6	61	974.2	90	974.7	105
SC-093	Multiple Links*	965.7	968.2	16	968.6	20	970.6	30	972.2	412	972.4	886
SC-094	Multiple Links*	965.6	969.3	88	969.9	112	972.4	197	973.5	334	973.7	392
SC-095	L-LSC-499	994.8	999.4	14	999.8	18	1000.0	45	1000.1	101	1000.2	130
SC-096	Multiple Links*	958.2	960.4	6	961.0	8	963.6	15	967.3	19	968.7	22
SC-097	L-LSC-505	967.6	968.0	1	968.1	1	968.5	3	969.2	4	969.6	5
SC-098	Multiple Links*	944.5	949.9	11	950.0	15	952.0	34	952.2	95	952.3	125
SC-099	Multiple Links*	949.4	951.2	10	951.5	13	952.3	40	952.7	92	952.8	119
SC-101	L-LSC-578	949.8	951.5	13	951.8	17	952.8	32	954.5	48	955.3	54
SC-102	L-LSC-517	940.0	940.2	14	940.3	18	940.4	41	940.5	80	940.5	101
SC-103	Multiple Links*	937.7	938.9	62	939.0	85	939.1	154	939.2	250	939.2	299
SC-104	Multiple Links*	968.9	971.2	48	971.5	57	973.0	108	975.4	127	976.6	137
SC-105	L-LSC-548	964.7	965.1	22	965.2	29	965.8	57	968.2	54	970.2	79
SC-106	Multiple Links*	962.3	964.4	22	964.8	28	965.8	48	968.2	61	970.2	70
SC-107	Multiple Links*	957.6	961.3	61	961.9	77	964.8	139	966.3	225	966.9	263
SC-108	Multiple Links*	970.3	971.6	17	971.8	20	973.4	34	975.8	59	976.9	69
SC-109	Multiple Links*	970.6	972.9	30	973.4	37	975.4	169	978.8	5416	979.9	4608
SC-110	Multiple Links*	970.2	972.4	30	972.8	37	976.1	101	978.8	109	979.9	230
SC-111	Multiple Links*	973.0	976.9	17	977.7	19	981.1	27	982.3	184	982.4	265
SC-112	L-LSC-354	983.8	987.9	71	988.5	88	990.1	127	991.1	203	991.4	260
SC-113	Multiple Links*	984.5	988.6	32	989.3	40	990.1	87	991.1	111	991.4	120
SC-114	L-LSC-308	989.9	991.4	8	991.6	9	993.1	14	995.8	17	996.8	17
SC-115	Multiple Links*	989.5	991.2	5	991.6	7	993.5	13	996.5	21	996.8	83
SC-116	Multiple Links*	988.2	988.8	1	988.9	2	990.9	4	993.5	9	993.7	11
SC-117	Multiple Links*	983.6	985.0	17	985.2	21	988.3	32	992.6	42	992.9	46
SC-118	Multiple Links*	980.5	982.0	21	982.1	24	982.5	31	983.2	40	984.5	65
SC-119	Multiple Links*	975.8	978.2	31	978.7	40	981.3	59	982.8	54	983.5	63
SC-120	Multiple Links*	975.6	977.8	33	978.2	43	980.8	66	982.4	70	983.0	67
SC-121	Multiple Links*	980.4	981.0	27	981.1	35	982.0	59	983.2	59	983.8	63
SC-122	Multiple Links*	972.5	975.2	36	975.7	47	977.9	70	979.8	81	980.8	87
SC-123	L-LSC-383	980.3	981.5	1	981.7	2	982.6	4	983.7	4	984.1	4
SC-124	Multiple Links*	968.4	974.0	39	974.3	48	975.4	66	978.8	84	979.9	91
SC-125	Multiple Links*	984.8	985.4	2	985.6	2	989.4	6	989.9	14	990.0	19
SC-126	Multiple Links*	976.3	978.3	24	980.4	27	983.7	34	984.5	48	984.7	63
SC-127	Multiple Links*	975.2	977.4	5	979.1	6	981.5	14	982.3	14	982.6	10
SC-128	L-LSC-382	970.4	976.9	31	978.3	36	980.7	43	982.4	52	982.9	53
SC-129	Multiple Links*	976.9	978.2	8	978.6	11	980.8	13	982.1	12	982.7	14
SC-130	Multiple Links*	973.8	976.2	24	977.8	28	980.4	33	982.1	35	982.6	23
SC-131	L-LSC-400	982.4	983.3	3	983.5	5	984.4	13	985.6	24	986.2	28

TABLE A.5.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
SC-132	Multiple Links*	973.6	974.4	2	975.5	3	978.6	4	979.9	4	980.7	4
SC-133	Multiple Links*	970.5	973.1	31	973.4	37	975.6	50	978.8	71	979.9	83
SC-134	L-LSC-151	1092.8	1094.2	15	1094.8	19	1096.1	62	1096.3	161	1096.3	214
SC-135	Multiple Links*	1079.2	1083.7	28	1084.1	29	1085.2	32	1086.7	37	1087.3	52
SC-136	Multiple Links*	979.8	982.1	8	983.7	11	985.6	30	985.7	61	985.7	71
SC-137	LSC569OC2	932.8	935.7	4	935.8	7	936.3	27	937.6	63	938.2	75
SC-138	Multiple Links*	1031.0	1031.8	6	1032.0	8	1033.0	14	1034.6	20	1035.1	32
SC-139	L-LSC-431	1027.3	1028.6	10	1028.9	14	1029.9	30	1031.4	44	1031.8	79
SC-140	Multiple Links*	1054.6	1055.5	17	1055.7	20	1056.4	43	1056.5	84	1056.5	101
SC-141	L-LSC-434	1065.0	1066.9	1	1067.3	1	1068.3	11	1069.7	23	1070.5	15
SC-143	Multiple Links*	1031.4	1032.9	4	1033.3	5	1034.7	16	1034.8	62	1034.9	91
SC-144	L-LSC-259	1006.1	1008.2	30	1008.7	36	1011.3	68	1014.5	122	1014.7	185
SC-145	Multiple Links*	1006.3	1008.2	60	1008.7	77	1011.3	143	1014.5	315	1014.7	489
SC-146	L-LSC-258	1019.0	1019.3	25	1019.3	33	1019.4	68	1019.6	121	1019.6	149
SC-147	Multiple Links*	1012.3	1014.9	81	1015.3	97	1016.1	137	1017.4	208	1017.7	293
SC-148	L-LSC-263	1014.3	1016.4	24	1016.7	30	1017.9	54	1020.0	82	1021.4	92
SC-149	Multiple Links*	1012.7	1013.7	2	1013.9	3	1014.7	4	1015.6	6	1015.8	9
SC-150	Multiple Links*	1032.8	1035.0	59	1035.7	71	1037.6	96	1040.3	130	1040.6	199
SC-151	Multiple Links*	1025.1	1027.1	5	1027.5	8	1027.6	23	1027.8	47	1027.9	59
SC-152	Multiple Links*	1000.8	1003.9	5	1004.4	5	1004.9	16	1005.0	31	1005.0	37
SC-153	Multiple Links*	1051.3	1054.2	28	1054.5	33	1055.7	45	1056.5	106	1056.6	144
SC-154	Multiple Links*	986.2	986.4	2	986.4	2	986.8	2	988.8	108	988.9	151
SC-155	Multiple Links*	982.6	984.0	3	984.3	3	985.5	5	986.2	23	986.3	34
SC-156	Multiple Links*	981.0	984.0	8	984.3	7	985.5	8	986.2	47	986.3	75
SC-157	L-LSC-822	984.2	984.4	6	984.4	6	984.6	6	985.3	6	985.6	6
SC-158	Multiple Links*	981.5	984.0	2	984.3	4	985.5	9	986.2	47	986.3	68
SC-159	Multiple Links*	949.7	950.2	10	950.4	11	951.0	15	951.9	22	952.4	25
SC-160	Multiple Links*	956.6	960.3	76	961.0	94	963.8	146	965.1	195	965.4	281
SC-161	Multiple Links*	949.0	952.7	108	953.5	134	958.5	233	959.0	327	959.3	362
SC-162	L-LSC-520	943.1	944.8	37	945.0	45	945.6	67	947.1	79	948.5	105
SC-163	Multiple Links*	939.7	943.3	29	943.7	31	944.7	44	945.0	110	945.1	140
SC-164	L-LSC-718	996.8	998.7	104	999.0	145	999.9	327	1000.5	651	1000.8	861
SC-165	L-LSC-332	979.2	981.7	19	983.1	25	985.4	33	986.3	36	986.7	38
SC-167	Multiple Links*	975.1	978.3	4	978.9	4	979.9	18	981.5	26	981.8	31
SC-169	L-LSC-588	948.5	950.7	6	951.0	7	951.6	9	951.8	24	951.9	41
SC-170	L-LSC-574	956.7	957.4	12	957.5	18	957.9	54	958.3	179	958.4	266
SC-171	L-LSC-761	1064.0	1064.2	9	1064.3	12	1064.4	23	1064.6	41	1064.6	51
SC-172	L-LSC-713	997.2	999.7	126	1000.0	167	1000.8	372	1001.3	552	1001.5	637
SC-173	L-830	926.4	931.7	436	932.3	560	933.9	1054	935.5	2102	936.2	2848
SC-174	Multiple Links*	1014.7	1017.1	68	1017.5	87	1019.2	173	1020.2	226	1020.7	243
SC-175	L-1351	930.4	932.7	98	932.9	149	933.2	333	933.5	601	933.6	723
SC-176	L-LSC-732	938.3	940.7	420	941.0	548	941.7	1003	942.5	2074	943.1	2762

TABLE A.5.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
SC-177	L-LSC-722	982.9	986.2	153	986.4	203	988.0	436	990.5	735	991.5	819
SC-178	L-LSC-739	1004.4	1005.2	12	1005.4	16	1006.7	44	1009.4	133	1010.6	176
SC-179	L-LSC-737	932.6	934.4	143	934.7	177	935.7	304	937.0	498	937.7	606
SC-180	L-LSC-805	988.4	991.1	22	991.6	49	991.8	293	992.1	756	992.2	1030
SC-181	L-LSC-842	952.0	953.3	15	953.5	19	954.0	37	954.8	88	955.4	144
SC-182	L-LSC-735	929.9	934.8	441	935.4	573	937.1	1048	940.5	2100	941.2	2824
SC-183	Multiple Links*	941.0	945.1	233	945.4	293	946.4	509	948.5	1083	949.4	1334
SC-184	L-LSC-839	957.6	961.0	154	961.6	202	963.8	366	964.6	854	964.8	1079
SC-185	L-LSC-644	1001.0	1003.3	141	1003.7	180	1005.1	386	1006.3	552	1006.7	612
SC-186	L-LSC-832	1045.6	1047.2	8	1047.4	10	1048.2	13	1049.1	17	1049.5	19
SC-187	L-LSC-831	1016.2	1019.6	29	1021.4	47	1021.9	147	1023.0	273	1023.5	327
SC-188	Multiple Links*	946.1	948.2	199	948.7	252	950.2	484	952.8	1000	953.0	1433
SC-189	Multiple Links*	962.2	965.0	139	965.4	180	967.0	320	970.4	883	970.6	1454
SC-190	Multiple Links*	956.5	959.5	151	960.3	208	962.0	380	965.9	927	966.6	1541
SC-191	L-LSC-754	951.7	955.7	168	956.2	227	957.5	415	959.7	920	960.7	1416
SC-192	L-LSC-745	986.8	990.1	78	990.7	102	992.6	262	993.1	577	993.3	850
SC-193	L-LSC-790	977.4	980.3	99	980.9	130	983.3	268	984.6	681	985.0	994
SC-194	Multiple Links*	977.0	979.5	100	980.1	132	982.1	247	984.2	683	984.4	1012
SC-195	Multiple Links*	968.0	969.3	121	969.6	158	970.2	280	973.1	759	973.4	1174
SC-196	Multiple Links*	965.2	968.3	130	968.7	169	970.0	297	973.1	885	973.3	1353
SC-197	L-LSC-741	949.9	950.8	53	952.0	77	953.9	185	957.0	323	958.3	363
SC-198	L-LSC-744	940.7	942.6	80	943.1	115	944.9	266	946.1	485	946.3	565
SC-200	L-LSC-809	959.6	961.3	39	962.0	69	963.9	166	966.9	301	967.7	327
SC-201	L-LSC-818	960.8	962.5	16	962.8	19	965.0	38	966.9	139	967.7	160
SC-202	L-LSC-815	942.7	945.4	71	945.7	88	946.9	178	949.3	306	950.2	343
SC-203	L-LSC-816	937.2	939.0	71	939.1	96	939.5	209	940.0	399	940.1	491
SC-204	L-1339	925.9	927.2	170	927.3	222	927.7	442	928.4	765	928.8	897
SC-206	L-LSC-750	975.6	977.6	121	977.9	158	978.5	280	979.7	759	980.0	1174
SC-207	Multiple Links*	974.1	977.6	124	978.0	164	978.5	286	979.7	950	980.1	1356
SC-208	L-LSC-850	1021.7	1022.2	108	1022.3	135	1022.5	236	1022.9	397	1023.0	495
CD12-5a	L-1618	1038.9	1044.8	98	1045.4	107	1047.7	164	1051.6	222	1053.5	249
CD12-5b	L-LSC-763	1083.8	1087.5	0	1088.3	0	1090.8	24	1092.0	244	1092.3	400
CD12-5c	L-LSC-764	1101.1	1105.0	171	1105.2	214	1105.6	377	1106.0	623	1106.1	757

*Discharge rates reported are the sum of peak flow rates of all downstream conduits

A.6 FARMINGTON OUTLET DISTRICT

The Farmington Outlet District is located east of Ipava Avenue and extends to the boundary with the City of Farmington, between 202nd Street and 175th Street. The district lies within the Vermillion River Watershed, which is managed by the VRWJPO. Lakeville is a member of this Joint Powers Organization. There are no large surface water bodies within this district. Drainage from the Farmington Outlet District flows east in existing channels through the City of Farmington into the Vermillion River, which discharges to the Mississippi River.

The watershed divides of the Farmington Outlet District are shown on **Figure A.6.1**. More detail on the drainage system is shown on **Figure A.6.2**. Drainage from this district flows in three main channels (located in FO-044, FO-042, and FO-053) to the City of Farmington. In the FO-044 channel, drainage from west of Dodd Boulevard is collected in the channel and flows directly east at 182nd Street. The central channel collects runoff from areas adjacent to 190th Street, and flows east through Subwatershed FO-042. Runoff from areas between 195th and 200th Street is collected in the southern channel and flows east through Subwatershed FO-053.

The Farmington Outlet District covers approximately 3,360 acres, which is primarily agricultural land. Compared to the northern and western portions of the City there is a considerable relief in this district. This relief has created several swales and channels. The streams of the Farmington Outlet District all discharge to the Vermillion River below the City of Farmington.

A.6.1 Flood Protection

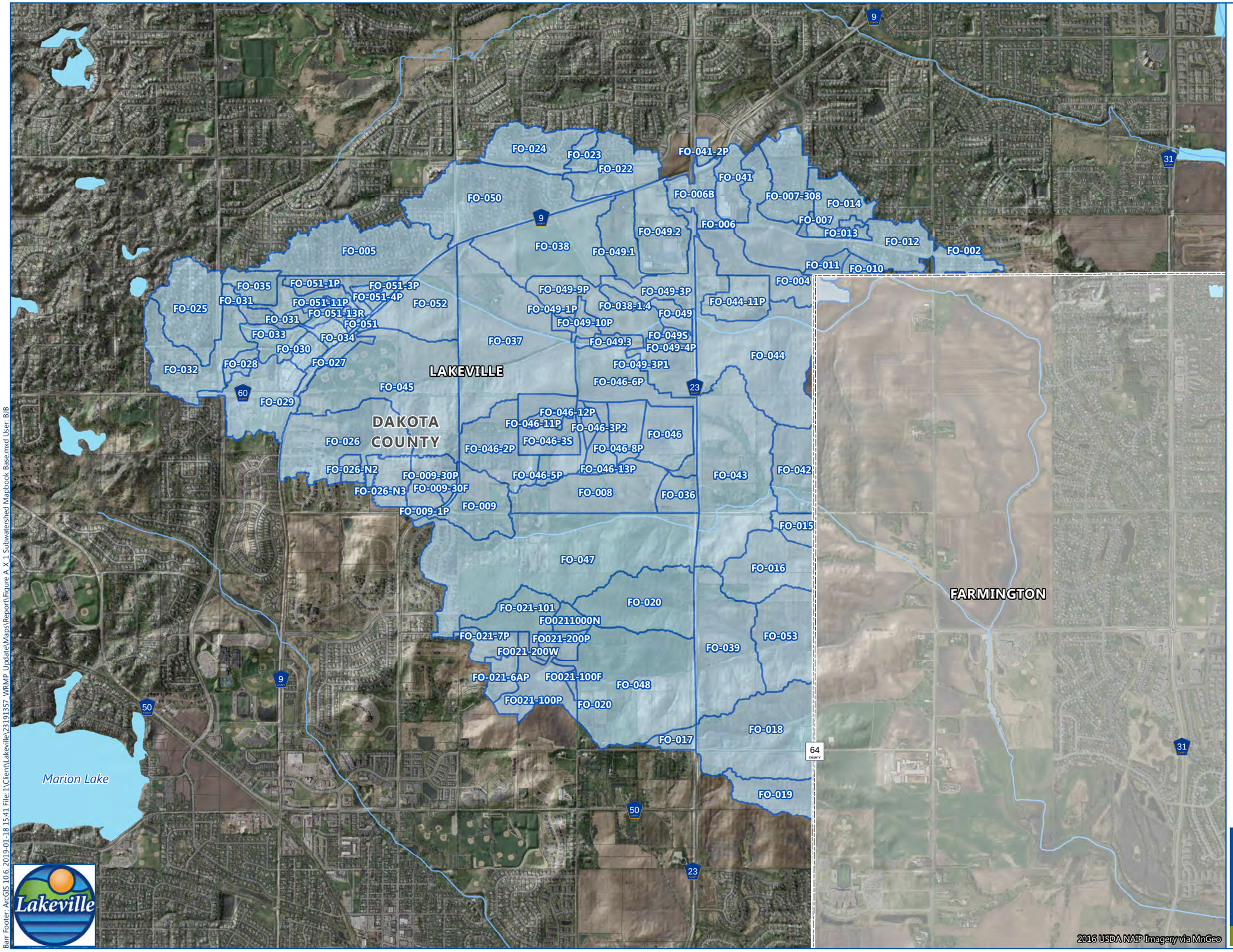
For each subwatershed and storage pond, peak runoff rates, flood levels, flood discharges, and storage volumes were calculated using the XP-SWMM model. The results of the modeling are shown in the following tables:

Table A.6.1	**Hydrologic Parameters - Existing Conditions—** (subwatershed data)
Table A.6.2	**Hydrologic Results - Existing Conditions—**(peak flow rates from subwatersheds)
Table A.6.3	**Hydraulic Results - Existing Conditions—**(peak discharges and elevations)

A.6.2 Subwatershed Pond Descriptions

The subwatersheds described in this section have unique characteristics or significant alterations maybe considered at the time of future development.

FO-036: Under existing conditions, the existing pond overtops 190th Street by approximately 0.3 feet during the 100-year event. To lower the 100-year flood level additional storage within the watershed maybe be considered at the time of future development, approximately 4.1 ac-ft of flood storage maybe necessary to prevent the road from overtopping.



County Boundary
Municipal Boundary
Parcel Boundary
Subwatersheds
Public Water Inventory Watercourses
Public Water Inventory Basins

Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

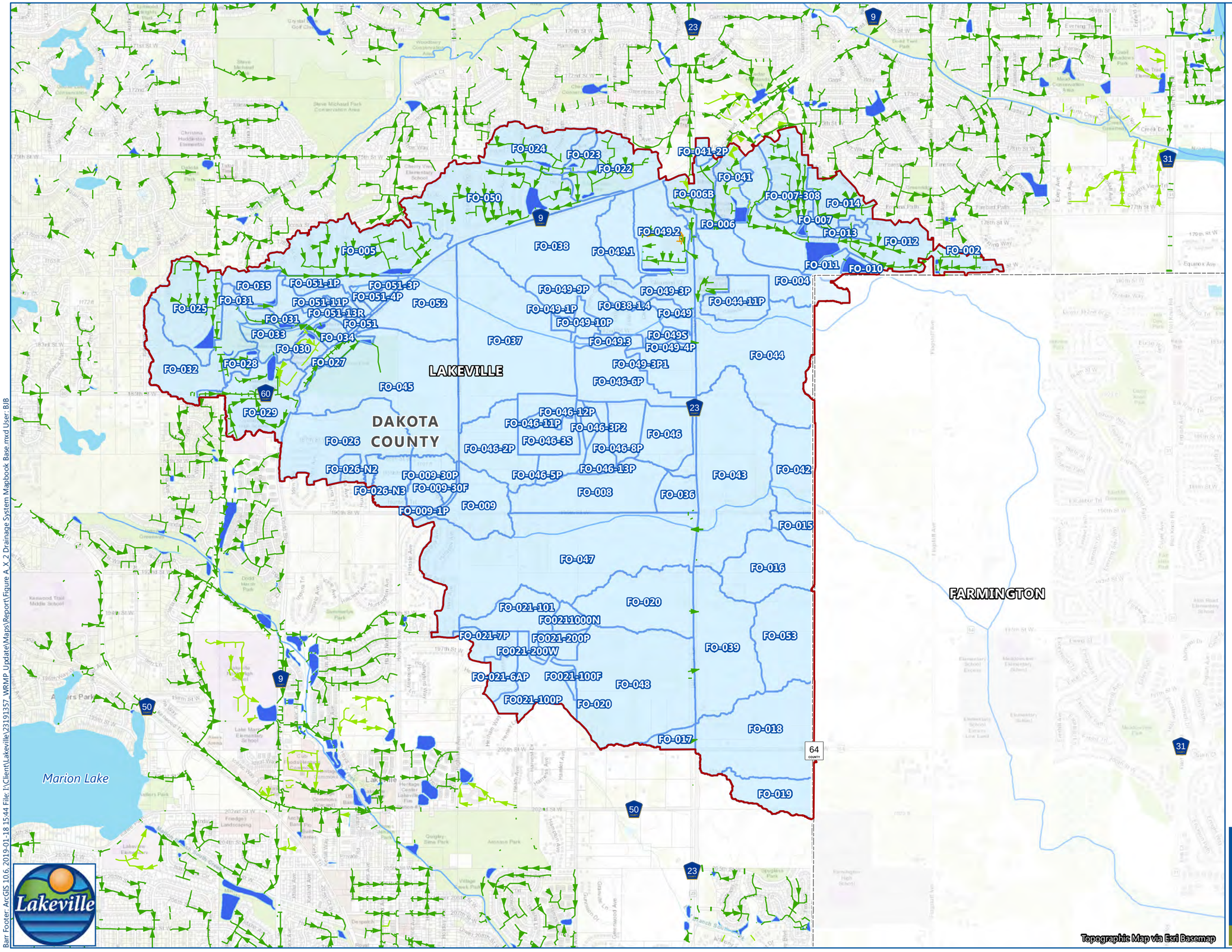
N

1,000 0 1,000
Feet

FARMINGTON OUTLET SUBWATERSHEDS
Water and Natural Resources Management Plan
City of Lakeville

FIGURE A.6.1

Barr Footer: ArcGIS 10.6, 2019-01-18 15:41 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure A.X.1 Subwatershed Mapbook Base.mxd User: BJB



County Boundary
Municipal Boundary
Parcel Boundary

Pipes

Storm Main
Private Storm Main
Drain Tile

Subwatersheds
Major Subwatersheds
Existing Pond
Public Water Inventory Watercourses
Public Water Inventory Basins

Major Watersheds, Ponds and Pipe data from the City of Lakeville. Subwatersheds from the City of Lakeville and edited by Barr Engineering as part of the 2018 XP-SWMM model update.

N

1,000 0 1,000
Feet

Topographic Map via Esri Basemap

FARMINGTON OUTLET DRAINAGE SYSTEM
Water and Natural Resources Management Plan
City of Lakeville

FIGURE A.6.2

Barr Footer: ArcGIS 10.6, 2019-01-18 15:44 File: I:\Client\Lakeville\23191357_WRMP_Update\Maps\Report\Figure A_X_2 Drainage System Mapbook Base.mxd User: BJB

TABLE A.6.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION	MINIMUM INFILTRATION	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
FO-002	14.5	0.00	425	0.042	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
FO-004	46.0	0.09	470	0.033	0.212	0.014	0.200	0.060	1.00	0.12	0.00110
FO-005	91.0	21.30	1317	0.073	0.273	0.014	0.170	0.060	1.00	0.11	0.00110
FO-006	1.3	31.83	130	0.046	0.239	0.014	0.180	0.060	1.00	0.11	0.00110
FO-006B	26.2	56.41	770	0.054	0.242	0.014	0.180	0.060	1.00	0.11	0.00110
FO-007	3.6	0.60	260	0.021	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
FO-007-308	43.5	16.66	703	0.054	0.241	0.014	0.180	0.060	1.00	0.12	0.00110
FO-008	65.9	0.30	926	0.054	0.301	0.014	0.200	0.060	1.00	0.13	0.00110
FO-009	41.0	2.10	927	0.047	0.243	0.014	0.190	0.060	1.00	0.11	0.00110
FO-009-1P	4.7	38.00	176	0.041	0.217	0.014	0.190	0.060	1.00	0.12	0.00110
FO-009-30F	2.0	38.00	222	0.031	0.212	0.014	0.200	0.060	1.00	0.03	0.00110
FO-009-30P	24.0	38.00	975	0.041	0.218	0.014	0.190	0.060	1.00	0.12	0.00110
FO-010	6.3	1.28	288	0.084	0.277	0.014	0.180	0.060	1.00	0.14	0.00110
FO-011	8.1	0.20	398	0.034	0.269	0.014	0.180	0.060	1.00	0.14	0.00110
FO-012	99.1	18.02	1731	0.044	0.249	0.014	0.180	0.060	1.00	0.13	0.00110
FO-013	2.0	2.35	272	0.045	0.281	0.014	0.180	0.060	1.00	0.14	0.00110
FO-014	28.7	22.35	554	0.051	0.274	0.014	0.170	0.060	1.00	0.14	0.00110
FO-015	13.3	0.00	512	0.059	0.300	0.014	0.200	0.060	1.00	0.14	0.00110
FO-016	55.2	0.10	948	0.050	0.299	0.014	0.200	0.060	1.00	0.13	0.00110
FO-017	9.9	4.20	292	0.034	0.294	0.014	0.190	0.060	1.00	0.11	0.00110
FO-018	104.4	0.30	1272	0.064	0.301	0.014	0.200	0.060	1.00	0.11	0.00110
FO-019	30.2	0.30	542	0.040	0.300	0.014	0.200	0.060	1.00	0.13	0.00110
FO-020	70.3	0.00	995	0.055	0.299	0.014	0.200	0.060	1.00	0.13	0.00110
FO-021-101	34.0	0.00	1061	0.039	0.215	0.014	0.200	0.060	1.00	0.10	0.00110
FO-021-6AP	13.8	0.00	619	0.035	0.216	0.014	0.200	0.060	1.00	0.10	0.00110
FO-021-7P	15.4	30.98	631	0.033	0.221	0.014	0.190	0.060	1.00	0.13	0.00110
FO-022	43.0	13.40	701	0.051	0.311	0.014	0.180	0.060	1.00	0.13	0.00110
FO-023	9.7	28.30	307	0.065	0.365	0.014	0.170	0.060	1.00	0.11	0.00110
FO-024	41.6	26.00	1065	0.065	0.366	0.014	0.170	0.060	1.00	0.13	0.00110
FO-025	57.4	9.50	803	0.055	0.289	0.014	0.180	0.060	1.00	0.13	0.00110
FO-026	84.8	0.88	903	0.043	0.246	0.014	0.190	0.060	1.00	0.09	0.00110
FO-026-N3	21.4	38.00	911	0.038	0.255	0.014	0.180	0.060	1.00	0.13	0.00110
FO-027	12.0	13.60	222	0.053	0.282	0.014	0.180	0.060	1.00	0.14	0.00110
FO-028	7.3	39.00	251	0.047	0.255	0.014	0.170	0.060	1.06	0.13	0.00110
FO-029	57.2	31.90	923	0.042	0.262	0.014	0.170	0.060	1.01	0.11	0.00110
FO-030	9.7	0.00	480	0.058	0.289	0.014	0.190	0.060	1.00	0.13	0.00110
FO-031	11.6	18.64	309	0.045	0.231	0.014	0.190	0.060	1.00	0.10	0.00110
FO-032	60.7	12.80	577	0.038	0.312	0.014	0.180	0.060	1.04	0.09	0.00110
FO-033	18.1	9.20	367	0.037	0.283	0.014	0.180	0.060	1.34	0.02	0.00110
FO-034	7.8	0.00	363	0.075	0.212	0.014	0.200	0.060	1.00	0.10	0.00110
FO-035	17.7	12.60	453	0.054	0.267	0.014	0.170	0.060	1.00	0.13	0.00110
FO-036	16.6	0.60	475	0.062	0.290	0.014	0.190	0.060	1.00	0.14	0.00110
FO-037	159.0	0.40	1598	0.048	0.216	0.014	0.200	0.060	1.00	0.09	0.00110
FO-038	84.1	0.79	927	0.044	0.212	0.014	0.200	0.060	1.00	0.11	0.00110
FO-038-1.4	5.8	11.00	225	0.028	0.212	0.014	0.200	0.060	1.00	0.06	0.00110
FO-039	88.5	0.60	1443	0.066	0.298	0.014	0.190	0.060	1.00	0.10	0.00110
FO-041	23.6	39.37	1162	0.049	0.249	0.014	0.180	0.060	1.00	0.10	0.00110
FO-041-2P	4.2	67.77	345	0.047	0.282	0.014	0.180	0.060	1.00	0.13	0.00110

TABLE A.6.1 HYDROLOGIC PARAMETERS- EXISTING CONDITIONS

WATERSHED	AREA	EXISTING CONDITIONS DIRECTLY CONNECTED PERCENT IMPERVIOUS	WIDTH	SLOPE	PERVIOUS ROUGHNESS	IMPERVIOUS ROUGHNESS	PERVIOUS DEPRESSION STORAGE	IMPERVIOUS DEPRESSION STORAGE	MAXIMUM INFILTRATION	MINIMUM INFILTRATION	DECAY RATE OF INFILTRATION
(-)	(ACRES)	(%)	(FT)	(FT/FT)	(-)	(-)	(INCHES)	(INCHES)	(IN/HR)	(IN/HR)	(1/SEC)
FO-042	41.6	0.60	711	0.053	0.295	0.014	0.190	0.060	1.00	0.10	0.00110
FO-043	139.9	1.40	1606	0.059	0.296	0.014	0.190	0.060	1.00	0.11	0.00110
FO-044	133.6	0.62	1332	0.039	0.214	0.014	0.200	0.060	1.00	0.10	0.00110
FO-044-11P	27.5	65.00	845	0.039	0.212	0.014	0.200	0.060	1.00	0.11	0.00110
FO-045	138.6	0.55	1426	0.053	0.248	0.014	0.190	0.060	1.00	0.10	0.00110
FO-046	33.9	0.00	829	0.045	0.216	0.014	0.200	0.060	1.00	0.09	0.00110
FO-046-11P	5.6	20.80	245	0.040	0.252	0.014	0.190	0.060	1.00	0.03	0.00110
FO-046-12P	0.5	32.00	108	0.029	0.248	0.014	0.190	0.060	1.00	0.02	0.00110
FO-046-13P	16.9	0.00	434	0.041	0.219	0.014	0.200	0.060	1.00	0.11	0.00110
FO-046-2P	49.9	0.00	1274	0.046	0.257	0.014	0.180	0.060	1.00	0.11	0.00110
FO-046-3P2	5.6	0.00	235	0.042	0.224	0.014	0.190	0.060	1.00	0.09	0.00110
FO-046-3S	34.3	31.92	1325	0.045	0.238	0.014	0.190	0.060	1.00	0.09	0.00110
FO-046-5P	16.2	0.00	726	0.047	0.219	0.014	0.190	0.060	1.00	0.09	0.00110
FO-046-6P	54.4	35.09	789	0.035	0.216	0.014	0.200	0.060	1.04	0.12	0.00110
FO-046-8P	21.4	0.00	577	0.039	0.214	0.014	0.200	0.060	1.00	0.09	0.00110
FO-047	227.0	1.09	1252	0.051	0.228	0.014	0.190	0.060	1.00	0.11	0.00110
FO-048	143.1	0.66	1754	0.063	0.221	0.014	0.190	0.060	1.00	0.10	0.00110
FO-049	9.7	15.00	469	0.015	0.212	0.014	0.200	0.060	1.00	0.04	0.00110
FO-049-10P	7.8	38.00	450	0.034	0.212	0.014	0.200	0.060	1.00	0.13	0.00110
FO-049-1P	4.0	34.51	379	0.062	0.212	0.014	0.200	0.060	1.00	0.12	0.00110
FO-049-3P	29.1	0.00	629	0.045	0.235	0.014	0.190	0.060	1.00	0.10	0.00110
FO-049-3P1	30.0	55.00	944	0.038	0.212	0.014	0.200	0.060	1.18	0.14	0.00110
FO-049-4P	2.0	55.00	107	0.017	0.212	0.014	0.200	0.060	1.13	0.06	0.00110
FO-049-9P	47.2	38.00	1316	0.035	0.212	0.014	0.200	0.060	1.00	0.11	0.00110
FO-049.1	31.4	0.17	528	0.045	0.224	0.014	0.190	0.060	1.00	0.10	0.00110
FO-049.2	46.5	28.89	495	0.047	0.260	0.014	0.180	0.060	1.00	0.12	0.00110
FO-049.3	9.0	6.00	220	0.036	0.212	0.014	0.200	0.060	1.02	0.03	0.00110
FO-049S	6.1	0.00	407	0.016	0.212	0.014	0.200	0.060	1.01	0.05	0.00110
FO-050	105.8	21.70	954	0.054	0.301	0.014	0.170	0.060	1.00	0.13	0.00110
FO-051	7.3	0.83	218	0.058	0.215	0.014	0.200	0.060	1.00	0.06	0.00110
FO-051-11P	2.2	44.08	171	0.033	0.212	0.014	0.200	0.060	1.00	0.12	0.00110
FO-051-12P	0.2	0.00	79	0.027	0.212	0.014	0.200	0.060	1.00	0.02	0.00110
FO-051-13P	3.3	29.27	381	0.047	0.212	0.014	0.200	0.060	1.00	0.14	0.00110
FO-051-13R	25.2	5.54	517	0.043	0.214	0.014	0.200	0.060	1.00	0.04	0.00110
FO-051-1P	19.3	30.95	1035	0.049	0.218	0.014	0.200	0.060	1.00	0.05	0.00110
FO-051-3P	0.2	0.00	77	0.078	0.212	0.014	0.200	0.060	1.00	0.11	0.00110
FO-051-4P	4.8	30.00	479	0.058	0.223	0.014	0.190	0.060	1.00	0.04	0.00110
FO-052	57.3	2.60	859	0.057	0.304	0.014	0.190	0.060	1.00	0.12	0.00110
FO-053	61.7	0.00	1205	0.057	0.300	0.014	0.200	0.060	1.00	0.12	0.00110
FO013-121b	2.4	3.23	208	0.029	0.281	0.014	0.180	0.060	1.00	0.14	0.00110
FO021-100F	2.7	30.00	213	0.049	0.212	0.014	0.200	0.060	1.00	0.06	0.00110
FO021-100P	34.6	0.00	613	0.043	0.212	0.014	0.200	0.060	1.00	0.12	0.00110
FO021-200P	13.1	30.24	475	0.056	0.212	0.014	0.200	0.060	1.00	0.09	0.00110
FO021-200W	2.6	30.00	329	0.048	0.212	0.014	0.200	0.060	1.00	0.10	0.00110
FO0211000N	9.3	0.00	576	0.045	0.212	0.014	0.200	0.060	1.00	0.13	0.00110
FO021TEMP	23.0	2.15	625	0.050	0.215	0.014	0.200	0.060	1.00	0.13	0.00110
FO-026-N2	6.7	38.00	553	0.037	0.212	0.014	0.200	0.060	1.00	0.12	0.00110

TABLE A.6.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
FO-002	14.5	0.7	6	1.0	8	2.2	20	4.2	39	5.3	49
FO-004	46.0	0.5	7	0.8	11	2.0	29	3.9	61	5.0	80
FO-005	91.0	1.3	86	1.6	109	2.9	198	5.0	334	6.1	405
FO-006	1.3	1.7	3	2.1	4	3.4	6	5.5	10	6.6	12
FO-006B	26.2	2.3	57	2.6	72	4.0	125	6.1	197	7.2	231
FO-007	3.6	0.8	2	1.1	3	2.3	6	4.3	11	5.4	14
FO-007-308	43.5	1.1	35	1.4	44	2.7	83	4.8	144	5.9	176
FO-008	65.9	0.5	13	0.8	18	2.0	47	4.0	100	5.0	129
FO-009	41.0	0.8	14	1.1	20	2.4	49	4.5	96	5.5	121
FO-009-1P	4.7	1.8	8	2.1	11	3.5	19	5.6	30	6.7	36
FO-009-30F	2.0	2.2	5	2.6	6	4.0	11	6.1	16	7.2	19
FO-009-30P	24.0	1.8	43	2.1	55	3.5	98	5.5	158	6.6	186
FO-010	6.3	0.8	4	1.1	5	2.4	12	4.4	23	5.5	28
FO-011	8.1	0.8	4	1.1	5	2.3	13	4.3	24	5.4	30
FO-012	99.1	1.1	81	1.4	104	2.7	192	4.8	332	5.8	405
FO-013	2.0	0.9	2	1.3	3	2.5	6	4.5	11	5.6	13
FO-014	28.7	1.3	28	1.6	36	2.8	65	4.9	111	6.0	134
FO-015	13.3	0.7	6	1.0	8	2.3	20	4.3	38	5.3	48
FO-016	55.2	0.6	12	0.8	18	2.0	44	4.0	92	5.1	119
FO-017	9.9	0.9	4	1.2	5	2.4	11	4.5	22	5.5	28
FO-018	104.4	0.6	20	0.9	30	2.2	75	4.2	157	5.2	202
FO-019	30.2	0.6	6	0.9	9	2.1	23	4.1	49	5.1	63
FO-020	70.3	0.6	14	0.8	20	2.0	51	4.0	108	5.1	140
FO-021-101	34.0	0.9	15	1.2	21	2.5	50	4.5	95	5.6	119
FO-021-6AP	13.8	0.9	8	1.2	11	2.5	25	4.6	46	5.7	57
FO-021-7P	15.4	1.6	23	1.9	30	3.2	54	5.3	89	6.4	106
FO-022	43.0	1.0	28	1.3	35	2.5	65	4.5	115	5.6	141
FO-023	9.7	1.6	13	1.9	17	3.2	30	5.3	48	6.4	58
FO-024	41.6	1.4	49	1.7	62	3.0	111	5.1	184	6.2	221
FO-025	57.4	0.8	28	1.1	36	2.3	70	4.3	127	5.4	158
FO-026	84.8	0.7	16	1.0	24	2.3	58	4.3	120	5.4	155
FO-026-N3	21.4	1.8	37	2.1	47	3.4	84	5.5	136	6.6	161
FO-027	12.0	1.0	8	1.3	10	2.5	20	4.5	35	5.6	43
FO-028	7.3	1.8	13	2.1	16	3.5	28	5.5	46	6.6	54
FO-029	57.2	1.6	67	1.9	85	3.2	152	5.3	251	6.4	301
FO-030	9.7	0.8	5	1.1	7	2.4	17	4.4	32	5.5	40
FO-031	11.6	1.3	11	1.6	15	3.0	28	5.0	48	6.1	58
FO-032	60.7	1.0	32	1.3	40	2.6	73	4.6	123	5.7	150
FO-033	18.1	1.8	12	2.1	15	3.5	27	5.6	48	6.7	59
FO-034	7.8	1.0	6	1.3	8	2.6	18	4.6	32	5.7	40
FO-035	17.7	1.1	13	1.4	17	2.6	33	4.7	60	5.8	74
FO-036	16.6	0.7	6	1.0	9	2.2	21	4.2	42	5.3	52
FO-037	159.0	0.7	33	1.0	47	2.3	118	4.3	242	5.4	310
FO-038	84.1	0.7	18	1.0	26	2.2	64	4.2	132	5.3	169
FO-038-1.4	5.8	1.4	5	1.8	7	3.1	13	5.2	22	6.3	27
FO-039	88.5	0.8	23	1.0	33	2.3	81	4.3	164	5.4	210
FO-041	23.6	1.9	47	2.2	59	3.6	104	5.7	165	6.8	194

TABLE A.6.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
FO-041-2P	4.2	2.5	13	2.9	16	4.2	27	6.4	40	7.5	47
FO-042	41.6	0.8	11	1.0	15	2.3	37	4.3	74	5.4	95
FO-043	139.9	0.6	27	0.9	38	2.2	97	4.1	201	5.2	260
FO-044	133.6	0.7	25	1.0	36	2.2	92	4.2	190	5.3	245
FO-044-11P	27.5	2.5	64	2.8	80	4.2	140	6.3	218	7.4	256
FO-045	138.6	0.7	27	1.0	39	2.3	98	4.3	202	5.3	260
FO-046	33.9	0.9	14	1.2	19	2.6	46	4.6	87	5.7	108
FO-046-11P	5.6	1.9	8	2.3	10	3.7	17	5.8	28	6.9	34
FO-046-12P	0.5	2.3	1	2.6	2	4.0	3	6.2	4	7.3	5
FO-046-13P	16.9	0.8	6	1.1	9	2.4	22	4.4	43	5.5	53
FO-046-2P	49.9	0.8	18	1.1	25	2.4	61	4.4	119	5.5	149
FO-046-3P2	5.6	1.0	3	1.3	5	2.7	10	4.7	19	5.8	23
FO-046-3S	34.3	1.7	55	2.1	70	3.4	126	5.5	204	6.6	242
FO-046-5P	16.2	1.0	10	1.3	15	2.7	32	4.7	58	5.8	72
FO-046-6P	54.4	1.6	64	1.9	81	3.2	146	5.3	243	6.4	293
FO-046-8P	21.4	0.9	9	1.2	13	2.6	30	4.6	56	5.7	70
FO-047	227.0	0.5	27	0.8	40	2.0	103	3.9	223	5.0	294
FO-048	143.1	0.8	38	1.0	53	2.3	130	4.3	263	5.4	337
FO-049	9.7	1.7	10	2.0	13	3.4	24	5.5	40	6.6	49
FO-049-10P	7.8	1.8	15	2.1	19	3.4	34	5.5	55	6.6	64
FO-049-1P	4.0	1.8	9	2.1	12	3.4	21	5.5	32	6.6	38
FO-049-3P	29.1	0.8	10	1.1	14	2.4	33	4.4	66	5.5	83
FO-049-3P1	30.0	2.2	62	2.5	78	3.8	138	6.0	220	7.1	258
FO-049-4P	2.0	2.4	5	2.7	6	4.1	10	6.2	15	7.4	18
FO-049-9P	47.2	1.8	74	2.1	94	3.5	169	5.5	275	6.6	327
FO-049.1	31.4	0.8	9	1.1	13	2.4	31	4.4	63	5.5	80
FO-049.2	46.5	1.4	45	1.7	57	3.0	102	5.1	170	6.2	204
FO-049.3	9.0	1.5	5	1.9	7	3.3	14	5.4	26	6.5	32
FO-049S	6.1	1.3	4	1.6	6	3.0	12	5.1	21	6.2	26
FO-050	105.8	1.1	81	1.4	102	2.6	182	4.6	304	5.7	367
FO-051	7.3	1.2	4	1.5	6	2.9	13	4.9	23	6.0	28
FO-051-11P	2.2	2.0	5	2.3	6	3.7	11	5.8	17	6.9	20
FO-051-12P	0.2	1.8	1	2.2	1	3.5	1	5.6	2	6.8	2
FO-051-13P	3.3	1.6	7	1.9	9	3.2	16	5.3	26	6.4	30
FO-051-13R	25.2	1.5	14	1.8	18	3.2	37	5.3	68	6.4	84
FO-051-1P	19.3	1.9	37	2.3	47	3.6	82	5.8	129	6.9	152
FO-051-3P	0.2	1.0	1	1.3	1	2.7	1	4.7	2	5.8	2
FO-051-4P	4.8	2.0	11	2.3	14	3.7	24	5.8	37	6.9	44
FO-052	57.3	0.7	13	1.0	19	2.2	46	4.2	95	5.3	122
FO-053	61.7	0.7	16	1.0	24	2.2	58	4.2	119	5.3	152
FO013-121b	2.4	0.9	2	1.2	2	2.5	5	4.5	9	5.6	12
FO021-100F	2.7	1.9	6	2.2	7	3.6	13	5.7	20	6.8	23
FO021-100P	34.6	0.7	10	1.0	14	2.2	35	4.2	71	5.3	91
FO021-200P	13.1	1.7	21	2.0	27	3.4	49	5.5	79	6.6	94
FO021-200W	2.6	1.7	6	2.1	8	3.4	14	5.5	21	6.6	25
FO0211000N	9.3	0.8	7	1.1	9	2.4	21	4.4	39	5.5	47
FO021TEMP	23.0	0.8	10	1.1	14	2.4	33	4.4	63	5.5	80

TABLE A.6.2 HYDROLOGIC RESULTS- EXISTING CONDITIONS

WATERSHED	TOTAL DRAINAGE AREA (AC)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
		RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)	RUNOFF (IN)	PEAK FLOW (CFS)
FO-026-N2	6.7	1.8	14	2.2	18	3.5	33	5.6	51	6.7	60

TABLE A.6.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
FO-002	Multiple Links*	964.7	966.4	1	966.7	1	968.5	2	969.2	21	969.3	33
FO-004	L-LMC-054	960.4	961.1	7	961.2	11	961.6	28	962.4	61	962.8	81
FO-005	Multiple Links*	1019.8	1023.5	16	1024.1	19	1026.5	42	1027.6	143	1027.8	199
FO-006	Multiple Links*	996.0	998.8	50	999.3	62	1000.6	103	1002.5	161	1003.1	175
FO-007	Multiple Links*	962.2	963.2	2	963.7	4	965.1	8	966.1	73	967.3	40
FO-008	Multiple Links*	991.8	993.5	13	993.8	18	995.4	47	996.5	100	996.7	129
FO-009	L-LMC-044	1035.5	1035.9	19	1036.0	29	1036.4	71	1036.6	125	1036.7	153
FO-010	Multiple Links*	958.0	958.5	5	958.8	6	960.3	8	963.0	11	964.1	58
FO-011	Multiple Links*	958.2	959.5	5	959.7	6	960.9	10	963.0	115	964.1	230
FO-012	Multiple Links*	958.2	960.3	8	960.8	10	962.8	24	964.7	137	965.0	250
FO-013	Multiple Links*	960.2	961.3	5	961.6	7	963.4	10	965.0	18	965.1	15
FO-014	Multiple Links*	962.1	963.4	6	963.7	8	964.9	19	966.7	38	968.0	41
FO-015	L-LMC-053	958.0	958.1	6	958.1	8	958.2	19	958.3	37	958.4	47
FO-016	L-LMC-052	973.2	973.6	12	973.7	17	973.9	44	974.0	92	974.1	118
FO-017	Multiple Links*	1038.2	1038.6	3	1038.7	5	1039.6	10	1040.3	19	1040.5	25
FO-018	L-LMC-051	966.5	967.5	23	967.6	32	968.1	79	968.4	169	968.6	219
FO-019	L-LMC-091	1013.4	1013.6	5	1013.7	8	1014.0	21	1014.3	46	1014.4	60
FO-020	L-LMC-047	1003.5	1004.3	14	1004.5	20	1006.5	51	1008.3	103	1009.2	123
FO-021	L-LMC-046	1020.5	1020.8	19	1020.9	29	1021.1	71	1021.4	151	1021.5	200
FO-022	Multiple Links*	1007.5	1009.1	10	1009.4	12	1010.4	22	1011.9	27	1012.6	27
FO-023	L-LMC-034	1013.8	1014.2	7	1014.3	9	1014.5	18	1014.8	31	1015.0	38
FO-024	Multiple Links*	1009.8	1010.4	34	1010.5	40	1011.4	70	1012.7	112	1013.6	121
FO-025	Multiple Links*	1075.2	1076.8	8	1077.2	11	1078.8	17	1080.8	42	1080.9	79
FO-026	L-LMC-018	1033.7	1034.8	30	1034.8	43	1035.2	96	1035.7	191	1035.8	245
FO-027	Multiple Links*	1063.8	1064.8	2	1065.1	3	1066.2	6	1068.1	9	1069.0	11
FO-028	Multiple Links*	1067.6	1070.7	3	1070.9	3	1071.8	5	1073.0	6	1073.5	9
FO-029	Multiple Links*	1065.0	1067.4	14	1067.8	16	1069.3	22	1071.6	37	1072.1	70
FO-030	L-LMC-089	1058.4	1061.3	5	1061.4	7	1061.7	15	1062.4	25	1062.8	30
FO-031	L-LMC-005	1058.0	1058.6	9	1059.1	11	1059.7	12	1060.6	21	1061.1	24
FO-032	L-LMC-014	1066.8	1067.5	31	1067.5	38	1067.7	66	1068.0	114	1068.1	156
FO-033	Multiple Links*	1051.9	1053.9	61	1054.2	67	1055.1	115	1056.3	191	1057.7	262
FO-034	L-LMC-002	1052.5	1052.8	5	1052.9	7	1053.1	15	1053.8	20	1054.2	22
FO-035	L-LMC-010	1067.0	1067.4	6	1067.4	8	1067.6	21	1067.8	42	1067.8	52
FO-036	L-LMC-040	990.7	991.1	3	991.4	5	992.1	8	994.1	25	995.2	30
FO-037	L-LMC-121	985.7	987.1	166	987.3	220	987.8	422	988.4	731	988.7	994
FO-038	Multiple Links*	986.0	988.0	43	988.4	59	989.8	110	991.8	186	992.4	303
FO-039	L-LMC-094	967.9	971.1	90	971.5	129	972.0	321	972.8	616	972.9	721
FO-040	L-LMC-097	929.7	934.5	124	935.0	174	936.8	433	937.6	827	937.8	959
FO-041	L-LMC-075	992.0	997.3	8	997.9	8	999.2	9	999.7	9	999.9	9
FO-042	L-LMC-119	948.2	949.7	114	950.1	146	951.6	380	952.0	629	952.3	750
FO-043	L-LMC-118	956.2	958.5	105	958.7	136	960.1	362	960.9	594	961.3	701
FO-044	L-LMC-133	957.7	962.2	273	962.6	365	963.5	602	965.0	1091	965.5	1443

TABLE A.6.3 HYDRAULIC RESULTS- EXISTING CONDITIONS

POND NAME	DOWNSTREAM LINK	NWL (FT)	1-YEAR		2-YEAR		10-YEAR		50-YEAR		100-YEAR	
			MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)	MAX WATER SURFACE ELEVATION (FT)	PEAK FLOW (CFS)
FO-045	L-LMC-129	1013.0	1014.8	59	1016.5	81	1019.1	175	1022.6	294	1024.3	336
FO-046	L-LMC-113	982.4	985.8	27	986.3	30	987.0	135	987.1	224	987.2	257
FO-047	L-LMC-115	982.2	984.5	58	985.1	83	987.3	184	990.8	277	992.2	309
FO-048	L-LMC-095	985.8	988.6	56	989.2	80	992.0	196	996.8	376	999.4	438
FO-049	L-LMC-124	968.2	972.4	217	973.4	300	977.2	487	979.3	566	980.0	592
FO-050	L-LMC-108	996.3	998.2	30	998.7	40	1000.6	72	1003.0	156	1003.2	259
FO-051	L-LMC-131	1019.8	1023.0	84	1023.5	106	1025.5	179	1027.6	439	1027.8	571
FO-052	L-LMC-128	1009.0	1012.8	89	1013.5	111	1015.5	187	1019.3	293	1020.6	504
FO-053	L-LMC-135	951.7	954.1	105	954.6	150	956.0	373	957.0	716	957.2	844

*Discharge rates reported are the sum of peak flow rates of all downstream conduits