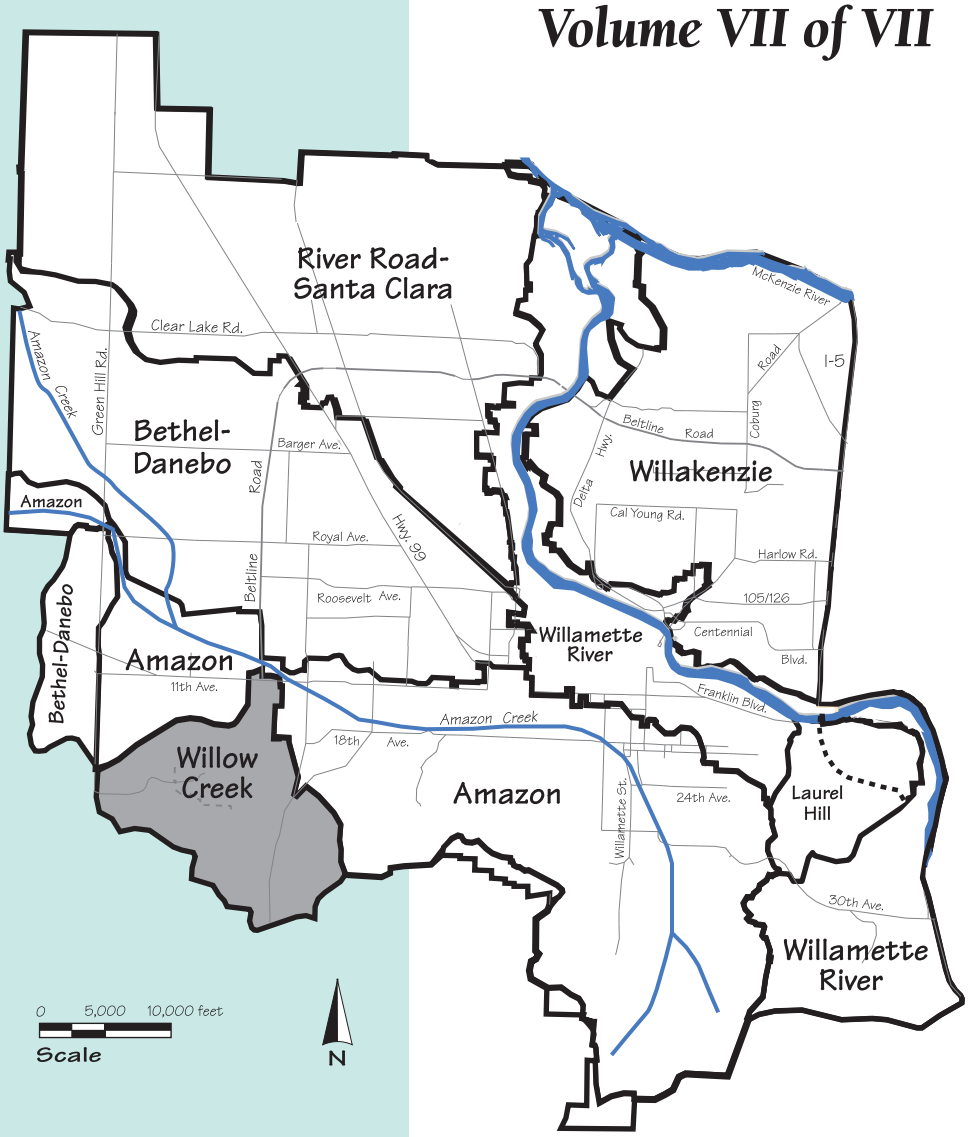
City of Eugene

Stormwater Basin Master Plan

Willow Creek Basin

Volume VII of VII



CITY OF EUGENE
STORMWATER
MANAGEMENT PROGRAM

August 2002

Prepared by:
City of Eugene
URS Corporation
Lane Council of Governments

Local Stormwater Planning Can Make a World of Difference

Stormwater Basin Master Plan

Volume VII of VII

Willow Creek Basin

December 2002

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ACKNOWLEDGEMENTS

The Stormwater Basin Master Plan represents the culmination of a long term planning effort by a multi-agency team consisting of representatives from the City of Eugene, Lane Council of Governments (LCOG), and URS Corporation.

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The information published in this report is subject to revision. Please contact the City of Eugene's Engineering Division for potential changes before proceeding with any engineering design that uses the information published herein.

TABLE OF CONTENTS

Executive Summary

Section 1 Introduction 1-1

Section 2 Study Area Characteristics 2-1

2.1 Location and Area 2-1
2.1.1 Regional Drainage Context 2-1
2.1.2 City of Eugene 2-1
2.1.3 Willow Creek Basin 2-4
2.2 Climate 2-4
2.3 Land Use and Surface Cover 2-5
2.3.1 Existing Land Use 2-5
2.3.2 Buildout Land Use 2-6
2.3.3 Surface Cover 2-8
2.4 Landform, Topography, Slopes 2-11
2.5 Surface Water Features and Drainage System 2-11
2.5.1 Waterways 2-11
2.5.2 Wetlands 2-12
2.5.3 Public Piped System 2-13
2.5.4 Maintaining the Drainage System 2-13
2.5.5 Floodplain 2-13
2.6 Water Quality 2-13
2.6.1 Documented Water Quality Problems 2-14
2.6.2 Oregon Department of Environmental Quality Water Quality Limited Designations [303(d) List] 2-19
2.6.3 Natural and Built Conditions 2-19
2.6.4 Conclusions 2-20
2.7 Rare, Threatened, and Endangered Plants, Animals, and Communities 2-21
2.8 Soils 2-22
2.8.1 Permeability 2-22
2.8.2 Runoff Potential 2-23
2.8.3 Erodible Soils 2-24
2.8.4 Unstable Slopes 2-24
2.8.5 Hydric Soils 2-24
2.9 Groundwater 2-25
2.10 Existing and Planned Educational Facilities 2-25
2.11 Existing and Planned Park and Recreational Facilities 2-26

Section 3 Flood Control Evaluation 3-1

3.1 Evaluation of Flood Control Under Existing and Expected Future Conditions 3-1
3.1.1 Willow Creek Basin Hydrologic Data 3-1
3.1.2 Willow Creek Basin Hydraulic Data 3-2

TABLE OF CONTENTS

3.1.3 Flooding Problems Identified by the Model 3-3
3.1.4 Other Identified Flooding Related Problems 3-5
3.2 Development of the Flood Control Strategy 3-5
3.2.1 Capital Project Alternatives 3-5
3.2.2 Development Standard Alternatives 3-8
3.3 Selected Alternatives 3-9
3.3.1 Scenario 1 – UGB Buildout 3-10
3.3.2 Scenario 2 – UGB/Urban Reserve Buildout 3-10

Section 4 Water Quality Evaluation 4-1

4.1 Evaluation of Water Quality Under Existing and Expected Future Conditions 4-1
4.2 Development of the Water Quality Strategy 4-2
4.2.1 Capital Project Alternatives 4-2
4.2.2 Development Standard Alternatives 4-3
4.3 Selected Alternatives 4-4

Section 5 Stormwater Related Natural Resources 5-1

5.1 Evaluation of Natural Resources Under Existing and Expected Future Conditions 5-1
5.2 Development of the Natural Resources Strategy 5-3
5.2.1 Capital Project Alternatives 5-4
5.2.2 Development Standard Alternatives 5-4
5.3 Selected Alternatives 5-5

Section 6 Integrated Stormwater Management Strategy 6-1

6.1 Integrated Stormwater Management Strategy 6-1
6.2 Summary of Strategy Benefits 6-2
6.3 Summary of Strategy Implementation and Costs 6-3

Appendix Capital Project Fact Sheets

LIST OF TABLES

Table 2-1 Average Storm Event 2-5
Table 2-2 Existing Land Use – Willow Creek Basin 2-6
Table 2-3 Buildout Land Use 2-7
Table 2-4 Willow Creek Basin Slope Distribution 2-11
Table 2-5 Willow Creek Policy Management Categories 2-13
Table 2-6 Summary of Stormwater Quality Monitoring in Eugene 2-14
Table 2-7 Rare Plants and Animals in Willow Creek Basin 2-22
Table 2-8 Soil Permeability in the Willow Creek Basin 2-23
Table 2-9 Runoff Potential in the Willow Creek Basin 2-23
Table 2-10 Soil Erodibility – Willow Creek Basin 2-24
Table 2-11 Hydric Soils in the Willow Creek Basin 2-25

TABLE OF CONTENTS

Table 3-1 Capacity Deficiencies Identified through Modeling and Proposed Capital Projects to Address Them 3-6
Table 3-2 Major Hydrologic Input/Output Data for the Willow Creek Storm Drainage System 3-12
Table 3-3 Hydraulic Performance of the Willow Creek Storm Drainage System 3-13
Table 6-1 Implementation Schedule Years 2001-2035 6-4
Table 6-2 Stream Corridor Acquisition Schedule Years 2001-2007 6-4

LIST OF FIGURES

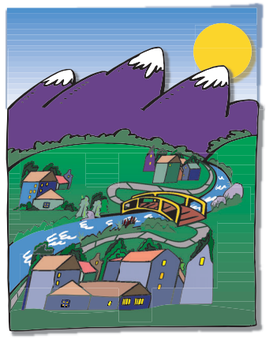
Figure 1-1 Process to Develop the Integrated Stormwater Management Strategies 1-5
Figure 2-1 Willamette Region Location Map 2-2
Figure 2-2 Basin Location Map 2-3
Figure 2-3 Average Monthly Rainfall 2-4
Figure 2-4 Surface Cover in the Willow Creek Basin UGB 2-10
Figure 2-5 Water Quality Monitoring Sites 2-15
Figure 2-6 Biological Monitoring Sites 2-18
Figure 2-7 Extent of Open Drainage System in the Willow Creek Basin (UGB) 2-19
Figure 2-8 Extent of Area as a Percentage of the Willow Creek Basin (UGB) 2-20
Figure 2-9 Extent of 100-Year Floodway Fringe that is Vacant in the Willow Creek Basin 2-20
Figure 3-1 Willow Creek Basin Drainage System Index Map ..... end of Section 3
Figure 3-2 Willow Creek Basin Drainage System ..... end of Section 3
Figure 3-3 Willow Creek Basin Drainage System ..... end of Section 3
Figure 4-1 Estimated Total Suspended Solids Loads Per Year in the Willow Creek Basin (UGB) 4-1
Figure 4-2 Estimated Increases in Total Suspended Solids Loads Associated with Future Buildout in the Willow Creek Basin (UGB) 4-1
Figure 4-3 Estimated Total Suspended Solids Loads Per Acre – Per Year in the Willow Creek Basin (UGB) 4-2

LIST OF MAPS (Located at end of Section 2)

Map 1 Existing Land Use
Map 2 Projected Land Use
Map 3 Surface Cover
Map 4 Slope and Topography
Map 5 Surface Water and Drainage System Features
Map 6 Soil Permeability
Map 7 Soil Runoff Potential
Map 8 Highly Erodible Soils
Map 9 Hydric Soils
Map 10 Soil Types
Map 11 High Water Table
Map 12 Park, Recreation & Education Facilities

Executive Summary

City of Eugene



Vision for a Green Infrastructure

Willow Creek Basin

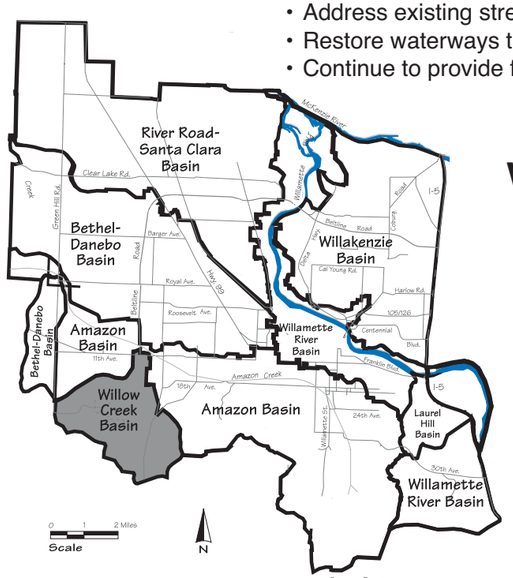
Stormwater Management Strategy

Mostly rural in character today, Willow Creek basin is the most physically and biologically diverse of all the basins within Eugene. Steep, forested hillsides flank a wetland-rich, flat, floodplain that contains extensive wetland prairies and numerous rare plant and animal species. Recent wetland protection efforts within the urban growth boundary have created urban services delivery challenges for the remaining area. The stormwater assessment process for this basin revealed there are relatively few flood control, water quality, and related natural resources problems under existing conditions, but there are likely to be significant problems under future conditions especially if the urban reserve area develops to urban densities.

Strategy

The recommended strategy for this basin is based on recent policy direction by elected officials to remove the urban reserve designation. If this occurs, nearly 55% of the basin would remain in rural resource use. Should this policy not be implemented, strategies in addition to those listed below, would be needed for the urban reserve area. Recommended strategies for the UGB include:

- Reduce existing pollutants to the extent feasible through system retrofits, especially in high source areas.
- Minimize future pollutants through on-site development standards and flow controls for headwater areas.
- Protect waterways through a combination of development standards, capital projects, setback requirements, and acquisition.
- Address existing stream bank stabilization problems through capital projects
- Restore waterways through federal-local partnerships.
- Continue to provide flood protection services basin wide.



Basin Context Map

Willow Creek Basin Facts

- Ranks sixth among all the basins in total size (2,567 acres).
- Ranks sixth in the amount of area designated as 100 year floodplain (22 acres).
- Ranks fifth in total length of open waterways (17 miles) but first in proportion of waterways to basin size.
- Impervious surface area in the UGB is projected to increase from 14% to 42% at full buildout.
- Is home to eleven plant and animal species listed or being considered for listing as threatened or endangered.
- Is a tributary to the Amazon Basin.

Comprehensive Plan

Cleaner, Safer, Healthier Environment

Adoption of the **Comprehensive Stormwater Management Plan** (CSWMP) in November 1993 ushered in a new vision for managing the City of Eugene's stormwater program. In addition to protecting the community from flooding problems, CSWMP expanded the program to include protection of stormwater quality and related natural resources.

Basin Planning

Bringing CSWMP into Focus

Basin Planning is one of many action items for implementing CSWMP. The basin planning process includes assessing existing conditions, identifying stormwater system problems and opportunities, and recommending management strategies for implementing several CSWMP policies. Each of the City's seven drainage basins offers unique conditions and opportunities for implementing capital projects and development standards. Basin planning, therefore, is a refinement of CSWMP's broader policy direction, and represents what is feasible and practical to implement at the stormwater system level.

Other Activities

In addition to Basin Planning, many other city activities are conducted to enhance water quality, protect stormwater-related natural resources, and prevent flooding. A few examples include:

- Erosion control for construction activities
- Education and outreach
- Monitor stormwater discharges of certain industrial uses
- Street sweeping
- Volunteer programs
- Vegetation management

Green Infrastructure

Green Infrastructure uses the beneficial flood control and water quality treatment characteristics of the natural landscapes to help meet stormwater management objectives. When linked with the constructed system, the two work together to form a coordinated drainage system of streams, ponds, streets, and pipes.

Why This Strategy?

Flood Control

- Capital projects are the most cost-effective solution for addressing existing problems and will be designed to address the incremental effects of new development within the UGB. (Note: If the Urban Reserve area is allowed to develop, capital projects are the most cost-effective solution for addressing existing problems and would be designed to meet these needs, and on-site development standards would be more cost-effective and more environmentally compatible for addressing problems associated with future development.)

Water Quality

- *Existing Pollution Problem*: Capital projects are the most cost-effective solution for addressing existing conditions, along with other ongoing program activities.
- *Pollution Associated with New Development*: Development standards are most effective for addressing pollutants at their source and minimizing water quality impacts of new development in headwater areas.

Stormwater-Related Natural Resources

- Capital projects are the most viable method for addressing negative effects of high runoff volumes in open waterways for existing developed areas.
- Stream corridor acquisition can be used to protect a limited number of high priority waterways.
- Development standards are effective at preventing encroachment into waterways and preserving water quality functions.

More Information

- Visit the City's website at www.ci.eugene.or.us/pw/storm
- Contact Therese Walch at (541) 682-6839

EUGENE

The Management Strategy

Flood Control

Issue: **Existing flooding problems are relatively minor and are limited to certain road culverts and bridges. The magnitude of future flooding will depend on whether new development is limited to the UGB or to include the urban reserve area.**

Desired Outcomes: Capacity problems at bridges and culverts are eliminated under existing and future conditions.

Actions:

Capital Projects - see map
- WC3C3 – Retrofit driveway culverts along West Branch of Willow Creek.
- WC3C4 – Retrofit culverts and bridge along East Branch of Willow Creek.

Development Standards - see map *(only applies if Urban Reserve develops)*
- All new development and significant redevelopment projects are required to control peak runoff rates to pre-development conditions.

Related Natural Resources

Issue: **Significant types and concentrations of natural resources are present throughout the basin and are susceptible to impact due to a lack of an overall management and implementation strategy.**

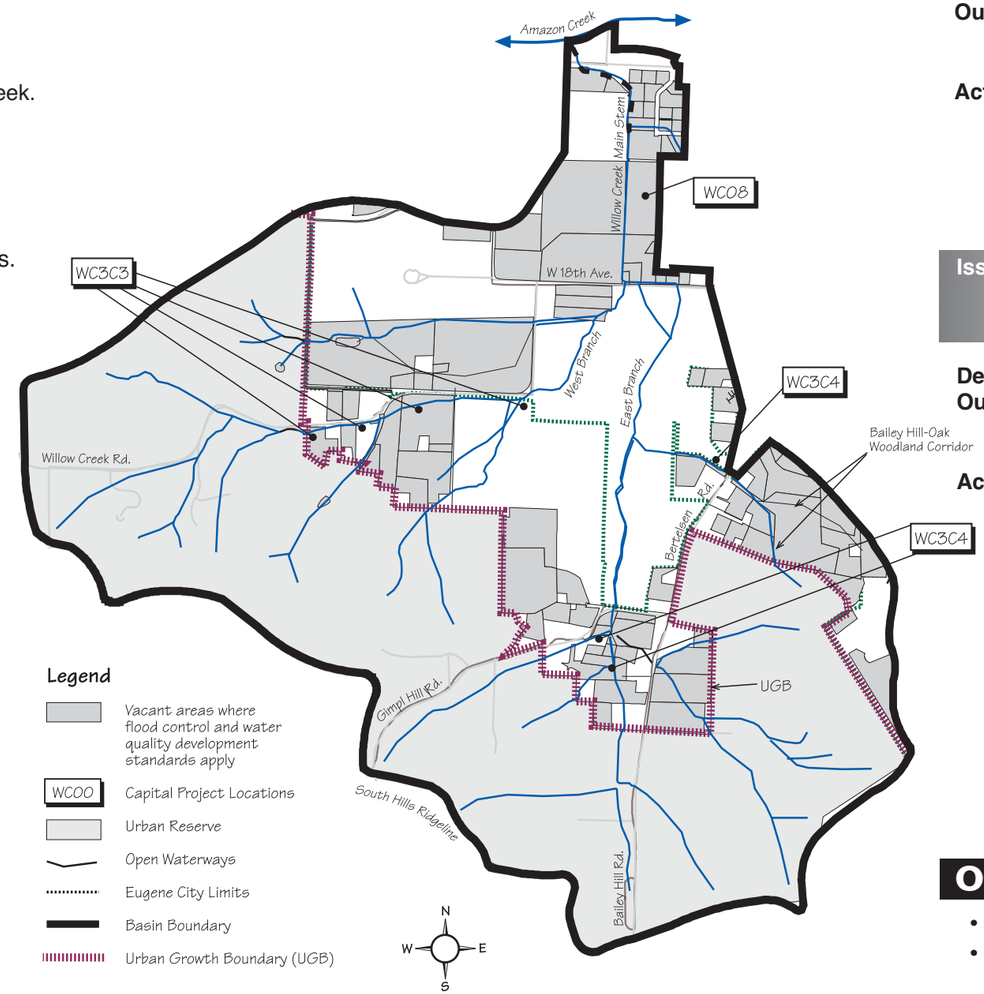
Desired Outcome: Maintain and improve the extent and quality of existing stormwater-related natural resources.

Actions:

Capital Projects (see map)
- WC08 – Realign and restore historic Willow Creek Main Stem between W. 18th and W. 11th avenues.
- Yearly budget item: Streambank Stabilization Projects.
- Ongoing: Restore waterways through federal-local partnerships (to be identified).

Acquisition
- Acquire stream corridors according to the *City's Stream Corridor Acquisition Study.*

Development Standards – see map
- Prohibit filling/piping of important storm waterway.
- Implement streamside setback requirements.
- Ensure hydrologic needs of natural resources are considered when developing future flood control and water quality discharge standards.



Water Quality

Issue: **Runoff from existing development is a source of pollutants.**

Desired Outcomes: Pollutants from existing land uses are reduced.

Actions:

Capital Projects (sites to be selected)
- Yearly Budget Item – water quality facilities in high source areas.
- Yearly Budget Category – outfall stabilization.

Issue: **Runoff from future development will increase pollutant discharges.**

Desired Outcomes: Reduce stormwater pollution from new development.

Actions:

Development Standards – see map
- New and significant redevelopment projects are required to treat all runoff from City's water quality design standard.
- Incentives – provide incentives for existing development to reduce effective impervious surface areas and treat stormwater runoff.
- Control rate of runoff into headwater streams for water quality benefits.

Other Elements to the Strategy

- General Stormwater Rehabilitation Projects.
- Channel Easement Acquisition.

CITY OF EUGENE STORMWATER MANAGEMENT PROGRAM

SECTION 1 Introduction

Adoption of the City of Eugene's *Comprehensive Stormwater Management Plan* (CSWMP) in November 1993 marked a significant shift in the City's approach to stormwater management. In addition to drainage and flood control services, the stormwater program was expanded to include the protection and enhancement of stormwater quality and related natural resources. Since the previous *Storm Drainage Master Plan* (OTAK, 1990) was developed solely for the purpose of addressing drainage and flood control issues, an update of that Plan was necessary to bring it into compliance with current City policy. As a result, the City initiated a project to develop multiple-objective Stormwater Basin Master Plans.

In addition to CSWMP, other locally adopted policy documents were reviewed for applicability to the Basin Master Planning effort. The following were identified for containing policies related to and supportive of protection of water quality and related natural resources:

1) Eugene/Springfield Metro Area General Plan (1987 Update) in general and, specifically, the following refinement plans:

    - Bethel-Danebo, 1982
    - Eugene Downtown Plan, 1984
    - Eugene Parks and Recreation Plan, 1989
    - Jefferson/Far West, 1983
    - Public Facilities and Services Plan, December 2001
    - Laurel Hill, 1982
    - Riverfront Park Study, 1985
    - River Road-Santa Clara Urban Facilities Plan, 1985
    - South Hills Study, 1974
    - Willakenzie Neighborhood, 1991
    - Willow Creek, 1982

2) Eugene Growth Management Study, 1998

The overall goal of the Stormwater Basin Master Plans was to provide a stormwater management strategy for each basin that proactively addresses the multiple objectives of CSWMP. In addition to flood control, these multiple objectives include:

- Protect and improve water quality.
- Protect natural resources that provide beneficial stormwater functions.
- Use best management practices that promote a green infrastructure.
- Address the unique qualities of each drainage basin.
- Meet federal, state, and local laws and policies (including CSWMP, the Clean Water Act, the Endangered Species Act, and State Underground Injection Control Rules – for these broader topics and other issues, please refer to Volume I).
- Complement other existing BMPs that are part of the City's stormwater program.
- Balance responsibilities community-wide.
- Provide a dynamic and flexible program that can be refined based on a changing regulatory climate.

SECTION 1 Introduction

This report presents the integrated stormwater management strategy (integrated strategy) for the Willow Creek basin. It represents Volume VII of a seven volume report generated to summarize and document the city-wide Stormwater Basin Master Plans. Volume I provides an overview of the project, describes the process for developing integrated strategies, and summarizes the information that is presented in detail in the six companion volumes, each of which covers one of the following City's six drainage basins: *Volume II - Amazon Creek, Volume III - Bethel-Danebo, Volume IV – Laurel Hill, Volume V - Willakenzie, Volume VI - Willamette River, Volume VII - Willow Creek.* Volumes II through VII provide more detailed information regarding development of stormwater management strategies for each of the six basins including: characteristics unique to the basin; results of the basin evaluation for flood control, water quality and natural resources; and resulting integrated stormwater management strategies. A basin specific plan was not produced for River Road Santa Clara, pending resolution of inter-jurisdictional issues as well as additional information gathering and analysis.

NOTE: It should be noted that the term basin is typically used to refer to a defined surface area that drains to a common discharge point. However, for the purposes of this study, the term basin is used to refer to a specific planning or study area. While the planning or study areas were developed based on topography and drainage patterns, they may include several discharge points, or they may exclude specific tributary areas based on convenience for planning purposes. In some cases, portions of the basin were not included in the planning area as they are managed by other jurisdictions. The basin areas as defined in this plan are also further divided into major subbasins and subbasins as described in Section 3.0.

The process conducted to develop integrated strategies for each of the six basins included the following thirteen steps. The details regarding each of these steps are provided in Volume I.

Step 1) Compile information regarding the unique characteristics of each basin that are related to the stormwater drainage system.
Step 2) Identify problems and opportunities associated with the stormwater drainage system with respect to flood control, water quality, natural resources, and maintenance.
Step 3) Develop potential solutions in the form of capital projects and development standards for addressing identified problems.
Step 4) Evaluate and compare potential solutions in terms of feasibility, costs, and effectiveness.
Step 5) Evaluate capital projects to address problems expected under existing conditions.
Step 6) Evaluate capital projects and development standards to address problems expected as a result of future build-out.
Step 7) Select an integrated stormwater management strategy based on the evaluations conducted in steps 5 and 6.
Step 8) Develop a maintenance strategy for the proposed solutions.
Step 9) Obtain feedback regarding integrated stormwater management strategies and the maintenance strategy from the public and refine the strategies as appropriate.
Step 10) Prioritize selected capital projects for implementation and conduct a financial analysis.

Step 11) Develop stormwater basin master plans to summarize the integrated stormwater management strategies including proposed capital projects and development standards.
Step 12) Develop an ordinance to implement the proposed development standards.
Step 13) Develop a best management practices manual to help guide developers in meeting the requirements of the development standards.

The process for conducting these steps is outlined in Figure 1-1. As a result of this process, a mix of capital projects and development standards was proposed for each of the basins. A total of 44 multiple-objective capital projects were selected for the integrated stormwater management strategies city-wide (not including the Santa Clara/River Road basin). Three of these are located in the Willow Creek basin. In addition, development standards were selected for treating the quality of runoff from new development and for protecting open waterways. These standards were proposed city-wide and therefore would apply to the Willow Creek basin when enacted. A development standard was adopted in April 2000 (Open Waterways Ordinance) that prohibited waterways from being filled and/or piped. The ordinance was subsequently appealed and remanded back to the City by the Oregon Court of Appeals (July 2001) and is no longer in effect. Additional methods and options for protecting open waterways are under review. In the meantime, waterway protection efforts will include stream corridor acquisitions and land use approval criteria where applicable.

Information updates related to this plan are provided at the end of this section. The integrated basin strategy specific to the Willow Creek basin is described in the following sections. Section 2.0 provides a summary of the specific characteristics in the Willow Creek basin. Sections 3.0, 4.0, and 5.0 provide summaries of the flood control, water quality, and natural resources evaluations respectively. Section 6.0 describes the resulting integrated basin strategy and Section 7.0 provides information regarding the implementation of the strategy including scheduling and financing.

Information Updates

The information contained in this document represents a "snapshot-in-time." The Study Area Characteristics data (Section 2) are current through 1998, and the evaluation data (Sections 3, 4, 5, 6) are current through June, 2001. As conditions in this basin change, the information in this document will need to be updated to reflect those conditions.

The following recent or imminent changes to conditions, information, or the integrated basin strategy are not reflected in this document, but will be addressed in the next update:

- As part of the W. 18th road improvement project recently completed, the bank stability problems identified on the west fork of Willow Creek, south of W. 18th have been resolved and additional bank stabilization at this location is no longer needed. See Section 4.2.1 for more information about this general category of projects.
- A portion of the Willow Creek basin was designated urban reserve when the Eugene-Springfield Metropolitan Plan was originally adopted in 1982. The flood control alternatives analysis conducted as part of the stormwater basin planning project included two potential scenarios for future development: future development of the designated urban reserve area

and no future development of the urban reserve area. These alternatives are described in Section 3.3 of this report. Subsequently, as part of the Eugene-Springfield Metropolitan Plan periodic review process in 2000, an analysis was conducted to determine consistency of the existing urban reserve areas with Statewide Planning Goals. The 2000 study concluded that the existing urban reserve areas do not comply with current administrative rules and direction was given to staff to initiate Metro Plan amendments. Action to remove the urban reserve designations is expected to occur as part of the final periodic review adoption process which is scheduled for 2003. The selected flood control strategy for the Willow Creek basin assumes follow through on the adoption of these Metro Plan amendments.

- Capital project WC08 has been incorporated into the Corps of Engineers Metropolitan Waterways project, currently underway in partnership with other metro agencies. This study, authorized by the Water Resources Development Act, will further define and prioritize needs for waterway restoration throughout the metro area including waterways in the Willow Creek basin, and will allow the City to partner with, and cost share with, the Corps and other agencies to optimize the use of local funds for stream restoration. The first phase of this study, the Reconnaissance Phase, was initiated in February 2002. The second phase, Feasibility, is expected to begin in spring 2003. Implementation of on-the-ground projects is anticipated by 2007.
- The narrative description of existing and future parks and schools in subsections 2.10.1 and 2.10.2 has been updated to the time of printing of this document. Map 12 (Section 2), Parks, Recreation, and Educational Facilities, has not been updated to match. Map 12 changes will be included in the next document update.
- Relationship to Eugene's ESA/Salmon response strategy.
- Relationship to and compliance with the State of Oregon's Underground Injection Well requirements.
- Updates to rare plant and animal species inventories through the Oregon Natural Heritage Program data base.

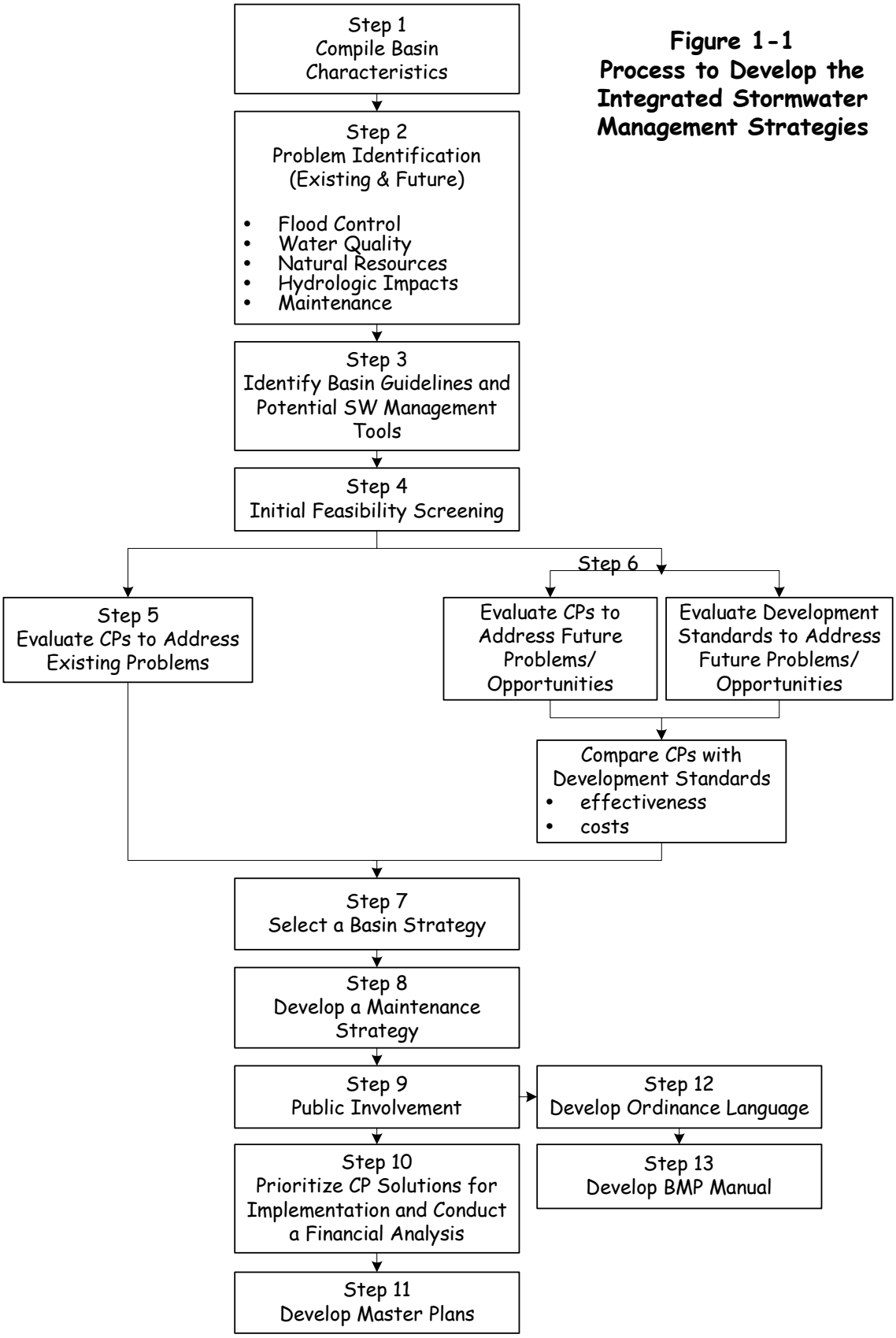


Figure 1-1
Process to Develop the Integrated Stormwater Management Strategies

This section provides background information regarding the existing physical characteristics of the Willow Creek basin. This information was used to assess opportunities and constraints for meeting the multiple-objective goals of the Stormwater Basin Master Plans. Specifically this section includes the following information for the basin: location and area; climate; land use and surface cover; land form; topography and slopes; surface water features and drainage system; water quality; rare, threatened and endangered plants, animals and communities; soils; groundwater; and recreational and educational facilities.

2.1 Location and Area

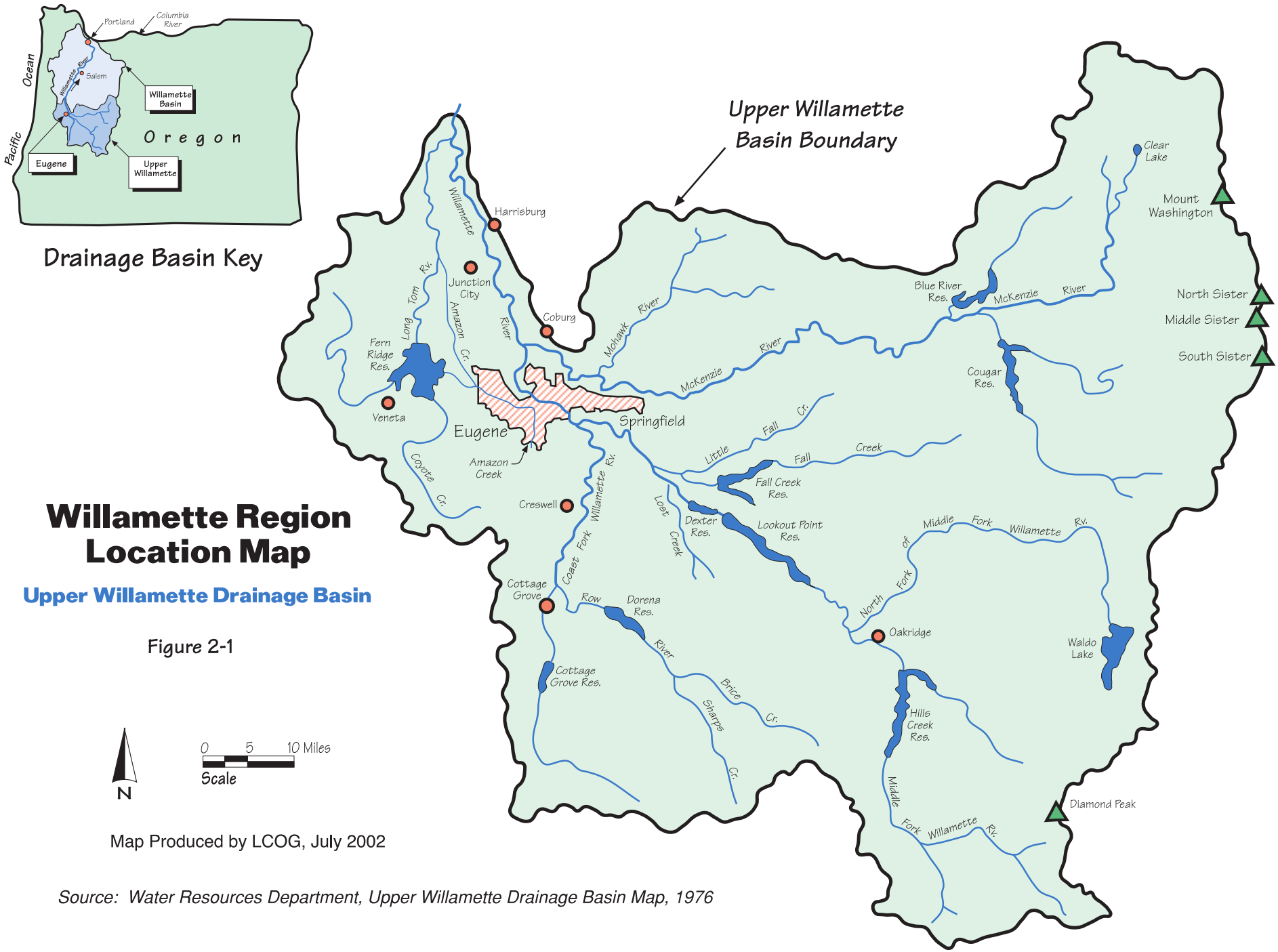
2.1.1 Regional Drainage Context

Eugene is located in the western third of the Upper Willamette Drainage Basin as shown on Figure 2-1. Drainage in the southern Willamette Valley is a combination of natural and built systems that have evolved over time. The natural system is composed of rivers, waterways, and a series of interconnected ponds and wetlands. Historically, the natural system had an extensive floodplain that typically experienced over-bank flooding every 1-2 years. The built drainage system includes a series of dams, pipes, and waterways that were built to contain over-bank flooding, and to retain water for recreational and irrigation purposes. The primary drainage features of the Upper Willamette Drainage Basin are: Main Stem of the Willamette River, Middle Fork of the Willamette River, Coast Fork of the Willamette River, McKenzie River, Amazon Creek, Coyote Creek, and the Long Tom River. From 1940 to 1960, the U.S. Army Corps of Engineers built nine dams on this system.

The cities of Cottage Grove, Creswell, and Springfield are all upstream from the City of Eugene and contribute urban runoff to the regional drainage system. Runoff from Cottage Grove, Creswell, and South Springfield flows through Eugene via the Willamette River. Approximately 4,800 acres of west Springfield's drainage area, as shown on Figure 2-2, discharges urban runoff into the Q Street Floodway, which is within Eugene's public drainage system. Eugene public drainage system refers to the system of stormwater facilities (i.e., pipes, ditches, open waterways) that Eugene is responsible for operating and maintaining.

2.1.2 City of Eugene

The City of Eugene is currently responsible for managing the stormwater quantity, quality, and related natural resources for the drainage area within its city limits. The area outside of the City limits but within the urban growth boundary (UGB) is expected to be annexed into the city as urban development occurs. Therefore, this Stormwater Basin Master Plan includes both the current city limits and the area within the UGB. The *Eugene-Springfield Metro Area General Plan (Metro Plan)* boundary covers the city limits, the UGB and, in some cases, areas beyond the UGB. For the purposes of characterizing the study area in this chapter, the area covered includes the *Metro Plan* boundary.



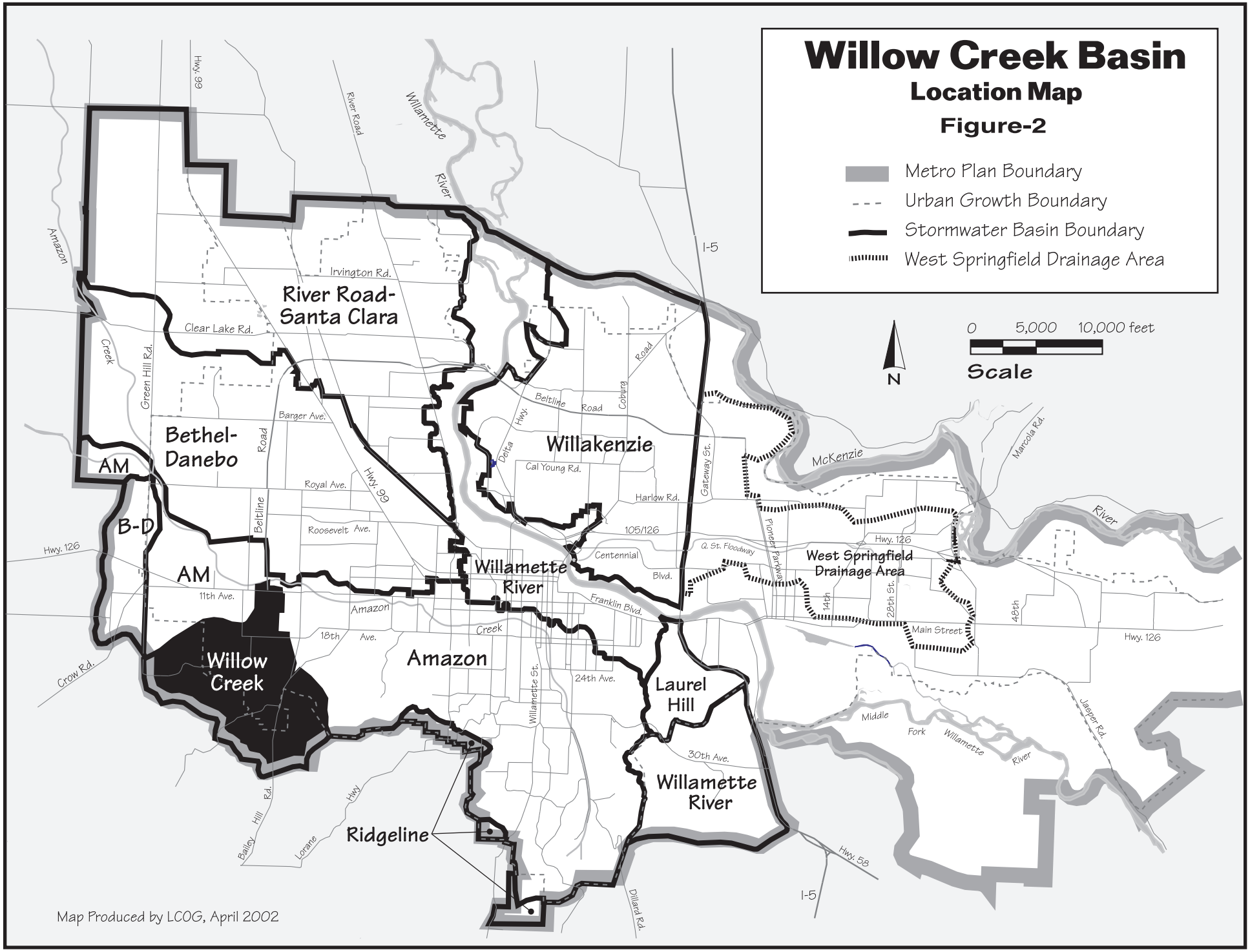
Willamette Region Location Map

Upper Willamette Drainage Basin

Figure 2-1

Map Produced by LCOG, July 2002

Source: Water Resources Department, Upper Willamette Drainage Basin Map, 1976


Willow Creek Basin
Location Map
Figure-2
Metro Plan Boundary
Urban Growth Boundary
Stormwater Basin Boundary
West Springfield Drainage Area
N
0 5,000 10,000 feet
Scale
River Road-Santa Clara
Bethel-Danebo
AM
B-D
AM
Willakenzie
Willamette River
Willow Creek
Amazon
Laurel Hill
Willamette River
Ridgeline
West Springfield Drainage Area
Hwy. 99
River Road
Willamette River
I-5
Irvington Rd.
Clear Lake Rd.
Green Hill Rd.
Amazon Creek
Barger Ave.
Royal Ave.
Roosevelt Ave.
Beltline Road
Hwy. 99
Delta Hwy.
Beltline Road
Coburg Road
Cal Young Rd.
Harlow Rd.
Gateway St.
105/126
Centennial Blvd.
Franklin Blvd.
Hwy. 126
11th Ave.
18th Ave.
Amazon Creek
24th Ave.
Willamette St.
Crow Rd.
Bailey Hill Rd.
Lorane Hwy
Dillard Rd.
30th Ave.
Hwy. 58
McKenzie
Marcola Rd.
Q. St. Floodway
Pioneer Parkway
14th
28th St.
48th
Main Street
Middle Fork Willamette River
Jasper Rd.
Hwy. 126
Map Produced by LCOG, April 2002

2.1.3 Willow Creek Basin

As shown on Figure 2-2, the Willow Creek basin forms the southwest corner of the Eugene-Springfield metropolitan area, and is generally bounded by the South Hills on the west, south, and east, and by Highway 126 (West 11th Avenue) to the north. The basin is 2,567 acres in size and about half (1,169 acres) is located within the Urban Growth Boundary (UGB).

2.2 Climate

The climate in the study area is primarily affected by humid air masses from the west and south, and infrequent influxes of cold, continental air masses from the east. As a result, the year-round climate in Eugene is moderate with relatively cool, wet winters, and warm, dry summers. Average minimum winter temperatures are in the mid-30s with extremes seldom dropping below 10 degrees Fahrenheit (-12.2 Celsius). Average maximum summer temperatures are in the low 80's (26.7 to 28.9 Celsius) with extremes seldom exceeding 100 degrees Fahrenheit (37.8 Celsius). Snowfall constitutes only 2 percent of the annual precipitation in Eugene. Winter snow does not accumulate; however, quick snow melt can contribute to flooding problems throughout the Eugene area.

The National Weather Service records rainfall information at the Mahlon Sweet Airport in Eugene. Average annual precipitation is approximately 46 inches with 86 percent occurring from October to May. Figure 2-3 presents the average monthly rainfall distribution based on the airport's 48-year rainfall record from 1949-1987.

Figure 2-3
Average Monthly Rainfall

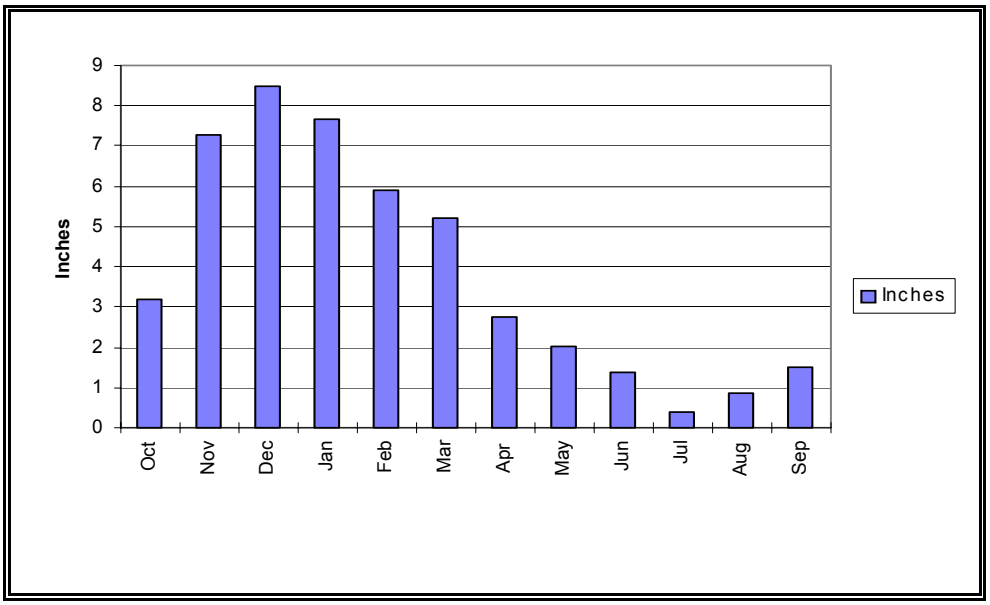


Table 2-1 characterizes a typical storm event for the Eugene area based on the historic 48-year precipitation record measured at the Eugene Airport:

Table 2-1
Average Storm Event

Storm Event Parameter	Average
Volume	0.67 inches
Duration	16.9 hours
Intensity	0.042 inches per hour

Since 1992, rainfall information has been recorded at six rain-gage stations within the Eugene city limits. Comparison of those data with the National Weather Service's Eugene Airport data indicates a significant difference between the two, with the airport data approximately 30 percent higher.

The Nature Conservancy has been collecting and monitoring precipitation data at the Willow Creek Natural Area since 1997. When compared with the airport data, this data is, on average, about 2.5 inches higher per rainfall year, or approximately 6% higher. Given the relative short duration for which this data has been collected and the uncertain quality control, this data was not used in the preparation of this basin plan.

For additional information regarding this issue, see Appendix H of Volume I.

Historically, performance of the City's drainage system has been very good. For example, the City's system handled the February 1996 storm event with very few problems even though this event caused widespread flooding in the Willamette River Valley.

2.3 Land Use and Surface Cover

The conversion from undisturbed to developed land uses can significantly affect the quantity and quality of stormwater runoff. Runoff volumes and velocities increase as impervious surface areas increase. Likewise, stormwater quality decreases due to nonpoint source pollution from highways and urban land uses such as commercial, industrial, and residential. The purpose of this section is to describe existing land use and impervious surface conditions within the basin and to forecast changes in these conditions due to buildout of remaining vacant lands within the UGB according to *Metro Plan* designations. Existing land use data presented in Map 1 are current to November 1998. Buildout data presented in Map 2 are based on current *Metro Plan* designations. See maps at the end of Section 2.

2.3.1 Existing Land Use

As shown in Table 2-2, the predominant land uses in the basin as of 1998 were: agriculture (636 acres); other undeveloped (562 acres); timber (441 acres); parks/open space/recreation (412

acres, mainly in the form of wetlands protection); low-density residential (283 acres); industrial (102 acres); and street rights-of-way (100 acres).

Table 2-2
Existing Land Use – Willow Creek Basin

Land Use Categories	Acres	Percent of Area
Inside UGB		
Low-Med. Density Residential	81	3.2%
Commercial	13	0.5%
Industrial	102	4.0%
Communication and Utilities	4	0.2%
Schools, Churches, & Cemeteries	3	0.1%
Parks, Open Space, & Recreation	355	13.8%
Golf Course	4	0.2%
Agriculture	317	12.4%
Timber/Forest	25	1.0%
Other Undeveloped Land	211	8.2%
Streets (R.O.W.)	54	2.1%
Subtotal	1,169	45.5%
In Urban Reserve		
Low-Med. Density Residential	202	7.9%
Communication and Utilities	7	0.3%
Parks, Open Space, & Recreation	57	2.2%
Agriculture	319	12.4%
Timber/Forest	416	16.2%
Other Undeveloped Land	351	13.7%
Streets (R.O.W.)	46	1.8%
Subtotal	1,398	54.5%
Grand Total	**2,567**	**100%**

Source: LCOG 1998 Parcel File

2.3.2 Buildout Land Use

The primary land use policies pertaining to the Willow Creek Basin are contained in the following locally adopted policy documents:

- *Eugene-Springfield Metro Area General Plan (1987).*
- *Willow Creek Special Area Study (1982).*
- *West Eugene Wetlands Plan (November 2000, amended).*
- *South Hills Study (1974).*

Lane County zoning applies to areas outside the UGB and City Codes apply within the UGB. Table 2-3 summarizes the buildout land use for the Willow Creek Basin.

2.3.2.1 Buildout Land Use Within the UGB

This area includes both the current city limits and the unincorporated UGB, totaling 1,169 acres. There are 553 vacant acres within the UGB. For the purposes of this report, the term "vacant acres" refers to lands within the UGB that are expected to develop to urban uses. As shown in Table 2-3, land use categories with significant remaining vacant acres include: low-density residential (310 acres), industrial and commercial-industrial mixed (107 acres), high-density residential (68 acres), medium-density residential (37 acres), and commercial and commercial-residential mixed (30 acres).

2.3.2.2 Projected Land Use Outside the UGB

Approximately half of the Willow Creek basin (1,398 acres) lies outside the UGB. This area is also designated as "urban reserve" which means at the time the Metro Plan was adopted (1982) it was identified as a potential area to be annexed to the UGB in order to meet future urban land use needs. A recent metro-wide study concluded the existing urban reserve areas do not meet current state criteria. The three Eugene-Springfield metro jurisdictions have directed these areas be removed from urban reserve designation as a future metro plan amendment. This area, therefore, will remain rural, and land use is restricted to the designations shown in Table 2-3 below. Areas outside the UGB are not permitted to develop to urban uses and, therefore, "vacant" acres do not apply here.

Table 2-3
Buildout Land Use

Generalized Plan Designation	Designated Acres	
	Total	Vacant* (1998) for Future Urban Development
Inside UGB		
Low-Density Residential	348	310
Medium-Density Residential	32	37
High-Density Residential and Mixed	68	68
Commercial and Commercial-Residential Mixed	48	30
Industrial and Commercial-Industrial Mixed	217	107
Natural Resource, Parks and Open Space	330	1
Streets (R.O.W.)**	126	-
Subtotal	1,169	553
Outside UGB and within Urban Reserve		
Rural Residential	214	**0**
Natural Resource, Parks, Open Space	58	**0**

Table 2-3 (continued)

Generalized Plan Designation	Designated Acres	
	Total	Vacant* (1998) for Future Urban Development
Agriculture	70	**0**
Forest	998	**0**
Streets (R.O.W.)**	58	**0**
Subtotal	1,398	**0**
Grand Total	**2,567**	**553**

Source: LCOG and City of Eugene Geographic Information System, 1998

***For purposes of this report, vacant acres apply to lands only within the urban growth boundary.**

***Notes: Streets (Right of Way). The Metro Plan does not have a "Streets" Plan designation. This amount was estimated based on the difference between total designated area and total basin size. In undeveloped areas, 15 percent of the land area was put into the Streets (Right of Way) category to account for streets that will serve future designated development.*

2.3.3 Surface Cover

Other than precipitation, surface cover is perhaps the single most influential factor that affects the volume, quality, and velocity of stormwater runoff and the ability to treat runoff through filtration and other natural processes. Pervious surfaces are undisturbed natural areas that retain native prairie or forest vegetation or lands in developed areas that are typically covered with lawn, agricultural fields, or pasture. In both cases, water is free to infiltrate into the ground. Undisturbed natural areas provide significant beneficial stormwater functions. They help reduce the volume and velocity of runoff by facilitating infiltration of precipitation into the groundwater. Stormwater quality is best in undisturbed natural areas. The vegetative cover associated with undisturbed natural areas is also important for stabilizing steep slopes and streambanks. Pervious surfaces in developed areas also provide stormwater benefits, although to a lesser degree than undisturbed natural areas. The infiltration capacity may be reduced during conversion to urban lawns and agricultural crops. Stormwater quality may also be impacted by lawn care and agricultural practices.

In contrast, impervious surfaces are lands covered by hard surfaces such as rooftops, roads, and parking lots and allow little or no infiltration of water. Impervious surfaces are unable to absorb and infiltrate precipitation, which results in greater runoff volumes, higher but shorter duration peak flows, and higher concentrations of pollutants. The transition from undisturbed to developed land uses and densities involves a significant change from pervious to impervious surfaces. As a consequence, adequate facilities must be planned, constructed, and maintained to minimize drainage and flood problems and impacts to water quality and natural resources.

The purpose of this section is to describe surface cover conditions as they exist in 1998 and as they are projected to exist at buildout of the Willow Creek basin urban growth boundary (UGB).

2.3.3.1 Impervious Surfaces

Total impervious surface area for the study area was calculated using a set of impervious surface area factors (ISAF) that were applied to the existing and buildout land use data. To calculate

total impervious surface area, the ISAF percentages were multiplied by the total land area in each of the land use categories.

The ISAFs used are provided in Volume I. These factors were derived through a process that used existing developed properties in Eugene to generate typical impervious percentages. Impervious surface area for residential, commercial, and industrial land uses had previously been digitized as the basis for calculating stormwater user fees. By using this data source, the resulting ISAFs have been calibrated specific to the City of Eugene and in some cases specific to the basin. The ISAFs for land use categories that were not previously digitized were derived through review of national standards and by calculating the impervious surface area on sample sites.

The amount of existing impervious surface area in the UGB portion of the Willow Creek basin is estimated to be 159 acres or 14 percent of the basin's UGB area. [Note: calculations for these data are available from the City of Eugene.] The majority of this impervious surface area is concentrated along West 11th, the Bailey Hill Road corridor and in the industrial area west of Willow Creek Road and 18th Avenue intersection. Map 3 depicts the existing generalized impervious surface area in pink. Due to the map scale and data restrictions, developed lots are shown entirely in pink. These pink areas are a mix of impervious surface and pervious surfaces associated with the land use such as lawns, streetscapes, parking lot planting, and other landscaped areas.

Assuming that future growth in the basin will follow conventional stormwater management drainage practices and will develop according to the land use categories depicted on the Eugene-Springfield Metro Plan designations (see Map 2), the amount of impervious acres in the UGB portion of the basin is projected to increase to 486 acres, or 42 percent of the basin's UGB area at buildout. [Note: calculations for these data are available from the City of Eugene.]

2.3.3.2 Pervious Surfaces

Except for the impervious surface areas noted above, the rest of the basin remains in a pervious condition, consisting mostly of prairie wetlands, forest, agriculture and lawns.

Overall, pervious area cover is expected to decrease from the current 86 percent of the UGB portion of the basin (1,005 acres) to 58 percent (678 acres) at UGB buildout. For the purposes of this report, pervious surface areas were identified and grouped into *Forest Cover*, *Landscaping*, and *Other Vegetated Areas* (refer to Figure 2-4) for the following reasons:

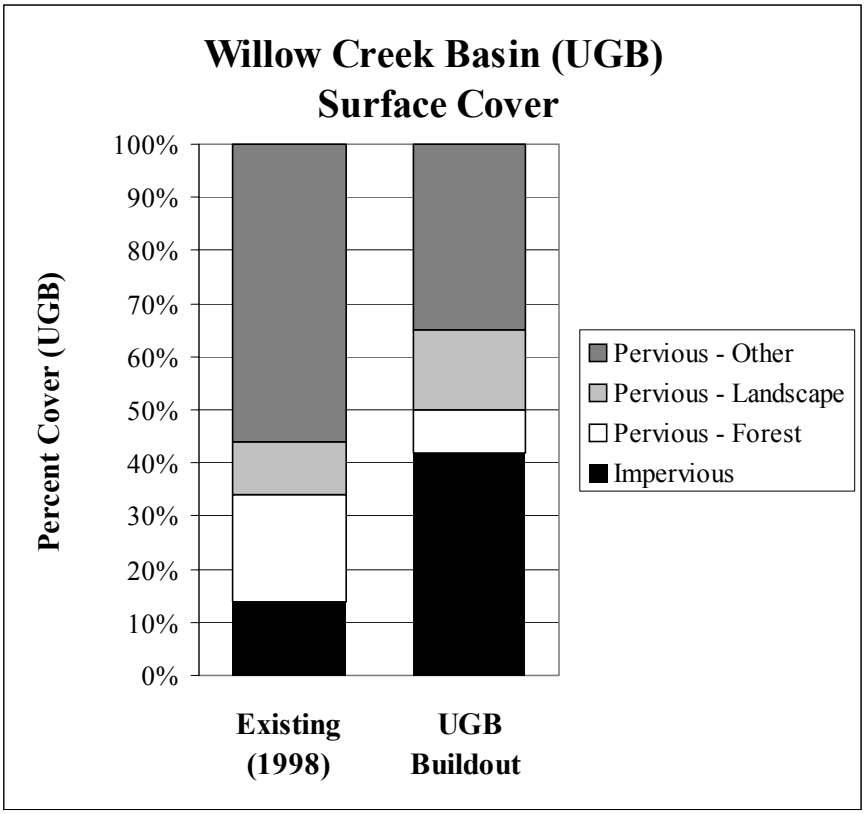
- Forest Cover is highly effective in reducing runoff volumes, and in preventing erosion (e.g., reduces soil impact by slowing down the velocity of precipitation and by intercepting up to 35 percent of it before hitting the ground) and stabilizing steep slopes (established root zones). Areas were included in this category if the forested area exceeded one acre in size. Fifty percent of the Willow Creek basin is currently in forest cover, with 20 percent located within the UGB. At UGB buildout, forest cover would decrease to 8 percent.

- Landscaping areas, including lawns, streetscape and parking lot landscaping are associated with site improvements due to urban development. This category was distinguished to highlight both its positive and potential negative impacts on stormwater resources and is included in the area shaded pink on Map 3. Positive impacts include protection of surface soils, filtration of sediments, and some infiltration (although this is reduced from pre-development conditions). The use of chemical fertilizers, pesticides, and herbicides can cause negative impacts to water quality. The amount of landscaped area in the UGB is projected to increase from the existing 10 percent to 15 percent at UGB buildout.

- Other Vegetated Areas are pervious surfaces not in *forest cover* or *landscaping* use, such as agricultural fields, pasture, vacant lots, prairie wetlands, and small clusters of trees (less than one acre). Similar to the landscaping category, these areas have both positive and negative impacts on stormwater resources. Agriculture and pasture uses can be significant contributors of pollutants in this category due to the use of chemical fertilizers, pesticides, herbicides, and fecal coliform due to grazing. This category is expected to decrease from 56 percent of the UGB to 35 percent at UGB buildout.

Figure 2-4 compares the percentage of existing and projected surface cover for the UGB portion of the Willow Creek basin.

Figure 2-4
Surface Cover in the Willow Creek Basin UGB



2.4 Landform, Topography, Slopes

The South Hills is the prominent land feature in the Willow Creek basin forming a horseshoe-shaped backdrop to the central and northern lowlands below. Elevations range from 360 feet above mean sea level at the confluence of Willow Creek with Amazon Creek to over 1,100 feet along portions of the South Hills ridgeline.

The topography is nearly level in the northern lowlands and changes abruptly from rolling hills to very steep slopes in the southern portion of the basin. The dramatic change in topography also marks the approximate location of the UGB. Seventy-seven percent of the UGB has slopes in the 0% to 10% percent range, while 90% of the non-UGB has slopes in the 11% to >25% range.

The following table is keyed to Map 4, Slope and Topography, and indicates the amount of acres affected by varying categories of slope steepness.

Table 2-4
Willow Creek Basin Slope Distribution

Location	Slope Distribution (percent)					
	Slopes 0-5%	Slopes 6-10%	Slopes 11-15%	Slopes 16-25%	Slopes >25%	Total
Within UGB	61%	16%	11%	10%	2%	100%
Outside UGB	2%	8%	20%	44%	26%	100%
Total Basin	29%	12%	16%	28%	15%	100%

2.5 Surface Water Features and Drainage System

This section describes the existing drainage features of the basin including the City's stormwater facilities, open waterways, and wetlands. Refer to Map 5.

2.5.1 Waterways

Pre-settlement (prior to 1855) morphological conditions in the Willamette Valley reflected a network of shallow, broad swales that would often over-bank during storm events creating ponded conditions. Today, most of the drainages have been altered into narrow, deep and well-defined channels where the management objective of preventing over banking conditions has been accomplished for most small storm events.

Willow Creek, a tributary to Amazon Creek, is the primary drainage feature in the basin and consists of three main segments: Main Stem, East Branch, and West Branch. Combined this system represents over 17 miles of open waterways.

2.5.1.1 East Branch

The East Branch is a seasonal stream that has its headwaters in the hills south of the UGB. This branch generally flows north to meet the west branch and main stem just north of West 18th Avenue.

Several headwater streams of the east branch converge just south of the City limits near Gimpl Hill Road. These streams are listed in the *Metropolitan Plan Natural Resources Study* (NR Study) as riparian resources (refer to E87: Willow Creek Tributaries; E88: Bailey Hill Riparian). There is evidence of erosion in this area. Vegetation is more disturbed in this segment than in any other segment of Willow Creek (Shafer, 1995). Between Gimpl Hill Road and West 18th Avenue, the east branch is relatively undisturbed and flows through The Willow Creek Natural Area. After crossing under West 18th Avenue, the east branch takes a sharp turn to the west in a channelized section constructed in the 1970s. At this point the east branch and the west branch meet to form the main stem.

2.5.1.2 West Branch

The West Branch is a seasonal stream and has two forks that meet in the Willow Creek Natural Area. The south fork of the West Branch originates in the upper slopes of the basin outside the UGB and is listed on the NR Study as part of the upland resource (refer to E35: West Eugene Uplands). The historic drainage pattern of this fork was diverted to the south for the construction of Willow Creek Road. Today the south fork generally follows the south side of Willow Creek Road gaining flow from several small tributaries in the hills to the south. The north fork of the West Branch originates in lower elevations west of an existing computer wafer manufacturing plant. The north fork crosses under Willow Creek Road about 700 feet south of West 18th. From this point, the north and south forks flow through the Willow Creek Natural Area where they meet to form a single waterway and then cross under West 18th Avenue.

2.5.1.3 Main Stem

Just north of West 18th Avenue, the east and west branches form the main stem of Willow Creek. The configuration of the creek and adjoining riparian vegetation changes dramatically along this stretch. The main stem has been channelized in a nearly straight line with relatively steep side banks. Riparian vegetation in this section contains a predominance of non-native species with low plant diversity and abundance. The lack of riparian vegetation may reflect the severing of the hydrologic linkage of the natural waterway and the floodplain due to channelization. The main stem flows north for about 3000 feet before bending to the west under West 11th Avenue, where it meets Amazon Creek.

Zoning restrictions apply to the main stem and the segments of the east and west branches within the city limits. These restrictions are intended to protect stormwater conveyance, water quality, and wildlife habitat functions.

2.5.2 Wetlands

Wetlands comprise about 12 percent (319 acres) of the Willow Creek basin and are primarily located in the lower elevations in the center of the basin. Many of these wetlands are hydrologically linked with Willow Creek and perform a significant role in storing, conveying, and treating stormwater in the basin.

These wetlands are part of the *West Eugene Wetlands Plan* where policy decisions have been made regarding protection, restoration, or future fill based on their relative values. The following table displays the policy management categories by acres.

Table 2-5
Willow Creek Policy Management Categories

Policy Management Category (acres)				Total
Protect	Restore	Future Fill		
		Tax Lot	Transportation/ Utility Corridor	
202	81	32	4	319

2.5.3 Public Piped System

Due to limited urban development and the presence of an extensive system of open waterways and other natural drainage features, the extent of storm pipes in the Willow Creek basin is minor (1.2 miles of public storm drain pipes) and is limited to areas of development in the northern portion of the basin.

2.5.4 Maintaining the Drainage System

Drainage system maintenance needs in this basin are relatively minor given the limited amount of development. Roadside drainage ditches are maintained by the City and Lane County depending on jurisdictional location. Areas of increased maintenance include the main stem north of 18th Avenue to West 11th Avenue, and the *tip-up* at Willow Creek Road and West 18th Avenue. Waterway maintenance activities along the main stem are performed periodically to ensure hydraulic conveyance capacity.

2.5.5 Floodplain

A Flood Insurance Study has not been conducted by the Federal Emergency Management Agency (FEMA) for Willow Creek. A small portion of the basin however is affected by the 100-year flood hazard zone identified for Amazon Creek near the confluence with Willow Creek.

2.6 Water Quality

This section provides a description of water quality conditions in the Willow Creek basin. Water quality conditions vary depending on time of day, weather conditions, land use activities conducted in the watershed, and location in the water body. Therefore, without significant amounts of data, it is often difficult to adequately evaluate water quality conditions. It is even more difficult to evaluate the water quality impacts of stormwater runoff on receiving waters. Therefore, a variety of available sources of water quality-related information were reviewed in an attempt to provide a general picture of water quality conditions in the basin. The following sources of information were reviewed and are described below:

- Documented water quality problems based on existing chemical, physical, and biological data.
- Oregon Department of Environmental Quality's (DEQ's) designations of water quality limited water bodies.
- Natural and built environmental conditions that influence water quality.

2.6.1 Documented Water Quality Problems

The following subsections describe the water quality problems that have been documented for the Willow Creek basin in terms of chemical stormwater monitoring data, macroinvertebrate sampling, and field observations.

2.6.1.1 Chemical Stormwater Monitoring Data

The City collected and analyzed samples of stormwater runoff from 1992 to 1997 at 6 sampling stations in Eugene (see Figure 2-5). The 6 sampling stations were selected to represent runoff from various land uses. In 1998, the storm event monitoring at the 6 sampling stations was discontinued and a pilot project on the A3 Channel using a basin approach to water quality monitoring was implemented. The revised monitoring plan consisted of collecting monthly composite samples at the original industrial land use station on the A3 Channel (station I1) and collecting samples at selected high source areas in the piped system on the A3 Channel.

The following table provides a summary of the results collected during 1992 to 1997 from the 6 sampling stations. Table 2-6 includes a description of the problem pollutants, typical sources of the pollutants, specific results from Eugene, and potential problems associated with the pollutants. Although none of the stormwater monitoring stations were located in the Willow Creek basin, the City-wide data were used to provide general information regarding stormwater quality in Eugene and to identify a stormwater management strategy for this basin.

Table 2-6
Summary of Stormwater Quality Monitoring in Eugene

Pollutant	Description	Sources	Eugene's Results	Potential Problems
Bacteria	- Enterococcus, - Fecal coliform, and - Fecal streptococcus	- Animal Wastes (droppings from wild/domestic animals), - Human Wastes (leaking sanitary sewer pipes, and seepage from septic tanks).	**Results from almost all of the samples significantly exceeded the DEQ standard for water quality**.	These are commonly used indicators of human pathogens. Water contact may cause eye and skin irritations and gastro-intestinal diseases if swallowed.
Heavy Metals	Antimony Arsenic Beryllium Cadmium Chromium Copper Lead Mercury Nickel Selenium Silver Thallium Zinc	- Vehicles (combustion of fossil fuels, improper disposal of car batteries, wear/tear of tires and brake pads), - Metal Corrosion, - Pigments for Paints, - Solder, - Fungicides, - Pesticides, - Wood Preservatives	Cadmium, chromium, copper, lead, nickel, and zinc were typically present in samples. **Copper, lead, and zinc in stormwater samples frequently exceeded DEQ standards for the protection of aquatic life.**	Heavy metals are toxic to freshwater aquatic ecosystems. These metals are considered to be the most significant toxic substances which are commonly found in urban stormwater runoff.

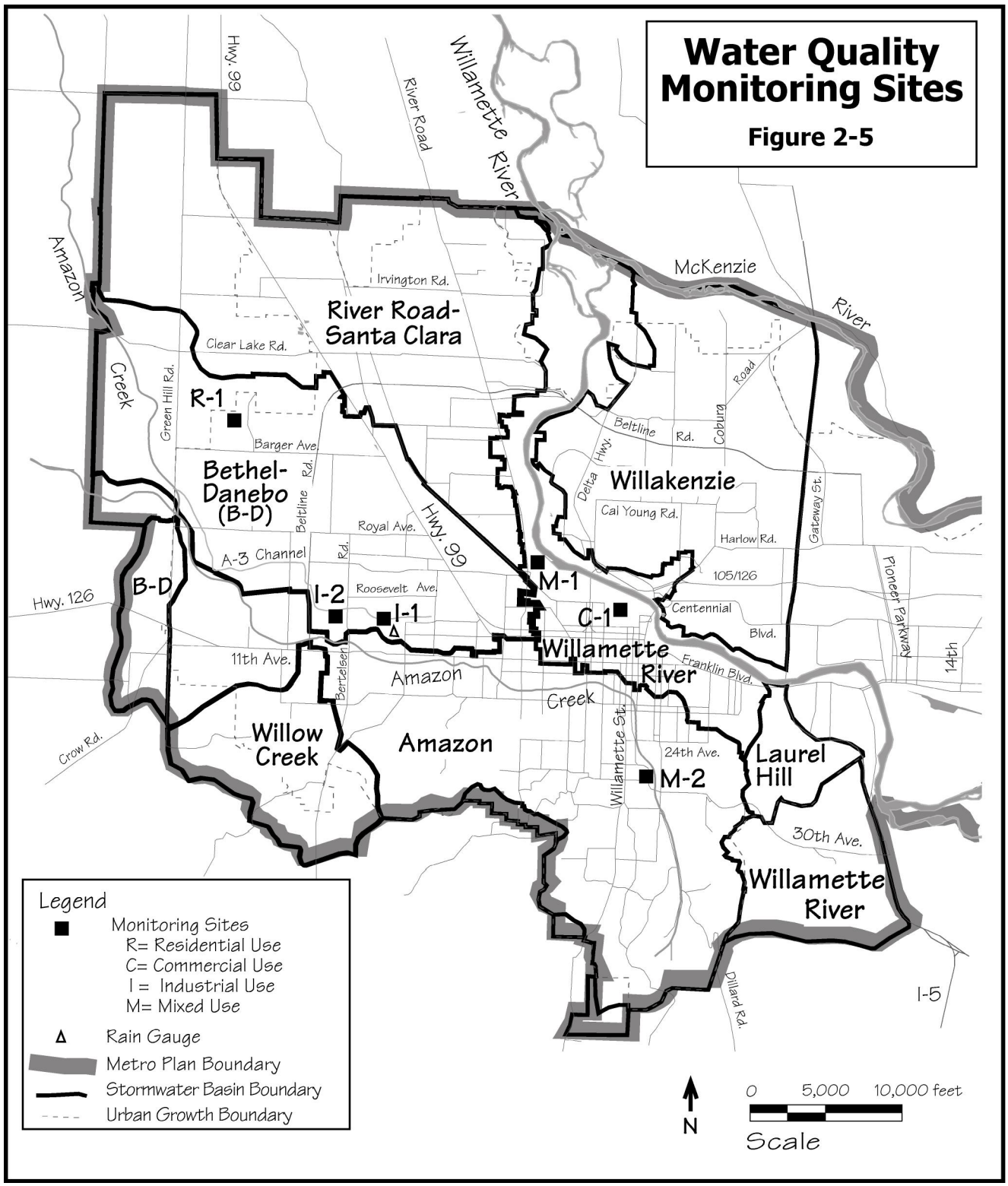

Water Quality Monitoring Sites
Figure 2-5
Hwy. 99
River Road
Willamette River
McKenzie River
Amazon Creek
Irvington Rd.
River Road-Santa Clara
Clear Lake Rd.
Green Hill Rd.
R-1
Barger Ave.
Bethel-Danebo (B-D)
Beltline Rd.
Royal Ave.
A-3 Channel
Hwy. 99
Willakenzie
Delta Hwy.
Beltline Rd.
Coburg Road
Cal Young Rd.
Harlow Rd.
Gateway St.
105/126
Centennial Blvd.
Pioneer Parkway
141st
M-1
C-1
B-D
Hwy. 126
I-2
Roosevelt Ave.
I-1
11th Ave.
Bertelsen
Amazon Creek
Willamette River
Franklin Blvd.
Willamette St.
24th Ave.
M-2
Laurel Hill
30th Ave.
Willamette River
Crow Rd.
Willow Creek
Amazon
Dillard Rd.
I-5
Legend
Monitoring Sites
R= Residential Use
C= Commercial Use
I = Industrial Use
M= Mixed Use
Rain Gauge
Metro Plan Boundary
Stormwater Basin Boundary
Urban Growth Boundary
N
0 5,000 10,000 feet
Scale

Table 2-6 (continued)

Pollutant	Description	Sources	Eugene's Results	Potential Problems
Oil & Grease	A broad group of pollutants including: - Animal fats, and - Petroleum products.	- Food Wastes (animal and vegetable fats from garbage), - Petroleum Products (gas, engine oil, lubricants, etc.).	**Two of fifty-three samples had concentrations which exceeded discharge limitations specified for industrial stormwater discharges (i.e., > 10 mg/L).**	These compounds can coat the surface of the water limiting oxygen exchange, clog fish gills, and cling to waterfowl feathers. When ingested these compounds can be toxic to birds, animals and other aquatic life.
Sediments	Sediments in the water are considered pollutants when they exceed natural concentrations and negatively affect water quality and/or beneficial uses of the water.	- Erosion from increased stream flows, - Construction site runoff, - Landscaping activities, - Agricultural activities, - Logging, - All other activities where the ground surface is disturbed.	**Excess levels were measured at all stations. Results from the urban sampling stations in Eugene were all 40% to 70% higher than results from an open space (i.e., undeveloped) sampling.**	Sediments cause increased turbidity, reduced prey capture for sight feeding predators, clogging of gills/filters of fish and aquatic insects, and blocked light which limits food production available for fish. Sediments also accumulate in stream bottoms which reduces the capacity of the stream (and hence increases the potential for flooding) and covers stream bottom habitats. Sediment also acts as a carrier of toxic pollutants such as metals and organics.
Nutrients	- Nitrate - Ammonia - Kjeldahl Nitrogen - Phosphorus - Orthophosphate	- Landscaping activities, - Yard debris, - Human wastes (leaks from septic tanks and sanitary sewers), - Animal wastes, - Vehicle exhausts, - Agricultural activities, - Detergents (car washing), - Food Processing	**The DEQ guidance value of 0.1 mg/L for total phosphorus was exceeded in 100% of the samples collected.**	Excess levels of nutrients can lead to eutrophication in downstream receiving waters. Problems include surface algal scums, odors, reduced oxygen levels, and dense mats of algae. In addition to water quality problems, these effects have a negative impact to the aesthetic quality of water bodies.
Organics	There are many organic compounds, however, the synthetic organics are of most concern and include: - Fuels - Solvents - Pesticides - Herbicides.	- Illegal dumping, - Illicit connections, - Spills, - Leaks from drums and storage tanks, - Landscaping activities - Agricultural activities.	Although sampling for these compounds was limited, **nine volatile organic compounds were detected (including one pesticide).**	Most synthetic organics are highly toxic to aquatic life at very low concentrations, and many are carcinogenic (cancer causing) or suspected carcinogens. Diazinon has been identified in many recent studies as one of the causes of toxicity in stormwater.
Litter and other Floatable Debris	- Plastics, - Paper products, - Yard debris, - Tires, - Metal, - Glass.	- Littering, - Dumping, - Spills.	Sampling for litter and floatables was not conducted, however, **specific problem dumping areas have been identified in Eugene** (see notes below).	These pollutants degrade the aesthetic quality of water bodies. In addition, they contribute pollutants as they decompose, and they can reduce the capacity of the water body. Excess yard debris contributes to high levels of nutrients and it reduces oxygen levels as it decomposes.

Based on results from the above monitoring program and the results from state-wide monitoring efforts (ACWA, 1997), industrial and commercial land uses have been identified as significant sources of stormwater pollutants (i.e., high source areas). In the Willow Creek basin, the commercial and industrial areas are in the following locations:

- Along West 11th Avenue.
- Along the west portion of West 18th Avenue.

2.6.1.2 Findings from Macroinvertebrate Sampling

Aquatic macroinvertebrate sampling is useful in evaluating water quality and ecological integrity. Pronounced changes in biological communities indicate a disruption of healthy environmental conditions and can be useful in identifying cumulative effects of pollutants, habitat alterations, effects from bioaccumulative chemicals, and other impacts that chemical monitoring may not reveal.

Samples were collected on March 7 and 8, 1995 at eight sampling sites in the Willow Creek drainage (see Figure 2-6). Six sampling stations were established in the portion of the creek upstream of West 18th Avenue, four in riffles and two in runs. In addition, two sampling sites were established in the channelized segment of Willow Creek downstream of West 18th Avenue.

Findings from the macroinvertebrate sampling suggest pollution and habitat impacts are highest in the downstream segments, possibly due to cattle grazing, channelization, maintenance activities, and pollution. Effects from organic pollutants generally increased in a downstream direction, with slight improvements at sites 3 and 6 in the Willow Creek Natural Area.

Taxa richness was lowest at sampling sites 2, 4, and 7.[1] Site 2 is immediately downstream of an unfenced stream segment where cattle have direct access to the creek and riparian habitat. Site 4 is downstream of a reach where human activity has contributed to bed scour and bank instability and undercutting. Site 7 is in the channelized section of Willow Creek where maintenance activities have removed creek bed and bank vegetation. For more information, refer to Willow Creek Basin Plan, Water Quality Component, January 1996.

2.6.1.3 Field Observations of Water Quality Problems

In addition to the information obtained from the stormwater monitoring data described above, specific water quality related problems/issues have been observed in this basin as follows:

- *Turbidity*: Measured turbidity levels are moderate (generally between 10-25 NTUs) but can be exacerbated by stream channel erosion and unprotected disturbed soils.

- *Tip-up:* Sediment and debris that has been observed to accumulate in a tip-up located at Willow Creek Rd. and West 18th is likely getting flushed into downstream open waterways during larger storm events.

- *Debris in the Open Waterways:* Significant amounts of trash and debris are dumped into the open waterways in this basin and maintenance access is often limited for removing debris.

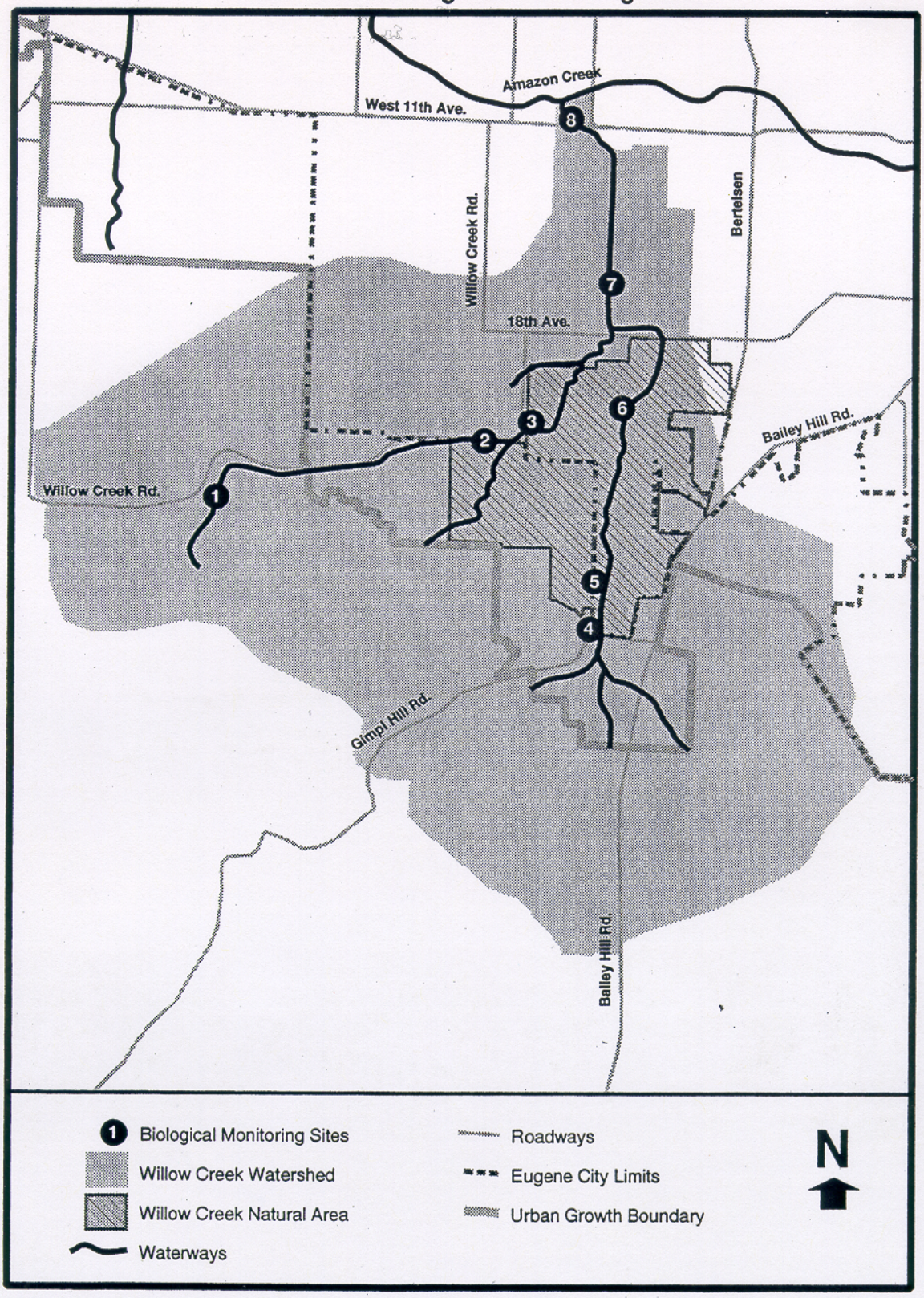
- *Unstable Banks:* Downcutting, erosion, removal of riparian vegetation and streambank failures have been observed at several open waterway locations in this basin.

- *Livestock Grazing*: Livestock grazing occurs within the riparian zone and creek upstream from the Nature Conservancy property.

[1] Taxa richness generally increases with increasing water quality.

Willow Creek Watershed

Figure 2-6 Biological Monitoring Sites



2.6.2 Oregon Department of Environmental Quality Water Quality Limited Designations [303(d) List]

The federal Clean Water Act requires states to maintain a list of water bodies that do not meet water quality standards. These standards are established to protect beneficial uses such as drinking water, fisheries, industrial water supply, recreational, and agricultural uses. This list is called the 303(d) List based on the section of the Clean Water Act that mandates this requirement. The list is meant only as a means of identifying water quality problems and not the causes.

States must monitor water quality and review available data and information to determine if the standards are being met. In Oregon, this responsibility is carried out by the Department of Environmental Quality (DEQ). If available data indicate a water body is not meeting water quality standards, and the data meet listing guidelines, DEQ must assume that the water body is water quality limited. Water bodies with no information, or information incompatible with the EPA guidelines, are not included on the 303(d) list. The 303(d) list is updated and revised every two years. Once a water body is included on the 303(d) list, DEQ is required to develop a total maximum daily load (TMDL) requirement for both point and non-point sources of the pollutants of concern. It is anticipated that DEQ will develop TMDL requirements for all designated water quality limited water bodies in the State of Oregon sometime within the next ten years.
No water bodies in the Willow Creek basin appear on the 303(d) list.

2.6.3 Natural and Built Conditions

Evaluating the natural and built conditions that influence water quality can be useful in indirectly assessing water quality conditions in the basin. As urbanization occurs, negative impacts to the health of receiving waters result from changes in the quality of stormwater runoff. Natural features such as riparian areas, wetlands, and open drainage systems have the ability to treat stormwater pollutants, prevent waterway scour by slowing down runoff rates, settle out sediments, and protect stream banks from erosion. However, with research showing that water quality degradation occurs at relatively low levels of imperviousness (10-20 percent), the implications of development on water quality is significant.[2] Figures 2-7, 2-8, and 2-9 examine natural and built conditions relative to the other Eugene drainage basins.

Figure 2-7
Extent of Open Drainage System in the Willow Creek Basin (UGB)

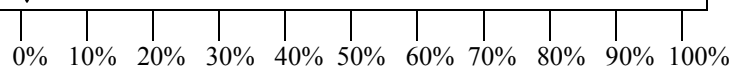
Miles per Square Mile Of Open Drainage System in the Willow Creek Basin	Willow Creek Basin [▼] Relative to the Range in Other Eugene Basins (miles/sq mile)
5.0	▼

0 1 2 3 4 5

[2] Tom Schueler, et al. *Site Planning for Urban Stream Protection: The Importance of Imperviousness*, 1995.

Figure 2-8
Extent of Area as a Percentage of the Willow Creek Basin (UGB)

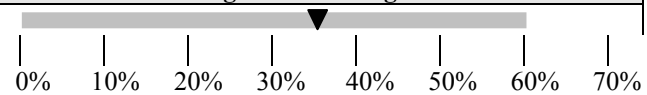
Factors	Percent in Willow Creek Basin	Willow Creek Basin [▼] Relative to The Range in other Eugene Basins
Remaining Vacant Lands*	**47%**	
Existing Impervious Surface Area	**14%**	
Projected Impervious Surface Area	**42%**	
Wetlands	**13%**	
100-Year Floodplain	**1%**	



Vacant land includes tax-lotted areas currently in vacant, agricultural, and timber uses.

Figure 2-9
Extent of 100-Year Floodway Fringe that is Vacant in the Willow Creek Basin

Percent of 100-Yr. Floodway Fringe Vacant* in the Willow Creek Basin	Willow Creek Basin [▼] Relative to The Range in other Eugene Basins
35%	



Vacant land includes tax-lotted areas currently in vacant, agricultural, and timber uses.

2.6.4 Conclusions

A summary of the above findings suggest that degraded water quality conditions exist in the Willow Creek basin as follows:

- Based on the analysis of stormwater runoff samples collected from Eugene and other urban areas in Oregon, the pollutants of concern that were identified are as follows:
  - Total Suspended Solids (TSS)
  - Nutrients
  - Heavy Metals
  - Bacteria
  - Oil and Grease
- Commercial and industrial areas have shown to be the most significant contributors of specific stormwater pollutants.
- Macroinvertebrate sampling in Willow Creek suggests pollution and habitat impacts are highest in the downstream segments, possibly due to cattle grazing, channelization, maintenance activities, and pollution.

- At 14 percent impervious surface coverage, the UGB currently has levels of imperviousness where problems with streambank erosion and habitat degradation begin to appear. At UGB buildout impervious surface area is projected to increase to 42 percent.
- Sediment and debris that has been observed to accumulate in a tip-up located at Willow Creek Rd. and West 18th is likely getting flushed into downstream open waterways during larger storm events.
- Significant amounts of trash and debris are dumped into the open waterways in this basin.
- Downcutting, erosion, removal of riparian vegetation and streambank failures have been observed at several open waterway locations in this basin.
- Livestock grazing occurs within the riparian zone and creek upstream from the Nature Conservancy property.

2.7 Rare, Threatened, and Endangered Plants, Animals, and Communities

Stormwater management decisions and practices can affect rare, threatened, and endangered plant and animal species. Local populations can be reduced or even eliminated as a result of decisions to pipe a waterway, install upstream detention, or to allow significant increases in runoff due to new development. The purpose of this section is to describe the known rare species and communities located in the study area so that the details of these resources can be consulted prior to any final decisions.

Table 2-7 indicates rare plant and animal species that have been observed in the Willow Creek basin and that appear on the Oregon Natural Heritage Program's data base. Specific locations of these species are available through the Oregon Natural Heritage Database Program. Due to the WEWP and The Nature Conservancy's interest in the Willamette Valley Wet Prairies, the most extensive surveys for rare plant and animal species have occurred in the Willow Creek, Amazon Creek, and Bethel-Danebo basins. As a consequence, more species information is known about these areas than in the other basins; however, given the relatively high level of urban development in the remaining basins, the occurrence of rare species is likely to be low when compared with basins within the WEWP Boundary.

In March 1999, the National Marine Fisheries Service (NMFS) listed spring-run Chinook salmon as a threatened species under the Endangered Species Act (ESA). It includes all naturally spawned populations of Spring Chinook in the Clackamas River, and in the Willamette River and its tributaries above Willamette Falls, Oregon. Because runoff from Eugene discharges either directly or indirectly to the Willamette River, the listing will affect the City's stormwater management program and practices.

A species that is listed as *threatened* means it is *likely to become endangered within the foreseeable future throughout all or a significant portion of its range.* Protective regulations, known as 4(d) rules have been developed that are *deemed necessary and advisable to provide for the conservation of the species*. These rules spell-out the *take* prohibitions that pertain to Spring Chinook and focus on the type of activities that are likely to lead to a *take*. The City is in the process of reviewing its own processes, procedures, and development standards for identifying and adjusting those that may not be compatible with the 4(d) rules.

Table 2-7 displays the inventoried rare plants and animal species within the Willow Creek basin.

Table 2-7
Rare Plants and Animals in Willow Creek Basin

Species/Communities	Federal		State		TNC Rank		Associated	ONHP
	Listed	Candidate	Listed	Candidate	Global	State	Habitat	List
Bradshaw's lomatium (*Lomatium bradshawii*)	E		E	SC	G2	S2	Wet Prairie	1
Fenders Blue Buttefly *(Icaricia icarioides fenderi)*	E				TI	S1	Upland Prairie	1
Kincaid's lupine (*Lupinus sulphureus ssp. Kincaidii)*			T				Upland Prairie	1
Tall bugbane (*Cimicifuga elata)*		SOC		C	G2	S2	Coniferous Forest	1
Timwort (*Cicendia quadrangularis)*					G4	S2	Wet Prairie	2
Wayside aster (*Aster vialis*)			T		G2	S2	Coniferous Forest	1
Western pond turtle (*Clemmys marmorata marmorata*)		SOC		SC	G3	S2	Riparian/Wetlands	2
White-topped aster (*Aster curtus*)		SOC	T		G3	S2	Prairie	1
Willamette valley daisy (*Erigeron decumbens var.decumbens*)	E		E		T1	S1	Prairie	1

KEY: *Federal and State (E=Endangered, T=Threatened, C=Candidate throughout its range, SOC=Species of Concern, SC=Sensitive/Critical, SV=Sensitive/Vulnerable, *=Under Consideration for Protective Status).* ***TNC Rank*** *(State Rank: 1=critically imperiled, 2=imperilled, 3=rare, uncommon or threatened but not immediately imperiled, 4=not rare and apparently secure, and 5=demonstrably secure, widespread. Global Rank: The number is prefixed by a "G" and for the state an "S". A "T" ranks subspecific species on a global scale (but not on state scale)).* ***ONHP List*** *(List 1= threatened or endangered throughout their range, List 2= threatened or endangered in Oregon but more stable elsewhere, List 3 = need more information, List 4=species of concern but are not currently threatened or endangered.)*

2.8 Soils

Soil characteristics are important factors in predicting the amount, rate, and quality of stormwater runoff and for selecting management measures for addressing the effects of runoff. This section describes the key soil parameters relative to stormwater issues and the distribution of those parameters in the Willow Creek basin. All soils data were obtained from the *USDA Soil Survey of Lane County*. Refer to Tables 2-8 to 2-10 and Maps 6 to 10 for a description of the soil mapping units and relevant stormwater related data found in the Willow Creek basin.

2.8.1 Permeability

Soil permeability measures the rate of water movement through the soil horizon. This factor is important in managing stormwater quantity and quality. Soils with slow permeability rates are more likely to result in higher stormwater runoff volumes than soils of high permeability. Under these conditions, larger and more extensive stormwater facilities are needed to accommodate new development where space permits. In more densely developed areas, slow permeable soils may be better suited to stormwater conveyance and storage facilities than infiltration facilities.

Storage facilities could include detention ponds and treatment ponds where time is desired for settling and filtering purposes.

Sixty-six percent of the soils in the Willow Creek basin UGB are rated either slow or very slow. The following table displays the distribution of soil permeability for the basin.

Table 2-8
Soil Permeability in the Willow Creek Basin

Location	Permeability (percent)						
	Very Rapid	Moderately Rapid	Moderate	Moderately Slow	Slow	Very Slow	Total
Within UGB	0%	0%	2%	29%	15%	54%	100%
Outside UGB	0%	0%	0%	33%	49%	18%	100%
Total Basin	0%	0%	3%	31%	33%	33%	100%

Source: USDA Soil Survey of Lane County Area, Oregon, 1987.

2.8.2 Runoff Potential

Soil groups have been rated according to their runoff potential under nonvegetated and saturated conditions without consideration of topographic conditions. Runoff potential measures a soil's capacity to permit infiltration and, therefore, can be used to describe the degree of runoff expected during storm events. For example, soils rated with a "low runoff potential" are more likely to have high infiltration rates and conversely, soils rated "high runoff potential" are more likely to have a very slow infiltration rate. Hydrologic stormwater models often use this parameter in conjunction with slope and surface cover factors for estimating surface flows under undeveloped conditions.

As shown on Map 7, the Willow Creek basin contains soil groups with either "moderately high" or "high" runoff potential. The geographic patterns associated with this parameter indicate the drainage corridors and adjoining wetlands are areas of high runoff potential with the remaining steeper slope areas being moderately high. The following table displays the distribution of potential runoff qualities of the basin:

Table 2-9
Runoff Potential in the Willow Creek Basin

Location	Runoff Potential (percent)				
	High	Moderately High	Moderately Low	Low	Total
Within UGB	72%	28%	0%	0%	100%
Outside UGB	51%	49%	0%	0%	100%
Total Basin	61%	39%	0%	0%	100%

Source:USDA Soil Survey of Lane County Area, Oregon, 1987.

2.8.3 Erodible Soils

Highly erodible soils have significant stormwater management implications. If not properly protected during construction and land clearing activities, erosion and sedimentation from these soils can have the following negative effects:

- Reduction in the conveyance capacity of downstream stormwater facilities resulting in potential drainage and flooding problems.
- Reduction or elimination of aquatic habitat and covering or destroying of spawning beds.
- Water quality impacts due to pollutants that are attached to sediments.

As shown on Map 8, highly erodible soils comprise nearly 66 percent of Willow Creek basin with most located in the steeper slopes of the "Urban Reserve" area. These locations are all upstream from surface water features and wetland habitats and, therefore, have the potential for impacting these resources.

Moderately erodible soils are located in foothill areas and along some drainages, and comprise approximately 13 percent of the basin. These soils are located on slopes up to 12 percent and because of either slow permeability and/or high runoff potential, potential for erosion is high depending on site specific conditions. The following table displays the distribution of erodible soil categories for the basin:

Table 2-10
Soil Erodibility – Willow Creek Basin

Location	Erodible Soils (percent)			
	High	Moderate	Low	Total
Within UGB	39%	17%	44%	100%
Outside UGB	88%	10%	2%	100%
Total Basin	65%	13%	22%	100%

Source: USDA Soil Survey of Lane County Area. Oregon, 1987.

2.8.4 Unstable Slopes

Thirty-one percent of the basin is affected by soils that are subject to slumping (see Map 10, Soil Types). These areas present structural problems especially where extensive grading occurs for roads and building pads. These soils are scattered throughout the basin and mostly located on the steeper slopes.

2.8.5 Hydric Soils

Hydric soil is one of three criteria for determining the presence of wetlands; the other two being inundated or saturated soil conditions and the presence of hydrophytic vegetation. Federal and state regulations limit activities that can occur in wetlands, including the direct discharge of untreated stormwater runoff. The Oregon DEQ has not yet established such standards for discharging into wetlands.

The following table displays the percentage of hydric soils found in the basin:

Table 2-11
Hydric Soils in Willow Creek Basin

Location	Hydric Soils (percent)	
	No	Yes
Within UGB	49%	51%
Outside UGB	91%	9%
Total Basin	72%	28%

Source:USDA Soil Survey of Lane County Area, Oregon, 1987.

2.9 Groundwater

Two aspects related to groundwater need to be given special consideration when planning for stormwater management. The first relates to the regional aquifer that underlies much of the lower Willamette Valley basin. This aquifer is the source of drinking water for rural residents and several nearby communities (i.e., Springfield, Coburg, Junction City) and has also been investigated as a potential future source of water for Eugene. For this reason, consideration needs to be given to the effects that stormwater management can have on groundwater quality and quantity.

The Willow Creek basin lies on the geologic fringes of the regional aquifer where the deeper aquifers are characterized as producing a “limited or erratic” water supply (208 Plan, 1978) and "are generally poorly permeable, yield water slowly to wells, or contain brackish water (GEM 1993)."

The second issue relates to the seasonal depth to the water table. Map 11 shows the depth to high water table during the wet season. This information is linked to soil type and comes from the *USDA Soil Survey of Lane County*. During the course of the year, these elevations respond to rainfall amounts and, therefore, vary accordingly.

As shown, the groundwater table is either relatively deep (greater than six feet) or very shallow (less than two feet). The location of these categories is strongly associated with the basin’s topography and drainage corridors. The northern lowlands and drainage courses have a very high water table that can be found within two feet of the surface due to perched conditions in winter and spring. The hillside areas have deeper water tables that are usually found to be greater than six feet from the surface.

2.10 Existing and Planned Educational Facilities

No public educational facilities currently exist in the Willow Creek basin. However, Churchill High School and John F. Kennedy Middle School are east of and within walking distance (less than one half mile) to the Willow Creek Natural Area.

The Bureau of Land Management has proposed an environmental education center near the confluence of the Willow Creek Main Stem and Amazon Creek.

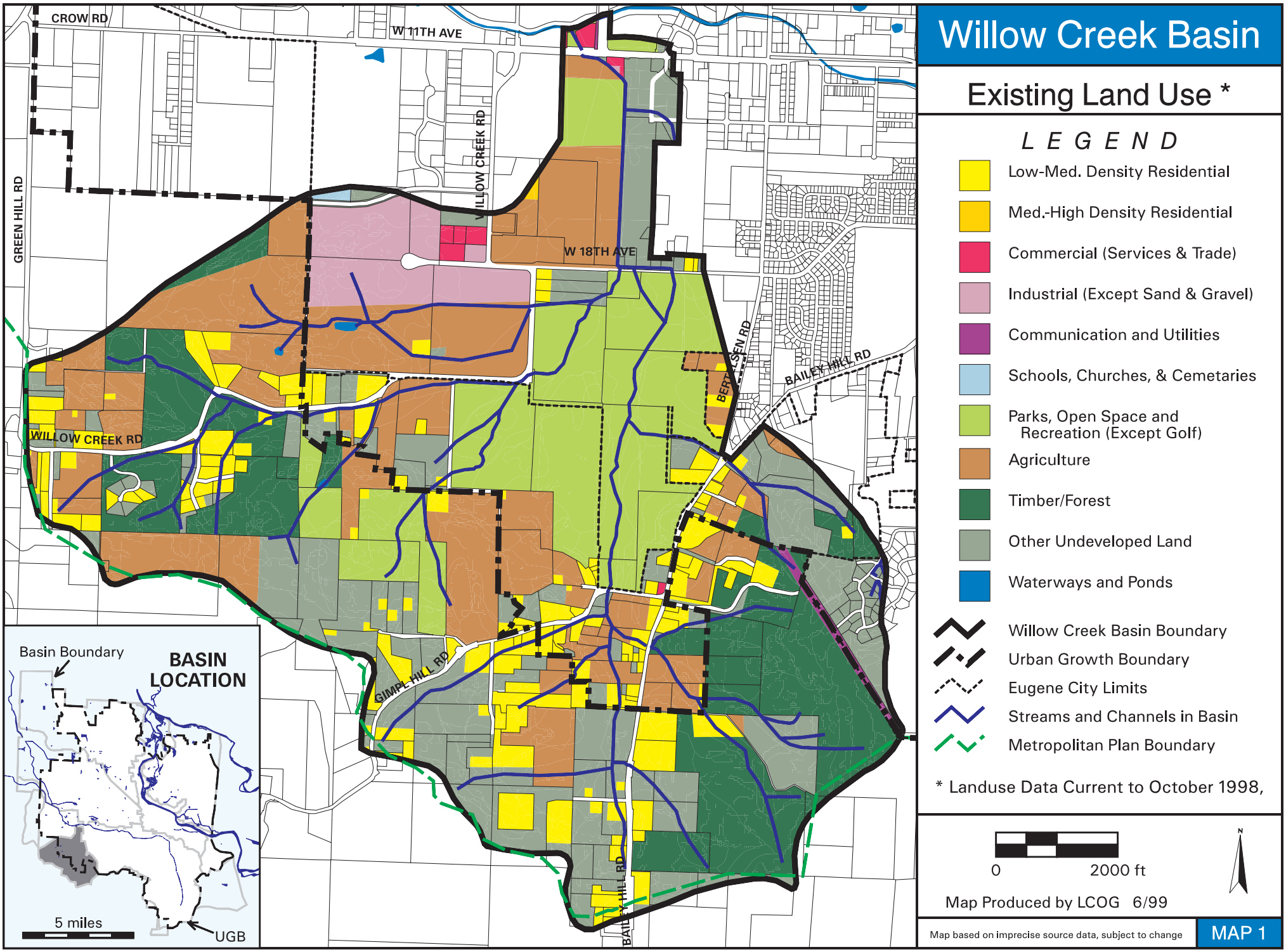
Refer to Map 12.

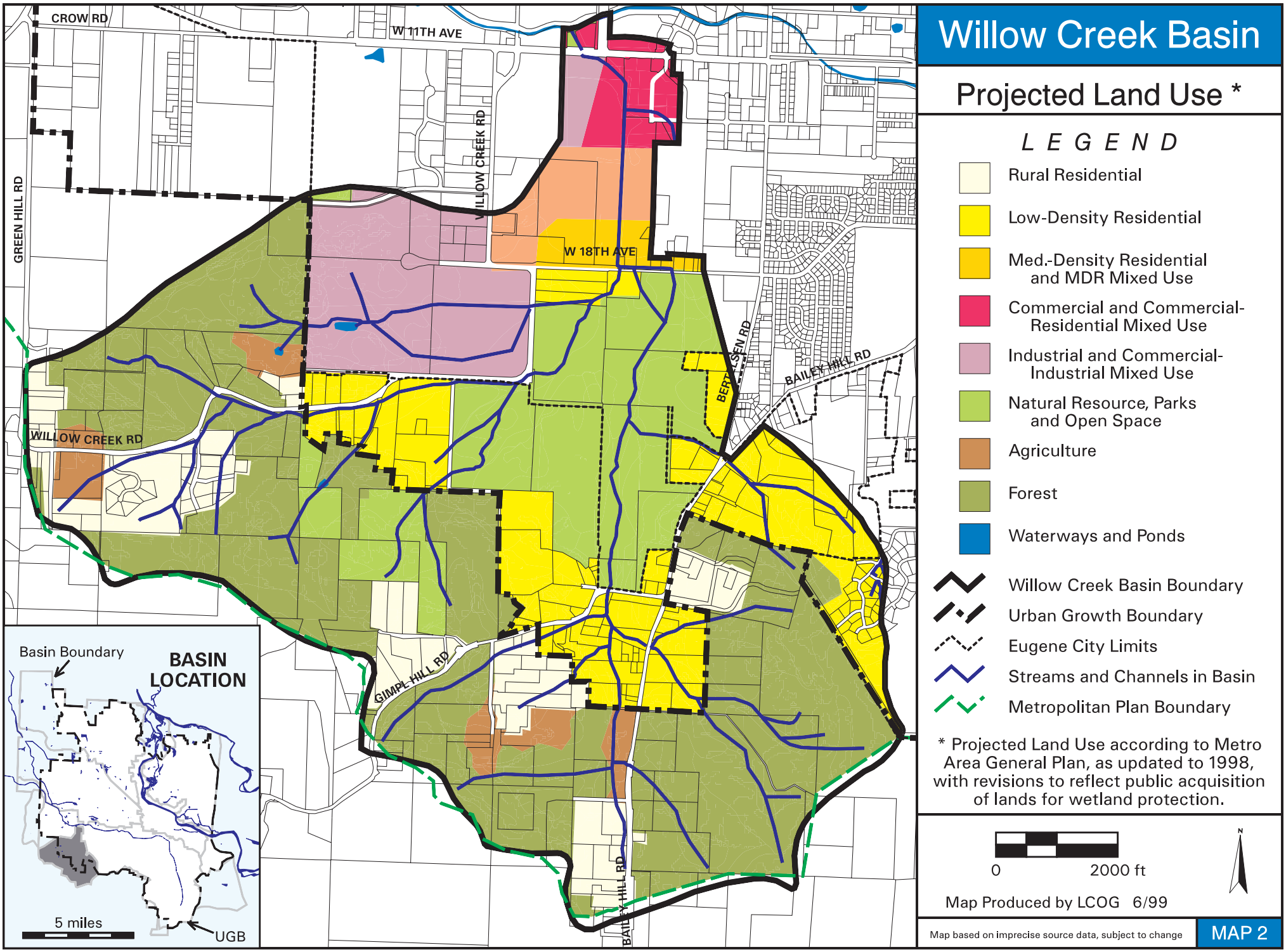
2.11 Existing and Planned Park and Recreational Facilities

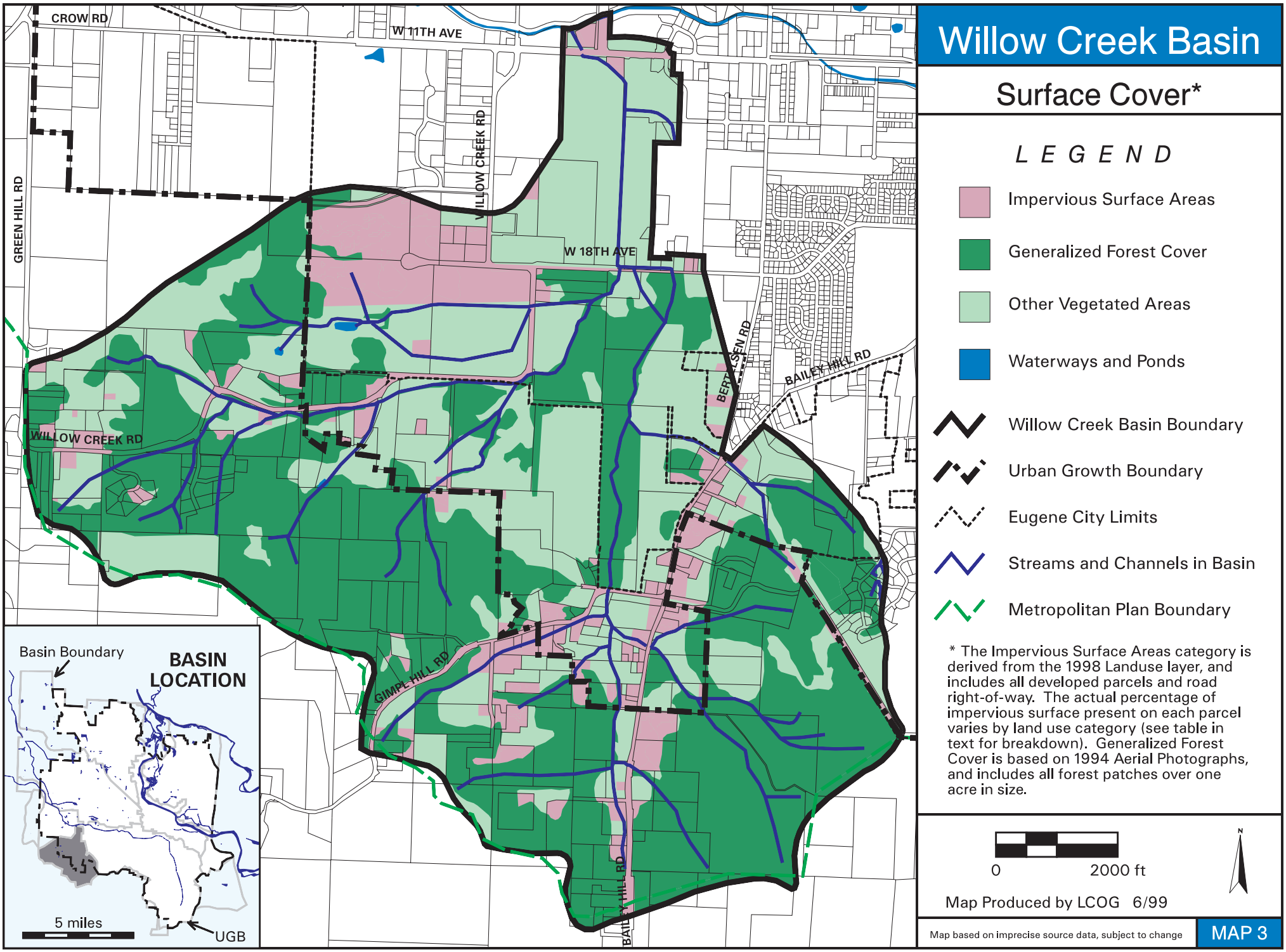
The *South Hills Study* (1974), the *Willow Creek Special Area Study* (1982), and the *Eugene Parks and Recreation Plan* (1989) all show the proposed ridgeline trail entering the Willow Creek basin along the ridge at the top of the basin and continuing to the west toward Oak Hill. The Parks Plan also shows two future neighborhood park sites in the basin near Bailey Hill Road and Willow Creek Road.

In November, 1998, voters in Eugene passed a $25.3 million general obligation bond measure for purposes of purchasing new parkland, developing parks and recreation facilities, and renovating existing facilities. In the Willow Creek Basin, these funds will be used to acquire new neighborhood park sites and portions of the Upper Willow Creek Ridgeline Park corridor. To date approximately 82 acres of ridgeline park corridor have been purchased.

The Willow Creek basin is currently served with on-street bicycle lanes and routes on Bailey Hill Road and West 18th Avenue.

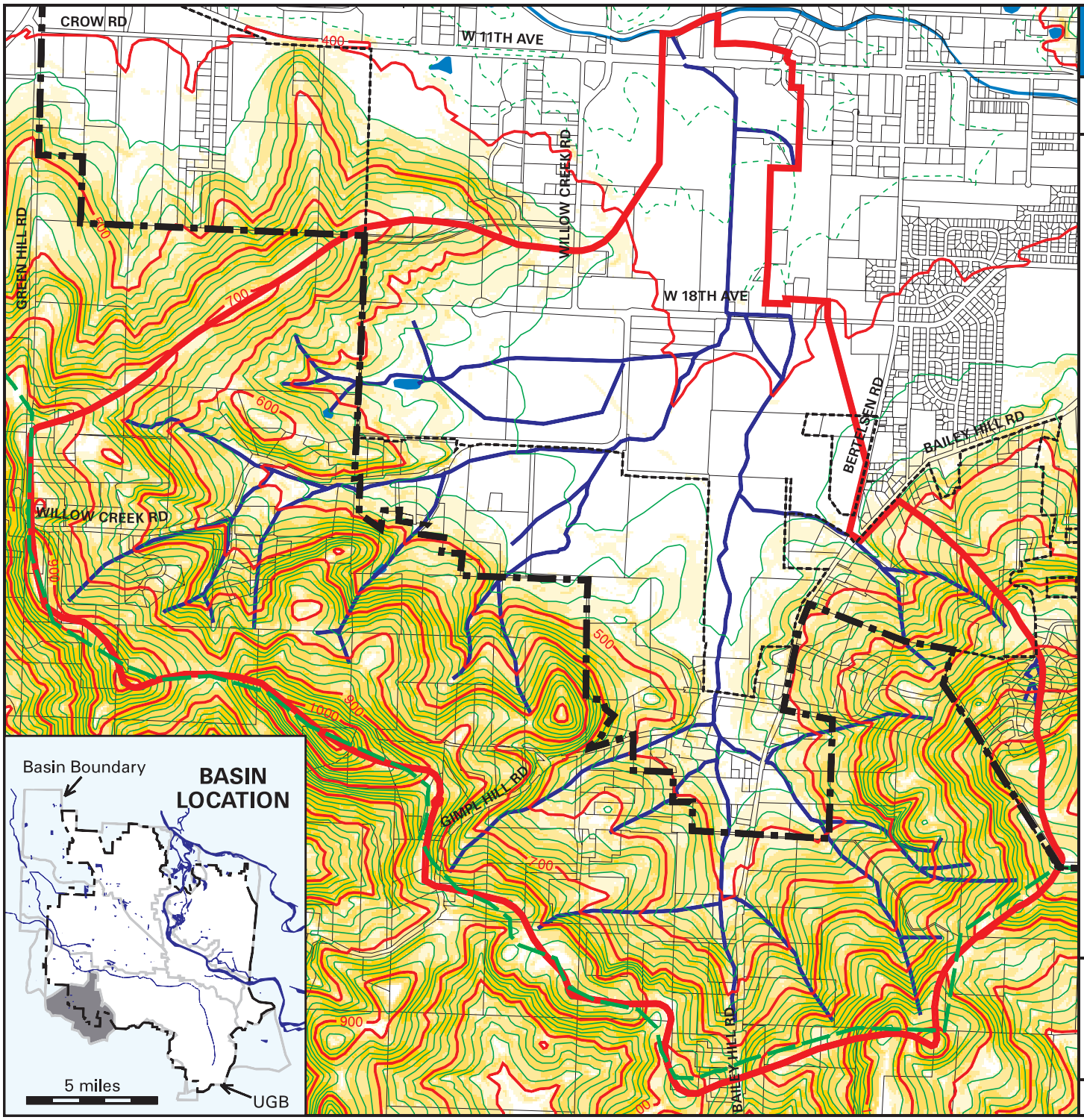

Willow Creek Basin
Existing Land Use *
LEGEND
Low-Med. Density Residential
Med.-High Density Residential
Commercial (Services & Trade)
Industrial (Except Sand & Gravel)
Communication and Utilities
Schools, Churches, & Cemetaries
Parks, Open Space and Recreation (Except Golf)
Agriculture
Timber/Forest
Other Undeveloped Land
Waterways and Ponds
Willow Creek Basin Boundary
Urban Growth Boundary
Eugene City Limits
Streams and Channels in Basin
Metropolitan Plan Boundary
* Landuse Data Current to October 1998,
0
2000 ft
N
Map Produced by LCOG 6/99
Map based on imprecise source data, subject to change
MAP 1
CROW RD
W 11TH AVE
GREEN HILL RD
WILLOW CREEK RD
W 18TH AVE
BERTELSEN RD
BAILEY HILL RD
GIMPL HILL RD
Basin Boundary
BASIN LOCATION
5 miles
UGB


Willow Creek Basin
Projected Land Use *
LEGEND
Rural Residential
Low-Density Residential
Med.-Density Residential and MDR Mixed Use
Commercial and Commercial-Residential Mixed Use
Industrial and Commercial-Industrial Mixed Use
Natural Resource, Parks and Open Space
Agriculture
Forest
Waterways and Ponds
Willow Creek Basin Boundary
Urban Growth Boundary
Eugene City Limits
Streams and Channels in Basin
Metropolitan Plan Boundary
* Projected Land Use according to Metro Area General Plan, as updated to 1998, with revisions to reflect public acquisition of lands for wetland protection.
0
2000 ft
N
Map Produced by LCOG 6/99
Map based on imprecise source data, subject to change
MAP 2
CROW RD
W 11TH AVE
GREEN HILL RD
WILLOW CREEK RD
W 18TH AVE
BERTELSEN RD
BAILEY HILL RD
GIMPL HILL RD
BASIN LOCATION
Basin Boundary
5 miles
UGB


Willow Creek Basin
Surface Cover*
LEGEND
Impervious Surface Areas
Generalized Forest Cover
Other Vegetated Areas
Waterways and Ponds
Willow Creek Basin Boundary
Urban Growth Boundary
Eugene City Limits
Streams and Channels in Basin
Metropolitan Plan Boundary
* The Impervious Surface Areas category is derived from the 1998 Landuse layer, and includes all developed parcels and road right-of-way. The actual percentage of impervious surface present on each parcel varies by land use category (see table in text for breakdown). Generalized Forest Cover is based on 1994 Aerial Photographs, and includes all forest patches over one acre in size.
0
2000 ft
N
Map Produced by LCOG 6/99
Map based on imprecise source data, subject to change
MAP 3
CROW RD
W 11TH AVE
GREEN HILL RD
WILLOW CREEK RD
W 18TH AVE
BERTELSEN RD
BAILEY HILL RD
GIMPLE HILL RD
Basin Boundary
BASIN LOCATION
5 miles
UGB

Willow Creek Basin

Slope and Topography *



L E G E N D

- 0 - 5% Slopes
- 5 - 10% Slopes
- 10 - 15% Slopes
- 15 - 25% Slopes
- > 25% Slopes
- Waterways and Ponds
- 100-foot contours
- 20-foot contours
- Intermediate contours
- Willow Creek Basin Boundary
- Urban Growth Boundary
- Eugene City Limits
- Streams and Channels *
- Metropolitan Plan Boundary

* Slopes and Contours derived from enhanced 10-meter USGS Digital Elevation Models (DEMs)

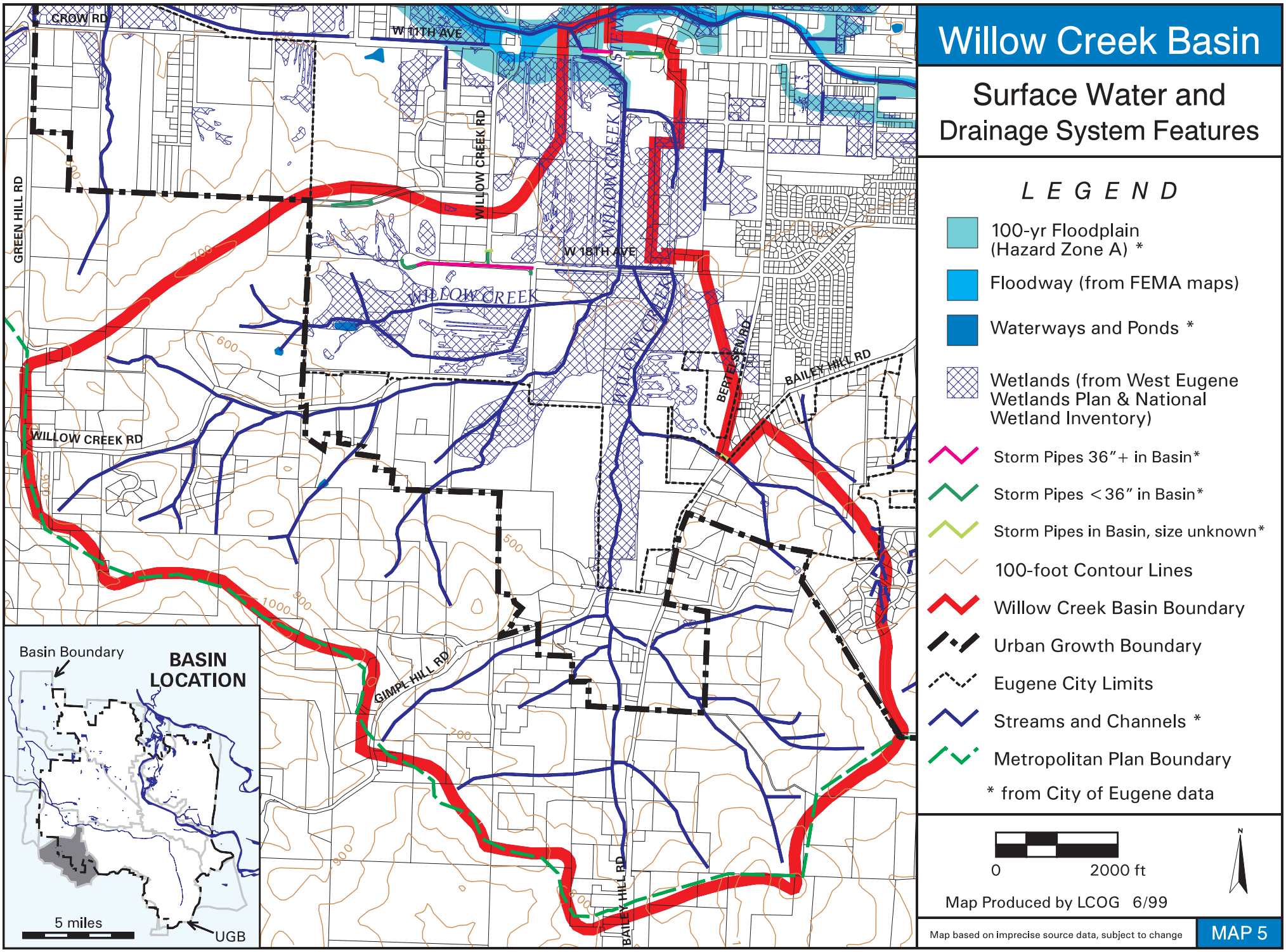
0 2000 ft

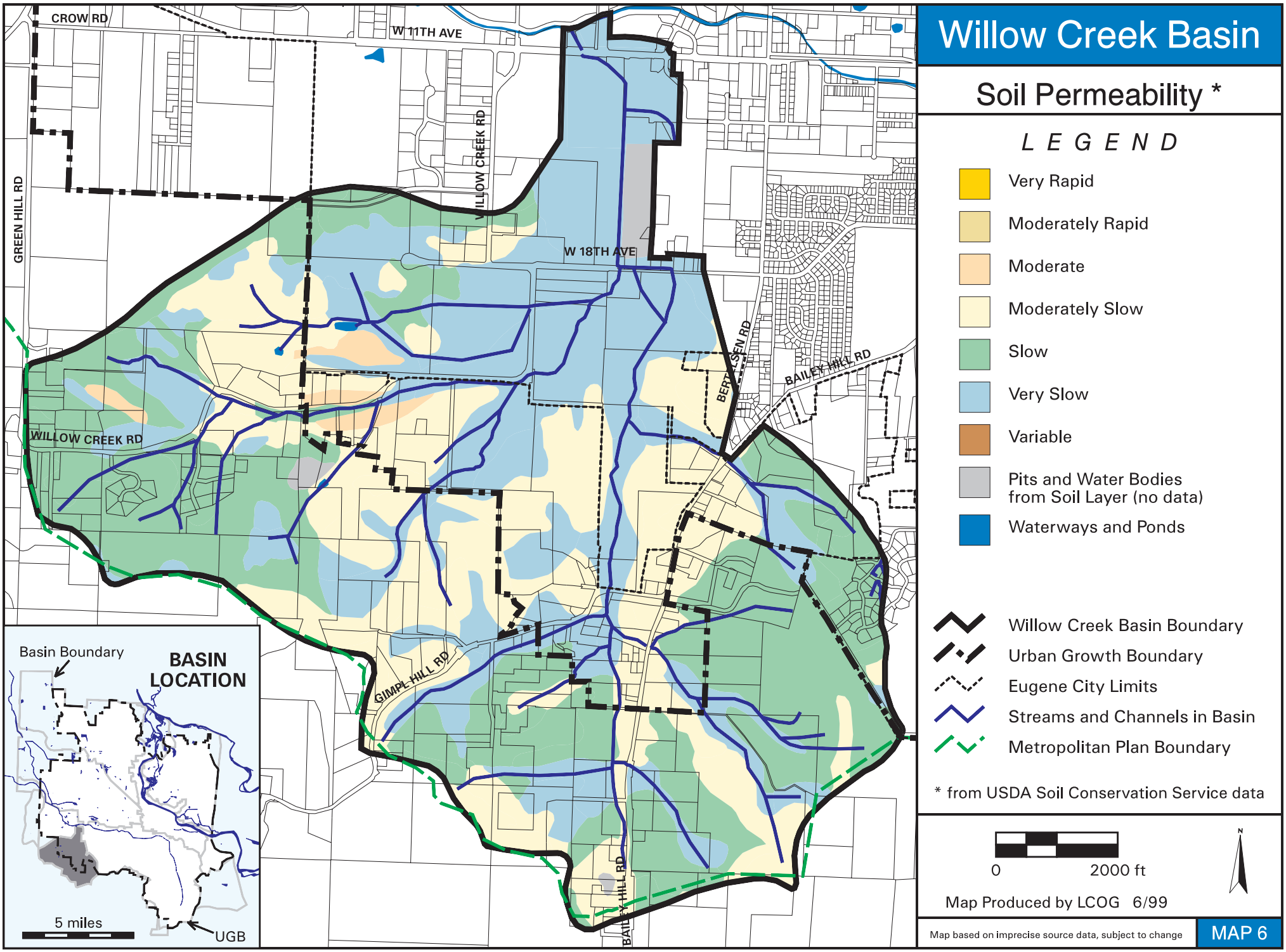
N

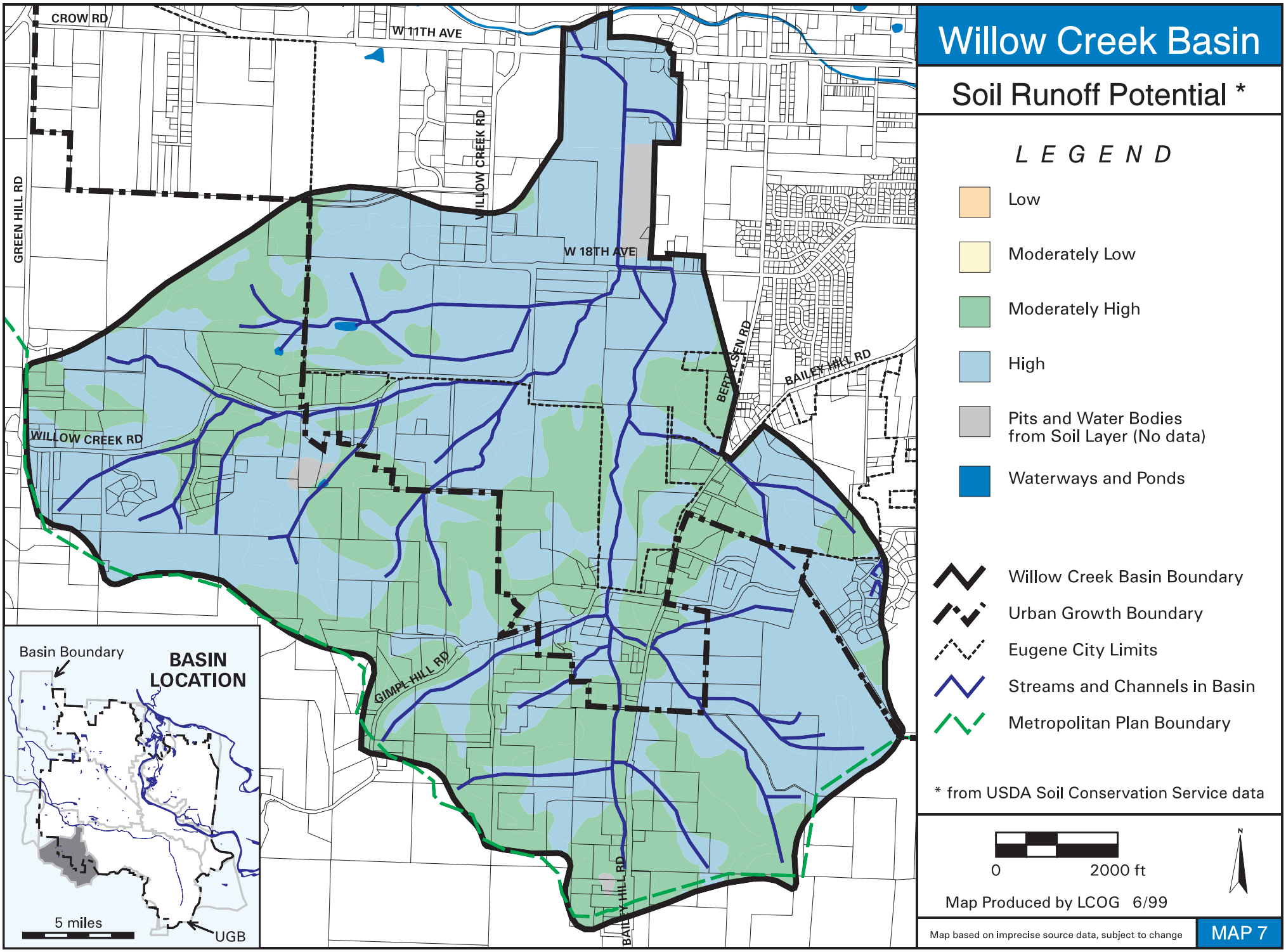
Map Produced by LCOG 6/99

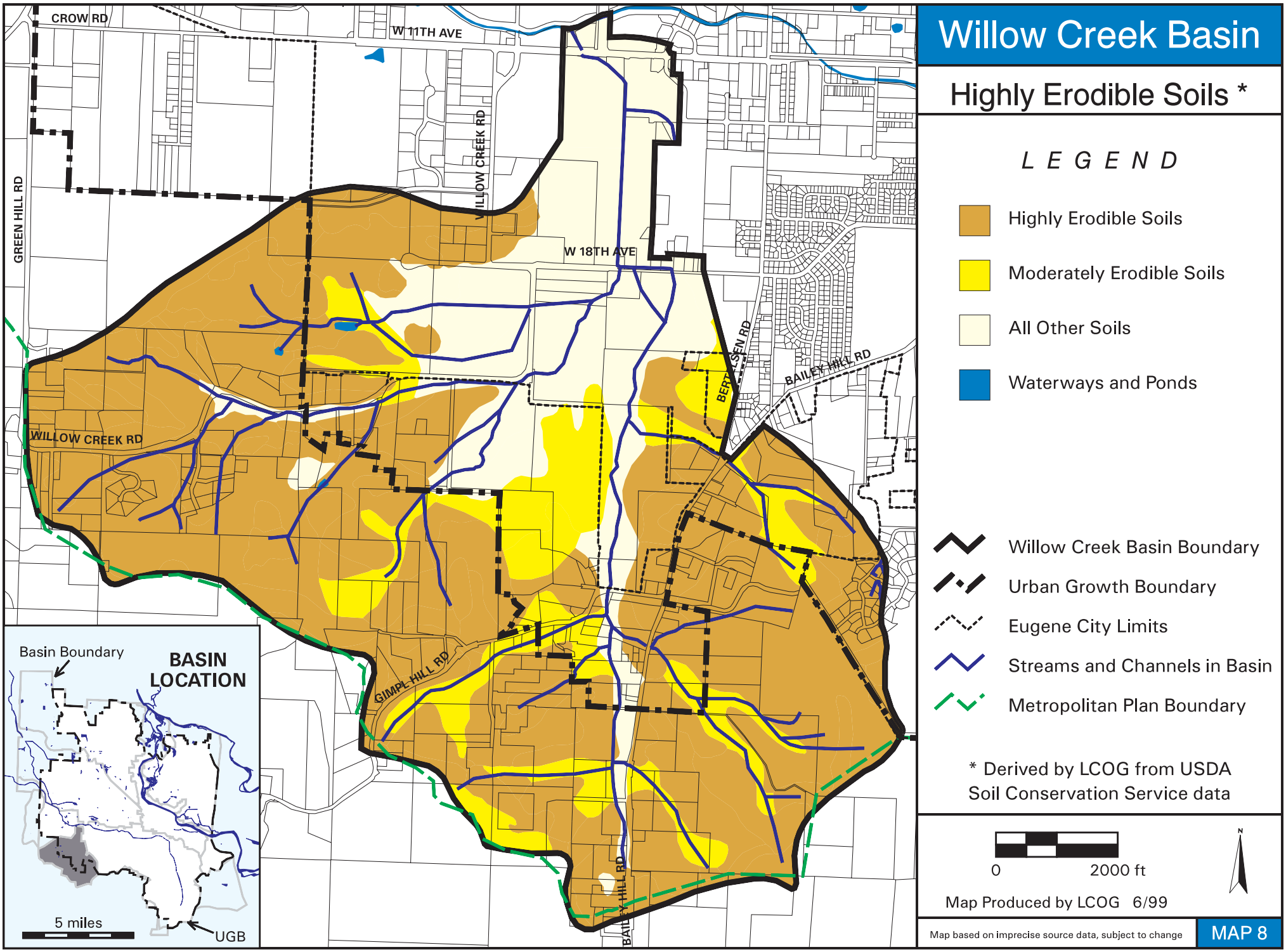
Map based on imprecise source data, subject to change

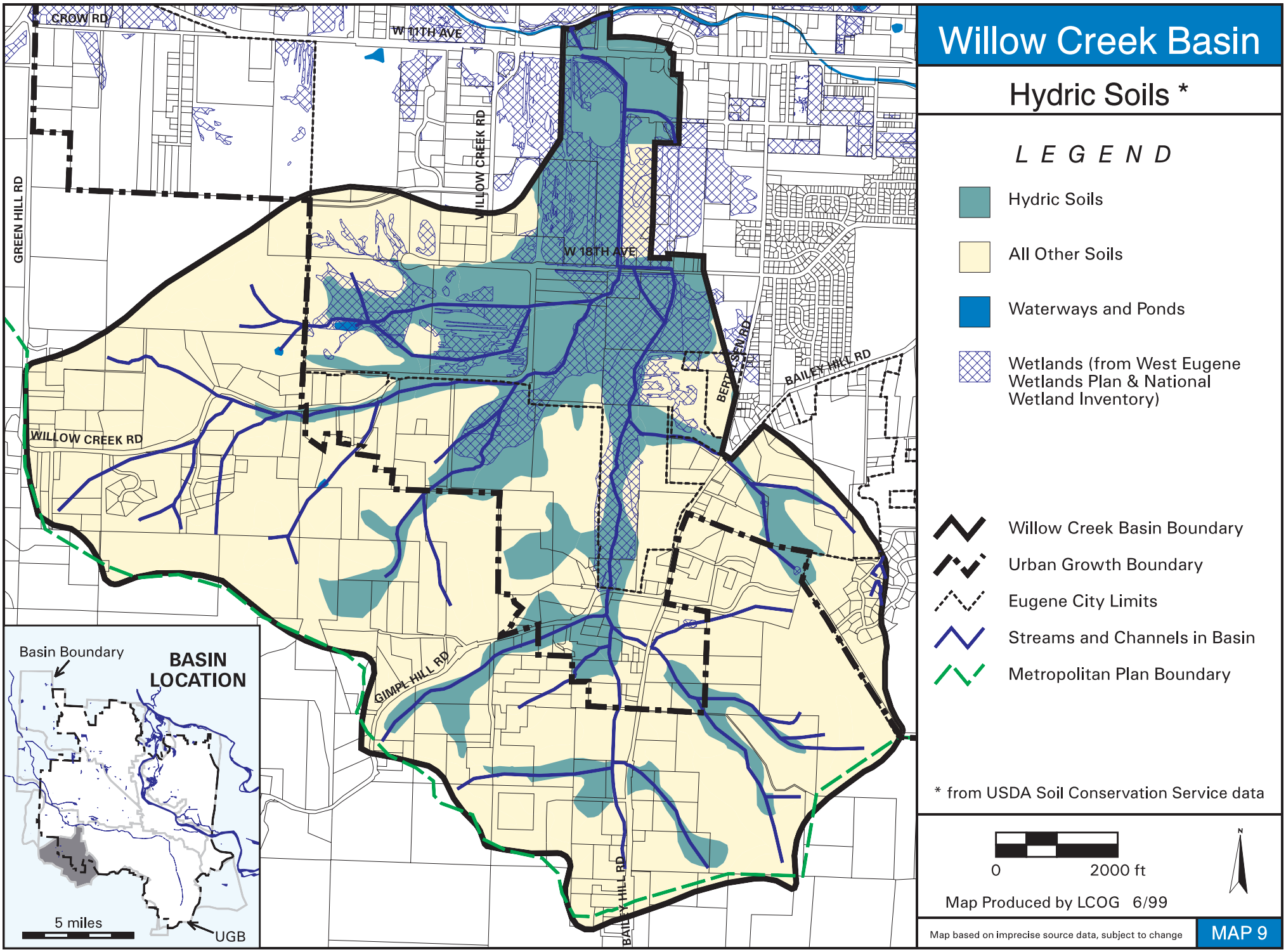
MAP 4


Willow Creek Basin
Surface Water and Drainage System Features
LEGEND
100-yr Floodplain (Hazard Zone A) *
Floodway (from FEMA maps)
Waterways and Ponds *
Wetlands (from West Eugene Wetlands Plan & National Wetland Inventory)
Storm Pipes 36"+ in Basin*
Storm Pipes <36" in Basin*
Storm Pipes in Basin, size unknown*
100-foot Contour Lines
Willow Creek Basin Boundary
Urban Growth Boundary
Eugene City Limits
Streams and Channels *
Metropolitan Plan Boundary
* from City of Eugene data
0
2000 ft
Map Produced by LCOG 6/99
Map based on imprecise source data, subject to change
MAP 5
CROW RD
W 11TH AVE
GREEN HILL RD
WILLOW CREEK RD
W 18TH AVE
WILLOW CREEK
WILLOW CREEK MAINSTEM
BERTELSEN RD
BAILEY HILL RD
GIMPL HILL RD
Basin Boundary
BASIN LOCATION
5 miles
UGB


Willow Creek Basin
Soil Permeability *
LEGEND
Very Rapid
Moderately Rapid
Moderate
Moderately Slow
Slow
Very Slow
Variable
Pits and Water Bodies from Soil Layer (no data)
Waterways and Ponds
Willow Creek Basin Boundary
Urban Growth Boundary
Eugene City Limits
Streams and Channels in Basin
Metropolitan Plan Boundary
* from USDA Soil Conservation Service data
0
2000 ft
N
Map Produced by LCOG 6/99
Map based on imprecise source data, subject to change
MAP 6
CROW RD
W 11TH AVE
GREEN HILL RD
WILLOW CREEK RD
W 18TH AVE
BERTELSEN RD
BAILEY HILL RD
GIMPL HILL RD
Basin Boundary
BASIN LOCATION
5 miles
UGB

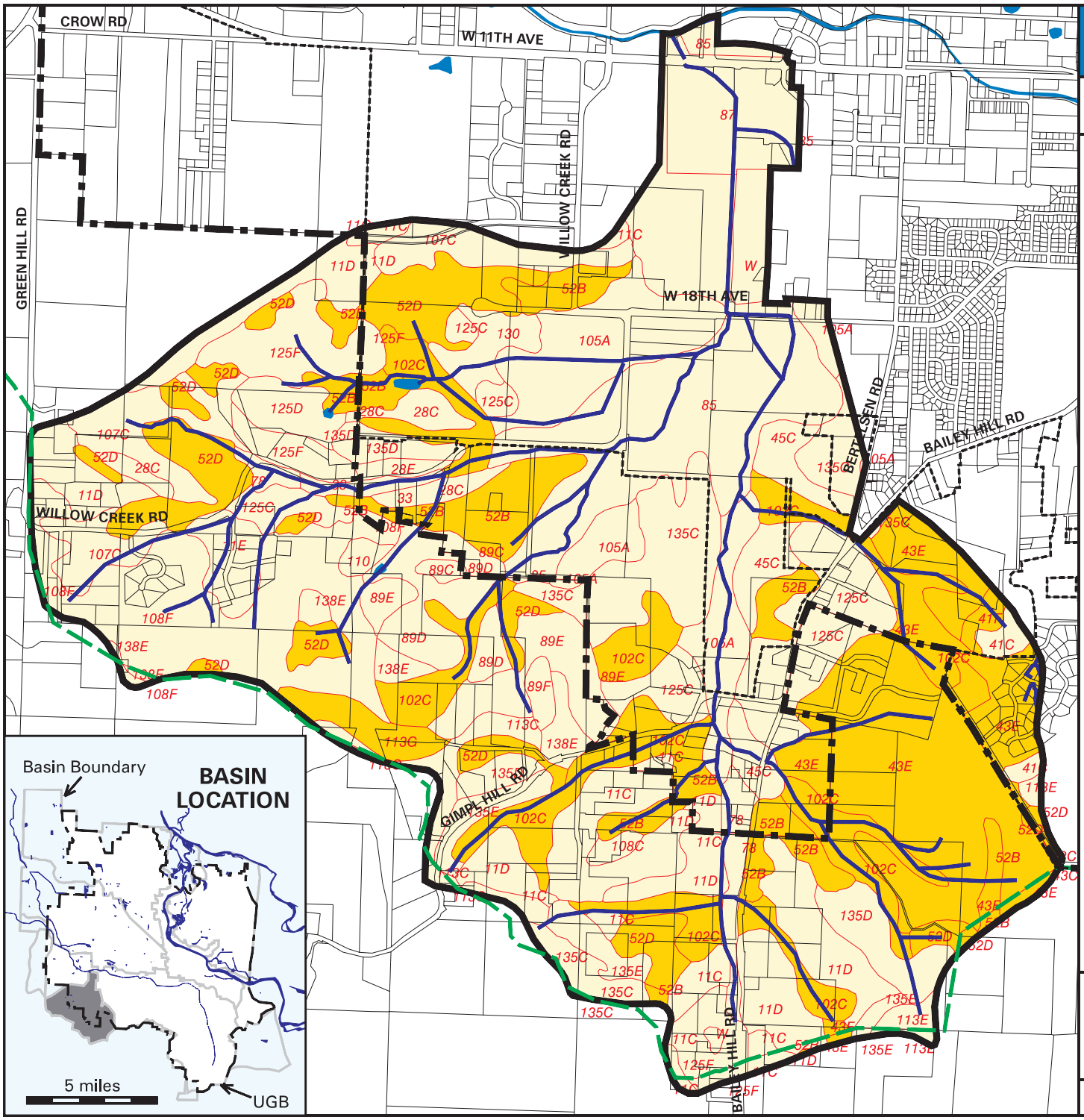

Willow Creek Basin
Soil Runoff Potential *
LEGEND
Low
Moderately Low
Moderately High
High
Pits and Water Bodies from Soil Layer (No data)
Waterways and Ponds
Willow Creek Basin Boundary
Urban Growth Boundary
Eugene City Limits
Streams and Channels in Basin
Metropolitan Plan Boundary
* from USDA Soil Conservation Service data
0
2000 ft
N
Map Produced by LCOG 6/99
Map based on imprecise source data, subject to change
MAP 7
CROW RD
W 11TH AVE
WILLOW CREEK RD
GREEN HILL RD
W 18TH AVE
BERTELSEN RD
BAILEY HILL RD
WILLOW CREEK RD
GIMPL HILL RD
BAILEY HILL RD
Basin Boundary
BASIN LOCATION
5 miles
UGB


Willow Creek Basin
Highly Erodible Soils *
LEGEND
Highly Erodible Soils
Moderately Erodible Soils
All Other Soils
Waterways and Ponds
Willow Creek Basin Boundary
Urban Growth Boundary
Eugene City Limits
Streams and Channels in Basin
Metropolitan Plan Boundary
* Derived by LCOG from USDA Soil Conservation Service data
0
2000 ft
N
Map Produced by LCOG 6/99
Map based on imprecise source data, subject to change
MAP 8
CROW RD
W 11TH AVE
WILLOW CREEK RD
GREEN HILL RD
W 18TH AVE
BERTELSEN RD
BAILEY HILL RD
WILLOW CREEK RD
GIMPL HILL RD
BAILEY HILL RD
Basin Boundary
BASIN LOCATION
5 miles
UGB


Willow Creek Basin
Hydric Soils *
LEGEND
Hydric Soils
All Other Soils
Waterways and Ponds
Wetlands (from West Eugene Wetlands Plan & National Wetland Inventory)
Willow Creek Basin Boundary
Urban Growth Boundary
Eugene City Limits
Streams and Channels in Basin
Metropolitan Plan Boundary
* from USDA Soil Conservation Service data
0
2000 ft
N
Map Produced by LCOG 6/99
Map based on imprecise source data, subject to change
MAP 9
CROW RD
W 11TH AVE
WILLOW CREEK RD
GREEN HILL RD
W 18TH AVE
BERTELSEN RD
BAILEY HILL RD
WILLOW CREEK RD
GIMPL HILL RD
BAILEY HILL RD
Basin Boundary
BASIN LOCATION
5 miles
UGB

Willow Creek Basin

Soil Types *



L E G E N D

- Soils subject to slumping
- All other soil types

11C, BELLPINE SILTY CLAY LOAM, 3 - 12% SLOPES
11D, BELLPINE SILTY CLAY LOAM, 12 - 20% SLOPES
11E, BELLPINE SILTY CLAY LOAM, 20 - 30% SLOPES
28C, CHEHULPUM SILT LOAM, 3 - 12% SLOPES
28E, CHEHULPUM SILT LOAM, 12 - 40% SLOPES
33, CONSER SILTY CLAY LOAM
41C, DIXONVILLE SILTY CLAY LOAM, 3 - 12% SLOPES
41F, DIXONVILLE SILTY CLAY LOAM, 30 - 50% SLOPES
43C, DIXONVILLE-PHILOMATH-HAZELAIR, 3 - 12%
43E, DIXONVILLE-PHILOMATH-HAZELAIR, 12 - 35%
45C, DUPEE SILT LOAM, 3 - 20% SLOPES
52B, HAZELAIR SILTY CLAY LOAM, 2 - 7% SLOPES
52D, HAZELAIR SILTY CLAY LOAM, 7 - 20% SLOPES
78, MCALPIN SILTY CLAY LOAM
85, NATROY SILTY CLAY LOAM
87, NATROY-URBAN LAND COMPLEX
89C, NEKIA SILTY CLAY LOAM, 2 - 12% SLOPES
89D, NEKIA SILTY CLAY LOAM, 12 - 20% SLOPES
89E, NEKIA SILTY CLAY LOAM, 20 - 30% SLOPES
89F, NEKIA SILTY CLAY LOAM, 30 - 50% SLOPES
102C, PANTHER SILTY CLAY LOAM, 2 - 12% SLOPES
105A, PENGRA SILT LOAM, 1 - 4% SLOPES
107C, PHILOMATH SILTY CLAY, 3 - 12% SLOPES
108C, PHILOMATH COBBLY SILTY CLAY, 3 - 12% SLOPES
108F, PHILOMATH COBBLY SILTY CLAY, 12 - 45% SLOPES
113C, RITNER COBBLY SILTY CLAY LOAM, 2 - 12% SLOPES
113E, RITNER COBBLY SILTY CLAY LOAM, 12 - 30% SLOPES
113G, RITNER COBBLY SILTY CLAY LOAM, 30 - 60% SLOPES
125C, STEIWER LOAM, 3 - 12% SLOPES
125D, STEIWER LOAM, 12 - 20% SLOPES
125F, STEIWER LOAM, 20 - 50% SLOPES
130, WALDO SILTY CLAY LOAM
135C, WILLAKENZIE CLAY LOAM, 2 - 12% SLOPES
135D, WILLAKENZIE CLAY LOAM, 12 - 20% SLOPES
135E, WILLAKENZIE CLAY LOAM, 20 - 30% SLOPES
138E, WITZEL VERY COBBLY LOAM, 3 - 30% SLOPES
138G, WITZEL VERY COBBLY LOAM, 30 - 75% SLOPES

- Waterways and Ponds
- Willow Creek Basin Boundary
- Urban Growth Boundary
- Eugene City Limits
- Streams and Channels in Basin
- Metropolitan Plan Boundary

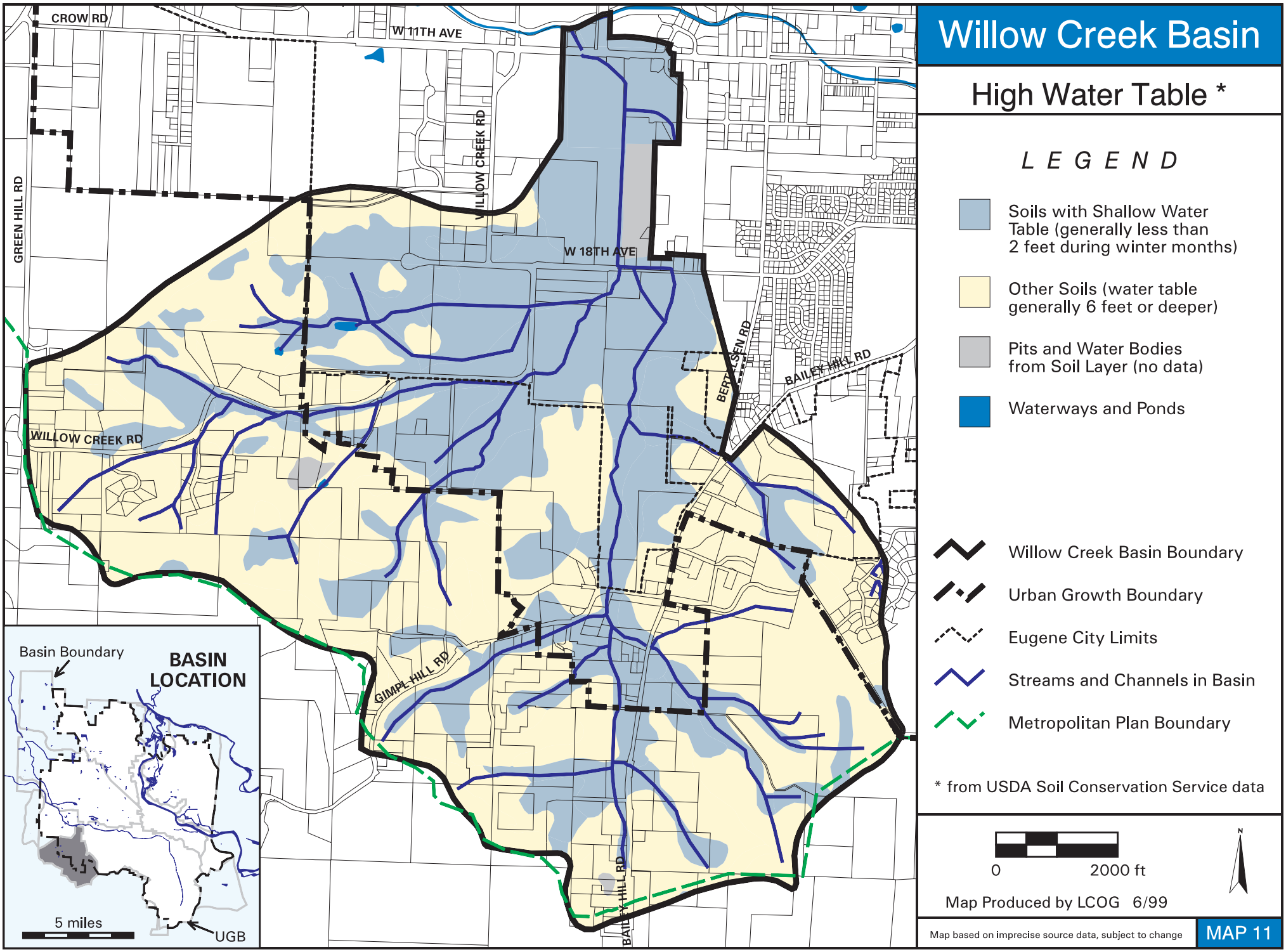
* from USDA Soil Conservation Service data

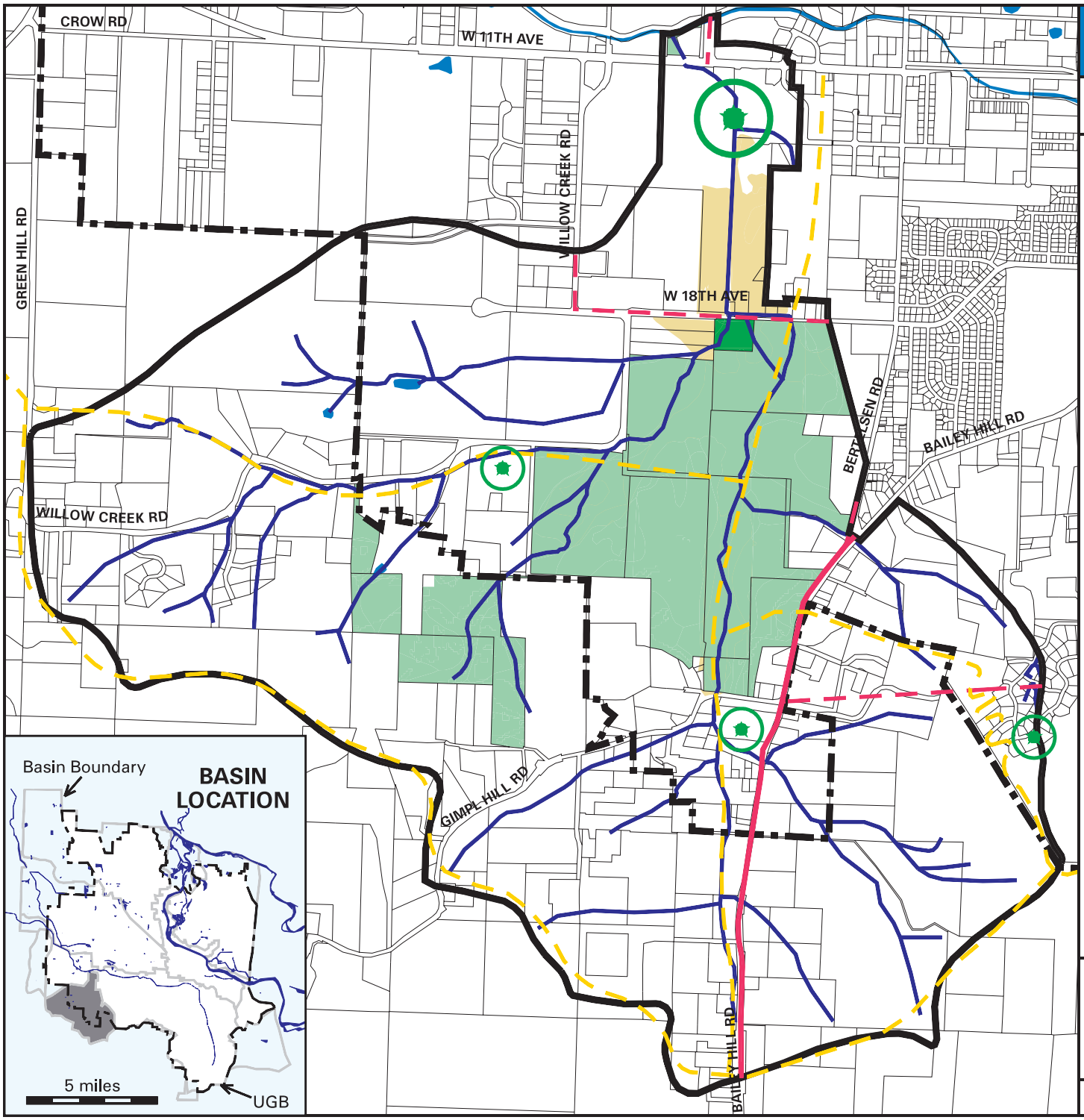
0 2000 ft

Map Produced by LCOG 6/99

Map based on imprecise source data, subject to change

MAP 10


Willow Creek Basin
High Water Table *
LEGEND
Soils with Shallow Water Table (generally less than 2 feet during winter months)
Other Soils (water table generally 6 feet or deeper)
Pits and Water Bodies from Soil Layer (no data)
Waterways and Ponds
Willow Creek Basin Boundary
Urban Growth Boundary
Eugene City Limits
Streams and Channels in Basin
Metropolitan Plan Boundary
* from USDA Soil Conservation Service data
0
2000 ft
N
Map Produced by LCOG 6/99
Map based on imprecise source data, subject to change
MAP 11
CROW RD
W 11TH AVE
GREEN HILL RD
WILLOW CREEK RD
W 18TH AVE
BERTELSEN RD
BAILEY HILL RD
GIMPL HILL RD
BASIN LOCATION
Basin Boundary
5 miles
UGB



Willow Creek Basin

Parks, Rec. & Ed. Facilities

LEGEND

EXISTING

- Parks
- Schools (Pub. & Pvt.)
- Golf Courses
- Public Ownership for Wetland Protection *
- Protected Wetlands in Private Ownership *
- Bikeways in Basin
- Trails

FUTURE

- Parks in Basin **
- Bikeways in Basin ***
- Trails **
- Willow Creek Basin Boundary
- Urban Growth Boundary
- Streams and Channels in Basin

* WEWP, 1992; Ownership data, 1998.

** Eugene Parks & Recreation Plan, 1989; Parks, Open Spaces, and Natural Areas Study, 1996.

*** Draft TransPlan Update, November 1997.

0 2000 ft

N

Map Produced by LCOG 6/99

Map based on imprecise source data, subject to change

MAP 12

To identify flood control problems and opportunities, a flood control evaluation was completed for the drainage system in the Willow Creek basin that is described in Section 2.5 and illustrated on Map 5. Section 3.1 describes the process used to identify flooding problems and a general description of each problem. Section 3.2 describes the capital project alternatives and development standard alternatives that were proposed to address the flooding problems. Section 3.3 describes the selected flood control alternatives.

3.1 Evaluation of Flood Control Under Existing and Expected Future Conditions

To develop a flood control strategy for the Willow Creek basin, a computer model was used to evaluate hydrologic/hydraulic conditions of the public storm drainage system. The storm system was evaluated under both existing and buildout land use conditions using XP-SWMM model software. The Willow Creek basin model includes the main stem of Willow Creek from West 18th Avenue downstream to the confluence with Amazon Creek, the west and east branches of the creek from West 18th Avenue upstream to the Urban Growth Boundary (UGB), and several smaller tributaries that contain important road crossings.

The Willow Creek basin drainage system is shown in Figures 3-1 through 3-3. Figure 3-1 is an index map that illustrates the relative locations of Figures 3-2 through 3-3. Modeled drainage segments and locations of the proposed capital projects are also illustrated on Figures 3-2 through 3-3.

The City-wide summary in Volume I contains detailed information regarding the process and sources of information that were used for identifying flood control problems and opportunities. Chapter 3 of Volume I specifically includes detailed information regarding the following:

- Model selection process.
- Sources of model input data.
- Model calibration.
- Design storm selection process.

This section of the Willow Creek report provides a summary of the basin specific hydrologic and hydraulic data used in the models and a summary of the basin specific model results with respect to flood control.

3.1.1 Willow Creek Basin Hydrologic Data

The Willow Creek basin was subdivided into 3 major subbasins. The major basin boundaries are presented on Figure 3-1. The 3 major subbasins were further divided into 18 subbasins for modeling purposes. The subbasin boundaries presented on Figures 3-1 through 3-3 were delineated based on both topography and the storm drainage system layout. The subbasin boundaries were digitized into the City's GIS so that hydrologic data could be compiled for each subbasin.

Seven-character names were assigned to each subbasin. The first two characters represent a two-letter abbreviation for the major basin; in this case WC for Willow Creek. The second two

characters represent a two-letter abbreviation for the major subbasin. The 3 major subbasins in the Willow Creek basin are as follows:

WE = West Branch Major Subbasin
EA = East Branch Major Subbasin
MN = Main Stem Major Subbasin

The last three characters of the subbasin name consist of numbers, starting with 010 and increasing in increments of 10 for each additional subbasin. For example, the first two subbasins in the West Branch major subbasin of the Willow Creek basin are WCWE010 and WCWE020. In addition, each subbasin has an associated inlet node number. The hydrologic component (i.e., RUNOFF block) of XP-SWMM was used to generate a stormwater runoff hydrograph for each subbasin. This hydrograph was routed by the hydraulic component (i.e., the EXTRAN block) of XP-SWMM to model the storm drainage system. The subbasin inlet node is the point where the subbasin hydrograph enters the storm drainage system for routing.

The following parameters were required for each subbasin in the hydrology component of XP-SWMM.

1. Subbasin name or number.
2. Channel or pipe inlet node number into the storm drainage system.
3. Subbasin area (acres).
4. Hydraulically connected impervious percentage for both existing and future land use scenarios (percent).
5. Average ground slope (dimensionless, ft/ft).
6. Subbasin width (feet).
7. Manning's roughness coefficient for impervious areas.
8. Manning's roughness coefficient for pervious areas.
9. Depression storage for impervious areas (inches of water over subbasin).
10. Depression storage for pervious areas (inches of water over subbasin).
11. Green-Ampt soil infiltration parameters: average capillary suction (inches) saturated hydraulic conductivity (inches/hour), and initial moisture deficit (volume air/volume voids).

Table 3-2 (provided at the back of this section) provides the major hydrologic information for each of the Willow Creek subbasins included in the model. Specifically, the table provides the information for parameters 1 – 5 listed above in addition to the expected increase in impervious surface under future conditions. More detailed hydrologic information, including information described for parameters 1 – 11, can be found in Appendix E of Volume I. Table 3-2 also provides peak runoff discharge information for each modeled subbasin.

3.1.2 Willow Creek Basin Hydraulic Data

The primary purpose of the modeling was to evaluate the capacity of the storm drainage system. The evaluation of the storm drainage system included a hydraulic analysis of the major storm sewer pipes, culverts, and open channels which convey stormwater discharges. Due to limited

urban development in this basin, the primary drainage features consist of open waterways and roadway crossings. The piped stormwater system is relatively limited.

Hydraulic information for the culverts and open channel segments was based primarily on physical data collected for the *Willow Creek Basin Plan –Water Quality Component* (January 1996) and supplemented with limited survey data collected by City survey crews. Information for the piped system was obtained from the City's GIS. In order to analyze the hydraulic capacity of the storm drainage system, the hydraulic component of XP-SWMM required the following parameters for each pipe, culvert or open channel section:

1. Conduit name.
2. Upstream node number.
3. Downstream node number.
4. Conduit size (diameter for pipes and culverts; and cross-section dimensions for open channels).
5. Conduit length.
6. Conduit material for pipes and culverts.
7. Upstream and downstream invert elevations.
8. Upstream and downstream ground surface elevations.
9. Channel roughness coefficients (for open channels).

For the Willow Creek basin, the model was used to evaluate the capacity of approximately 31 open waterway segments (representing approximately 5 open waterway miles), 18 culvert crossings; five of which include double culverts (representing approximately 1350 feet), 2 bridge crossings, and 2 storm pipe segments under existing and future land use conditions. Table 3-3 (provided at the back of this section) provides the major hydraulic information for each of the modeled conduits in the Willow Creek basin. Specifically, the table provides the information for parameters 1 – 6 listed above in addition to the drainage area for each conduit, the relevant design storm, and the model results for the relevant design storm. Model results are presented in terms of peak flows and maximum water surface elevations. The results for all storm events that were routed through the models (i.e., 10-year, 25-year, 50-year, and 100-year storms) can be found in an appendix to Volume I. The hydraulic information provided in Table 3-3 and the appendix to Volume I is presented following a general sequence from downstream to upstream.

3.1.3 Flooding Problems Identified by the Model

This section provides a general description of model-identified flooding problems. The model results are summarized in Table 3-3 which includes peak flows and water surface elevations for the relevant design storm under both existing and buildout conditions. The last column in the table indicates which conduits are expected to be deficient and when (i.e., under existing and/or future land use conditions). For pipe segments and roadway crossings, surcharging was considered to be acceptable and flooding problems were only identified if the models showed water getting out of the system and into the streets. For open waterways, deficiencies were identified when the depth of the design flow exceeded the tops of the channel banks. The model-identified flooding problems are summarized below for the main stem and east and west branches of the creek.

Willow Creek Main Stem

The main stem of Willow Creek was evaluated using the 25-year recurrence interval design storm under existing and buildout land use conditions. The bridge crossing at West 11th Avenue was evaluated using the 50-year design storm since West 11th Avenue is considered to be a major arterial in the City. Based on the modeling results, all three open channel segments (WCMN010A, WCMN010C and WCMN010D) are expected to have overbank flooding under existing land use conditions. The bridge at West 11th is expected to have adequate capacity for the 50-year design storm under both existing and buildout land use conditions.

West Branch

Based on the modeling results, 13 model-identified flooding problems are expected in the West Branch. Eight open waterway segments (representing approximately seventy percent of modeled open waterway segments on the West Branch) are expected to have overbank flooding for their respective design storm,. Five roadway culverts (representing more than sixty percent of the modeled culvert crossing on the West Branch) do not have adequate capacity for the required design storms. These culvert crossings are listed below following a general sequence from downstream to upstream:

- WCWE100C - Two 42" x 27" corrugated metal pipes on a tributary of the West Branch that convey stormwater runoff under Willow Creek Road from the Hynix property.
- WCWE100F – A 48" concrete pipe on the West Branch under an unnamed road near the 90-degree bend of Willow Creek Road.
- WCWE110C –A 12" concrete pipe and a 15" concrete pipe on the West Branch under Louvering Lane.
- WCWE120B – A 42" concrete pipe on the West Branch under an unnamed road.
- WCWE120D- An 18" concrete pipe and a 24" concrete pipe on the West Branch under an unnamed road.

All deficiencies for open waterway segments and culvert crossings on the West Branch are expected to occur under existing land use conditions.

A small tributary consisting of storm pipe segments at Willow Creek Circle and a roadside ditch that discharges to the Willow Creek main stem at West 18th Avenue was also included in the Willow Creek basin model. Capacity deficiencies were not identified for this small tributary.

All flooding problems identified above are described in more detail in Section 3.2 in association with the proposed capital project to address the problem.

East Branch

The Willow Creek basin model of the east branch consists of 17 open waterway segments and 9 roadway crossings. Based on the modeling results, 17 model-identified flooding problems are expected for the East Branch. Thirteen out of 17 open waterways were identified to have

overbank flooding during the required design storm, while 4 roadway crossings were identified to be deficient under either the 10-year or 25-year design storms. These four culvert crossings are listed generally from downstream to upstream:

- WCEA030B – A 24" concrete pipe on a tributary of the East Branch at the intersection of Bailey Hill and Bertlesen Roads.
- WCEA050C – A 30"x 42" corrugated metal pipe on a tributary of the East Branch under an unnamed road.
- WCEA060D- Two 18" corrugated metal pipes and one 27"x 42" elliptical corrugated metal pipe on the East Branch under an unnamed road.
- WCEA060F- A 36" corrugated metal pipe on the East Branch under an unnamed access road.

All open waterway overbank flooding and culvert crossing deficiencies are expected to occur under existing land use conditions.

3.1.4 Other Identified Flooding Related Problems

In addition to flooding problems identified as a result of system modeling, other flooding-related problems have been identified through field observations of maintenance staff. In general, these problems are associated with dumping of garbage and debris in the open waterways in the basin. These illegal dumping activities can cause conveyance capacity problems.

3.2 Development of the Flood Control Strategy

As shown in the Stormwater Basin Planning Project process flow chart in Figure 1-1, Step 1 included a compilation of basin characteristics. These basin characteristics are summarized in Section 2.0 of this document. Step 2 in the process included problem identification under both existing and buildout land use conditions. The evaluation was focused on the major components of the public drainage system and the expectation was that the system would convey the design storm associated with drainage area. The results of this step for flood control are provided in Section 3.1 above. The next step included the development of potential stormwater management tools (i.e., capital projects or development standards) to address the identified problems. These stormwater management tools were developed as a result of an all-day basin assessment meeting. The meeting was attended by a large multi-disciplinary group of people including staff with experience in water quality, engineering, maintenance, natural resources, planning, and groundwater resources. Preliminary ideas were developed based on the goals and objectives of the project. This section describes the capital projects and flood control development standards that were proposed to address the identified flooding problems.

3.2.1 Capital Project Alternatives

All existing and future flooding problems identified through modeling and observations, and the proposed capital projects to address these problems are presented in Table 3-1. The locations of these proposed capital projects are illustrated on Figures 3-2 through 3-3. As shown in Table 3-1, three capital projects were proposed to address the expected flooding problems identified based

on modeling results in the Willow Creek basin. Table 3-1 also lists when the flooding problem is expected to occur (i.e., under existing or future conditions). Note that the flooding problems listed in Table 3-1 are associated with segment names. To locate a segment, one should first look up the upstream node and downstream node associated with the segment in Table 3-3, then pinpoint the segment on Figures 3-2 through 3-3.

Table 3-1
Capacity Deficiencies Identified Through Modeling and Proposed Capital Projects to Address Them

Expected Flooding Problems		Capital Project Alternatives Considered for Addressing Capacity Deficiencies	Selected Flood Control Capital Project
Segment Name	**When Deficient**		
Willow Creek – Main Stem Major Subbasin			
WCMN010A WCMN010C WCMN010D	25-yr existing	WC08 – Realign/Restore the Mainstem of Willow Creek	**WC08 –** This capital project includes relocating, realigning and restoring the main stem of Willow Creek to its historic condition to the extent feasible. This includes the portions of the east and west branches north of W. 18th to the point where they historically converged; and then from this convergence of the two branches north to West 11th. This capital project also includes constructing a low flow channel for these sections of the open waterway and protecting the floodplain for Willow Creek along this historical channel alignment. The realignment of the main stem of Willow Creek will allow for the surrounding floodplain and wetland areas to be preserved as flood storage for the high flow events, while the low flow channel would be designed to adequately convey the 2-year design storm under future land use conditions. In addition to the flood control benefits, this capital project will provide water quality and natural resources benefits for Willow Creek. The location of the capital project is illustrated on Figure 3-2

Table 3-1 (continued)

Expected Flooding Problems		Capital Project Alternatives Considered for Addressing Capacity Deficiencies	Selected Flood Control Capital Project
Segment Name	**When Deficient**		
Willow Creek – West Branch Major Subbasin			
WCWE100B WCWE100C WCWE110A WCWE110C WCWE120B WCWE120C WCWE120D WCWE130A WCWE130C WCWE100A WCWE100D WCWE100E WCWE100F	10-yr existing 25-yr existing	WC3C3 – Willow Creek West Branch Culvert/Channel Improvements	**WC3C3 –** This capital project includes the replacement/retrofit of four of the five culverts that are expected to be deficient under existing land use conditions, and re-grading the culverts and a portion of the open waterways upstream and downstream of the culverts WCWE110C and WCWE100F to reduce the slope of the culverts. The replacement of culvert WCWE100C was not included in this capital project because the new stormwater detention pond located on private property (i.e., Hynix Semiconductor America, Inc.) is expected to address the capacity problems. In addition to the culvert crossings, eight open waterway segments are expected to have overbank flooding under existing land use conditions for their respective design storms on the West Branch. When flows exceed the tops of the channel banks, they spread out into the surrounding areas. As most of the areas adjacent to Willow Creek are undeveloped, these flood flows are not expected to cause property damage. Therefore, although more than seventy percent of the open waterways were identified as deficient under existing conditions, a capital project was not proposed to address these flooding problems due to the fact that space is available to accommodate these flows; and this space is expected to continue to be available under future conditions. The location of the capital project is illustrated on Figure 3-2

Table 3-1 (continued)

Expected Flooding Problems		Capital Project Alternatives Considered for Addressing Capacity Deficiencies	Selected Flood Control Capital Project
Segment Name	**When Deficient**		
Willow Creek – East Branch Major Subbasin			
WCEA030A WCEA030B WCEA050B WCEA050C WCEA050D WCEA060C WCEA060D WCEA060E WCEA060F WCMN10F1 WCMN10F2 WCEA005B WCEA10A1 WCEA10A2 WCEA030C WCEA030D WCEA050A	10-yr existing 25-yr existing	WC3C4 – Willow Creek East Branch Culvert Improvements	**WC3C4 –** This capital project includes the replacement/retrofit of four culverts that are expected to be deficient under existing land use conditions. For the 13 open waterway flooding problems that were identified for the East Branch, 9 were expected to be related to capacity. The other 4 were associated with constrictions resolved as a result of implementing the above capital projects. A capital project was not proposed to eliminate the overbank flooding problems identified for the other 9 open waterway segments on the East Branch due to the fact that these overbank flooding problems are not expected to cause property damage. The location of the capital project is illustrated on Figures 3-2 and 3-3

In addition to the flooding problems identified as a result of basin modeling, the following capital project was proposed to address other identified flooding problems.

Citywide Annual Budget Line Item – Tip-ups – There is one tip-up that has been identified as a potential cause of flooding problems in this basin. A tip-up retrofit is proposed to address the potential maintenance-related flooding issue at this location. The tip-up retrofit that is proposed includes a manhole or vault-like structure that will allow for the capture and removal of sediments/debris and will also allow for maintenance access. The tip-up location that has been identified in this basin is as follows:

WCMN020A – located at Willow Creek Rd. and West 18th.
Node 54494 to 54462
Page 21 of 97 in the City of Eugene Wastewater and Stormwater Index Map Book.
Tip-up offset = 2.1 ft.

3.2.2 Development Standard Alternatives

In addition to capital project alternatives, development standard alternatives were evaluated for addressing those problems that are expected to occur as a result of future buildout conditions. The two flood control development standards that were evaluated for the Willow Creek basin were as follows:

- *Require post-development peak flows to equal pre-development peak flows* – This standard would require developers to ensure that post-development peak flow rates would not exceed pre-development peak flow rates from their sites for the flood control design storm of concern. This requirement could be met through the use of reduced effective impervious areas, infiltration, or detention.

- *Require post-development peak flows to equal available capacity* – This standard would require developers to ensure that post-development peak flow rates would not exceed the design capacity of the existing public stormwater conveyance system that would be accepting these flows. This standard would allow developers to take advantage of available surplus capacity where it exists in the public system. This standard would require that the City conduct hydraulic analyses in order to provide information to developers regarding available capacity. This requirement could also be met through the use of reduced effective impervious areas, infiltration, or detention. This standard is currently required where there are no model results and capital projects are not proposed.

3.3 Selected Alternatives

Capital projects were selected to address all of the flooding problems expected to occur under existing conditions. When several capital project options were proposed for addressing the same flooding problem, one capital project option was chosen as a result of a capital project selection and prioritization process that was implemented for this project (see Section 4.0 and Appendix J of Volume I).

For addressing flooding problems expected to occur under future buildout conditions, the capital project and development standards alternatives were compared in terms of both costs and effectiveness under two future development scenarios: Scenario 1: UGB Buildout (1,169 acres), and Scenario 2: UGB/Urban Reserve Buildout (1,398 acres). While Scenario 1 is the most likely outcome for this area, Scenario 2 is also presented in the event the Metro Plan amendment process described below does not come to fruition.

Subsequent to this flood evaluation and selection of alternatives, a study was conducted (2000) as part of the Eugene-Springfield Metropolitan Plan periodic review process to determine consistency of the existing urban reserve areas with Statewide Planning Goals. These areas were initially designated urban reserve when the Eugene-Springfield Metropolitan Plan was originally adopted - 1982. At that time, there were no administrative rules governing urban reserves and the designation of these areas remained urban reserve up to the current period review process. The 2000 study concluded, and each jurisdiction agreed, the existing urban reserve areas do not comply with current administrative rules and direction was given to staff to initiate Metro Plan amendments. Action to remove the urban reserve designations is expected to occur as part of the final periodic review adoption process which is scheduled for 2003.

The following describes the alternatives selected for each scenario.

3.3.1 Scenario 1 – UGB Buildout

The capital project alternatives were estimated to be more cost effective than the development standard alternatives under this scenario for the following reasons:

- All capacity related flooding problems are expected to occur under existing land use conditions as well as future land use conditions. Therefore, development standards alone would not be expected to resolve these problems and capital projects will be required regardless of which approach is taken.
- An issue associated with new development is adverse impacts to waterways from the increase in volume of stormwater discharged to them. Increased flow volumes can result in erosion, downcutting and riparian habitat degradation. Detention systems designed solely for flood control would not address this issue of hydrologic (volume) impacts due to new development. Standards to control flows from new development in headwater area are being proposed as a part of the Water Quality Strategy. See Section 4.2.2 for more information about headwater flow controls.

In summary, the selected flood control alternatives to address the expected flooding problems under both existing and future conditions for this basin include each of the three capital projects listed below. For more detail regarding each of these projects, capital project fact sheets are provided in the Appendix. The full range of flood control, water quality and natural resource capital projects are listed in Section 6.3 and shown on Figures 3-2 through 3-3.

- **Capital Project WC08 – Realign/Restore Main Stem of Willow Creek:** Realign and enhance the main stem of Willow Creek between West 11th and West 18th. Preserve the adjacent floodplain and wetland areas to allow for flood storage during high flow events.

- **Capital Project WC3C3 – Willow Creek West Branch Culvert/Channel Improvements:** Retrofit four culverts on the West Branch of Willow Creek and regrade a portion of the open waterway system.

- **Capital Project WC3C4 – Willow Creek East Branch Culvert Improvements:** Retrofit four culverts on the East Branch of Willow Creek.

- **Citywide Annual Budget Line Item – Tip-ups:** Retrofit the existing tip-up in this basin with a vault-like structure to provide maintenance access.

- **Multiple Objective Stormwater Capital Improvement Program:** In general, all stormwater capital projects, including water quality and natural resources projects, will consider flood control objectives when feasible and appropriate.

3.3.2 Scenario 2 – UGB/Urban Reserve Buildout

A combination of new development standards and selected capital projects were estimated to be more cost-effective and more appropriate for this scenario, for the following reasons:

- Development of the urban reserve area will more than double the amount of urbanization in the basin, creating significant capacity-related flooding problems. Resolving these problems through capital projects would require significant financial investment. Addressing future peak flows through development standards is more cost-effective than capital projects.
- The physical characteristics of the urban reserve area – especially the steep, forested slopes, and the highly erodible soils, create design constraints for locating and building capital projects that would not have significant environmental and water quality impacts.
- There is little downstream land available for locating and building the size of capital projects needed to resolve these problems.
- Development standards that include both flow controls and water quality treatment at the site level are likely to be more affordable and environmentally compatible than capital projects.

In summary, the selected flood control alternative for Scenario Two includes a combination of development standards (to address future land use conditions in the urban reserve area) and the three capital projects listed below (same projects identified for Scenario One). For more detail regarding each of these projects, refer to the capital project fact sheets located in the Appendix.

- **Capital Project WC08 – Realign/Restore Main Stem of Willow Creek:** Realign and enhance the main stem of Willow Creek between West 11th and West 18th. Preserve the adjacent floodplain and wetland areas to allow for flood storage during high flow events.

- **Capital Project WC3C3 – Willow Creek West Branch Culvert/Channel Improvements:** Retrofit four culverts on the West Branch of Willow Creek and regrade a portion of the open waterway system.

- **Capital Project WC3C4 – Willow Creek East Branch Culvert Improvements:** Retrofit four culverts on the East Branch of Willow Creek.

- **Citywide Annual Budget Line Item – Tip-ups:** Retrofit the existing tip-up in this basin with a vault-like structure to provide maintenance access.

- **Multiple Objective Stormwater Capital Improvement Program:** In general, all stormwater capital projects, including water quality and natural resources projects, will consider flood control objectives when feasible and appropriate.

TABLE 3-2
MAJOR HYDROLOGIC INPUT/OUTPUT DATA FOR THE WILLOW CREEK STORM DRAINAGE SYSTEM

Subbasin Name	Inlet Node	Subbasin Area (acres)	Impervious Area (%)					Average Subbasin Slope (ft/ft)	Subbasin Peak Flow (cfs) Existing Land Use Conditions					Subbasin Peak Flow (cfs) Future Land Use Conditions				
			Existing Land Use		Future Land Use		Increase [1] (%)											
			Mapped	Effective	Mapped	Effective			10-Year	25-Year-W[2]	25-Year-S[3]	50-Year	100-Year	10-Year	25-Year-W[2]	25-Year-S[3]	50-Year	100-Year
Willow Creek - East Branch																		
WCEA-005	76015	12.4	0.0	0.0	0.0	0.0	0.0	0.003	3	4	2	5	6	3	4	2	5	6
WCEA-010	73500	80.7	1.2	1.0	6.0	5.1	4.1	0.011	26	32	16	38	47	28	33	20	44	53
WCEA-020	51998	134.2	4.7	4.0	39.1	33.2	29.2	0.200	42	51	33	66	82	61	63	77	129	151
WCEA-030	71041	193.0	8.2	7.0	6.0	5.1	-1.9	0.144	87	91	90	158	186	86	90	86	153	180
WCEA-040	71016	37.7	16.5	14.0	37.1	31.5	17.5	0.240	13	13	14	26	32	16	16	21	37	44
WCEA-050	71014	141.9	16.5	14.0	22.0	18.7	4.7	0.240	51	60	52	97	115	55	62	59	107	126
WCEA-060	71044	67.9	18.8	16.0	32.0	27.2	11.2	0.110	23	26	20	42	52	27	29	29	55	66
WCEA-070	71012	308.3	5.9	5.0	17.1	14.5	9.5	0.240	88	112	64	131	164	103	123	96	182	220
WCEA-080	71008	229.4	9.4	8.0	17.1	14.5	6.5	0.223	73	88	63	122	149	80	93	79	147	177
Willow Creek - Main Stem																		
WCMN-010	71037	192.5	7.1	6.0	63.1	53.6	47.6	0.008	72	81	51	112	134	108	108	151	227	262
WCMN-020	54495	31.0	36.5	31.0	37.1	31.5	0.5	0.057	14	14	16	28	33	14	14	16	28	33
Willow Creek - West Branch																		
WCWE-010	76010	86.5	7.1	6.0	6.0	5.1	-0.9	0.005	24	32	14	32	40	23	31	13	31	38
WCWE-030	71030	247.2	3.5	3.0	12.0	10.2	7.2	0.230	77	95	48	109	135	85	101	68	140	168
WCWE-040	71028	84.7	10.6	9.0	35.1	29.8	20.8	0.150	34	36	33	67	82	40	43	51	93	110
WCWE-050	71024	88.7	2.4	2.0	15.1	12.8	10.8	0.270	26	32	17	36	46	30	35	28	53	64
WCWE-070	71020	339.4	10.6	9.0	18.0	15.3	6.3	0.224	106	128	86	168	208	116	135	110	205	249
WCWE-COMP	71032	292.0	1.2	1.0	11.8	10.0	9.0	0.119	94	114	61	135	167	105	122	90	179	214

Note.
1. Increase in effective impervious percentage from existing land use conditions to future land use conditions.
2. W = Winter
3. S = Summer

TABLE 3-3
HYDRAULIC PERFORMANCE OF THE WILLOW CREEK STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient
								Existing Land Use		Future Land Use		
	US	DS				Existing	Future	US	DS	US	DS	
Willow Creek - Main Stem												
WCMN010A	71038	71120	Natural	400	25	821	870	390.0	389.8	390.2	390.0	25-yr Existing
WCMN010B	71037	71038	bridge	34	50	670	798	389.0	389.0	389.7	389.6	
WCMN010C	71049	71037	Natural	900	25	780	836	390.3	390.0	390.5	390.2	25-yr Existing
WCMN010D	73754	71049	Natural	3000	25	814	869	397.7	390.3	397.7	390.5	25-yr Existing
Willow Creek - West Branch												
WCMN010H	54462	73754	Natural	1500	10	14	14	399.5	395.2	399.5	395.6	
WCMN020A	54494	54462	48" CSP	125	10	14	14	399.6	399.5	399.6	399.5	
WCMN020Ard	54494	54462	Roadway	125		0	0	399.5	399.5	399.5	399.5	
WCMN020B	54495	54494	48" CSP	450	10	14	14	400.1	399.6	400.1	399.6	
WCMN020Brd	54495	54494	Roadway	450		0	0	399.6	399.6	399.6	399.6	
WCMN010E#1	76010	73754	4'x12' box culvert	64	25	189	200	398.0	397.7	398.0	397.7	
WCMN010E#2	76010	73754	4'x12' box culvert	64	25	189	200	398.0	397.7	398.0	397.7	
WCMN010Erd	76010	73754	Roadway	64		0	0	395.2	395.2	395.6	395.6	
WCWE100A	71034	76010	Natural	676	25	381	389	398.2	398.0	398.3	398.0	25-yr Existing
WCWE100B	71033	71034	Natural	960	10	98	108	405.6	397.5	405.7	397.5	10-yr Existing
WCWE100C#1	71032	71033	42"x27" CMP elliptical culvert	47	10	27	27	405.8	405.6	405.9	405.7	10-yr Existing
WCWE100C#2	71032	71033	42"x27" CMP elliptical culvert	47	10	27	28	405.8	405.6	405.9	405.7	10-yr Existing
WCWE100Crd	71032	71033	Roadway	47		47	59	405.8	405.6	405.9	405.7	
WCWE100D	71040	71034	Natural	417	25	270	279	401.2	398.2	401.3	398.3	25-yr Existing
WCWE100E	71031	71040	Natural	1200	25	270	279	409.6	401.2	409.6	401.3	25-yr Existing
WCWE100F	71030	71031	48" CSP culvert	32	25	149	149	411.5	409.6	411.5	409.6	25-yr Existing
WCWE100Frd	71030	71031	Roadway	32		84	102	411.3	411.1	411.4	411.1	

TABLE 3-3 (continued)
HYDRAULIC PERFORMANCE OF THE WILLOW CREEK STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient
								Existing Land Use		Future Land Use		
	US	DS				Existing	Future	US	DS	US	DS	
WCWE110A	71050	71030	Natural	450	10	148	162	411.8	411.3	411.9	411.4	10-yr Existing
WCWE110B	71029	71050	Natural	800	10	148	162	415.4	411.8	415.6	411.9	
WCWE110C#1	71028	71029	12" CSP culverts	19	10	7	7	417.0	415.4	417.0	415.6	10-yr Existing
WCWE110C#2	71028	71029	15" CSP culvert	19	10	12	12	417.0	415.4	417.0	415.6	10-yr Existing
WCWE110Crd	71028	71029	Roadway	19		131	146	417.0	416.7	417.0	416.7	
WCWE120A	71027	71028	Natural	1300	10	124	135	427.6	417.0	427.7	417.0	
WCWE120B	71026	71027	42" CSP culvert	32	10	103	104	431.5	429.4	431.5	429.4	10-yr Existing
WCWE120Brd	71026	71027	Roadway	32		22	32	431.5	431.3	431.5	431.3	
WCWE120C	71025	71026	Natural	320	10	126	137	434.8	431.5	434.8	431.5	10-yr Existing
WCWE120D#1	71024	71025	18" CSP culverts	20	10	17	17	435.4	434.8	435.4	434.8	10-yr Existing
WCWE120D#2	71024	71025	24" CSP culvert	20	10	27	27	435.4	434.8	435.4	434.8	10-yr Existing
WCWE120Drd	71024	71025	Roadway	20		97	109	435.4	435.0	435.4	435.0	
WCWE130A	71023	71024	Natural	700	10	100	110	442.0	435.4	442.0	435.4	10-yr Existing
WCWE130B	71022	71023	48" CMP culvert	30	10	101	111	447.3	445.0	447.7	445.2	
WCWE130C	71021	71022	Natural	500	10	108	119	457.0	447.3	457.1	447.7	10-yr Existing
WCWE130D	71020	71021	48" CMP culvert	31	10	109	120	461.7	459.4	462.3	459.6	
WCWE130Drd	71020	71021	Roadway	31		0	0	457.0	457.0	457.1	457.1	
Willow Creek - East Branch												
WCMN10F1	73761	73754	Natural	290	25	432	442	398.1	397.7	398.2	397.7	25-yr Existing
WCEA005A	76015	73761	48" CSP culvert	50	25	49	52	398.4	398.1	398.4	398.2	
WCEA005Ard	76015	73761	Roadway	33		0	0	395.6	395.6	395.9	395.9	
WCEA005B	73501	76015	Natural	550	25	65	69	398.4	398.4	398.4	398.4	25-yr Existing
WCEA005C	73500	73501	Natural	2000	25	71	73	404.4	398.4	404.5	398.4	
WCMN10F2	73768	73761	Natural	535	25	364	369	398.7	398.1	398.7	398.2	25-yr Existing

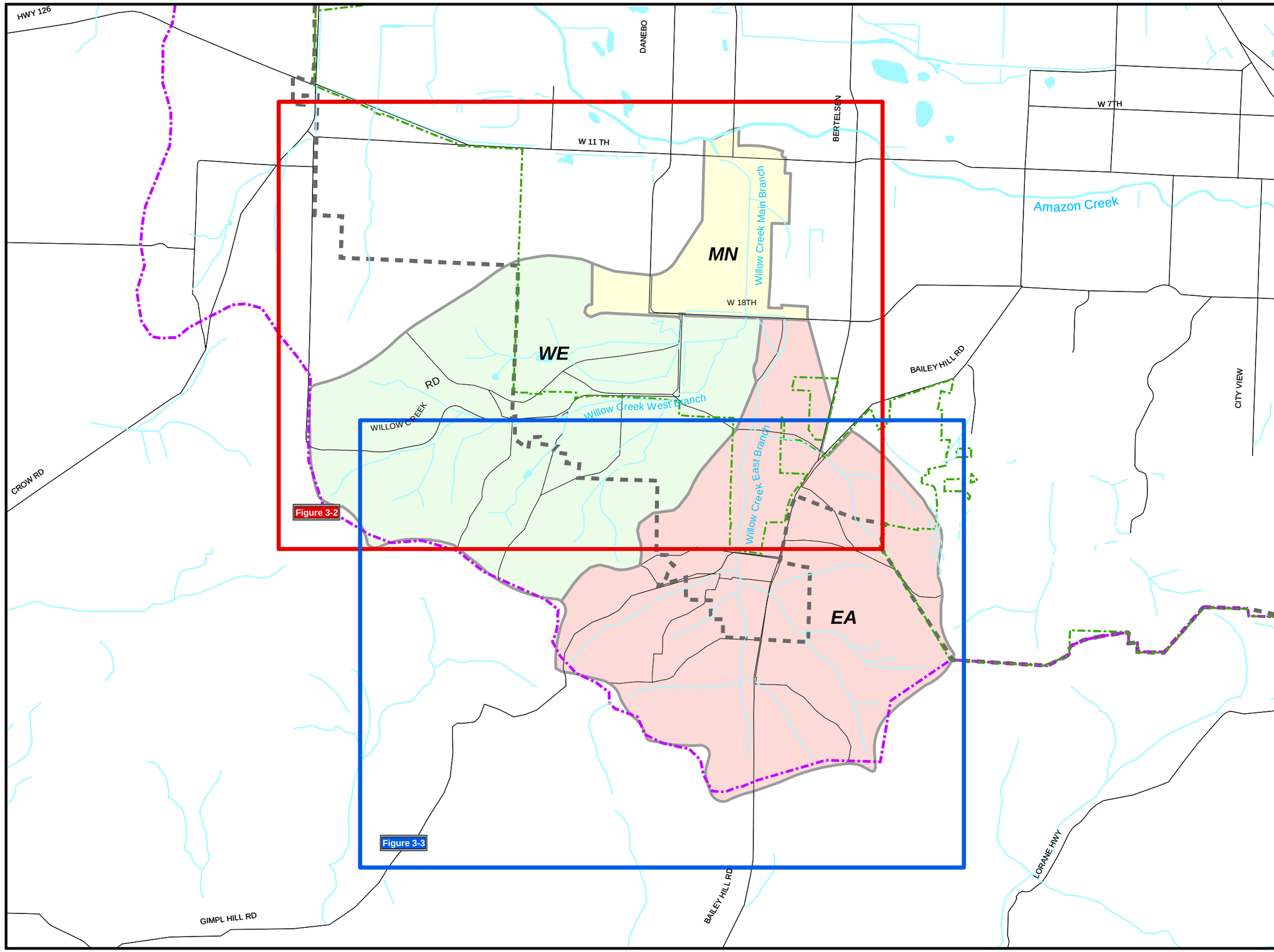
TABLE 3-3 (continued)
HYDRAULIC PERFORMANCE OF THE WILLOW CREEK STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient
								Existing Land Use		Future Land Use		
	US	DS				Existing	Future	US	DS	US	DS	
WCMN010G#1	76016	73768	6'x8' box culvert	64	25	175	179	399.0	398.7	399.0	398.7	
WCMN010G#2	76016	73768	6'x8' box culvert	64	25	175	179	399.0	398.7	399.0	398.7	
WCMN010Grd	76016	73768	Roadway	64		0	0	396.1	396.1	396.5	396.5	
WCEA10A1	73500	76016	Natural	1300	25	385	390	404.4	399.0	404.5	399.0	25-yr Existing
WCEA10A2	71041	73500	Natural	1322	25	434	445	410.8	404.4	410.8	404.5	25-yr Existing
WCEA030A	51997	71041	Natural	1774	10	28	41	437.5	410.5	437.5	410.6	10-yr Existing
WCEA030B	51998	51997	24" CSP culvert	164	10	39	40	445.5	437.5	445.7	437.5	10-yr Existing
WCEA030Brd	51998	51997	Roadway	164		5	23	445.5	445.3	445.7	445.4	
WCEA030C	71042	71041	Natural	1200	25	273	273	424.7	410.8	424.7	410.8	25-yr Existing
WCEA030D	71017	71042	Natural	2000	25	274	274	437.9	424.7	438.3	424.7	25-yr Existing
WCEA030E	71016	71017	bridge	35	25	279	285	438.0	437.9	438.3	438.3	
WCEA050A	71043	71016	Natural	414	25	271	279	438.9	438.0	439.0	438.3	25-yr Existing
WCEA050B	71015	71043	Natural	364	10	55	58	444.9	438.6	445.0	438.8	10-yr Existing
WCEA050C	71014	71015	30"x42" CMP elliptical culvert	51	10	54	55	451.8	449.3	451.9	449.3	10-yr Existing
WCEA050Crd	71014	71015	Roadway	51		1	3	451.8	451.7	451.9	451.7	
WCEA050D	71044	71043	Natural	250	10	176	203	440.1	438.6	440.2	438.8	10-yr Existing
WCEA060A	71013	71044	Natural	647	10	91	106	447.5	440.1	447.6	440.2	
WCEA060B	71012	71013	36" CSP culvert	82	10	92	107	453.6	448.9	455.2	449.6	
WCEA060Brd	71012	71013	Roadway	82		0	0	447.5	447.5	447.6	447.6	
WCEA060C	71011	71044	Natural	600	10	72	81	452.5	440.1	452.5	440.2	10-yr Existing
WCEA060D#1	71010	71011	27"x42" CMP elliptical culvert	23	10	48	49	453.9	452.5	453.9	452.5	10-yr Existing

TABLE 3-3 (continued)
HYDRAULIC PERFORMANCE OF THE WILLOW CREEK STORM DRAINAGE SYSTEM

Segment ID	Node ID		Segment Size/Type	Segment Length (ft)	Design Storm	Peak Flow (cfs) For Design Storm		Water Surface Elevation For Design Storm (ft)				When Deficient
								Existing Land Use		Future Land Use		
	US	DS				Existing	Future	US	DS	US	DS	
WCEA060D#2	71010	71011	18" CMP culvert	23	10	11	11	453.9	452.5	453.9	452.5	10-yr Existing
WCEA060D#3	71010	71011	18" CMP culvert	23	10	11	11	453.9	452.5	453.9	452.5	10-yr Existing
WCEA060Drd	71010	71011	Roadway	23		6	14	453.9	453.7	453.9	453.8	
WCEA060E	71045	71010	Natural	228	10	76	84	455.0	453.9	455.1	453.9	10-yr Existing
WCEA060F	71046	71045	36" CMP culvert	41	10	62	63	461.7	458.8	461.7	458.8	10-yr Existing
WCEA060Frd	71046	71045	Roadway	41		15	21	461.7	461.5	461.7	461.5	
WCEA060G	71048	71046	Natural	100	10	77	84	461.7	461.7	461.8	461.7	
WCEA060H	71009	71048	Natural	400	10	77	85	468.9	461.7	469.0	461.8	
WCEA060I	71008	71009	36" CSP culvert	24	10	78	85	472.8	470.1	473.3	470.3	
WCEA060Ird	71008	71009	Roadway	24		0	0	468.9	468.9	469.0	469.0	

Willow Creek Basin Drainage System



INDEX MAP

This index map shows the layout of the Willow Creek basin into two geographic areas depicted on Figures 3-2 through 3-3. These figures contain detailed drainage system information for areas within the city limits and urban growth boundary (UGB).

L E G E N D

Eugene City Limits
Urban Growth Boundary
Eugene Plan Boundary

Basin Map Coverage
(Alternating color borders to distinquish overlapping areas.)

Willow Creek Basin Major Subbasins

MN = Main Stem
EA = East Branch
WE = West Branch

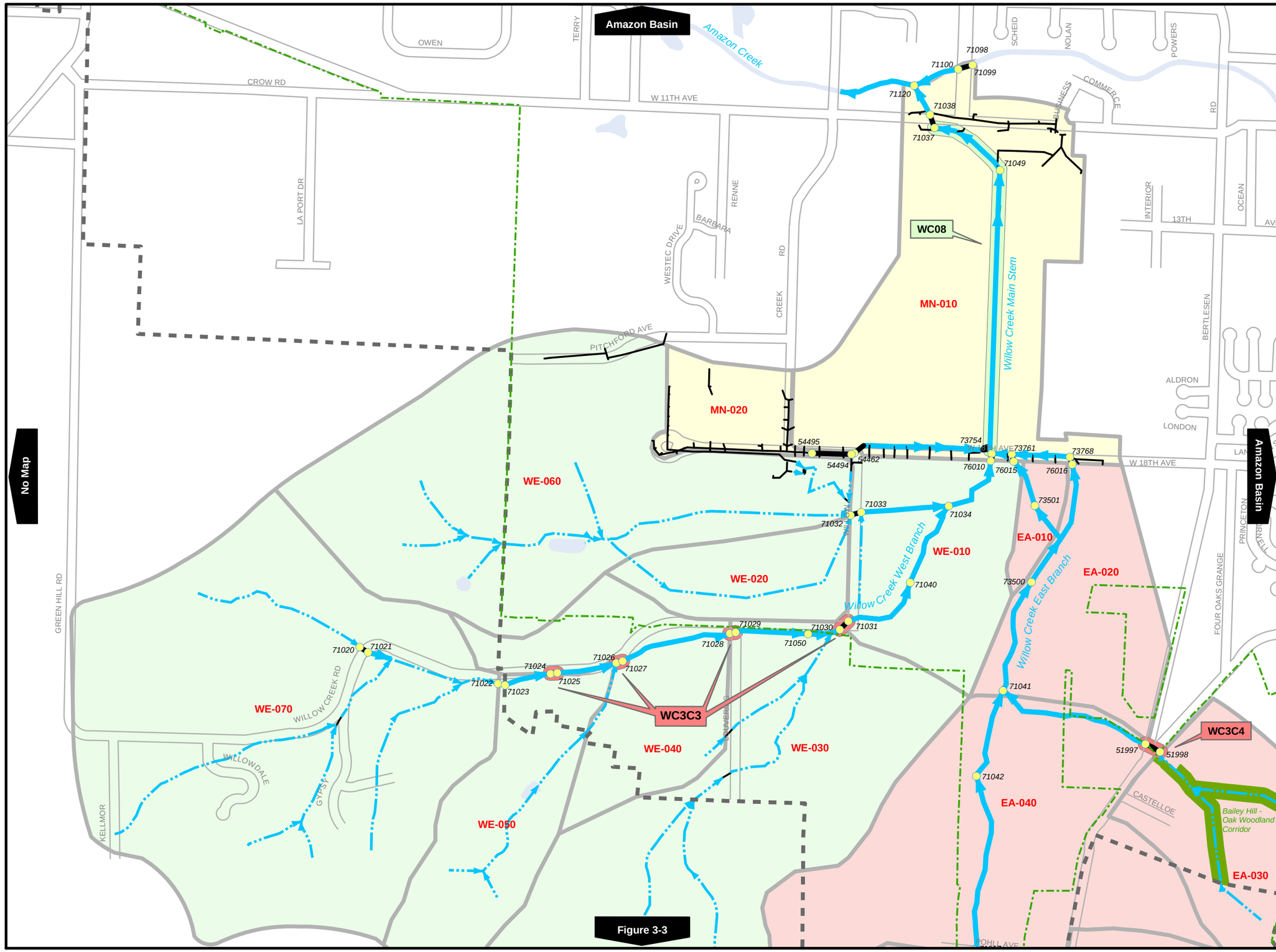
N
W E
S

1 inch equals 0.4 miles

Miles
0.2 0 0.2 0.4

Produced by LCOG - August 2002
g:proj/eug/drainage_maps/willow_creek/wc_index.apr

Figure 3-1



Willow Creek Basin Drainage System

Legend

- Drainpipe - Modeled
- Drainpipe - Not Modeled
- Waterway - modeled
- Waterway - not modeled

Major Subbasins on this map

- MN = Main Stem
- WE = West Branch
- EA = East Branch

AB-123 Subbasin ID's within Major Subbasins

- Modeled Point
- 12345 Modeled Reference Numbers

Capital Projects

- WCxx Water Quality
- WCxx Natural Resources
- WCxx Flood Control

- Other Water Features
- Acquisition Corridor
- Urban Growth Boundary
- Eugene City Limits

Due to the scale of these maps, the display of some modeled pipe segments may either hide other nearby pipes, or appear connected when they are not.
To verify actual connections please refer to Table 3-3.

N W E S

EUGENE

1 inch equals 1,000 feet

500 0 500 1,000 Feet

Produced by LCOG - August 2002
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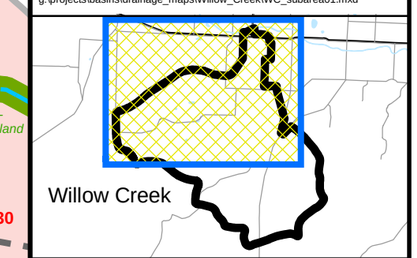
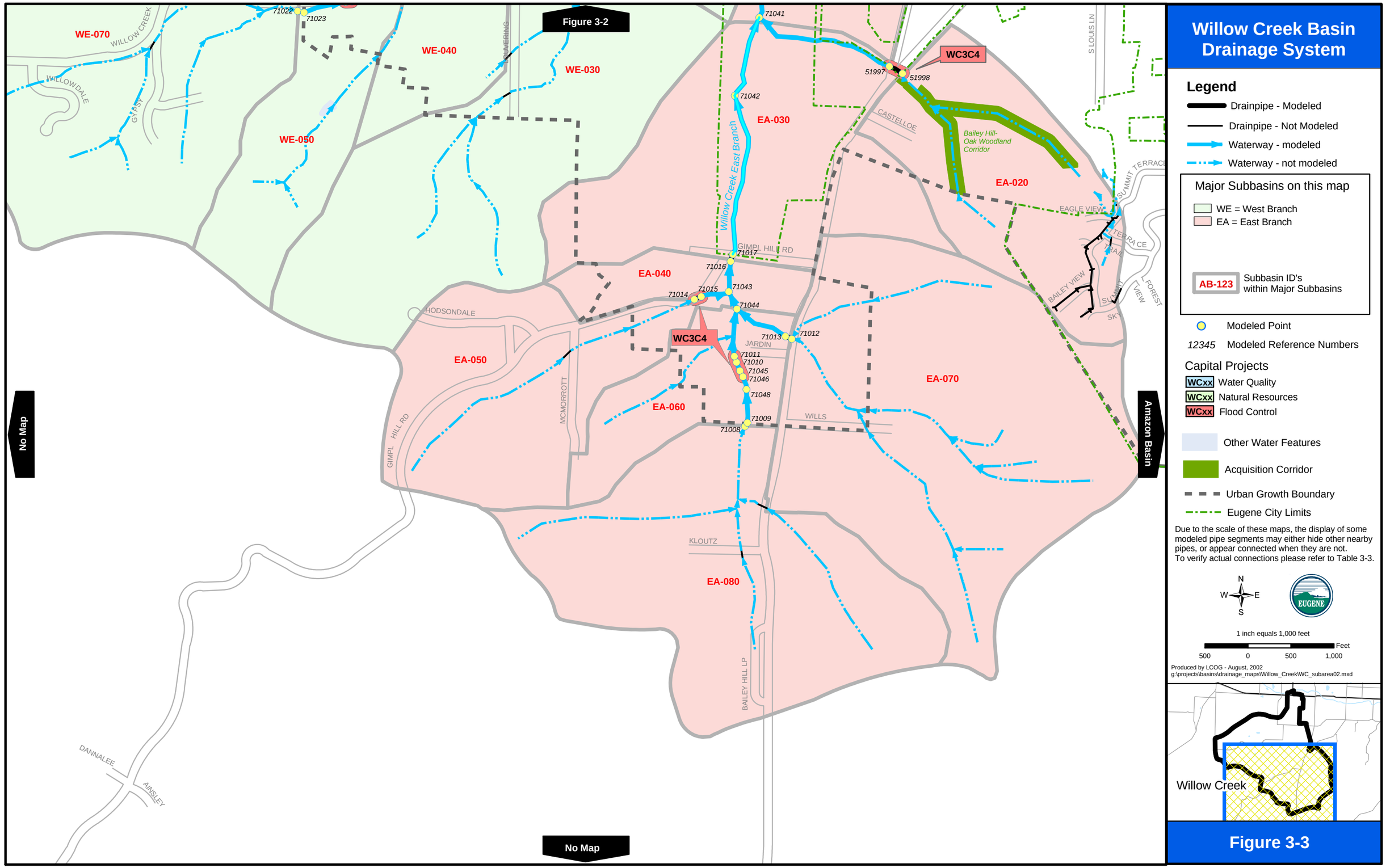


Figure 3-2



Willow Creek Basin Drainage System

Legend

- Drainpipe - Modeled
- Drainpipe - Not Modeled
- Waterway - modeled
- Waterway - not modeled

Major Subbasins on this map

- WE = West Branch
- EA = East Branch

AB-123 Subbasin ID's within Major Subbasins

- Modeled Point
- 12345 Modeled Reference Numbers

Capital Projects

- WCxx Water Quality
- WCxx Natural Resources
- WCxx Flood Control

- Other Water Features
- Acquisition Corridor
- Urban Growth Boundary
- Eugene City Limits

Due to the scale of these maps, the display of some modeled pipe segments may either hide other nearby pipes, or appear connected when they are not.
To verify actual connections please refer to Table 3-3.

N W E S

EUGENE

1 inch equals 1,000 feet

500 0 500 1,000 Feet

Produced by LCOG - August, 2002
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Figure 3-3

A general characterization of water quality in the Willow Creek basin is described in Section 2.6. This section describes the processes that were used to evaluate the existing water quality data (Section 4.1). Then, it describes the capital project alternatives and development standard alternatives (Section 4.2) that were proposed to address the water quality problems. Section 4.3 describes the selected water quality alternatives.

4.1 Evaluation of Water Quality Under Existing and Expected Future Conditions

To supplement the water quality information provided in Section 2.6, pollutant loads for Total Suspended Solids were calculated for the basin. Although TSS has not been shown to be directly related to all other pollutants, it was used as a general indicator of other pollutants for the purposes of making relative comparisons. The relative values and not the absolute values of the pollutant loads were used to assign priorities and to target those drainage subbasins or land uses that appear to contribute the largest pollutant loads to receiving waters. The values were also used to evaluate the relative contribution of pollutant loads expected as a result of future development. The methods used to estimate pollutant loads are described in Volume I, Section 3.2. The results for the Willow Creek basin are provided in Figures 4-1 through 4-3 below. As mentioned in Section 2.6, these results are based on stormwater quality monitoring conducted n the City of Eugene. Although none of the stormwater monitoring stations were located in the Willow Creek basin, the City-wide data were used to provide general information regarding stormwater quality in Eugene and to identify a stormwater management strategy for this basin. In general, the Willow Creek basin pollutant load is 177,000 pounds per year under existing condition and pollutant load is expected to increase by 117% as a result of future development (based on results from the TSS pollutant loads estimations).

Figure 4-1
Estimated Total Suspended Solids Loads Per Year in the Willow Creek Basin (UGB)

Estimated TSS Pounds Per Year in the Willow Creek basin	1,000 Pounds	Willow Creek basin Relative to the Range of TSS Pounds Per Year in Other Eugene Basins
From Existing Development	177	
From Development of Vacant Land	206	
Total Buildout	383	

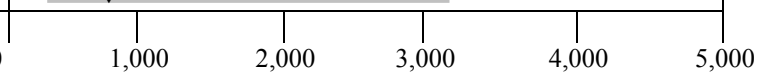
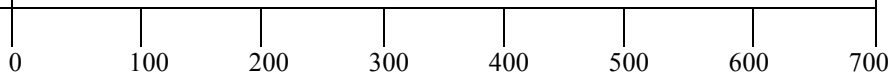


Figure 4-2
Estimated Increases in Total Suspended Solids Loads Associated with Future Buildout in the Willow Creek Basin (UGB)

Estimated Increase in TSS Loads	Percent	Willow Creek basin Relative to the Range of Increase in TSS Loading in Other Eugene Basins
From Future Development	117	

Figure 4-3
Estimated Total Suspended Solids Loads Per Acre - Per Year in the Willow Creek Basin (UGB)

Estimated TSS Pounds Per Acre Per Year in the Willow Creek basin	Pounds per Acre per Year	Willow Creek basin Relative to the Range of TSS Pounds Per Acre Per Year in Other Eugene Basins
Existing Development	151	
Development of Vacant Land	177	
Total Buildout	328	



The above information, along with the information provided in Section 2.6, was used to develop capital project and development standard alternatives for addressing water quality. The capital project alternatives and the development standard alternatives are described in Section 4.2 and the selected alternatives for the water quality portion of the basin strategy are described in Section 4.3.

4.2 Development of the Water Quality Strategy

As shown in the stormwater basin master planning process flow chart in Figure 1-1, Step 1 included a compilation of basin characteristics. These basin characteristics are summarized in Section 2.0 of this document. Step 2 in the process included problem identification under both existing and future land use conditions. The results of this step for water quality are provided in Section 4.1 above. The next step included the development of potential stormwater management tools (i.e., capital projects or development standards) to address the identified problems. These stormwater management tools were developed as a result of an all-day basin assessment meeting. The meeting was attended by a large multi-disciplinary group of people including staff with experience in water quality, engineering, maintenance, natural resources, planning, and groundwater resources. Preliminary ideas were developed based on the goals and objectives of the project. This section describes the capital projects and water quality development standards that were proposed to address the identified water quality problems.

4.2.1 Capital Project Alternatives

Identifying potential capital projects to address water quality concerns is very different from identifying capital projects to address flooding issues. With respect to flooding, specific capacity deficiencies are identified through modeling and capital projects are proposed to address those deficiencies. With respect to water quality, pollutant discharges associated with urban runoff are ubiquitous. Therefore, with the exception of the specifically observed water quality problems, the focus of developing capital project alternatives for water quality was on identifying opportunity areas for the siting of surface water capital projects. This included looking for areas with the following characteristics: 1) sufficient space was available for a surface water quality facility, 2) space was available that was publicly owned or vacant and potentially available for

purchase, 3) the location drained a large and densely developed high source area, and 4) the location could be used to construct a capital project that addresses multiple objectives in addition to water quality control (i.e., flood control, natural resources enhancement, recreation, education).

For the Willow Creek basin, capital project options were evaluated and considered for addressing pollutant discharges in runoff from both existing and future development and for addressing existing erosion, bank stability downcutting problems that have been observed or that are expected to occur as a result of future buildout. The capital project is listed below:

Citywide Annual Budget Line Item – Stream Bank Stabilization – This proposed project alternative includes using bioengineering techniques to stabilize the creek bank at locations where problems have been observed or are expected to occur as a result of future development. Specific problem locations have been identified in the Willow Creek basin as follows:

- On the south side of W. 18th (model segment WCWE100A).
- In sections of the west branch of Willow Creek along the curve of Willow Creek Rd. (model segments WCWE100E and WCWE110A).
- On the north and south sides of Gimple Hill Rd. (model segment WCEA050A).
- In the most downstream segment of the east branch, on the north side of W. 18th (model segment WCMN010F).
- On the upstream side of the Bailey Hill/Bertelsen intersection (just upstream of model segment WCEA030I).
- Just upstream of W.11th where there is an existing 90° bend in the creek.

Citywide Annual Budget Line Item – Tip-ups – Tip-ups are considered to be opportunity areas for addressing multiple objectives. In addition to localized flooding problems caused by sediment and debris buildup in tip-ups, the accumulated sediment and debris may be flushed into the downstream open waterway when large storms occur. Typically, the existing tip-ups do not have adequate access for maintenance. Tip-up retrofits were proposed to address potential maintenance-related flooding issues as described in Section 3.2.1. To address multiple objectives, the tip-up retrofits that were proposed included manhole or vault-like structures for water quality benefits. These structures would allow for the capture and removal of sediments/debris and would also allow for maintenance access. There is one tip-up location that as been identified in this basin at Willow Creek Rd. and W. 18th.

4.2.2 Development Standard Alternatives

Potential development standards were considered for addressing the identified water quality problems in the Willow Creek basin. The standards that were considered include:

- *Require Best Management Practices (BMPs) to reduce pollutants associated with stormwater runoff from new development for a design storm representing a specified amount of rainfall* – This standard would require developers to construct stormwater quality BMPs to reduce pollutants in stormwater runoff associated with a specific design event. Based on an analysis of rainfall data from Eugene, the design event was selected to represent 80% of the average

total annual rainfall. An evaluation of the design storms representing 70%, 80%, and 90% of the average total annual rainfall was conducted. The design storm representing 80% was found to be the most cost effective. Significant cost increases were estimated using the 90% event with not much additional treatment. And, the cost difference between the 70% and 80% events was insignificant. Therefore, the 80% event was selected. As a result, the water quality design storm volume for detention type facilities is 1.4 inches over a 24 hour period; and the water quality design storm intensity for flow through type facilities is 0.22 inches/hour for on-line facilities and 0.13 inches/hour for off-line facilities. For more details on the analysis conducted to develop the water quality design storm parameters, see Appendix K of Volume I.

- *Require additional BMPs for specific land uses* – This standard would be implemented in addition to the standard listed above. The standard listed above would result in a base set of water quality BMPs required for all land uses. This development standard would require additional water quality BMPs for specific land uses. Specifically, it would require oil control for high traffic areas, and structural source controls for industrial/commercial activities that are exposed to stormwater.

- *Require flow controls for headwater areas* – This standard would require developers to control and minimize increased flows from new development into headwater tributaries. The objective is to prevent downcutting and erosion of waterways due to the increased flows, thereby protecting water quality and the structural integrity of the waterway.

- *Require developers to construct stormwater quality BMPs that remove a specified percentage of pollutants (e.g., 80% removal of TSS)* - This development standard was not considered viable, however, due to its many disadvantages including: 1) this approach is very difficult for the development community to address because there are many unknowns about how to meet such a performance standard; 2) it is difficult to enforce compliance with this approach without conducting very expensive chemical monitoring of the influent and effluent; and 3) this approach does not address the fact that some constituents may be of concern in one receiving water but not another.

- *Prohibit filling and/or piping of key waterways* – This standard would prohibit filling and piping of "key" waterways that provide important stormwater functions including water quality protection and treatment. Criteria would be established for identifying "key" waterways for protection. This standard is covered in Section 5.2.2 of this plan.

4.3 Selected Alternatives

The water quality management alternatives selected address pollutant discharges from both existing and new development. A significant portion of the Willow Creek basin remains to be developed. This will result in incremental increases in the discharge of pollutant loads to the creek. Therefore, development standards which reduce the discharge of pollutants are recommended as they would effectively prevent significant increases in pollutant discharges. The development standard also applies to significant re-development as it will reduce additional pollutant discharges resulting from the re-development and will aid in addressing the existing

water quality condition. The resulting water quality management strategy for the Willow Creek basin consists of the following elements. For more detail regarding each of the capital projects, capital project fact sheets are provided in the Appendix.

- **Water Quality Development Standards:**
  - Require treatment BMPs that are designed according to the BMP Manual and the City's water quality design storms.
  - Require additional BMPs for specific land use activities of concern (i.e., oil control for high traffic areas, and structural source controls for commercial/industrial activities that are exposed to stormwater).
  - Require flow controls for headwater areas to protect water quality.
  - Prohibit filling and/or piping of key waterways (covered in Section 5.2.2).
- **Incentives for Existing Development:** Financial incentives will be incorporated into the stormwater user fee structure to encourage existing development not subject to the new water quality development standards to construct (retrofit) new stormwater quality BMPs.
- **Capital Project Citywide Annual Budget Line Item – Stream Bank Stabilization:** Use bioengineering techniques to stabilize the creek bank at locations where problems have been observed or are expected to occur as a result of future development (for a list of specific problem locations in this basin, see Section 4.2.1.
- ***Capital Project Citywide Annual Budget Line Item – Retrofit of Tip-ups:** Retrofit the existing tip-up with a vault-like structure that provides water quality benefits and maintenance access.
- **Multiple Objective Stormwater Capital Improvement Program:** In general, all stormwater capital projects, including flood control and natural resources projects, will consider water quality objectives when feasible and appropriate.

* Also listed under the flood control strategy in Section 3.0.

Note: It should be noted that this basin stormwater management strategy was intended to focus on water quality management tools in the form of development standards and capital projects. To comply with the National Pollutant Discharge Elimination System (NPDES) permit for stormwater discharges, the City is or has been also implementing a significant number of other stormwater quality management practices that will supplement this strategy and help to reduce the discharge of pollutants in stormwater. These include the following:

Inspection, Enforcement, and Monitoring

- Strengthen Enforcement to Prevent and Eliminate Illicit Connections
- Field Screening to Detect and Eliminate Illicit Connections
- Monitor Stormwater Discharges from Industrial Facilities

Operations and Maintenance

- Revise Comprehensive Operation and Maintenance Plans
- On-going Evaluation of City Vegetation Management Practices to Protect Stormwater Quality
- On-going Evaluation of Ice and Snow Road Traction Practices to Protect Stormwater Quality
- Evaluate and Improve DOT Practices to Improve Stormwater Quality
- Improve Clean-up After Accidents and Fires
- Evaluate and Improve Existing Street Sweeping Program
- Evaluate and Improve Effectiveness of Storm System Cleaning
- Storm System Mapping and Data Management
- Improve Litter Pickup Programs in Public Areas and Major Events
- Prevent Leaks and Spills from Municipal Trucks
- Maintain and Equip a Trained Environmental Spill Response Team

Planning and Administration

- Review Street Design Standards with Respect to Water Quality (this has been completed)
- Erosion Prevention and Construction Site Management Program (a new ordinance was developed in 1999)
- Illegal Dumping Program
- Improve Solid Waste Management Program to Address Stormwater Quality
- Inventory and Maintain Wetland Mitigation Sites to Ensure Benefits are Maintained in Perpetuity

Public Education

- Stormwater Information and Education Activities
- Storm Drain Stenciling
- Support government and community Tree Planting Programs
- Eugene Stream Team Volunteer Activities
- Educate Commercial/Industrial Business About Good Housekeeping Practices
- Improve Reporting of Illegal Dumping
- Education for Stormwater-Friendly Design Practices
- Expand Household Hazardous Waste Disposal Program

For purposes of the basin planning process, the term "natural resources" pertains specifically to the City's open waterways drainage system and the characteristics of it that provide or assist in providing beneficial stormwater functions such as: storm conveyance, flood storage, water quality preservation or treatment, aquatic and riparian habitat, and water temperature controls. These natural resources include the primary waterway corridors of Eugene and adjoining riparian and wetland areas, and headwater streams and wetlands. These characteristics are described in Section 2.0 of this report.

Section 5.1 describes the evaluation process used and the basin-specific problems and opportunities identified under existing and expected future conditions. A description of existing waterway protection measures, other related efforts underway, and gaps in stormwater related natural resources data is also included. Section 5.2 describes the alternatives considered for addressing these problems and opportunities, and Section 5.3 describes the selected alternatives.

5.1 Evaluation of Natural Resources Under Existing and Expected Future Conditions

The following provides the objectives, methods, and results of the stormwater related natural resources evaluation for the Willow Creek basin.

Objectives of the Evaluation

- Determine the extent of the open waterway drainage system that should be protected for beneficial stormwater functions.
- Determine where existing protection policies apply and where gaps exist.
- Determine where restoration efforts should be targeted to improve stormwater functions.
- Determine where intervention efforts are needed to correct streambank stability problems.
- Determine what other efforts are underway which may ultimately provide protection consistent with stormwater program objectives.

Methods Used to Conduct the Evaluation

Several methods were used to conduct the natural resources evaluation including the following:

- The following information was compiled and reviewed to assess the location, condition, and function of the Willow Creek basin waterway system. Most of the data were contained in the City's geographic information system (GIS):
  - Open waterway drainage system.
  - Draft inventory of the Eugene-Springfield Metropolitan Plan Natural Resources Study.
  - FEMA floodway and floodplain areas.
  - National wetland inventory.
  - Soil Survey of Lane County Area, Oregon (1987), Natural Resources Conservation Service.
  - Historic photos, hydric soils – to help reconstruct the historic drainage system (i.e. pre-settlement).
  - Areas with stormwater pipe system.

  - 1999 aerial photography of the Willow Creek basin.
- Site visits to collect and verify GIS information about select portions of the waterway system including location, size, condition, and function. For the site visits that were conducted, functions were evaluated using a modified version of the Oregon Freshwater Assessment Methodology (OFWAM). This method was modified to focus on the stormwater related benefits of natural resources.
- Eugene Public Works Department engineering and maintenance staff were interviewed as to their knowledge of the system.
- Property owners provided site specific information at public workshops and through other contacts.
- Policy plans were reviewed to determine where and how waterways were protected in the Willow Creek basin.
- Other City of Eugene and Metro area staff were consulted to identify other on-going efforts which may ultimately provide protection for waterways consistent with stormwater program objectives.

Results of the Evaluation

The results are provided below in terms of both existing conditions and expected future conditions.

Existing Waterway System Conditions:
- About 17 miles of waterways exist in this basin.
- These waterways form a connected drainage system beginning in the South Hills as riparian headwater streams and eventually flowing into the East and West Branches of Willow Creek and then into the Main Stem.
- Except for some evidence of erosion and downcutting, the waterways are in relatively good condition south of 18th Avenue.
- North of 18th Avenue, the Main Stem has been channelized and existing riparian habitat function is low.

Expected Future Waterway System Conditions:
- Future conditions for "private" waterways within the UGB are expected to remain in relatively good condition given the waterside protection overlay zone restrictions that apply to the Main Stem and the East and West Branches of Willow Creek, and The Nature Conservancy ownership pattern south of 18th Avenue.
- Future conditions of "publicly owned and/or maintained" waterways are expected to remain the same or improve over existing conditions due to the City's commitment to environmentally friendly maintenance practices and increasing level of responsibility for managing the open waterway system.

The remainder of this section provides additional context for the stormwater related natural resources evaluation:

Existing Protection Measures

- The Waterside Protection Overlay Zone (EC 9.4700) applies within West Eugene Wetlands Plan (WEWP) boundary and provides protection for channels, setbacks and contiguous riparian areas. All of Willow Creek basin is within WEWP boundary.
- The Natural Resource Zone (EC 9.2500) is intended to protect outstanding natural resource areas in adopted plans (EC 9.2500). It currently does not apply to any specific property but could be used in the future as a waterway protection tool.
- The Planned Unit Development (EC 9.8300) provisions contain specific approval criteria for protecting significant natural resources. These criteria are to be balanced with other policy needs and standards and, therefore, offer some but no consistent protection standards for waterways.
- Site Review (EC 9.8425) provisions contain approval criteria that could be used for waterways protection if specifically identified for protection.

Other Related On-going Efforts

- Endangered Species/Salmon program is expected to develop strategies for responding to the *January 2001* listing of spring Chinook salmon. Strategies are likely to include incentives and regulatory measures for protection and restoration of salmon habitat in Eugene. The timeline for developing strategy options for Council consideration is fall 2002.
- The Metro Natural Resources Study (NR Study) is expected to provide increased protection of waterways with riparian habitat functions. The timeline for implementation of protection measures is 2005.

Data Gaps

- There are little data as to existing aquatic habitat and species condition in the Willow Creek basin waterways. These data would not only help further inform the condition of the waterways, but would also allow for better evaluation of the effects of proposed capital improvements to these waterways.

5.2 Development of the Natural Resources Strategy

As shown in the stormwater basin master planning process flow chart in Figure 1-1, Step 1 included a compilation of basin characteristics. These basin characteristics are summarized in Section 2.0 of this document. Step 2 in the process included problem identification under both existing and future land use conditions. The results of this step for natural resources are provided in Section 5.1 above. The next step included the development of potential stormwater management tools (i.e., capital projects or development standards) to address the identified problems and opportunities. These stormwater management tools were developed as a result of an all-day basin assessment meeting. The meeting was attended by a large multi-disciplinary group of people including staff with experience in water quality, engineering, maintenance, natural resources, planning, and groundwater resources. Preliminary ideas were developed based on the goals and objectives of the project. This section describes the capital projects and

development standards that were proposed to address the identified stormwater-related natural resource problems and opportunities.

5.2.1 Capital Project Alternatives

The following capital projects were considered that would address stormwater related natural resources problems and opportunities:

Stream Corridor Acquisition - Stream corridors and specific sites with relatively high stormwater values which are also at risk of future development would be identified for acquisition. The Willow Creek Main Stem and Bailey Hill-Oak Woodland corridors (shown on Figures 3-2 through 3-3) were considered for possible acquisition and, due to cost limitations, only the Bailey Hill-Oak Woodland corridor was recommended for acquisition.

In addition to cost considerations, the Willow Creek Main Stem was not recommended for acquisition as part of this program element given the longer-term vision to relocate and restore the historic Main Stem alignment. Acquisition for relocation purposes could occur as part of the broader capital project (WC08).

Citywide Annual Budget Line Item – Streambank Stabilization – This would be an annual budget line item for identifying and implementing streambank stabilization projects to help streams adjust to increased runoff volumes while limiting negative impacts associated with downcutting, sedimentation, and erosion. Where appropriate, bioengineering techniques would be used. Specific locations in this basin where problems have been observed are listed in Section 4.2.1.

5.2.2 Development Standard Alternatives

Potential development standards were considered for addressing identified stormwater related natural resources problems and opportunities in the Willow Creek basin.

- *Prohibit filling and/or piping of key waterways* – Using this approach, criteria would be established for identifying "key" waterways to be protected. A map of the key waterways and requirements would be adopted that would prohibit filling and/or piping of the waterways unless exemptions could be obtained. The key waterways approach would recognize that certain waterways possess characteristics that provide important stormwater functions and should be protected, while other smaller, isolated, segmented waterways provide little or no stormwater function and protection would not be warranted. This code would only apply within the Eugene city limits.

- *Pursue setback protection requirements for key waterways through other appropriate processes* – There is significant overlap between the stormwater program, NR Study, and ESA/Salmon program. This approach would rely on these other processes for providing some or all natural resources protection policies.

- *Require flow controls for headwaters areas* – This standard would require developers to control and minimize increased flows from new development into headwater tributaries. The objective is to prevent downcutting and erosion of waterways due to the increased flows, thereby protecting water quality and the structural integrity of the waterway. This standard is covered in Section 4.2.2.

- *Require BMPs to reduce pollutants associated with stormwater runoff from new development* – This standard would require new development to control the quality of stormwater runoff by selecting, designing, constructing, and maintaining a water quality facility. This standard is covered in Section 4.2.2 of this plan.

5.3 Selected Alternatives

The selected natural resources management strategy includes a combination of capital projects, development standards, and other items to address existing and future stormwater related natural resources problems and opportunities, as follows:

- **Support Existing Waterway Protection Standards:** (i.e., Waterside Protection Overlay Zone, "Needed Housing", Natural Resource Zone, Planned Unit Development provisions, Site Review provisions as applicable).

- **Prohibit Filling and/or Piping of Key Waterways:**

  Note: This standard was selected and an ordinance was processed through the Eugene Planning Commission and City Council. Ultimately, this standard was replaced by an approach that would apply no-fill/no-pipe prohibitions to all waterways until the NR Study was completed. When processed for adoption, this standard was referred to as the Open Waterways ordinance. The Open Waterways ordinance was challenged and subsequently remanded back to the City by the Land Use Board of Appeals for further processing. This ordinance is no longer in effect. The strategy for protecting stormwater significant waterways from being piped and filled is currently under development.

- ***Water Quality Development Standards:** These standards are selected to prevent pollutants from entering the waterways. They include: treatment BMPs for stormwater runoff from new development, additional BMPs for specific land use activities of concern, and flow controls for headwater areas to protect water quality, and are covered in Section 4.2.2 of this plan.

- **Pursue Waterway Setback Protection Measures in Coordination with Natural Resources Study and ESA/Salmon Program (described in Section 5.1):** Coordination will continue to ensure consistency with stormwater program objectives for long term stream corridor protection and to identify and fill gaps in protection measures for waterways.

- **Stream Corridor Acquisitions:** Acquire the Bailey Hill-Oak Woodland corridor.

- ***Citywide Annual Budget Line Item - Streambank Stabilization:** Projects to be determined on an annual basis.

- **Multiple objective stormwater Capital Improvement Program:** In general, all stormwater capital projects, including flood control and water quality projects, will consider stormwater related natural resources protection and enhancement as project objectives when feasible.

- **Aquatic Habitat and Species Data Collection:** Opportunities to fill-in data gaps will be explored via local studies and/or as part of partnership arrangements with federal and state agencies.

*Also listed under the flood control strategy and/or the water quality strategy in Sections 3.0 and 4.0.

6.1 Integrated Stormwater Management Strategy

The stormwater management strategy for the Willow Creek basin represents the City's recommended combined approach of capital projects and development standards to address the flood control, water quality, stormwater related natural resources and maintenance problems and opportunities associated with stormwater discharges. The purpose of this section is to summarize the flood control, water quality, and stormwater related natural resource elements of the strategy as they were presented in Sections 3.0, 4.0, and 5.0 respectively. In addition, this section discusses the costs and priorities associated with implementing the strategy. The elements of the stormwater management strategy are presented below:

Flood Control Strategy

The following capital projects are proposed:

- **Capital Project WC08 – Realign/Restore Main Stem of Willow Creek:** Realign and enhance the main stem of Willow Creek between West 11th and West 18th. Preserve the adjacent floodplain and wetland areas to allow for flood storage during high flow events.
- **Capital Project WC3C3 – Willow Creek West Branch Culvert/Channel Improvements:** Retrofit four culverts on the West Branch of Willow Creek and regrade a portion of the open waterway system.
- **Capital Project WC3C4 – Willow Creek East Branch Culvert Improvements:** Retrofit four culverts on the East Branch of Willow Creek.
- **Citywide Annual Budget Line Item – Retrofit of Tip-ups:** Retrofit the existing tip-up located in this basin with a vault-like structure that provides maintenance access.

Water Quality Strategy

In order to reduce the pollutant load, the City proposes to implement an on-site water quality development standard for all new development and significant redevelopment throughout the basin. This development standard requires treatment BMPs that are designed according to the BMP Manual. The standard also requires additional BMPs for specific land use activities of concern (i.e., oil control for high traffic areas, and structural source controls for commercial/industrial activities that are exposed to stormwater). Flow control standards will be implemented for the headwater tributaries. The purpose of this standard will be to minimize downcutting and erosion in these streams.

Financial incentives will be incorporated into the stormwater user fee structure to encourage existing development not subject to the new water quality development standards to construct (retrofit) new stormwater quality BMPs.

In addition, the following capital projects are proposed:

- **Capital Project Citywide Annual Budget Line Item – Stream Bank Stabilization:** Use bioengineering techniques to stabilize the creek bank at locations where problems have been

observed or are expected to occur as a result of future development (for a list of specific problem locations in this basin, see Section 4.2.1.

- ***Citywide Annual Budget Line Item – Retrofit of Tip-ups:** Retrofit the existing tip-ups located throughout the basin with a vault-like structure that provides for settling and/or filtering of pollutants and that provides maintenance access.

* Provides flood control benefits as well and is included in the list of flood control capital projects provided above.

Natural Resources Management Strategy

The natural resources strategy is focused on the protection and enhancement of open waterways for their stormwater functions and benefits. Part of the strategy will include support for existing waterway protection standards (i.e., Waterside Protection Overlay Zone, Natural Resource Zone, Planned Unit Developments provisions, Site Review provisions as applicable). Another part of the strategy involves coordinating with other related on-going efforts (NR Study, ESA) to ensure that, ultimately, the stormwater functions and benefits of stream corridors are protected and enhanced.

In addition, the following capital projects are proposed to improve open waterways in the basin:

- **Stream Corridor Acquisitions:** Acquire the Bailey Hill-Oak Woodland corridor.
- ***Citywide Annual Budget Line Item – Streambank Stabilization:** Projects to be determined on an annual basis.

* Also provides water quality benefits and is included in the list of water quality capital projects above.

Multiple Objective Stormwater Capital Improvement Program

It should be noted that, in general, all stormwater capital projects, will consider flood control, water quality and natural resources protection and enhancement as project objectives when feasible and appropriate. All stormwater capital projects will conform to adopted code requirements for private development, including stormwater quality standards. Opportunities to fill in aquatic habitat and species data gaps will be explored via local studies and/or as part of partnership arrangements with federal and state agencies.

6.2 Summary of Strategy Benefits

When implemented, the integrated strategy is expected to provide the following benefits:

1. Provide the required level of flood protection basin-wide through capital projects.
2. Reduce existing pollutant loads through capital projects and financial incentives to retrofit existing developments.
3. Reduce pollutant loads associated with new developments through development standards.

4. Identify, protect and manage significant open waterways for their beneficial stormwater functions.

6.3 Summary of Strategy Implementation and Costs

For a description of implementation of water quality and stormwater related natural resources standards, refer to Volume I – Citywide Basin Master Plan Report.

This section describes the approach for capital project implementation in the Willow Creek basin. It also provides estimated costs and expected funding sources for each of the capital projects.

Three specific projects were selected and prioritized for implementation over a 35-year time period (2001-2035). Six generic capital project categories pertain to the Willow Creek basin and were also identified for construction city-wide, annually, over the same 35-year period. These generic capital project categories include tip-up retrofits and streambank stabilization projects at problem areas that have been identified in Willow Creek (see Section 4.2.1). In addition, 0.6 miles of stream corridors representing 11.0 acres are targeted for acquisition over a five-to-seven year period. Together these categories of capital projects constitute the City's capital programming for the Willow Creek basin. Refer to Figures 3-1 through 3-3 for a generalized location of these projects.

For a general description of the capital prioritization methodology and financing approach, refer to Volume I – Citywide Basin Master Plan Report. Table 6-1 shows the priority schedule, cost, and funding allocations for the three specific capital projects and the yearly line item projects.

A separate scheme was developed for prioritizing open waterway sites for acquisition. There is one stream corridor identified for acquisition in the Willow Creek basin: Bailey Hill Oak Woodland. Table 6-2 indicates the acquisition corridor and estimated cost. For more detailed background information see *City of Eugene Stream Corridor Acquisition Study (May 2001).*

Table 6-1
Implementation Schedule Years 2001 – 2035

Capital Project Identification	Priority	Total Estimated Cost	Estimated Funding Source and Allocation		
			SDCs	User Fees	Federal Priority Funds
WC 3C3 – Willow Creek West Branch Culvert/Channel Improv.	2001 - 2005	$82,200	$0	$82,200 [100%]	$0
WC 3C4 – Willow Creek East Branch Culvert Improvements	2011 - 2035	$69,400	$0	$69,400 [100%]	$0
WC 08 – Realign/Restore Willow Creek Mainstem	2011 - 2035	$920,200	$0	$322,070 [35%]	$598,130 [65%]
Subtotal:		**$1,071,800**	**$0**	**$473,670**	**$598,130**
Yearly Capital Program Line Items Citywide: • Streambank Stabilization • Retrofit Tip-ups • General Rehabilitation • Stream Corridor Acquisition • Services for New Development • Wetland Mitigation Bank		These costs have not been calculated on a basin specific basis. See Volume I Citywide for overall cost estimates.			

Table 6-2
Stream Corridor Acquisition Schedule Years 2001 – 2007

Priority Stream Corridor	Area Miles/Acres	Estimated Cost
Bailey Hill Oak Woodland	0.6 miles / 11.0 acres	$330,000

APPENDIX

CAPITAL PROJECT FACT SHEETS

Project Identifier	**WC01 - Citywide Annual Budget Line Item**
Project Title	**Willow Creek Streambank Stabilization**

Project Location

Open waterways throughout the Willow Creek Basin. Bank stability and headcut problems have been identified at six locations in the Willow Creek basin.

Subbasin	**NA**	
GIS U/S Node Location	**NA**	
GIS D/S Node Location	**NA**	
Drainage Area Served by Capital Project	**NA**	Acres
% Impervious (1994 Existing Land Use)	**NA**	
% Impervious (Future)	**NA**	
Design Flow (Future Conditions	**NA**	cfs

Project Description

Implement streambank stabilization projects to help streams adjust to increased runoff volumes while limiting negative impacts associated with downcutting, sedimentation, and erosion. Where appropriate, use bioengineering techniques to stabilize streambanks.

Project Elements

0 SY – Streambank Stabilization

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Downcutting, sedimentation, and erosion problems have been observed in open waterways that are receiving increased runoff volumes associated with urbanization.

Opportunities

Streambank stabilization provides the opportunity to improve or restore riparian vegetation and aquatic habitat conditions.

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Streambank Stabilization	Inspect vegetation and banks for erosion.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

N/A

Water Quality

This CP eliminates localized erosion of streambeds and streambanks.

Natural Resources

This CP can help restore native riparian vegetation and improve aquatic habitat conditions.

Other City Objectives Addressed by the Capital Project

To be completed by the City

Costs

Construction Costs:	
Site Acquisition:	$0
Engineering / Administration:	
Capital Project Implementation Costs	

There will be a $150,000 annual line item in the capital project budget to address streambank stabilization projects on a city-wide basis.

Annual Maintenance Costs	**$0**

Design Assumptions

The following bank instability and headcut problems have been identified in the Willow Creek Basin:

1) WCWE100A--75ft W x 100ft L
2) WCWE100E and WCWE110A--15ft W x 600ft L
3) WCEA050A--25ft W x 400ft L
4) WCMN010F--20ft W x 825ft L
5) Portion of stream segment between nodes 71041 and 51997--10ft W x 100ft L
6) WCMN010C--15ft W x 100ft L

The lengths of the channel segments were estimated from survey results if available, or aerial photographs (aerial photographs pages 6 and 7). The sides of the channel segments were approximated from survey cross sections if available, or visual observations.

Project Identifier	**WC04 - Citywide Annual Budget Line Item**
Project Title	**Retrofit of Tip-ups**
Project Location	

Tip-ups located throughout the Willow Creek Basin.

Subbasin	**N/A**	
GIS U/S Node Location	**N/A**	
GIS D/S Node Location	**N/A**	
Drainage Area Served by Capital Project	**N/A**	Acres
% Impervious (1994 Existing Land Use)	**N/A**	
% Impervious (Future)	**N/A**	
Design Flow (Future Conditions	**N/A**	cfs

Project Description

Retrofit the tip-ups with manholes that provide sedimentation storage and maintenance access. Re-install outlet pipe at a positive grade.

Project Elements

0 EA – Retrofit of Tip-up

Problems and/or Opportunities Addressed by the Capital Projects

Problems

Surcharging, build up of sediment and debris, and limited access for maintenance are all problems associated with the existing tip-ups.

Opportunities

This CP provides an opportunity to reduce sedimentation problems and to facilitate maintenance.

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Retrofit of Tip-up	Inspect sediment loading and debris accumulation, remove debris and sediment.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

This CP is expected to reduce capacity problems due to sediment buildup.

Water Quality

The new manhole will provide storage of sediment and debris which can be periodically removed.

Natural Resources

N/A

Other City Objectives Addressed by the Capital Project

To be Completed by the City

Costs

Construction Costs:	
Site Acquisition:	$0
Engineering / Administration:	
Capital Project Implementation Costs	

There will be a $125,000 annual line item in the capital project budget to address tip-up retrofit projects on a city-wide basis.

Annual Maintenance Costs	**$0**

Project Identifier	**WC3C3**
Project Title	**Willow Creek West Branch Culvert/Channel Improvements**
Project Location	
West branch of Willow Creek	
Subbasin	**WCWE**
GIS U/S Node Location	**71024**
GIS D/S Node Location	**71031**
Drainage Area Served by Capital Project	**513** Acres
% Impervious (1994 Existing Land Use)	**8**
% Impervious (Future)	**N/A**
Design Flow (Future Conditions	**N/A** cfs

Project Description

This CP includes the following culvert replacements: Segment WCWE120D (20 ft 2-18" and 24" CSPs replaced by 2.5' x 8' box culvert); segment WCWE120B (32 ft 42" CSP replaced by 3.5' x 6' box culvert at a positive slope); segment WCWE110C (19 ft 2-12" and 15" CSPs replaced by 4' x 6' box culvert); and segment WCWE100F (32 ft 48" CSP replaced by 5' x 8' box culvert). For pipe segments WCWE120D, WCWE110C, and WCWE100F fill is to be placed in order to raise the elevation of the driveways approximately 1'-1.5'. A portion of the open waterways upstream and downstream of culverts WCWE110C and WCWE100F will need to be regraded to reduce the slope of the culverts.

Project Elements

32 LF – 5' x 8' Concrete Box Culvert (0-5 ft. of cover)
19 LF – 4' x 6' box culvert
1 EA – WC3C3 Open Waterway Improvements
20 LF – 2.5' x 8' box culvet
32 LF – 3.5' x 6' box culvert

Problems and/or Opportunities Addressed by the Capital Projects

Problems

The hydraulic capacity of segments WCWE100C; WCWE110A, C; WCWE120B, C, D; WCWE130A, and C is expected to be deficient under existing land use conditions for a 10-year design storm, and the hydraulic capacity of segments WCWE100A; WCWE100D, E, and F is expected to be deficient for a 25-year design storm under existing land use conditions.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
5' x 8' Concrete Box Culvert (0-5 ft. of cover)	N/A
4' x 6' box culvert	N/A
WC3C3 Open Waterway Improvements	Inspect vegetation and banks for erosion.
2.5' x 8' box culvet	N/A
3.5' x 6' box culvert	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

This CP is expected to eliminate the predicted surface flooding problems for the 10-year design storm under existing and future land use conditions in segments WCWE130C, WCWE130A, WCWE120D, WCWE120C, WCWE120B, WCWE110C, and WCWE110A. Predicted surface flooding problems are expected to be eliminated for the 25-year design storm under existing land use conditions in segments WCWE100 F.

Water Quality

N/A

Natural Resources

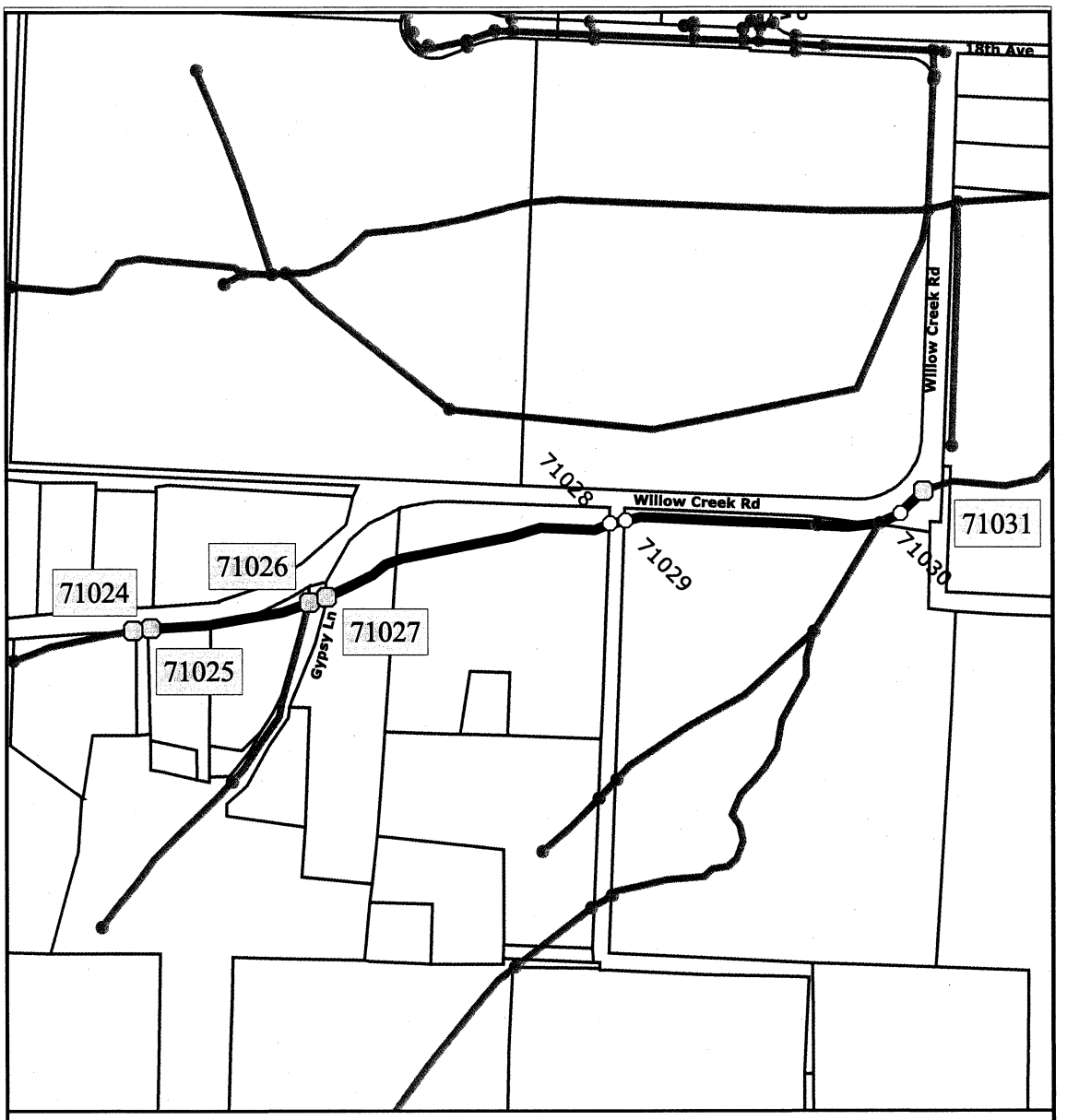
N/A

Other City Objectives Addressed by the Capital Project

To be Completed by the City

Costs

Construction Costs:	$68,500
Site Acquisition:	$0
Engineering / Administration:	$13,700
Capital Project Implementation Costs	**$82,200**
Annual Maintenance Costs	**$0**



Property Parcel Boundary
Capital Project Location
Storm Drainage System (Pipe or Open Channel)
Capital Improvement Project Element
Upstream/Downstream Node
Upstream/Downstream Subnode
Manholes or Catch Basins

200 0 200 400 Feet

N

Site Map for CIP # WC3C3

Willow Creek West Branch Culvert Improvements
Willow Creek Basin
City of Eugene
Capital Project

April 2001
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WC3C3

Design Assumptions

The capital project does not address flooding problems identified on private property (i.e. WCWE100B and C). The capital project does not address flooding problem in the open channel segments because the flooding problems do not cause any property damage.

Project Identifier	**WC3C4**
Project Title	**Willow Creek East Branch Culvert Improvements**
Project Location	
East Branch of Willow Creek	
Subbasin	**WCEA**
GIS U/S Node Location	**NA**
GIS D/S Node Location	**NA**
Drainage Area Served by Capital Project	**748** Acres
% Impervious (1994 Existing Land Use)	**9**
% Impervious (Future)	**N/A**
Design Flow (Future Conditions	**N/A** cfs

Project Description

This CP includes the following culvert replacements: Segment WCEA060F (41 ft 36" CMP replaced by 36" CSP at a steeper slope); segment WCEA050C (51 ft 30"x42" CMP replaced by 27" CSP); segment WCEA030B (164 ft 24" CSP replaced by 36" CSP); and segment WCEA060D (2-18" and a 36" CMPs replaced with a 3' x 5' box culvert).

Project Elements

41 Ft – 36" CSP (2-5 ft. cover)
164 Ft – 36" CSP (2-5 ft. cover)
51 Ft – 27" CSP (2-5 ft. cover)
23 LF – 3' x 5' box culvet

Problems and/or Opportunities Addressed by the Capital Projects

Problems

The hydraulic capacity of segments WCEA060F; WCEA060C; WCEA060D; WCEA060E; WCEA050B, C, D; WCEA030B, and A are expected to be deficient under existing land use conditions for a 10-year design storm, and the hydraulic capacity of segments WCEA050A; WCEA030C, D; WCEA10A1, and A2 are expected to be deficient for a 25-year design storm under existing land use conditions.

Opportunities

N/A

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
36" CSP (2-5 ft. cover)	N/A
36" CSP (2-5 ft. cover)	N/A
27" CSP (2-5 ft. cover)	N/A
3' x 5' box culvet	N/A

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

This CP is expected to eliminate the predicted surface flooding problem for the 10-year design storm under existing land use conditions identified in segments WCEA060F, WCEA060E, WCEA060D, WCEA050C, and WCEA030B.

Water Quality

N/A

Natural Resources

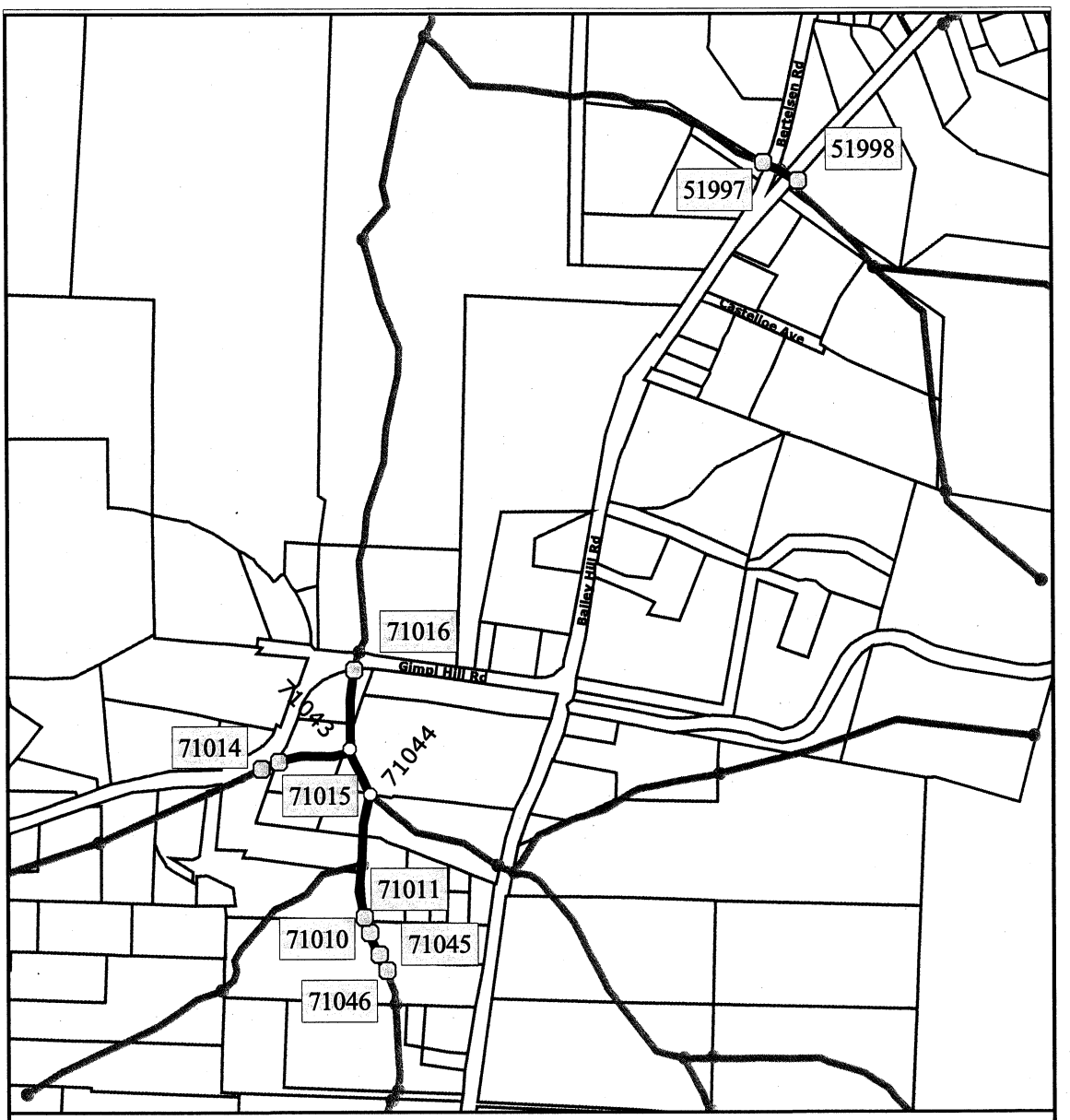
N/A

Other City Objectives Addressed by the Capital Project

To be Completed by the City

Costs

Construction Costs:	$57,900
Site Acquisition:	$0
Engineering / Administration:	$11,500
Capital Project Implementation Costs	**$69,400**
Annual Maintenance Costs	**$0**



Property Parcel Boundary

Capital Project Location

Storm Drainage System (Pipe or Open Channel)

Capital Improvement Project Element

Upstream/Downstream Node

Upstream/Downstream Subnode

Manholes or Catch Basins

200 0 200 400 Feet

N

Site Map for CIP # WC3C4

Willow Creek East Branch
Culvert Improvements
Willow Creek Basin
City of Eugene
Capital Project

April 2001
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WC3C4

Design Assumptions

the capital project does not address flooding problems in the open channel segments because the flooding problems are not expected to cause any property damage. Capital projects were not developed in areas currently owned by the Nature Conservancy or that will be acquired by the City.

The cost for a 30" CSP was used to cost out the proposed 27" CSP.

Capital Project Fact Sheet

Basin Name: Willow Basin

Project Identifier	**WC08**
Project Title	**Lower Willow Creek Restoration**
Project Location	
The main stem of Willow Creek between W. 11th Avenue and W. 18th Avenue.	
Subbasin	**WCMN**
GIS U/S Node Location	**73754**
GIS D/S Node Location	**71037**
Drainage Area Served by Capital Project	**N/A** Acres
% Impervious (1994 Existing Land Use)	**N/A**
% Impervious (Future)	**N/A**
Design Flow (Future Conditions	**N/A** cfs

Project Description

Relocate, realign and restore the main stem of Willow Creek to its historic conditions to the extent feasible. This includes the portions of the east and west branches north of W. 18th to the point where they historically converged; and then from this convergence of the two branches north to W. 11th. Construct a low flow channel for these sections of the open waterway and protect the floodplain for Willow Creek along this historical channel alignment.

Project Elements

10500 SY – Natural Resource Enhancement

1 EA – WC08 Open Waterway Improvement

Problems and/or Opportunities Addressed by the Capital Projects

Problems

There are expected existing overbank flooding problems located along the main stem of Willow Creek that could be resolved by realigning the channel and using the associated flood storage available in the existing floodplain/wetland area.

Opportunities

The restoration of the main stem of Willow Creek provides an opportunity to preserve and enhance the main stem, as well as to protect and enhance its flood control, water quality, and natural resource benefits.

Maintenance Requirements

Facility Type	*Annual Maintenance Activities*
Natural Resource Enhancement	Inspect vegetation, remove debris.
WC08 Open Waterway Improvement	Inspect vegetation and banks for erosion.

CSWMP Objectives and Policies Addressed by the Capital Project

Flood Control

The realignment of the main stem of Willow Creek will allow for the surrounding floodplain and wetland areas to be preserved as flood storage for the high flow events, while the low flow channel is designed to adequately convey the 2-year design storm under future land use conditions.

Water Quality

This capital project protects the existing water quality benefits associated with the floodplain/wetland areas adjacent to the main stem of Willow Creek.

Natural Resources

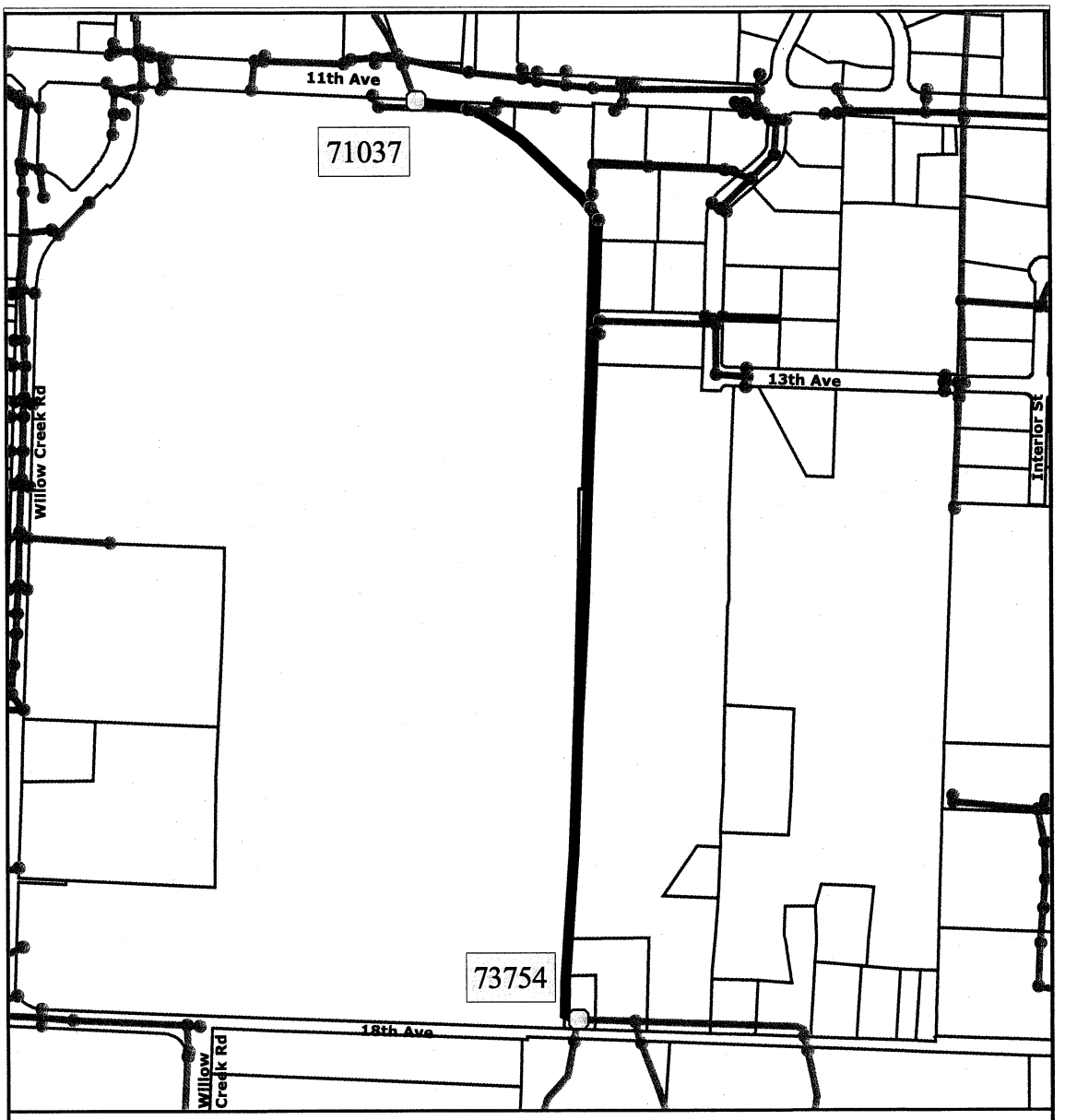
Natural resource enhancement of the 20' wide buffer areas associated with this CP will cover a total of approximately 2.2 acres. Restoration of the open waterway will improve riparian vegetation and aquatic habitat conditions.

Other City Objectives Addressed by the Capital Project

To be Completed by the City

Costs

Construction Costs:	$766,900
Site Acquisition:	$0
Engineering / Administration:	$153,300
Capital Project Implementation Costs	**$920,200**
Annual Maintenance Costs	**$1,176,000**



Property Parcel Boundary

Capital Project Location

Storm Drainage System (Pipe or Open Channel)

Capital Improvement Project Element

Upstream/Downstream Node

Upstream/Downstream Subnode

Manholes or Catch Basins

200 0 200 400 Feet

N

Site Map for CIP # WC08

Realign/Restore Main Stem of Willow Creek
Willow Creek Basin
City of Eugene
Capital Project

April 2001
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WC08

Design Assumptions

This CP is located within the property owned by the Bureau of Land Management (BLM). For each segment, the low flow channel was designed to convey the 2-year design storm under future land use conditions. The floodplain in addition to the low flow channel was designed to convey the 25-year design storm under future conditions. The floodplain is contained within the existing property boundary/existing wetland area.

The following low flow channels are designed to convey the 5-year design storm.

The west branch north of W. 18th (segments WCMN010E1 and WCMN010E2) was designed to have a 4' bottom width, 6' depth, 2:1 side slopes, and to be approximately 1200 ft. long.

The east branch north of W. 18th (segment WCMN010F2) was designed to have a 10' bottom width, 6' depth, 2:1 side slopes, and to be approximately 1300 ft. long.

The main stem channel (segment WCMN010D) was designed to have a 22' bottom width, 6' depth, 2:1 side slopes, and be approximately 2200 ft. long.

Segment WCMN010F1 was designed to have a 4' bottom width, 6' depth, 2:1 side slopes, and be approximately 700 ft. long.

The size of floodplain required to convey the 25-year design storm is approximately 190' on either side of the main channel.