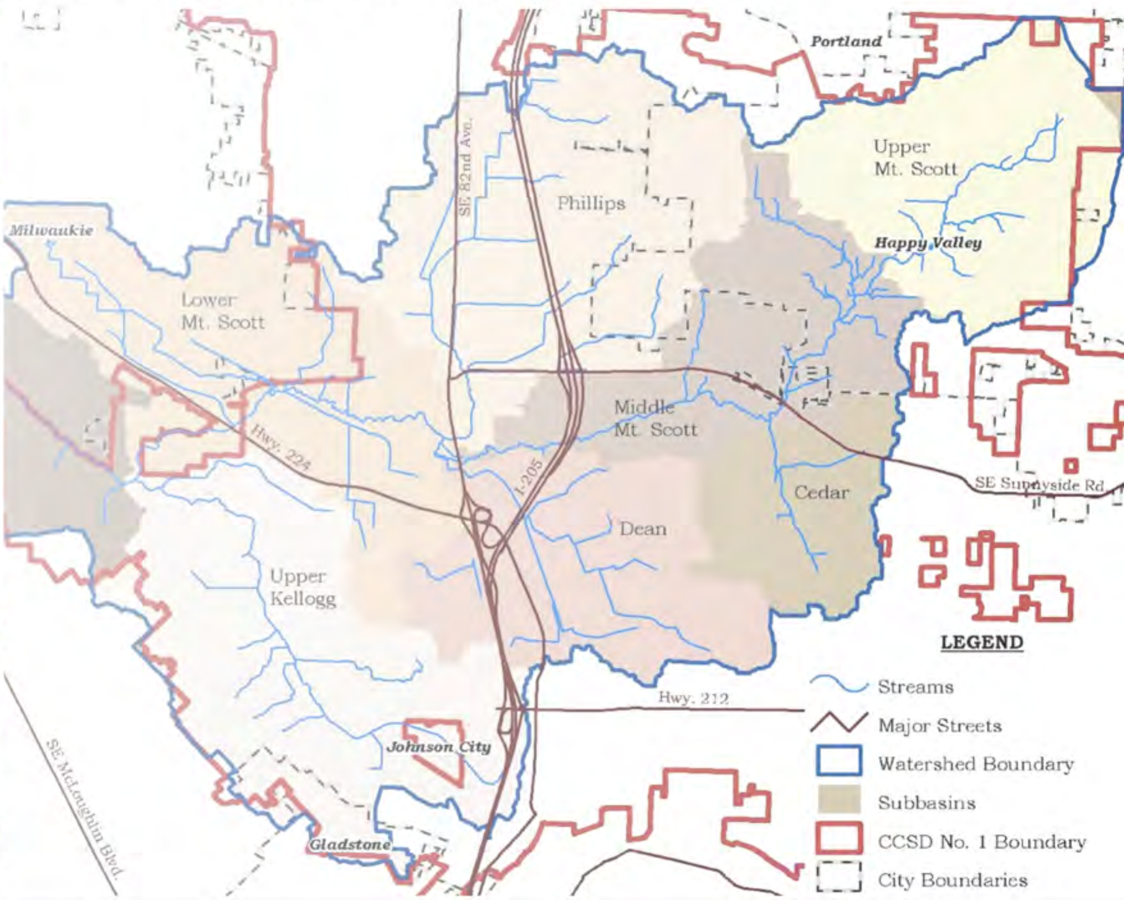
WATER ENVIRONMENT SERVICES
A Department of Clackamas County

Watershed Action Plan
Kellogg-Mt. Scott Watershed
June 2009

Prepared by Brown and Caldwell, Ellis Ecological, and Waterways Consulting





BROWN AND CALDWELL
Environmental Engineers & Consultants

WATERSHED ACTION PLAN
Kellogg-Mt. Scott Watershed

Prepared for

Water Environment Services

June 30, 2009

Brown and Caldwell Project Number 135774

BROWN AND CALDWELL

6500 SW Macadam Avenue, Suite 200
Portland, Oregon 97239

ACKNOWLEDGEMENTS

Clackamas County

Water Environment Services

Director: Mike Kuenzi

Water Environment Services Project Team Leaders: Robert Storer, Carol Murdock, Leah Johanson, Dan Henninger

Water Environment Services Staff Contributors: Amy Kyle, Mona LaPierre, Don Kemp, Kris Sayre, Susan Ottersen, Kim Lockwood, John Nagy, Andrew Swanson, Lana Rulien, Andy Robins, Mike Bickerton, Mark Miller

Consultants

Brown and Caldwell

Brown and Caldwell Project Team Leaders: Jim Harper and Jennifer Belknap Williamson

Brown and Caldwell Contributors: Steffran Neff, Mike Milne, Janice Keeley, Krista Reininga, Corianne Hart, Laura Porter, Nate Whirty, Anthony Dubin

Ellis Ecological Services

Robert Ellis and Laurel Brown

Waterways Consulting/Swanson Hydrology + Geomorphology

John Dvorsky

JLA Public Involvement

Vaughn Brown

Stakeholder Group

The following individuals were invited to participate in the 2008-2009 Stakeholder Meetings for the Kellogg-Mt. Scott and Rock Creek Watershed Action Plans: Steve Gaschler, City of Damascus; Ron Partch, City of Gladstone; Michael Walter, City of Happy Valley; Orvin Roody, City of Johnson City; JoAnne Herrigel and Nicole West, City of Milwaukie; Brett Arvidson, Oak Lodge Sanitary District; Steve Berliner, Doug Bollam, Rick Gruen, Dick Jones, Dan McFarlane, Ernie Platt, Chris Runyard, Pat Russell, and Dick Shook, Clackamas County Soil and Water Conservation District; Ugo Dilullo, Clackamas County Department of Transportation and Development; Mary Anderson, Clackamas County Development Agency; Jennifer Hughes, Clackamas County Land Use and Planning; Tonia Burns, Clackamas County Parks; Cheryl McGinnis, Clackamas River Basin Council; Manette Simpson, Oregon Department of Environmental Quality; Todd Alsbury, Oregon Department of Fish and Wildlife; Kim Anderson, Sunrise Water Authority

TABLE OF CONTENTS

LIST OF FIGURES

*follows page number listed

LIST OF TABLES

*follows page number listed

LIST OF PHOTOGRAPHS

LIST OF ACRONYMS

ACWA	Oregon Association of Clean Water Agencies
B-IBI	Benthic Index of Biological Integrity
BMPs	Best Management Practices
BOD	biochemical oxygen demand
C	celsius
CCSD No. 1	Clackamas County Service District No. 1
cfs	cubic feet per second
CIP	Capital Improvement Program
CMMS	Computerized Maintenance Management System
CWA	Clean Water Act
D	District wide
dbh	diameter at breast height
DEQ	Oregon Department of Environmental Quality
DFIRM	Digital Flood Insurance Rate Map
DO	dissolved oxygen
DTD	Clackamas County Department of Transportation and Development
E. coli	*Escherichia coli*
ERCO	erosion prevention and sediment control
ESA	Endangered Species Act
ESU	Equivalent Service Unit
F	Fahrenheit
F-IBI	Fish Index of Biological Integrity
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FTE	full-time equivalent
GIS	Geographic Information System
HBI	Hilsenhoff Biotic Index
HEC	Hydrologic Engineering Center
HMS	Hydrologic Modeling System
I-205	Interstate 205
IER	Interim Evaluation Report
IGA	inter-governmental agreement
IVR	Internal Voice Recognition
JCWC	Johnson Creek Watershed Council
KMS	Kellogg-Mt. Scott
LA	load allocation

LID	low impact development
LOS	Level of Service
LWD	large woody debris
MEP	maximum extent practicable
mg/L	millgrams per liter
MS4	Municipal Separate Storm Sewer System
MWH	Montgomery Watson Harza
NCPRD	North Clackamas Parks and Recreation District
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources and Conservation Service
NWI	National Wetlands Inventory
ODFW	Oregon Department of Fish and Wildlife
ODOT	Oregon Department of Transportation
OWEB	Oregon Watershed Enhancement Board
OWQI	Oregon Water Quality Index
PM	preventive maintenance
PSU	Portland State University
PWR	Pacific Water Resources
R&R	refurbishment and replacement
RC	Rock Creek
SDCs	system development charges
SFR	single family residential
SWM	Surface Water Management
SWMACC	Surface Water Management Agency of Clackamas County
SWMP	Stormwater Management Plan
SWMPMP	Surface Water Management Program Master Plan
TMDL	total maximum daily load
TP	total phosphorus
TSA	Technical Services Assistant
TSS	Total Suspended Solids
UGB	urban growth boundary
UIC	underground injection control
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WAP	Watershed Action Plan
WES	Water Environment Services
WLA	waste load allocation
WPCF	Water Pollution Control Facility

KELLOGG-MT. SCOTT WATERSHED ACTION PLAN

Introduction

Water Environment Services (WES), a department of Clackamas County, conducts and manages surface water and wastewater management services in several districts including Clackamas County Service District No. 1 (CCSD No. 1, also known as the District). WES' surface water management program reviews development plans, maintains stormwater facility infrastructure, and conducts activities to protect and enhance the health and function of the watershed, including water quality, aquatic habitat, and hydrologic functions.

WES is completing the Rock Creek (RC) and Kellogg Mount Scott (KMS) Watershed Action Plans (Action Plans) in order to prioritize surface water management program activities and future investments for watershed management. The approach to the Action Plan process is illustrated in Figure ES-1. The key elements of the Action Plan include the following:

- **Characterization Report**. The Characterization Report includes an inventory of watershed conditions, an identification of key factors that limit watershed health, and a summary of WES activities that affect watershed health based on existing information. The Characterization Report is contained in Chapters 1 through 4 of the Action Plan.
- **Assessment Report**. The Assessment Report includes an assessment of watershed conditions based on the characterization report results and identifies specific WES surface water programs, projects, and activities that are appropriate to improve watershed health efficiently and effectively. The Assessment Report is contained in Chapter 5 of the Action Plan.
- **Action Plan Summary**. The Action Plan Summary includes an evaluation and prioritization of the programs, projects, and activities described in the Assessment Report using scientifically-based criteria and an asset management Level of Service (LOS)-based evaluation process. The Action Plan Summary provides a process for sequencing the actions for implementation. It is contained in Chapter 6 of the Action Plan.
- **Implementation and Adaptive Management**. WES will implement the Action Plan components over time, and monitor and adapt their components as needed to continually improve watershed health.

Figure ES-1. Watershed Action Planning Process

Chapter 1 includes an overview of the KMS watershed, an overview of the approach used to evaluate and characterize the watershed, and a summary of WES policies and practices that affect watershed health. Chapters 2 through 4 summarize information related to hydrology, water quality, and aquatic habitat and biological communities, and include discussions of the data reviewed for the characterization, data gaps identified, and watershed conditions and limiting factors. Chapter 5 contains a synthesis of the data evaluated in Chapters 1 through 4, including a reach-by-reach analysis of the stream and contributing area conditions. Chapter 6 contains the recommended actions developed based on the Chapter 5 assessment to assist WES in achieving its LOS goals.

Watershed Action Plan Goals and Objectives

WES' over-arching surface water management program goals are to improve and protect water quality and reduce the impacts of urbanization on hydrology. The objective of the Watershed Action Plans is to develop basin-specific plans to prioritize District activities and future investments for watershed management.

WES is incorporating the principles of an asset management program into the Surface Water Management program. As a part of this process, WES developed Levels of Service in 2009 to guide its program management and activities. The Level of Service (LOS) goals for the surface water management program elements are shown below. Further information on the LOS goals and performance measures for the goals is described in Appendix D.

- Environmental Permit Program Management
  - Meet Permit Requirements
  - Reduce Pollutant Loads through Structural Best Management Practices (BMPs)
  - Reduce Pollutant Loads through Non-Structural BMPs
- Environmental Policy and Watershed Health
  - Support Functioning Aquatic Ecosystems
  - Improve Water Quality
  - Improve Aquatic Habitat and Biology
  - Improve Hydrology and Geomorpology
- Erosion Prevention and Sediment Control
  - Conduct Inspections Based on Priority
  - Reduce Water Quality Impacts of Construction
- Program Management
  - Engage in Effective Partnering
  - Ensure Staff Understand Roles; Skills and Resources Meet Needs
  - Collect Monitoring Data Used for Decision-Making
  - Program Evaluation and Effectiveness
- Development Plan Review and Permitting
  - Ensure Development Needs Are Met and Ecosystem Services Protected
- Asset Management
  - Maximize Cost/Benefit of Service
  - Fully Implement the Asset Management Program
  - Ensure the Storm System is Reliable
- Customer Service
  - Implement Sustainability Action Plan
  - Conduct Effective Public Outreach Program
  - Maintain Employee Health and Safety

- Business Management
  - Maximize Use of Alternative Funding Sources
  - Full Capital Improvement Program Implementation
  - Ensure Rate Adequacy
  - Budget Management Effectiveness
  - Maintain Appropriate Policies for WAPs
- Stormwater Maintenance
  - Regularly Scheduled Maintenance Addressed
  - Scheduled versus Non-Scheduled Maintenance Balanced
  - Request-Driven Maintenance Addressed

One of WES' main goals and outcomes of the Action Plan is to be able to prioritize what stormwater management actions and activities should be conducted in specific sub-basin areas, such as where to assist the operations and maintenance staff in targeting specific activities in various locations. Watershed Action Plans will be utilized to provide priorities and benefits including the following:

- Raise awareness of issues and constraints
- Identify key problems and opportunities
- Identify areas in which efforts should be focused both in terms of protection and restoration efforts and asset management activities
- Implement policies, programs, and standards in specific areas
- Build support for stewardship and implementation and serve as a tool for funding

WES Policies and Practices

WES is a department within Clackamas County that conducts and manages wastewater and stormwater management services in several districts including CCSD No. 1, the Surface Water Management Agency of Clackamas County (SWMACC), and the Tri-City Service District. CCSD No. 1 includes an agreement with and encompasses portions of Happy Valley.

WES has retooled its surface water management program and is transitioning from a utility-based, regulatory-driven program to an approach focused on watershed health and integrated watershed management. WES' vision is to improve watershed health by managing its surface water program efficiently and effectively, using financial resources to provide the most benefit through prioritized activities and investments.

Functional program elements within WES that relate to surface water management as shown in the current organizational chart are summarized below. It is important to note that as WES implements its vision to improve watershed health by managing its surface water program efficiently and effectively; changes may be made to the current organizational structure.

- Asset management
  - Development plan review and permitting
  - Erosion prevention and sediment control
- Water quality services
  - Stormwater system maintenance
  - Program management

- Environmental monitoring
  - Environmental permit program management
  - Laboratory operation
- Administration
  - Environmental policy and watershed health
  - Public information and outreach
- Business services
  - Customer service
- Financial services
  - Utility billing
  - Asset management reporting

Chapter 1 includes a summary of existing policies and practices implemented by WES that affect watershed conditions and identifies opportunities for potential improvements that will help WES to improve and protect watershed health more efficiently and effectively. These opportunities for potential improvements were evaluated further during the assessment phase of the project (Chapter 5) with WES staff input. Additional details on the existing policies and practices implemented by WES are provided in Appendix A, including work flows for several program elements.

Watershed Characterization and Assessment Process

The watershed characterization was used to develop the watershed assessment and the Action Plan. As illustrated in Figure ES-2, the watershed characterization and assessment process evaluates watershed health stressors, responses, and key indicators.

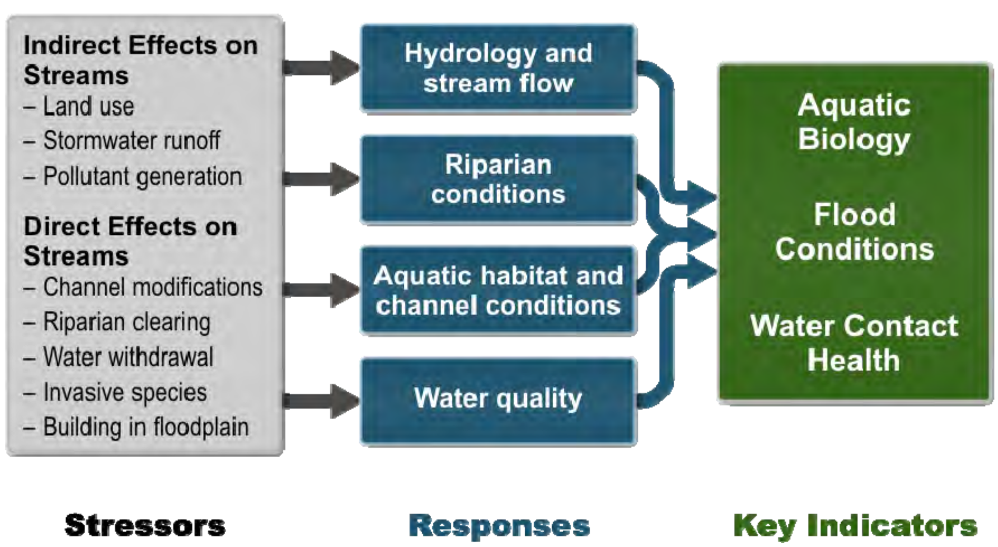


Figure ES-2. Watershed Characterization and Assessment Process (Modified from Booth et al., 2005 and Karr and Yoder, 2004)

The watershed characterization and watershed assessment will help WES to do the following:

- Identify features and processes important to hydrology, biological, habitat, and water quality resources
- Determine how natural processes influence those resources
- Understand if/how human activities and WES stormwater management practices are affecting resources and limiting watershed health conditions
- Evaluate the cumulative effects of land management and stormwater management practices over time

Chapters 2 through 5 contain the analysis of key indicators, responses, and stressors in the watershed. Watersheds respond differently to stressors in the environment depending on the extent of modification to the watershed (such as how much riparian clearing has occurred and how stormwater runoff is collected, treated, and conveyed) as well as the interaction between stressors (such as the combination of effects from water withdrawals and riparian clearing on water temperatures). Conditions such as soils, slopes, vegetation, and stream morphology also play an important role in how watersheds respond to stressors. Evaluating key indicators of watershed health helps to determine how a watershed is responding to the unique combination of stressors in the environment. The results of the watershed characterization will be used in the assessment to identify what management strategies and priority activities and actions are likely to improve functions and conditions.

In Chapters 2 through 5, key indicators are evaluated using available data that provide insight into how a combination of stressors and responses are affecting watershed health. Examples of key indicators evaluated include benthic macroinvertebrate and fish populations, flood conditions and channel erosion, and concentrations of water pollutants that could affect human health. Stressors such as land use, stormwater runoff, channel modifications, aquatic habitat conditions, and riparian clearing are evaluated and compared to available data on specific watershed responses as well as to key indicators in order to understand limiting factors for watershed health. Because several studies have been conducted that document watershed conditions extensively, in particular the 2006 Master Plan, Chapters 2 through 5 do not attempt to describe the watershed exhaustively. Instead, key aspects of available data are summarized and evaluated in the context of the goals for the Action Plans.

Chapters 2 through 4 summarize data on hydrology, water quality, and aquatic habitat and biological communities. These elements of watershed health often contain interrelated problems and integrated opportunities for improvement. Work in the watershed assessment phase of the project was completed to evaluate interrelated issues and to identify priority actions and management activities appropriate for WES to undertake to address factors that are limiting watershed health.

The watershed characterization and assessment were conducted with a focus on addressing the following questions that are of interest to WES.

Hydrology

- How can hydrologic goals or flow control objectives be achieved through design standards and retrofitting to improve watershed health?
- Where does regional detention and infiltration make the most hydrological and soil feasibility sense and where is land available to implement these projects?
- What specific stormwater infrastructure structures or areas require retrofits, what are state-of-the-art techniques that can be utilized, and what are the priorities?
- Where is flooding potentially a problem now or in the future?

Water Quality

- What are the most limiting water quality problems, what are the most important potential sources, and what are potential best management practices (BMPs) and solutions for these problems?
- What specific stormwater infrastructure structures or areas require retrofits, what are state-of-the-art techniques that can be utilized, and what are the priorities?
- Where and what parameters should WES monitor in the future to document watershed health and overall effectiveness of programs, policies, and actions and to address regulatory permits?

Aquatic Habitat and Biological Communities

- Where are the most sensitive and valuable habitats and functions to protect?
- Where are the highest priority and most degraded stream channel reaches to restore?
- What are the highest priority fish barriers to remove or retrofit?
- Where are the highest priority stream reaches for establishing native vegetation and canopy?

WES Policies and Programs

- How can ecosystem services be protected and enhanced through WES activities and policies?
- What traditional or innovative maintenance practices are most important and where should the focus be?
- Which management policies/programs/activities should be utilized to enhance, protect, restore or address the issues identified?
- What are the high priority areas for maintenance/retrofit/Capital Improvement Program (CIP) activities, what is the methodology, and what are the criteria for prioritizing these activities?
- What is the current maintenance process, what are the criteria for prioritizing maintenance activities, and who has the responsibility for implementing maintenance of the surface water drainage system?
- What are the recommended prioritized maintenance activities?
- What are the recommended actions for interdepartmental maintenance coordination including recommendations for coordination with the Clackamas County Department of Transportation and Development (DTD)?
- What are the recommended actions for the development review process, changes to development standards and development rules and regulations including low impact development?
- What is the recommended methodology and criteria for prioritizing erosion prevention and sediment control and establishing performance metrics?
- What are the gaps in customer service, including opportunities to enhance the Service Request database as a proactive tool for management activities and future CIP identification?
- What information is needed to inform decisions and track performance metrics in the future?

Following is a summary of the watershed characterization and assessment results.

Watershed Overview

The KMS watershed, illustrated in Figure ES-3, encompasses approximately 10,300 acres and is the largest watershed within CCSD No. 1. It includes the following eight major sub-basins: Lower and Upper Kellogg; Lower, Middle, and Upper Mt. Scott; Phillips; Dean; and Cedar Creeks. Minthorne Creek, which is almost entirely within the City of Milwaukie, is part of the Lower Mt. Scott sub-basin.

The KMS watershed is a highly developed urban watershed that is approximately 34 percent impervious. General concerns and challenges within the watershed include but are not limited to impervious area, fish passage, flooding, poor streamside practices, lack of riparian vegetation, in-stream erosion and down cutting, and water quality concerns.

Eighty percent of the watershed is within CCSD No. 1. CCSD No. 1 includes portions of Happy Valley, and 20 percent of the watershed is within Happy Valley. The lower portion of the watershed is in Milwaukie, which encompasses about 12 percent of the watershed. Small portions of the watershed are also in Gladstone, Johnson City, and unincorporated areas outside of CCSD No. 1. Kellogg Creek joins the Willamette River 18 miles upstream from the mouth of the Willamette's confluence with the Columbia River. Kellogg Creek is a third order stream. Mt. Scott Creek joins Kellogg Creek east of North Clackamas Central Park and provides approximately 90 percent of the flow in the stream (Montgomery Watson Harza [MWH], 2001). Phillips, Dean, and Minthorne Creeks are tributaries to Mt. Scott Creek

The streams in the KMS watershed have been altered significantly and impacted by agriculture and urbanization since the early 1900s (MWH 2001). The land use in the watershed from Interstate 205 (I-205) west includes commercial and industrial areas, along with large areas of older residential construction. Land use east of I-205 is primarily newer residential development.

Adult salmon, steelhead, and cutthroat trout have been documented in Kellogg and Mt. Scott Creeks (Oregon Department of Fish and Wildlife [ODFW], 2008). A dam constructed under the Highway 99 Bridge at the confluence of Kellogg Creek with the Willamette River has created a potential impediment for upstream migrating salmonids (MWH, 2001). There is a fish passage ladder at the dam that has been determined to be a partial (temporal) fish passage barrier by ODFW. The presence of adult salmon and steelhead above the ladder is evidence that it is passable at some times of the year (MWH, 2001). Kellogg Lake, a shallow warm lake approximately 12 acres in size, is formed by the dam and extends approximately 0.75 mile up on Kellogg Creek.

Photos ES-1 through ES-12 of the KMS watershed follow.

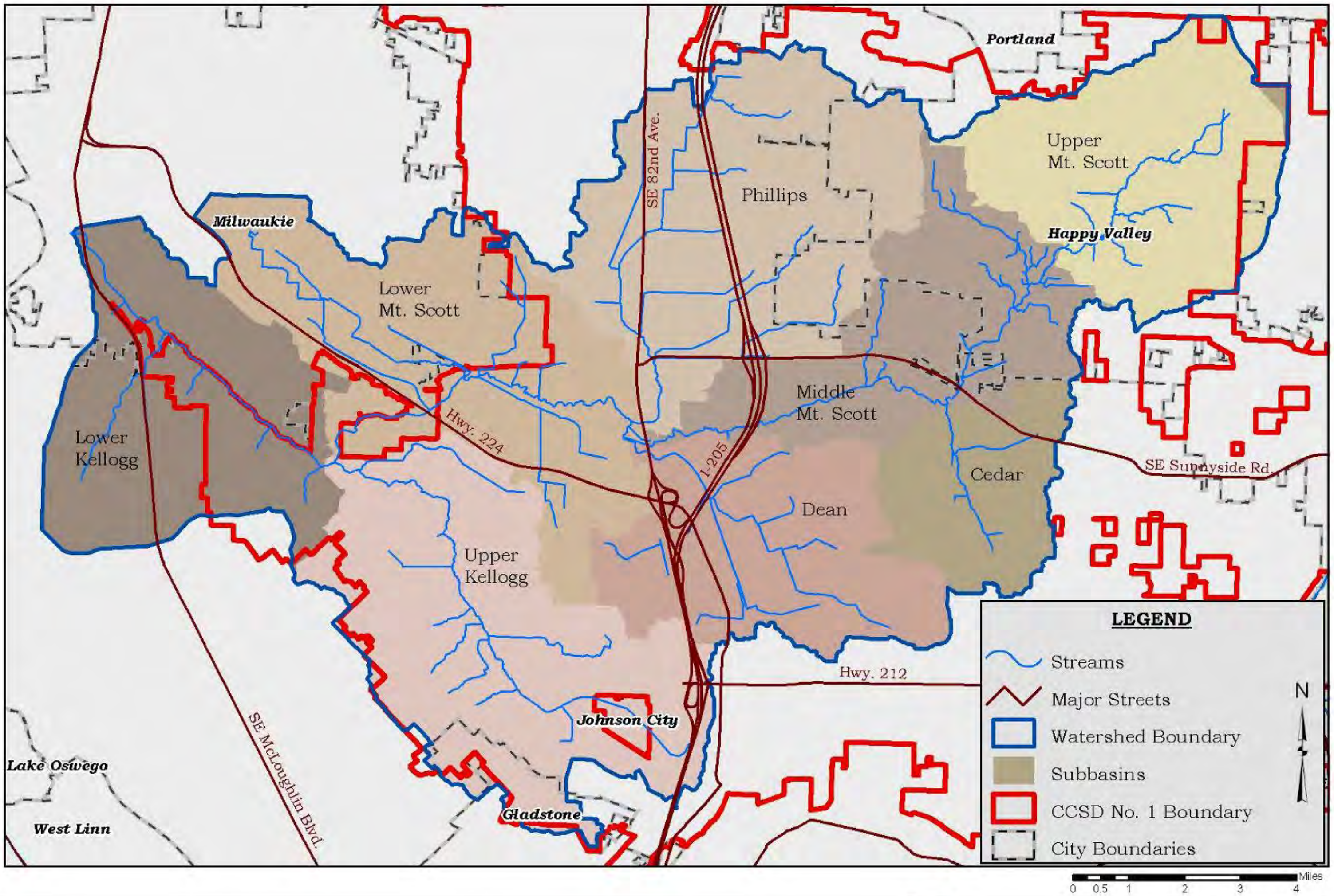


Figure ES-3
Kellogg-Mt. Scott Watershed
WES WATERSHED ACTION PLAN

Water Environment Services
Beyond clean water. www.clackamas.us/wes
Swanson Hydrology + Geomorphology
Ellis Ecological Services, Inc.

Photo ES-1. Kellogg Lake

Photo ES-2. Kellogg Dam Fish Ladder and Highway 99 Bridge

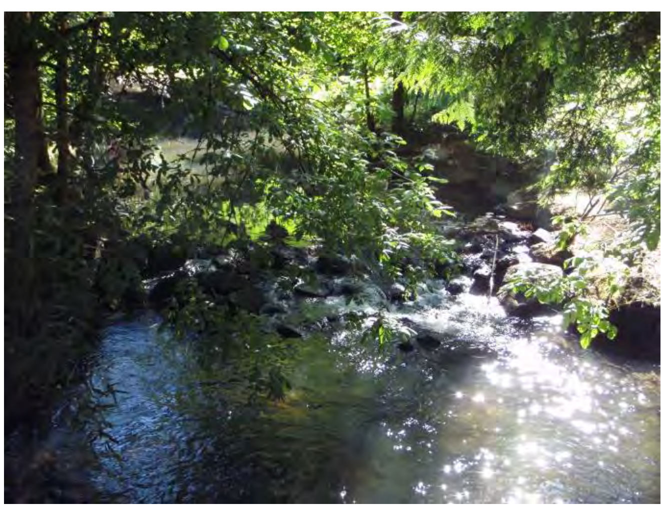


Photo ES-3. Kellogg Creek at Keuhn Road

Photo ES-4. Kellogg Creek at Parmenter Road

Photo ES-5. Kellogg Creek at Aldercrest Road

Photo ES-6. Kellogg Creek at Clackamas Road

Photo ES-7. Leona Lake at Upper Kellogg Creek

Photo ES-8. Mt. Scott Creek in Three Creeks Natural Area

Photo ES-9. Pond downstream of flood control facility on Mt. Scott Creek in Three Creeks Natural Area

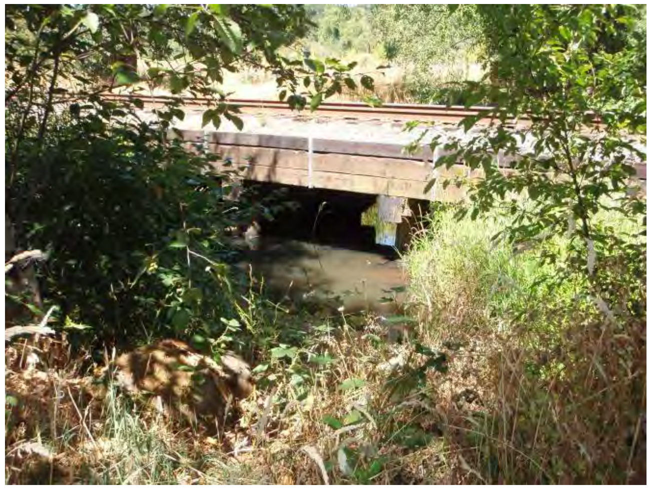


Photo ES-10. Railroad bridge over Dean Creek in Three Creeks Natural Area

Photo ES-11. Mt. Scott Creek near 97th Avenue

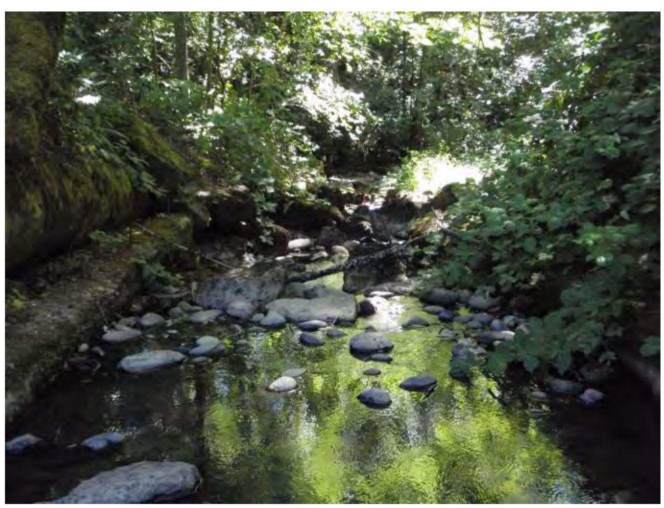


Photo ES-12. Mt. Scott Creek at Spring Mountain Dam Removal Site

Watershed Analysis

The KMS watershed is a highly developed urban watershed. The 2007 Metro aerial photography analysis indicates that 39 percent of the watershed is covered by impervious features such as roofs, roads, and parking areas; 31 percent of the watershed contains tree canopy; and 29 percent of the watershed contains grass, shrubs, and other low-structure vegetation. Aerial photographs and key stream reach features are shown for the major sub-basins within the KMS watershed in Chapter 5.

The land use in the watershed includes 56 percent single-family residential, 10 percent commercial, nine percent industrial, six percent multi-family residential, and one percent farmland. Approximately 17 percent of the watershed is classified as tract land or is undefined in the County Tax Assessor data. Tract land includes institutional land uses such as schools and parks as well as undeveloped parcels. The extent of development in the tract and undefined land uses in the watershed is unknown at this time. As much as 10 percent of the watershed may still be available for further development based on the buildable lands assessment conducted by WES. Approximately 23 percent of the watershed is treated with structural Best Management Practices (BMPs) such as stormwater detention ponds and biofiltration swales.

Based on the results of the Characterization Report, key stressors in the watershed include:

- Loss of infiltration of rainwater and efficient delivery of runoff to streams due to impervious surfaces and the piped storm drainage system
- Loss of tree canopy in riparian corridors and uplands
- Untreated runoff from impervious surfaces
- Floodplain development
- Land management practices

In addition to these key stressors identified in the Characterization Report, there may be other key stressors affecting watershed health that are not fully understood due to data gaps. Examples of other potential stressors include man-made lakes (e.g., Kellogg Lake and Leona Lake), water withdrawals, and channel modifications. Further data collection and analysis of these potential stressors would be valuable.

Key responses to these stressors in the watershed include:

- Increased flow volume and duration during storm events
- Channel instability including bank erosion and channel widening
- Flooding affecting infrastructure
- Lower flow during summer
- Streams exceeding water quality standards for temperature and bacteria as well as other pollutants
- Reduction in populations of sensitive aquatic species
- Increase in populations of aquatic species tolerant of poor water quality conditions and habitat
- Reduction in quality of aquatic habitat through fine sediment accumulation and loss of instream structure such as deep pool habitat and large woody debris

Watershed-wide and reach-specific opportunities to address these stressors and responses are summarized below and described further in Chapter 5. The opportunities were used to develop the Action Plan in Chapter 6.

Hydrology Issues and Opportunities

The hydrology of the KMS watershed has been altered significantly from pre-development conditions due to land use changes, loss of native vegetation, the development of the piped stormwater drainage network, and the lack of hydrologic controls on older development. Prior to 1993, the treatment of stormwater in new developments with structural stormwater BMPs was not required by design standards, and these developments generally lack hydrologic controls. From 1993 through 2002, WES required new development to detain runoff from a 25-year storm event and release it at a rate equivalent to the runoff from a 5-year storm event under pre-developed conditions. From 2002 to the present, WES has required new development and significant re-development to detain runoff from a 2-year storm event and release it at a rate equivalent to the runoff from one-half of a 2-year storm event.

The effects of hydrologic changes on stream channels are known as "hydromodification." In the KMS watershed, hydromodification has likely had a significant impact on water quality, stream habitat, and channel conditions during the last 100 years. Hydromodification impacts may be reduced in the future as the stream system reaches a new equilibrium under relatively stable land use conditions.

Based on the characterization phase results described in Chapter 2, many of the mainstem portions of the KMS watershed stream system appear to be stabilizing and reaching a new equilibrium as development activity in the watershed decreases. However, relatively little is known about the conditions of the upper tributaries to the stream system and these areas may be prone to instability if future development does not adequately protect drainage areas and mitigate runoff.

The apparent stability in the mainstem of the KMS watershed system is likely due to relatively consistent flows in the stream channels in recent years, reduced sediment loads, grade control throughout the lower reaches, and channel conditions in the middle and upper reaches. Although overall stream flow volume has increased significantly during storm events due to development, the watershed is reaching a point where year-to-year flows will be somewhat consistent with rainfall patterns due to less new development and land clearing. Based on field observations of stream conditions by a project team biologist, the slowing of development activity along with the WES Erosion Prevention and Sediment Control program appears to have reduced the annual sediment load, reducing scour and fine sediment buildup. The lower KMS watershed also has many culvert crossings and armored banks along the channel, which provide grade control throughout the reaches and limit how much the channel can meander or down cut. The middle and upper reaches of the Mt. Scott Creek system consist of a steep channel system with relatively intact riparian buffers, a coarse substrate with large cobbles and good roughness along the channel. The mainstem channel along these reaches appears to be stable and efforts should be concentrated on maintaining these conditions.

Specific areas of potential risk or concern to hydrology include reaches where 5 percent or more of the banks are eroding and reaches with overall risk to channel stability based on low gradient conditions, high entrenchment ratios, and stream beds with less than 30 percent coarse substrate. Reaches where 5 percent or more of the banks are currently eroding based on the Oregon Department of Fish and Wildlife (ODFW) habitat analysis are Lower Mt. Scott Creek and the portion of Upper Kellogg Creek upstream of the confluence with Mt. Scott Creek. Reaches with risk to overall channel stability include the mainstem of Mt. Scott Creek from the Three Creeks Natural Area up through the Interstate 205 (I-205) and Sunnyside corridors (see Figure 5-7).

The most at risk areas for erosion were mapped based on slopes steeper than 30 percent underlain by highly erodible soils. Erodible soils are identified in soil maps by the Natural Resources and Conservation Service (NRCS) and U.S. Department of Agriculture (USDA). Erodible soils are measured by the k-factor, which represents the susceptibility of soil to erosion and the rate of runoff according to NRCS-USDA standards. The high risk areas for soil erosion appear to be the immediate area adjacent to stream channels, specifically Lower Kellogg Creek, the terrace bluffs, and the buttes associated with the Boring Lavas. Additional development is expected around Mt. Scott, which presents a relatively high risk of mass failure.

There are incidents of flooding in the KMS watershed that affect infrastructure, which includes roads, residences, and businesses, as well as surrounding property. The floodplain of the KMS watershed stream system is developed in some areas, which places structures in those areas at a high risk for flooding. WES addresses flooding directly related to WES infrastructure such as stormwater detention ponds and provides emergency-driven maintenance of the storm sewer system. The Clackamas County Department of Transportation and Development (DTD) addresses road flooding and is responsible for land use planning decisions such as whether to permit development in the floodplain. If development is allowed, DTD also sets mitigation requirements for the developed land.

Summary of Recommended Actions

Returning the KMS watershed stream system to a significantly more natural hydrologic flow regime is likely not feasible due to the extent of development in the watershed. However, as the stream system stabilizes under the new equilibrium land use and hydrology conditions, it has the opportunity to serve as functioning aquatic habitat if managed appropriately.

Appropriate WES management activities to reduce hydromodification impacts are recommended to focus on establishing and maintaining a hydrologic equilibrium throughout the watershed, proactively addressing risk factors, and filling data gaps. The following potential actions will support this management strategy:

- Update stormwater design standards to promote low impact development (LID) techniques for new development and re-development areas; implement hydrologic control of runoff from small and large storm events for new development, as well as re-development when feasible.
- Ensure that the replacement of structures (e.g., road culverts and bridges) at upstream locations does not change the high flow conditions downstream (or appropriately mitigate for such impacts) and address the potential for channel migration during structure replacement.
- Maintain, and where possible, improve, the riparian buffer conditions around stream channels.
- Maintain, and where possible, increase, the upland tree canopy in the watershed.
- Evaluate and prioritize opportunities to retrofit older detention ponds to provide flow control and water quality treatment for smaller storm events.
- Track stream channel conditions and bank stability in at-risk areas for erosion and instability in the mainstem and upper tributaries; compare periodically to lower risk areas.
- Implement strong Erosion Prevention and Sediment Control practices in areas at high risk for erosion based on steep slopes and erodible soils, including conducting frequent high priority site inspections and periodically reviewing site inspection data to continually improve process.
- Continue to track flooding complaints and issues related to WES infrastructure. Evaluate opportunities to assist DTD in addressing other flooding issues as appropriate in support of overall watershed health.
- Where feasible, provide additional off-channel flood storage and enhanced wetlands with connections to streams.
- Where feasible, improve in-stream habitat using designs appropriate for the current flow regime.
- Investigate use of water rights and active water withdrawals in areas where low summer flow is a concern, such as in Upper Kellogg Creek.

Water Quality Issues and Opportunities

Water quality in the KMS watershed has been significantly degraded from pre-development conditions in some areas due to land use changes, hydromodification, and untreated runoff from impervious surfaces. Key water quality parameters evaluated in this assessment include benthic macroinvertebrate abundance and diversity, BMP treatment areas, water temperature, dissolved metals, nutrients, suspended solids, *E. coli*, future land development and forested cover in the contributing area.

Key water quality issues in the KMS watershed include the following:

- Stream temperatures exceed water quality criteria for summer conditions.

Riparian canopies and forests have been altered and removed in portions of the watershed, leaving the streams open to increased heat gain from solar radiation. Installation of impervious surfaces has likely reduced infiltration and aquifer recharge, resulting in less groundwater discharge to streams during the summer. Less groundwater discharge can increase stream temperatures because groundwater tends to be cooler than surface runoff during the summer, and less total flow in the stream allows solar radiation to affect a greater proportion of the water column. Enhanced stream shading through riparian buffer plantings is expected to improve water temperature conditions over time. Implementation of LID practices in areas of new development and re-development may also provide incremental improvements in groundwater discharge to the streams.

- Benthic macroinvertebrate and fish population surveys indicate that the streams in the watershed primarily support moderately to severely impaired biological communities.

The benthic macroinvertebrate communities surveyed in 2007 are largely comprised of organisms that are able to tolerate elevated sediment loads, increased water temperatures, periods of sustained high or low flows, and other characteristics of urbanized streams. According to the Watershed Health Index assessment of benthic macroinvertebrate communities as a biological index, the KMS watershed stream system at the sites where benthic macroinvertebrate data have been collected is far below its biological potential even considering the level of development in the watershed.

The causes for the poor biological index results in the KMS watershed are not fully known at this time, although potential contributing factors include hydrologic regime disturbances, erosion and sedimentation in streams, and increased water temperatures. Water quality pollutants such as pesticides, dissolved metals, and other toxic materials could also be contributing to the reduced biological quality in the streams. Additional surveys of stream conditions and targeted water quality monitoring efforts may provide further insight into the contributing factors and help guide WES management activities intended to improve the biological index results.

- Elevated levels of *E. coli* bacteria, a key indicator of water contact human health issues, were found throughout the watershed.

A Total Maximum Daily Load (TMDL) has been established for *E. coli* in Kellogg, Phillips, and Mt. Scott Creeks. The TMDL requires a 78-percent reduction in in-stream *E. coli* concentrations. *E. coli* is an indicator of fecal matter, which can contain a wide range of pathogenic organisms. There are many potential sources of *E. coli* in streams including from wildlife, pets, livestock, and humans. The sources of *E. coli* in the KMS watershed are not well understood at this time. Increased understanding of sources would be helpful to guide management activities to address this issue.

- Changing National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit requirements and Underground Injection Control (UIC) management may require additional water quality monitoring and retrofits to the existing storm system to improve water quality.

The NPDES MS4 permit is being modified by the Oregon Department of Environmental Quality (DEQ). The new requirements of the permit are not fully known at this time; however there may be required changes to WES' monitoring program or other activities.

WES and DTD jointly applied for an area-wide Water Pollution Control Facility (WPCF) permit from DEQ for stormwater UIC devices (e.g., drywells) on December 19, 2001. As of 2009, this WPCF permit had not been issued; however there may be required changes to WES' monitoring program or other activities in the future to address UIC management.

Summary of Recommended Actions

A continued active management strategy to improve water quality in the KMS watershed is recommended for watershed health and to comply with NPDES MS4, TMDL, and UIC requirements. Many of the potential actions described above for addressing hydrologic issues also serve to address water quality issues. Additional potential actions that will support the active management strategy to improve water quality include the following:

- Develop an integrated monitoring plan that addresses key questions and provides a framework for organizing and analyzing data from all sources (water quality sampling, flow measurement, biological surveys, and special studies).
- Expand benthic macroinvertebrate sampling locations and frequency for compiling the Watershed Health Index.
- Consider a Microbial Source Tracking project to increase understanding of *E. coli* bacteria sources.
- Develop a stormwater quality retrofit program for WES stormwater treatment ponds. Over 30 ponds in Clackamas County Service District No. 1 and the Surface Water Management Agency of Clackamas County (the Districts) have been identified by WES staff as potential opportunities to retrofit to function better.
- Develop a stormwater quality structural BMP retrofit program for streets in coordination with DTD.
- Develop a stormwater quality retrofit technical assistance program aimed at institutional landowners (e.g., churches and schools) and commercial landowners with large parking areas to reduce pollutant loads from existing development.
- Continue implementing the private water quality facility cleaning and inspection program.
- Evaluate opportunities to enhance street sweeping effectiveness in reducing pollutant loads from high volume streets through increased frequency and enhanced technology. Evaluate areas in the watershed where enhanced street sweeping may cost-effectively benefit water quality.
- Continue investigating the water quality impacts of man-made lakes in the watershed including Leona and Kellogg Lakes.
- Develop monitoring protocols, data quality objectives, and evaluation processes to analyze the effectiveness and results associated with non-structural BMPs.

Aquatic Habitat and Biological Communities Issues and Opportunities

Similar to the hydrologic conditions and water quality in the KMS watershed, aquatic habitat and biological communities have been altered significantly from pre-development conditions. Criteria for the assessment of aquatic habitat and biological communities were developed for habitat complexity, in-stream structure, substrate in riffle habitat, overhead shade, riparian buffer shade, summer flow, fish diversity and abundance and migration access. Assessment of these parameters illustrated that many of the issues related to hydrology and water quality also impact aquatic habitat and biological communities.

Additional key aquatic habitat and biological community issues in the KMS watershed that have not been raised in the hydrology and water quality sections include the following:

- Native fish populations are present, although limiting factors within and beyond the watershed affect population size and diversity.

  Adult salmon, steelhead, and cutthroat trout have been documented in Kellogg and Mt. Scott Creeks. The Kellogg Dam at the confluence of Kellogg Creek with the Willamette River has created a potential impediment for upstream migrating salmonids. There is a fish passage ladder at the dam that has been determined to be a partial (temporal) fish passage barrier by ODFW. The presence of adult salmon and steelhead above the ladder is evidence that it is passable at some times of the year. Limiting factors for fish populations may include elevated summer stream temperatures, other water quality issues, degraded aquatic habitat and passage impediments to upstream movement of adults and downstream movement of juveniles.

- Opportunities for improvements to aquatic habitat.

In the analysis of aquatic habitat conditions in Chapter 4, there were far more moderate and low scores on the habitat parameters than there were high scores throughout the watershed study area. This suggests that there is opportunity for improvement of aquatic habitat conditions within the watershed.

The Kellogg Creek reaches are extremely lacking in Large Woody Debris (LWD), shade, and large boulders, and have excess fine sediment, indicating that habitat complexity may be limiting. High water temperatures are also a problem, although monitoring data throughout the system are lacking, and adequate cold water is present in at least one area of the watershed (Kellogg Creek upstream of the Mt. Scott Creek confluence). During a site visit conducted on August 13, 2008, much of Upper Kellogg Creek had very low flow with nearly stagnant pool conditions at several locations. Low summer flow is probably a major limiting factor during dry summers in Upper Kellogg Creek.

On the whole, habitat survey reaches within Mt. Scott Creek scored poorly on the deep pools per kilometer, slackwater pools metrics, and on the LWD metrics. This suggests that the habitat within Mt. Scott Creek could be improved through the installation of large wood (and the improvement of the riparian zone which would result in greater future LWD recruitment), although more analysis is necessary. The installation of large wood would also likely result in the development of deep pools and slackwater areas. Sedimentation does not appear to be a significant issue in Mt. Scott Creek.

- Fish passage barriers.

Presently, there are only two known partial barriers to adult salmonid movements between the mouth of Kellogg Creek and known spawning habitat in Upper Mt. Scott Creek, although ODFW identified other potential barriers during the 2008 habitat survey that may require further investigation. The fish passage facility at the outlet of Kellogg Lake in the City of Milwaukie is a partial barrier to migration. Further analysis of this facility and alternatives for improving access and habitat at the mouth of Kellogg Creek will be valuable, since all returning adults must pass over the fish ladder and returning juveniles must pass through Kellogg Lake. The other partial barrier is located at the culvert under Southeast 82nd Avenue and probably represents a relatively minor obstacle for returning adults. However, it may represent a low flow barrier to upstream migrating juveniles during the summer months. There is also one culvert on private land just upstream of the uppermost ODFW fish sampling reach that may be blocking access to the uppermost reaches of Mt. Scott Creek. Information is lacking about the condition of this culvert.

Clackamas County lists two culverts for replacement in the KMS watershed on minor tributaries. Clackamas County's list of culverts for replacement provides a priority rating of low or high based on potential biological benefits and the cost and logistics of replacement. Both of the culverts identified for potential replacement in the KMS Creek watershed are rated as low priority. ODFW also has a list of culverts identified for replacement and provides priority ratings for those identified. Prioritization for replacement of culverts through the Watershed Action Plans will require additional site-specific information on the condition of the culverts, the species affected, and quality and availability of upstream habitat.

Summary of Recommended Actions

A management strategy aimed at targeted investments to enhance aquatic habitat and biological communities is recommended. Many of the potential actions described above for addressing hydrologic issues and water quality issues also pertain to aquatic habitat and biological community issues. Additional potential actions that will support the targeted management strategy to enhance aquatic habitat and biological communities include the following:

- Continue partnering with non-profits and volunteer groups to make strategic, targeted improvements in aquatic habitat and biological communities.
- Engage in targeted outreach with private landowners to improve aquatic habitat and stream conditions through LWD placement, bank stabilization, and buffer enhancements.
- Evaluate areas lacking shade and engage in buffer enhancements on public land and private land (where feasible) to support aquatic habitat and Temperature TMDL implementation.
- Continue participation in Kellogg for Coho initiative and evaluation of Kellogg Lake and Dam impacts on watershed health.
- Collaborate with DTD and other agencies to further evaluate fish barrier removal priorities.
- Integrate ODFW recommendations on habitat improvement opportunities into partnering efforts and Capital Improvement Program (CIP) planning as appropriate.

Watershed Action Plan

The Watershed Action Plan actions were developed based on the recommended management strategies and potential actions described in the Assessment Report, input provided by Stakeholders during Stakeholder Meetings, and input provided by WES staff. There are many potential actions that WES could undertake as a part of its surface water management program. The project team developed a list of actions that are most likely to assist WES in meeting its LOS goals in the near term. Additional potential actions that are not included in the current Action Plan may be incorporated by WES into longer term actions in the future. The Action Description Sheets in Chapter 6 provide details on the recommended actions.

Stakeholder Input

A stakeholder group was convened in the fall of 2008 to participate in the Watershed Action Planning process and provide feedback on the results of the study to the Clackamas County Citizens Advisory Committee (CAC). Stakeholders met in October and November of 2008 and in March, April and June of 2009. Stakeholders discussed areas of concern and opportunity in the watershed, possible watershed management actions, provided input on the importance of actions, and provided feedback on the Action Planning process. Further information on stakeholder involvement is included in Chapter 5.

Summary of Actions

The Watershed Action Plan contains recommended capital improvement projects, programmatic measures and capital improvement programs that address watershed issues and opportunities identified in the Assessment Report. The Watershed Action Plan includes recommendations for both the Kellogg-Mt. Scott and Rock Creek Watersheds, because those watersheds were evaluated at the same time.

Capital Improvement Projects

Capital improvement projects recommended in this plan include stream channel and restoration work in Dean Creek, Mt. Scott Creek and Rock Creek as well as construction of a regional decant facility. These actions are listed as capital projects because they are primarily focused on implementation of specific construction activities.

Programmatic Measures

The Action Plan proposes a variety of programmatic (or operational) measures. Programmatic measures developed for this action plan include the continuation of current District programs and implementation of new programs, which are directed toward regulations, design standards, studies and monitoring, watershed enhancement, policy and practices, customer service, and coordination with other entities.

Capital Improvement and Programmatic Measures

The Action Plan proposes a variety of measures that include both capital improvements and programmatic elements within a larger program effort. The purpose of this approach is to provide the District with programs that will develop, implement, and monitor projects to improve basin hydrology, water quality, and aquatic habitat while also providing capital improvement funding for the implementation of those projects. There are many specific locations in the watersheds where capital projects could be implemented as a part of the combined capital improvement and programmatic measures, as described further in Chapter 5.

A summary table of the actions is provided below (Table 6-1). Actions that include elements related to specific Stakeholder Group recommendations are noted. A more detailed summary table is provided at the end of this chapter, along with Action Description Sheets that provide detailed information on each action.

Prioritization

Actions were prioritized based on the action's capacity to meet the District LOS goals in a workshop setting with WES staff, using a LOS prioritization tool. The LOS prioritization tool is a decision-support tool for WES. The prioritization score for actions that results from the LOS prioritization process is one of the key factors considered in the implementation sequencing of the Action Plan. Other important considerations included current District opportunities, needs, and planned projects. Table 6-1 below summarizes the high priority actions for 2009-2010 based on the LOS analysis and current District opportunities and needs.

The process for prioritizing the actions included the following steps:

1. Develop LOS goals and performance measures (described in Appendix D).
2. Evaluate current and anticipated future metrics for WES activities against LOS goals and performance measures. Determine the "LOS gap" for each performance measure (described in Appendix D).
3. Evaluate actions in terms of action's capacity to close the LOS gap for each performance measure using consistent LOS prioritization tool that provides scores for prioritization of each action.
4. Evaluate prioritization scores for each action as well as other factors such as current District opportunities, needs, and currently planned projects. Develop list of High Priority Actions for 2009-2010 implementation.
5. Adaptively manage Action Plan prioritization as needed to reflect changing priorities and opportunities.

Implementation

To implement the Action Plans, the WES Surface Water Management Steering Committee is organizing the work into program categories and developing a multi-year budgeting outlook under current funding and under proposed LOS funding. Implementation of the Action Plan will depend on the available resources. WES operates the Districts and provides wastewater and surface water management services using revenue from several sources. The Surface Water Management Program for CCSD No. 1 is funded through three primary sources: monthly SWM utility fees, systems development charges (SDCs), and permit fees. WES currently spends approximately $0.5 million annually on the existing programmatic elements of the Surface

Water Management Program. These program elements are described in Appendix A. The amount of capital expenditures made by WES each year varies.

The recommended actions summarized in Table ES-1 describe programmatic activities and capital expenditures that will move WES toward meeting its LOS goals. It is anticipated that as part of implementing the WAPs, WES will evaluate resources and funding to support the Action Plans and to meet future LOS goals.

The estimated cost for implementing all recommended actions over a five-year period is approximately $22.4 million, an average of approximately $4.5 million per year. The estimated cost for implementing the Action Plans over a five-year period is presented in 2009 dollars. Of the approximately $4.5 million per year in expenditures recommended in the Action Plans, approximately $1.0 million (20 percent) is for programmatic elements and approximately $3.5 million (80 percent) is for capital expenditures.

Table ES-1. WES Watershed Action Plan Summary

Action Name[1]	5-Year cost (2009 dollars[2])	High Priority 2009-2010	Stakeholder Rec's[3]
D-19 Stakeholder Communication Plan	$200,000	X	X
D-7 Update Erosion Control Protocol	$72,000	X	
RC-2 Regional Detention Prop Ac	$3,540,000	X	
D-3 Integrated Monitoring Program	$354,000	X	X
D-10 Benthic Macro Surveys	$390,750	X	X
D-4 Channel Morph Monitoring	$315,000	X	
D-11 Microbial Source Study	$106,000	X	
D-1 Update SW Design Standards	$355,200	X	X
D-5 Improve Riparian Buffer	$600,000	X	X
D-2 SW Detention Retrofit	$412,000	X	X
KMS-1 Enhanced Street Sweeping	$572,000	X	X
RC-1 Wetlands Reach RK5	$1,434,238		X
RC-5 Pilot Graham Ck Basin	$500,000		X
D-13 WET Retrofit Program	$1,400,000		X
KMS-3 Dean Creek Wetlands	$741,000		X
D-8 Erosion Control Hotline	$33,800		X
KMS-4 Mount Scott in 3 Creeks	$253,692		X
D-20 Regional SW Task Force	$40,000		X
KMS-5 Flood-prone Culverts	$417,500		
KMS-6 Willing-seller Program	$2,048,000		X
D-12 Street Retrofit Program	$1,032,000		X
KMS-8 WQ Man-made Lakes	$43,375		X
D-14 Private WQ Inventory	$560,000		X
RC-4 Riparian Buffer Acq RC5	$270,000		X
RC-3 Riparian Buffer RK1 RK2	$76,000		X
KMS-9 Kellogg-for-Coho Init	$3,200		X
D-9 Track Flood Complaints	$20,000		
D-16 LWD w Partners	$133,750		X
KMS-2 Evaluate Low Summer Flow	$16,000		X
D-18 Improve fish passage	$1,667,000		X

Table ES-1. WES Watershed Action Plan Summary

D-17 Invasive Species Mgmt	$140,000		X
D-6 Upland Tree Canopy	$165,000		X
D-15 Riparian Buffer Analysis	$20,000		X
D-21 Regional Decant Facility	$2,000,000		
D-22 (AEX) Erosion Control	$330,145	X	
D-23 (AEX) Sampling/WQ	$170,960	X	
D-24 (AEX) Spills/Illicit Discharges	$68,435	X	
D-25 (AEX) Planning & Projects	$463,300	X	
D-26 (AEX) On-Site Maintenance	$885,165	X	
D-27 (AEX) Regulatory	$234,570	X	
D-28 (AEX) Customer Service Coordination	$102,035	X	
D-29 (AEX) Intergovernmental Coordination	$99,495	X	
D-30 (AEX) SWM Program Admin	$133,340	X	

[1] In the Action Names, "D" signifies a District-wide action, "KMS" signifies an action in the Kellogg-Mt. Scott watershed, "RC" signifies an action in the Rock Creek watershed, and "AEX" signifies an existing program element.

[2] Five-year cost estimates are in 2009 dollars and do not include inflation or the cost of capital.

[3] Denotes actions that include specific recommendations provided by Stakeholder Group.

CHAPTER 1 – WATERSHED OVERVIEW AND POLICIES AND PRACTICES

Overview

Water Environment Services (WES), a department of Clackamas County, conducts and manages surface water and wastewater management services in several Districts including Clackamas County Service District No. 1 (CCSD No. 1, also known as the District). WES' surface water management program reviews development plans, maintains stormwater facility infrastructure, and conducts activities to protect and enhance the health and function of the watershed, including water quality, aquatic habitat, and hydrologic functions.

WES is completing the Kellogg-Mt. Scott Creek (KMS) Watershed Action Plan (Action Plan) in order to prioritize surface water management program activities and future investments for watershed management. The approach to the Action Plan process is illustrated in Figure 1-1. The key elements of the Action Plan include the following:

- **Characterization Report**. The Characterization Report includes an inventory of watershed conditions, an identification of key factors that limit watershed health, and a summary of WES activities that affect watershed health based on existing information. The Characterization Report is contained in Chapters 1 through 4 of the Action Plan.
- **Assessment Report**. The Assessment Report includes an assessment of watershed conditions based on the characterization report results and identifies specific WES surface water programs, projects, and activities that are appropriate to improve watershed health efficiently and effectively. The Assessment Report is contained in Chapter 5 of the Action Plan.
- **Action Plan Summary**. The Action Plan Summary includes an evaluation and prioritization of the programs, projects, and activities described in the Assessment Report using scientifically-based criteria and an asset management Level of Service (LOS)-based evaluation process. The Action Plan Summary provides a process for sequencing the actions for implementation. It is contained in Chapter 6 of the Action Plan.
- **Implementation and Adaptive Management**. WES will implement the Action Plan components over time, and monitor and adapt them as needed to continually improve watershed health.

Figure 1-1. Watershed Action Planning Process

This chapter includes an overview of the KMS watershed, an overview of the approach used to evaluate and characterize the watershed, and a summary of WES policies and practices that affect watershed health. Chapters 2 through 4 summarize information related to hydrology, water quality, and aquatic habitat and biological communities, and include discussions of the data reviewed for the characterization, data gaps identified, and watershed conditions and limiting factors. Chapter 5 contains a synthesis of the data evaluated in Chapters 1 through 4, including a reach-by-reach analysis of the stream and contributing area conditions. Chapter 6 contains the recommended actions developed based on the Chapter 5 assessment to assist WES in achieving its LOS goals.

Watershed Overview

The KMS watershed, illustrated in Figure 1-2, encompasses approximately 10,300 acres and is the largest watershed within CCSD No. 1. It includes the following eight major sub-basins: Lower and Upper Kellogg; Lower, Middle, and Upper Mt. Scott; Phillips; Dean; and Cedar Creeks. Minthorne Creek, which is almost entirely within the City of Milwaukie, is part of the Lower Mt. Scott sub-basin. Figure 1-3 illustrates the major sub-basin boundaries and Table 1-1 summarizes the characteristics of each sub-basin.

The KMS watershed is a highly developed urban watershed that is approximately 34 percent impervious. General concerns and challenges within the watershed include but are not limited to impervious area, fish passage, flooding, poor streamside practices, lack of riparian vegetation, in-stream erosion and down cutting, and water quality concerns.

Table 1-2 summarizes the jurisdictional areas in the KMS watershed. Eighty percent of the watershed is within CCSD No. 1. CCSD No. 1 includes portions of the City of Happy Valley, and 20 percent of the watershed is within Happy Valley. The lower portion of the watershed is in the City of Milwaukie, which encompasses about 12 percent of the watershed. Small portions of the watershed are also in Gladstone, Johnson City, and unincorporated areas outside of CCSD No. 1.

Table 1-1. KMS Sub-basin Characteristics

Sub-basin	Area, square mile	Primary land use	Total impervious area, percent[1]	Estimated effective impervious area, percent[2]	Canopy, percent[3]	Q100 Peak flow, cfs[4]	Q100/ drainage area, cfs/square mile
Lower Kellogg	15.64	Residential	35	18	16	2045	131
Upper Kellogg	2.73	Residential	34	15	18	448	164
Lower Mt. Scott	11.04	Commercial	35	19	15	1484	134
Middle Mt. Scott	4.34	Residential	30	14	23	688	158
Upper Mt. Scott	1.81	Residential	21	7	19	263	145
Phillips	2.68	Commercial	44	28	13	527	197
Dean	1.69	Commercial	31	15	24	266	157
Cedar	0.79	Residential	39	21	19	159	201

[1] Measured from 2004 aerial photos

[2] Calculated by WES

[3] 2007 Metro land cover analysis from aerial photos

[4] Peak flow in stream during 100-year recurrence-interval storm (1 percent probability of occurring each year) estimated from 2006 hydraulic model. cfs = cubic feet per second.

Table 1-2 Jurisdictional Areas in the KMS Watershed

	CCSD No. 1	Happy Valley[1]	Milwaukie	Gladstone	Damascus	Johnson City	Unincorporated outside CCSD No. 1
Percent of land in KMS watershed	80	20	12	1	0	<1	<1

[1] Happy Valley is partially contained within CCSD No. 1. The overlap in some jurisdictional areas results in this summary not totaling 100 percent.

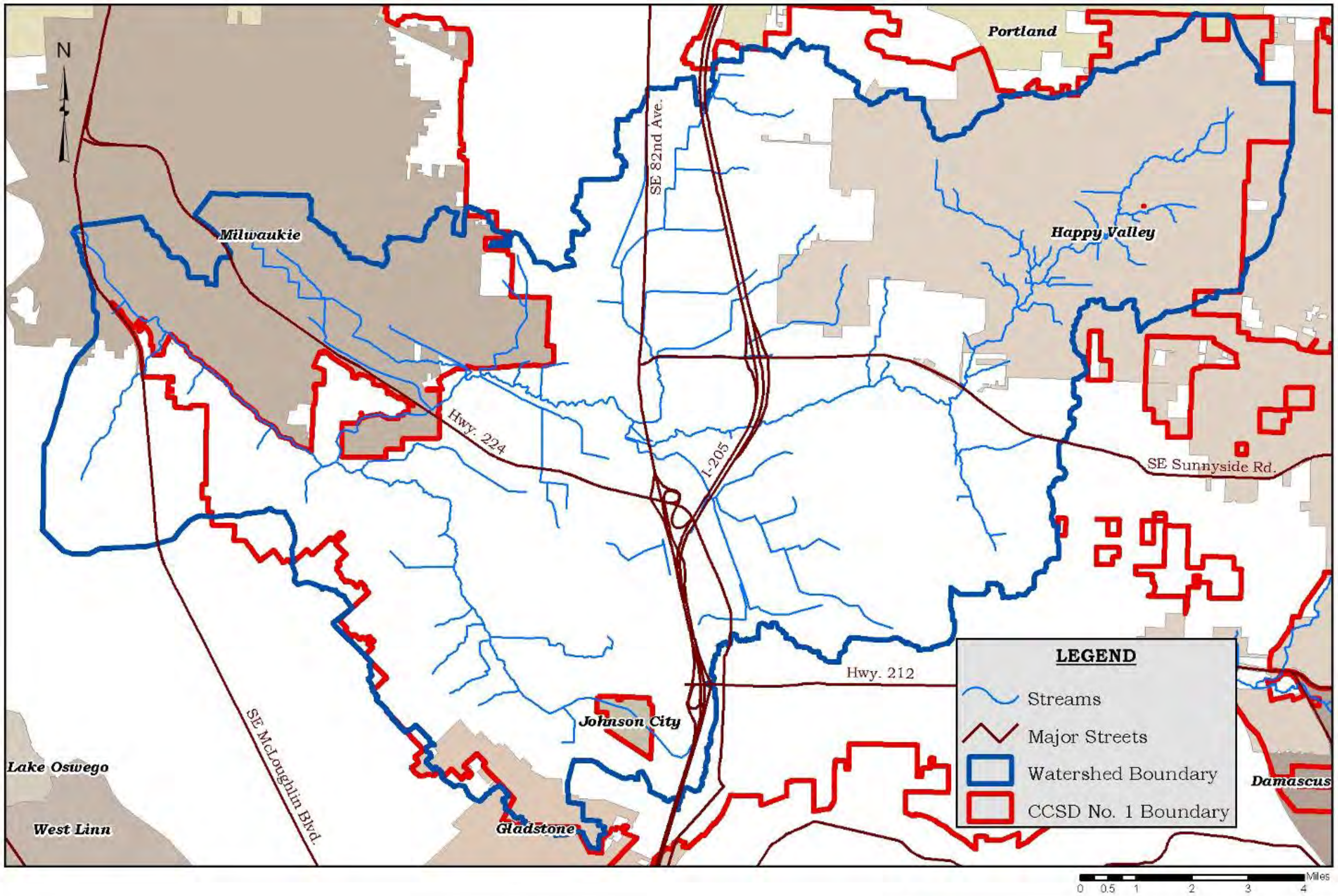


Figure 1-2

KELLOGG-MT. SCOTT WATERSHED OVERVIEW

WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES
Beyond clean water. www.clackamas.us/wes

SWANSON HYDROLOGY + GEOMORPHOLOGY

Ellis Ecological Services, Inc.

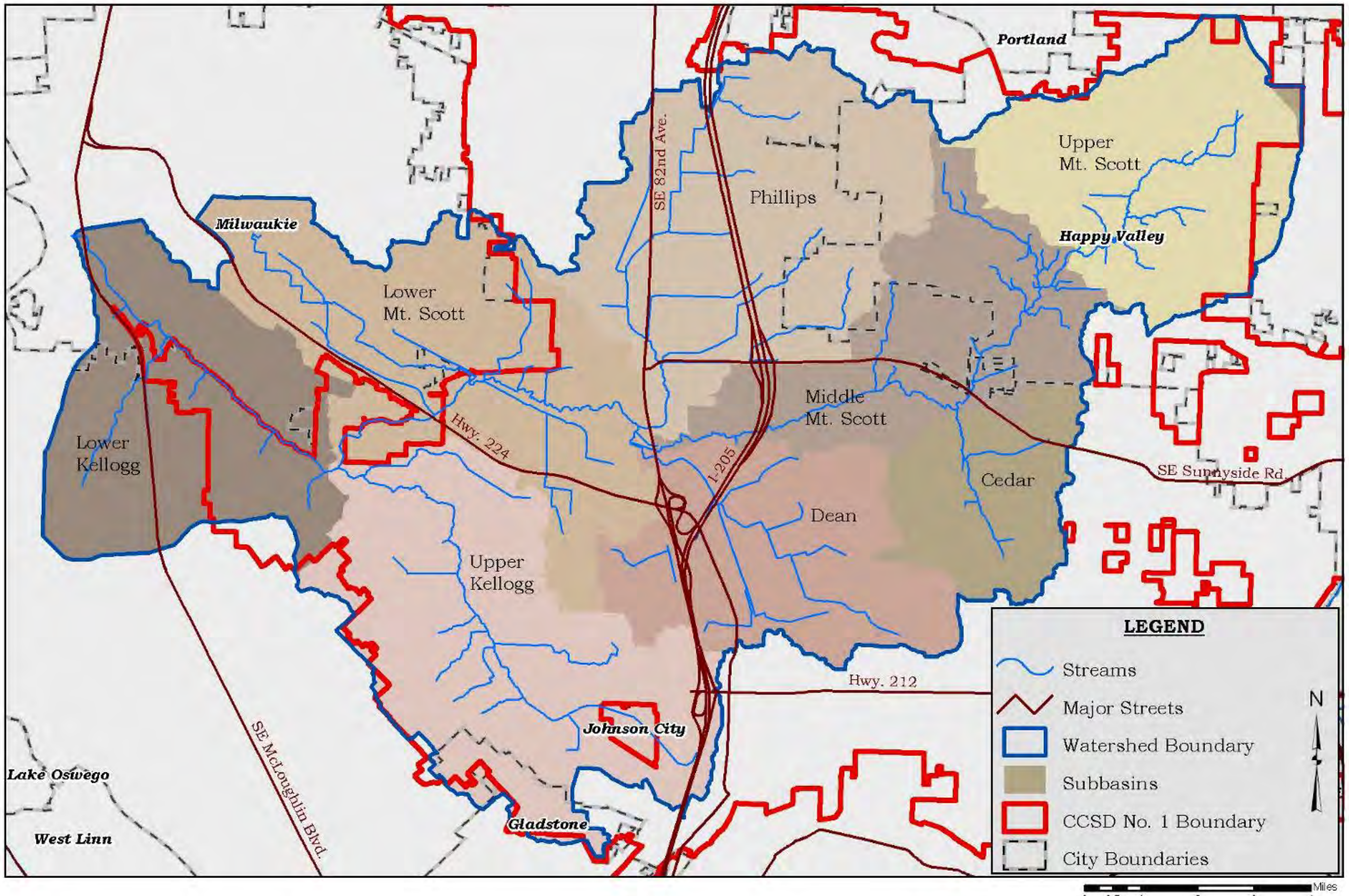


Figure 1-3

KELLOGG-MT. SCOTT MAJOR SUBBASINS

WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES
Beyond clean water. www.clackamas.us/wes

SWANSON HYDROLOGY +GEOMORPHOLOGY

Ellis Ecological Services, Inc.

\BCTUC02\T:\IWVWD\133908 - IWVWD Groundwater Flow Model\GIS\ARCMAPS\FIGURES\FDraft_012108

The KMS watershed, which is in the northwestern portion of Clackamas County, is characterized by the Natural Resources and Conservation Service (NRCS) as having warm, dry summers and cool, moist winters. The average daily temperature in the study area is 41 degrees Fahrenheit (F) during the winter and 64 degrees F during the summer. Total average annual precipitation is approximately 43 inches, 75 percent of which usually falls from October through March. During the wet winter season, rainfall is generally light with periods of more intense rainfall. Summers are usually dry.

Soils in the study area are predominantly NRCS hydrologic group C with some hydrologic group B soils present. Group C soils are characterized by the NRCS as somewhat poorly drained with slow to rapid runoff and low permeability. Soils are discussed further in Chapter 2.

Kellogg Creek joins the Willamette River 18 miles upstream from the mouth of the Willamette's confluence with the Columbia River. Kellogg Creek is a third order stream. Mt. Scott Creek joins Kellogg Creek east of North Clackamas Central Park and provides approximately 90 percent of the flow in the stream (Montgomery Watson Harza [MWH], 2001). Phillips, Dean, and Minthorne Creeks are tributaries to Mt. Scott Creek. Hydrology is discussed in more detailed in Chapter 2.

The streams in the KMS watershed have been altered significantly and impacted by agriculture and urbanization since the early 1900s (MWH 2001). The land use in the watershed from Interstate 205 (I-205) west includes commercial and industrial areas, along with large areas of older residential construction. Land use east of I-205 is primarily newer residential development. The impacts of land use on water quality in the watershed are discussed in more detail in Chapter 3.

Adult salmon, steelhead, and cutthroat trout have been documented in Kellogg and Mt. Scott Creeks (Oregon Department of Fish and Wildlife [ODFW], 2008). A dam constructed under the Highway 99 Bridge at the confluence of Kellogg Creek with the Willamette River has created a potential impediment for upstream migrating salmonids (MWH, 2001). There is a fish passage ladder at the dam that has been determined to be a partial (temporal) fish passage barrier by ODFW. The presence of adult salmon and steelhead above the ladder is evidence that it is passable at some times of the year (MWH, 2001). Kellogg Lake, a shallow warm lake approximately 12 acres in size, is formed by the dam and extends approximately 0.75 mile up on Kellogg Creek. Additional aquatic habitat, fish passage, and biological community issues are discussed further in Chapter 4.

Photos 1-1 through 1-12 of the KMS watershed follow.

Photo 1-1. Kellogg Lake

Photo 1-2. Kellogg Dam Fish Ladder and Highway 99 Bridge

Photo 1-3. Kellogg Creek at Keuhn Road

Photo 1-4. Kellogg Creek at Parmenter Road

Photo 1-5. Kellogg Creek at Aldercrest Road

Photo 1-6. Kellogg Creek at Clackamas Road

Photo 1-7. Leona Lake at upper Kellogg Creek

Photo 1-8. Mt. Scott Creek in Three Creeks Natural Area

Photo 1-9. Pond downstream of flood control facility on Mt. Scott Creek in Three Creeks Natural Area

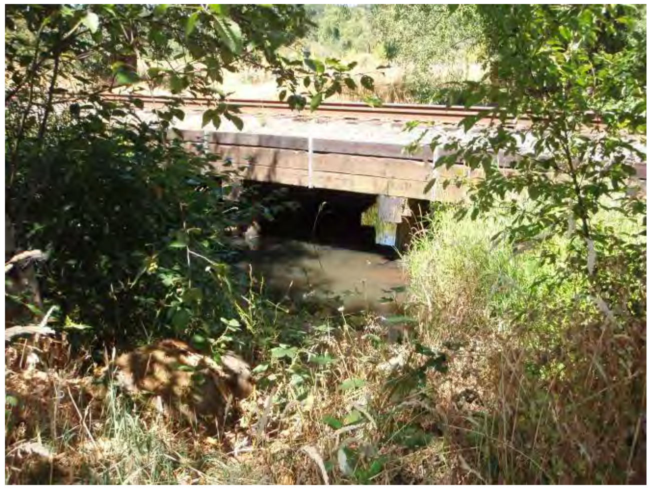


Photo 1-10. Railroad bridge over Dean Creek in Three Creeks Natural Area

Photo 1-11. Mt. Scott Creek near 97th Avenue

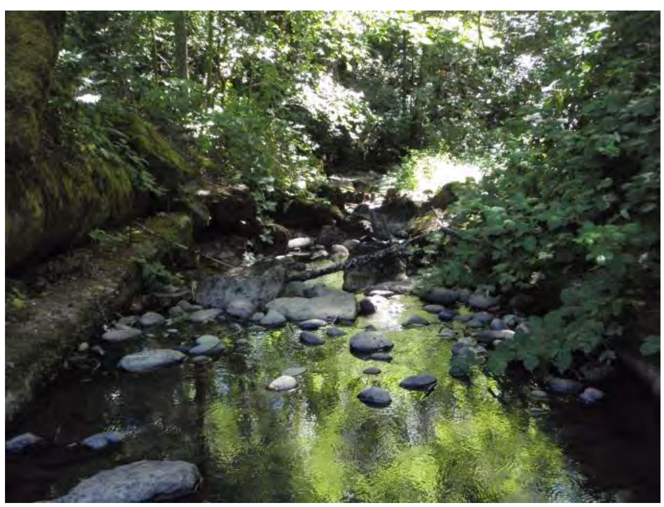


Photo 1-12. Mt. Scott Creek at Spring Mountain Dam Removal Site

Watershed Characterization and Assessment Process

The watershed characterization was used to develop the watershed assessment and the Action Plan. As illustrated in Figure 1-4, the watershed characterization and assessment process evaluates watershed health stressors, responses, and key indicators.

The watershed characterization and watershed assessment will help WES to do the following:

- Identify features and processes important to hydrology, biological, habitat, and water quality resources
- Determine how natural processes influence those resources
- Understand if/how human activities and WES stormwater management practices are affecting resources and limiting watershed health conditions
- Evaluate the cumulative effects of land management and stormwater management practices over time

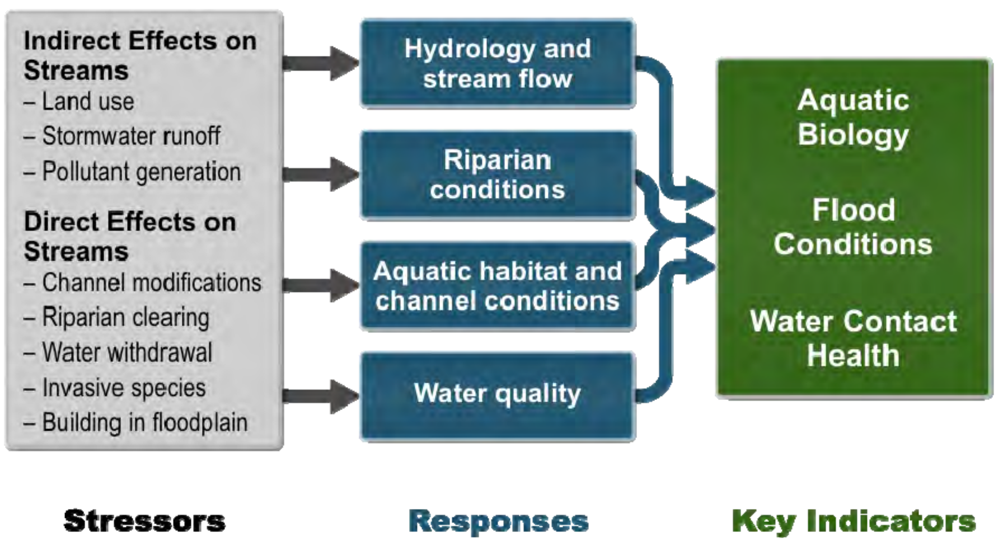


Figure 1-4. Watershed Characterization and Assessment Process (Modified from Booth et al., 2005 and Karr and Yoder, 2004)

The Characterization Report contains the initial analysis of key indicators, responses, and stressors in the watershed. Watersheds respond differently to stressors in the environment depending on the extent of modification to the watershed (such as how much riparian clearing has occurred and how stormwater runoff is collected, treated, and conveyed) as well as the interaction between stressors (such as the combination of effects from water withdrawals and riparian clearing on water temperatures). Conditions such as soils, slopes, vegetation, and stream morphology also play an important role in how watersheds respond to stressors. Evaluating key indicators of watershed health helps to determine how a watershed is responding to the unique combination of stressors in the environment. The results of the watershed characterization will be used in the assessment to identify what management strategies and priority activities and actions are likely to improve functions and conditions.

In Chapters 2, 3, and 4 of this report, key indicators are evaluated using available data that provide insight into how a combination of stressors and responses are affecting watershed health. Examples of key indicators evaluated include benthic macroinvertebrate and fish populations, flood conditions and channel erosion, and concentrations of water pollutants that could affect human health. Stressors such as land use, stormwater runoff, channel modifications, aquatic habitat conditions, and riparian clearing are evaluated and compared to available data on specific watershed responses as well as to key indicators in order to understand limiting factors for watershed health. Because several studies have been conducted that document watershed conditions extensively, in particular the 2006 Master Plan, Chapters 2 through 4 do not attempt to describe the watershed exhaustively. Instead, key aspects of available data are summarized and evaluated in the context of the goals for the Action Plans.

Chapters 2 through 4 summarize data on hydrology, water quality, and aquatic habitat and biological communities. These elements of watershed health often contain interrelated problems and integrated opportunities for improvement. Following work in the watershed assessment phase of the project was completed to evaluate interrelated issues and to identify priority actions and management activities appropriate for WES to undertake to address factors that are limiting watershed health.

The watershed assessment was conducted using the information in Chapters 1 through 4 of the Characterization Report with a focus on addressing the following questions that are of interest to WES.

Hydrology

- How can hydrologic goals or flow control objectives be achieved through design standards and retrofitting to improve watershed health?
- Where does regional detention and infiltration make the most hydrological and soil feasibility sense and where is land available to implement these projects?
- What specific stormwater infrastructure structures or areas require retrofits, what are state-of-the-art techniques that can be utilized, and what are the priorities?
- Where is flooding potentially a problem now or in the future?

Water Quality

- What are the most limiting water quality problems, what are the most important potential sources, and what are potential best management practices (BMPs) and solutions for these problems?
- What specific stormwater infrastructure structures or areas require retrofits, what are state-of-the-art techniques that can be utilized, and what are the priorities?
- Where and what parameters should WES monitor in the future to document watershed health and overall effectiveness of programs, policies, and actions and to address regulatory permits?

Aquatic Habitat and Biological Communities

- Where are the most sensitive and valuable habitats and functions to protect?
- Where are the highest priority and most degraded stream channel reaches to restore?
- What are the highest priority fish barriers to remove or retrofit?
- Where are the highest priority stream reaches for establishing native vegetation and canopy?

WES Policies and Programs

- How can ecosystem services be protected and enhanced through WES activities and policies?
- What traditional or innovative maintenance practices are most important and where should the focus be?
- Which management policies/programs/activities should be utilized to enhance, protect, restore or address the issues identified?
- What are the high priority areas for maintenance/retrofit/Capital Improvement Program (CIP) activities, what is the methodology, and what are the criteria for prioritizing these activities?
- What is the current maintenance process, what are the criteria for prioritizing maintenance activities, and who has the responsibility for implementing maintenance of the surface water drainage system?
- What are the recommended prioritized maintenance activities?

- What are the recommended actions for interdepartmental maintenance coordination including recommendations for coordination with the Clackamas County Department of Transportation and Development (DTD)?
- What are the recommended actions for the development review process, changes to development standards and development rules and regulations including low impact development?
- What is the recommended methodology and criteria for prioritizing erosion prevention and sediment control and establishing performance metrics?
- What are the gaps in customer service, including opportunities to enhance the Service Request database as a proactive tool for management activities and future CIP identification?
- What information is needed to inform decisions and track performance metrics in the future?

Following completion of the watershed characterization and watershed assessment, an Action Plan will be developed to recommend site-specific and reach-oriented solutions and management programs for problems and opportunities related to flooding, erosion and deposition, water quality, habitat, and other watershed health issues.

WES is incorporating the principles of an asset management program into the Surface Water Management program by developing a LOS-based decision matrix for prioritizing and evaluating the effectiveness of current and proposed projects and activities. The LOS-based decision matrix and scientifically-based criteria will be used to evaluate, prioritize, and sequence the programs, projects, and activities that are included in the Action Plan.

One of WES' main goals and outcomes of the Action Plan is to be able to prioritize what stormwater management actions and activities should be conducted in specific sub-basin areas, such as where to assist the operations and maintenance staff in targeting specific activities in various locations. Watershed Action Plans will be utilized to provide priorities and benefits including the following:

- Raise awareness of issues and constraints
- Identify key problems and opportunities
- Identify areas in which efforts should be focused both in terms of protection and restoration efforts and asset management activities
- Implement policies, programs, and standards in specific areas
- Build support for stewardship and implementation and serve as a tool for funding

WES Policies and Practices

WES is a department within Clackamas County that conducts and manages wastewater and stormwater management services in several Districts including CCSD No. 1, the Surface Water Management Agency of Clackamas County (SWMACC), and the Tri-City Service District. CCSD No. 1 includes an agreement with and encompasses portions of the City of Happy Valley, as shown in Figure 1-2.

WES has retooled its surface water management program and is transitioning from a utility-based, regulatory-driven program to an approach focused on watershed health and integrated watershed management. WES' vision is to improve watershed health by managing its surface water program efficiently and effectively, using financial resources to provide the most benefit through prioritized activities and investments. An organizational chart for WES is provided in Figure 1-5.

Functional program elements within WES that relate to surface water management as shown in the current organizational chart are summarized below. It is important to note that as WES implements its vision to improve watershed health by managing its surface water program efficiently and effectively; changes may be made to the current organizational structure described below.

- Asset management
  - Development plan review and permitting
  - Erosion prevention and sediment control
- Water quality services
  - Stormwater system maintenance
  - Program management
- Environmental monitoring
  - Environmental permit program management
  - Laboratory operation
- Administration
  - Environmental policy and watershed health
  - Public information and outreach
- Business services
  - Customer service
- Financial services
  - Utility billing
  - Asset management reporting

The purpose of the following section is to summarize existing policies and practices implemented by WES that affect watershed conditions and identify opportunities for potential improvements that will help WES to improve and protect watershed health more efficiently and effectively. These opportunities for potential improvements were evaluated further during the assessment phase of the project (Chapter 5) with WES staff input. Additional details on the existing policies and practices implemented by WES are provided in Appendix A, including work flows for several program elements.

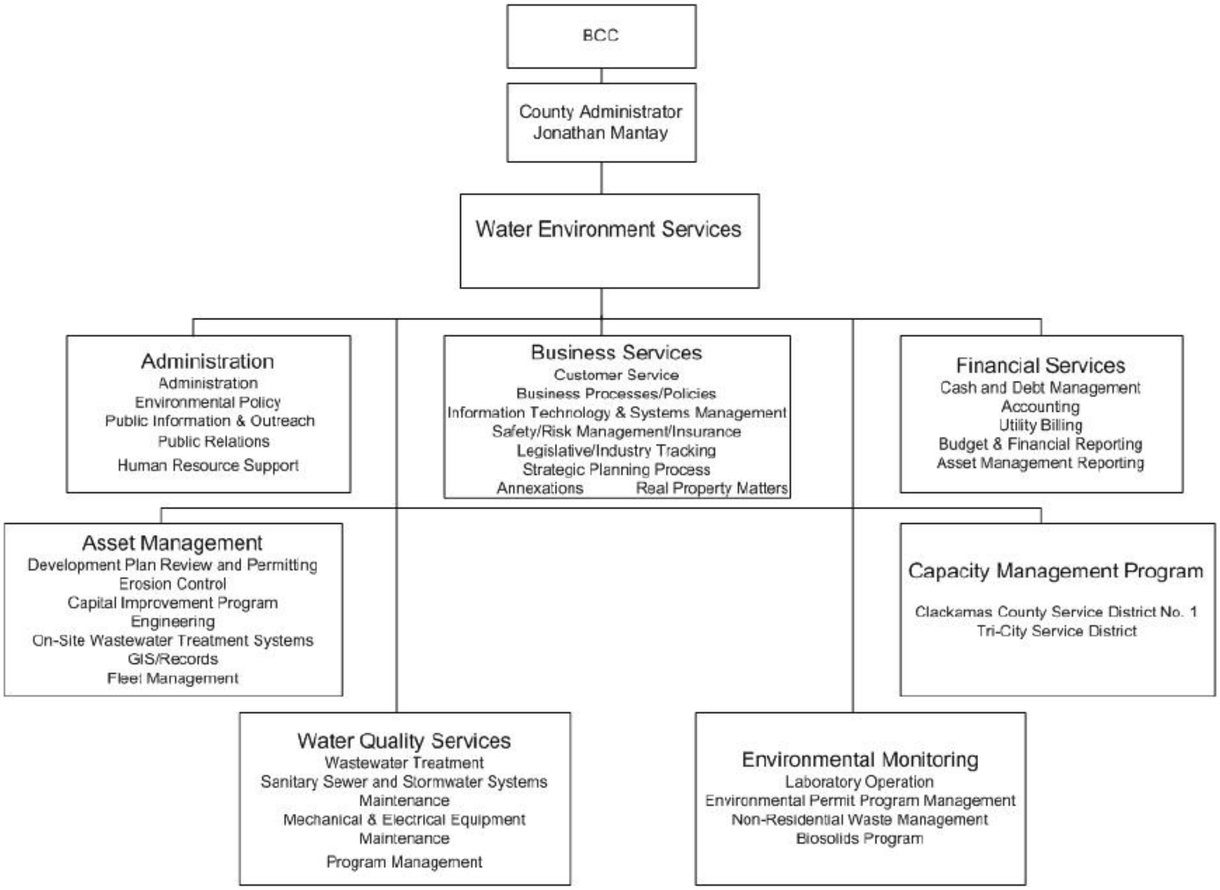


Figure 1-5. WES Organizational Chart

Asset Management

Asset management at WES includes the following program components: development plan review and permitting, erosion prevention and sediment control (ERCO), CIP, engineering, onsite wastewater treatment systems, Geographic Information System (GIS)/records, and fleet management.

The CIP plans, designs, and builds major capital facilities in the three area Districts, so that operating divisions can serve District customers' wastewater and surface water needs. Examples of CIP projects that affect watershed health include regional stormwater detention and treatment systems and public stormwater infrastructure projects including pipes and bioswales.

The GIS/records program is also an important element of asset management for watershed health. GIS is a useful tool for tracking watershed health metrics and management activities as well as analyzing information about watershed conditions. The WESworks GIS is used by WES staff for data display and queries, such as to identify the location of stormwater assets. ArcGIS is used for data input, storage, and analysis. Opportunities are being identified to improve the efficiency and usefulness of the data collected by WES staff related to environmental monitoring, watershed health, development review, maintenance, and erosion control. The collection, storage, display, and analysis of these data could be improved potentially with assistance from the GIS staff using capabilities in WESworks and ArcGIS.

The asset management program element includes the following WES staffing levels expressed as employee full-time equivalent (FTE) engaged in development review, capital projects, planning, and erosion control:

- 0.2 FTE Program Manager
- 0.5 FTE Surface Water Coordinator
- 0.2 FTE Soils Program Supervisor
- 0.2 FTE Development Review Supervisor
- 1.0 FTE Administrative Support
- 0.5 FTE Senior Civil Engineer
- 0.5 FTE Civil Engineer
- 1.0 FTE Surface Water Technician
- 1.5 FTE Plan Reviewer
- 1.5 FTE Erosion Control Inspectors
- 0.5 FTE Single Family Plan Reviewer
- 2.5 FTE for WES-related GIS work.
- Additional staff through DTD for floodplain and miscellaneous land use issues.

Development Review and ERCO are discussed in more detail below.

Development Plan Review and Permitting

WES reviews development plans for installation of public sewers and stormwater systems within CCSD No. 1. The development plan review and permitting process is performed by WES staff in conjunction with development review and permitting conducted by the DTD and the Land Use Planning division within DTD. WES provides sewer and stormwater development review services for the City of Happy Valley areas within CCSD No. 1. The development review process includes subdivisions, partition plats, commercial and industrial development, single family residential (SFR), and other facilities that discharge into the public sanitary sewer or stormwater system.

The development plan review process is a critical element of WES policies and practices that affects watershed health. The design standards, rules, regulations, and administrative procedures for stormwater management applied by WES Development Review staff for the permitting of new development and redevelopment in the Districts have long-term consequences on water quality and hydrology in developed areas. These direct impacts also contribute to secondary impacts on aquatic habitat and biological communities.

Development Review processes for subdivision/partition, commercial, and single family permit approval was discussed by WES staff during two workflow mapping workshops, held on October 30 and November 19, 2008. WES staff collaborated at the workshops to revise the existing process map to reflect the actual processes for permit approval. The revised process maps are provided in Appendix A along with a detailed description of the current Development Review process. Appendix A also includes a summary of the current design standards for stormwater, which are used by developers, engineers, and contractors to guide the design of stormwater treatment systems included with new development.

Stormwater Design Standards

The design standards and requirements for stormwater management applied by WES Development Review staff for the permitting of new development in the Districts have long-term consequences on water quality, hydrology, aquatic habitat, and biological communities. The creation of impervious surfaces, removal of vegetation, and modification of topography during development alters hydrology and creates pathways for pollutants to enter water bodies. The requirements for stormwater treatment, site design, and site construction in the design standards are a key aspect of WES' work to protect and improve watershed health.

This section summarizes the current design standards in the Districts, which are used by developers, engineers, and contractors to guide the design of sites and the stormwater treatment systems included with new development. This summary is focused on elements of the design standards that affect watershed health, and is not intended to be a complete documentation of the current standards. In the assessment phase of the project, potential improvements to these design standards will be evaluated and recommendations will be developed to include in the Action Plan.

Stormwater is managed by WES using the following two documents: *Surface Water Management Agency of Clackamas County Rules and Regulations* (December 15, 2002) and *Surface Water Management Rules and Regulations for Clackamas County Service District No. 1* (February 1, 2005).

The standards for both Districts are largely the same. Key elements of the standards include the following:

- Under Section 5.2.4 Onsite Detention Design Criteria, CCSD No. 1 requires detention of the 25-year 24-hour post development flow to the 2-year 24-hour flow in areas with limited downstream capacity in the storm sewer system.
- CCSD No. 1 standards contains Section 5.3 Water Quality Standards that require treatment of two-thirds of a 2-year, 24-hour post development storm. The SWMACC standards contain a larger Section 6 on Permanent Onsite Water Quality Facilities.
- All development and redevelopment must include a system for controlling storm/surface water within the development without causing harm to the natural environment or to property or persons (Section 5.1.1.3). Some exemptions are provided for SFR development.
- Infiltration systems are required for all new development and redevelopment. Infiltration systems must be able to infiltrate runoff from storm events up to 1/2 inch of rainfall in 24 hours (Section 5.2.6). Treatment must be provided prior to or concurrent with the infiltration system; for example, infiltration can be incorporated into detention facilities. Exceptions to the infiltration requirement are allowed where soil conditions are not adequate for infiltration.
- Water quality treatment using vegetated treatment systems is required for all new development and redevelopment (Section 5.2.6). Acceptable vegetated treatment facilities are swales, filter strips, wetlands, wet ponds, and extended detention basins. Design criteria for these facilities are provided in Appendix D of the CCSD No. 1 Standard Surface Water Specifications.
- Proprietary mechanical stormwater treatment systems may be used with approval from WES. Currently approved proprietary systems include Stormceptor, CDS, Downstream Defender, Vortechnics, and Stormgate Separator.

Appendix A contains a more detailed summary of the standards for both Districts and a discussion of current issues and opportunities for future improvements identified during the process mapping workshops.

Erosion Prevention and Sediment Control

The ERCO program is intended to prevent erosion and improve sediment control at construction sites and existing stormwater facilities within WES' jurisdiction, including CCSD No. 1, SWMACC, Boring, Hoodland, Gladstone, and all 1200-C permit sites in Clackamas County. 1200-C permit sites are those in which construction activities disturb one or more acres of land, including smaller sites of less than one acre that are part of a larger common plan of development.

ERCO is very important to watershed health. Uncontrolled erosion at construction sites can contribute heavily to water quality problems including poor water clarity, high pollutant loads, damage to aquatic habitat, and maintenance problems in the storm drainage system from sediment deposition in pipes, catch basins, culverts, outfalls, ponds, and swales.

Grading permits are also an element of the erosion control permitting process in that erosion control inspections are completed as enforcement for grading permits. The grading permit process regulates and controls excavation, grading, and earthwork construction, including fills and embankments for issuance of permits. It also provides for approval of plans and inspection of grading construction. Whether or not a permit is required, all excavation and grading must conform to Clackamas County Code requirements, and must prevent erosion and control sediment as well as protect adjacent properties.

The WES process for erosion control permitting and inspecting for new construction sites was discussed by WES staff during two erosion control workflow mapping workshops, held on October 31 and November 19, 2008. WES staff collaborated at the workshops to revise the existing process map to reflect the actual process for new construction permits. The revised process maps for ERCO and grading as well as a summary of the current process are included in Appendix A.

WES currently provides erosion control services for development in CCSD No. 1, SWMACC, Boring, Hoodland, Gladstone, and in and out of District 1200-C permits. From July 2007 through June 2008, 817 erosion control permits were issued and 2,046 inspections were performed by CCSD No. 1 with 1.5 FTE. Happy Valley took over responsibility for administering the erosion control program within its city limits in 2005. Happy Valley performed 215 erosion control inspections from July 2007 to June 2008.

To maintain quality service to its customers, WES accepts call-in and over-the-counter complaints from the public with regard to erosion problems. Following receipt of a complaint, the receiver updates the WES maintenance management system. WES does not currently have an erosion control hotline phone number that is posted at construction sites to facilitate public reporting of erosion control problems, although a requirement for this is being considered for the future.

More information on the maintenance process is below. Appendix A contains a discussion of current issues and opportunities for future improvements identified during the process mapping workshops.

Stormwater System Maintenance

The WES Stormwater Maintenance program is responsible for inspecting and maintaining detention ponds and pipes, vortex separators, pollution control systems, catch basins, manholes, open channels including natural drainage features, and public underground injection control (UIC) systems.

The stormwater maintenance crew primarily inspects sites and prescribes maintenance work. Most field maintenance is performed by the sanitary maintenance crew.

As of 2008, WES Stormwater Maintenance is responsible for the following:

- 304 miles of stormwater pipe
- 23,000 storm structures including catch basins and manholes
- 262 detention ponds
- 700 detention pipes
- 31 treatment facilities (swales and underground devices)

The following Stormwater Maintenance staff and equipment are required:

- 0.2 FTE Program Manager
- 2.0 FTE Surface Water Technicians
- 3.3 FTE Collection System Technicians
- 1.2 FTE Seasonal Employees
- 1.0 FTE contracted with DTD
- Use of two fully equipped maintenance utility trucks

- Use of combination vacuum/hydrocleaner trucks (Vactor trucks)
- Use of regenerative air sweepers (for street sweeping)
- Use of pipe video equipment

Maintenance is performed primarily for cleaning and to ensure structural integrity. Catch basins, pollution control manholes and other debris capturing structures are cleaned periodically to remove sediment, pollutants, debris and other materials before they gain entrance into the storm system pipes and discharge to receiving waters. WES is directly responsible for maintenance in the maintenance agreement areas (generally all subdivisions constructed since 1998, including a large number in Happy Valley) and the storm sewer pipe network in the Districts. WES also began additional maintenance in the CCSD No. 1 road rights-of-way several years ago, although there is a lack of clarification of the responsibilities for stormwater infrastructure maintenance on Clackamas County roads.

In the maintenance agreement areas, which include over 240 subdivisions, WES collects a maintenance fee in addition to the standard surface water management fee from property owners. In other areas, the owners of stormwater treatment facilities and equipment are responsible for stormwater maintenance. However, in emergency situations, WES has stepped in and cleaned or serviced stormwater equipment or treatment systems in the past even when out of its jurisdiction.

Following is a summary of the maintenance activities conducted in CCSD No. 1 and Happy Valley as reported in the July 2007 to June 2008 Annual Report for the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit:

- 1,206 structures, 108 ponds, and 275 feet of storm line were inspected and/or cleaned
- 14.69 tons of material was removed from the non-pipe storm drainage components and 2.75 tons of material was removed from the storm drain pipes
- 3,801 feet of storm drain ditches were maintained and 546.6 tons of material were removed
- 757 miles of streets were swept in the KMS watershed by DTD (1,292 miles of streets were swept and 840 cubic yards of material was removed in all of CCSD No. 1)
- 105 miles of streets were swept and 50 cubic yards of material was removed by Happy Valley.

Currently maintenance activity is generated in one of two ways: by complaint or service request-generated activity, and by maintenance activity generated from the inspection of facilities. Other responsibilities of the maintenance staff include the inspection of facilities, the review of new development submittals for maintenance feasibility, and the acceptance of the facilities associated with new development.

WES is just beginning to develop its preventive maintenance program for stormwater assets. Data have been populated in the computerized maintenance management system for the past 14 months and an inspection system has begun. Currently, only 5 to 10 percent of the residential systems have been inspected through this program, although the stormwater ponds are inspected each spring. WES also has a 4-year-old cleaning program. Every maintenance agreement subdivision for which WES has responsibility has been cleaned at least once in this time-frame, and vortex separators are cleaned every 6 months.

WES Stormwater Maintenance is in the process of developing predictive maintenance programs for pond condition assessment and vortex cleaning. Maintenance staff also want to develop predictive methods for refurbishment and replacement of assets.

Street sweeping is contracted with DTD, and WES provides requests to DTD on occasion if it knows of a troubled area. Major arterial curbed streets are swept on a regular basis. The frequency varies depending on a variety of factors such as traffic volumes. In the KMS watershed, approximately 757 miles of streets were swept by DTD in 2007. Street sweeping within Happy Valley is the responsibility of the city. In October 2008, Happy Valley began sweeping all city streets once per month. Areas where street sweeping is conducted by WES and Happy Valley are illustrated in Figure 1-6.

WES processes for existing work orders, reactive requests, and new system acceptance were discussed by WES staff during two maintenance workflow mapping workshops, held on October 30 and November 19, 2008. WES staff collaborated at the workshops to revise the existing process map to reflect actual maintenance processes. The revised process maps and a summary of the current process are in Appendix A. Appendix A also contains a discussion of current issues and opportunities for future improvements identified during the process mapping workshops.

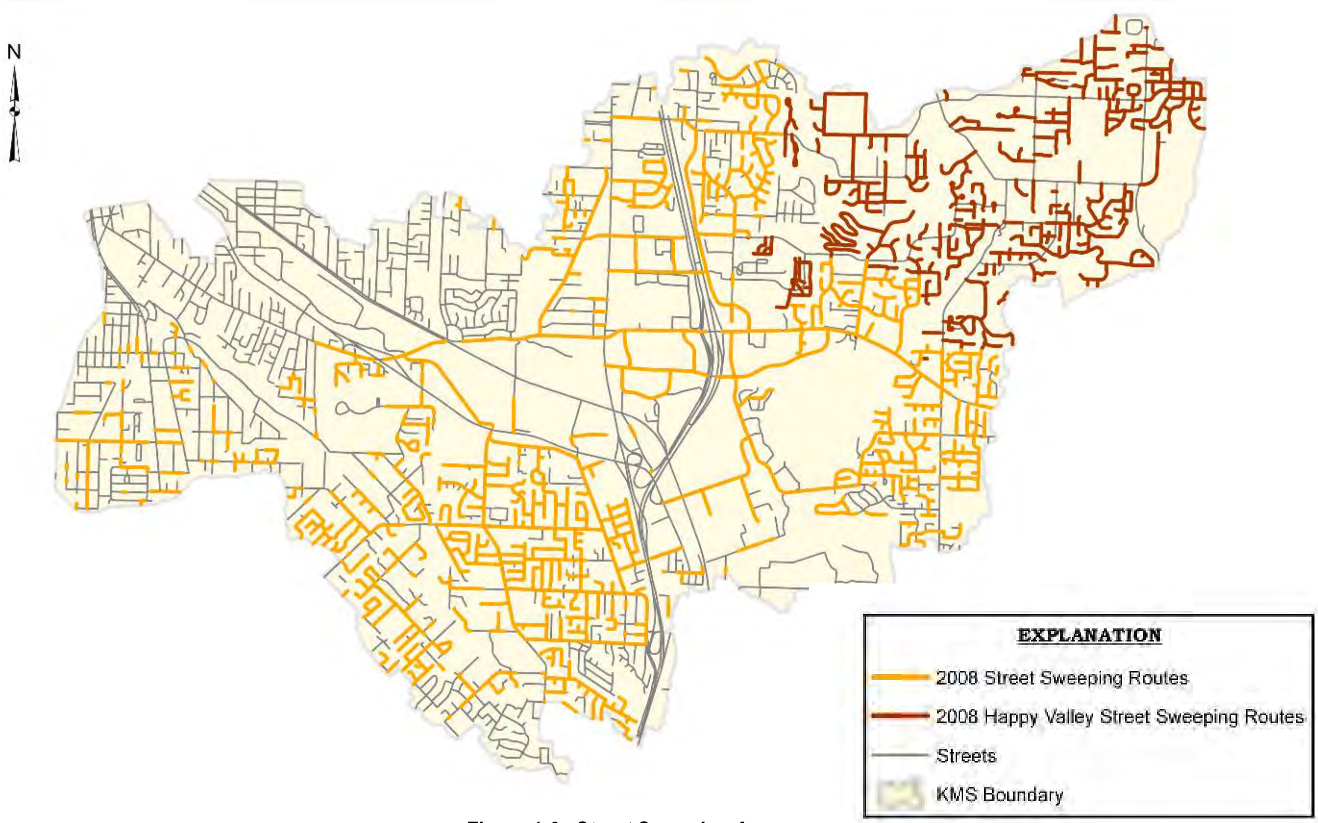


Figure 1-6. Street Sweeping Areas

Environmental Monitoring

The WES Environmental Monitoring program is responsible for tracking, reporting, and in some cases, managing environmental conditions associated with surface water, stormwater, and treated wastewater in order to meet regulations and permit requirements as well as WES program objectives. The Environmental Monitoring program includes environmental permit program management, laboratory operation, non-residential waste management, and a biosolids program. The Environmental Monitoring program includes the following staff:

- 0.2 FTE Program Manager
- 0.6 FTE Water Quality Analyst
- 0.2 FTE Sample Collection (through Compliance Services)
- 0.2 FTE Additional staff perform spill response and laboratory analysis on samples, and maintain continuous surface water monitoring equipment

Environmental Monitoring program staff conducted internal workflow mapping exercises during 2008. These process maps are provided in Appendix A. The environmental permit program management element is an important part of WES' work to comply with the Clean Water Act (CWA) and other regulations, and for the protection and improvement of watershed health. This element is summarized below and discussed in detail in Appendix A. Appendix A also contains a discussion of current issues and opportunities for future improvements identified during the characterization phase of the project.

Environmental Permit Program Management

The environmental permit program management element of WES is responsible for managing several permits, including the NPDES MS4 permit and the UIC requirements. The MS4 permit program is one of the key regulatory tools used to address the stormwater impacts from urban development. The UIC program regulates the discharge of stormwater below ground. This section includes a summary of the evolution of the MS4 discharge permit program requirements and of the watershed management activities and monitoring implemented by WES as a part of the MS4 permit program, as well as a summary of the UIC program.

Most parts of the MS4-permitted surface-discharging storm sewer system are comprised of piped storm sewers, but some swales and open ditches are also present. Many privately-owned surface discharging storm sewer systems are present near WES' MS4-permitted systems. These privately-owned surface-discharging storm sewer systems are not regulated by WES' MS4 permit.

NPDES MS4 Permit Background. In the early 1990s, the CWA required municipalities in metropolitan areas with populations greater than 100,000 to apply for and obtain an NPDES permit for their stormwater discharges under Phase 1 of the MS4 permit program. CCSD No. 1 and SWMACC (the Districts), Oak Lodge Sanitary District, Clackamas County (including DTD), and the Cities of Happy Valley, Rivergrove, Gladstone, Johnson City, Lake Oswego, Milwaukie, Oregon City, West Linn, and Wilsonville are Phase 1 co-permittees on an NPDES MS4 permit that is referred to as the Clackamas County MS4 permit. The Clackamas County MS4 permit was first issued by the Oregon Department of Environmental Quality (DEQ) in 1995. In August 2008, WES submitted a permit renewal application to DEQ which included an updated Stormwater Management Plan (SWMP).

As a part of the initial MS4 permit application, a joint SWMP was developed in 1993 for CCSD No. 1 and SWMACC. As total maximum daily load (TMDL) requirements are developed for streams that are in violation of water quality standards, the portion of TMDLs allocated for municipal stormwater are addressed through NPDES MS4 permits and the SWMPs.

The effectiveness of the SWMP is revisited annually. Each year, Clackamas County and co-permittees are required to submit an annual compliance report for their MS4 NPDES permit. The annual report is required to describe the status of implementing the components of the stormwater management program, proposed changes to the SWMP, and water quality monitoring results. The annual report provides an overall assessment of the permittees' actions to minimize pollutants in MS4-regulated stormwater systems. The annual reports contain a wealth of information about stormwater management activities undertaken in the Districts in the reporting year.

NPDES MS4 Program Implementation. According to the CWA, MS4 permittees must implement a program to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and systems, and design and engineering methods. The program varies by municipality and is intended to be developed in a flexible manner in consideration of site-specific conditions to optimize reductions in stormwater pollutants. The program includes BMPs, monitoring, and other available and reasonable controls, which are then documented as requirements in the permit and SWMP. SWMPs can be revised using adaptive management to improve overall program effectiveness.

WES' proposed 2008 SWMP is similar to the 2006 SWMP, which is the currently approved SWMP until the new permits are issued by DEQ. As a part of the 2008 permit renewal submittal, a comprehensive review of the SWMPs and an evaluation of program effectiveness, local applicability, and program resources was performed. As a result of this review, several changes were made to the 2008 SWMP including updating the monitoring plan to include a plan for sampling for selective pesticides and implementing a new BMP related to inspecting and maintaining private stormwater systems for new development. Further changes to the SWMP may be required during the permit negotiation process in 2009.

The proposed 2008 SWMP includes the following components with key BMPs listed beneath each component:

- Component #1: Structural and Source Control BMPs to Reduce Pollutants from Commercial and Residential Areas
  - Stormwater system maintenance
  - Planning procedures for new development
  - Street sweeping
  - Water quality and flood management projects
  - Public education to reduce the discharge of pesticides, herbicides and fertilizers
- Component #2: A Program to Detect and Remove Illicit Discharges and Improper Disposal Into the Storm Sewer System
  - Conducting dry weather inspections
  - Implementing the spill response program
  - Facilitating public reporting of illicit discharges and spills
  - Controlling infiltration and cross connections to the storm sewer system.
- Component #3: A Program to Monitor and Control Pollutants from Industrial Facilities
  - Addressing runoff from hazardous waste treatment, disposal, and recovery facilities, and other non-1200Z permitted industrial facilities
- Component #4: A Program to Reduce Pollutants in Stormwater Discharges from Construction Sites
  - Implementing requirements for structural and non-structural BMPs at construction sites
  - Identifying priorities for inspecting sites and conducting enforcement actions
  - Conducting training for construction site operators

Each BMP in the SWMP includes measurable goals and tracking measures appropriate for it. Progress toward measurable goals and the results of tracking of the BMPs are reported in the annual reports.

The BMPs in the SWMP encompass most of the policy and practice areas described herein. Several of the key BMPs have been described already in the earlier sections on Development Review, ERCO, and maintenance. Following is a summary of the water quality monitoring and illicit discharge detection and elimination performed as a part of the MS4 permit program, and a discussion of the UIC program.

Water Quality Monitoring. As part of the MS4 permit requirements, WES, and other Clackamas County co-permittees are required to develop and implement a stormwater monitoring program. WES currently administers a routine and storm event-related water quality and flow monitoring program within CCSD No. 1. Parameters currently measured as a part of the MS4 permit monitoring include dissolved and total metals (copper, lead and zinc), hardness, *E. coli* bacteria, nutrients (nitrogen and phosphorus), solids (total, dissolved, and volatile), and field insitu measurements of conductivity, pH, temperature, flow, and dissolved oxygen.

In addition to monitoring conducted for the MS4 permit program, WES also conducts periodic monitoring of other environmental conditions that are related to water quality, including benthic macroinvertebrate sampling, fish sampling, and associated habitat surveys. This monitoring is typically conducted under direction of the Environmental Policy Specialist as part of the Watershed Health functional program element of WES (described below) and is not performed by the WES Environmental Monitoring program. In the proposed 2008 Monitoring Plan, WES has proposed monitoring for selective pesticides as requested by DEQ. It is likely that many of the other Clackamas County co-permittees will conduct this monitoring jointly in a single coordinated study. The monitoring program is discussed further in Chapter 3 and in Appendix A.

Illicit Discharge Detection and Elimination. Twenty-nine major outfalls are located in the portion of CCSD No. 1 regulated by the MS4 permit program (CCSD No. 1-urban growth boundary). Major outfalls are defined as pipes greater than 36 inches in diameter, conveyance from lands zoned for industrial activity, and conveyance from lands serving a drainage area of more than 50 acres. In an effort to identify and control illicit discharges of non-stormwater substances to the stormwater system, each major outfall receives at least one dry-weather inspection per year.

UIC Devices. Discharges from injection-type storm sewer systems that discharge stormwater below ground are regulated by the federal Safe Drinking Water Act under a UIC program. Due to the program name, injection-type storm sewer devices are often called UIC devices or UICs. Discharges from injection-type storm sewer systems are not regulated by any MS4 permit because they convey stormwater to the subsurface rather than through an MS4 conveyance system into surface water bodies.

DTD and WES jointly own and manage about 150 injection-type storm sewer systems that are in or near CCSD No. 1. DTD and WES also jointly manage about 50 injection-type storm sewer systems near the SWMACC's MS4-permitted area. Nearly all of these stormwater injection devices are drywells, which are essentially perforated manhole shafts that discharge stormwater below the ground surface to infiltrate into the surrounding soil.

WES and DTD jointly applied for an area-wide Water Pollution Control Facility (WPCF) permit from DEQ for these devices on December 19, 2001. As of 2008, this WPCF permit had not been issued. A separate stormwater management plan guides WES' and DTD's stormwater management programs in the geographic areas that drain to drywells. WES is involved in an ongoing water quality monitoring program in Oregon related to UIC devices.

Environmental Policy and Watershed Health

WES employs 1.0 FTE as an environmental policy specialist in the Environmental Policy and Watershed Health functional program element. This element is a part of WES Administration. The responsibilities of the environmental policy specialist are varied and include assessing watershed conditions in the Districts, assisting in developing management strategies to improve or protect environmental conditions, assisting in public information and outreach efforts, reviewing WES and other County projects for permit compliance, and serving as a representative of WES on a wide variety of committees and advisory bodies addressing watershed health issues. The Environmental Policy and Watershed Health functional program element addresses numerous environmental regulatory programs including the Endangered Species Act (ESA). The Environmental Policy program element conducts periodic monitoring of environmental conditions that are related to water quality, including benthic macroinvertebrate sampling, fish sampling, and habitat surveys.

The Environmental Policy Specialist is responsible for all of WES' biological monitoring programs, developing and tracking watershed health performance metrics, and development of a Watershed Health Index. This staff person also is responsible for developing partnerships with other agencies and nonprofit groups in the implementation of watershed improvement projects.

Public Information and Outreach

WES administers a public outreach and education program which provides information that attempts to change behaviors and motivates residents and workers in the county to reduce stormwater pollution and improve watershed health. WES employs 1.0 FTE as a community relations specialist. This staff member is responsible for conducting public information and outreach related to both the sewer program and the surface water management program.

WES shares information with the public through newsletters, the WES website, brochures, and local public involvement campaigns including television and radio outreach. Additional information on public information and outreach activities conducted by WES as well as public survey results related to water resources in Clackamas County are provided in Appendix A.

Financial Services

WES operates the Districts and provides wastewater and surface water management services using revenue from several sources. The Surface Water Management (SWM) program for CCSD No. 1 is funded through three primary sources: monthly SWM utility fees, system development charges (SDCs), and permit fees.

The SWM fee is based on the amount of impervious surface on each site. The monthly surface water management fee is based on the Equivalent Service Unit (ESU). One ESU equals 2,500 square feet of impervious surface.

The current SWM rate is $6 per month per ESU in CCSD No. 1 and $4 per month per ESU in SWMACC. Single family residences are charged for 2,500 square feet of impervious service area or 1 ESU (shown as 1.00 unit on billing statements) per month, based on this average measurement. SFR customers who live in developments built since 1998 also pay a monthly maintenance agreement fee of $3 per ESU, which is dedicated for maintenance of local subdivision stormwater conveyance, detention, treatment, and infiltration facilities.

Non-single family properties, including businesses, schools, governments and industrial areas, pay based on measured impervious area. For example, a business with 10,000 square feet of impervious surface (4 ESUs) would be charged $16 per month ($4/10,000 square feet ÷ 2,500 square feet = $16). Through this approach, properties that generate more stormwater runoff and contribute more to the need for surface water management pay a greater proportion of the program costs.

SDCs are collected from new development and are dedicated to planning, design, and construction of additional stormwater infrastructure capacity needed to accommodate growth. The current SDC rate is $205 per ESU.

Table 1-4 compares the number of ESUs in July 2005 and 2006 for residential and commercial/industrial land uses. Excluding roadways, the amount of impervious area in CCSD No. 1 increased by 44 acres (749 ESUs) during this period from 2005 to 2006. Based on aerial mapping, new roadways (not reflected in customer billing records) are estimated to account for an additional 22 acres of impervious surface added in CCSD No. 1 from 2005 to 2006.

Table 1-4. Equivalent Service Units in CCSD No. 1 2005-2006

ESUs	July 2005	July 2006	Change
Residential	14,213	14,972	759
Commercial/industrial	29,112	29,112	0
Total	43,325	44,084	759

Based on the period from 2003 to 2007, the average annual growth rate for the ESUs was calculated to be 3 percent, which is generally considered to be a reliable predictor of average future revenue, although current economic conditions could result in a slower growth rate in the near future. Table 1-5 summarizes WES' projected surface water rate revenues for CCSD No. 1. This estimate uses the current surface water rate of $6 per ESU for CCSD No. 1. The surface water rate is held constant for estimating future revenue. The estimate also does not include revenue from SDCs.

Table 1-5. CCSD No. 1 Surface Water Rate Revenue Forecast

Year	ESUs	Rate revenue, dollars
2008	45,504	3,432,372
2009	46870	3,535,343
2010	48,276	3,641,403
2011	49,724	3,750,646
2012	51,216	3,863,165
2013	52,752	3,979,060

In the fiscal evaluation conducted as a part of the 2008 MS4 permit renewal, WES anticipates that the annual surface water budgets for CCSD No. 1 will continue to grow in order to meet regulatory requirements, system expansion, and to refurbish and enhance existing system facilities. In the permit renewal, it is noted that it is likely that future budgets may require rate increases and possibly additional staffing.

Other Clackamas County Departments

The following Clackamas County departments, divisions, and Districts also implement policies and practices that affect watershed health:

- Sustainability
- Development Agency
- Engineering
- Planning
- Parks Department
- North Clackamas Parks and Recreation District

Further details on each of these departments and divisions is provided in Appendix A.

Cities

The KMS watershed encompasses the Cities of Milwaukie, Happy Valley, Gladstone, and Johnson City as described earlier. CCSD No. 1 includes a service agreement with Happy Valley to provide stormwater management services.

The City of Milwaukie is currently undertaking an initiative called Kellogg for Coho, which is evaluating options to improve fish passage through the dam on Kellogg Creek at Highway 99 and restore Kellogg Lake to a free-flowing section of the stream. The primary option being evaluated is to remove Kellogg Dam during replacement of the Highway 99 bridge. The City of Milwaukie has held several public and stakeholder meetings on this project and has obtained some limited grant funds. The city has partnered with the U.S. Army Corps of Engineers (USACE) and has conducted a few preliminary environmental studies. WES is a current partner (limited at this time to staff support and study review and attendance at meetings) in the project and has been invited to all of these meetings. The City of Milwaukie and USACE are planning additional surveys and analysis of the project. The City of Milwaukie is continuing to look for additional partners and funding opportunities in association with its downtown and redevelopment plans.

Other Agencies and Organizations

A wide variety of other agencies and organizations implement policies and practices that affect watershed health in the KMS watershed, including state and federal agencies, Metro, local service providers, watershed groups, community groups, and others.

Data Reviewed

WES has numerous internal and external data sources available to characterize and assess the watershed. This Characterization Report (Chapters 1 through 4) is based primarily on existing data available as of August 2008. Following is a partial listing of key materials that were reviewed for Chapters 1 through 4. A full list of all materials reviewed for the Characterization Report is available in the Summary of Existing Information in Appendix B. In the following chapters on hydrology, water quality, and aquatic habitat and biological communities, key data sources reviewed for each section are also described.

- Draft MS4 NPDES Permit Stormwater Management Plan for Clackamas County Service District No. 1 and the City of Happy Valley, Updated July 2008.
- Surface Water Management Rules and Regulations for Clackamas County Service District No. 1, February 1, 2005.
- Surface Water Management Administrative Procedures for Clackamas County Service District No. 1, January 3, 2003.
- Metro Goal 5 Resource Classification (Fish and Wildlife Habitat) and other various related maps.
- A Watershed Assessment of Kellogg and Mt. Scott Creeks, Final Report, MWH, November, 2001.
- Kellogg-Mt. Scott Creeks Watershed Surface Water Master Plan, Montgomery Watson, July 1997.
- Technical Memorandum: Natural Resource Assessment of Rock and Richardson Creeks, URS Corporation, December 1999.
- Rock and Richardson Creeks Master Plan, WES/URS, 2000.
- Distribution of Fish and Crayfish and Measurement of Available Habitat in Streams of the North Clackamas County, WES/ODFW, 1997-1999.
- Assessment of Macroinvertebrate Communities in Streams of North Clackamas County, Oregon, 2002, ABR, Inc., March 2003.
- Baseline Assessment of Stream Habitat and Macroinvertebrate Communities in and Adjacent to the Damascus Area Urban Growth Boundary Expansion, Oregon, ABR, Inc. May 2004.
- Stormwater Management Program Master Plan Update Project – Stream Reach Evaluation Tool for Assessing Potential Urbanization Effects of the Damascus Concept Plan on the Rock Creek Subwatershed, Clackamas County, Oregon; Prepared by Bob Storer and Carol Murdock (WES), and Lori Hennings (Metro), 2006.
- Clackamas County Service District No. 1 Surface Water Management Program Master Plan, Final Report, April 2006, (Prepared by Shaun Pigott Associates, LLC; Pacific Water Resources, Inc.; GeoSyntec Consultants; Donovan Enterprises, Inc.; and Norton Arnold & Company).

CHAPTER 2 - HYDROLOGY

Overview

This chapter summarizes hydrologic conditions in the Kellogg-Mt. Scott (KMS) watershed based on an evaluation of existing data, modeling results, and reports of watershed conditions. Key sources of information regarding hydrology in the KMS watershed include the following:

- Hydrologic and hydraulic models of the watershed
- Federal Emergency Management Agency (FEMA) flood maps
- Oregon Department of Fish and Wildlife (ODFW) Habitat Assessment Surveys
- WES Geographic Information System (GIS) database
- Field visit to the watershed during a significant storm event
- Previous studies and master plans for the KMS watershed

Key indicators of watershed health related to hydrology include flood conditions and channel erosion. These indicators are affected by watershed hydrology and stream channel hydraulics as well as by channel morphology. This chapter evaluates the current hydrologic conditions in the KMS watershed, including the types of hydrologic impacts that have been observed in the watershed, the extent of flood impacts, and the future risks to stream channels as the watershed continues to develop. Hydrology, hydraulics, and channel morphology are evaluated to identify watershed stressors and responses.

Key issues related to hydrology in the KMS watershed include the following:

- **Urbanization.** The KMS watershed, located in northern Clackamas County, is a highly urbanized watershed. Urbanization and the associated changes in hydrologic conditions have resulted in concerns about flooding, impacts to channel morphology, and degradation of watershed health. There is extensive background in the scientific literature about the impacts to stream channels and changes to the timing and magnitude of peak events as well as the chronic impacts due to the duration of high flows that result from uncontrolled stormwater runoff from urban areas. Although overbank topping of stream channels is a natural part of the hydrologic function of watersheds, when watersheds are developed, the magnitude and frequency of flooding typically increases. The impacts to streams and associated biological communities as well as to development in the floodplain from increased flooding associated with urbanization can become problematic.
- **Hydrologic and Geomorphic Data.** Limited hydrologic and geomorphic data are available to assist in evaluating historical, current, and future watershed conditions and potential risks. Unfortunately, data on historic hydrologic conditions are not widely available for the KMS watershed. Long-term, high-quality stream gauge records are not available for the watershed and data vital to evaluating channel and in-channel morphology, such as repeat cross-sections, bank erosion surveys, or bed substrate data are not available. Instead, this characterization relies primarily on existing information collected on channel conditions from habitat surveys and makes inferences about potential future risks given expected changes in the hydrologic condition associated with future development. The primary data sources available to characterize existing conditions and conduct an analysis of future risk include hydrologic and hydraulic modeling prepared by Pacific Water Resources (PWR) and FEMA, and a

channel conditions assessment recently prepared by ODFW as part of a comprehensive aquatic habitat and fish abundance surveys. These data were used, in conjunction with a GIS database available from WES, to evaluate historic, existing, and future hydrologic and geomorphic conditions in the watershed.

- **Flooding Impacts.** The results of the analysis suggest that hydrologic changes have occurred in the watershed and that future changes associated with future development are also expected. Flooding risk is already a potential problem, with extensive flooding areas possible in Upper Kellogg Creek and in the lower portion of Mt. Scott Creek along the Highway 224/Interstate 205 (I-205) urban corridors. Although current design standards for stormwater are intended to reduce the hydrologic impacts associated with new development, future development may exacerbate flooding areas unless steps are taken to retrofit existing developments to reduce the timing and volume of water delivered to stream channels.
- **Channel Modification.** In addition to the potential hydrologic changes in the watershed, there is risk associated with the corresponding potential morphologic responses of the channels. Geomorphically, it is difficult to evaluate how channels have changed over time due to hydromodification and loss of floodplain associated with development. Many of the direct channel modifications most likely occurred pre-development when the land use was converting from forest to farmland. Those conversions often included ditching and relocating channels to drain wetlands and enhance the prospect for farming. Those changes most likely drove an initial wave of incision that was arrested through grade control measures at road crossings and other locations. The biggest impact from urbanization is most likely associated with increased impervious areas and associated higher storm flows resulting in channel widening (i.e., bank erosion).

Further analysis of existing and potential future flooding issues and channel modification problems associated with altered hydrology were conducted during the assessment phase of the project, and appropriate management strategies for Water Environment Services (WES) to undertake to address these issues are provided in Chapter 5.

Data Reviewed

Evaluation of the historic and existing hydrologic and geomorphic conditions in the KMS watershed relied primarily on existing data, reports, and modeling results provided by WES. Key data sources that were reviewed are summarized below.

Hydrologic Model

The HEC-HMS hydrologic computer model is a modeling tool developed by the U.S. Army Corps of Engineers (USACE) Hydrologic Engineering Center (HEC) as a Hydrologic Modeling System (HMS). An HEC-HMS model prepared by Pacific Water Resources (PWR) as part of the Clackamas County Service District No. 1 (CCSD No. 1), Surface Water Management Program Master Plan (SWMPMP, or 2006 Master Plan), April 2006, was reviewed. The modeling simulated several hydrologic scenarios under the SWMPMP using input information such as rainfall, topography, land cover, drainage infrastructure, and soil hydrologic properties. The model variables were adjusted to assess pre-developed or 1930s forested, existing (as defined during the preparation of the SWMPMP), and future conditions to produce discharge estimates for the 1-, 2-, 5-, 10-, 25-, 50-, and 100-year return intervals. The PWR hydrologic modeling covers the entire KMS watershed. The hydrologic reaches generated as part of the subwatersheds and channel network delineation constitute the reach delineation framework adopted for this study. Figure 2-1 summarizes the extent of the channel network and subwatershed stream reaches used in this study.

Hydraulic Modeling

The available HEC-RAS (River Analysis System) hydraulic modeling for portions of Kellogg, Mt. Scott, Phillips, and Dean Creek watersheds was reviewed. The extent of the hydraulic modeling on Kellogg and Mt. Scott Creeks is shown in Figure 2-1. Based upon review of the SWMPMP, the HEC-RAS models have several different origins. The reaches of Lower Kellogg Creek, Mt. Scott Creek, Phillips Creek, and Dean Creek (also locally known as Deer Creek) were translated from HEC-2 to HEC-RAS by PWR during the SWMPMP process. The topographic data that was used to generate the HEC-2 models are based upon field survey data from the early 1980s generated by the USACE, which consisted of approximately five to six survey points. The simplified nature of the cross-section data limits what applications to which the model can be applied. It is our understanding that hydraulic structures, such as bridges and culverts, were resurveyed for the SWMPMP and the model has been updated to reflect current conditions. Based upon the findings of the SWMPMP, the HEC-RAS model for Upper Kellogg Creek meets FEMA standards because of an update prepared in 2000 to support a Letter of Map Revision in 2001. This subwatershed reach of the modeling is therefore considered to be accurate for the purposes of the watershed assessment.

FEMA Flood Insurance Rate Maps

To evaluate areas in the watershed where flooding is likely to occur, GIS shapefiles representing the FEMA 100-year or Base Flood Mapping, and the effective mapping, from FEMA, dated June 17, 2008, were reviewed. The effective Flood Insurance Rate Maps (FIRMs) maps have been updated recently through the FEMA Digital FIRM (DFIRM) process. The DFIRM process updates the old paper maps to digital files in GIS. The floodplain boundaries on the DFIRM are consistent with the old paper maps. The FIRMs illustrate the extent of flooding resulting from the 100-year or base flood event. The FIRMs also illustrate the floodway for each creek. The floodway is the 'channel' of the creek and the adjacent land areas that must be protected in order to discharge the base flood without cumulatively increasing the water surface elevation locally more than 1 foot.

1996 Flood Event Inundation Maps

In 1996, the Portland region experienced extensive flooding associated with heavy, low elevation snowfall followed by a prolonged period of intense precipitation. This rain-on-snow event was widespread and affected small watersheds such as KMS as well as large watersheds such as the Willamette River. This 4.3 day event began at approximately 8 a.m. on February 5 and ended at approximately 4 p.m. on February 9, totaling 6.95 inches of rain. To evaluate the extent of flooding in the Portland region, Metro, the regional planning agency, conducted aerial reconnaissance and produced an aerial photo series and associated product depicting flooding extent in the urban region. These data provide a useful tool for not only visually assessing the extent of flooding during a major event, but to evaluate and calibrate the quality and accuracy of previous and future modeling efforts. Mapped areas only include areas in the lower portions of Kellogg and Mt. Scott Creeks, where broader floodplains exist and/or the flooding persisted long enough for the aerial photos taken at the time to capture the inundated areas.

Oregon Department of Fish and Wildlife Habitat Assessment Surveys

In 2008, ODFW fish biologists conducted a comprehensive assessment of habitat and channel conditions in the lower portions of the KMS watershed. The extent of the surveys are shown in Figure 2-2 with a description of reach identifiers used in the ODFW data and in the PWR data presented in Table 2-1. The purpose of the assessment was to evaluate aquatic habitat conditions and fish populations and abundance within the WES service district area. The habitat assessments were conducted using ODFW Aquatic Inventories basin-type protocols for fish habitat surveys (Moore et al., 2007). Geomorphic variables measured during the survey include an estimate of the percent of the delineated reach that was experiencing active erosion, channel geometry characteristics, active channel and floodplain widths, and substrate.

Although the focus of the study was primarily biological, a significant amount of data are available that describe channel morphology and dynamics. Data were provided to WES in a GIS database format, which was then linked to the reaches delineated for the watershed characterization.

Water Environment Services GIS Database

WES maintains a comprehensive and up-to-date GIS database for its service district areas and surrounding region. Consequently, this database was available to the Watershed Action Plan (WAP) assessment team for review and analysis. In most cases, WES staff members provided the necessary data evaluations and outputs and provided them to the WAP assessment team. GIS layers that are important for the hydrologic and geomorphic analysis include the FEMA floodplain mapping, 1996 flood maps, reach layers from the PWR studies, roads, land use, geology, soils, flooding complaints, and parcel boundaries, etc. In addition to the GIS database, the WAP assessment team incorporated data layers from other sources such as the U.S. Geological Survey (USGS).

Field Visit to Kellogg-Mt. Scott Creeks during Significant Storm Event

On January 2, 2009, a significant storm event occurred in the KMS watershed. This 1.3 day event began at approximately 7 p.m. on December 31, 2008, and ended at approximately 3 a.m. on January 2, 2009, totaling 3.95 inches of rain. The event produced localized flooding on several roads. A WES consultant conducted a field visit approximately 8 hours after the peak flows occurred to evaluate the stream conditions and identify areas where flooding may have occurred. Due to the timing of this event, the results of the field visit were not evaluated extensively for this Characterization Report (Chapters 1 to 4). Further analysis of the 2009 field visit results were incorporated in the Assessment Report (Chapter 5), along with information collected by WES staff during other recent significant storm events.

Upper Kellogg Creek Flood Hazard Reduction Projects Report

The Upper Kellogg Creek Flood Hazard Study (Harper, Houf, Righellis, Inc., 2000) evaluates current flooding problems in the Upper Kellogg Creek watershed and discusses possible solutions to reduce the existing flood conditions. The report identified several potential projects including channel widening, detention storage, and improving several road crossings. Several conclusions of the report can be summarized as follows: 1) some of the recommended projects, such as channel widening to improve conveyance, would be difficult to permit and would require significant mitigation; 2) replacing road crossings potentially would lead to loss of flood storage and increased peak flows downstream; and 3) the area available for potential detention in the system would lead to only very minor reductions in peak flow rates.

Kellogg and Mt. Scott Creeks Watershed Assessment

Montgomery Watson Harza completed a study in 2001 to evaluate opportunities in the Kellogg Creek Basin to enhance and restore Coho salmon, steelhead trout, and coastal cutthroat trout populations. The study evaluates conditions in the watershed to support these species and assesses limiting factors for discrete segments of the primary channel. The key areas addressed include existing fish passage barriers, water quality, adjacent land use pressures, and in-channel habitat conditions. Where available, population estimates are presented and reviewed. The general conclusions of the report are that multiple factors limit fish production and sustainable populations in Kellogg Creek that are linked primarily to urban land uses and the effect those uses have on water quality, habitat continuity, and the resilience of the system to support fish. A significant portion of the report is devoted to a conceptual discussion of the passage issue at the mouth of Kellogg Creek.

Data Gaps

The purpose of the data gaps analysis is three-fold:

- Identify gaps or deficiencies in existing information that limit understanding of watershed conditions and potential project opportunities
- Identify data gaps that limit the ability of WES to evaluate watershed conditions long-term
- Identify gaps in monitoring and other data sources that, if these data were available, would provide WES with the opportunity to evaluate the success of any implemented action

Following is a discussion of potential data gaps based on those criteria.

Hydrologic Modeling Data

In general, the hydrologic modeling is founded on quality information and was prepared relatively recently, making it more than adequate for use in the current study. Its limitations consist of those that are inherent in all hydrologic modeling, such as limited calibration data, calibration at a single point in the watershed, and lack of model confidence at the site-specific scale.

The primary limitation identified during the investigation of the hydrologic modeling is the generation of discharge values for forested conditions. It is our understanding that flows for an historic, forested condition were generated using the existing conditions model with adjustments made to the model parameters that generate runoff to mimic a forested condition. Upon evaluating the results, many of the low order tributaries produce a 2-year and 10-year peak flow that is very small (0.1 cubic feet per second) or even zero in some cases. These values are in most cases tens to hundreds of times lower than the expected 2-year runoff event under existing conditions. Even with fully forested watersheds, one would expect some surface runoff to occur during a 2-year rainfall event.

When the forested condition modeling results are used to calculate a Flashiness Index, which is defined in a current WES project as the ratio between the current 2-year discharge and the 10-year forested discharge, the results are potentially misleading. Therefore, it is recommended that the forested peak flow results and the Flashiness Index should be used with caution.

The primary limitation of developing discharge events for a forested, pre-development condition is that it is difficult to predict the runoff values for a condition in which calibration or verification data are not available. In addition, the channel network and runoff processes may be quite different which is not reflected in the modeling effort. To achieve realistic results from the model, it is generally not as simple as merely changing the hydrologic properties of the soil, modifying the land cover, and altering the area covered by impervious surfaces. Groundwater dynamics have most likely changed, affecting baseflow, return flow, and saturated overland flow. If these changes are not reflected in the model, the pre-development, forested condition may not be accurate. Without historic runoff gauge data for the watersheds to assist in evaluating these historic changes, it is difficult to have high confidence in the results of the pre-development, forested model scenarios.

The HEC-HMS model could be re-calibrated to better predict historic conditions in the KMS watershed. To improve or increase the accuracy of the existing hydrologic modeling runoff rates for a pre-development, forested condition, reference data from a forested watershed could be used, constituting a reference condition. It may also be possible to locate peak flow data for a watershed of similar natural characteristics that is currently forested. Alternatively, the model could be calibrated using USGS regional regression equations for forested conditions, similar to the process used by PWR for the existing conditions model.

Geomorphic Data

The geomorphic analysis for this study is based primarily on the recent data collected during ODFW's habitat assessment surveys. Because the focus of the surveys was to evaluate fish populations and aquatic habitat conditions, and the primary surveyors were fisheries biologists, rigorous application of the data to evaluate channel morphology, channel geometry, and channel stability need to be placed in the context of the data collection effort. In addition, much of these data were collected at the habitat unit scale and have been compiled and averaged at the reach scale. For example, the ODFW *Manual for Stream Habitat Assessments* (1999) states:

> **"Percent Actively Eroding Bank:** Estimate the total percent of distance on both sides of the habitat unit (up to 100%) that is actively eroding at the active channel height. Active erosion is defined as currently eroding, recently eroding, or collapsing banks that may show exposed soils and rocks, evidence of tension cracks, active sloughing, or superficial vegetation that does not contribute to bank stability."

The ocular estimate is averaged at the habitat scale and does not consider the mechanism, severity of erosion, or type of material being eroded. All that is being considered is the unit length of erosion along a streambank which may or may not have consequences for biological integrity or watershed health. Although the data are valuable and provide us with the ability to compare relative rates of bank erosion from one reach to the next, they should not be extended to other types of analysis such as an attempt to calculate sediment delivery from bank erosion or contribute to an overall sediment budget for the watershed.

Another limitation of the ODFW study for the purposes of the watershed assessment is the limited spatial extent of the survey in comparison to the extension network of channels that exist in the watershed (Figure 2-2). The ODFW survey focuses on channels in the watershed that have the potential to support salmonids and where landowner permission is granted. Consequently, it is the mainstem channels that are surveyed. Unfortunately it is often the smaller, steeper headwater channels that are at the most risk when a watershed converts from rural to urban land uses. The lack of a comprehensive channel conditions dataset for these smaller headwater channels is a significant data gap in this study.

The frequency of overbank flow was evaluated in this characterization as a proxy for understanding channel and floodplain interactions and the potential for channel instability associated with high flows and energy being focused in the active channel during large storm runoff events. The dataset used to evaluate overbank flow frequency was the cross-section data from the hydraulic model. Unfortunately, the data for the hydraulic model were adapted from the data in the FEMA model, which is low-precision data collected in the early 1980s. Although the analysis was conducted, the quality and age of the data result in a coarse-level analysis and generally limit our conclusions to order-of-magnitude estimates of where channels frequently access floodplain and where they generally do not.

The missing pieces of geomorphic data that would be a valuable set of tools to understand channel morphology, stability, and long-term changes include the following:

- **Channel Modification Mapping.** Acquisition of historic aerial photos and mapping to document channel modifications was beyond the scope of this study. In addition, many of the most significant channel changes, such as conversion of a natural stream to an agricultural ditch, relocation of a channel, or straightening, most likely occurred prior to the first aerial photos of the watershed being available (typically late 1930s). Nonetheless, a robust dataset using historic aerial photos would be a valuable tool for understanding how past impacts to channels have affected channel function, morphology, and physical habitat. Also, this analysis could be improved through a detailed documentation of current bank modifications, hard structures, and in-channel structures, etc. If a repeat study by ODFW is completed in the future, it would be valuable to add a team member to document and map existing channel conditions in addition to establishing historic channel conditions.

- **Bank and Channel Stability Analysis.** A comprehensive analysis of bank stability, especially in those areas where bank erosion risk is deemed to be of concern, would provide valuable data. There are a variety of techniques available to evaluate bank and channel stability. This analysis would provide a credible tool to define at risk areas and allow WES to prioritize potential restoration and treatment areas.
- **Cross-section Monitoring Stations.** Data currently does not exist to evaluate long-term conditions of the channel such as widening or incision. Establishing a network of cross-section monitoring stations would be an effective way to monitor channel conditions long-term. In addition to cross-section monitoring, the sites could be used to evaluate bed substrate conditions and possibly even extended longitudinally to evaluate pool-riffle ratios, benthic macroinvertebrates, embeddedness, and pool depths at key locations in the watershed.

In summary, the current dataset used to characterize the watershed is adequate in understanding reach-scale conditions and to prioritize at-risk areas in the watershed where data are available. What is currently limiting our ability to evaluate conditions throughout the watershed is the lack of data in the smaller tributary channels and headwaters. Consequently, we are unable to characterize these areas, except in the most general terms. Devising a field strategy to evaluate areas where survey information is not available will be an important gap to fill. Without that data we may be missing project sites that are an important component of the overall strategy to improve watershed health. Unfortunately, devising a strategy to collect data in these areas is limited by their inaccessibility, the number of channels that would need to be assessed, and the need to obtain landowner permission to conduct surveys.

Watershed Conditions

In this section, watershed conditions discussed include hydrology and hydraulics, and channel morphology.

Hydrology and Hydraulics

The watershed setting, streamflows, flashiness index, and hydraulic modeling and mapping are discussed below.

Setting

The climate of the KMS watershed is characterized by a wet season and a dry season. The wet season typically runs from October to May and the dry season runs from June to September with most of the precipitation occurring as rainfall. Although snowfall occurs on occasion, it typically melts within several days and is not a significant component of the hydrologic cycle. Average annual rainfall ranges from 35 to 40 inches in the watershed with little to no orographic effect given the lack of significant relief across the watershed. As mentioned earlier, the rainfall depth and duration of the 1996 and 2009 storm events were 6.95 inches over 4.3 days and 3.95 inches over 1.3 days, respectively. For comparison, the 24-hour design storm depths for CCSD No. 1 are 2.4, 3.0, 3.4, 4.0, 4.5, and 50 inches for the 2-year, 5-year, 10-year, 25-year, 50-year and 100-year storm, respectively.

Streamflow

There is a lack of long-term measured discharge data for the streams in the KMS watershed. Several continuously monitoring streamflow gauges have been established in the watershed. WES has not conducted an analysis of the streamflow gauge data recently. Both gauges have been operating for a limited time, and are therefore not currently useful for understanding long-term changes in the magnitudes of peak flow events.

To generate peak discharge data for the hydraulic models, PWR built a hydrologic model using HEC-HMS for the watershed. A summary of the peak discharge rates predicted by the HEC-HMS hydrologic modeling for the SWMPMP are presented in Table 2-2. Values are presented at various locations in the watershed for the 2-, 10-, and 100-year return intervals for pre-developed or 1930s forested condition, existing condition (as defined during the preparation of the SWMPMP), and predicted future condition. The HEC-HMS hydrologic model was calibrated to a limited amount of historic gauge data. The calibration was performed using limited gauge data available from 2001 on Upper Kellogg and Philips Creek. PWR performed a check of the predicted peak flow rates by comparing them to USGS Regional Regression Equations. Since that time, WES has collected additional data on streamflow during several large storm events.

As discussed in the data gaps discussion, the predicted flows under forested pre-development conditions may be underestimated. In most cases, existing flow conditions are estimated to be two orders of magnitude greater than estimated flows under pre-development conditions. Further evaluation of this issue in the future would be helpful for additional hydrologic and hydraulic analysis.

There have been several large storm events in the KMS watershed that created significant stream flows in Kellogg and Mt. Scott Creeks and the tributaries. Photos 2-1 through 2-14 follow. Some from the January 2, 2009 event are compared to photos of lower flow conditions where available.

Photos 2-1 and 2-2. Kellogg Creek at confluence with Willamette River on January 2, 2009 and August 13, 2008

Photo 2-3. Kellogg Creek at Oatfield Road on January 2, 2009

Photo 2-4. Kellogg Creek at Oatfield Road on January 2, 2009

Photo 2-5. Kellogg Creek near Keuhn Road on January 2, 2009

Photo 2-6. Kellogg Creek near Upper Aldercrest Drive on January 2, 2009

Photo 2-7. Kellogg Creek near Upper Aldercrest Drive on January 2, 2009

Photos 2-8 and 2-9. Kellogg Creek upstream of Clackamas Road on January 2, 2009 and August 13, 2008

Photo 2-10. Off-channel Flooding near Kellogg Creek upstream of Clackamas Road on January 2, 2009

Photo 2-11. Mt. Scott downstream of Rusk Road on January 2, 2009

Photo 2-12. Mt. Scott Creek upstream of Rusk Road on January 2, 2009

Photo 2-13. Mt. Scott Creek upstream of SE 84th Ave. on January 2, 2009

Photo 2-14. Mt. Scott Creek upstream of SE 84th Ave. and Oak Bluff Road on January 2, 2009

Flashiness Index

In June 2008, PWR was retained by WES to conduct a study in which several different methods were researched for creating a watershed Flashiness Index. The Flashiness Index yields a numerical value that is used as a proxy to evaluate whether or not a channel is stable or unstable as a result of increased urbanization of a watershed. The purpose of a Flashiness Index is to characterize the magnitude of urban development in a given watershed by developing relationships between pre-developed or historic flow rates and those measured or modeled under today's land use condition.

Based upon the lack of availability of stream data to support other more complex methods, PWR chose to use an index developed by Booth and Jackson (1997). Booth and Jackson postulated that when the 2-year recurrence interval flow under current conditions (Q_2 current) is greater than the 10-year recurrence interval flow under forested conditions (Q_{10} forest), stream channels in the analysis area are potentially at risk to become unstable. The Flashiness Index is a measurement of the ratio of Q_{10} forest/Q_2 current. When the Flashiness Index is equal to or less than 1, the stream channel is considered to be potentially at risk of becoming unstable.

As previously discussed, the HEC-HMS modeling results for the forested conditions runoff rates appear low. Low forested runoff rates yield low values in the Flashiness Index which potentially could lead to unreasonable assumptions about the degree of instability of stream channels in the KMS watershed. Given the level of uncertainty associated with the estimated pre-development flows, at best the Flashiness Index should be used to evaluate only the relative potential of channel instability between reaches in the watershed. If field investigations show that a specific reach is stable, then one could generally assume that another reach in the same watershed with a similar Flashiness Index value could also be stable, all other conditions being equal. Reaches with values below those of verified stable reaches could then potentially be considered unstable. The best approach would be to calibrate the Flashiness Index with field data by evaluating actual channel stability conditions at a range of index values. If a local relationship could be developed, that relationship could be applied to stream reaches that were not surveyed to estimate the potential for instability.

The results of the Flashiness Index calculations for the KMS watershed are illustrated in Figure 2-3. The results suggest that the Kellogg Creek mainstem and smaller tributaries, both upstream and downstream of the Mt. Scott confluence have low Flashiness Index values, a sign of channel instability. Conversely, the Mt. Scott mainstem has a relatively low Flashiness Index value, with higher index values present in some of the Mt. Scott tributaries.

Since the Flashiness Index values are derived from modeling information that relies predominately on land cover/land use data, the results ultimately reflect the level of development in areas contributing flow to the stream channel with a cumulative effect as you move downstream. In the case of the Kellogg Creek channel, that portion of the watershed is more developed and has less open space, whereas the Mt. Scott watershed is still in the process of developing and has more open space such as Mt. Scott and Mt. Talbert, and the Three Creeks area.

Hydraulic Modeling and Mapping

FEMA publishes a set of maps defining the 100-year floodplain. These identify the anticipated flooding areas associated with a 100-year recurrence interval storm event (which is the event with a 1.0 percent probability of occurring in any given year). The maps are referred to as FIRM and dictate locally which parcel owners may purchase federal flood insurance. FEMA recently updated its FIRM product, known as DFIRM, in 2007, but the study results are still based on modeling completed in 1983-1984. WES recently commissioned a study in 2007 to revise the hydraulic modeling and 100-year flood extent mapping for Kellogg-Mt. Scott. This study was completed by PWR and is currently under review by FEMA as part of a petition requesting a FIRM revision.

Since the more recent 100-year floodplain maps are still under review by FEMA and have not been certified, we relied primarily on the FIRMs currently published by FEMA to evaluate the extent of flooding on KMS Creek and the degree to which property and structures are affected by the flooding. In addition, we extended our analysis to include mapping provided by WES and Metro depicting the extents of flooding during the 1996 flood event. It is unclear if the 1996 event constituted a 25-, 50-, or 100-year flood event in the Kellogg Creek watershed because gauge data are not available to do a reasonable statistical evaluation. Regardless, it was one of the larger events on record and presents an opportunity to assess actual flooding conditions to those modeled and published by FEMA as a 100-year event. The results of the field visit to the watershed during the January 2, 2009 storm event are compared briefly with the hydraulic modeling and mapping results discussed below.

Figures 2-4 and 2-5 depict predicted flooding conditions on KMS streams during the 100-year recurrence interval event. In Figure 2-4, the FEMA 100-year floodplain data is depicted along with the parcels that fall within the 100-year floodplain. Please note that some parcels are somewhat large and may have been highlighted through the analysis despite the fact that only a small portion of the parcel is affected by flooding. In addition to depicting which parcels are affected by flooding, we have identified locations in the watershed where structures occur in the floodplain and also where flooding complaints have been logged by WES from property owners who are experiencing flooding.

It is apparent from the analysis that most of the predicted flooding in the watershed occurs on Kellogg Creek and the lower portions of Mt. Scott Creek along the Highway 224/I-205 corridors. In addition, the 1996 flood mapping data appear to follow closely the flooding extents depicted in the FEMA mapping. More specific information follows.

- **Lower Kellogg Creek.** Based upon review of FEMA mapping, the floodplain width in Lower Kellogg Creek is relatively narrow with the exception of Kellogg Lake. A few structures are located within the floodplain, but it appears that only two flood-related complaints since the early 1990s have been recorded in the WES database for this reach of Kellogg Creek. Localized yard flooding along Oatfield Road and Aldercrest Road was observed during the January 2, 2009 storm.
- **Upper Kellogg Creek**. Based upon review of FEMA mapping, the floodplain of Upper Kellogg Creek has several areas of overbank inundation and backwater into areas adjacent to the creek, including minor tributaries. Data obtained from Clackamas County illustrates that a history of structure flooding has occurred in and around the following locations: northeast of Southeast Aldercrest Road and Southeast Hill Loop, west of Southeast Clackamas Road as it crosses Upper

Kellogg Creek, northwest of Southeast Mabel Avenue as it crosses Upper Kellogg Creek, and Southeast Lillian Avenue east of Webster Road. Much of these areas contain large segments of hydric soils. Flooding was observed during the January 2, 2009 storm in these areas.

- **Lower Mt. Scott Creek.** FEMA mapping illustrates that the Lower Mt. Scott Creek reach has a much wider floodplain than Kellogg Creek, inundating several adjacent land areas. Most notable flood-prone areas are the North Clackamas Park, the mixed use area between Highway 224 and the railroad tracks, and the area upstream of the railroad tracks to the confluence with Phillips and Dean Creeks. Clackamas County records indicate that there are three clusters of documented structure flooding. These areas are immediately east of North Clackamas Park, the mixed use area just upstream of Highway 224, and near the confluence of Dean Creek. Much of these areas contain large segments of hydric soils. Flooding was observed during the January 2, 2009 storm in these areas.
- **Phillips Creek.** FEMA mapping illustrates that Phillips Creek has a relatively narrow floodplain width with the exception being near the confluence with Mt. Scott Creek. No records indicate reports of structure flooding or complaints being filed since the early 1990s. Phillips Creek was not visited during the January 2, 2009 storm event.
- **Dean Creek.** FEMA flood maps indicate that Dean Creek produces flooding in and around the industrial/commercial area upstream of the confluence with Mt. Scott Creek. As with Phillips Creek, no structure flooding reports have been filed since the early 1990s. Much of these areas contain large segments of hydric soils. Dean Creek was not visited during the January 2, 2009 storm event.

Using the cross-section data from the hydraulic model prepared by FEMA, a reach-level analysis was prepared to identify what return event is expected to cause the flow in the creek to leave the main channel and flood the overbank or floodplain areas. Using the HEC-RAS models, the water surface elevations for several return intervals were calculated and examined within a given reach to determine when flood water overtopped the banks. A database for each reach was created for use in the GIS dataset.

Figure 2-6 illustrates the results of the channel-floodplain interaction analysis. Please note that this analysis, as discussed in the data gaps section, is highly dependant on the accuracy of the survey field data. The HEC-RAS models in most of the stream reaches utilize outdated and potentially inaccurate survey data, bringing into question the precision of the results of this analysis. The following observations were made regarding the results:

- **Lower Kellogg Creek.** The data suggest that Lower Kellogg Creek does not readily access its floodplain except in events greater than the 10- to 25-year return period design storms. This is not surprising given the fact that the channel is confined to a narrow gorge and lacks much natural floodplain. Consequently, the result is more an artifact of the valley morphology than an indication of channel incision or poor access to the floodplain. One large floodplain actually still exists just downstream of the KMS confluence. A field evaluation may show that some remnant floodplain exists in other areas, but this reach has been heavily developed and experiences nuisance flooding of backyards.
- **Upper Kellogg Creek.** Upper Kellogg Creek is less confined than Lower Kellogg Creek. The hydraulic modeling indicates that flow in many of the reaches can access the floodplain in events as frequent as the 2-year event. While access to the floodplain is more frequent than Lower Kellogg Creek, a number of flood-prone structures are also located within the floodplain, and Clackamas County records indicate that a number of structures have experienced flood damage.
- **Lower Mt. Scott Creek.** Lower Mt. Scott Creek has a much larger mapped floodplain area than Lower or Upper Kellogg Creeks. The hydraulic modeling indicates that flow in many of the reaches can begin accessing its floodplain in events as frequent as the 5-year event. Two areas, the North Clackamas Park and the areas immediately upstream of the railroad tracks, do not contain flood-prone

structures and allow the creek to flood without damage. The area upstream of Highway 224 and the railroad tracks contain a number of flood-prone structures and a high degree of impervious cover such as structures and pavement.

- **Phillips Creek.** Phillips Creek is fairly incised, allowing little access to a floodplain area. The most upstream reaches do not flow overbank in events as large as a 100-year event. Only the lower reaches begin to flow overbank but only during events greater than a 5-year event, most likely influenced by backwater from Mt. Scott Creek. Phillips Creek is highly modified and drains a highly modified and impervious watershed.
- **Dean Creek.** The lower reaches of Dean Creek spill flow to the floodplain in between the 2- and 5-year events. Based upon the proximity to the confluence of Mt. Scott Creek, it can be assumed that the overbank flow in the lower reaches is likely influenced by backwater elevations rather than an active floodplain. The upper reaches access the floodplain only in large events greater than a 50-year event.

Additional analysis is needed to evaluate and compare the observed flooding conditions in the KMS watershed with the modeling results. WES staff have observed flooding during relatively small precipitation events (e.g., 2- and 5-year events). The function of the flood control facility and the Three Creeks Natural Area during high flow events also needs further evaluation.

Channel Morphology

In this section, the geologic setting, watershed processes, and channel conditions are discussed.

Geologic Setting

The KMS watershed is sandwiched between Johnson Creek to the north and the Clackamas River to the south, flowing primarily in a westward direction to meet the Willamette River near downtown Milwaukie. The shape of the watershed, location of the mouth, and topography of the watershed have been influenced significantly by the Boring Lava Domes, created more than 2 million years ago, the presence of the Clackamas River, a large tributary to the Willamette River, and recent and persistent catastrophic flood events on the Columbia River known as the Missoula Floods. The Missoula Floods, occurring as recently as 10,000 years ago, may have altered significantly the location of the historic confluence of the Clackamas and Willamette Rivers, pushing the Clackamas River mouth to the south as alluvial material, delivered from the Columbia River Gorge, was deposited to the north in the Portland Basin. The surficial geology of the KMS lowlands is dominated by Quaternary deposits consisting of glaciofluvial, lacustrine, and fluvial sedimentary deposits with the highlands dominated by basalts from the Columbia River deposits and the Boring Lavas (Figure 2-7).

Watershed Processes

Channel morphology is affected by a variety of watershed processes. Stream channels function in a physical sense to transport watershed products and energy, including water, sediment, woody debris, and nutrients, to the lower end of the catchment. All of the fundamental characteristics of the channel, such as planform, capacity, and width to depth ratio, are reflective of the quantity and characteristics of watershed products supplied to the channel, and eventually transported through it. Changes in the quantity or characteristics of watershed products supplied to the channel are likely to result in changes in fundamental channel characteristics, although the link between the watershed and the channel is complex and specific channel response to watershed changes may be difficult to predict (Lisle, 1999).

There are a variety of erosional processes that contribute sediment to stream channels, including landsliding, slumping, rilling, debris flows, and bank failures. Each process differs by the quantity, timing, and grain size of sediment delivered to stream channels that may act as impairing sediment to salmonid production and rearing. Also, each process can be classified into sources that are natural and those that are a result of human land use impacts. Erosion sources can be classified into those that are episodic and those that are chronic.

Landsliding results from weak geologic formations, steep topography caused by tectonic uplift, and occurrence of intense periods of rainfall and seismic forces. Landslides often terminate at and impinge upon stream channels, sometimes feeding a seemingly endless supply of fine material directly into the channels. In the worst cases, chronic sediment loading from landslides can eliminate pools, riffles, and coarse substrate for hundreds of feet below the point of delivery. An important mechanism to store delivered sediment and attenuate sediment delivery downstream relates to the presence of large woody material and debris jams (Keller and Talley, 1979; Keller et al., 1981).

Steep slopes are an important factor in erosion in general and for landslides in particular. Weathered bedrock, soils, and colluvium are subject to saturation by rainfall. Saturated conditions can produce a nearly instantaneous and deadly failure of a rapidly moving landslide called a *debris flow*. Debris flows occur during intense periods of rainfall after hundreds of years of persistent slope wash and colluvium accumulation in swales. The swales are often underlain by bedrock, which has a lower permeability than the overlying colluvium. When the rate of rainfall exceeds the rate that the colluvium and soil can drain water off, the saturated zone or water table above the less permeable bedrock deepens. When the saturated mass overcomes the resistance holding it on the hillslope, the mass liquefies instantly and moves down the hillslope carrying trees, soil, and whatever else is in its path. In some cases, water separates from the debris flow mass as it reaches lower gradients and a debris torrent is unleashed—a wall of mud and debris that moves very fast and is extremely destructive.

Road building is a common and often dominant theme in land use disturbance. From farm road development to driveways and public thoroughfares, roads are required for access to nearly every land use. Roads are also generally the largest pollutant load generator in the urban environment and by far the most destructive element in the landscape as far as excessive fine sediment generation per unit area. Roads constructed along canyon floors and steep inner gorge slopes cause channel realignment resulting in direct delivery of sediment to streams. Erosion from road surfaces, ditches, shoulders and other human-induced land clearing contribute mostly fine-grained sediment. Paved and unpaved roads modify local hillslope drainage patterns, concentrate flow, and increase runoff rates. Runoff on roads concentrates over soils exposed on the roadbed and shoulder, drainage ditches, road cuts, sidecasts and fills. In terms of managing sediment loads to reduce aquatic habitat impairment, fine sediment source reduction from roads often will be the most effective treatment. Road crossings also can impact the channel erosion by constricting access to the floodplain and increasing velocities around bridges.

Bank erosion, reworking of old floodplain deposits, and drainage network expansion associated with gullying also contributes significantly to the amount of fine sediment in the channel. These sources contribute fine sediment directly to the channel and have a significant impact on aquatic habitat conditions. Reworking of old floodplain deposits that might have been delivered to the stream channel due to historic land uses may be especially important in watersheds where there is a history of logging and splash damming.

Several researchers have attempted to describe a predictable evolutionary sequence of channel response to urbanization (Simon, 1989; Arnold et al., 1982; Gregory et al., 1992; Park, 1997). One model, developed by Douglas (1985) describes a conceptual relationship between land use changes, relative sediment yield, and channel stability. At the onset of urban development, this model suggests the sediment yield would be very heavy due to increased runoff from impervious surfaces, resulting in increased gullying, undercutting, and bank erosion. The impact on channel stability would be rapid aggradation and some bank erosion. Assuming no net increase in urbanization, the Douglas model predicts that a watershed would proceed through a period of stabilization that would last on the order of 25 years. During this period, sediment yields would be moderate as channels adjusted to the new hydrologic condition and readily available sediment supplies were exhausted. Reduced sediment yields during this transitional period would result in channel degradation and severe bank erosion. Eventually, the channel is expected to reach a stable urban condition with low to moderate sediment yields and a relatively stable channel. This whole channel evolutionary process is expected to take 50 to 75 years due to lags in land use change and channel response. The timing would be highly dependent upon the size of the watershed, the rate of urbanization, and the time it takes for land use conditions to stabilize.

Urbanization in the KMS watershed has proceeded at a relatively rapid rate over the past 30 years with, presumably, a response along stream channels associated with an increase in the frequency and magnitude of discharge. In addition to the changes in the hydrology, the channel has been directly modified, stream crossings have been constructed, floodplains have been modified, and riparian areas have been impacted. The most likely effect has been in inability for stream channels in the watershed to adapt to the changes in hydrologic and physical conditions, resulting in increased bank erosion, channel incision, a reduction in morphological variability, and an inability of the stream channel to maintain and create new, high quality physical habitat. Since the watershed continues to change, new equilibrium conditions cannot be reached.

Channel Conditions

Morphologically, stream channels in the KMS basin can be divided into four distinct provinces consisting of the Lower Kellogg Creek canyon, the broad alluvial plain represented by Upper Kellogg Creek and Lower Mt. Scott Creek, including the Three Creeks area, the middle reaches of Mt. Scott Creek, and the upper reaches of Mt. Scott Creek within Happy Valley. These morphologic provinces can be observed easily by evaluating channel slope (Figure 2-8) and the degree to which the channel is confined within a valley. Channel slope, though available from estimates provided as part of the ODFW habitat surveys, was derived, by reach, through the use of a 10-meter digital elevation model.

The underlying differences in the morphologic provinces are primarily associated with differences in the surficial geologic units, valley confinement, and channel slope. The characteristics dictate channel bed conditions and what material dominates in the reach, as depicted in Figure 2-9 from the ODFW data. Coarse substrate was defined as gravel, cobble, or boulder. A high percentage of coarse material in the bed most likely indicates a bed that is resistant to significant scour. Figure 2-9 suggests that stream reaches with a coarse bed are associated with higher gradient channels that are more confined. Channels that lack significant coarse substrate are associated with lower gradient areas where the channel flows through large alluvial valleys, such as in the Three Creeks area or Upper Kellogg Creek.

To better characterize stream reaches in the project area based on morphologic conditions, and provide a common language to describe channel conditions, the Rosgen (1994) classification system was used. Since ODFW data were the primary data source used to classify stream channels, Rosgen's basic classification system was used rather than his more complex system. Additionally, the extent of classification mapping was limited to the ODFW survey area. Consequently, lower order tributaries and headwater channels were not classified.

The key variables that Rosgen uses to classify streams are channel slope, degree of channel entrenchment, dominant substrate, width to depth ratios, and sinuosity to assign a reach identifier to the channel consisting of a letter from A to G and a number from 1 to 6. The letter represents the channel and valley form, from narrow to wide valley, and the number represents the dominant substrate, from bedrock to silt/clay. In most cases, the key variables that define the class assigned to a particular reach are the channel slope, degree of entrenchment, and the dominant substrate.

For the classification of KMS, the channel slope derived from the Digital Elevation Model, and the degree of entrenchment and dominant substrate data included in the ODFW database were used. The degree of channel entrenchment, or entrenchment ratio (Figure 2-10), is calculated as the ratio of the flood-prone width and the active channel width. Flood-prone width is measured in the field as the width of the valley at two times the bankfull, or active channel, depth. Conceptually, entrenchment is meant to describe the extent of floodplain along a reach. Channels confined in narrow valleys or channels that are incised into historic floodplain will have a low value for the entrenchment ratio and consequently be highly entrenched. Using these two variables, reaches within the ODFW study area were classified (Figure 2-11). Adjustments were made to the classes for each reach based on field observations of the channels. Reaches classified as 'A' or 'B' channels are typically better functioning than those classified as 'F' or 'G' channels since 'F' and 'G' classes represent incised conditions of 'B' channels and are associated with low entrenchment ratios. Additional field work is required to verify the classification in many of these areas. Nonetheless, this represents an initial attempt to characterize the morphology of the mainstem reaches.

Another important parameter that was included in the ODFW assessment is an estimate of the degree to which bank erosion was occurring along each reach. As mentioned previously, this variable is recorded by the surveyors by estimating what percent of the stream banks are eroding within each surveyed habitat unit. WES staff then compiled this information by reach by taking a weighted average of habitat units along the reach. The results, presented in Figure 2-12, suggests that the stream banks through the lower portions of Mt. Scott, specifically in the Three Creeks area, is the area where bank erosion is most active, with greater than 7 percent of the banks eroding. These results are consistent with other data suggesting that the Three Creeks area lacks coarse substrate in the bed, and presumably in banks, and is experiencing incision.

Potential Future Risks and Further Analysis Recommended

The KMS watershed has experienced rapid urbanization over the last several decades, with the resulting hydromodification altering the timing and frequency of peak flow events significantly. Water that historically was intercepted by vegetation, absorbed into the soil, and discharged slowly through natural runoff processes now runs off roads, roofs, sidewalks, and other impervious areas, to the creek through a direct and efficient flow path. Since most of the development occurred prior to concerns being raised about the effects of hydromodification on stream channels, the KMS watershed is especially at risk of future channel changes as the creeks adjust to the modified hydrologic regime.

In addition to the modification over the past several decades, portions of the watershed are still developing rapidly, in particular the Happy Valley area. Although the design standards for new development are intended to minimize changes to the hydrologic regime from future development, the timing and magnitude of peak discharge events will likely still be altered by the new development.

To analyze expected future changes in flows under a future built-out conditions, PWR adjusted its hydrologic model to account for the expected increase in impervious areas. Figure 2-13 summarizes the expected changes that would occur at the 2-year recurrence discharge under full build-out condition. The data are presented as a ratio between the expected future 2-year discharge event and the current 2-year modeled discharge event. The results, therefore, depict the expected geometric increase in discharge.

The results of the potential future flow analysis suggest that most of the modeled reaches could see flow increases of greater than 50 percent with most of the mainstem reaches expecting a 200 percent or more increase in flow. These types of flow increases on top of flow increases associated with past development could have a severe and lasting affect on channel conditions as well as the potential for increased flooding of the lower mainstem channels of Kellogg and Mt. Scott Creeks.

To evaluate how increased peak discharges would affect the potential for an increase in flooding, scenarios could be run using the HEC-RAS model to evaluate changes to the 100-year floodplain footprint. Since the model has been built already and the future flow hydrology has been developed, running an expected future 100-year flood scenario would be a straightforward and useful exercise. This information could then be combined with the parcel and structure database to generate a figure similar to what we present in Figure 2-4 for expected future conditions.

As mentioned previously, hydromodification of the watershed has the potential to affect the morphologic character of stream channels that receive stormflows. The effect is often observed throughout the channel network since, functionally, the geometry of a stream channel (e.g., channel width, channel depth) is directly correlated with discharge. The dominant theory suggests that the geometry of the channel is dictated by a specific channel forming flow that typically falls in the range of the 1.5- to 2.33-year recurrence event. Since these frequent peak events occur often, averaged over time they typically perform the most work. Large floods obviously do a significant amount of work to the channel and floodplain and are responsible for events such as avulsions and debris flows, but when a new active channel is formed it is typically responding to the more frequent and smaller discharge events.

When the hydrology of a watershed is modified, the observed changes vary spatially and temporally. Headwater channels often incise, widen, and experience headward migration. Erosion in these headwater channels result in aggradation and widening of higher order channels downstream. Eventually the headwater channels adjust and the process is typically transferred downstream. Mainstem channels often go through cycles of aggradation and downcutting in response to the processes occurring in the lower order channels upstream. Typically bank erosion is a significant issue in mainstem channels as they aggrade and downcut.

In addition to the risk to channels, changes in local runoff patterns associated with roads, an increase in impervious areas, and removal of vegetation also have the potential to increase the risk of landslides and debris flows in zero order basins. Figure 2-14 depicts areas in the watershed that are at risk of mass failures, overlain onto a land use map of the watershed. High erosion risk areas are defined as slopes steeper than 30 percent underlain by highly erodible soils. The most at risk areas appear to be the inner gorge along stream channels, specifically Lower Kellogg Creek, the terrace bluffs, and the buttes associated with the Boring Lavas. Additional development is expected around Mt. Scott which presents a relatively high risk of mass failure.

To evaluate the potential future risk of continued hydromodification on stream channels, we used existing data available from the ODFW assessment along with data layers provided by WES. One of the most significant concerns stemming from hydromodification is likely to be bank erosion. Channel incision most likely has been arrested in most locations due to road crossings and instream structures that act to hold grade. As the total amount of energy increases in a channel, due to an increase in peak flow, much of the additional work will be focused on stream banks as the channels attempt widen, meander, and build floodplain that has been lost due to past incision. Eroding banks, though inherently a natural process, can be problematic when the erosion is excessive. Banks that are currently eroding are more likely to be at risk than banks that are currently stable because it implies something about the composition and condition of the existing bank and potentially the geomorphic setting.

Figure 2-15 summarizes the ODFW bank erosion analysis. Reaches where 5 percent or more of the banks are currently eroding are presented as at-risk of eroding further in the future in response to changes in the hydrology. The areas of most concern are Lower Mt. Scott Creek and the portion of Upper Kellogg Creek upstream of the confluence with Mt. Scott Creek.

Stream channels with roads directly adjacent to the channel also present a future risk. When roads are located close to the channel, it is likely those roads have had an impact on the floodplain or even resulted in direct modification of the channel during construction. Channels modified by the impingement of roads are often less stable. As changes to the hydrology occur, these channels may be more at risk of bank erosion or downcutting. To assess the location of these roads, WES calculated the length of road within a 25-foot buffer on either side of the creeks for each reach. To better understand the results, we made the assumption that roads within 25 feet of the channel most likely run parallel to the channel and only along one side of the channel. That assumption allowed us to estimate the percent of channel length that was impacted by a road.

The results of the road analysis are presented in Figure 2-16. The results suggest that roads primarily impact the first order and headwater channels in the KMS watershed and mostly along the urban core areas within the Highway 224/I-205 corridors. These channels may also be a significant source of delivered fine sediment to the mainstem channel.

In our final risk analysis, we attempted to overlay several variables included in the ODFW database to assess current and expected future risks to overall channel stability. After evaluating several variables, we decided to use the following criteria to identify channels where stability may be an issue:

- **Gradient.** Lower gradient channels are often inherently more unstable than higher gradient channels because they are primarily alluvial in nature, meaning they are underlain by mobile substrate and can therefore adjust spatially across the valley floor, the bed is often less coarse or armored, and they tend to occur lower in the watershed where sediment loads are delivered and deposited.
- **Entrenchment.** Entrenchment is often used as a proxy for understanding the potential energy acting on the channel bed and banks and the degree to which the floodplain is accessed. Highly entrenched channel will, by definition, have higher per unit shear stresses which can affect channel stability.
- **Bed Substrate.** Channels with coarse, armored beds are typically more stable over the long-term than channels with a bed, and presumably banks, composed of finer material. Although armored beds still have the potential to incise over time through selective coarsening, the magnitude of incision is much less than in beds composed of finer, more mobile material.

Using these variables, we selected reaches where the gradient is low (less than 2 percent), entrenchment is high (entrenchment ratio < 1.4), and coarse substrate composes less than 25 percent of the bed. The results are presented in Figure 2-17. Channels that meet the criteria are confined to the mainstem of Mt. Scott Creek from the Three Creeks area up through the I-205 and Sunnyside corridors.

Further analysis of these issues and integration of the hydrologic data with the data on water quality, aquatic habitat, and biological resources was conducted for the watershed assessment phase of this project, which is contained in Chapter 5.

Bibliography

Arnold, C., Boison, P., and Patton, P. 1982. Sawmill Brook, an example of rapid geomorphic change related to urbanization. Journal of Geology, 90, 155-166.

Booth, D.B. and Jackson, C.R.. October 1997. Urbanization of Aquatic Systems: Degradation Thresholds, Stormwater Detention, and the Limits of Mitigation. Journal of the American Water Resources Association, Vol 33, No. 5, p 1077.

Douglas, I. 1985. Urban sedimentology. Progress in Physical Geography, 9, 255-280.

Gregory, K., Davis, R., and Downs, P. 1992. Identification of river channel change due to urbanization. Applied Geography, 12, 299-318.

Harper, Houf, Reghellis, Inc. 2000. Upper Kellogg Creek Flood Hazard Reduction Projects Report. Prepared for Water Environment Services, Clackamas County Service District No. 1.

Keller, E. A and Talley, T. 1979. Effects of large organic debris on channel form and fluvial processes in the coastal redwood environment. In D. D. Rhodes and G.P. Williams (eds.) Adjustments of the fluvial system, p. 169 -197. Proceedings, Tenth Annual Geomorphology Symposium. State University of New York, Binghamton. Kendall/Hunt Publishing Co. Dubuque, Iowa.

Keller, E. A., MacDonald, A., and Tally, T. 1981. Streams in the coastal redwood environment: The role of large organic debris. In R. N. Coates (ed.) Proceedings of a Symposium on Watershed Rehabilitation in Redwood National Park and Other Pacific Coastal Areas, p. 167 -176. Center for Natural Resource Studies, John Muir Institute, Inc.

Lisle, T. 1999. Channel Processes and Watershed Function. In: *Using Stream Geomorphic Characteristics as a Long-term Monitoring Tool to Assess Watershed Function*. Proceedings of a symposium held at Humboldt State University, March 18-19, 1999. Fish, Farm and Forest Communities Forum, Sacramento, CA.

Oregon Department of Fish and Wildlife. 2008. Draft Report: Fish species distribution and abundance and habitat assessment of streams in Clackamas County Service District No. 1. Prepared by Alex Neerman and Jessica Vogt.

Park, C. 1997. Channel cross-sectional change. In: Changing River Channels, edited by A. Gurnell and G. Petts, John Wiley and Sons, Chichester, 117-145

Pacific Water Resources, Inc. 2008. Hydrologic flashiness index. Prepared for Water Environment Services, Clackamas County Service District No. 1.

Rosgen, D. 1994. *A classification of natural rivers*. Amsterdam, The Netherlands: Elsevier Publications.

Shaun Pigott Associates, LLC, Pacific Water Resources, Inc., GeoSyntec Consultants, Donovan Enterprises, Inc., Norton Arnold & Company. 2006. Final Report: Surface Water Management Program Master Plan.

Simon, A. 1989. A model of channel response in disturbed alluvial channels. Earth Surface Processes and Landforms, 14, 11-26.

Montgomery, Watson, Harza. 2001. Final Report: A watershed assessment of Kellogg and Mt. Scott Creeks.

FIGURES 2-1 TO 2-17
TABLES 2-1 AND 2-2

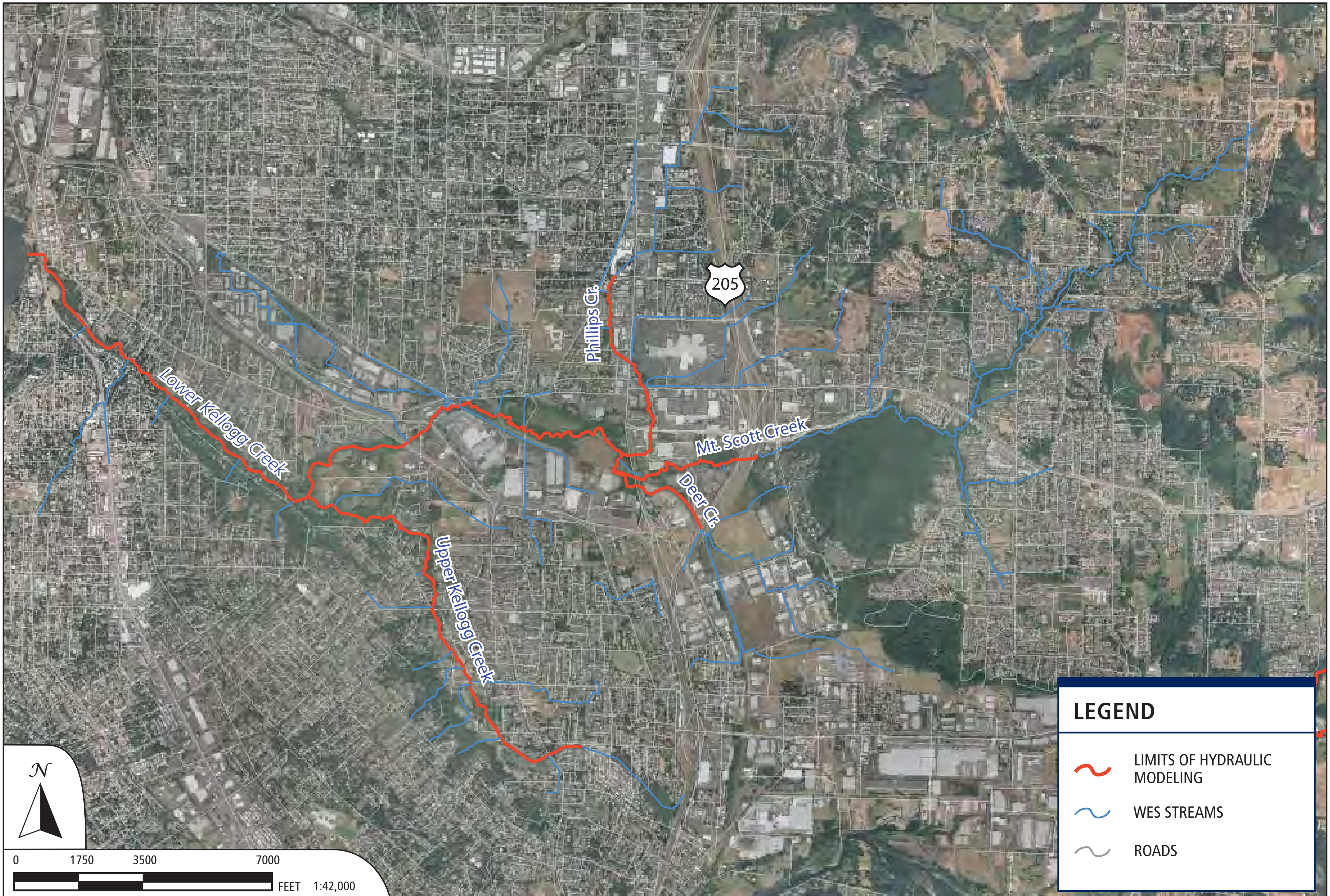


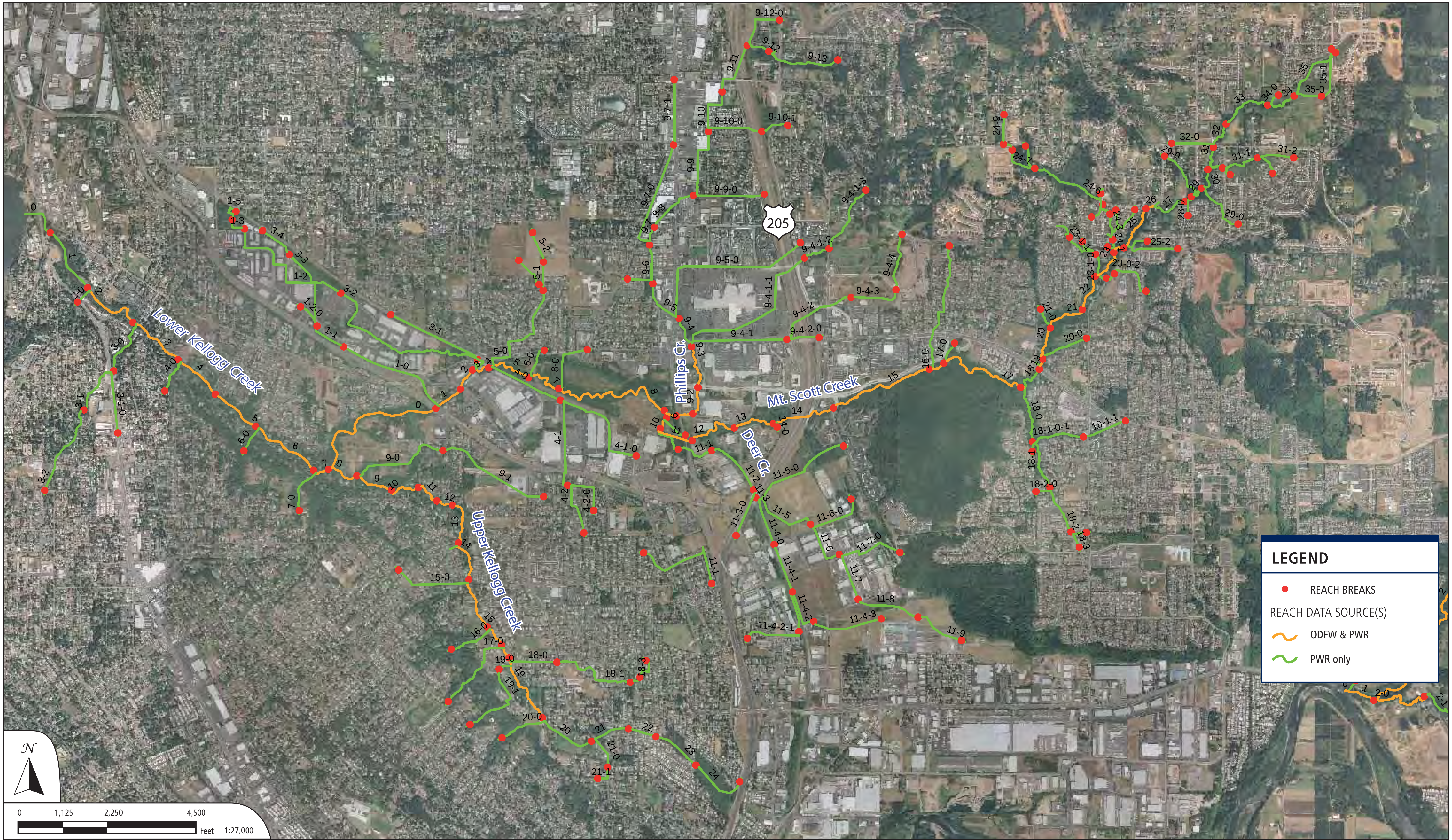
Figure 2-1
Kellogg/Mt. Scott - Hydraulic Modeling
ExtentsWES WATERSHED ACTION PLAN

Water Environment Services
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL

SWANSON HYDROLOGY + GEOMORPHOLOGY

Ellis Ecological Services, Inc.



WATER ENVIRONMENT SERVICES
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

Figure 2-2
Kellogg/Mt. Scott - Extent of Data Sources
WES WATERSHED ACTION PLAN

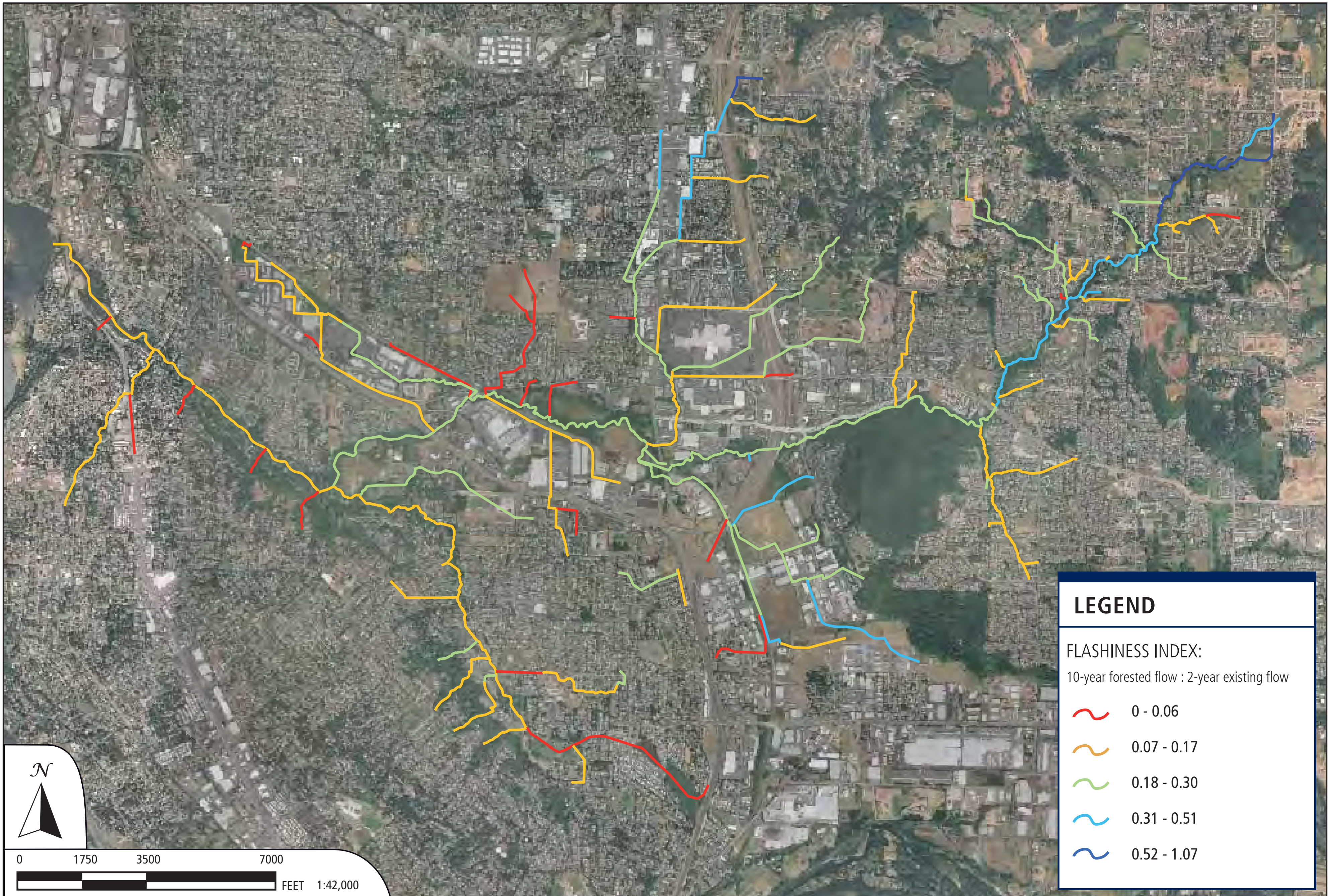


Figure 2-3

Kellogg/Mt. Scott - Flashiness Index

WES WATERSHED ACTION PLAN

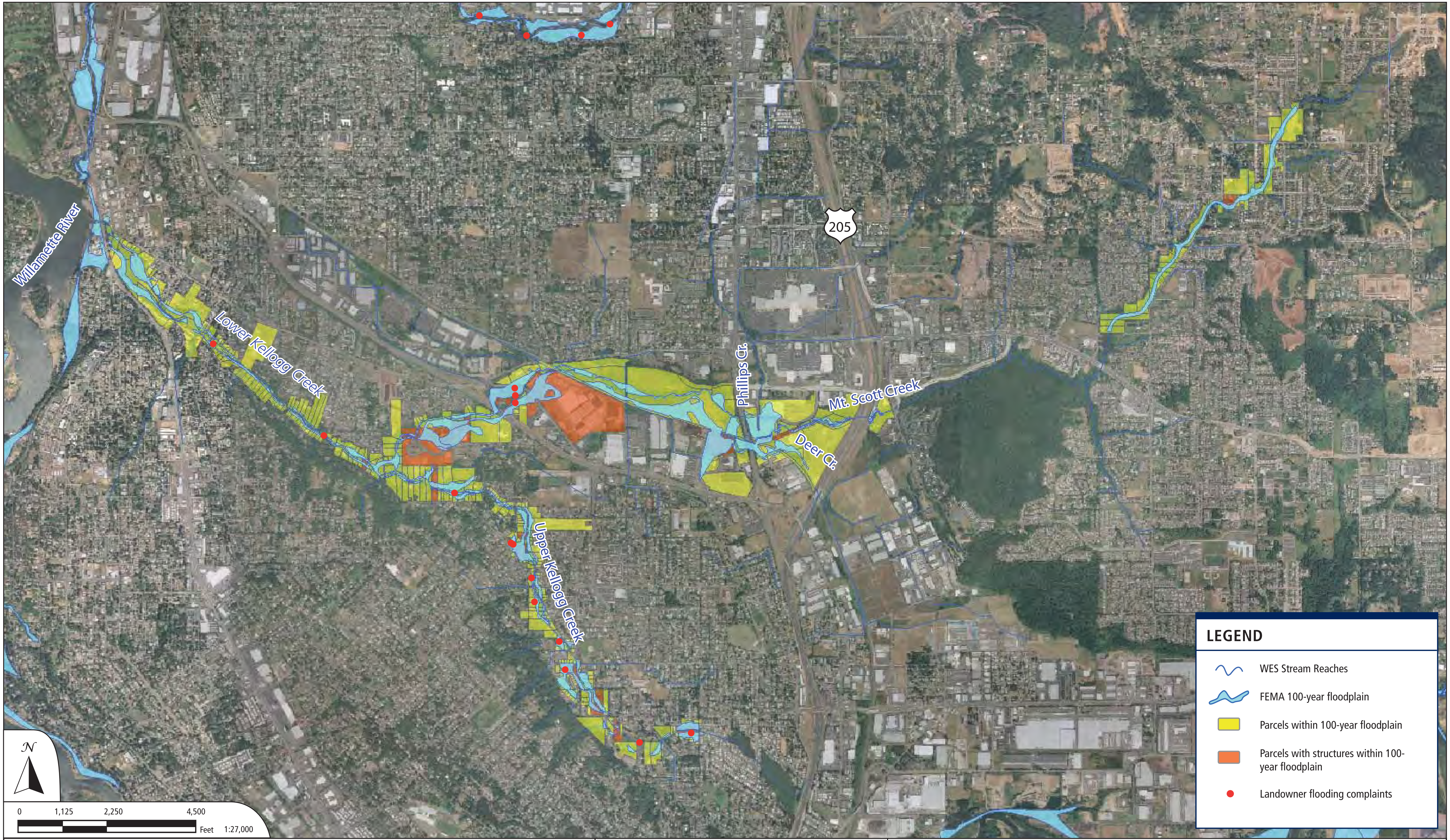
Water Environment Services

Beyond clean water. www.clackamas.us/wes

Brown and Caldwell

Swanson Hydrology + Geomorphology

Ellis Ecological Services, Inc.



WATER ENVIRONMENT SERVICES
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

Figure 2-4
Kellogg/Mt. Scott - Floodplain Conditions
WES WATERSHED ACTION PLAN

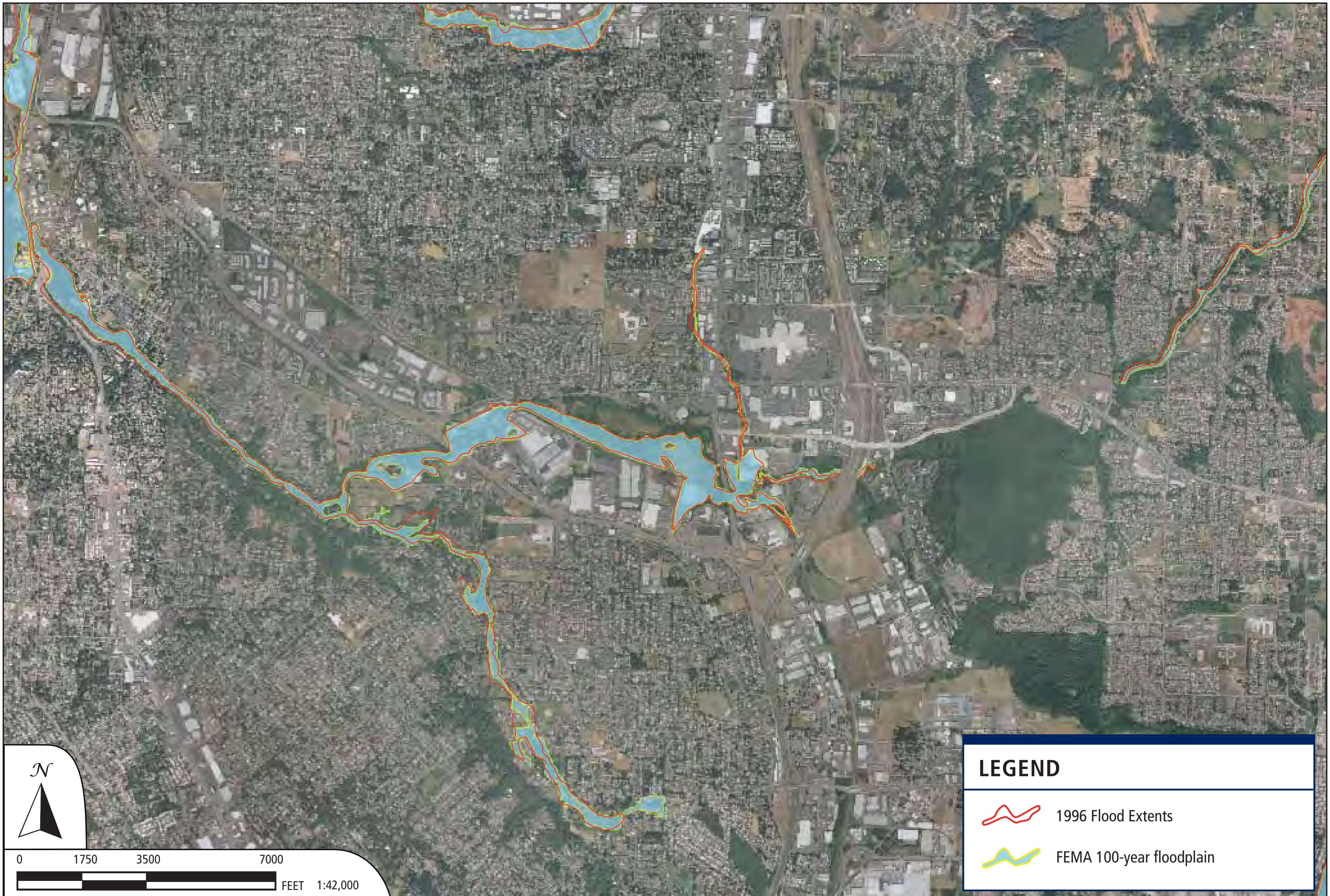


Figure 2-5
Kellogg/Mt. Scott - 100-year Floodplain
WES WATERSHED ACTION PLAN

Water Environment Services
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

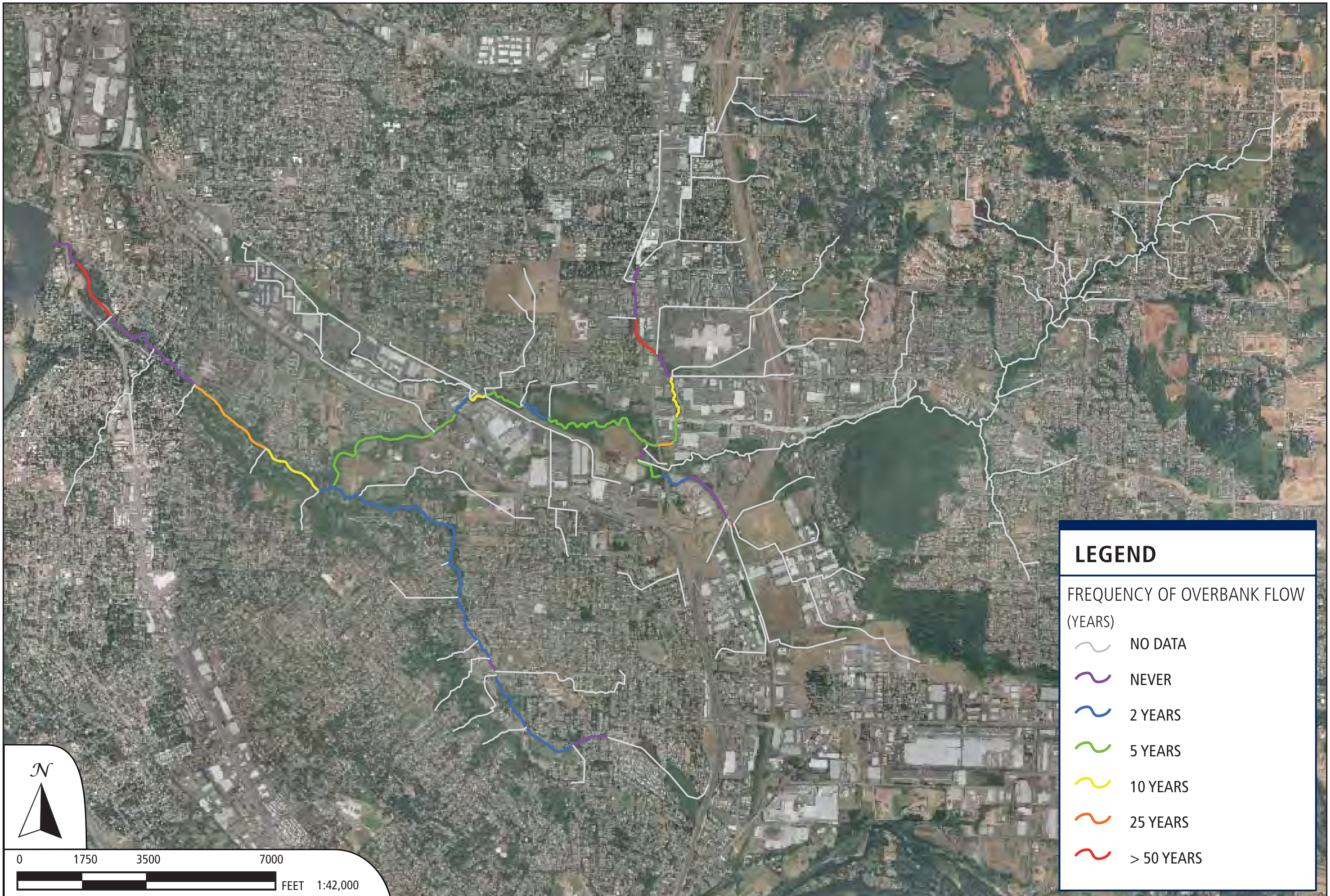


Figure 2-6
Kellogg/Mt. Scott - Frequency of Overbank Flow
WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

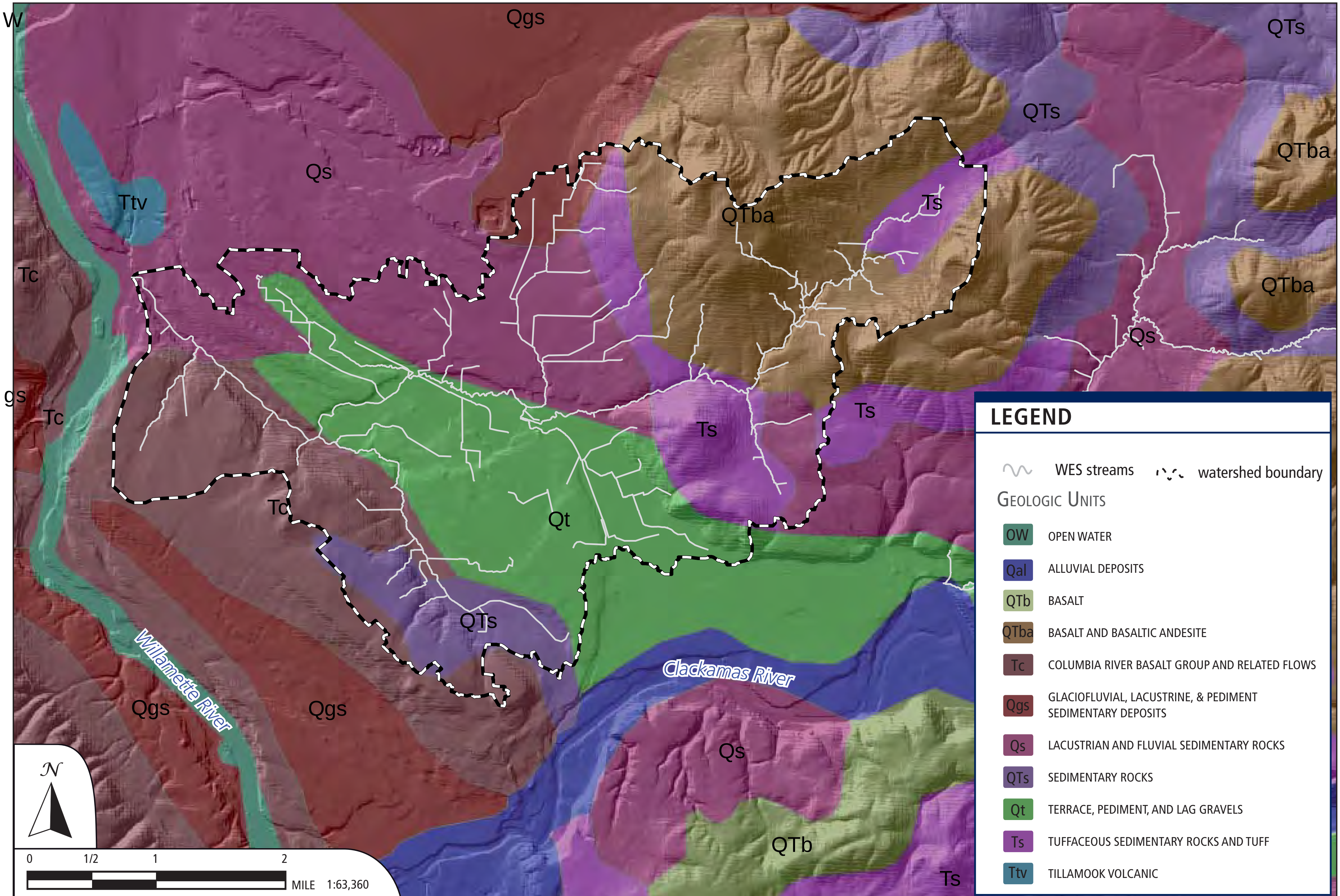


Figure 2-7
Kellogg/Mt. Scott - Geologic Units
WATERSHED ACTION PLAN

Water Environment Services
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

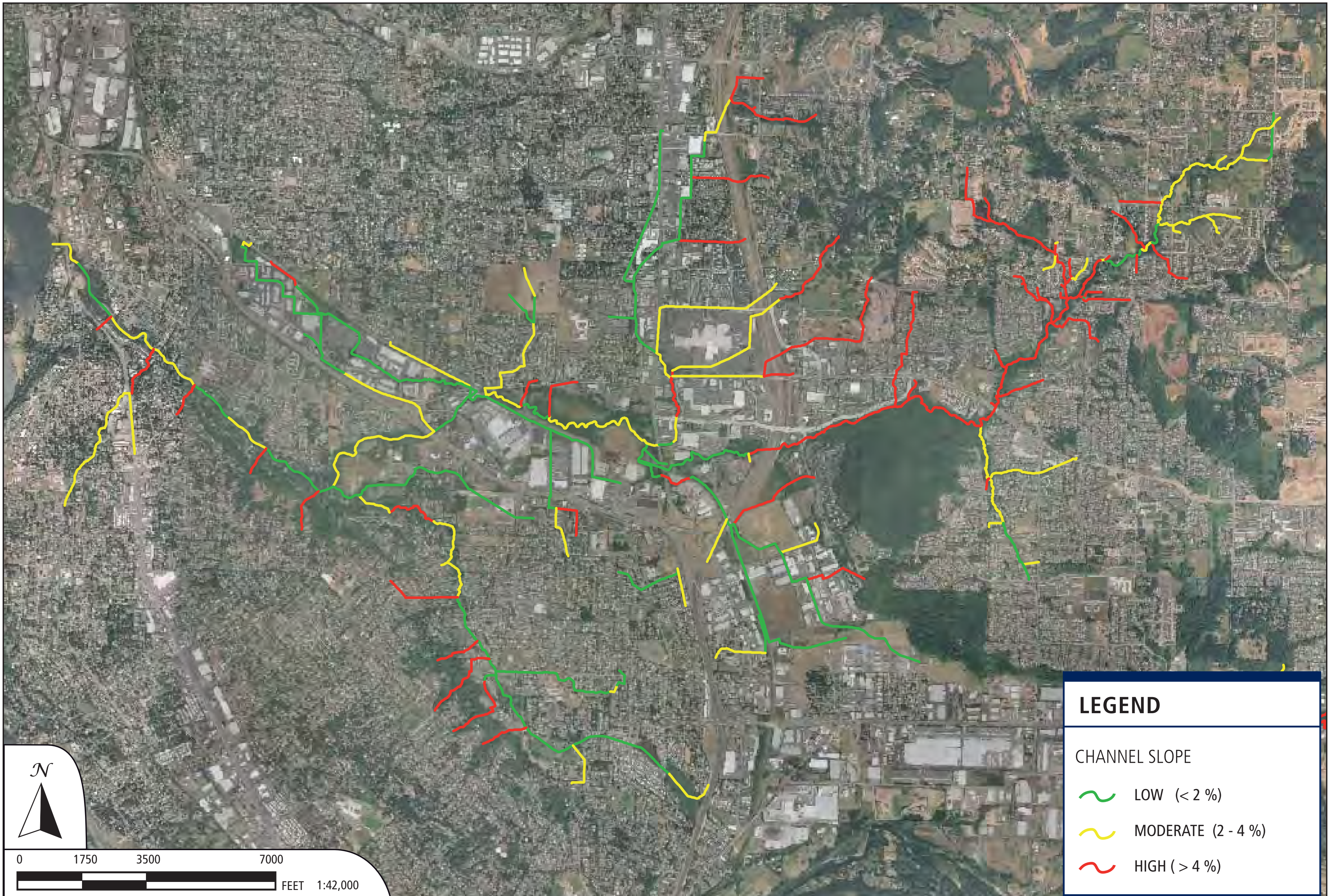


Figure 2-8
Kellogg/Mt. Scott - Channel Slope
WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

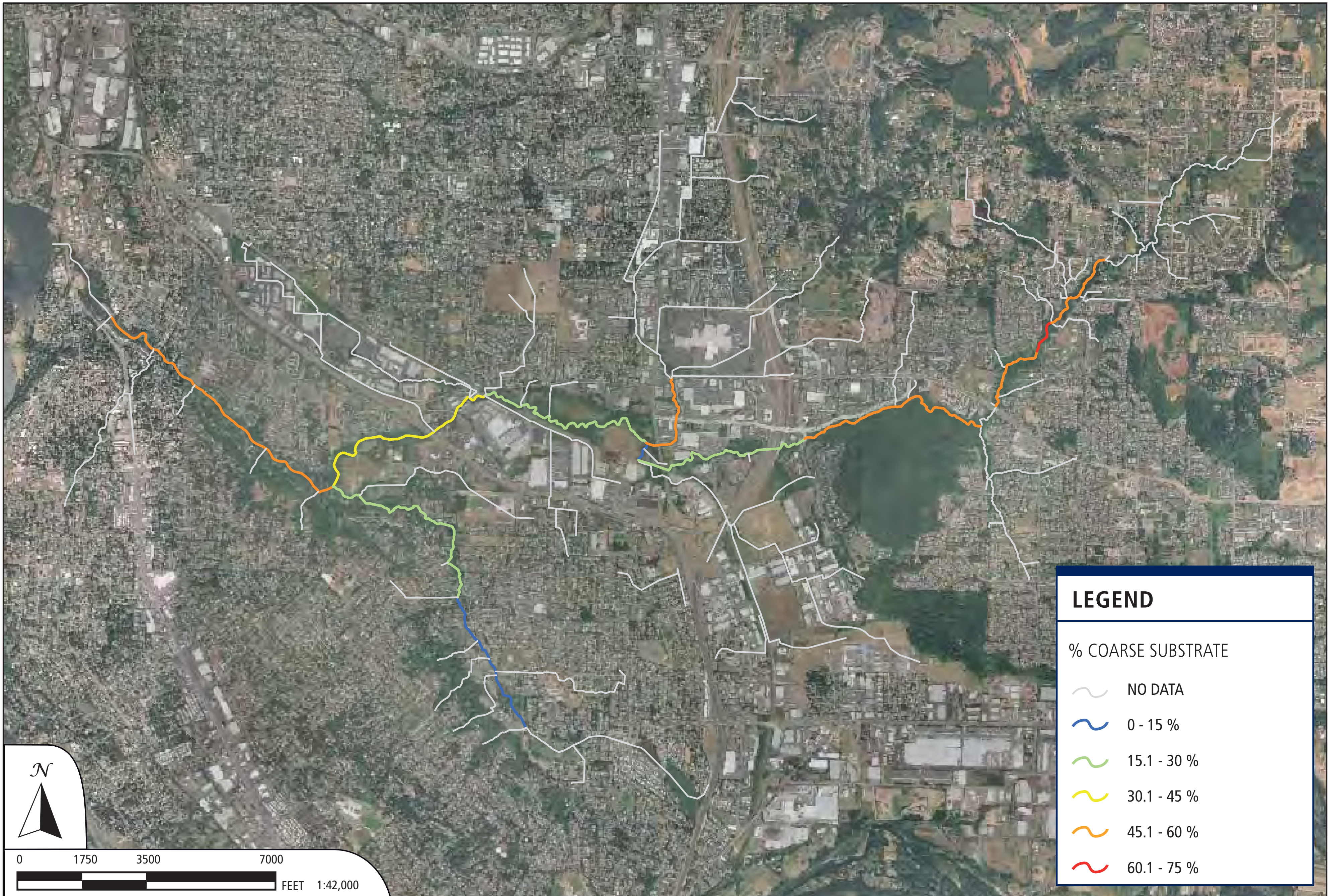


Figure 2-9
Kellogg/Mt. Scott - Coarse Substrate by Reach
WES WATERSHED ACTION PLAN

Water Environment Services
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

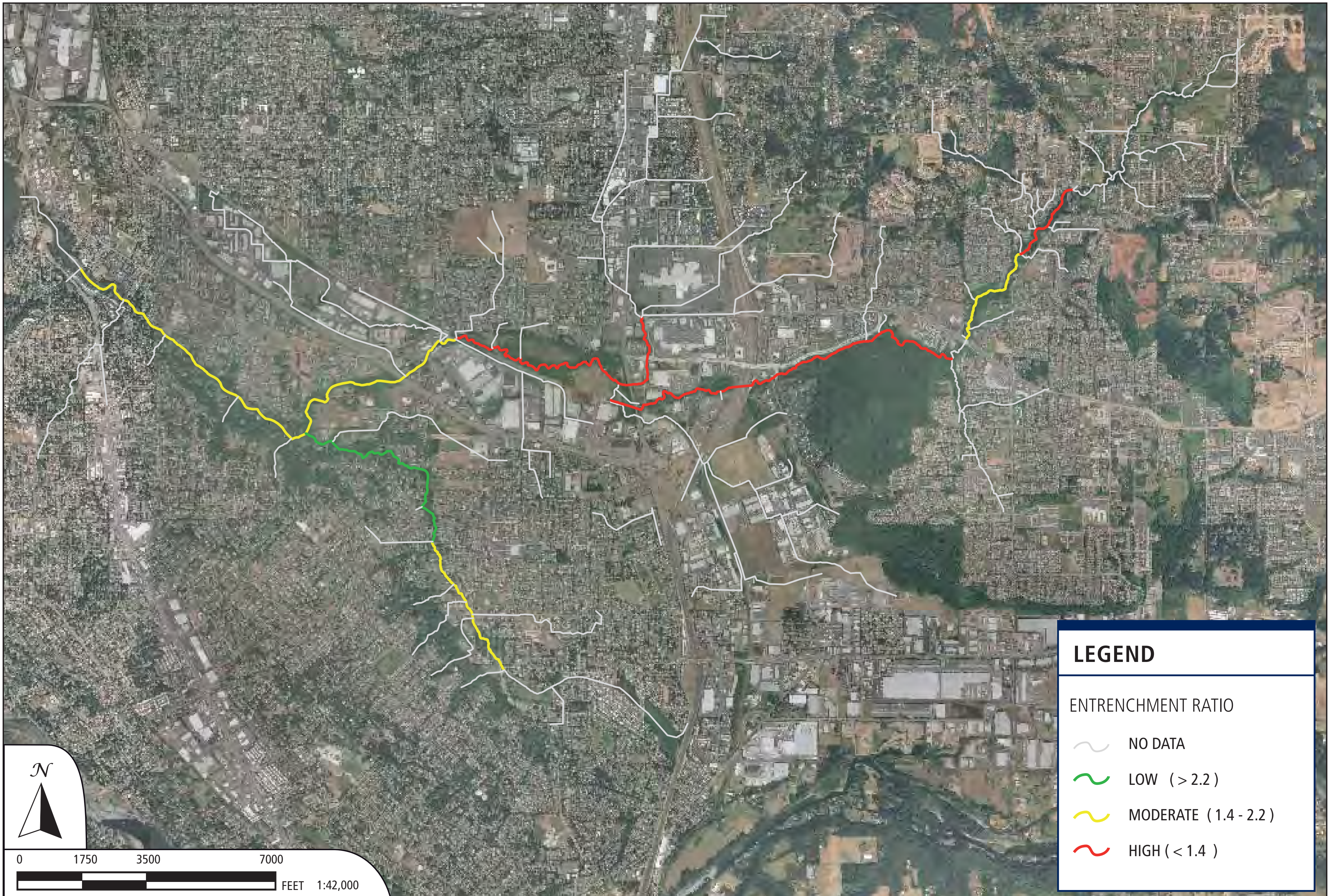


Figure 2-10
Kellogg/Mt. Scott - Entrenchment Ratio
WES WATERSHED ACTION PLAN

Water Environment Services
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

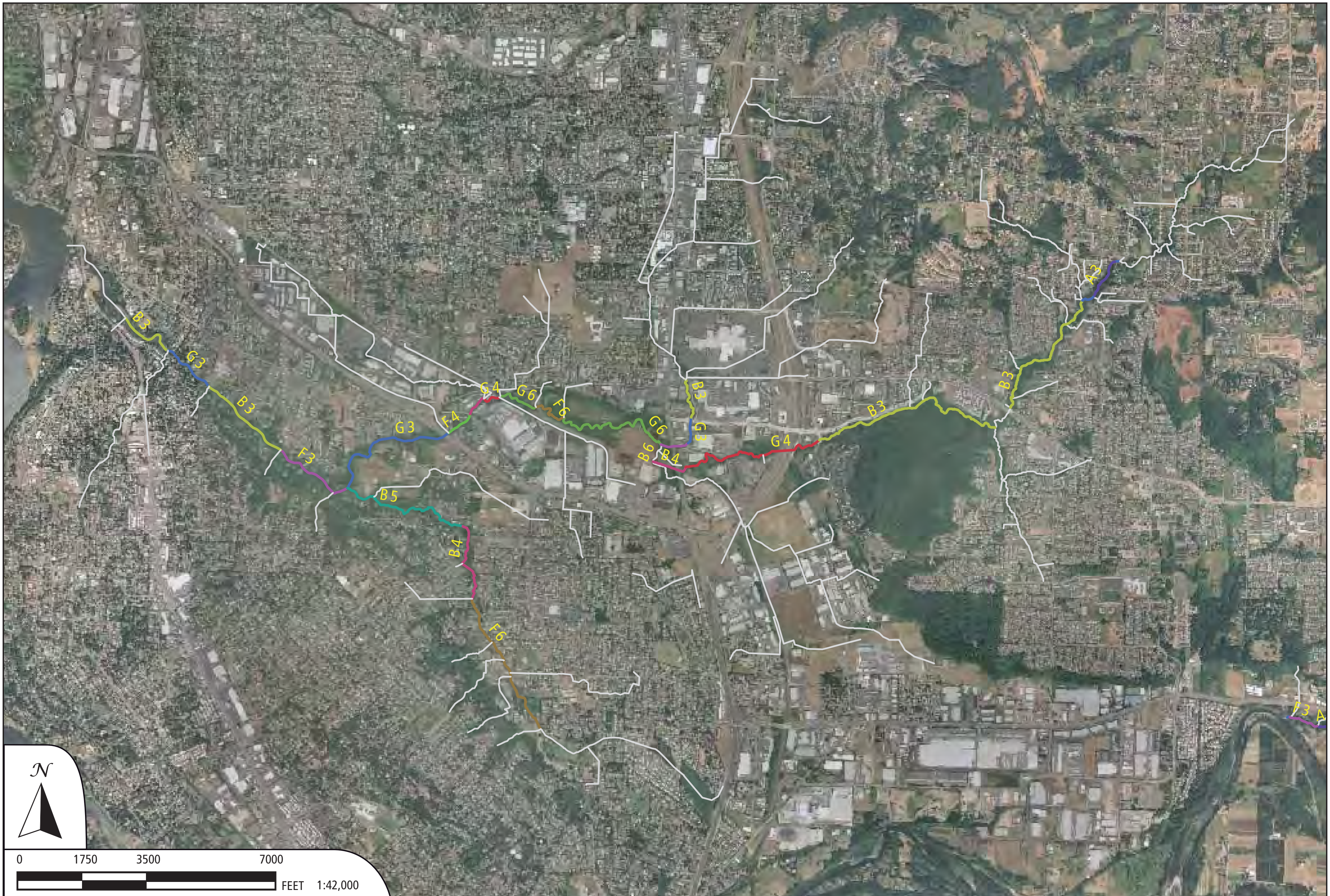


Figure 2-11
Kellogg/Mt. Scott - Channel Classification (Rosgen)
WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

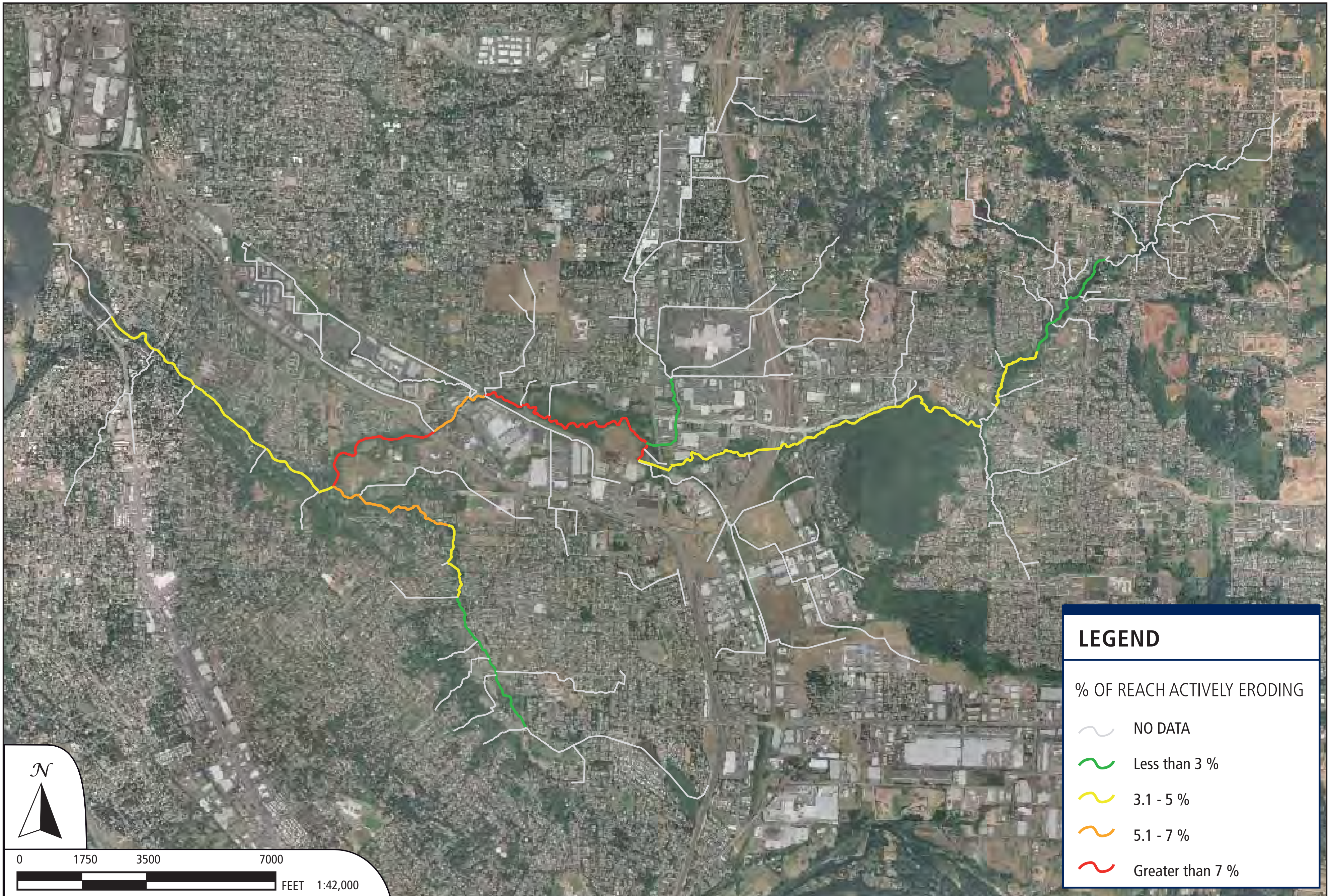


Figure 2-12
Kellogg/Mt. Scott - Bank Erosion by Reach
WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

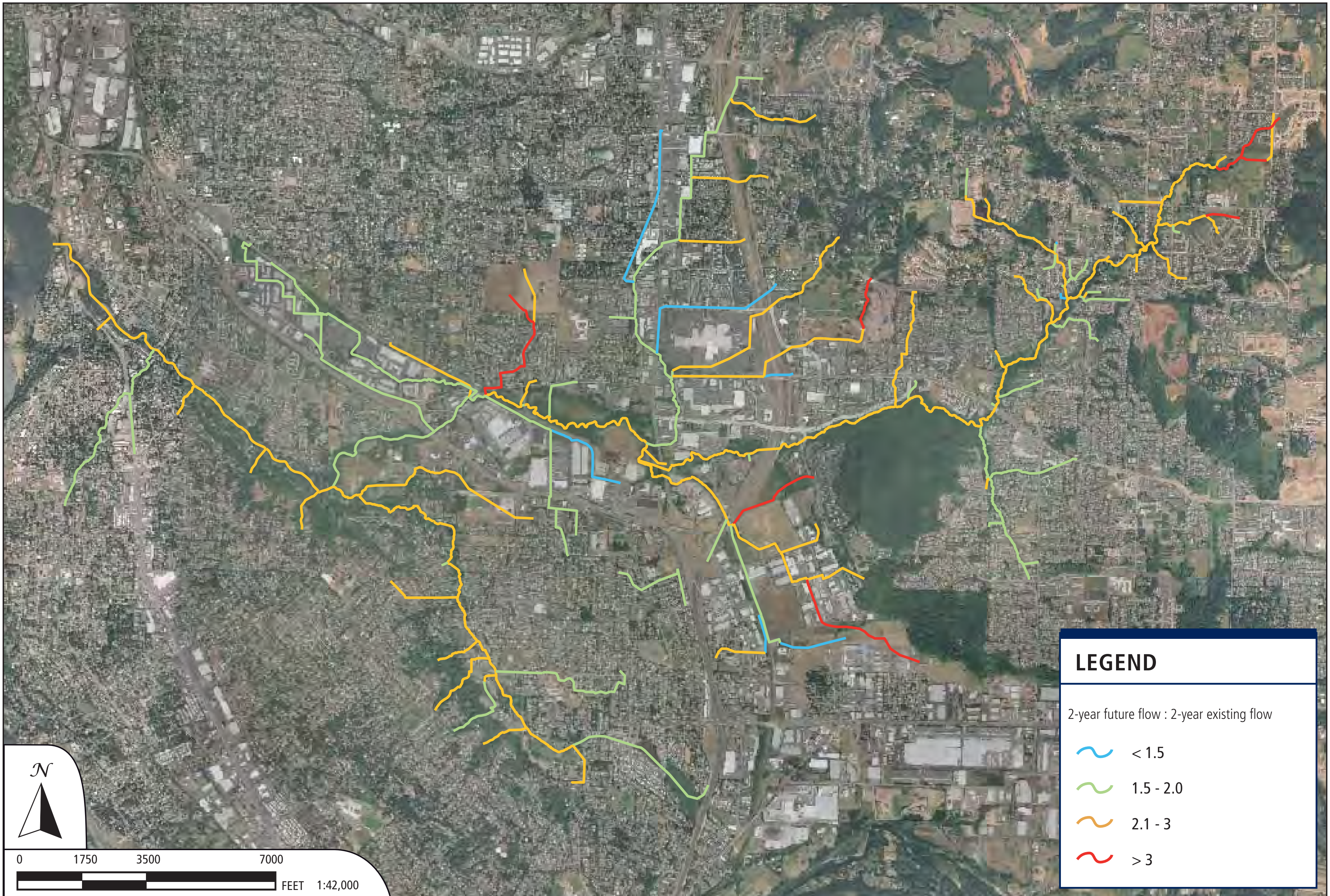


Figure 2-13
Kellogg/Mt. Scott - Modeled Future Flow Conditions
WES WATERSHED ACTION PLAN

Water Environment Services
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

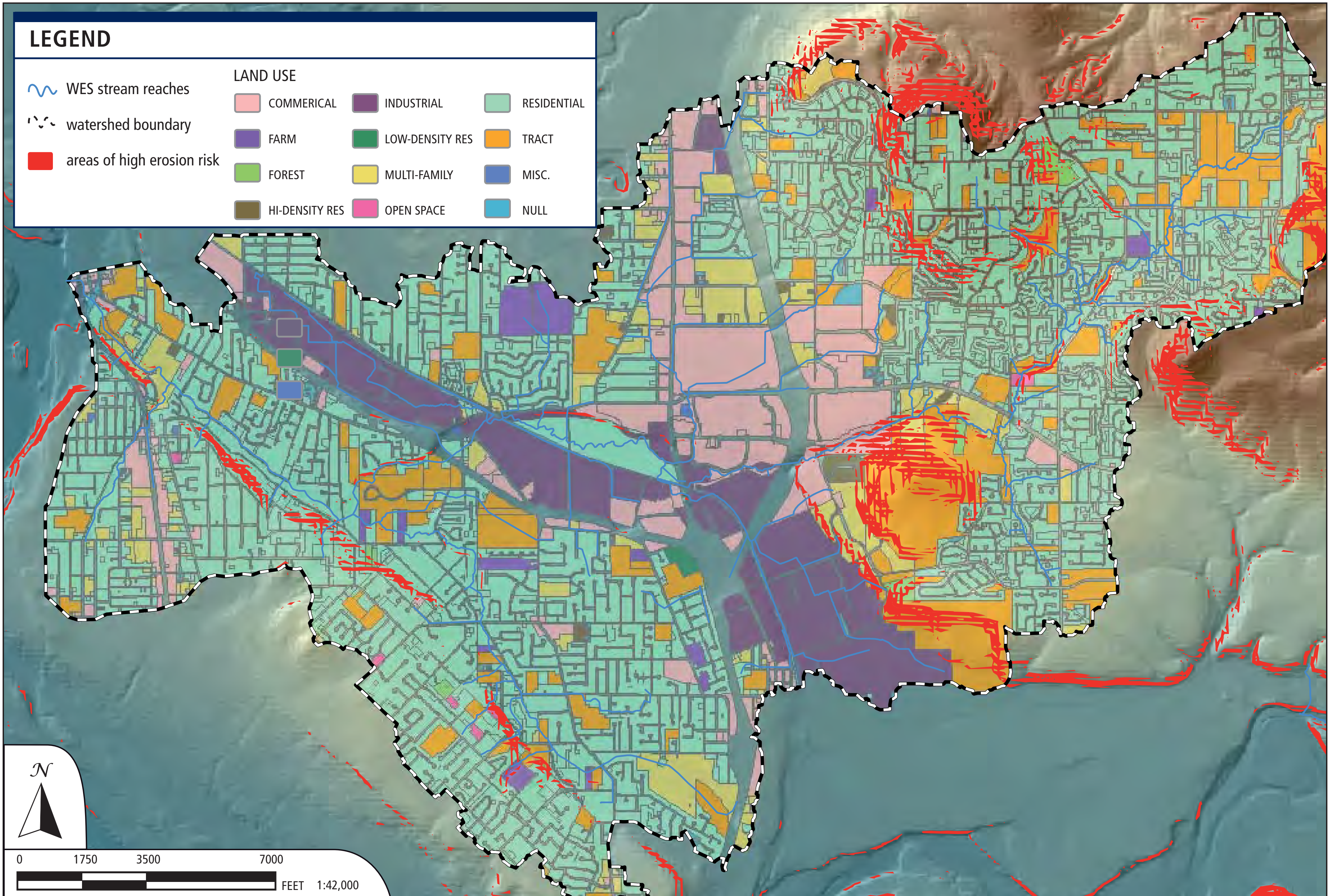


Figure 2-14
Kellogg/Mt. Scott - Landslide and Erosion
RiskWES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES
Beyond clean water. www.clackamas.us/wes
BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

Figure 2-15
Kellogg/Mt. Scott - At Risk Channels due to Bank Erosion
WES WATERSHED ACTION PLAN

Water Environment Services
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

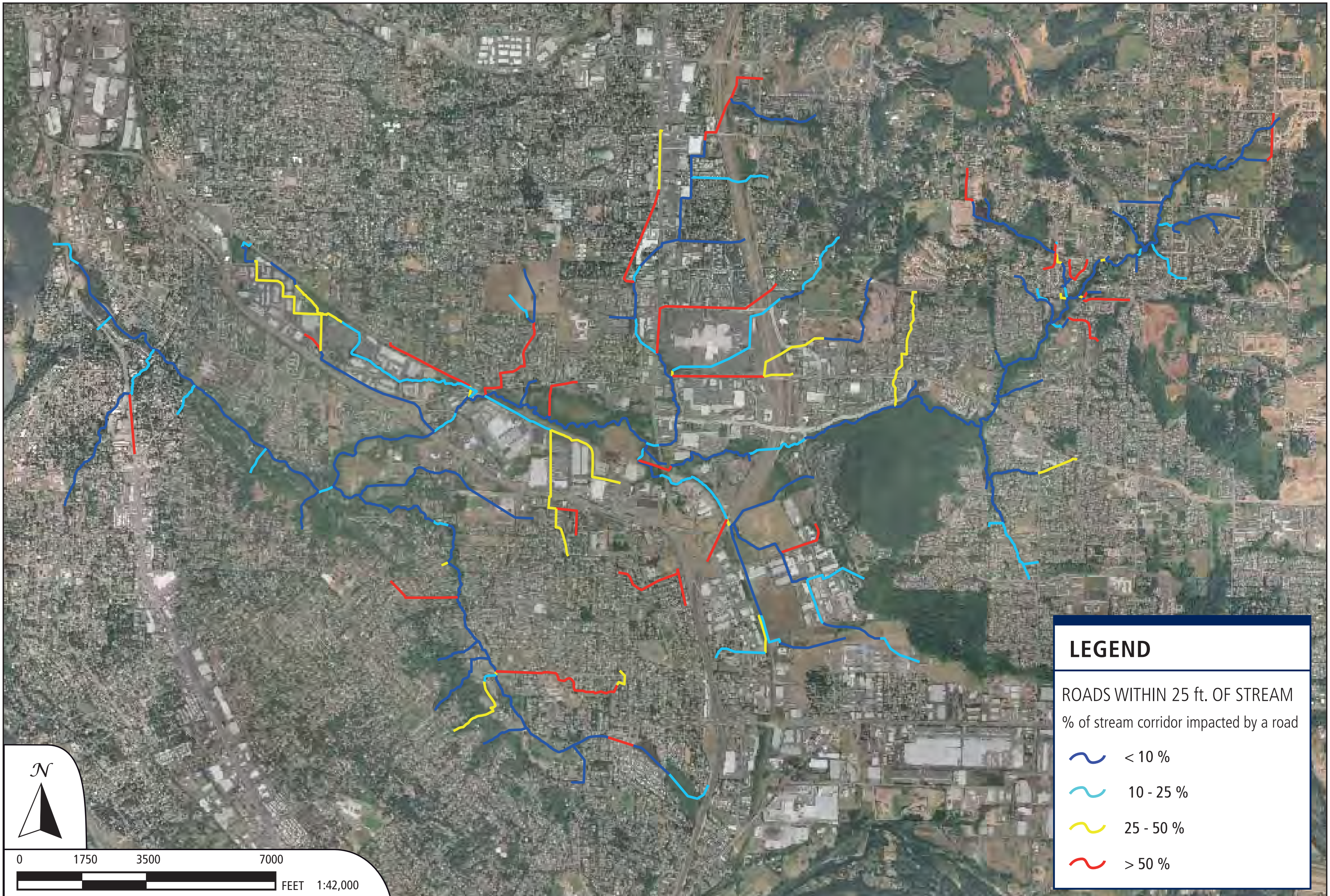


Figure 2-16
Kellogg/Mt. Scott - Channel Impacts from Roads
WES WATERSHED ACTION PLAN

Water Environment Services
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL
SWANSON HYDROLOGY + GEOMORPHOLOGY
Ellis Ecological Services, Inc.

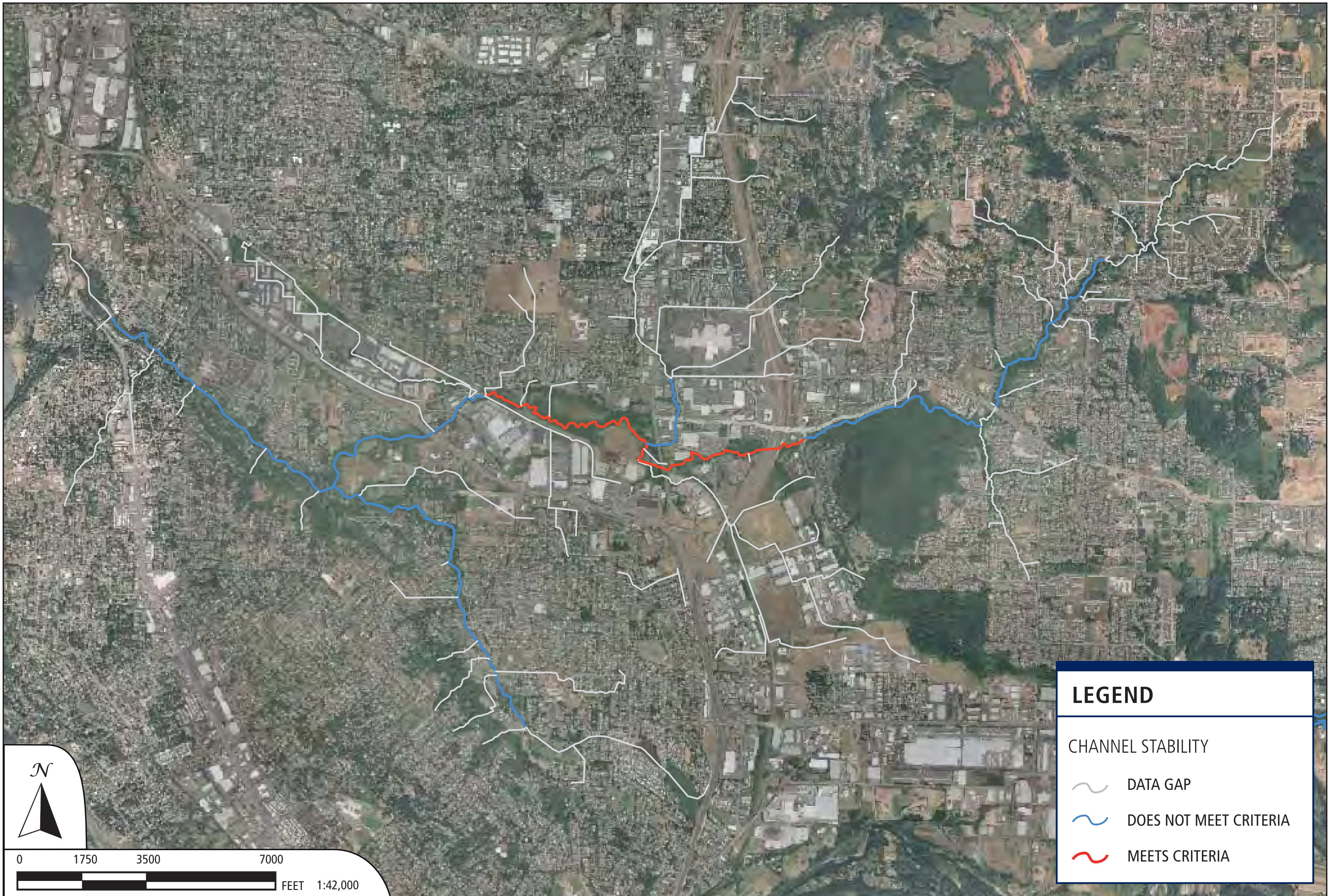


Figure 2-17

Kellogg/Mt. Scott - At Risk Channels due to Channel Stability

WES WATERSHED ACTION PLAN

Reaches with high risk of erosion due to a low gradient (<2%), high entrenchment (entrenchment ratio < 1.4), and low coarse substrate (< 25%).

WATER ENVIRONMENT SERVICES
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL

SWANSON HYDROLOGY + GEOMORPHOLOGY

Ellis Ecological Services, Inc.

SUBBASIN	PWR ID	ODFW ID	SH+G ID					LENGTH (FT)
			Level 1	Level 2	Level 3	Level 4	Combined	
KC	KL029	KG1	2	--	--	--	2	1745
KC	KL039	KG1	3	--	--	--	3	1569
KC	KL049	KG1	4	--	--	--	4	1321
KC	KL059	KG1	5	--	--	--	5	1344
KC	KL069	KG1	6	--	--	--	6	1939
KC	KL079	KG1	7	--	--	--	7	438
KC	KU009	KG2	8	--	--	--	8	881
KC	KU019	KG2	9	--	--	--	9	1027
KC	KU029	KG2	10	--	--	--	10	864
KC	KU039	KG2	11	--	--	--	11	729
KC	KU049	KG2	12	--	--	--	12	429
KC	KU059	KG3	13	--	--	--	13	1187
KC	KU069	KG3	14	--	--	--	14	1199
KC	KU079	KG4	15	--	--	--	15	1405
KC	KU089	KG4	16	--	--	--	16	624
KC	KU099	KG4	17	--	--	--	17	390
KC	KU109	KG4	18	--	--	--	18	110
KC	KU119	KG4	19	--	--	--	19	1773
MS	ML009	MS1	0	--	--	--	0	4017
MS	ML019	MS2	1	--	--	--	1	806
MS	ML029	MS2	2	--	--	--	2	602
MS	ML039	MS2	3	--	--	--	3	513
MS	ML049	MS3	4	--	--	--	4	57
MS	ML059	MS3	5	--	--	--	5	1182
MS	ML069	MS3	6	--	--	--	6	81
MS	ML079	MS3	7	--	--	--	7	1070
MS	ML089	MS3	8	--	--	--	8	3810
MS	ML099	MS4	9	--	--	--	9	202
MS	ML109	MS4	10	--	--	--	10	357
MS	MM009	MS5	11	--	--	--	11	1008
MS	MM015	MS5	12	--	--	--	12	1491
MS	MM019	MS5	13	--	--	--	13	1137
MS	MM029	MS5	14	--	--	--	14	1738
MS	MM039	MS7	15	--	--	--	15	2786
MS	MM049	MS7	16	--	--	--	16	429
MS	MM059	MS8	17	--	--	--	17	2605
MS	MM079	MS9	19	--	--	--	19	293
MS	MM089	MS9	20	--	--	--	20	921
MS	MM099	MS9	21	--	--	--	21	1082
MS	MM109	MS10	22	--	--	--	22	974
MS	MP009	MS11	23	--	--	--	23	916
MS	MP019	MS11	24	--	--	--	24	320
MS	MP029	MS12	25	--	--	--	25	1227
MS	MU009	MS12	26	--	--	--	26	149
MS	PC009	PH1	9	0	--	--	9-0	360
MS	PC019	PH1	9	1	--	--	9-1	418
MS	PC029	PH1	9	2	--	--	9-2	741
MS	PC039	PH1	9	3	--	--	9-3	1180

Table 2-1
REACH IDENTIFICATION TABLE
WES WATERSHED ACTION PLAN

Table 2-2. Peak Discharge Rates for Selected Points in the Kellogg/Mt. Scott Creek Watersheds									
Kellogg Creek	**2-year Discharge Rates per Land Use Condition**			**10-year Discharge Rates per Land Use Condition**			**100-year Discharge Rates per Land Use Condition**		
	Forested (cfs)	**Existing (cfs)**	**Future (cfs)**	**Forested (cfs)**	**Existing (cfs)**	**Future (cfs)**	**Forested (cfs)**	**Existing (cfs)**	**Future (cfs)**
Kellogg Lake Dam	9.9	659.8	1411.4	75.9	1277.1	1890.1	472	2062.6	2977.9
SE Oatfield Road	13.3	673.5	1393.3	103.8	1295.6	1837	549	2014.2	2914.2
SE Kuehn Road	13.2	642.1	1306.8	102.2	1223.7	1714.9	530.3	1885.6	2734.9
SE Rusk Road	0.7	111.3	238.8	9	222.2	340.8	67.5	396.4	502.8
SE Thiessen Road	0.5	80.5	173.6	7.5	160.8	247.5	52.2	286.7	364.6
SE Aldercrest Court	0.4	75.5	159.7	5.9	149.5	227.8	44.2	265.5	335.6
SE Clackamas Road	0.3	61.6	130.5	5.3	122.7	185.8	37.2	216.7	272.6
SE Mabel Avenue	0.3	55.5	117	4.4	110.4	166.4	31.6	194.4	243.9
SE Webster Road	0.1	31.4	59.3	0.3	59.5	84	9.4	100.8	121.8
Leona Lake	0	20.7	36.8	0.2	38.5	52.1	8.7	64.3	76.7
Mt. Scott Creek									
North Clackamas Park	13	526.1	1049.3	94.2	990.3	1356.8	460	1504.3	2201.5
SE Lake Road	12.7	499.3	992.2	90.7	937.3	1281	434.7	1427	2084.1
Mintthorne Creek at SE Lake Road	0	19.4	42.3	0.2	38.1	60	7.6	68.3	88.2
SE 84th Avenue	6.5	191.1	418.3	39.2	374.2	616.7	176.1	688.6	910.9
SE 97th Avenue	7.5	190.7	417.9	43.4	377.1	616.4	181.8	690.4	907.3
Southern Lites Park	7.2	83.7	206.1	29.3	167.6	310.7	101	340.2	456.8
Detention Pond Waterford Court	6.5	30.6	87.5	21.5	60	130	53.6	138.6	191.3
Happy Vallry Park and Ponds	4.5	21.2	61.1	14.8	39.2	91.3	37.6	97.2	134.4
Deer Creek									
Above Mt. Scott/Phillips Confluence	8	266.6	581.5	55.4	522.8	846.9	256.1	947.8	1251.8
SE 84th Avenue	1.7	61.2	130.6	14.6	118	185.2	68.2	210	272.6
Phillips Creek									
Phillips/Mt. Scott Regional Ponds	4.3	175.8	301.1	27.5	315.1	427.1	113.3	525.4	627.6

Table 2-2

Kellogg/Mt. Scott - PEAK DISCHARGE RATES

WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES

SWANSON HYDROLOGY+ GEOMORPHOLOGY

Ellis Ecological Services, Inc.

CHAPTER 3 - WATER QUALITY

Overview

This chapter summarizes water quality in the Kellogg-Mt. Scott (KMS) watershed based on an evaluation of existing environmental monitoring data and reports of watershed conditions. Key sources of information regarding water quality in the KMS watershed include the following:

- Benthic macroinvertebrate surveys and Benthic Index of Biological Integrity (B-IBI) scores
- Fish surveys and Fish Index of Biological Integrity (F-IBI) scores
- Continuous flow and water quality monitoring data
- Grab sample data from in-stream and stormwater outfall locations
- Water quality pollutant loads model results
- Data from studies on specific water quality issues in the watershed area such as best management practice (BMP) effectiveness

Figure 3-1 illustrates the water quality, continuous flow, benthic macroinvertebrate, and fish monitoring sites in the KMS watershed.

Biological indicators such as benthic macroinvertebrate communities and fish populations can provide a long-term metric of water quality and insights on watershed health when sampled regularly over time. Since some of these species are long-lived, live in the water, and are sensitive to changes in water quality, studying the make-up of these communities provides clues about overall water quality conditions and levels of certain water quality constituents that can be limiting factors for aquatic organisms. WES retained contractors to collect data on benthic macroinvertebrate communities in 2002 and 2007 (Lemke and Cole, 2008) and on fish populations in 1997-98, 2002-03, and 2008 (Oregon Department of Fish and Wildlife [ODFW], 2008). The results from these biological monitoring surveys are briefly summarized below and discussed in more detail in Chapter 4.

In addition to the biological indicators, Water Environment Services (WES) has over 14 years of water quality monitoring data including grab samples and continuous monitoring. In the watershed conditions and limiting factors discussion below, key water quality parameters are evaluated against water quality criteria set by the Oregon Department of Environmental Quality (DEQ) as well as guidance levels from other sources where criteria have not been set by DEQ. An initial analysis of the results of water quality monitoring in comparison to the contributing watershed conditions is provided in this chapter; further analysis of the contributing areas and WES management activities in these areas will be performed during the watershed assessment.

The results of water quality modeling conducted as a part of the 2006 Clackamas County Service District No. 1 (CCSD No. 1 or District) Master Plan and the 2008 National Pollutant Discharge Elimination System (NPDES) Mutual Separate Storm Sewer Systems (MS4) permit renewal submittal and the results of other studies of specific water quality issues are also evaluated in the watershed conditions and limiting factors discussion. The results of studies on specific water quality issues are also summarized, including the monitoring of stormwater detention ponds by Portland State University (PSU) and the pesticide studies in the Lower Clackamas Basin by the U.S. Geological Survey (USGS).

Key water quality issues in the KMS watershed include the following:

- Benthic macroinvertebrate and fish population surveys indicate that the streams in the watershed primarily support moderately to severely impaired biological communities. The benthic macroinvertebrate communities surveyed in 2007 are largely comprised of organisms that are able to tolerate elevated sediment loads, increased water temperatures, periods of sustained high or low flows, and other characteristics of urbanized streams (Lemke and Cole, 2008).
- Elevated levels of *E. coli* bacteria, a key indicator of water contact human health issues, were found throughout the watershed. A Total Maximum Daily Load (TMDL) has been established for *E. coli* in Kellogg, Phillips, and Mt. Scott Creeks. The TMDL requires a 78 percent reduction in in-stream *E. coli* concentrations. *E. coli* is associated with fecal matter, which can contain a wide range of pathogenic organisms. There are many potential sources of *E. coli* in streams including wildlife, pets, livestock, and humans.
- Elevated water temperatures have been observed in the streams during the summer. Riparian canopies and forests have been altered and removed in portions of the watershed, leaving the streams open to increased heat gain from solar radiation. Installation of impervious surfaces has likely reduced infiltration and aquifer recharge, resulting in less groundwater discharge to streams during the summer. Less groundwater discharge can increase stream temperatures because groundwater tends to be cooler than surface runoff during the summer, and less total flow in the stream allows solar radiation to affect a greater proportion of the water column.
- DEQ has proposed a mercury TMDL for the Willamette basin, which if approved, will likely impose mercury monitoring requirements and development of mercury reduction strategies in the watershed.
- A high proportion of water quality complaints in the District's complaint log are related to construction site runoff. There is concern about the adequacy of construction site BMPs for projects on steep slopes during the winter rainy season that contribute sediment loads.
- Although pesticides have not been monitored in KMS streams, pesticide monitoring performed by USGS in the adjacent Clackamas basin found several pesticides that may exceed established or recommended criteria. WES has proposed participating in a future monitoring study with USGS that may encompass pesticides in the KMS watershed.
- Limited sampling of dissolved metals (copper, lead, and zinc) was conducted in 2007-2008. The samples collected have not exceeded the acute criteria for dissolved metals established by DEQ.

The potential causes of these water quality issues, risks and opportunities, and appropriate management strategies for WES to undertake to address these issues are discussed further in the watershed assessment (Chapter 5).

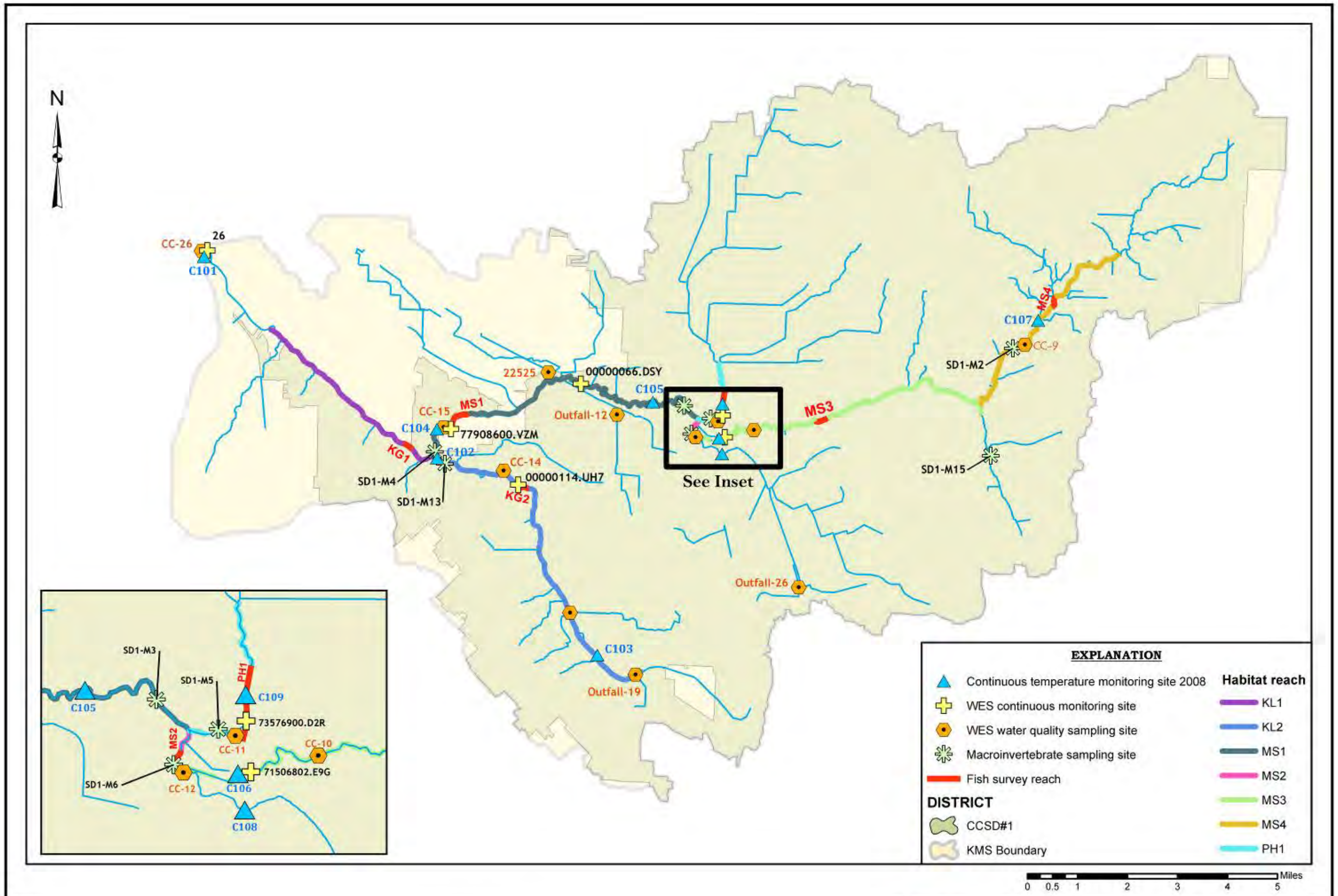


Figure 3-1
Environmental Monitoring Sites
WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES
Beyond clean water. www.clackamas.us/wes

BROWN AND CALDWELL

SWANSON HYDROLOGY + GEOMORPHOLOGY

Ellis Ecological Services, Inc.

(BCTUC02)T:\IWVWD\133908 - IWVWD Groundwater Flow Model\GIS\ARCMAPS\FIGURES\FDraft_012108

Data Reviewed

To characterize water quality in the KMS watershed and evaluate limiting factors related to water quality, existing environmental monitoring data and reports of watershed conditions were reviewed. Key data sources evaluated include the following:

- WES Environmental Monitoring Data from 1994 to 2007 (WES, 2008a)
- WES Water Quality Annual Monitoring Reports (WES, 2006 and 2008b)
- NPDES MS4 permit renewal submittal (WES, 2008c)
- WES Water Quality Trend Analysis (Brown and Caldwell, 2008)
- Benthic Macroinvertebrate Survey Results (Lemke and Cole, 2008)
- ODFW Draft Report of Fish Species Distribution and Abundance and Habitat Assessment of Streams in Clackamas County Service District No. 1 (ODFW, 2008)
- CCSD No. 1 Surface Water Management Program Master Plan (Shaun Piggott Associates et al., 2006)
- A Watershed Assessment of Kellogg and Mt. Scott Creeks (Montgomery Watson Harza, 2001)

Data Gaps

The purpose of the data gaps analysis is three-fold:

- Identify gaps or deficiencies in existing information that limit our understanding of watershed conditions and potential project opportunities
- Identify data gaps that limit the ability of WES to evaluate watershed conditions long-term
- Identify gaps in monitoring data that, if these data were available, would provide WES with the opportunity to evaluate the success of any implemented action

Following is a discussion of potential data gaps based on those criteria:

- The WES GIS layer for the water quality monitoring sites does not have a consistent naming convention for the monitoring sites. There is a need to clarify the type, location, name, dates, and associated data for each historic and current monitoring site in the WES Geographic Information System (GIS) to improve future tracking of monitoring results.
- The water quality monitoring sites, continuous flow monitoring sites, benthic macroinvertebrate monitoring sites, and fish monitoring sites are not located together in many cases, as shown in Figure 3-1. This lack of data from consistent locations makes it challenging to evaluate stream conditions holistically. It would be helpful to add or change monitoring sites to better characterize multiple measures of water quality conditions at consistent locations.
- Benthic macroinvertebrate sampling coverage for Kellogg Creek, Mt. Scott Creek, and their tributaries is presently insufficient to allow reach-by-reach comparisons needed to evaluate stream habitat conditions and water quality conditions. Only two riffle sites on Mt. Scott Creek have been sampled. To allow comparisons between sites and with other studies in other streams, it is important that comparisons be made in riffle habitat. Additional benthic macroinvertebrate monitoring sites are needed.
- Most of the current water quality monitoring sites are located downstream of large catchment areas with varied land uses and management activities occurring upstream. These locations can make it challenging to evaluate the water quality data in the context of the effectiveness of the WES surface water management program activities. It may be helpful to add or change water quality monitoring sites to monitor changes in watershed conditions in the upper tributaries and near smaller contributing

areas where WES is adding new management activities or stormwater treatment systems. Stormwater monitoring of MS4 discharges could also be targeted to specific land use types of interest, such as commercial and industrial areas, and residential areas of varying density, type, and age.

- Much of the water quality data collected by WES is in the form of grab samples. Water quality data from grab samples represent conditions during a specific snapshot in time. Ambient water quality can vary considerably within short time intervals, especially during storm runoff events. Further sampling should be collected as composites.
- Summer low flow data are needed on Upper Kellogg, Lower Kellogg, and Lower Mt. Scott Creeks. WES collects in-stream continuous flow monitoring data, however no analysis of this data has been conducted by WES recently.
- The fish survey reach on Upper Kellogg Creek should be extended to include the spring-fed reach, which appears to extend from near the confluence of Mt. Scott Creek to about where the fish survey now begins on Upper Kellogg Creek. This could be an important summer thermal refuge area for salmonids.
- Continuous water temperature data were collected by ODFW under contract to WES at a number of locations in the KMS watershed during spring, summer, and early fall 2008. Some of the data were available and provided important insight into potential limiting factors.
- To support TMDL compliance efforts, additional monitoring of TMDL constituents could be conducted. WES could consider conducting studies to identify the sources of *E. coli* in the watershed using Microbial Source Tracking (e.g., DNA ribotyping or Bacteroides).

Changes to the NPDES MS4 water quality monitoring program elements, including site locations, are possible through the adaptive management process for the Stormwater Management Plan, but any changes to the MS4 permit monitoring must be coordinated with the other Clackamas County co-permittees that collaborate on the monitoring plan with WES and approved by the Oregon Department of Environmental Quality (DEQ). However, there may be opportunities to modify monitoring program elements that are not associated with the MS4 permit monitoring to better coordinate among these monitoring efforts.

Watershed Conditions

Several studies have been conducted recently that address water quality conditions in detail, including the 2006 Master Plan; therefore, this section does not attempt to address all water quality conditions in the watershed exhaustively. Key issues identified from existing data and reports as well as areas requiring further analysis are the focus of this section.

Watershed Processes

A wide variety of anthropogenic and natural factors in the watershed can have an impact on water quality. Watershed attributes that often affect water quality include effective impervious surface, land uses, age of development, structural and non-structural BMPs utilized, transportation systems, agricultural practices, forestry practices, air deposition of pollutants, soils, vegetation, and channel stability.

The KMS watershed is a highly developed urban watershed that is approximately 46 percent impervious. As described in Chapter 2, conversion of natural and rural areas to urban land uses often alters the volume and delivery of surface water runoff, and associated water quality may become impaired. The volume of stormwater runoff increases due to the creation of impervious areas that prevent the interception and infiltration of rainfall into shallow soils. During dry weather, base flows may be altered by loss of groundwater discharge or by artificial flows from urban activities.

The water quality of surface flows can be impacted by the entrainment of pollutants in runoff. A variety of studies have been conducted to identify potential sources of pollutants in urban stormwater. Although the specific sources or factors contributing to the observed trends in water quality in the KMS watershed are not fully known at this time, it is likely that some of the common contributors to water quality play a role in the KMS watersheds.

As described in the 2006 Master Plan (Piggot et al., 2006), there are a wide variety of potential sources of pollutants in urban watersheds including the following:

- Sediment from construction sites, roads, agriculture, and urban landscaping
- Nutrients from fertilizers applied to urban lawns or agricultural operations
- Metals from urban building materials, automobile use, and fluids from automobiles in disrepair
- Oil and grease from automobiles and commercial-related activities
- Pesticides from agricultural and landscape areas
- Organic compounds from commercial and industrial areas
- Bacteria from animal wastes and failing septic systems
- Trash and debris from improper handling and disposal, including litter
- Temperature increases due to riparian vegetation clearing, reduced stream flow, and reduced groundwater input to streams

Water Environment Services Water Quality Management Activities

A wide variety of management activities can be employed to lessen the hydrologic and water quality impacts associated with development. Examples include requirements for stormwater volume control, quality treatment systems, and site design in new development (known as development standards and design standards), protection of natural features such as riparian buffers, enhancement of natural systems that are degraded, and non-structural BMPs, such as street sweeping and public education.

Water quality management activities in the KMS watershed are conducted primarily by WES, Clackamas County Department of Transportation and Development (DTD), Happy Valley, and Milwaukie, along with a multitude of other partners. WES currently provides stormwater management and development review services in the western portions of Happy Valley through an inter-governmental agreement (IGA) and in the CCSD No. 1 service area, illustrated in Figure 1-2. Eighty percent of the watershed is within CCSD No. 1. CCSD No. 1 includes portions of the City of Happy Valley, and 20 percent of the watershed is within Happy Valley. The lower portion of the watershed is in the City of Milwaukie, which encompasses about 12 percent of the watershed. Small portions of the watershed are also in Gladstone, Johnson City, and unincorporated areas outside of CCSD No. 1.

As described further in Chapter 1, WES requires stormwater treatment systems for new residential subdivisions as well as commercial and industrial facilities in the watershed. The requirements for stormwater treatment for new Clackamas County roads and other DTD-reviewed projects are handled on a case-by-case basis, whereas the requirements for development in CCSD No. 1 and the portion of Happy Valley in the IGA with WES are based on the CCSD No. 1 rules and regulations, administrative procedures, and technical design standards. Much of the watershed is currently developed without stormwater volume control or quality treatment systems. As a result, only a relatively small portion of the KMS watershed is treated with stormwater volume control or quality treatment systems, as illustrated in Figure 3-2 from the 2006 Master Plan.

Figure 3-2 illustrates the areas draining to BMP categories of flood control basins, detention basins, treatment wetlands, water quality basins, and swales, as well as the location of features such as drywells. The BMP categories in Figure 3-2 reflect the design and primary intended function of the BMP structures. Flood control basins, for example, are detention ponds that are intended primarily to reduce downstream flooding. Flood control BMPs are often designed differently than water quality BMPs, although they may still provide water quality treatment.

WES currently maintains over 260 detention ponds that both detain and treat stormwater runoff. Many of these detention ponds are in Happy Valley. During the Early Action Item evaluation process, WES staff proposed retrofitting a number of existing stormwater treatment ponds to better treat runoff from smaller storms. Detention pond retrofit opportunities are detailed in Action D-2 of Chapter 6.

WES also allows developers to install proprietary stormwater treatment devices underground. Currently approved propriety systems include Stormceptor, CDS, Downstream Defender, Vortechnics, and Stormgate Separator. While these systems are usually effective at removing large-diameter sediment and litter from stormwater, they are often less effective at removing fine sediment and dissolved pollutants such as nutrients and metals from stormwater.

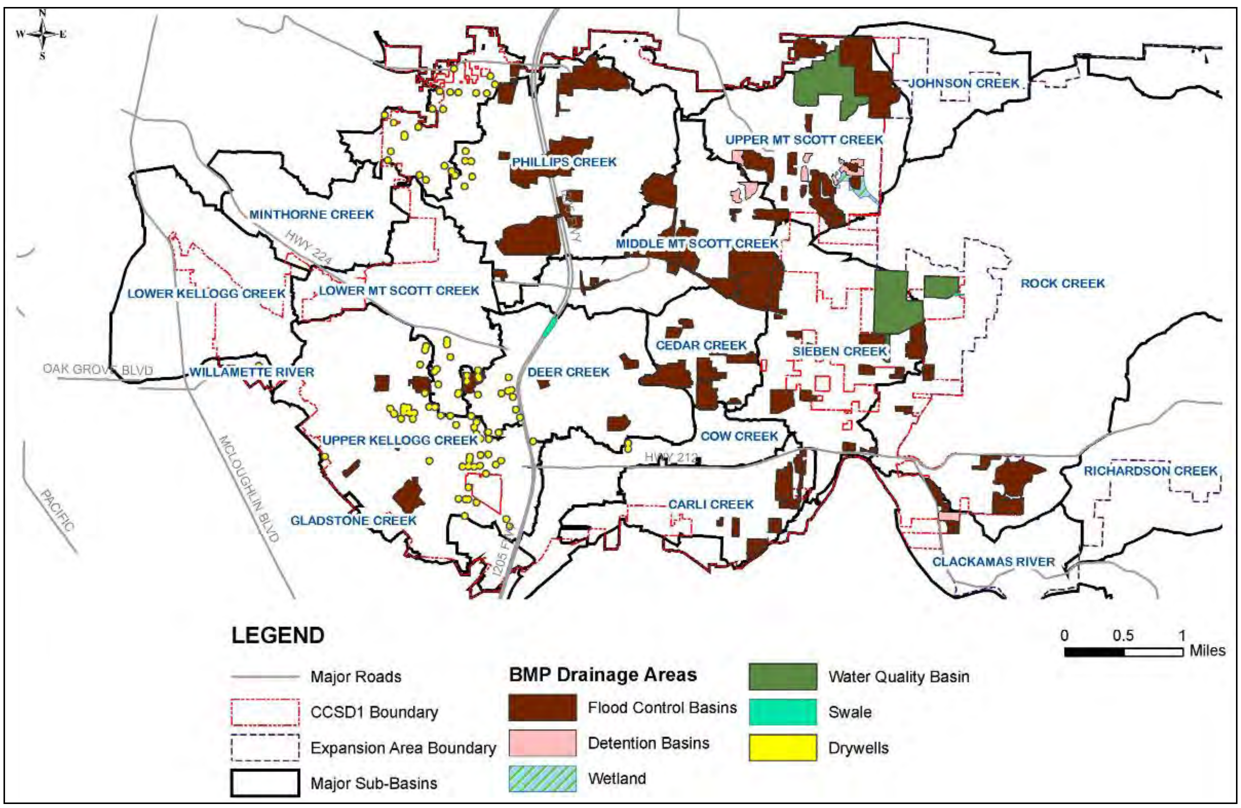


Figure 3-2. Drainage areas with stormwater treatment as of 2006.

In addition to requiring structural treatment systems, WES, Happy Valley, Milwaukie, and DTD also provide non-structural BMPs in the watershed to protect and improve water quality. These non-structural BMPs include activities like street sweeping and clean-up of spills of hazardous materials on roadways. Non-structural BMPs also include public education and outreach efforts to encourage actions that promote stewardship and protect watershed health. WES, Happy Valley, Milwaukie, and DTD summarize their surface water management activities in their annual reports for the NPDES MS4 permit.

Land Use and Impervious Surfaces

Uncontrolled runoff from impervious surfaces contributes to a variety of water quality problems and is therefore an important watershed stressor to evaluate. Figure 3-3 illustrates the range of impervious surfaces in the KMS and Rock Creek watersheds as of 2004. Overall, the KMS watershed is approximately 34 percent impervious. Although the actual imperviousness of the KMS watershed will likely increase in the future due to additional new development and re-development in the watershed, over time the directly connected, or *effective* imperviousness of the watershed can be reduced through retrofitting existing impervious areas and applying low impact development (LID) techniques to new development.

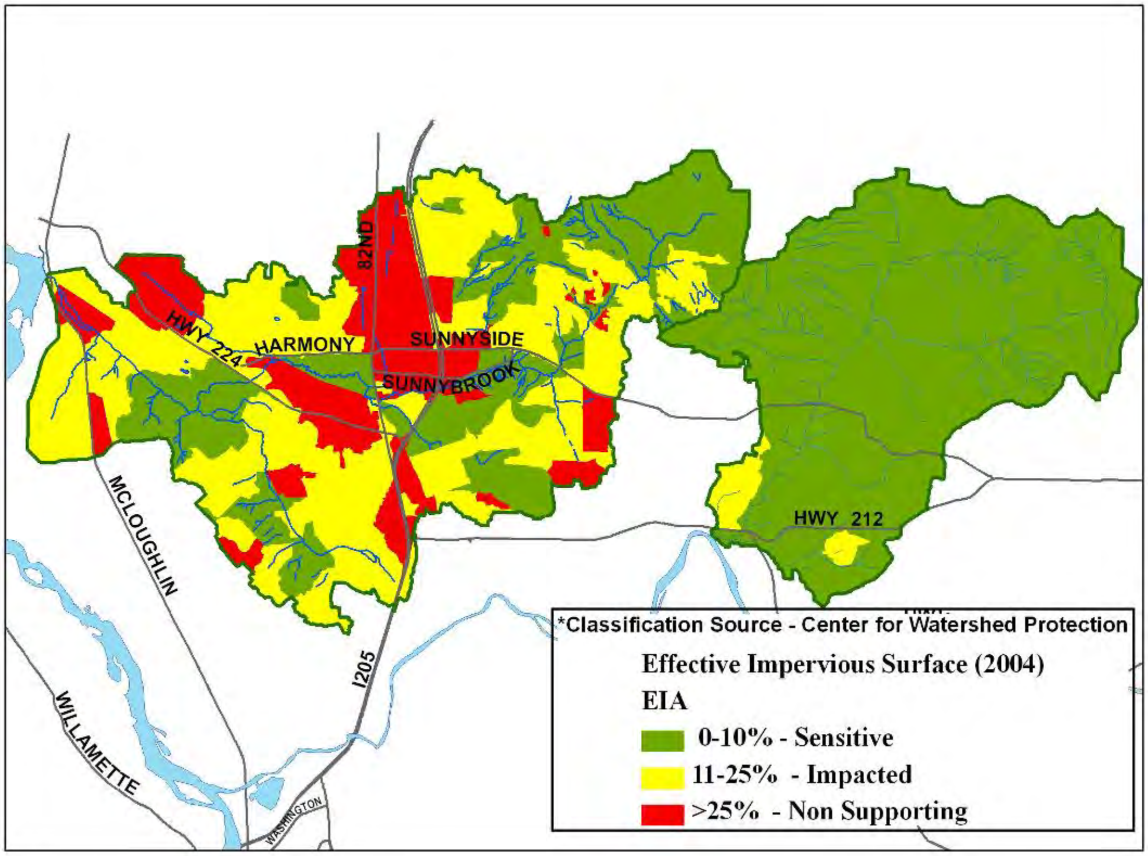


Figure 3-3. Effective Impervious surface summary of the KMS and RC watersheds in 2004.

Note: Figure 3-3 classifies imperviousness according to the Center for Watershed Protection method for evaluating the impact of untreated impervious surfaces in urban areas on streams.

LID or sustainable development techniques encompass a variety of site design and stormwater management techniques intended to reduce the effective imperviousness of development by directing runoff from roofs and pavement to vegetated areas where it can be detained, treated, evapotranspired, and in some cases, infiltrated into the soil. Four main principles of LID site design include the following: 1) reduce and soften the impervious footprint; 2) retain native vegetation and soils; 3) control runoff and pollutants at their source; and 4) increase infiltration. These practices aim to mimic the natural hydrology of a site under post-development conditions.

LID techniques can be effective at reducing runoff and improving stormwater quality, particularly for smaller storms. Larger storms may still require the use of more traditional stormwater treatment and conveyance systems, such as regional detention ponds and stormwater pipes, although the need for this varies based on individual site conditions such as soils and slopes as well as the amount of land used for LID techniques within a development. Retrofitting developed areas with LID techniques and regional stormwater treatment systems where feasible can help reduce the effective imperviousness of a watershed and improve watershed health.

Areas with high levels of imperviousness that lack stormwater treatment systems are areas to consider for prioritization to retrofit with regional stormwater treatment systems or site design modifications to allow more stormwater runoff to be stored, treated, and infiltrated in vegetated areas or other treatment systems. However, ameliorating the impacts of heavily developed urban areas can be challenging due to the magnitude of retrofits that would be necessary to see a measurable difference in in-stream water quality as well as other issues such as private landowner owner willingness to participate in retrofitting projects. In addition, available land in areas with high levels of imperviousness may be difficult to find and expensive to use for stormwater treatment. Areas with moderate levels of imperviousness also provide opportunities to retrofit with stormwater treatment systems, and may offer more available land for this purpose.

Water Environment Services Biological Indicator Monitoring

As discussed above, biological indicators such as benthic macroinvertebrate communities and fish communities provide a long-term metric of water quality and insight into overall watershed health. Since some of these species are long-lived, live in the water, and are sensitive to changes in water quality, studying the make-up of these communities provides clues about overall water quality conditions and levels of water quality constituents that can be limiting factors for aquatic organisms.

However, it is also important to recognize that biological indicators can be affected by other limiting factors than water quality. Fish populations, in particular, can be affected significantly by habitat conditions as well as by a variety of other issues including competition with invasive species, passage and access to quality or suitable habitats, overfishing, ocean conditions (for anadromous fish), and other constraints. Therefore, low fish population scores (F-IBI) are not necessarily indicative of poor water quality. On the other hand, higher fish population scores generally indicate that minimal water quality requirements for sensitive species are being met or conditions are at least tolerable. Salmonids (e.g., trout and salmon) have similar basic requirements for reproduction, rearing and migration including cool water temperatures; clean, well oxygenated water; and appropriate substrate with low levels of fines for spawning, amongst other habitat requirements. The presence of these species in a given reach is indicative of water quality that is meeting fish population needs at some level, although the movement of fish through the stream can make it difficult to correlate specific fish population data with reach-scale water quality.

Benthic macroinvertebrate surveys may be a more reliable indicator of water quality than fish populations. Benthic macroinvertebrates are generally stationary, and thus are exposed to water quality conditions at a single location over time. The level of impairment in the benthic macroinvertebrate scores (B-IBI) indicates the proportion of organisms found in the surveys that are able to tolerate elevated sediment loads, increased water temperatures, periods of sustained high or low flows, and other characteristics of urbanized streams (Lemke and Cole, 2008). Benthic communities can become impaired due to temporary disturbance of the stream channel or other factors in addition to water quality issues.

WES retained contractors to collect data on benthic macroinvertebrate communities in 2002 and 2007 (Lemke and Cole, 2008) and on fish communities in 1997-98, 2002-03, and 2008 (ODFW, 2008). The results from these biological monitoring surveys are briefly summarized below and discussed in more detail in Chapter 4.

Benthic macroinvertebrate and fish population surveys indicate that the streams in the watershed primarily support moderately to severely impaired biological communities. The benthic macroinvertebrate communities surveyed in 2007 are largely comprised of organisms that are able to tolerate elevated sediment loads, increased water temperatures, periods of sustained high or low flows, and other characteristics of urbanized streams (Lemke and Cole, 2008).

However, recent sampling conducted by ODFW in 2008 found evidence that Steelhead trout, Coho salmon and Cutthroat trout are still present in selective reaches of streams in the watershed and are successfully reproducing in some areas (ODFW, 2008). The three species of salmonids have similar basic requirements for reproduction, rearing, and migration. They all require cool water temperatures; clean, well oxygenated water; and appropriate substrate with low levels of fines for spawning amongst other habitat requirements. Therefore, the presence of these species in a given reach indicates that at least minimal water quality requirements for these sensitive species are tolerable or are being met.

Additional discussion of the biological indicators in the KMS watershed, including a discussion of the B-IBI and F-IBI scores, is provided in Chapter 4.

Water Environment Services Water Quality Monitoring

WES has been collecting water quality monitoring data since 1994 as a part of its NPDES MS4 permit program. WES also operates continuous monitoring stations that collect in-stream flow data, rainfall data, and some limited water quality data such as stream temperature, pH, dissolved oxygen (DO), and conductivity. The environmental monitoring sites are illustrated in Figure 3-1. WES has a number of historic monitoring sites with varying data available as well as current monitoring sites.

Prior to 2006, WES primarily collected grab samples at 14 in-stream sites and four outfall sites, and performed continuous monitoring at one site in CCSD No. 1 for its MS4 permit monitoring. In-stream samples were collected once every 1 to 2 months, and slightly less than 20 percent of samples were generally collected during storms. For some streams, only limited field parameters such as temperature, conductivity, total dissolved solids, pH, and DO were collected. At stormwater outfalls, WES collected grab samples once per year during storm events.

In 2006, WES modified its stormwater sampling program for its MS4 permit. The number of sites where data is collected was reduced to nine in CCSD No. 1, but more composite samples are collected and more water quality parameters are measured at the remaining sites. Composite samples are multiple samples (usually three) collected at defined intervals from the same storm and combined (composited) prior to analysis for most parameters. Composite samples generally better represent the water quality impacts of a storm event than a single grab sample.

Sites currently included in the stormwater sampling program for the MS4 permit include the following:

- CC-11: Phillips Creek at Southeast 84th Avenue and Sunnybrook
- CC-15: Mt. Scott Creek at North Clackamas Park
- CC-14: Kellogg Creek at Southeast Rusk Road and Aldercrest
- CC-26: Kellogg Creek at Highway 99E in the City of Milwaukie
- Outfall #19: SE Webster Road at Kellogg Creek (primarily residential land use)
- Outfall #12: Pheasant Court (primarily mixed use land use)
- Outfall #26: Southeast Tollbert Road and Northeast 94th Avenue (primarily mixed use land use)
- Outfall Near 147th Avenue and Sunnyside Road (primarily commercial land use)

The parameters measured at these sites since 2006 include the following:

- DO
- Conductivity
- Temperature
- pH
- Flow
- Total Dissolved Solids
- Total Suspended Solids (TSS)
- Total Volatile Solids
- *E. coli* bacteria
- Nitrogen – Ammonia
- Nitrogen – Nitrate
- Total Phosphorus (TP)
- Phosphorus – Orthophosphate (dissolved phosphorus)
- Oil and grease
- Total metals: copper, lead, and zinc
- Dissolved metals: copper, lead, and zinc
- Total hardness

Water Quality Monitoring Results

Trend Analysis

As a part of the 2008 MS4 permit renewal, WES performed a trend analysis of its monitoring data to determine whether the monitoring results have exhibited statistically significant trends either upward or downward during the last 13 years of data collection (Brown and Caldwell, 2008). Only wet season datasets with an adequate number of detected results to perform a statistically valid analysis were evaluated. The results of the trend analysis are summarized in Table 3-1.

Table 3-1. Detailed Trend Analysis Results for Wet Season Datasets, Significance level = 5 percent

Site ID	Site	Ammonia (mg/L[1])	Copper (ug/L[2])	DO (mg/L)	*E. Coli* (MPN/ 100 ml[3])	Hardness (mg/L)	Nitrate (mg/L)	Ortho-phosphate (mg/L)	Total Phosphorus (mg/L)	TSS (mg/L)	Zinc (ug/L)
CC-09	Mt. Scott Creek at SE 122nd/129th Avenue	Downward			No trend		Downward	Downward	No trend	No trend	
CC-10	Mt. Scott Creek at SE Oak Bluff Boulevard				No trend	No trend	No trend	No trend	No trend	No trend	
CC-11	Phillips Creek at SE 84th Avenue				No trend	No trend	No trend	No trend	No trend	Upward	No trend
CC-12	Dean Creek near Mt. Scott Creek	Downward	Upward		No trend	No trend	No trend	No trend	No trend	No trend	Upward
CC-14	Kellogg Creek at SE Rusk Road	Downward			No trend	No trend	Downward	No trend	No trend	No trend	No trend

Table 3-1. Detailed Trend Analysis Results for Wet Season Datasets, Significance level = 5 percent

Site ID	Site	Ammonia (mg/L[1])	Copper (ug/L[2])	DO (mg/L)	*E. Coli* (MPN/ 100 ml[3])	Hardness (mg/L)	Nitrate (mg/L)	Ortho-phosphate (mg/L)	Total Phosphorus (mg/L)	TSS (mg/L)	Zinc (ug/L)
CC-15	Mt. Scott Creek at N. Clackamas Central Park	Downward		No trend	Upward	No trend	No trend	No trend	No trend	No trend	No trend

[1] mg/L = milligrams per liter
[2] ug/L = micrograms per liter
[3] mL = milliliters

Oregon Water Quality Index

WES also conducted analyses of monitoring data in CCSD No. 1 through a study conducted by EnviroData Solutions in 2000. As part of the analysis, EnviroData Solutions (2000) calculated a modified Oregon Water Quality Index (OWQI) (modified due to lack of biochemical oxygen demand [BOD] and fecal coliform data). The OWQI is a single-value measure of overall water quality developed by DEQ. The index was developed to provide a simple method for expressing the significance of regularly generated laboratory data, and was designed to aid in the assessment of water quality for general recreational uses. The OWQI integrates measurements of temperature, DO, BOD, pH, ammonia+nitrate-nitrogen, TP, total solids, and fecal coliform bacteria into a score ranging between 10 (poor) and 100 (excellent). Although the integration of a variety of surface water parameters into a single value provides an interesting way of viewing data, the results of such an analysis often have limited value for assessing specific watershed conditions due to the combination of so many factors and the lack of detailed information on parameters such as the time of the day the data were collected (which can be very important for both temperature and DO). The value of the OWQI is also limited because it does not address parameters such as metals.

In 2000, CCSD No. 1 monitoring stations with the poorest water quality in the OWQI analysis were located at the manhole at La Jolla Street and Linwood Avenue (near the western boundary of the District), at two locations on Kellogg Creek (at Rusk Road and at Clackamas Road), and at two locations on Cow Creek. Land uses in these areas are commercial, industrial, and older residential development. The modified OWQI at these locations ranged from 23 to 42, indicating poor water quality.

CCSD No. 1 monitoring stations with the highest water quality are located on the Clackamas River (at Highway 99 and at Carver), outside the KMS watershed. The modified OWQI at these locations is 87 and 94, indicating good to excellent water quality. This is supported by findings in the annual Oregon Water Quality Index Summary Report (DEQ, 2005) which shows that stations on the Clackamas River have excellent water quality.

Boxplot Analysis of Water Quality Data

To further characterize water quality conditions in the watershed, as a part of this study WES monitoring data on key water quality parameters were evaluated against water quality criteria set by DEQ as well as guidance levels from other sources where criteria have not been set by DEQ. Boxplots were used to display and analyze the data.

Boxplots can be used to examine data spread, central tendency, skewness, and the presence or absence of outliers. Comparing boxplots can help identify possible differences between locations or time periods. The type of boxplot used in this analysis is the standard boxplot. The box itself contains the center 50 percent of the data (i.e., the interquartile range), and the median is indicated as a horizontal line within the box. The top edge of the box is the 75th percentile and the bottom edge is the 25th percentile. Vertical lines, sometimes called whiskers, extend to the last observation within one step beyond either end of the box. A step is 1.5 times the height of the box. Data points that fall outside one step are considered to be outliers, and values that fall outside of two steps are labeled extreme. Outliers and extremes are individually plotted.

The following parameters were evaluated and the results are displayed in the accompanying figures:

- DO (Figure 3-15)
- pH (Figure 3-16)
- TP (Figure 3-17)
- Nitrate (Figure 3-18)
- *E. coli* (Figure 3-19)
- TSS (Figure 3-20)
- Dissolved copper (Figure 3-21)
- Dissolved lead (Figure 3-22)
- Dissolved zinc (Figure 3-23)
- Temperature – continuous monitoring June 2008 to October 2008 (Figures 3-4 through 3-13)
- Temperature – grab samples (Figure 3-14)

Correlating data from in-stream and outfall water quality sampling with surface water management activities is a challenging task due to the myriad of other influences on water quality within the overall contributing drainage or watershed. An initial analysis of the results of water quality monitoring in comparison to the contributing watershed conditions is provided in this section; further analysis of the contributing areas and WES management activities in these areas will be performed during the watershed assessment. Results are summarized by monitoring site in Tables 3-2 through 3-7 and illustrated in boxplots comparing multiple sites in Figures 3-13 through 3-23 and Tables 3-9 through 3-19.

The temperature data are contained in two different datasets. The first temperature dataset, illustrated in Figures 3-4 to 3-12, is from continuous temperature monitoring completed by ODFW under contract to WES from June through October 2008. The 7-day moving average of the hourly maximum temperatures is compared to the summer 7-day average temperature standard (18 degrees Celsius [C]) in Figure 3-13. Table 3-19 summarizes the continuous temperature monitoring site locations. Due to the recent acquisition of the continuous temperature dataset, analysis of the data is not provided in this section.

The second temperature dataset is from grab samples collected primarily during the fall, winter, and spring as a part of the MS4 monitoring effort. These data are compared to the winter temperature standard (13 degrees C for October 15 to May 15).

CC-09

Site CC-09 is located in the Upper Mt. Scott Creek sub-basin at Southeast 122nd Avenue/Southeast 129th Avenue. The contributing area to CC-09 is 1,457 acres. Land use in the contributing area is primarily newer residential. Site CC-09 is upstream and close to the benthic macroinvertebrate monitoring site SD1-M2 and downstream of the fish monitoring site MS4.

The results of the boxplot analysis for CC-09 are presented in Table 3-2 and Figures 3-17 through 3-20. Based on the results of the analysis, it appears that this site may exhibit limiting factors for nutrients (TP) and bacteria (*E. coli*). Single day *E. coli* criteria were exceeded in 39 percent of samples. The TSS levels measured at this site are relatively low. In the 2008 trend analysis, CC-09 exhibited downward trends in ammonia, nitrate and orthophosphate, and no trend in total phosphorus, *E. coli*, and TSS.

Table 3-2. Constituents analyzed for water quality characterization at Site CC-09

Item	Date	Total samples	Number of exceedances	Percent exceedances	Criteria (DEQ) or *Indicator/Guidance level (other sources)*
TP	1996–2007	59	49	83	*Indicator: 0.05 mg/L (OWEB[1], 1999)*
Nitrate	1996–2007	59	0	0	*Guidance: 5 mg/L (1/2 of MCL, USEPA[2], 2008)*
E. Coli	1996-2007	59	23	39	Single Day: 406 E.coli/100mL
TSS	1999-2007	59	0	0	*Guidance: 100 mg/L (not a published reference)*

[1]OWEB = Oregon Watershed Enhancement Board
[2] USEPA = U.S. Environmental Protection Agency

CC-10

Site CC-10 is located on Mt. Scott Creek at Southeast Oak Bluff Boulevard, west of I-205 and east of Southeast 82nd Avenue. It is downstream from CC-09. The contributing area for site CC-10 is approximately 2,958 acres. Table 3-3 summarizes the constituents analyzed for the water quality characterization at Site CC-10. Of the 10 constituents analyzed, only five have been sampled for at this site: DO, TP, nitrate, *E. coli*, and TSS. Boxplots for these constituents are provided in Figures 3-15, 3-17, 3-18, 3-19, and 3-20. Based on the results of the analysis, it appears that this site may exhibit limiting factors for nutrients (TP) and bacteria (*E. coli*). The *E. coli* criterion was more often exceeded during dry months, with 18 samples exceeding the criterion in dry months and 10 samples exceeding it during wet months. The DO measurements at this site are good and the TSS levels measured at this site are generally low. Previous results from the trend analysis indicate no trend for the wet season *E. coli*, nitrate, TP, and TSS measurements at this location.

Table 3-3. Constituents analyzed for water quality characterization at Site CC-10

Item	Date	Total samples	Number of exceedances	Percent exceedances	Criteria (DEQ) or *Indicator/Guidance level (other sources)*
DO	2002–2007	17	0	0	Not to be below 8 mg/L
TP	1996–2007	123	81	66	*Indicator: 0.05 mg/L (OWEB, 1999)*
Nitrate	1996–2007	125	1	1	*Guidance: 5 mg/L (1/2 of MCL, USEPA, 2008)*
E. Coli	1996–2007	127	28	22	Single Day: 406 E.coli/100mL
TSS	1999–2007	97	1	1	*Guidance: 100 mg/L (not a published reference)*

CC-11

Site CC-11 is located on Phillips Creek at Southeast 84th Avenue. The contributing area to CC-11 (Phillips Creek at Southeast 84th Avenue) is approximately 1,830 acres. The contributing area is highly urbanized and is approximately 53 percent impervious. A large proportion of the impervious area in this contributing area is for roads. The development in this area includes single-family residential (SFR) and multi-family residential (MFR) and commercial land. Much of the commercial land along Southeast 82nd Avenue was developed in the 1970s and 1980s, before water quality BMPs were required for new development. There has been some recent residential development in the contributing area.

Historically, the contributing area has not had extensive or consistent maintenance. In 2008, WES expanded systematic maintenance in the contributing area by performing Vactor truck removal of sediment from catchbasins along Southeast 82nd Avenue. Much of the channel of Phillips Creek in the contributing area is piped. It is possible that the increasing trend in TSS at CC-11 is due to increased traffic on the streets in the contributing area or to increased sediment loads due to poorly managed runoff from new development.

Table 3-4 summarizes the constituents analyzed for the water quality characterization at Site CC-11. All 10 constituents were sampled at this site and boxplots for these constituents are provided in Figures 3-15 through 3-23. Similar to Sites CC-09 and CC-10, it appears that this site may also exhibit limiting factors for nutrients (TP) and bacteria (*E. coli*). The *E. coli* criteria and TP guidance were exceeded in 43 and 76 percent of the samples, respectively. The DO, pH, nitrate, TSS, and dissolved copper, lead, and zinc measurements at this site were all within the applicable criteria.

Unlike the other sites in KMS watershed, *E. coli* exceedances occurred equally in the wet and the dry months, with 30 exceedances occurring during dry months and 29 occurring during wet months. Previous data analysis from the trend analysis indicated no trends over time for *E. coli*, nitrate, TP, and total zinc but an upward trend for TSS at this location.

Table 3-4. Constituents analyzed for water quality characterization at Site CC-11

Item	Date	Total samples	Number of exceedances	Percent exceedances	Criteria (DEQ) or *Indicator/Guidance level (other sources)*
Temperature (grab samples)	2007-2008	8	1	12.5	Not to exceed 13 degrees C October 15 to May 15
DO	2007–2008	7	0	0	Not to be below 8 mg/L
pH	2007–2008	8	0	0	Between 6.5 and 8.5 units
TP	1996–2008	131	100	76	*Indicator: 0.05 mg/L (OWEB, 1999)*
Nitrate	1996–2008	135	0	0	*Guidance: 5 mg/L (1/2 of MCL, USEPA, 2008)*
E. Coli	1996–2008	137	59	43	Single Day: 406 E.coli/100mL
TSS	1999–2008	105	0	0	*Guidance: 100 mg/L (not a published reference)*
Dissolved copper	2007–2008	6	0	0	Acute criteria based on hardness
Dissolved lead	2007–2008	6	0	0	Acute criteria based on hardness
Dissolved zinc	2007–2008	6	0	0	Acute criteria based on hardness

CC-12

Site CC-12 is located on Dean Creek near Mt. Scott Creek. The contributing area to CC-12 is approximately 1,060 acres. The contributing area is highly urbanized and is approximately 50 percent impervious. A large proportion of the impervious area in this contributing area is for roads. The development in this area includes nearly 40 percent industrial land, 20 percent residential land, and 7 percent commercial land.

Table 3-5 summarizes the constituents analyzed for the water quality characterization at Site CC-12. All 10 constituents were sampled at this site and boxplots for these constituents are provided in Figures 3-15 through 3-23. The criterion for TP was exceeded in 88 percent of the samples collected during the last 12 years of sampling at this location. Elevated TP may result in an increase in algae growth, which in turn can adversely affect DO and pH in the stream. DO is also highly influenced by temperature.

The temperature, nitrate, TSS and dissolved lead and zinc measurements at this site were all within required criteria or guidance limits. Although the pH constituent frequently did not exceed the required criteria, measured values tended to be more on the acidic side of the pH criteria with pH measuring between 5.9 and 6.8 units. Low pH may indicate more organic decay and carbon dioxide production occurring in the associated waters.

Similar to Site CC-10, the majority of *E. coli* exceedances occurred in the dry months. Of the 40 times the criteria were exceeded, 27 times were during dry months and 11 times were during wet months. Increasing trends were observed for total zinc and total copper in the 2008 trend analysis. The source of the metals in the samples evaluated in the trend analysis is not known. It is possible that the increasing trends in zinc and copper at CC-12 are due to materials commonly used in industrial areas, including zinc-galvanized metal buildings and copper used in forming materials such as copper pipe. Increased traffic on the streets in the contributing area could also contribute to the increasing trend.

Table 3-5. Constituents analyzed for water quality characterization at Site CC-12

Item	Date	Total samples	Number of exceedances	Percent exceedances	Criteria (DEQ) or *Indicator/Guidance level (other sources)*
Temperature (grab samples)	2007-2008	8	0	0	Not to exceed 13 degrees C October 15 to May 15
DO	2002, 2007-2008	8	2	25	Not to be below 8 mg/L
pH	2007-2008	8	2	13	Between 6.5 and 8.5 units
TP	1996-2008	131	115	88	*Indicator: 0.05 mg/L (OWEB, 1999)*
Nitrate	1996-2008	135	0	0	*Guidance: 5 mg/L (1/2 of MCL, USEPA, 2008)*
E. Coli	1996-2008	137	40	29	Single Day: 406 E.coli/100mL
TSS	1999-2008	106	0	0	*Guidance: 100 mg/L (not a published reference)*
Dissolved copper	2007-2008	6	1	17	Acute criteria based on hardness
Dissolved lead	2007-2008	6	0	0	Acute criteria based on hardness
Dissolved zinc	2007-2008	6	0	0	Acute criteria based on hardness

CC-14

Site CC-14 is located on Kellogg Creek at Southeast Rusk Road. The contributing area to CC-14 is 1,521 acres and contains primarily residential development.

Table 3-6 summarizes the constituents analyzed for the water quality characterization at Site CC-14. All 10 constituents were sampled at this site and boxplots for these constituents are provided in Figures 3-15 through 3-23. The indicator level for TP was exceeded in 95 percent of samples during the last 12 years of sampling at this location. Elevated TP may result in an increase in algae growth and therefore limit the DO available in the stream.

Similar to other sites in the watershed, it appears that this site may also exhibit limiting factors for nutrients (TP) and bacteria (*E. coli*). The *E. coli* criteria and TP indicator level were exceeded in 52 and 95 percent of the samples collected, respectively. The DO, pH, nitrate, TSS, and dissolved metals measurements at this site were generally within required criteria or guidance limits, with occasional exceedances of nitrate, pH, and DO. The trend analysis conducted in 2008 found a downward trend for nitrate and no trend for *E. coli*, TP, TSS and total zinc at this location.

Table 3-6. Constituents analyzed for water quality characterization at Site CC-14

Item	Date	Total samples	Number of exceedances	Percent exceedances	Criteria (DEQ) or *Indicator/Guidance level (other sources)*
Temperature (grab samples)	2007-2008	8	0	0	Not to exceed 13 degrees C October 15 to May 15 Not to exceed 18 degrees C
DO	2003, 2007-2008	8	1	13	Not to be below 8 mg/L
pH	2007-2008	8	1	13	Between 6.5 and 8.5 units
TP	1996-2008	132	126	95	*Indicator: 0.05 mg/L (OWEB, 1999)*
Nitrate	1996-2008	136	8	6	*Guidance: 5 mg/L (1/2 of MCL, USEPA, 2008)*
E. Coli	1996-2008	138	72	52	Single Day: 406 E.coli/100mL
TSS	1999-2008	106	0	0	*Guidance: 100 mg/L (not a published reference)*
Dissolved copper	2007-2008	6	0	0	Acute criteria based on hardness
Dissolved lead	2007-2008	6	0	0	Acute criteria based on hardness
Dissolved zinc	2007-2008	6	0	0	Acute criteria based on hardness

CC-15

Site CC-15 is located on Mt. Scott Creek at North Clackamas Central Park. The contributing area to CC-15 (Mt. Scott Creek at North Clackamas Central Park) is approximately 7,625 acres. The contributing area is approximately 26 percent impervious. The area includes 45 percent SFR land use, a smaller amount (6 to 12 percent each) of MFR, commercial, and industrial land use.

Table 3-7 summarizes the constituents analyzed for the water quality characterization at Site CC-15. All 10 constituents were sampled at this site and boxplots for these constituents are provided in Figures 3-15 through 3-23. Based on the results of the analysis, it appears that this site may also exhibit factors limiting watershed health for nutrients (TP) and bacteria (*E. coli*). Due to the contributing area containing mostly single-family residential, high TP levels could be derived from runoff from residential landscaping containing phosphorous-rich fertilizers. Higher TP concentrations often occurred during summer months when it would be assumed that the landscaping is frequently irrigated.

The temperature, pH, TSS, nitrate, and dissolved copper, lead and zinc measurements at this site were all generally within required criteria or guidance limits, with only one exceedance measured for both pH and TSS during the sampling period. Similar to other discussed sites, the majority of exceedances of *E. coli* from this site occurred during the dry months.

An increasing trend for *E. coli* was observed at CC-15 during the 2008 trend analysis. This may be due to its location in the park, where geese and ducks frequently congregate. Other potential sources of *E. coli* include domestic animals in the watershed (such as dogs, cats, and horses) and wild animals (such as rodents, raccoons, rabbits, and waterfowl). Bacteria can be difficult to address due to the wide variety of potential sources. Microbial Source Tracking (MST) can be used in the future by WES to determine the sources of bacteria so that control methods can be targeted.

Table 3-7. Constituents analyzed for water quality characterization at Site CC-15

Item	Date	Total samples	Number of exceedances	Percent exceedances	Criteria (DEQ) or *Indicator/Guidance level (other sources)*
Temperature (grab samples)	2007-2008	8	0	0	Not to exceed 13 degrees C October 15 to May 15 Not to exceed 18 degrees C
DO	2002-2008	57	8	14	Not to be below 8 mg/L
pH	2007-2008	8	1	13	Between 6.5 and 8.5 units
TP	1996-2008	130	111	85	*Indicator: 0.05 mg/L (OWEB, 1999)*
Nitrate	1996-2008	134	0	0	*Guidance: 5 mg/L (1/2 of MCL, USEPA, 2008)*
E. Coli	1996-2008	135	43	32	Single Day: 406 E.coli/100 mL
TSS	1999-2008	104	1	1	*Guidance: 100 mg/L (not a published reference)*
Dissolved copper	2007-2008	6	0	0	Acute criteria based on hardness
Dissolved lead	2007-2008	6	0	0	Acute criteria based on hardness
Dissolved zinc	2007-2008	6	0	0	Acute criteria based on hardness

Regional Water Quality Analysis Summary

The 2006 Master Plan contained a summary of water quality analysis results based on regional data from the Oregon Association of Clean Water Agencies (ACWA) stormwater monitoring database compiled in the mid-1990s and limited stormwater grab sampling conducted as part of the Master Plan for targeted residential, agricultural, open space land uses (Shaun Piggot Associates et al., 2006). The water quality analysis summary findings in the Master Plan are generally consistent with the boxplot analysis of water quality data in the KMS watershed and other findings from the watershed characterization. The Master Plan reported the following conclusions based on available data and literature:

- Commercial and industrial areas lacking effective stormwater treatment are likely to serve as urban sources of TSS and metal loadings.
- Stormwater runoff from older residential areas that lack effective stormwater treatment can have significant metal loadings due to road runoff and other sources. Due to very low hardness levels, the metal concentrations for zinc and copper may exceed acute water quality criteria.
- Stormwater quality is often better in runoff from undeveloped open spaces, newer low density residential areas, and low density rural residential areas. This is supported by very low pollutant concentrations for most water quality parameters that were measured in stormwater runoff from newer residential areas in the northeastern portion of the District, from open space runoff on Mt. Talbert, and from runoff of rural residential areas in the expansion study area. The main exception was measurement of *E. coli* bacteria concentrations. Nutrient levels can also be high in runoff from open spaces and residential areas, depending on land management practices and other watershed factors.
- Consistent with literature information, runoff from agricultural areas exhibits higher levels of nutrients (nitrogen and phosphorus) and TSS in comparison to urban areas.
- The Oregon single sample criterion for *E. coli* is exceeded with varying frequency in runoff from nearly all land uses. The only exception was in runoff from undeveloped forested areas. Based on monitoring conducted, highest median *E. coli* concentrations are associated with runoff from agricultural and rural residential areas. Older residential areas in CCSD No. 1 appeared to have higher median *E. coli* concentrations than newer residential areas.
- A high proportion of water quality complaints in the District's complaint log are related to issues of construction site runoff. There is concern about the adequacy of required construction site BMPs for construction projects on steep slopes during the winter rainy season.

Pollutant Loads Modeling

WES conducted pollutant loads modeling of the CCSD No. 1 and Surface Water Management Agency of Clackamas County (SWMACC) areas for the NPDES MS4 permit renewal in 2008 and for the Master Plan in 2006. For the MS4 permit renewal, the modeling included establishing new pollutant load reduction benchmarks and evaluating progress towards achieving already developed benchmarks for receiving waters with approved TMDLs. The following information is from the 2008 MS4 permit renewal (WES 2008).

Total Maximum Daily Loads

A TMDL is an estimate of the total load of pollutants from point, non-point, and natural sources that a water body may receive without exceeding applicable water quality standards (with a factor of safety included). TMDLs are generally developed as a way to project the maximum pollutant load capacity of a waterbody, so as not to exceed water quality standards. To translate the TMDL into guidelines for municipalities and industries, waste load allocations (WLAs) and load allocations (LAs) are developed, which allocate a proportion of the TMDL to contributing sources (industries, future growth, municipalities, groundwater, CSO, wastewater treatment plants, etc). WLAs were originally developed as a means to regulate discharges from well-defined point sources (industries and wastewater treatment plants). But with the implementation of NPDES permits for industries, wastewater treatment plants, and MS4s, permits are now used to regulate WLAs from their point sources that are covered by the permits. LAs are used to address stormwater discharges outside the MS4 permit area.

A TMDL has been established for *E. coli* in Kellogg, Phillips, and Mt. Scott Creeks. The TMDL requires a 78-percent reduction in in-stream *E. coli* loads. *E. coli* generally signifies the presence of fecal contamination. There are many potential sources of *E. coli* in streams including a variety of wildlife, birds, domestic animals, pets, and humans.

The Willamette River TMDL became effective in 2006. The WLAs described in the Willamette River TMDL apply to all of the current Phase 1 NPDES MS4 permittees and co-permittees in the State of Oregon. Basin-wide, the Willamette River TMDL is specific for mercury, bacteria, and temperature, although some tributaries have additional TMDL parameters. Temperature is not considered a stormwater pollutant in the Willamette River TMDL, and consequently is not addressed by the permittees' NPDES MS4 permits. Temperature is considered to be a nonpoint source issue and is therefore addressed through jurisdictional TMDL Implementation Plans, which are focused on improving riparian tree canopy.

Mercury is a phased TMDL with monitoring requirements expected for the first phase to support DEQ's development of WLAs for the second phase. Although mercury can be associated with stormwater, permittees are not required to establish benchmarks for the pollutant at this time since WLAs have not yet been developed. *E. coli* bacteria is the only Willamette River TMDL parameter that requires a new benchmark to be established for permit renewal.

MS4 Permit Renewal Pollutant Load Modeling

As a part of the 2008 permit renewal submittal, WES developed updated estimates of annual pollutant loads in urban runoff from the MS4 permit area. The pollutant load is the total mass of pollutant in runoff during a given period of time (e.g., pounds per year). Loading is the product of runoff volume and pollutant concentration.

The pollutant load estimates were developed using a spreadsheet model that estimates pollutant loads based on local land use together with stormwater quality data collected from all Oregon Phase 1 jurisdictions and compiled by ACWA.

Establishing benchmarks relies on the use of a pollutant loadings model to calculate pollutant loads for select parameters, select scenarios, and under select development conditions. Once loads are generated, both with and without BMP implementation, a comparison between the loads and the WLA identified in the TMDL can be used to show progress in how the District's current stormwater management program is attempting to achieve WLAs. A benchmark is defined as a pollutant load reduction estimate. Therefore, the differences between loads without BMPs and reduced loads associated with BMPs define the District's benchmarks.

To conduct the pollutant loading analysis, CCSD No. 1 and SWMACC (the Districts) opted to use the pollutant load model developed as part of the 2006 Master Plan. The Clackamas County pollutant loads model is basically a spreadsheet model with a GIS interface that utilizes the USEPA Simple Method for pollutant load generation for each TMDL watershed.

Estimates of pollutant concentrations are based on land use. Using the USEPA Simple Method equations and GIS layers containing BMP drainage areas, watersheds, land use, and impervious information, loads are automatically calculated. The model was used to estimate current and future condition pollutant loads, assuming no structural BMPs in place and with structural BMPs in place. Estimates of the relative effectiveness of non-structural BMPs were based on best professional judgment. The model does not forecast stormwater characteristics for specific storms or monitoring periods.

The model uses the mean, the Upper 95 percent confidence interval, and the lower 95 percent confidence interval to produce a range of associated pollutant loading. Revised mean and median land use concentrations and the associated upper and lower confidence intervals are provided in the NPDES MS4 permit renewal submittal.

For the Lower and Middle Willamette River and tributaries (e.g., the KMS tributaries and the Clackamas River), the current condition (2008) model results with structural BMPs indicate that the Districts may not be meeting their WLAs for bacteria. However, bacteria reduction associated with structural BMPs is limited and many bacteria sources are those that are not readily influenced as a result of BMP (structural and non-structural) implementation.

Bacterial sources in urban environments typically have a very small human-derived component. The more predominant sources of bacteria include wildlife (avian and rodent), farm animals, and/or domestic pets. It is difficult to develop a benchmark for this parameter because the WLA includes all sources of *E. Coli* including those that the Districts would not be responsible for reducing (i.e., the goal is generally not to reduce wildlife such as avians). Recent bacteria source tracking studies in the region found that bacterial sources in urban environments are not predominantly human, as a result the District's bacteria benchmark for the Lower Willamette River will be focused on continued educational activities to reduce human and pet sources of bacteria and less focused on loads.

Master Plan Pollutant Load Modeling Results and Recommendations

The pollutant load model was used in the 2006 Master Plan to estimate stormwater pollutant loadings in the study area in order to do the following:

- Determine areas of highest existing loadings
- Estimate the changes in loadings with expected future development
- Help target recommended Capital Improvement Program (CIP) projects and other pollutant reduction for water quality enhancement.

Key results reported in the Master Plan are as follows:

- In general, the highest estimated pollutant loads were associated with areas of concentrated urban development, which is to be expected because the pollutant load model is based on land use. Increased runoff due to impervious surfaces and generally higher pollutant concentrations both contribute to higher loading estimates for urban areas. Thus, there is a potential for substantial increases in pollutant loadings in areas where growth and development are anticipated. This emphasizes the need in developing areas for hydrologic controls to reduce runoff volume and site design and treatment BMPs to reduce pollutant concentrations.
- TSS loads on a per-acre basis are predicted to be highest in areas that are dominated by commercial and industrial land use, again due to the land use basis of the model. Sub-basins with high estimated TSS loads include the Phillips, Dean (Deer), and Lower Mt. Scott Watersheds. Metal concentrations and loadings also are generally predicted to be greatest in areas that are dominated by commercial and industrial land uses. This suggests that retrofit projects to reduce sediment and metal loadings in industrial areas could help to protect existing water quality. Potential retrofit projects to target sediment and metal loading in the Phillips, Lower Mt. Scott, and Kellogg Creek Watersheds could help to improve water quality in these areas and should be considered for CIP projects.
- Highest concentrations and loadings of phosphorus are predicted in watersheds that are dominated by industrial land use. CIP projects that help to reduce sediment loads in these watersheds would help to reduce phosphorus loadings.
- Highest predicted concentrations of *E. coli* bacteria are associated with industrial, commercial, and residential development and are found in the Mt. Scott, Phillips, and Kellogg Creek sub-basins. These areas generally coincide with the 303(d) listings and TMDLs for *E. coli*. They also coincide with areas predicted to be generally high in sediment and metals loadings. CIP projects to reduce sediment and metals loading through sedimentation could also provide some reduction in *E. coli* levels. Infiltration facilities, treatment wetlands within extended detention basins could help to improve *E. coli* reductions, and should be considered for potential CIP projects in these watersheds.

Specific Study Results

Detention Pond Study Results

WES currently maintains over 260 detention ponds in suburban landscapes to treat and detain stormwater runoff. Many of these ponds are in Happy Valley. Prior to 2008 WES had no continuous, local data to evaluate whether the ponds reduce flows and/or significantly treat storm water runoff with respect to TSS. Studies performed on ponds in the region in 2005 found that the standard set of sampling and monitoring techniques involving grab samples taken during storm events were insufficient to quantify pond performance.

The efficiency of wet detention ponds at removing TSS, organic matter, and the percentage of fine and sand-sized particles from stormwater runoff were investigated at three ponds in Clackamas County, Oregon by a PSU graduate student (Rudolph, 2008).

Flow weighted composite samples were collected by automatic samplers during storm events at the inlet and outlet of the ponds on Waldorf Lane, Valley Way and Taryn Court. Composite data collected between December 2007 and March 2008 showed that wet detention ponds can significantly reduce the mass of sediment contained in pond effluent. However, how well detention ponds slow flow and remove pollutants is limited by design and environmental elements that influence the hydrologic loading rate, such as the pond area to drainage area ratio and storm intensity.

The pond on Taryn Court with the pond area to drainage area ratio of 4.2 percent removed an average 94 percent of suspended solids, while the pond on Waldorf Lane with a pond area to drainage area ratio of 0.1 percent removed an average 62 percent of solids from incoming stormwater. Enough storms were captured at the pond on Waldorf Lane to also show a strong correlation ($r = -0.85$) between increasing storm intensity and a decreasing pond efficiency.

The ponds on Waldorf Lane and Taryn Court showed significant removal of TSS and organic matter, as well as attenuation of flow. However, the pond on Valley Way was ineffective at removing solids and attenuating flow due to an influx of groundwater into the pond. TSS effluent concentrations for all ponds were found to be composed primarily of fine material (< 63 µm) as the ponds removed 75 to 97 percent of the incoming coarse material (> 63 µm).

Pesticide Monitoring Studies

The 2006 Master Plan provided a summary of pesticide monitoring studies that WES has participated in. Following is a discussion from the Master Plan that has been updated with recent information. Pesticides (including herbicides, insecticides, and fungicides) in water and sediments of surface streams can cause toxicity to aquatic organisms. A wide variety of pesticides are associated with agricultural practices, but many are also used in urban areas for landscape maintenance and vegetation control along roadways. Legacy pesticides such as DDT and dieldrin, which have been banned from use, continue to persist in the environment and may also be found in surface streams.

The presence of pesticides in surface runoff and surface streams is not routinely monitored. WES has participated in a number of special monitoring studies to investigate the presence of pesticides in area streams, and in coming years it is likely that WES will participate in additional pesticide monitoring as a part of the NPDES MS4 permit program.

WES cooperated in a study of pesticides in the Lower Clackamas River published by the USGS (2004a). Although this study did not include the KMS watershed, it took place in watersheds immediately east of the KMS watershed. The watersheds evaluated in this study are generally less developed than the KMS watershed and contain a higher proportion of agriculture land use than is found in the KMS watershed. The results for the urbanized streams studied that are adjacent to the KMS watershed (Cow and Carli Creeks) may be relevant to the KMS watershed.

Over the course of studies conducted from 2000 through 2005, 119 water samples were analyzed for a suite of 86 to 198 dissolved pesticides using ultra low detection level methods. In all, 63 pesticide compounds were detected, including 33 herbicides, 15 insecticides, 6 fungicides, and 9 pesticide degradation products. Atrazine and simazine were detected in about half of the samples. Other high-use herbicides such as glyphosate, triclopyr, 2,4-D, and metolachlor were also frequently detected. The significance of these mostly trace-level concentrations of pesticides is not yet known. USGS notes that conducting additional studies to both assess pesticide occurrence and levels in sediments and examine the potential effects on aquatic life and human health would be valuable (USGS, 2008).

In the USGS studies from 2000-2005, pesticide occurrence at relatively low levels was widespread in the tributaries that drain the northwestern area of the Lower Clackamas River basin including Rock, Deep, Richardson, Sieben, Carli, and Cow Creeks. Pesticides were detected in all 59 storm samples collected from these streams. Most of the samples containing the highest pesticide concentrations or the greatest number of compounds also had relatively high turbidity values.

Some concentrations of insecticides exceeded USEPA aquatic-life benchmarks in Carli, Sieben, Rock, Noyer, Doane, and North Fork Deep Creeks. For example, the diazinon concentrations in storm samples collected from Carli, Sieben, and Rock Creeks exceeded the USEPA aquatic-life criterion for benthic invertebrates by as much as 2.5. However, the levels of diazinon measured in these streams was lower than the levels that have been found to impair Chinook salmon predator avoidance behavior and homing ability (which is in the range of 1 to 10 μg/L) (USGS, 2008). Diazinon sales for residential usage ended recently in December 2004.

WES also cooperated in studies investigating the presence of organochlorine compounds (legacy pesticides and PCBs) in the Johnson Creek watershed. A USGS study (USGS, 2004b) evaluated the levels of organochlorine compounds (with a focus on DDT and dieldrin during storm flows) in the middle and Lower Johnson Creek watershed from 1988 to 2002. Organochlorine compounds were detected at most sites in 2002. The greatest concentrations were detected at the most upstream sites (mainly rural residential and agricultural and nursery land uses), and lowest concentrations at the downstream sites. The concentration of total DDT has decreased by an order of magnitude since 1989-90; however, the chronic freshwater criteria are still potentially exceeded for DDT, dieldrin, chlordane and total PCBs. Concentrations of total DDT were found to correlate with TSS concentration. Regression functions indicate that total DDT exceeds chronic criteria when the TSS concentration exceeds 8 mg/L at the most upstream station (Palmblad Road site in Gresham) and 15 mg/L at the most downstream station in Milwaukie. The concentration of dieldrin did not correlate with TSS.

WES cooperated in a project to investigate levels of legacy pesticides in the upper reaches of the Johnson Creek watershed (Johnson Creek Watershed Council [JCWC], 2005). The study included monitoring stations on Sunshine Creek, which is in the northeast corner of the expansion area. The JCWC study found that concentrations of legacy pesticides in water samples collected in both urban and rural locations exceed acceptable water quality and health standards. The study also found that during storm events, there is a strong relationship between TSS in the water and concentrations of total DDT. No such relationship exists during dry weather, indicating that erosion from rainfall carries DDT contaminated soil into the stream. Dieldrin concentrations appear more closely linked to turbidity than TSS. The study also found that the concentrations of legacy pesticides are substantially lower in residential streams and stormwater outfalls than in the agricultural and nursery areas.

Potential Future Risks and Further Analysis Recommended

As described earlier, the KMS watershed is a highly urbanized watershed. Portions of the watershed are expected to develop further in the future, particularly in the upper reaches of Mt. Scott Creek. Runoff from existing development and changes to watershed hydrology from new development and re-development pose potential future risks to water quality and other elements of watershed health. Many of the same issues addressed in Chapter 2 related to hydrology and stream channel stability could also affect water quality.

Policies and practices implemented to address the hydrologic and water quality impacts of existing development will be important to watershed health in the future. Design standards, regulations, land use policies, and sustainable practices will also play a significant role in determining the impact that future development and re-development has on the watershed.

There are several key issues related to water quality that were further analyzed during the watershed assessment phase in Chapter 5, including contributing factors to elevated stream temperatures, opportunities to reduce pollutant loads from existing land uses, opportunities to reduce the impacts associated with changes in land use, and potential changes to the monitoring program to better meet WES objectives.

As discussed in Chapter 1, the elements of watershed health (hydrology, water quality, aquatic habitat, and biological communities) often contain interrelated problems and integrated opportunities for improvement. Further work in the watershed assessment phase of the project was conducted to evaluate interrelated issues and to identify priority actions and management activities appropriate for WES to undertake to address factors that are limiting watershed health. See Chapters 5 and 6 for detailed information.

Bibliography

ABR, Inc., March 2003. Assessment of Macroinvertebrate Communities in Streams of North Clackamas County, Oregon, 2003, Final Report prepared by M. Cole, ABR, Inc. – Environmental Research and Services, Forest Grove, Oregon.

Brown and Caldwell, 2008. WES Water Quality Trend Analysis for NPDES MS4 permit renewal.

Clackamas County Service District No. 1, 2002. Surface Water Management Rules and Regulations for Clackamas County Service District No. 1, August 1, 2002.

Clackamas County. 2001. Tributaries of the Clackamas River Watershed, Water Quality Monitoring Report, prepared by the Clackamas County Soil & Water Conservation District.

Clackamas County, 2002. Storm Water Management Plan for Underground Injection Control for the Clackamas County Department of Transportation & Development, CCSD No. 1, and Surface Water Management Agency of Clackamas County, June 12, 2002.

Clackamas County, 2004. Summary Report for Clackamas County and County Service District-Owned/Operated Stormwater Injection Devices, report submitted to Oregon DEQ by Clackamas County Department of Transportation & Development, CCSD#1, and Surface Water Management Agency of Clackamas County, June 29, 2004.

Department of Environmental Quality, Oregon (DEQ), 2004a. National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System (Ms4) Discharge Permit No. 101348, issued by the Oregon Department of Environmental Quality, March 3, 2004.

Department of Environmental Quality, Oregon (DEQ), 2005a. Amended National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System (Ms4) Discharge Permit No. 101348, issued by the Oregon Department of Environmental Quality, July 27, 2005.

Department of Environmental Quality, Oregon (DEQ), 2005b. Oregon Water Quality Index Summary Report Water Years 1995-2004, prepared by the Oregon Department of Environmental Quality.

Department of Environmental Quality, Oregon (DEQ), 2008. Water Quality Standards. http://www.deq.state.or.us/WQ/standards/standards.htm Accessed December 10, 2008.

EnviroData, 2000. Water Quality Data Evaluation - CCSD No. 1 and SWMACC, prepared by EnviroData Solutions, Inc. for Water Environment Services, Clackamas County, July 21, 2000.

GeoSyntec Consultants, 2005. Qualitative and Quantitative Assessment of CCSD No. 1 Rules & Regulations for Stormwater Quality and Treatment Performance, Technical Memorandum prepared for Clackamas County Service District #1, June 29, 2005.

Johnson Creek Watershed Council (JCWC), 2005. Johnson Creek Legacy Pesticide Study: Source Investigation of Legacy Pesticides in the Upper Johnson Creek Watershed, prepared by the Johnson Creek Watershed Council.

Lemke, Jena L and Michael Cole. 2008. Assessment of Macrovinvertebrate Communities in Streams of Clackamas County Service District No. 1, Clackamas County, Oregon. Clackamas County Water Environment Services.

Montgomery, Watson, Harza. 2001. A watershed assessment of Kellogg and Mount Scott Creeks. Final Report prepared for Clackamas County Water Environment Services.

Oregon Department of Fish & Wildlife (ODFW). 2008. Fish Species Distribution and Abundance and Habitat Assessment of Streams in Clackamas County Service District No. 1 (CCSD No.1). Draft Report. October 15, 2008. Prepared by Alex Neerman and Jessica Vogt.

Oregon Department of Fish & Wildlife (ODFW), October 2003. Abundance and Distribution of Fish in Clackamas County Urban Streams, Final Report 2003-2003, prepared by E. Tinus, J. Koloszar, D. Ward of the Columbia River Investigation Program, Oregon Department of Fish and Wildlife.

Oregon Watershed Enhancement Board (OWEB). 1999. Oregon Watershed Assessment Manual. Prepared by the Watershed Professionals Network.

Rudolph, Ashlee Bryant, 2008. Efficiency of Wet Detention Ponds at Removing Solids from Storm Water Runoff in Clackamas County, Oregon. Portland State University Environmental Sciences and Management graduate program.

Shaun Piggott Associates et. al., 2006. CCSD No. 1 Surface Water Management Program Master Plan.

URS, 2008. Comprehensive Clackamas County Stormwater Monitoring Plan.

United States Environmental Protection Agency (EPA), 2008. Drinking Water Health Advisories. http://www.epa.gov/waterscience/criteria/drinking/. Accessed November 19, 2008.

United States Geological Survey (USGS), 2004a. Pesticides in the Lower Clackamas River Basin, Oregon, 2000-01, prepared by Kurt D. Carpenter, U.S. Geological Survey, Water-Resources Investigations Report 03-4145, Portland, Oregon.

United States Geological Survey (USGS), 2004b. Organochlorine Pesticides in the Johnson Creek Basin, Oregon, 1998-2002, prepared by Dwight Q. Tanner and Karl K. Lee, U.S. Geological Survey, Scientific Investigations Report 2004-5061, Portland, Oregon.

Water Environment Services (WES), 2000. Rock and Richardson Watershed Master Plan, prepared by URS Corporation for Water Environment Services of Clackamas County.

WES, April 2001. Surface Water and Storm Water Monitoring Plan for CCSD No. 1 and SWMACC, prepared by Andrew Swanson, Water Environment Services.

WES, 2006. 2005-2006 Water Quality Monitoring Report for Municipal Separate Storm System Permit #101348, prepared by the Water Environment Services of Clackamas County.

WES, 2008a. WES Environmental Monitoring Data from 1994 to 2007

WES, 2008b. 2007-2008 Water Quality Monitoring Report for Municipal Separate Storm System Permit #101348, prepared by the Water Environment Services of Clackamas County.

WES, 2008c. NPDES MS4 permit renewal submittal.

WES, 2005. Clackamas County Service District #1's Surface Water Management Program Master Plan's Short Term Stormwater Monitoring Study, March 23, 2005.

Tables 3-8 through 3-19
Figures 3-4 through 3-23

Table 3-8. Locations and Site Names for Continuous Temperature Monitoring Conducted in 2008			
Site Name	**Stream**	**Reach**	**Location description**
C101	Kellogg	1	Below Kellogg Lake Outlet
C102	Kellogg	2	Just upstream where Mt. Scott enters
C103	Kellogg	3	Mabel Road
C104	Mt. Scott	1	Mouth, just upstream of Kellogg Confluence
C105	Mt. Scott	1	At Biostabilization project off of Pheasant Court
C106	Mt. Scott	3	Above Dean Creek confluence near Southeast 82nd Avenue
C107	Mt. Scott	4	Spring Mt. Dam removal site
C108	Dean	N/A	Just upstream of culvert at confluence with Mt. Scott
C109	Phillips	1	Just upstream of Southeast 84th Avenue culvert

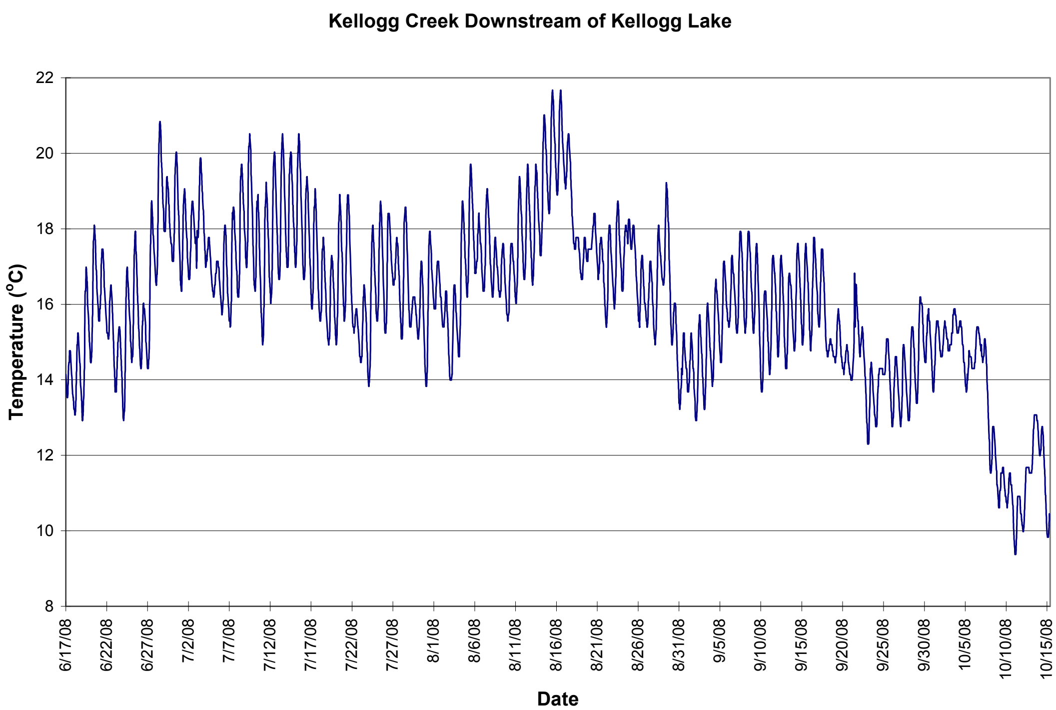


Figure 3-4. Site C101 continuous temperature monitoring 6/08 to 10/08.

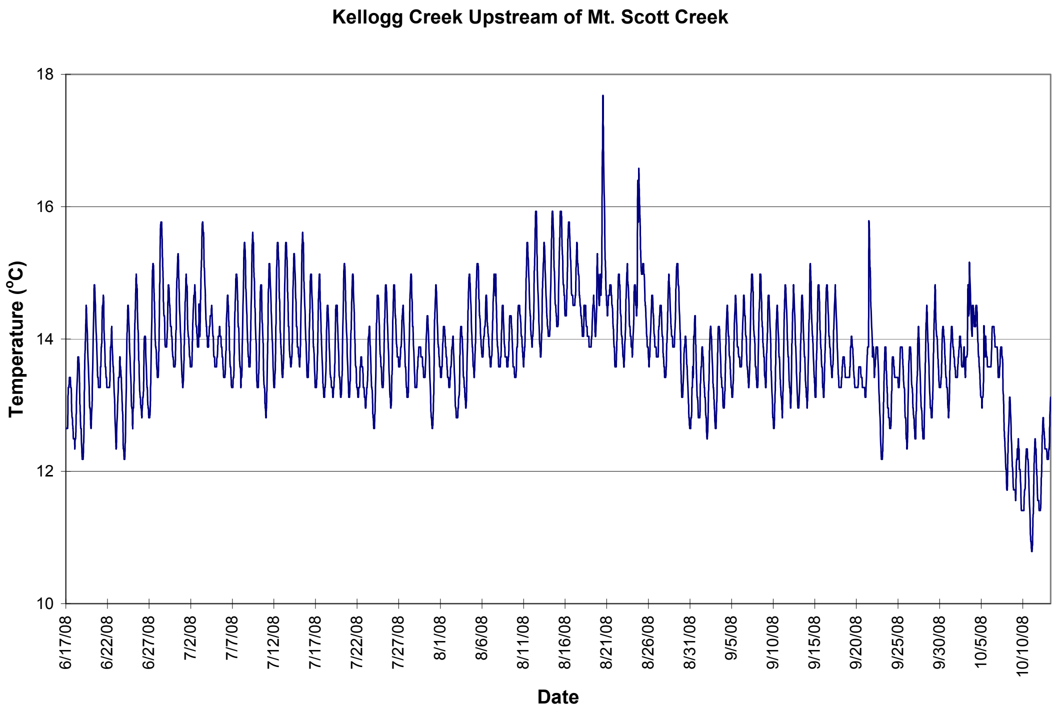


Figure 3-5. Site C102 continuous temperature monitoring 6/08 to 10/08.

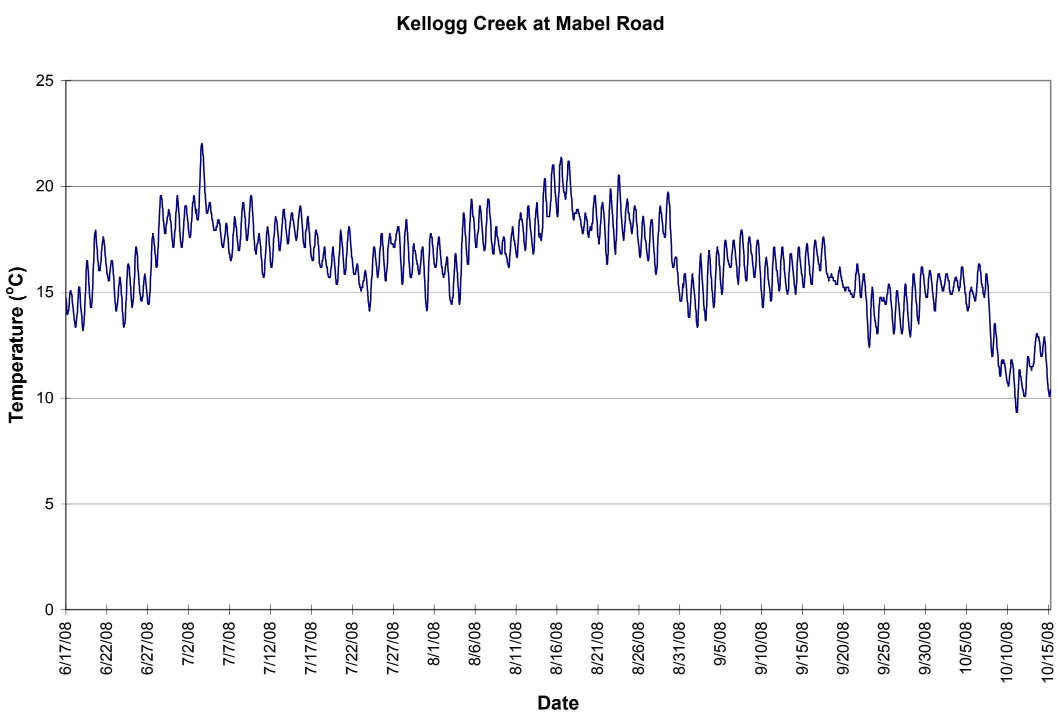


Figure 3-6. Site C103 continuous temperature monitoring 6/08 to 10/08.

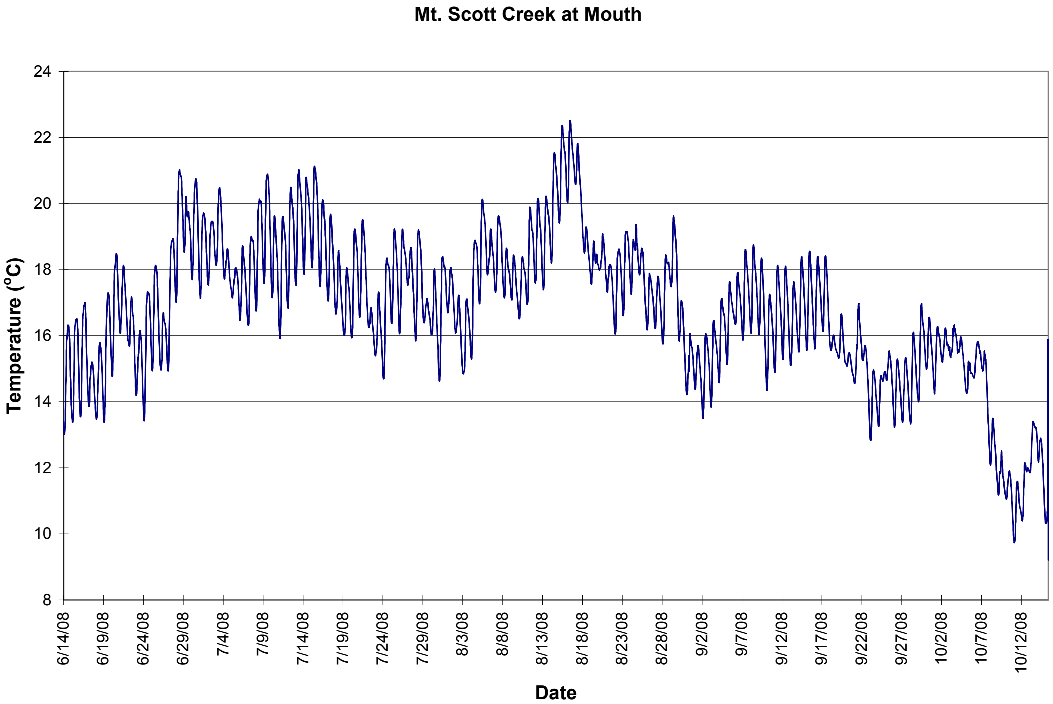


Figure 3-7. Site C104 continuous temperature monitoring 6/08 to 10/08.

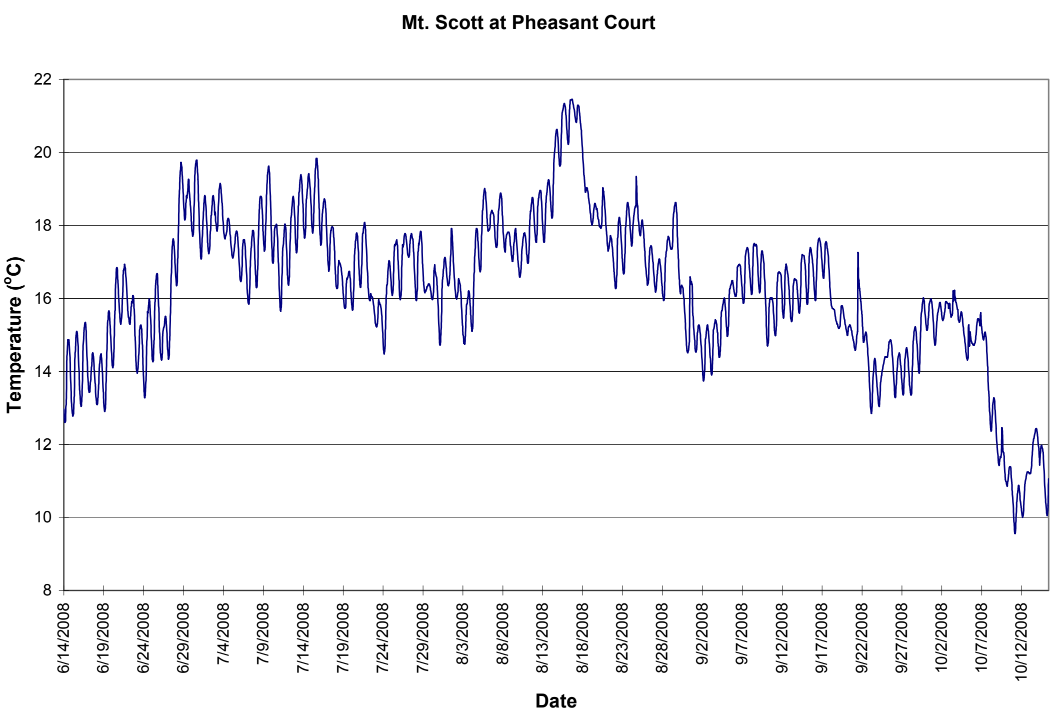


Figure 3-8. Site C105 continuous temperature monitoring 6/08 to 10/08.

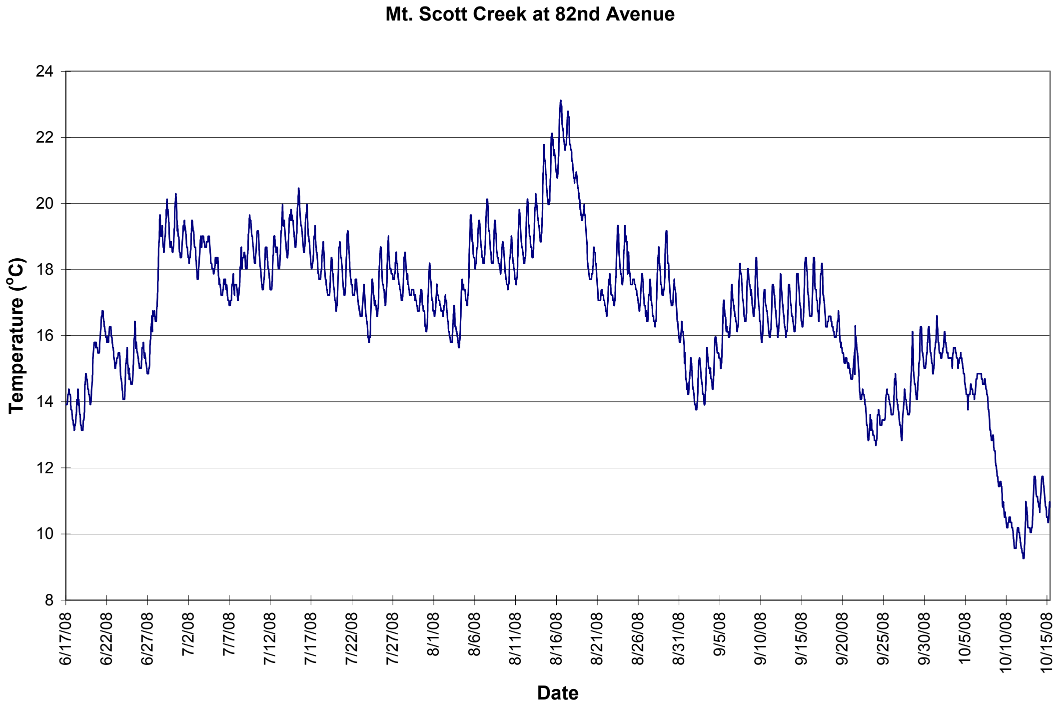


Figure 3-9. Site C106 continuous temperature monitoring 6/08 to 10/08.

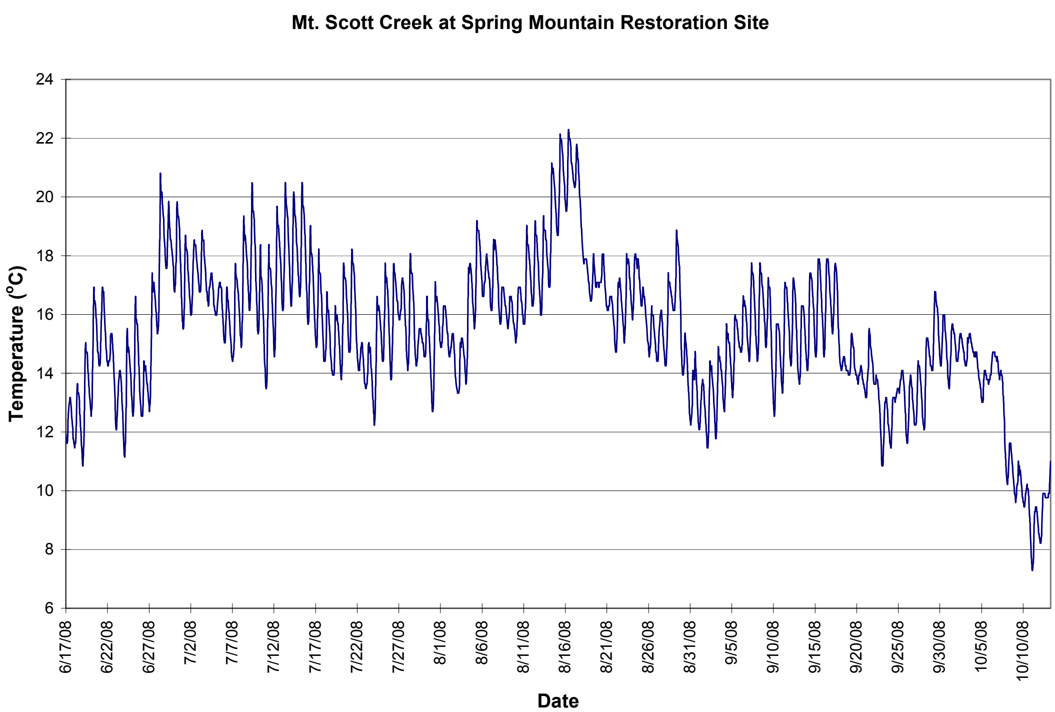


Figure 3-10. Site C107 continuous temperature monitoring 6/08 to 10/08.

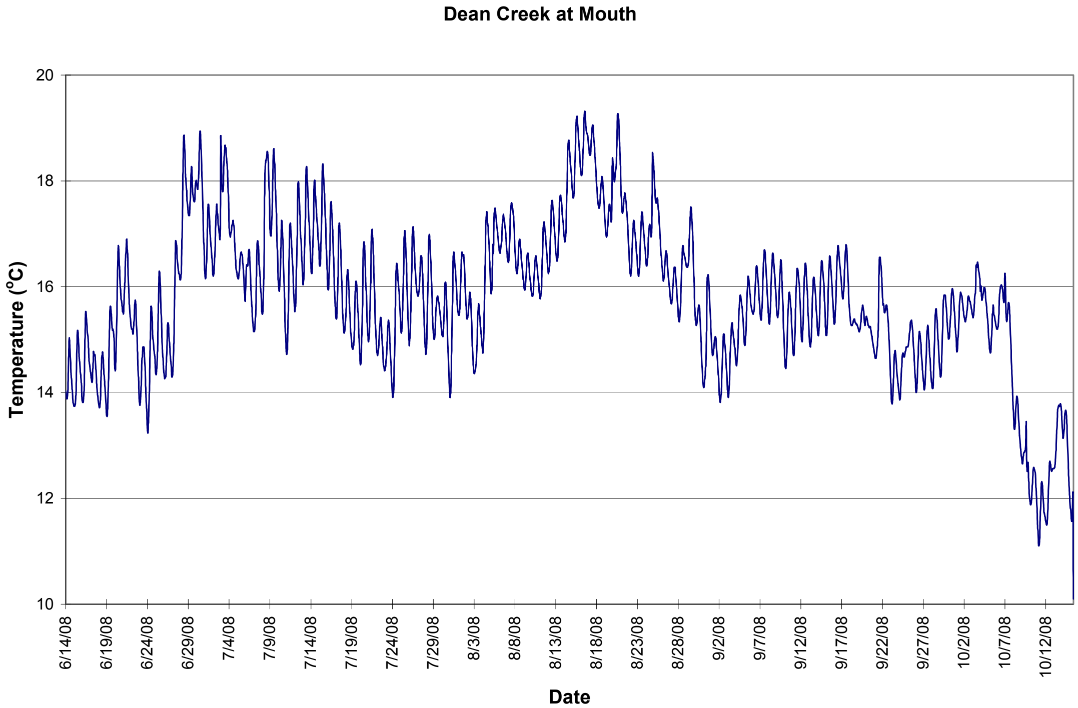


Figure 3-11. Site C108 continuous temperature monitoring 6/08 to 10/08.

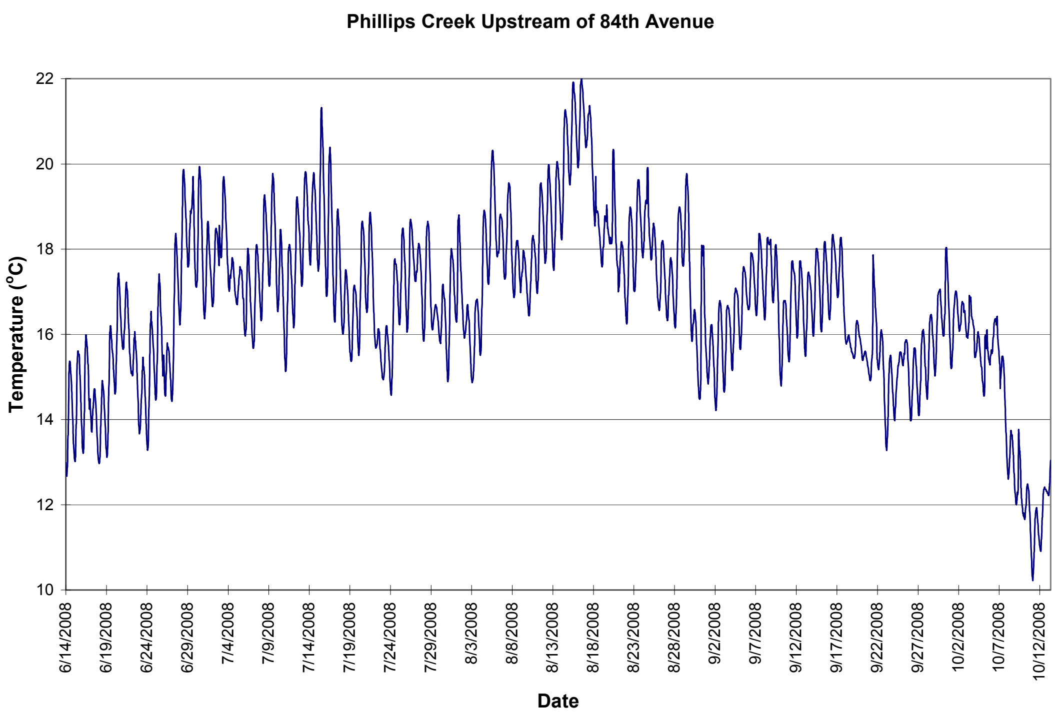


Figure 3-12. Site C109 continuous temperature monitoring 6/08 to 10/08.

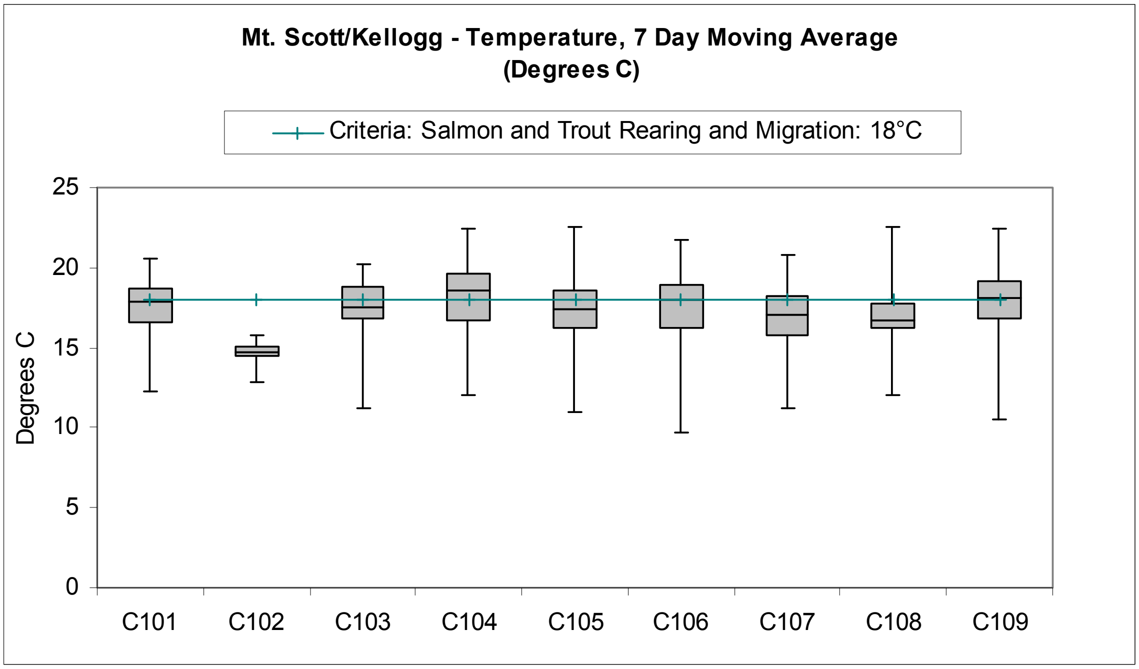


Figure 3-13. Seven-day moving average based on hourly maximum temperature from monitoring 6/08 to 10/08.

Table 3-9. Boxplot Data for Mt. Scott/Kellogg Temperature, 7-Day Moving Average (Degrees C)

	C101	C102	C103	C104	C105	C106	C107	C108	C109
Maximum, degrees C	20.5	15.8	20.3	22.5	22.6	21.7	20.8	22.6	22.4
Upper Quartile, degrees C	18.7	15.0	18.8	19.6	18.6	18.9	18.2	17.7	19.1
Median, degrees C	17.9	14.7	17.6	18.6	17.5	18.0	17.0	16.7	18.1
Lower Quartile, degrees C	16.6	14.4	16.8	16.7	16.3	16.2	15.8	16.2	16.9
Minimum, degrees C	4.4	1.5	5.6	4.6	5.3	6.5	4.6	4.1	6.3
Count	115	113	117	131	131	117	113	131	131
Dates (6/08 – 10/08)	2008	2008	2008	2008	2008	2008	2008	2008	2008
Salmon and Trout Rearing and Migration, degrees C	18	18	18	18	18	18	18	18	18

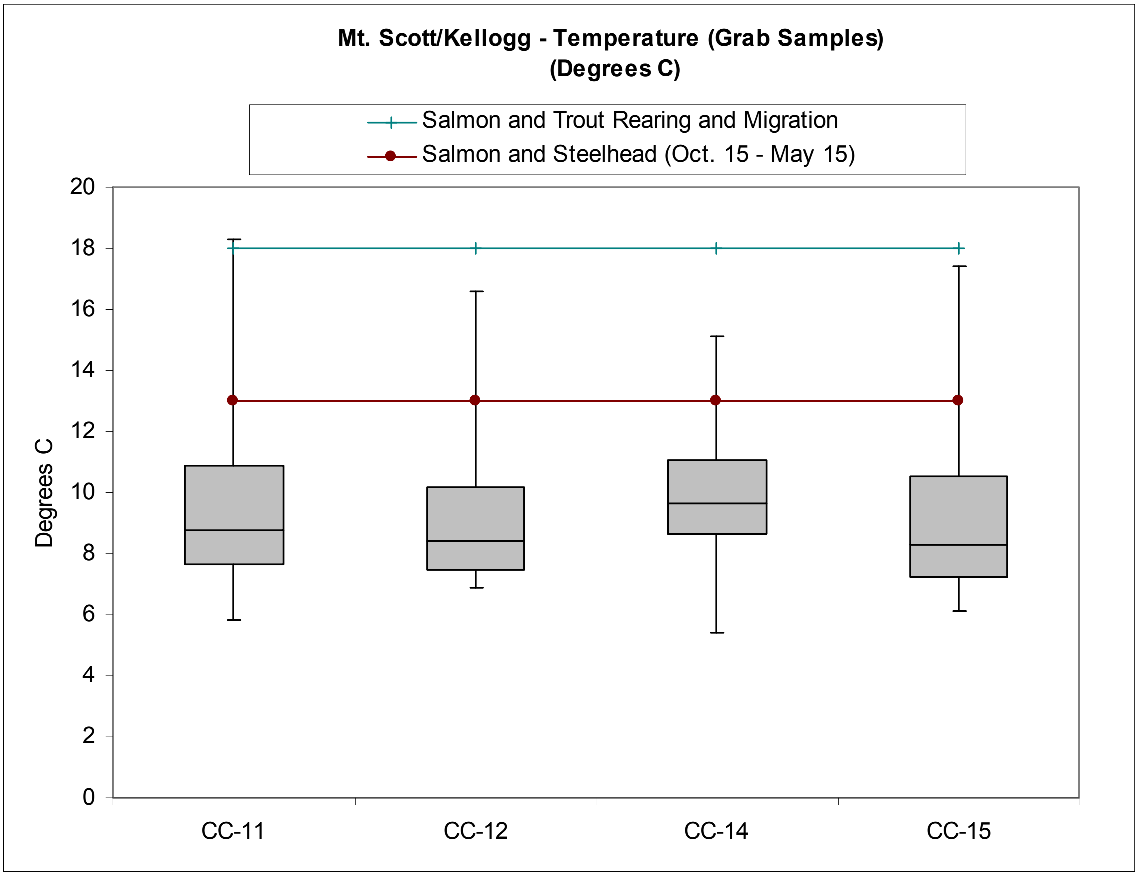


Figure 3-14. Temperature grab samples.

Table 3-10. Boxplot Data for Mt. Scott/Kellogg Grab Sample Temperature, Degrees C

	CC-11	CC-12	CC-14	CC-15
Maximum	18.3	16.6	15.1	17.4
Upper Quartile	10.9	10.2	11.1	10.5
Median	8.8	8.4	9.7	8.3
Lower Quartile	7.7	7.5	8.6	7.3
Minimum	5.8	6.9	5.4	6.1
Count	8	8	8	8
Dates	2007–2008	2007–2008	2007–2008	2007–2008
Salmon and Steelhead (Oct. 15 – May 15)	13	13	13	13
Salmon and Trout Rearing and Migration	18	18	18	18

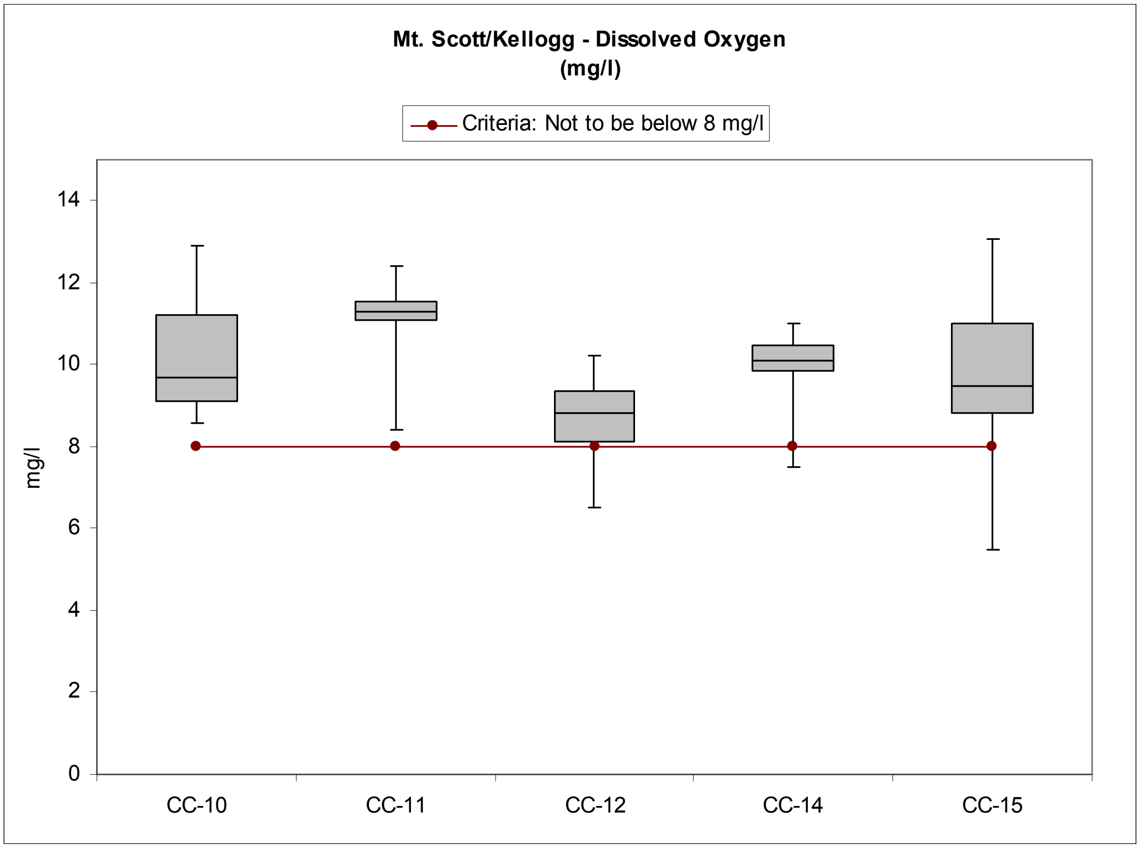


Figure 3-15. DO Data.

Table 3-11. Boxplot Data for Mt. Scott/Kellogg DO (mg/L)					
	CC-10	**CC-11**	**CC-12**	**CC-14**	**CC-15**
Maximum	12.9	12.4	10.2	11.0	13.1
Upper Quartile	11.2	11.6	9.4	10.5	11.0
Median	9.7	11.3	8.8	10.1	9.5
Lower Quartile	9.1	11.1	8.1	9.9	8.8
Minimum	8.6	8.4	6.5	7.5	5.5
Count	17	7	8	8	57
Dates	2002–2007	2007–2008	2002, 2007-2008	2003, 2007-2008	2002–2008
Criteria: mg/l	8	8	8	8	8

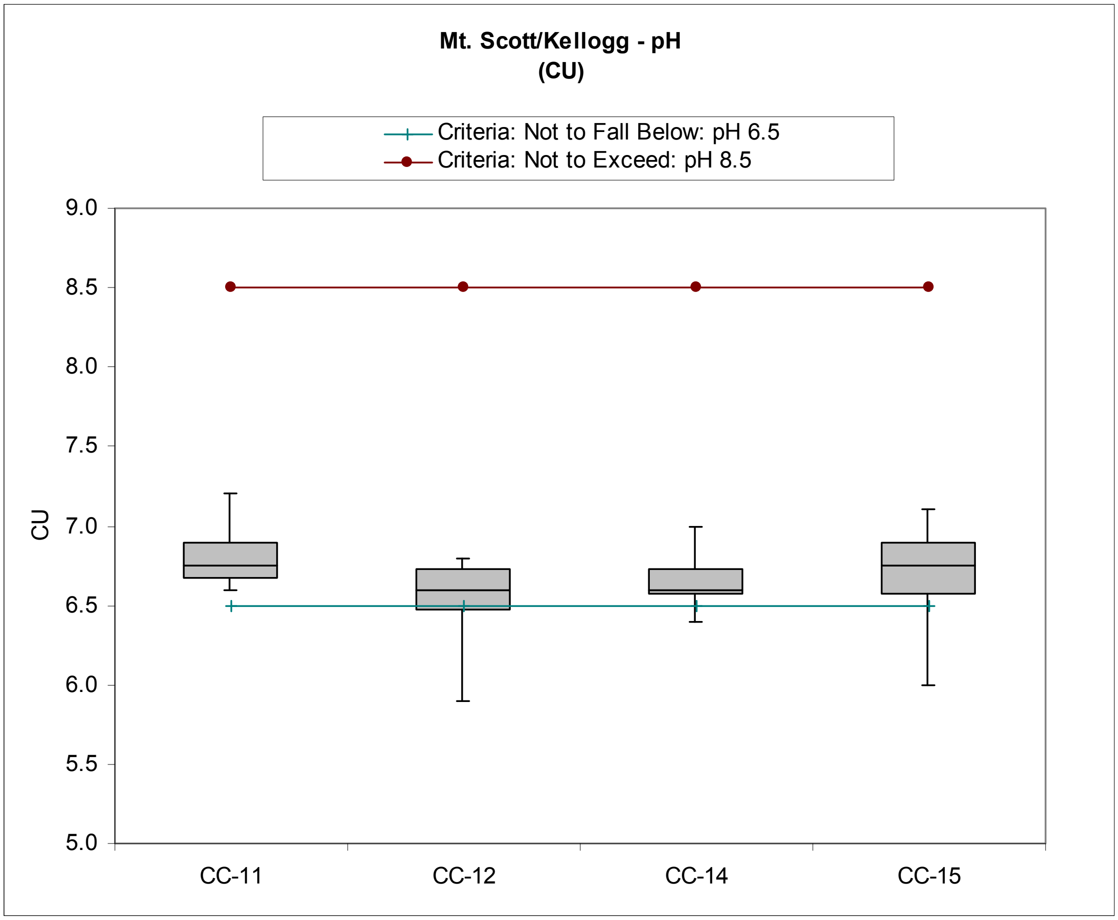


Figure 3-16. pH Data.

Table 3-12. Boxplot Data for Mt. Scott/Kellogg pH (units)

	CC-11	CC-12	CC-14	CC-15
Maximum	7.2	6.8	7.0	7.1
Upper Quartile	6.9	6.7	6.7	6.9
Median	6.8	6.6	6.6	6.8
Lower Quartile	6.7	6.5	6.6	6.6
Minimum	6.6	5.9	6.4	6.0
Count	8	8	8	8
Dates	2007–2008	2007–2008	2007–2008	2007–2008
Criteria: Not to exceed	8.5	8.5	8.5	8.5
Criteria: Not to fall below	6.5	6.5	6.5	6.5

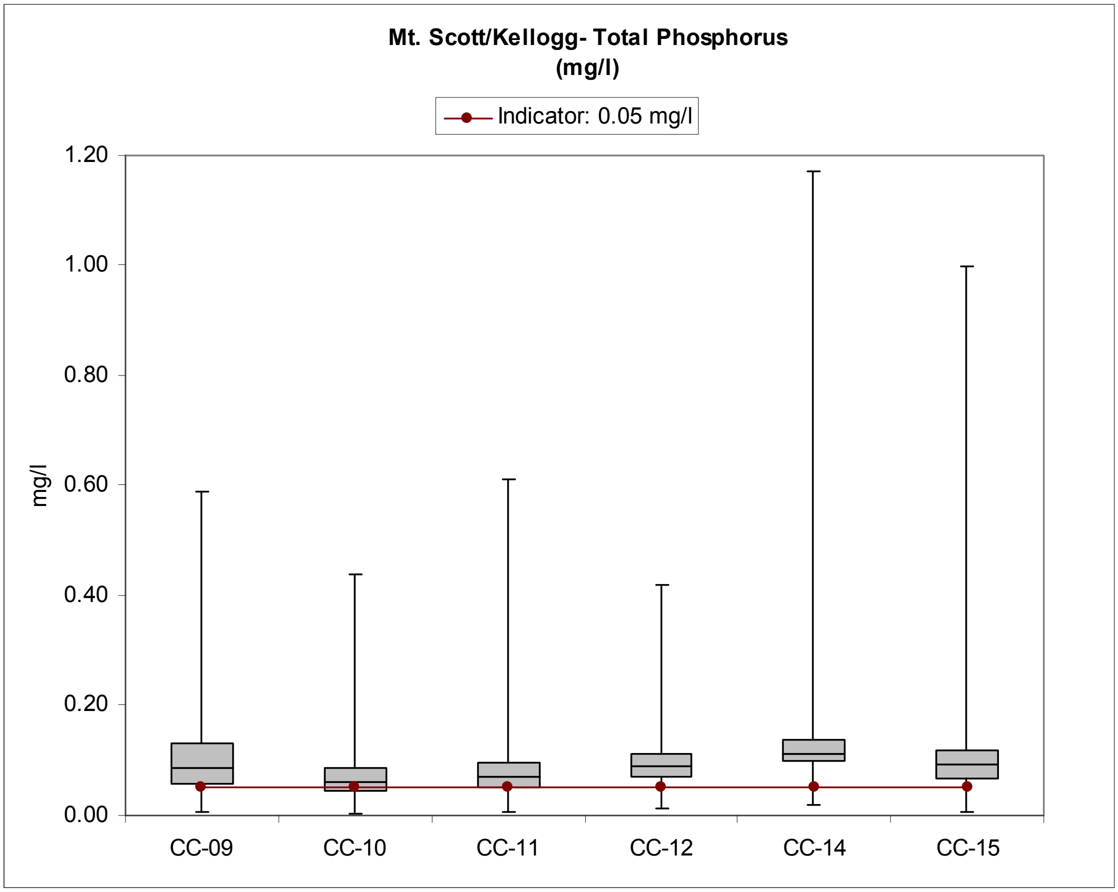


Figure 3-17. Total Phosphorus Data.

Table 3-13. Boxplot Data for Mt. Scott/Kellogg Total Phosphorus (mg/L)

	CC-09	CC-10	CC-11	CC-12	CC-14	CC-15
Maximum	0.590	0.437	0.610	0.420	1.172	1.000
Upper Quartile	0.130	0.087	0.095	0.111	0.137	0.120
Median	0.085	0.062	0.072	0.089	0.112	0.094
Lower Quartile	0.059	0.046	0.052	0.070	0.100	0.068
Minimum	0.005	0.003	0.005	0.013	0.020	0.005
Count	59	123	131	131	132	130
Dates	1996-2007	1996-2007	1996-2008	1996-2008	1996-2008	1996-2008
Indicator: mg/L	0.05	0.05	0.05	0.05	0.05	0.05

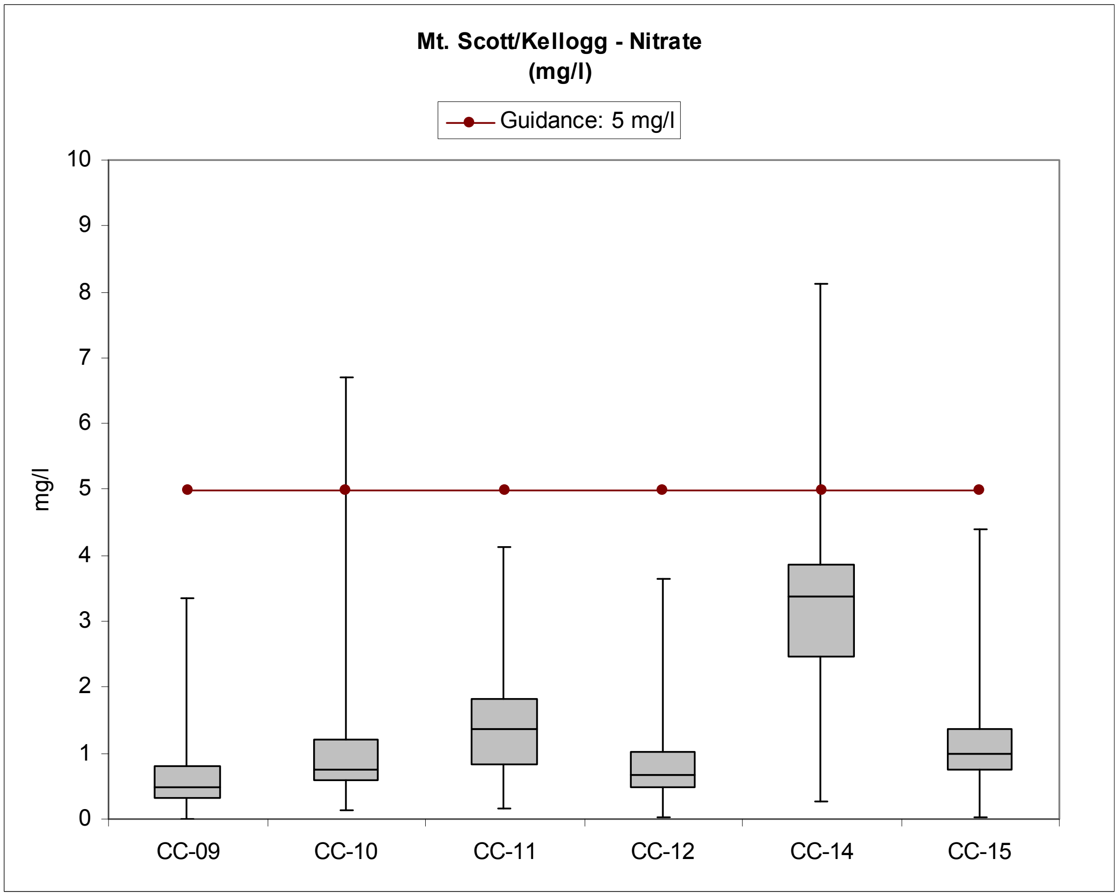


Figure 3-18. Nitrate Data.

Table 3-14. Boxplot Data for Mt. Scott/Kellogg Nitrate (mg/L)						
	CC-09	**CC-10**	**CC-11**	**CC-12**	**CC-14**	**CC-15**
Maximum	3.35	6.70	4.13	3.65	8.13	4.39
Upper Quartile	0.80	1.21	1.84	1.01	3.86	1.36
Median	0.47	0.76	1.36	0.66	3.38	0.98
Lower Quartile	0.32	0.58	0.84	0.47	2.47	0.75
Minimum	0.01	0.14	0.15	0.03	0.26	0.03
Count	59	125	135	135	136	134
Dates	1996-2007	1996-2007	1996-2008	1996-2008	1996-2008	1996-2008
Guidance: mg/L	5.00	5.00	5.00	5.00	5.00	5.00

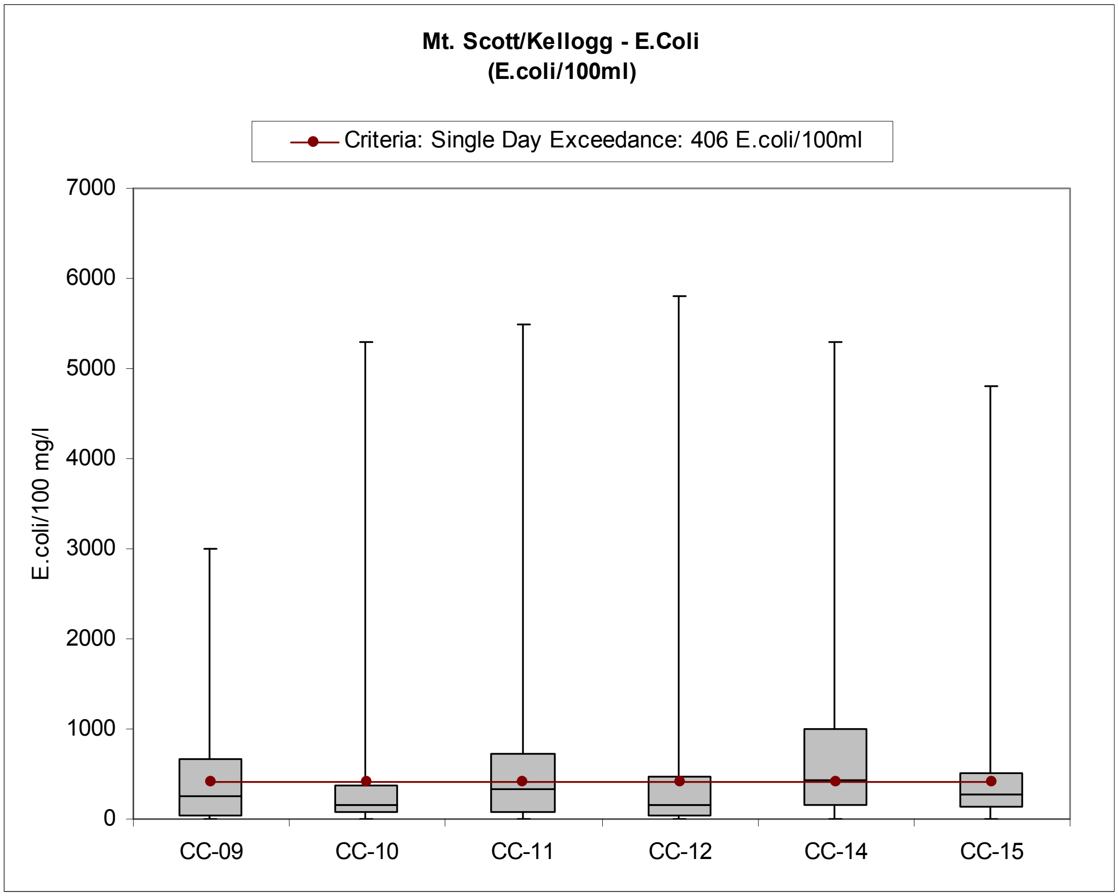


Figure 3-19. E. Coli Data.

Table 3-15. Boxplot Data for Mt. Scott/Kellogg *E. coli* (E.coli/100 mg/L)

	CC-09	CC-10	CC-11	CC-12	CC-14	CC-15
Maximum	3000	5300	5500	5800	5300	4800
Upper Quartile	660	365	727	470	1005	517
Median	250	166	330	156	435	270
Lower Quartile	37	73	88	46	149	140
Minimum	1	1	1	1	1	1
Count	59	127	137	137	138	135
Dates	1996-2007	1996-2007	1996-2008	1996-2008	1996-2008	1996-2008
Single Day Criteria: E. coli/100mL	406	406	406	406	406	406

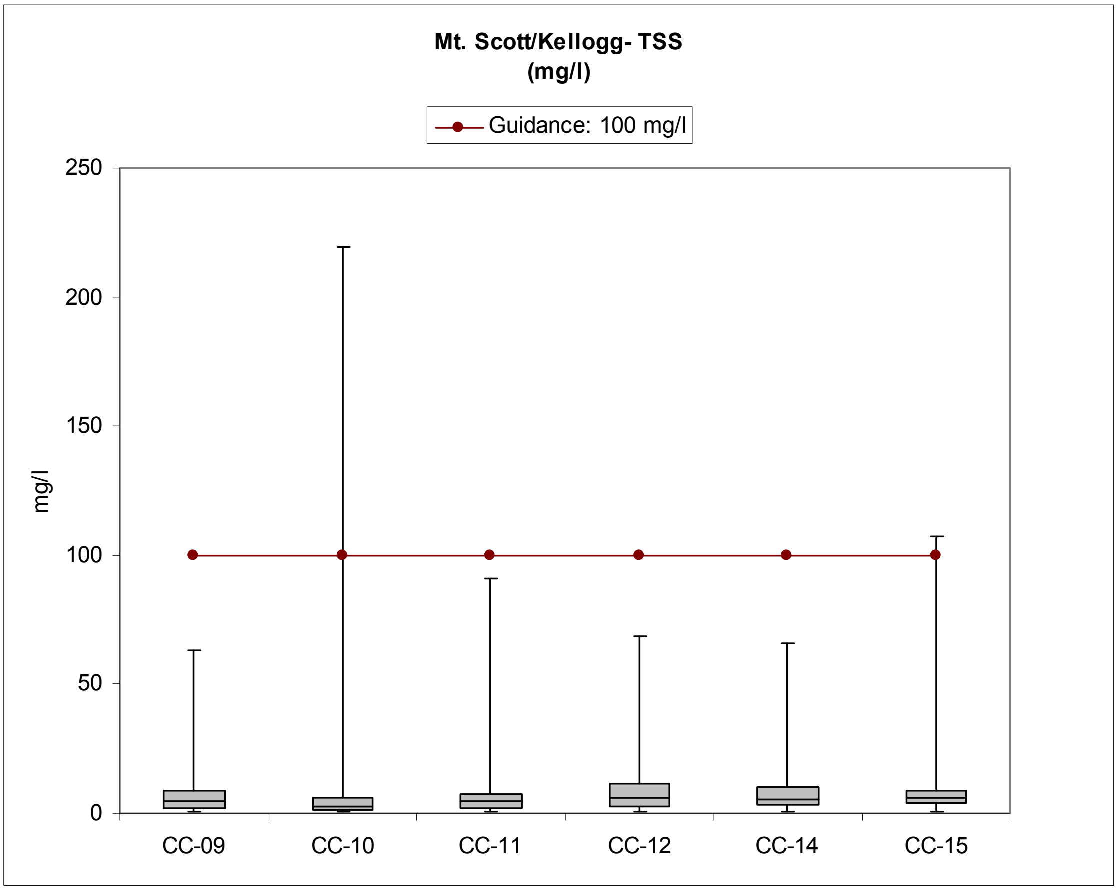


Figure 3-20. TSS Data.

Table 3-16. Boxplot Data for Mt. Scott/Kellogg TSS (mg/L)

	CC-09	CC-10	CC-11	CC-12	CC-14	CC-15
Maximum	63.0	219.2	91.2	68.8	66.0	107.6
Upper Quartile	9.0	5.8	7.2	11.8	10.0	8.6
Median	5.0	3.0	4.6	6.1	5.1	5.9
Lower Quartile	2.0	1.4	2.0	3.0	3.2	3.8
Minimum	0.5	0.5	0.5	0.5	0.5	1.0
Count	59	97	105	106	106	104
Dates	1999-2007	1999-2007	1999-2008	1999-2008	1999-2008	1999-2008
Guidance: mg/L	100	100	100	100	100	100

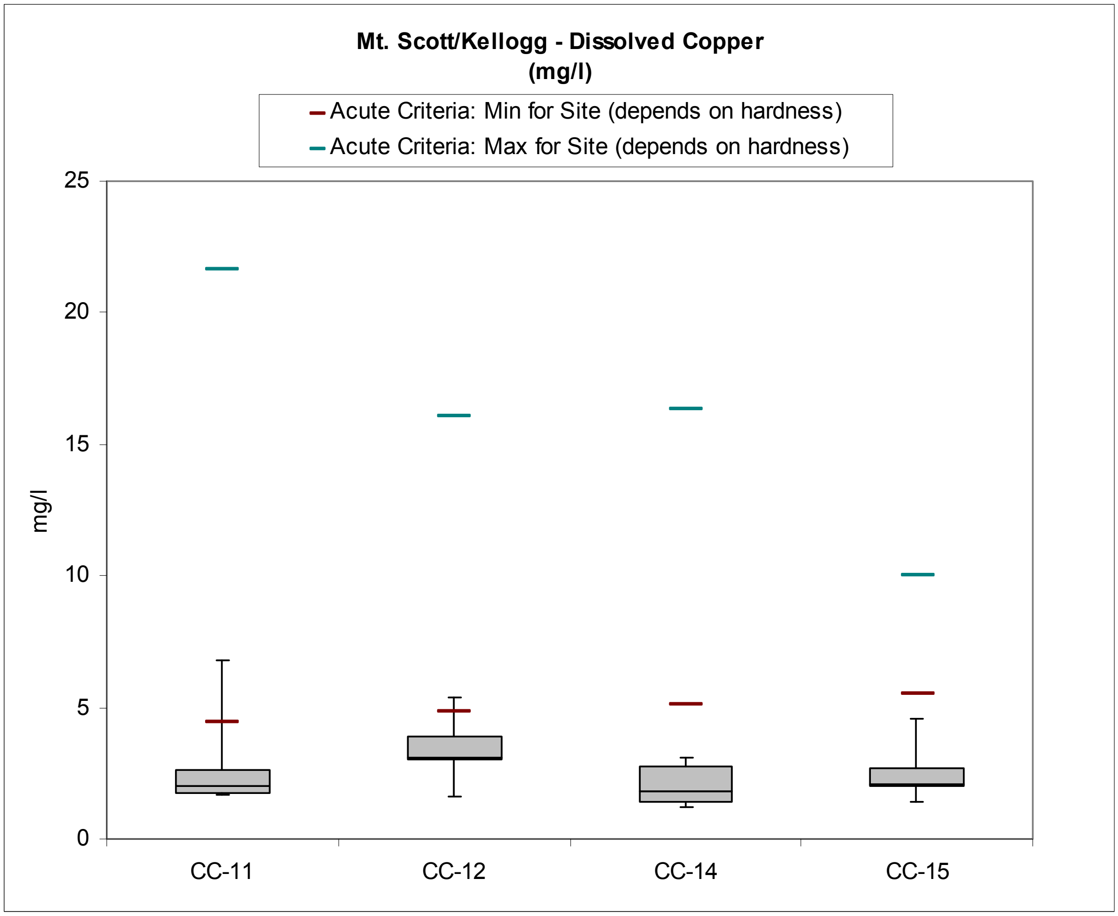


Figure 3-21. Dissolved Copper Data.

Table 3-17. Boxplot Data for Mt. Scott/Kellogg Dissolved Copper (mg/L)

	CC-11	CC-12	CC-14	CC-15
Maximum	1.7	1.6	1.2	1.4
Upper Quartile	2.7	3.9	2.8	2.7
Median	2.0	3.1	1.8	2.1
Lower Quartile	1.7	3.0	1.4	2.0
Minimum	1.7	1.6	1.2	1.4
Count	6	6	6	6
Dates	2007–2008	2007–2008	2007–2008	2007–2008
Acute Criteria, depends on hardness: mg/L	DNE[1]	# of times exceeded: 1	DNE[1]	DNE[1]

[1]DNE: Did not exceed criteria at this sampling location during the sampling period.

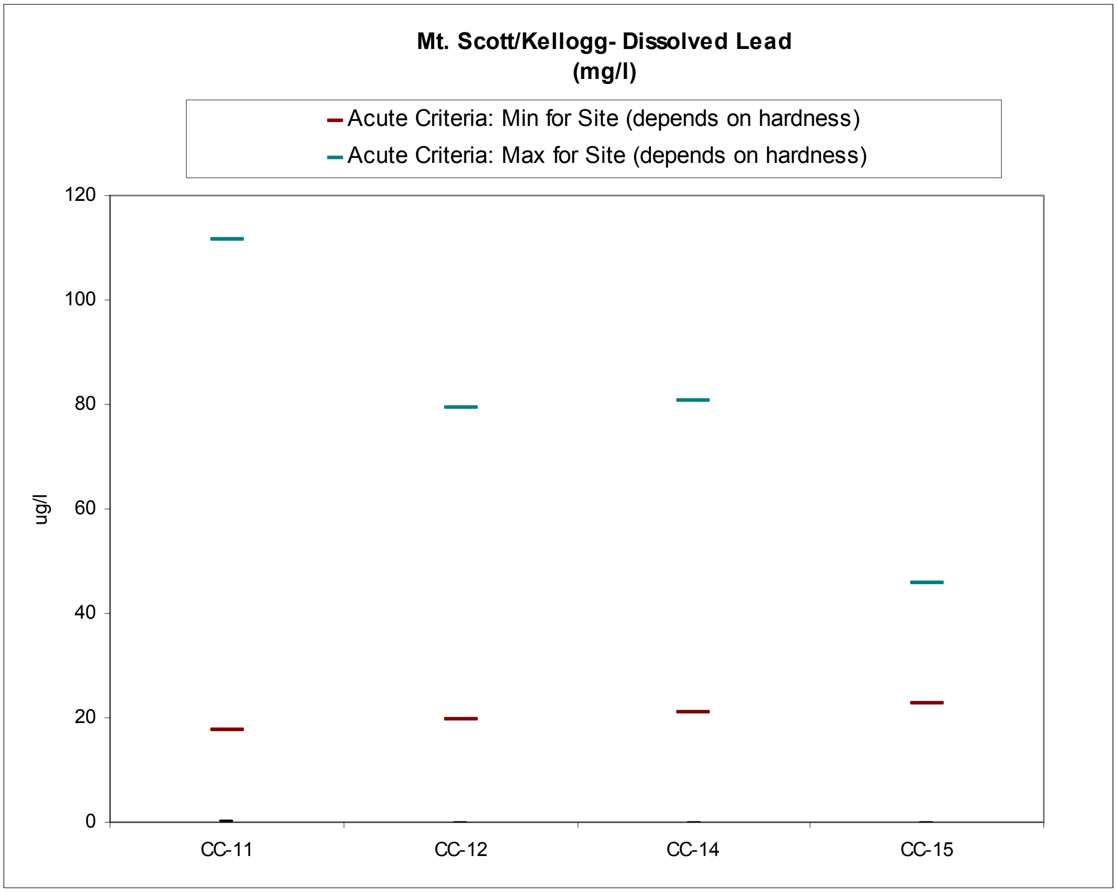


Figure 3-22. Dissolved Lead Data.

Boxes not visible due to low concentrations

Table 3-18. Boxplot Data for Mt. Scott/Kellogg Dissolved Lead (µg/L)

	CC-11	CC-12	CC-14	CC-15
Maximum	0.25	0.15	0.09	0.13
Upper Quartile	0.14	0.15	0.08	0.07
Median	0.05	0.12	0.06	0.05
Lower Quartile	0.03	0.07	0.05	0.04
Minimum	0.03	0.03	0.04	0.03
Count	6	6	6	6
Dates	2007–2008	2007–2008	2007–2008	2007–2008
Acute criteria, depends on hardness: µg/L	DNE[1]	DNE[1]	DNE[1]	DNE[1]

[1]DNE: Did not exceed criteria at this sampling location during the sampling period.

Boxes not visible on figure due to low concentrations.

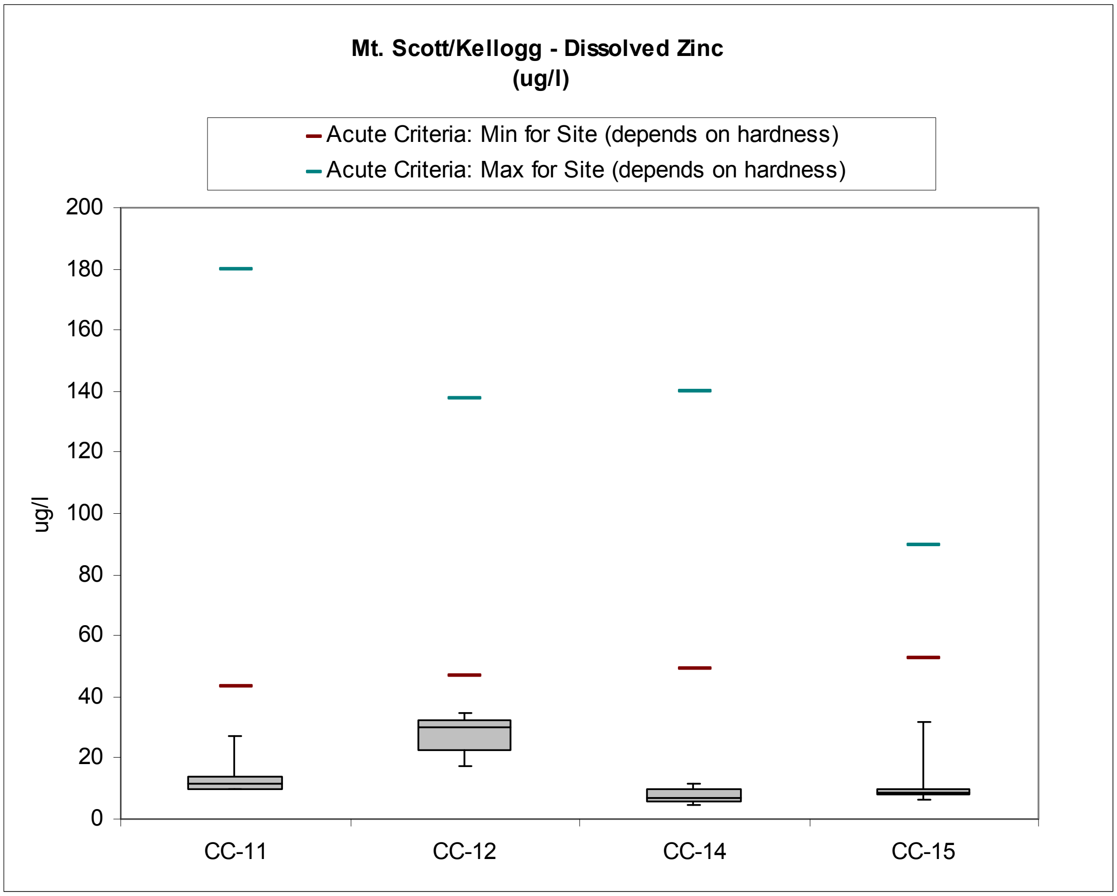


Figure 3-23. Dissolved Zinc Data.

Table 3-19. Boxplot Data for Mt. Scott/Kellogg Dissolved Zinc (ug/L)

	CC-11	CC-12	CC-14	CC-15
Maximum	26.9	34.8	11.7	31.9
Upper Quartile	13.9	32.2	9.9	9.7
Median	11.7	29.9	6.9	8.9
Lower Quartile	10.1	22.7	5.8	8.1
Minimum	9.9	17.3	4.9	6.4
Count	6	6	6	6
Dates	2007–2008	2007–2008	2007–2008	2007–2008
Acute criteria, depends on hardness: μg/L	DNE[1]	DNE[1]	DNE[1]	DNE[1]

[1]DNE: Did not exceed criteria at this sampling location during the sampling period.

CHAPTER 4 – AQUATIC HABITAT AND BIOLOGICAL COMMUNITIES

Overview

This chapter summarizes aquatic habitat and biological communities in the Kellogg-Mt. Scott (KMS) watershed based on an evaluation of existing environmental monitoring data and reports of watershed conditions. Key sources of information regarding aquatic habitat and biological communities in the KMS watershed include the following:

- Benthic macroinvertebrate surveys and Benthic Index of Biological Integrity (B-IBI) scores
- Fish surveys, fish habitat assessments, and Fish Index of Biological Integrity (F-IBI) scores
- Continuous flow and water quality monitoring data
- Geographic Information System (GIS) data and studies describing forest canopy in the watershed
- Studies describing biological communities in the watershed

This chapter describes how key biological indicators are being used to characterize the present level of biological and aquatic habitat impairment in selected reaches of Kellogg and Mt. Scott Creeks. This information was used to identify specific management activities (Chapter 5) appropriate for Water Environment Services (WES) to undertake, including reaches of the stream identified for activities focused on protection, restoration, or for prevention of further degradation.

Fish and benthic macroinvertebrate bioassessment indices and information on the distribution and relative abundance of salmonids were selected as the key indicators to assess the aquatic habitat component of overall watershed health. It is important to recognize that biological indicators can be affected by a wide variety of limiting factors, many of which go beyond the scope of WES as a stormwater management service provider. Fish populations, in particular, can be affected significantly by a wide variety of habitat conditions, water quality conditions, competition with invasive species, access to streams, overfishing, ocean conditions (for anadromous fish), and other constraints. WES' efforts to improve watershed health are complemented by the actions of many other agencies and stakeholders to improve conditions for biological indicators.

Comparisons between reaches sampled by Oregon Department of Fish and Wildlife (ODFW) (i.e., fish sampling reaches) are presented for the key aquatic habitat indicators. Stream reaches were also characterized with respect to an array of habitat parameters known to be important for maintenance of healthy salmonid populations in Western Oregon streams. Rating scores were established for each habitat parameter and scores were compared among ODFW's habitat sampling reaches and fish sampling reaches. Overall habitat scores indicated that all reaches of Mt. Scott Creek are below optimal conditions for the habitat parameters evaluated. However, the highest combined scores agreed well with the salmonid distribution and relative abundance data.

Limiting factors for salmonids in the watershed are discussed with respect to physical habitat and limited water temperature monitoring data. A complete limiting factors analysis was conducted for the assessment phase of the project after all of the various potential limiting factors were consolidated from the relevant sections of this chapter.

Riparian conditions are described with respect to riparian buffer intactness, and structural differences (i.e., distribution of trees and shrubs) along the mainstems and tributaries to Kellogg and Mt. Scott Creeks. Examples of how available GIS databases will be used to prioritize reaches for riparian restoration and protection actions are also provided.

Finally, fish passage issues within the watershed are identified and biological criteria for prioritizing which passage problems need to be resolved are presented. Presently, access of adult salmonids to spawning habitat in Upper Mt. Scott Creek is not blocked. However, there are several partial barriers that may result in temporal delays of adult upstream migrants. Also, there are a number of culverts, mostly on smaller tributaries, that may be blocking use of the tributaries by adult and/or juvenile salmonids.

Data Reviewed

To characterize aquatic habitat and biological communities in the KMS watershed and evaluate factors limiting watershed health, existing environmental monitoring data and reports of watershed conditions were reviewed. Although all available previous reports dealing with the biological status and habitat conditions within the KMS drainage were reviewed, key data sources evaluated include the following:

- Benthic Macroinvertebrate Survey Results collected by ABR (Lemke and Cole, 2008 and Cole, 2004)
- ODFW Draft Report of Fish Species Distribution and Abundance and Habitat Assessment of Streams in Clackamas County Service District No. 1 (ODFW, 2008)
- ODFW Fish and Habitat Surveys (Tinus et al., 2003 and Freisen and Zimmerman, 1999)
- A watershed assessment of Kellogg and Mount Scott Creeks. Final Report prepared for Clackamas County Water Environment Services. (Montgomery Watson Harza [MWH], 2001)

Data Gaps

The following data gaps were identified:

- Benthic macroinvertebrate sampling coverage for Kellogg Creek, Mt. Scott Creek and their tributaries is presently insufficient to allow reach-by-reach comparisons needed to evaluate stream habitat conditions. Only two riffle sites on Mt. Scott Creek have been sampled. To allow comparisons between sites and with other studies in other streams, it is important that comparisons be made in riffle habitat. Several samples from glide habitat were available but were typically much less diverse than those from riffle habitats and could not be used for reach-to-reach comparisons.
- Summer low flow data are needed on Upper Kellogg, Lower Kellogg, and Lower Mt. Scott Creeks.
- The fish survey reach on Upper Kellogg Creek should be extended (if land owner permission is obtained) to include the spring-fed reach, which appears to extend from near the confluence of Mt. Scott Creek to about where the fish survey now begins on Upper Kellogg Creek. This could be an important summer thermal refuge area for salmonids.
- Continuous water temperature data were collected at a number of locations in the KMS watershed during spring, summer, and early fall 2008. Some of these data were available and provided important insight into potential limiting factors. Some of the continuous temperature records are still at ODFW and will become available in the near future for the analysis phase of the project.
- Culvert inspections will be required to determine present status of those that have been identified as potential obstacles. These inspections would evaluate the conditions of the culvert as well as the potential upstream use by salmonids.

Watershed Conditions

Wetlands

The historic distribution of wetlands in the KMS watershed is largely unknown due to the significant agricultural land clearing and urban development in the watershed. Historic wetlands in the watershed may have been forested with ash, alder, cottonwood, and red cedar (CRBC, 2000). Most of the existing wetlands are palustrine forested, palustrine shrub/scrub, and palustrine emergent. Non-native plant species are prevalent in the existing wetlands. A large, recently restored wetland exists in the upper reach of Mt. Scott Creek.

The National Wetlands Inventory (NWI) data identify the size, type, and location of wetlands at the watershed scale based on aerial photo analysis, however these data are often incomplete.

NWI data for KMS watershed are summarized below:

- Number of wetlands: 22
- Average wetland size: 3.24 acres
- Total wetland acreage: 71.21 acres
- Types of wetlands: freshwater ponds, forested/shrub, riverine

In addition to the NWI, Clackamas County has more detailed wetlands information for selected areas of each watershed. The Sunrise Project Wetlands Report, Clackamas County Department of Transportation and Development Wetland Conservation Sites Report, and Wetland Mitigation Reports contain additional information on wetland location, size, type, function, and impact on water resources.

Stream Reach Characterization

Historic Setting

Kellogg and Mt. Scott Creeks historically supported cold-water fish populations and benthic macroinvertebrate communities. Anadromous Steelhead trout, Coho salmon and sea-run Cutthroat trout as well as resident Cutthroat trout spawned and reared in both creeks (State of Oregon Fish Commission, 1951, Willis et al., 1960). Juvenile Chinook salmon may have used the lower reaches for rearing but the streams are considered to be too small to have supported Chinook salmon spawning (Neerman and Vogt, 2008). Based on stream gradient and substrate composition requirements, it is reasonable to assume that Steelhead trout and Coho salmon historically utilized the majority of the mainstem of both creeks for spawning and rearing. Cutthroat trout (both resident and sea-run) probably spawned in the smaller headwater areas and tributaries.

Estimates of historic (pre-1950) run sizes for Steelhead trout and Coho salmon are not available for either Kellogg or Mt. Scott Creeks. Oregon Fish Commission records (1951) grouped Abernathy, Kellogg, and Johnson Creeks together. They estimated that combined spawning escapements to these streams averaged about 700 Coho and 500 Steelhead. Kellogg Creek was reported as supplying a sizeable run of Coho and a few Steelhead (ibid.). Willis et al. (1960) reported that Mt. Scott Creek supplied a small run of silver (Coho) salmon and also that a few Steelhead and Cutthroat trout spawned annually. Between 1950 and 1966, spotty spawning ground surveys were conducted by Oregon Fish Commission (unpublished data) on 0.5 to 1.0 mile of Mt. Scott Creek, just upstream of Southeast 82nd Avenue. Numbers of redds counted ranged from 0 to 13. The limited historic data were collected after both watersheds had been impacted by agriculture, logging, and some residential development.

Access for returning adult salmonids to Upper Mt. Scott Creek has changed over the years. An earthen dam located approximately 0.25 mile upstream of the Sunnyside Road crossing of Mt. Scott Creek blocked access to the far upper reaches of Mt. Scott Creek until it was removed by WES with grant funds in 2003. Also, construction of a long concrete box culvert under Interstate 205 (I-205) in 1974 blocked both adult and juvenile upstream migration until large boulders were placed on the floor of the culvert in 2005 to improve passage conditions. Removal of a second box culvert under the Sunnyside Road crossing in the early 2000s and replacement with a bridge improved conditions for upstream migration of both adult and juvenile salmonids.

Biological Characterization Process

Essentially the same analytical process will be followed for identifying stream reaches that should be protected (Objective 1) and stream reaches that have a high priority for restoration as well as those that are the most severely degraded (Objective 2). In this report, the stream reaches will be characterized relative to their present condition. Stream reaches used in this analysis will be the same as those in the ODFW fish surveys (Figure 1). The basic approach to characterization of the various reaches of Kellogg and Mt. Scott Creeks is to use a combination of biological indicators to rank the reaches into the following three categories: 1) severely degraded; 2) moderately degraded; and 3) properly functioning. The spatial and temporal distribution of indicator fish species will be used in conjunction with indices of fish community and benthic invertebrate community health to rank reaches.

Indicator Species. Considering the amount of urbanization that has taken place in the KMS watershed, it is encouraging that recent sampling conducted by ODFW in 2008 found evidence that Steelhead trout, Coho salmon, Cutthroat trout, lamprey, and other native species are still present in the watershed and are reproducing successfully in certain areas (ODFW, 2008). The three species of salmonids have similar basic requirements for reproduction, rearing and migration. They all require cool water temperatures; clean, well oxygenated water; appropriate substrate with low levels of sediment fines for spawning; areas of refuge from high winter flow events; adequate cover (deep pools, root wads, undercut banks, etc.); intact riparian areas and canopy coverage; and adequate food production areas (e.g., shallow, clean riffle habitat). Therefore, presence of expected life stages of these species in a given reach indicates that at least minimal requirements for these sensitive species are being met. The use of Steelhead trout and Coho salmon as indicator species also makes sense in that both species are federally listed under the Endangered Species Act as threatened species in these watersheds.

Seasonal fish sampling data were collected from two representative reaches of Kellogg Creek and four representative reaches of Mt. Scott Creek by ODFW in 1997-98 (Friesen and Zimmerman, 1999), 2002-03 (Tinus et al., 2003) and in the spring of 2008. These data were used to determine which reaches appear to provide the best conditions for the indicator salmonid species. Note that presence of salmonids does not necessarily indicate that the conditions are optimal.

Biological Indices. The scientific literature contains a number of biological indices that have been developed for use with both fish and benthic macroinvertebrate sampling data. Each index is composed of a number of "metrics" calculated from sample data. The individual metrics are selected to provide information that describes specific aspects or sensitivities of the target community. Generally the upper limits of these biological indices are based on a reference condition in which water quality and habitat are considered to be unimpaired. Ranges in index values are typically established for categorizing impairment into three or more levels (e.g., severe impairment, moderate impairment and no impairment). The primary utility of biological indices is that they integrate a great deal of information about habitat conditions into a single value.

ODFW uses the F-IBI and has routinely calculated index values for each of the fish samples they have collected in the KMS watershed since 1997. The F-IBI combines the following twelve metrics:

Taxonomic richness

- Number of native families
- Number of native species

Habitat guilds

- Number of native benthic species
- Number of native water column species
- Number of hider species
- Number of sensitive species
- Number of native non-guarding lithophil nester species (e.g., salmonids and lamprey)
- Percent tolerant individuals

Trophic guilds

- Percent filter-feeding individuals
- Percent omnivores

Individual health and abundance

- Percent of target species that include lunkers (i.e., relatively large individuals over specified lengths)
- Percent of individuals with anomalies

Each of the above metrics is given a score between 0 and 10 based on an established range of raw values for each metric. To distinguish between fish communities in very small streams (stream order 1) and larger streams (orders 2 and 3) separate ranges for raw scores have been developed. The F-IBI is scaled to provide values between 0 and 120. However, the final F-IBI scores are given as a percentage of the maximum total of 120, yielding a final range between 0 and 100. Streams or reaches with an F-IBI ≤ 50 are considered to be severely impaired, those scoring 51 to 74 are considered to be marginally impaired, and those with a score ≤ 75 are considered to be acceptable. Note that the F-IBI focuses on conditions for native species rather than just salmonids. Therefore, a relatively high F-IBI score could be achieved without salmonids being present in the sample.

Macroinvertebrate sampling was conducted at several locations in the KMS watershed on behalf of WES in 2002 and 2007 (Cole, 2004 and Lemke and Cole, 2008). Benthic macroinvertebrate taxonomic data were analyzed using Oregon Department of Environmental Quality's (DEQ) multimetric analysis for western Oregon streams, hereafter referred to as the B-IBI. This analysis employs a set of ten metrics, each of which describes an attribute of the benthic macroinvertebrate community that is known to be responsive to one or more types of pollution or habitat degradation. As with the F-IBI, each metric is converted to a standardized score; standardized scores of all metrics are summed to produce a single multimetric score that is a numeric measure of overall biotic integrity. The ten metrics and scoring criteria are listed in Table 4-1.

Table 4-1. Metric Set and Scoring Criteria used to Assess Condition of Macroinvertebrate Communities from Riffles in the KMS Watershed (from Lemke and Cole, 2008)

	Scoring criteria		
Metric	**5 (good)**	**3 (fair)**	**1 (poor)**
Positive metrics			
Taxa richness	> 35	19 to 35	< 19
Mayfly richness	> 8	4 to 8	< 4
Stonefly richness	> 5	3 to 5	< 3
Caddisfly richness	> 8	4 to 8	< 4
Number of sensitive taxa	> 4	2 to 4	< 2
Number of sediment-sensitive taxa	> 2	1	0

Table 4-1. Metric Set and Scoring Criteria used to Assess Condition of Macroinvertebrate Communities from Riffles in the KMS Watershed (from Lemke and Cole, 2008)

	Scoring criteria		
Metric	**5 (good)**	**3 (fair)**	**1 (poor)**
Negative metrics			
Modified HBI[1]	< 4	4.0 to 5.0	> 5.0
Percent tolerant taxa	< 15	15 to 45	> 45
Percent sediment-tolerant taxa	< 10	10 to 25	> 25
Percent dominant	< 20	20 to 40	> 40

[1] Modified HBI = Modified Hilsenhoff Biotic Index.

The multimetric benthic index is scaled to yield values between 10 and 50. Impairment levels are as follows: severe (<20); moderate (20-30); slight (30-39); and unimpaired (>39).

At the stream reach level, indices based on benthic macroinvertebrate community data may provide a somewhat better description of stream health than fish indices. This is because benthic organisms are relatively immobile and cannot move from reach to reach as can fish. Therefore, benthic indices are more likely to integrate responses to conditions that have occurred in the reach over a longer period of time.

The above indices will be used on a reach-by-reach basis to identify the level of impairment compared to an unimpaired reference condition. However, it should be recognized that urbanized and/or urbanizing catchments (i.e., watersheds) place limits on achievable biological conditions. Attainment goals for urban catchments must be considered with respect to largely unalterable effects associated with urbanization. These attainment goals can be expected to be higher for a catchment basin with low levels of urban development compared with one with high levels of urban development. In other words, the level of urbanization in a catchment basin sets relative limits on what can be achieved with regard to recovery from existing impaired conditions. Standard bioassessment indices do not take the level of urbanization into account.

This problem has been addressed in recent research conducted by Barbour et al. (2006). Their approach attempts to provide a nationally applicable measure of urbanization, a process for developing urban-specific biological indicators, and empirically defined and realistic aquatic life use benchmarks for urban areas. Their paper describes a three-step process: 1) developing a primary urbanization gradient; 2) assembling an appropriate urban biological index; and 3) defining a biological potential that describes the highest biological condition currently achieved along the urban gradient. Their research was conducted across three distinct climatic regions with similar results found in each region. We believe that the approach described by Barbour et al. (2006) may be useful for prioritizing locations for protection and restoration efforts within the watershed.

Barbour et al.'s (2006) approach requires the calculation of an index of urbanization based on measures of land use, road density, and human population density, and calculation of a biological index that is sensitive to different levels of urbanization. The biological index was selected after testing many combinations of benthic metrics against the urban gradient. The best fit was provided by averaging the number of Ephemeroptera (Mayfly), Trichoptera (Stonefly) and Plecotera (Caddisfly) taxa, or (EPT index); filterer taxa richness and clinger numbers as a percent of total numbers. The index of urban biological condition developed by Barbour et al. (ibid) was found to have wide applicability across the U.S.

Data for calculation of the index of urbanization are available for each catchment basin in the greater KMS watershed. Unfortunately, benthic data for the KMS watershed are limited and as yet do not provide the coverage needed for a thorough analysis. However, we used the available benthic macroinvertebrate sampling data to calculate a few values for the urban index of biological condition and present them below to show how they vary relative to the B-IBI scores. These index values should be viewed as preliminary in that not all of the details and assumptions used by Barbour et al. (2006) in their calculation of the urban gradient or biological index of urban effects were presented in their paper.

Existing Aquatic Biological Conditions

Indicator Fish Species. The most recent information on the distribution of fish within the KMS watershed was sampling data collected by ODFW in spring 2008 in two reaches of Kellogg Creek (KG01 and KG02), reaches of Mt. Scott Creek (MS1.1 MS1.3, MS02, MS03, and MS04), and one reach on Phillips Creek (Tables 4-2 and 4-3). Note that the catch data for MS03 was subdivided into reaches 3.0 and 3.1 but reported as a single reach since there was no gap between the two subdivisions. The habitat and fish reaches are illustrated in Figure 3-1.

In spring 2008, Cutthroat trout and Steelhead/Rainbow trout were the most widely distributed salmonid species in the watershed. Cutthroat trout were present in KG01, MS1.1, MS1.3, MS03, and MS04. Juvenile Steelhead trout were found in reaches KG01, KG02, MS1.1, MS03, and MS04. Juvenile Coho salmon were found only in MS03 and MS04. In addition to the three salmonid species identified there were a considerable number of juvenile salmonids that were classified as unidentified salmonids. Unidentified salmonids were found in reaches KG01, MS1.1, MS1.3, MS03, and MS04 (Tables 4-2 and 4-3.).

As indicated in Figure 4-2, there were large differences between stream reaches in the abundance per kilometer of salmonids. By far the majority of salmonids were found in the two upper reaches of Mt. Scott Creek (MS03 and MS04), primarily upstream of I-205. Of the 147 salmonids caught in reach MS03, 135 were from above the I-205 culvert. Sampling in other reaches in spring 2008 produced from zero to seven individuals, with most containing one or two individuals.

Previous fish sampling in 1997-98 and 2002-03 on Mt. Scott Creek was conducted prior to fish passage improvements at the I-205 culvert, which was completed in 2006. Before the improvements, the I-205 culvert essentially blocked upstream migration of adult salmonids. Only one juvenile Coho salmon and one Steelhead/Rainbow trout were collected upstream of I-205 during the two previous ODFW fish surveys. Sources of these two fish are not known, but introductions of hatchery fish may have been responsible. Fish sampling in years prior to 2008 was performed seasonally with data collected summer, fall, winter, and spring. Cutthroat trout were the only salmonids collected in Mt. Scott Creek during summer, fall and winter collections in 1997-98 and 2002-03 (Friesen and Zimmereman, 1999; Tinus et al., 2003). All of these fish were captured in Upper Mt. Scott Creek reaches MS03 and MS04. Spring was the only season that Cutthroat trout were collected in Lower Mt. Scott Creek (MS01). These results support the conclusion that MS03 and MS04 are the reaches of Mt. Scott Creek that consistently provide conditions that at least meet the minimum requirements for maintenance of salmonid populations.

Phillips Creek, a small tributary to Mt. Scott Creek, was sampled in 1997-98 and 2002-03 during summer, fall, winter, and spring; and spring 2008. Low numbers (range 0 to 11) of Cutthroat trout and a few juvenile Steelhead trout were collected in the two sampling reaches on Phillips Creek. Fewest fish were found during winter sampling with only one Cutthroat trout collected during the two survey periods. The largest numbers of Cutthroat trout (11) were collected during the spring of 1998. No salmonids were collected during the spring 2008 survey. When spring sampling results are compared from 1998 through 2008, the number of salmonids reveal a steady decline from 11 in 1998, to 2 in 2003, and none in 2008.

Low numbers of Cutthroat trout also were captured during summer, fall, and winter in Kellogg Creek. Reach KG01 was not sampled in the winter of 1997-98. Other salmonid species occasionally captured in low numbers (range 1 to 2) in either KG01 or KG02 were juvenile Coho salmon, juvenile Steelhead/Rainbow trout, juvenile Chinook salmon, and one Brook trout. The sampling results for Kellogg Creek indicate that habitat conditions in Kellogg Creek are marginal for salmonids.

Table 4-2. Number of Individuals of each Salmonid Species/Group Collected in Mt. Scott Creek During Spring 1997, 2002, and 2008 by ODFW

Spring							
		Site					
Species	Year	MS01	MS1.1	MS1.3	MS02	MS03	MS04
Cutthroat trout	1997/1998	0	N/S	N/S	N/S	0	0
	2002/2003	**1**	N/S	N/S	N/S	0	**18**
	2008	N/S	**2**	**2**	0	**49**	**72**
Coho salmon	1997/1998	0	N/S	N/S	N/S	0	**1**
	2002/2003	0	N/S	N/S	N/S	0	0
	2008	N/S	0	0	0	**6**	0
Rainbow/Steelhead trout	1997/1998	0	N/S	N/S	N/S	0	**1**
	2002/2003	0	N/S	N/S	N/S	0	0
	2008	N/S	0	**1**	0	**31**	**2**
Unidentified salmonid	2008	N/S	**1**	**1**	0	**61**	**80**

N/S = Not sampled

Table 4-3. Number of Individuals of Each Salmonid Species/Group Collected in Kellogg Creek During Spring 1997, 2002, and 2008 by ODFW

Spring			
		Site	
Species	Year	KG01	KG02
Cutthroat trout	1997/1998	0	0
	2002/2003	0	**5**
	2008	**2**	0
Coho salmon	1997/1998	0	0
	2002/2003	0	0
	2008	0	0
Rainbow/Steelhead trout	1997/1998	0	**1**
	2002/2003	0	0
	2008	**1**	**1**
Unidentified salmonid	2008	**4**	0

Bioassessment Indices. F-IBI scores, based on spring fish collections in five reaches in Mt. Scott Creek, two reaches in Kellogg Creek and one reach in Phillips Creek, are compared in Table 4-4 for the three fish survey periods. In 2008, all of the F-IBI scores for Mt. Scott Creek fell within the marginally impaired category, ranging from 61 to 72. The highest score, which approached acceptable conditions, occurred in reach MS03 and corresponds to one of the two reaches that support relatively high numbers of salmonids. However, reach MS04, the other reach with relatively high salmonid numbers, received one of the lowest scores (61). Some of the raw data used to calculate the F-IBI scores as well as the rationale used by the analysts in scoring was not available in the survey reports. Therefore, the source of the differences between index scores could not be explained with any certainty. However, it is clear from inspection of the list of species collected from the two reaches, that samples from reach MS03 contained substantially more Families and Species of fish than those from MS04.

F-IBI scores for surveys conducted in Mt. Scott Creek in spring 1998 and spring 2003 were consistently in the severely impaired category (Table 4-4). This suggests that improvement in the fish community and hence habitat condition has occurred in Mt. Scott Creek since 2003. Some possible preliminary explanations for this improvement are discussed below relative to limiting factors, but further analysis will be required before any conclusive statements can be made.

For fish surveys conducted in 1997-98 and 2002-03, F-IBI scores were calculated for summer, fall, and winter as well as spring (Table 4-5). From inspection of the scores for Mt. Scott Creek, it can be seen that scores for MS01 were consistently in the severely impaired range throughout the year with relatively minor seasonal variation. During the winter of 1997-98, the score for MS03 rose to the low end of the marginally impaired category but remained in the severely impaired range during summer and fall. All values for MS03 in 2002-03 were in the severely impaired range. MS04, the uppermost site on Mt. Scott Creek received a marginally impaired score (56) in the summer of 1997-98 and a marginally impaired score (51) in winter of 2002-03 (Table 4-5). In general, there did not appear to be any seasonal patterns in F-IBI scores in these earlier surveys.

The lower reach of Kellogg Creek (KG01), which contained few salmonids, received an F-IBI score of 71 in spring of 2008. This score was nearly as high as the highest score on Mt. Scott Creek. Like Mt. Scott Creek, Lower Kellogg Creek F-IBI scores have improved from severely impaired in 1998 and 2003 spring samples to marginally impaired in 2008.

Table 4-4. F-IBI Scores in Mt. Scott, Kellogg, and Phillips Creeks during Spring

Site	Year		
	1998	2003	2008
Mt. Scott Creek			
MS01	34	36	64
MS02	NS	NS	61
MS03	30	41	72
MS04	48	46	61
Kellogg Creek			
KG01	38	44	71
KG02	83	64	57
Phillips Creek			
PH01	76	62	47

N/S = Not sampled

Table 4-5. F-IBI Scores for Summer, Fall and Winter Samples Collected in Mt. Scott, Kellogg, and Phillips Creeks in 1997-98 and 2002-03 by ODFW

Site	Fish IBI					
	1997-1998			2002-2003		
	Summer	Fall	Winter	Summer	Fall	Winter
Mt. Scott Creek						
MS01	28	34	41	39	33	30
MS02	NS	NS	NS	NS	NS	NS
MS03	41	30	55	41	46	41
MS04	56	39	32	44	41	52

Table 4-5. F-IBI Scores for Summer, Fall and Winter Samples Collected in Mt. Scott, Kellogg, and Phillips Creeks in 1997-98 and 2002-03 by ODFW

Site	Fish IBI					
	1997-1998			2002-2003		
Kellogg Creek						
KG01	57	53	NS	43	27	38
KG02	58	34	49	66	44	64
Phillips Creek						
PH01	65	81	42	68	56	39

N/S = Not sampled

Upper Kellogg Creek (KG02) showed an opposite trend moving from an acceptable score of 83 in spring 1998 to the lower end of the marginally impaired category (score of 57) in spring of 2008. As discussed above, fish sampling in Upper Kellogg Creek has indicated that salmonids have been present consistently but in low numbers. Understanding the reason(s) for the steady decline in F-IBI scores in Upper Kellogg Creek will require further analysis. The declines could be the result of very minimal summer low flows. In addition, poor habitat and water quality conditions resulting from development pressures and backyard and streamside practices by landowners (e.g., creek diversions, clearing of riparian vegetation; and landscaping and animal keeping practices) could contribute to declines in F-IBI scores.

The Phillips Creek F-IBI score for spring 2008 was well within the severely impaired range (Table 4-4). The F-IBI scores for spring 1998 and 2003 were considerably higher, with the 1998 value (75) within the acceptable range. Based on the trend in scores for spring samples it appears that Phillips Creek has undergone a steady decline in habitat conditions. The seasonal scores for Phillips Creek (Table 4-5) show considerable seasonal variability with summer and fall having relatively good scores in 1997-98 and 2002-03 and winter having relatively low scores. These differences could reflect seasonal movements of fish into and out of Phillips Creek.

Benthic macroinvertebrate index scores from riffle habitat in Mt. Scott Creek were collected in fall and were available only for the upper and lower reaches of the creek. These sample areas correspond to fish reaches MS04 and MS01, respectively. In spring 2008, B-IBI scores for the upper and lower reaches were both 16, indicating severe impairment at both locations. In spring 2003, both sites scored exactly the same as in 2008, indicating no improvement in conditions for the benthic macroinvertebrate community.

The biological index for urban gradient was also calculated for the two Mt. Scott benthic macroinvertebrate sampling sites and for the Phillips Creek sampling site. Results for fall 2007 and 2002 are compared in Table 4-6 with the F-IBI and B-IBI indices. Although we do not yet have the information needed to calculate where the data fit on the urban gradient index, it is reasonable to assume that Phillips Creek, which originates upstream of the heavily developed Clackamas Town Square area, would be more impacted by urban development than the other two sites on Mt. Scott Creek. Consistent with this assumption, the biological index for urban gradient score was much lower for Phillips Creek than the two Mt. Scott Creek sites in 2008 (Table 4-6). However in 2002, the Phillips Creek score was slightly higher than the score for Lower Mt. Scott Creek. The biological index for urban gradient score for Upper Mt. Scott Creek was the same for both sample years.

Table 4-6. Comparison of the B-IBI, F-IBI and the Biological Index of Urban Gradient

Creek	B-IBI and Biological Index for Urban Grad. Site and number	F-IBI site which contains the B-IBI sampling location	B-IBI 2003 (fall)	F-IBI 2003 (spring)	Biological Index for Urban Gradient* (spring)	B-IBI 2007 (fall)	F-IBI 2008 (spring)	Biological Index for Urban Gradient[1] (spring)	B-IBI trend	F-IBI trend
Mt. Scott	SD1-M2	MS04	16	46	27	16	61	27	unchanged	increasing
Mt. Scott	SD1-M3	MS01	16	36	13	16	64	28	unchanged	increasing
Phillips	SD1-M5	PH01	16	62	16	14	47	2	decreasing	decreasing

[1]Based on calculations described in Barbour et al. (2006)

In summary, the distribution and abundance data for salmonids in the KMS watershed indicates that only the two upper reaches (MS03 and MS04) of Mt. Scott Creek are consistently meeting the basic requirements for salmonid spawning and rearing. Presence of all life stages of Cutthroat trout, juvenile Coho salmon, and Steelhead trout indicated that these reaches are providing both spawning and rearing habitat under existing conditions. This does not appear to be the case in any of the other mainstem reaches of Mt. Scott, Phillips, or Kellogg Creeks.

The F-IBI scores do not appear to be good indicators of suitable salmonid habitat, since similar marginally impaired scores were obtained in Lower Mt. Scott Creek and Lower Kellogg Creek in spring 2008. The F-IBI scores for spring 2008 do not agree with the fall 2007 B-IBI scores, which indicated severely impaired conditions in both the upper (MS04) and lower (MS01) fish sampling reaches in Mt. Scott Creek.

From previous benthic surveys conducted in 2002, it appears that the severe impairment indicated by the low B-IBI scores has persisted since 2002. These results indicate that the benthic macroinvertebrate community is responding differently to water quality or habitat conditions than the F-IBI. Due to the conflicting results between the distribution of salmonids and the two biological indicators, it is clear that additional analysis will be required before appropriate recommendations (i.e., protection, restoration, or maintenance) can be made for stream reaches within the KMS watershed.

Physical Habitat Characterization Process

Only physical habitat data collected in association with the 2008 fish sampling were assessed. Lemke and Cole (2008) did collect habitat variables in their benthic macroinvertebrate habitat survey reaches, but as described above, only three of their reaches were located within the fish habitat reaches. Furthermore, the data that were collected were significantly different than the data collected by Neerman and Vogt (2008), making direct comparisons impossible. A discussion of habitat variables as they related to benthic invertebrate distribution and abundance is included in the Limiting Factors section below.

Descriptions of fish habitat require information on the physical characteristics of the streambed and channel, water quality conditions (e.g., temperature, dissolved oxygen [DO], contaminant levels, etc.), hydrology (flow conditions) and biological conditions (e.g., food resources, competitors, and predators). In this section, we will describe and compare selected physical habitat features that have been identified in the scientific literature as being important for the maintenance of healthy populations of the three salmonid species found in the KMS watershed. Water quality, hydrology, and stream channel morphology are presented in other sections and were evaluated relative to fish habitat during the analysis phase of this project.

In its 2006 "Fish Habitat Assessment in the Oregon Department of Forestry North Cascade Study Area," (Kavanaugh et al. 2006), ODFW identified 13 key habitat parameters for salmonids and discussed stream reaches in terms of these parameters as they related to selected "reference reaches" in relatively undisturbed areas. The ODFW parameters included the following:

- percent pools
- deep pools per kilometer
- percent slackwater pools
- percent secondary channels
- percent fines in riffles, percent gravel in riffles
- percent bedrock in stream
- pieces of large woody debris (LWD) per 100 meters of stream
- key pieces of LWD per 100 meters of stream
- volume of LWD per 100 meters of stream
- number of conifers > 50 centimeter diameter at breast height (dbh) within 30 meters on each side of the stream
- number of conifers > 50 centimeter dbh within 30 meters on each side of the stream
- percent shade

The 2007 ODFW habitat survey (Neerman and Vogt, 2008) provided data on all of these parameters (except for percent bedrock in the stream) for each of the habitat survey reaches in the KMS study area (four on Kellogg Creek, one on Phillips Creek, and twelve on Mt. Scott Creek). The fish survey and habitat survey reaches are shown on Figure 4-1. In an attempt to illuminate differences between the study reaches and thereby identify limiting factors, we created a ranking system for each of 11 important habitat parameters. The two conifer tree parameters identified by Kavanaugh et al. (2006) were eliminated from our analysis due to a lack of large conifers along any of the streams in the study area. We also added a category ranking the number of large boulders per square meter of habitat.

The rankings were based on "high" and "low" values identified by ODFW for streams in the north and west Cascades (Kavanaugh et al., 2006); by "desirable" and "undesirable" benchmark values identified for Oregon streams in Foster et al. (2001); and/or by Habitat Suitability Indices for Coho salmon (McMahon, 1983). Low, moderate, and high values were determined for each habitat parameter and a corresponding score of 1, 2, or 3 was assigned to each habitat survey reach on that parameter. The parameters utilized are listed in Table 4-7 and the rationale for inclusion of each is presented in Appendix C. After compilation of the scores for each parameter (or "metric"), all scores were totaled for an over-all combined habitat score.

Scores on individual metrics and overall combined scores are presented on Table 4-8. To allow a comparison of habitat within fish survey reaches, the values for the habitat survey reaches within each fish survey reach were summed and an average was calculated for each parameter. Mean habitat scores within fish survey reaches are presented in Table 4-9. It should be noted that habitat reaches do not exist in isolation and all parameters should be viewed in that context. For example, a reach that was 100 percent riffle could provide important habitat if nearby reaches were more complex (including pools, glides, slackwater, etc.) but lacking in riffle habitat. The numbers represented by the habitat scores are useful primarily in comparing the habitat reaches to one another and do not represent absolute stand-alone "habitat values" outside of this context. It should also be noted that these habitat values are calculated only for data from spring 2008 and do not allow comparisons within habitat reaches over time.

Results of Habitat Characterization

In general, there were far more moderate and low scores on the habitat parameters than there were high scores throughout the study area. This suggests that there is opportunity for improvement of fish habitat within the watershed, if sustainable fish populations is a goal.

The maximum possible score on the habitat matrix is 33. Habitat survey reaches in Mt. Scott Creek ranged from 16 to 21 (habitat reach MS04 in fish reach MS02 scored only 14, but did not contain riffles, and therefore no score could be assigned on the riffle metrics). Mt. Scott Creek reaches had relatively high rankings on percent fines in riffles, percent pools, and percent shade; but scored poorly on the deep pools per kilometer, slackwater pools metrics, and on the LWD metrics. The one area that made Mt. Scott Creek stand out among other streams within the survey area, was the boulders metric, and in fact, habitat reaches within MS04 had the highest average number of boulders per 100 square meters (Table 4-10) of any habitat reach in the study area. This may be because boulders were placed in this reach as part of the Spring Mt. Dam removal project in 2003.

Habitat scores in Kellogg Creek were low (with a maximum of 17), and in fact, the lowest score of any of the habitat reaches was achieved by KG04, the most upstream of the Kellogg Creek reaches, which scored only 13. Kellogg Creek is lacking in deep pools, LWD, and large boulders, and scored, at best, moderately on most of the remaining metrics. Phillips Creek scored in the middle of the pack at 18 and scores high on the pool metrics, moderately on the shade metric and poorly on all other parameters.

As can be seen, MS04 has the highest mean combined score (19.25), followed by MS03 and Phillips Creek (18), and MS01 (17.33). The two fish survey sites on Kellogg Creek had the lowest mean combined scores (15.67 and 17). MS03 has recently undergone significant habitat enhancement, with the placement of large amounts of LWD from just upstream of the I-205 crossing through approximately two-thirds of the remainder of the reach.

Physical habitat variables have been collected too infrequently to identify trends with any degree of certainty. Some habitat variables were collected in 1997, but only summaries (rather than detailed results) are available (Neerman and Vogt, 2008). It should also be noted that any direct comparison of habitat variables that are collected subjectively (for instance, the percentage of substrate as silt is visually estimated) is suspect. Therefore, small changes year-to-year (approximately 5 percent or less) are likely to be well within the sampling error.

Within Mt. Scott Creek, the percentage of the substrate as silt (Table 4-11) remained generally stable from 1997 to 2008, with the exception of MS02, which is a very small fish survey reach, containing only one habitat reach (MS04). During the same time period, the percentage of banks that were eroding decreased somewhat in Mt. Scott Creek (again, except in MS02). The percentage of pools and the percentage of fast water also increased markedly between 1997 and 2008, although these scores may be an artifact of the amount of flow at the time that the surveys were conducted. In both Kellogg and Phillips Creeks, the percent silt and percent eroding banks decreased markedly between 1997 and 2008 and percent pool and percent fast water increased, suggesting an improvement in habitat conditions.

Table 4-7. Fish Habitat Criteria

Parameter	Definition	Low score criteria	Moderate score criteria	High score criteria
Percent pools	Percent of the primary channel area represented by pool habitat	< 7 or > 90	7 to 40 and 60 to 90	> 40 and ≤ 60
Deep pools per kilometer	Number of pools greater than 1 meter deep per kilometer of the primary channel	< 2	≥ 2 and < 4	≥ 4
Percent slackwater pools	Percent of the primary channel area in slackwater pool habitat. Slackwater pools include beaver ponds, backwaters, alcoves and isolated pools.	< 0.25 or > 30	> 0.25 and < 0.5	> 0.5 to 30
Percent secondary channels	Percent of the total channel area (primary and secondary channels combined) composed of secondary channels	< 2	≥ 2 and < 4	≥ 4
Percent fines in riffles	Percent of the substrate in riffles < 2 millimeter in diameter	> 20	> 10 and ≤ 20	≤ 10

Table 4-7. Fish Habitat Criteria

Parameter	Definition	Low score criteria	Moderate score criteria	High score criteria
Percent gravel in riffles	Percent of the substrate in riffles 2 to 64 millimeter in diameter	< 20	≥ 20 and < 49	≥ 49
Pieces of LWD per 100 meters	Pieces of LWD > 0.15 meters in diameter by 3 meters in length per 100 meters of channel length	< 7	≥ 7 and < 21	≥ 21
Key pieces of LWD per 100 meters	Pieces of LWD > 0.06 meter in diameter by 12 meters in length per 100 meters of channel length	< 1	≥ 1 and < 3	≥ 3
Volume of LWD per 100 meters	Volume (cubic meters) of wood > 0.15 meters in diameter by 3 meters in length per 100 meters of channel length	≤ 20	20 to 30	≥ 30
Large boulders per square meter	Number of large boulders per square meter of channel area	< 0.10	0.10 to 0.25	≥ 0.25
Percent shade	Percent of the 180 degrees above the stream (the "sky") visible. Includes topographic an tree shade	< 60	≥ 60 and < 70	≥ 70

Table 4-8. Fish Habitat Scores

Stream	Fish sampling reach	Habitat reach	Percent pools	Deep pools/km	Percent slackwater pools	Percent secondary channels	Percent fines in riffles	Percent gravel in riffles	Pieces of LWD/100 m	Key pieces of LWD/100 m	Volume LWD/100 m	Percent shade	Large boulders/m²	Total score
Kellogg	KG01	KG01	2	1	3	1	3	2	1	1	1	1	1	17
	KG02	KG02	2	1	3	3	1	2	1	1	1	1	1	17
		KG03	2	1	1	3	1	3	1	1	1	2	1	17
		KG04	3	1	1	1	1	1	1	1	1	1	1	13
Mt. Scott	MS01	MS01	3	2	1	1	2	2	1	1	1	1	1	16
		MS02	3	1	1	1	2	3	1	1	1	2	1	17
		MS03	2	1	3	1	2	3	1	1	1	3	1	19
	MS02	MS04[1]	1	1	1	3	No riffles		2	1	1	3	1	14*
	MS03	MS05	2	2	1	3	2	3	1	1	1	2	1	19
		MS06	2	1	1	1	2	2	2	1	1	3	2	18
		MS07	2	1	1	2	2	2	2	2	2	3	2	21
		MS08	3	3	1	1	2	2	1	1	1	3	1	19
	MS04	MS09	2	1	2	1	2	2	1	1	1	3	3	19
		MS10	1	1	1	3	2	1	1	1	1	1	3	16
		MS11	2	1	1	1	3	1	1	1	1	3	2	17
		MS12	1	1	1	3	2	2	2	2	1	3	2	20
Phillips	PH01	PH01	3	3	3	1	1	1	1	1	1	2	1	18

[1] Due to a lack of riffles, the MS04 score is artificially low comparable to the other site scores.

Table 4-9. Mean Habitat Scores by Fish Sampling Reach

Stream	Fish sampling reach	Habitat reach	Total score	Mean score per fish reach
Kellogg	KG01	KG01	17	17
	KG02	KG02	17	15.67
		KG03	17	
		KG04	13	
Mt. Scott	MS01	MS01	16	17.33
		MS02	17	
		MS03	19	
	MS02	MS04*	14*	14*
	MS03	MS05	19	19.25
		MS06	18	
		MS07	21	
		MS08	19	
	MS04	MS09	19	18
		MS10	16	
		MS11	17	
		MS12	20	
Phillips	PH01	PH01	18	18

Table 4-10. Number of Large Boulders Per Square Meter of Channel Area In Habitat Survey Reaches and the Mean of those Values Within Fish Survey Reaches

Stream	Fish sampling reach	Habitat reach	Large boulders/m²	Mean large boulders/m² by fish reach
Kellogg	KG01	KG01	0.02	0.02
	KG02	KG02	0.01	0.01
		KG03	0.01	
		KG04	0.01	
Mt. Scott	MS01	MS01	0.00	0.01
		MS02	0.02	
		MS03	0.00	
	MS02	MS04	0.00	0.00
	MS03	MS05	0.01	0.09
		MS06	0.17	
		MS07	0.14	
		MS08	0.04	
	MS04	MS09	0.26	0.27
		MS10	0.55	
		MS11	0.10	
		MS12	0.16	
Phillips	PH01	PH01	0.04	0.04

Table 4-11. Selected Habitat Parameters, 1997 and 2008

Creek	Fish sampling site	Percent silt		Percent eroding banks		Percent pool		Percent fast water	
		1997	2008	1997	2008	1997	2008	1997	2008
Kellogg	KG01	15	8	9	4	0	25	25	45
	KG02	55	33	17	4	14	33	25	46
Mt. Scott	MS01	20	20	17	9	0	57	0	58
	MS02	22	53	0	9	0	95	0	0
	MS03	12	13	7	5	13	52	33	44
	MS04	2	6	11	3	14	16	14	79
Phillips	PH01	26	12	27	3	4	45	30	43
Rock	RC01	8	6	2	4	20	47	40	53
	RC02	1	9	11	7	24	45	45	48
	RC03	0	12	0	9	14	27	47	64
	RC04	35	15	24	7	12	69	37	29
	RC05	11	11	79	6	12	35	41	51

Identification of Limiting Factors

Fish and benthic macroinvertebrate sampling surveys have provided data on where species occur within the study area. However, *why* these species occur in one reach and are absent or rare from a superficially similar adjacent reach is not at all clear. In the absence of one overriding factor (for instance, a point source of pollution that by itself is limiting to salmonid abundance and distribution) the reason for the observed patchy distribution is almost certainly a combination of multiple factors that may or may not be currently occurring or being measured.

If one or a combination of the ten habitat variables discussed above is indeed limiting to salmonid abundance and distribution in the study area, those sites with the most salmonids should rank higher on either individual habitat variables or on the entire suite of variables combined. If salmonid distribution is not related to the habitat parameter rankings, then it is likely that some other factor (temperature, toxic releases, food resources) or an interplay of factors is limiting to salmonid distribution and abundance. The overall combined habitat scores within the study area ranged from 13 to 26, with a mean of 17.92 and a median of 17.5.

Because we are using salmonids as indicator species in the study area, the following is a discussion of potential limiting factors to salmonid distribution and abundance in the study area. Because of the small amount of benthic macroinvertebrate data, identification of limiting factors is more challenging. We are attempting to estimate the inherent capacity of different sites to support macroinvertebrates based on the degree of catchment urbanization as described above, and will continue this process as more data becomes available.

Mt. Scott Creek

There are four fish sampling reaches on Mt. Scott Creek, three of which (MS01, MS03 and MS04) have been sampled in multiple seasons over 3 years (see section discussion above). The assessed habitat reaches occur within the fish sampling reaches as illustrated in Table 4.8 and on Figure 4-1. The only salmonids that consistently occur in Mt. Scott Creek are Cutthroat trout (with small numbers of Coho salmon, Steelhead/Rainbow trout, and larger numbers of unidentified salmonids collected in 2008). Cutthroat trout occur primarily in the upstream reaches of Mt. Scott Creek (MS03 and MS04), with the highest number in the most upstream reach, MS04. The MS04 fish survey reach contains habitat reaches MS09 to MS12. Table 4-12 presents a reach by reach summary of the lowest and highest scoring parameters in Mt. Scott Creek.

Table 4-12. Mt. Scott Creek Fish Reach Habitat Summaries

Fish reach	Lowest scoring parameters	Highest scoring parameters
MS01	Secondary channels, large boulders, three LWD metrics	Percent pools, percent gravel in riffles
MS02	Pools, deep pools, slackwater pools, key pieces and volume of LWD, large boulders	Secondary channels, shade
MS03	Slackwater pools, key pieces, and volume of LWD	Shade, pools, gravel in riffles
MS04	Deep pools, slackwater pools, three LWD metrics	Fines in riffles, shade, large boulders

On the whole, habitat survey reaches within Mt. Scott Creek scored poorly on the deep pools per kilometer and slackwater pools metrics and on the LWD metrics. This suggests that the habitat within Mt. Scott Creek could be improved through the installation of large wood (and the improvement of the riparian zone which would result in greater future LWD recruitment), although more analysis is necessary. The installation of large wood would also likely result in the development of deep pools and slackwater areas. Sedimentation does not appear to be a significant issue in Mt. Scott Creek.

The Upper Mt. Scott Creek fish survey reaches did have the highest mean habitat scores, but the habitat survey reaches within the fish survey reaches where salmonids have historically been present (MS05 to MS12) did not have any obvious and consistent habitat advantages on individual metrics over the other reaches in Mt. Scott Creek. In fact, the lowest scoring habitat reach in Mt. Scott Creek (MS10) occurred within the fish reach with the highest number of salmonids (fish reach MS04). The one exception to this observation is the boulders metric. The habitat reaches within MS04 had the highest average number of boulders per 100 square meters (Table 4-10) of any habitat reach in the study area, followed by the habitat reaches within fish reach MS03. This further suggests that the lower reaches in Mt. Scott Creek (and possibly the upper reaches as well) could benefit from additional structure, both in the form of boulders and LWD. A second component of the physical environment which is fairly well correlated with salmonid presence is the amount of high structure vegetation (predominantly trees) within a 25-foot riparian zone (Figure 4-3). This suggests that fish would benefit from restoration of trees to the riparian zone in those areas where the riparian zone is predominantly shrubs and grassy areas. Additional discussion of the riparian zone is provided below.

It is of course possible—if not likely—that other factors such as temperature, contaminants, nutrient inputs, flashiness, etc. could be limiting salmonid populations. Data compilation on many of these other physical variables and habitat components is currently ongoing and will be analyzed further in the assessment phase. However, some initial data from temperature monitoring is available. Mt. Scott, Kellogg, and Rock Creek are identified by the DEQ as having salmonid rearing and migration habitat and as having spawning habitat from October 15 to May 15. Based on this, DEQ regulations specify that the 7-day running average temperature in these streams may not exceed 13.0 degrees Celsius (C) (55.4 degrees Fahrenheit [F]) between October 15 and May 15, and may not exceed 18 degrees C (64.4 degrees F) the rest of the year (Oregon Administrative Rules 340-041-0028).

Five continuous temperature monitors were deployed from June 16 through October 17, 2008. Figure 4-4 presents the 7-day running average maximum temperature for the five temperature monitors. The monitors are listed from the most downstream monitor to the most upstream monitor and are numbered accordingly (from 1 to 5). Also indicated on the graph is the 18 degree C line, which corresponds to the DEQ upper temperature limit for salmonid rearing and migration during the summer. The habitat reaches where the temperature monitors were located are presented on Table 4-13.

Table 4-13. Temperature Monitor Locations

Temperature logger number (numbered from downstream to upstream)	Temperature logger	Habitat reach
1	Lower Kellogg Creek at Oatfield Road	KG01
2	Kellogg Creek upstream of Mt. Scott confluence	KG02
3	Mt. Scott Creek near Regional Ponds at Southeast 82nd Avenue	MS05
4	Kellogg Creek at Roots Road	KG04
5	Mt. Scott Creek at Spring Mountain Road	MS11

With the exception of temperature logger 2 (located in KG02, which presumably receives groundwater inflow from springs, moderating its temperature), all of the locations regularly exceeded 18 degrees C throughout the summer. The high summer temperatures recorded suggest that in the absence of cold water refugia, temperature could be limiting to salmonids throughout many areas of the system in the summer. The cold water input to Kellogg Creek near its confluence with Mt. Scott Creek may serve as an important summer thermal refuge area and could help maintain temperatures in Lower Kellogg Creek for some distance below the confluence with Mt. Scott Creek. More information on the distribution and abundance of fish in these areas is needed.

Habitat reach MS05 (fish reach MS03) contains a large beaver dam that impounds water for several hundred feet of the stream length and produces a shallow pond. This provides a large surface for thermal loading and likely contributes to the high temperatures recorded at temperature logger 3 in Mt. Scott Creek a short distance downstream from the dam. A spot measurement collected by Ellis Ecological Services just downstream of the beaver pond on August 13, 2008 showed a temperature of 24.4 degrees C, and a DO concentration of 4.4 milligrams per liter. Such high temperatures and low DO concentrations would be seriously limiting to salmonids. Other locations on Mt. Scott Creek measured that same day had lower temperatures: 21.0 degrees C (farther downstream of the beaver pond at the flood control facility and WES' biostabilization project); and 19.5 degrees C (upstream of the beaver pond, just upstream of I-205).

The locations of temperature loggers 1, 4, and 5 exhibit similar patterns among themselves, with the most upstream location (Mt. Scott Creek and Spring Mountain Road) consistently showing the lowest temperatures but still exceeding the 18 degrees C standard.

Kellogg Creek

Of the two fish sampling reaches in Kellogg Creek, salmonids (Cutthroat trout) are more often found in the upstream (KG02) reach. The upstream fish sampling reach contains three habitat reaches (KG02 to KG04). As in Mt. Scott Creek, the upstream habitat reaches have no clear advantages over the downstream reach. The Kellogg reaches are extremely lacking in LWD, shade, and large boulders, indicating that habitat complexity may be limiting. High water temperatures are also a problem, although monitoring data throughout the system is lacking, and adequate cold water is present in at least one area of the watershed (Kellogg Creek upstream of the Mt. Scott Creek confluence). During a site visit conducted on August 13, 2008, much of Upper Kellogg Creek had very low flow conditions with nearly stagnant pool conditions at several locations. Low summer flow is probably a major limiting factor during dry summers in Upper Kellogg Creek.

Phillips Creek

Phillips Creek contains just one habitat reach and one fish sampling reach (two fish reaches were sampled in 1997 and 2002). The habitat reach received a mid-range score of 18. Only Cutthroat trout have historically been collected in Phillips Creek and those have been present only in low numbers. Because of low scores on all parameters other than pools, there may be multiple factors limiting salmonid abundance and distribution in Phillips Creek. No temperature data are available from Phillips Creek.

Previous Findings

Previous investigators have made initial attempts to identify limiting factors, and have made some recommendations. In regard to Kellogg and Mt. Scott Creeks, Neerman and Vogt (2008), stated,

> "Kellogg Creek and the lower two reaches of Mt. Scott Creek are also of particular importance for improving fluvial and anadromous access to habitat in Kellogg Creek watershed. These areas would greatly benefit from focused habitat restoration projects (particularly fish passage), increased protection or riparian/floodplain areas, increased public awareness, and outreach related to understanding of watershed health issues. Fish populations would benefit from the removal of the Kellogg Creek dam at it's confluence with the Willamette River which would allow unimpeded access by migratory fish species. Subsequently, it is important that land use regulations that currently protect habitat in the upper three reaches of Mt. Scott Creek remain in place with continued efforts to improve areas within these reaches that still need restoration."

These findings were based on general observations rather than any rigorous analysis.

Lemke and Cole (2008) conducted multiple correlation analyses between physical habitat variables and B-IBI scores. Among water quality variables, they found statistically significant correlations between riffle B-IBI scores and water temperature, conductivity, specific conductance (all negatively correlated) and DO (positively correlated). Among the habitat variables there were statistically significant correlations between riffle B-IBI scores and reach gradient, riparian buffer width, percent coarse substrate (all positively correlated) and percent of the sample reach as glide, percent eroding banks, percent undercut banks, and percent fine substrate (all negatively correlated). Based on their analysis, they stated:

> "Results of the correlation analyses suggest that temperature and substrate may be playing an important role in mediating macroinvertebrate community condition in area streams. In addition to focused riparian zone improvements, any land use or infrastructural improvements (Structural and Non-structural Source Controls, Low Impact Development and other Best Management Practices (BMPs) to preserve native soils and vegetation, reduce impervious footprint, stormwater retention ponds with enhanced water quality treatment attributes, and using pervious surfaces, etc.) that can be implemented to reduce stormwater surface runoff and improve low-flow conditions. These hydrologic improvements would certainly benefit the physical instream environment to which benthic communities respond."

Riparian Vegetation Characterization

Riparian vegetation plays important roles in the maintenance of salmonid habitat in streams. It helps maintain water temperatures by providing shade during summer and early fall, it provides a source of large woody debris to the stream channel that promotes channel complexity and it acts as a filter to remove contaminants and absorb runoff from surrounding areas. As discussed above, summer water temperatures exceed DEQ standards throughout Mt. Scott Creek and most of Kellogg Creek. High summer water temperatures in streams are typically related to low summer flows, aspect of the stream channel to incident solar radiation and amount of riparian vegetation and canopy cover (shade).

Data for characterization of the riparian cover along stream channels in the KMS watershed are available in 2007 Metro land cover data base as well as site-specific information for habitat reaches surveyed by ODFW during spring 2008 (Neerman and Vogt 2008). The Metro data categorize land cover based on the structure of the vegetation, high (trees) and low (brush and grass), percent scarified (urbanized) and percent waterbodies. These data can be manipulated in numerous ways to examine the existing condition of the riparian vegetation. WES performed analysis in GIS to determine the percentage of the riparian corridor within 25 and 100 feet of either side of the stream channel that is in each land cover classification. Areas with high structure vegetation (trees) are considered to be intact buffers.

Figure 4-5 shows the location of mainstem and tributary reaches with 0 to 33 percent, 34 to 66 percent, and 67 to 100 percent intact buffers within 25 feet of either side of the stream channels. A similar figure could be generated for the 100-foot buffer width. Note that areas with low intactness are primarily located in small tributary and headwater areas, although there are a few sections of the mainstems of both Kellogg and Mt. Scott Creeks that have low intactness. In general, it appears from the intactness data that the mainstems of Mt. Scott Creek and much of Kellogg Creek have intact 25-foot-wide riparian buffers and that substantial areas have intact 100-foot buffers.

Figure 4-6 provides an example of how the Metro structure data can be used to show areas within the 67 to 100 percent intact buffers that have trees (high structure) and comprise greater than 76 percent of the 25-foot-wide buffer. Much of the buffer along both Kellogg and Mt. Scott Creeks has a relatively high percentage of trees. Where trees are present along small streams such as Kellogg and Mt. Scott Creeks, shading would be expected to be relatively good.

Figure 4-7 shows the percent low structure vegetation in those channels that have 25-foot buffers and are less than 33 percent intact. Many of these channels are very small tributaries to Kellogg and Mt. Scott Creeks and have a relatively high percentage of low vegetation cover. Any of these tributaries that flow during the summer would likely be adding warm water to the mainstem reaches. Determining target sites for riparian restoration will require additional analysis, but it is clear at this point that the majority of the data needed for these analyses are available.

Location of Fish Passage Barriers and Prioritization for Removal

Adults of both anadromous and resident salmonids in the KMS watershed require barrier-free access to suitable spawning habitat, which presently is located in the upper mainstem of Mt. Scott Creek. Although poorly studied, it is also likely that unobstructed access to tributaries may be important in allowing access to refuge habitat during winter high flow events.

Data on the presence of human-made and natural barriers to fish passage were found in StreamNet data files, lists of culverts in Clackamas County identified as partial or complete barriers and ODFW's lists of partial and complete barriers. Figure 4-8 shows the location of known obstacles to fish migration within the watershed.

Presently, there are only two known partial barriers to adult salmonid movements between the mouth of Kellogg Creek and known spawning habitat in Upper Mt. Scott Creek. There is one culvert on private land just upstream of the uppermost ODFW fish sampling reach that may be blocking access to the uppermost reaches of Mt. Scott Creek. However, no detailed description could be found for that culvert. The fish passage facility at the outlet of Kellogg Lake in the City of Milwaukee is an important partial barrier to migration and should be given a high priority for removal since it is located close to the mouth of the Creek and all returning adults must pass over the fish ladder. Specific problems with the fish passage facilities have been detailed in a report prepared by MWH (2001) for WES. The other partial barrier is located at the culvert under Southeast 82nd Avenue and probably represents a relatively minor obstacle for returning adults. However, it may represent a low flow barrier to upstream migrating juveniles during the summer months.

Clackamas County lists only two culverts for replacement in the KMS watershed (Figure 4-8). These culverts are located on minor tributaries. Prioritization for replacement of culverts will require additional site-specific information on the condition of the culverts and the species and life stages affected, if any, and quality and availability of upstream habitat. Clackamas County's list of culverts for replacement provides a priority rating of low or high. All of the culverts identified for potential replacement in the KMS watershed are rated as low priority. The county's rating system takes into account both the potential biological benefits and the cost and logistics of replacement. ODFW also has a list of culverts identified for replacement and provides priority ratings for those identified. None of the culverts in the KMS watershed are identified as high priority for removal by ODFW.

Potential Future Risks

As described earlier, the KMS watershed is a highly urbanized watershed. Portions of the watershed are expected to develop further in the future, particularly in the upper reaches of Mt. Scott Creek. Runoff from existing development and changes to watershed hydrology from new and re-development pose potential future risks to aquatic habitat and biological communities as well as other elements of watershed health. Many of the same issues addressed in Chapters 2 and 3 related to hydrology, stream channel stability, and water quality could also affect aquatic habitat and biological communities. Policies and practices implemented to address the hydrologic and water quality impacts of existing development will be important to watershed health in the future. Design standards, regulations, land use policies, and sustainable practices will also play a significant role in determining the impact that future development and re-development has on the watershed.

As discussed in Chapter 1, the elements of watershed health (hydrology, water quality, aquatic habitat, and biological communities) often contain interrelated problems and integrated opportunities for improvement. Further work in the watershed assessment phase of the project was completed to evaluate interrelated issues and to identify priority actions and management activities appropriate for WES to undertake to address factors that are limiting watershed health. The identification of specific restoration or protection measures on a reach by reach basis required a synthesis of all the available information in the watershed assessment phase, and is available in Chapters 5 and 6.

Bibliography

Barbour, M.T., M. J. Paul, D. W. Bressler, A. P. O'Dowd, V.H. Resh and E. Rankin. 2007. Research Digest 01-WSM-03: Bioassessment: A Tool for Managing Aquatic Life Uses for Urban Streams.

Cole, M.B. 2004. Baseline Assessment of Stream Habitat and Macroinvertebrate Communities in and Adjacent to the Damascus Area Urban Growth Boundary Expansion, Oregon. ABR, Inc. Environmental Research and Services.

Foster, S.C., C.H. Stein, and K.K. Jones. 2001. A guide to interpreting stream survey reports. Edited by P.A. Bowers. Information Reports 2001-06. Oregon Department of Fish and Wildlife, Portland.

Friesen, Thomas A. and Mark P. Zimmerman. 1999. Distribution of fish and crayfish, and measurement of available habitat in urban streams of north Clackamas County. Oregon Department of Fish and Wildlife, Clackamas, OR 97015.

Kavanaugh, P., P. Jacobsen, K. Jones, and K. Anlauf. 2006. Fish Habitat Assessment in the Oregon Department of Forestry Astoria North Study Area. Oregon Department of Fish and Wildlife, Salem, Oregon.

Lemke, Jena L. and Michael Cole. 2008. Assessment of Macrovinvertebrate Communities in Streams of Clackamas County Service District No. 1, Clackamas County, Oregon. Clackamas county Water Environment Services.

McMahon, T. E. 1983. Habitat Suitability Index Models: Coho Salmon. Western Energy and Land Use Team, Division of Biological Service, Research and Development. USFWS.

Montgomery, Watson, Harza. 2001. A watershed assessment of Kellogg and Mount Scott Creeks. Final Report prepared for Clackamas County Water Environment Services.

ODFW. See Oregon Department of Fish and Wildlife.

Oregon Department of Fish and Wildlife (ODFW). 2008. Draft Report: Fish species distribution and abundance and habitat assessment of streams in Clackamas County Service District No. 1. Prepared by Alex Neerman and Jessica Vogt.

Oregon Department of Fish and Wildlife (ODFW). 1992. Clackamas River and Basin Fisheries Management Plan.

State of Oregon Fish Commission in Collaboration with Fish and Wildlife Service, USDI. 1951. Lower Columbia River Fisheries Development Program, Willamette River, Oregon.

Tinus, Eric S., James A. Koloszar, and David L. Ward. 2003. Abundance and distribution of fish in Clackamas County urban streams: Final Report 2002-3. Oregon Department of Fish and Wildlife, Clackamas, OR 97015.

Willis, R. A., M. D. Collins, and R.E. Sams. 1960. Environmental survey report pertaining to salmon and Steelhead in certain rivers of eastern Oregon and the Willamette River and its tributaries. Fish Commission of Oregon, Clackamas.

FIGURES 4-1 TO 4-8

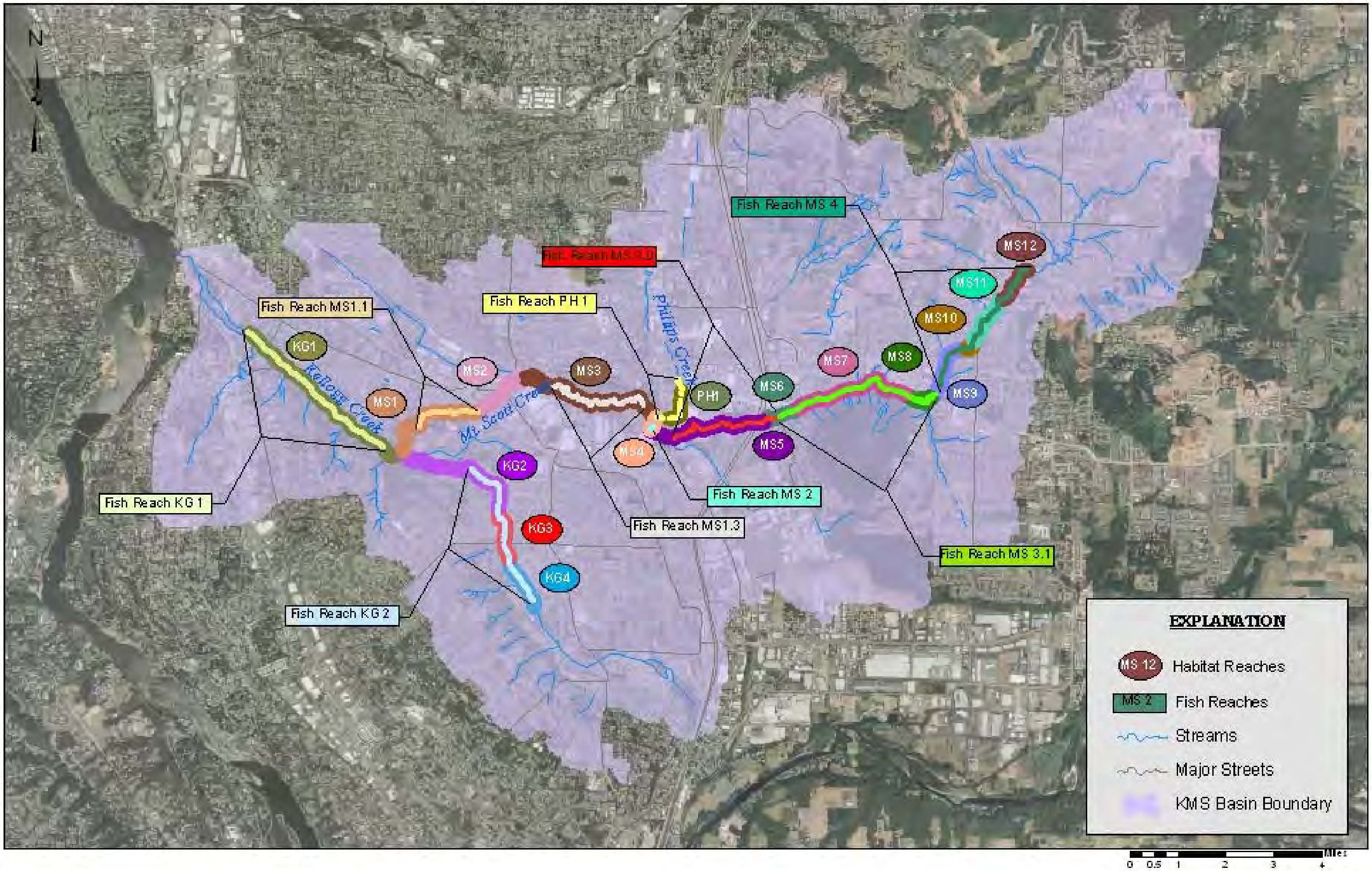


Figure 4-1
Kellogg-Mt. Scott Habitat and Fish Study Reaches
WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES

BROWN AND CALDWELL

Ellis Ecological Services, Inc.

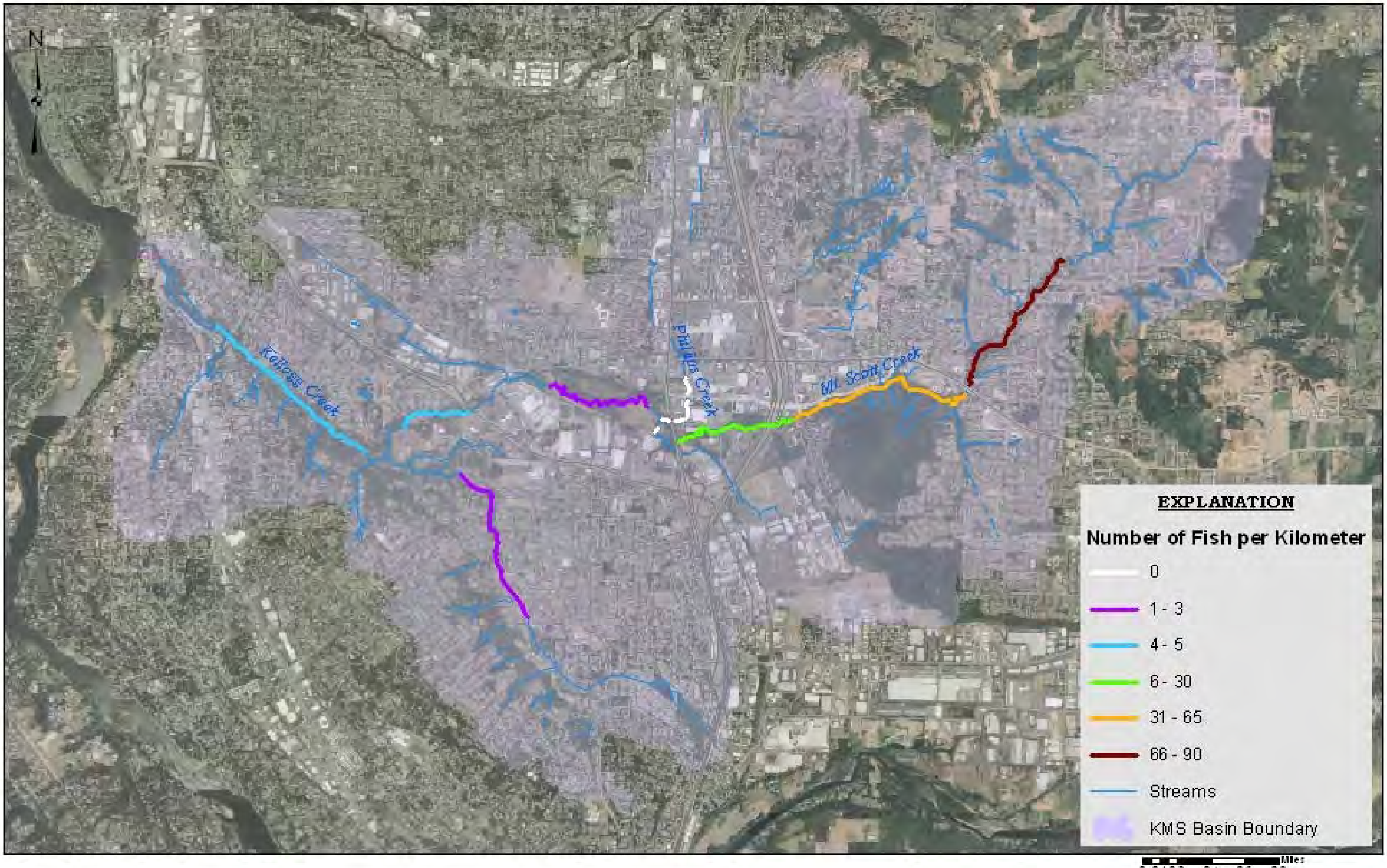


Figure 4-2
Relative Salmonid Abundance in ODFW Presence/Absence Surveys
WES WATERSHED ACTION PLAN

Water Environment Services

Brown and Caldwell

Swanson Hydrology + Geomorphology

Ellis Ecological Services, Inc.

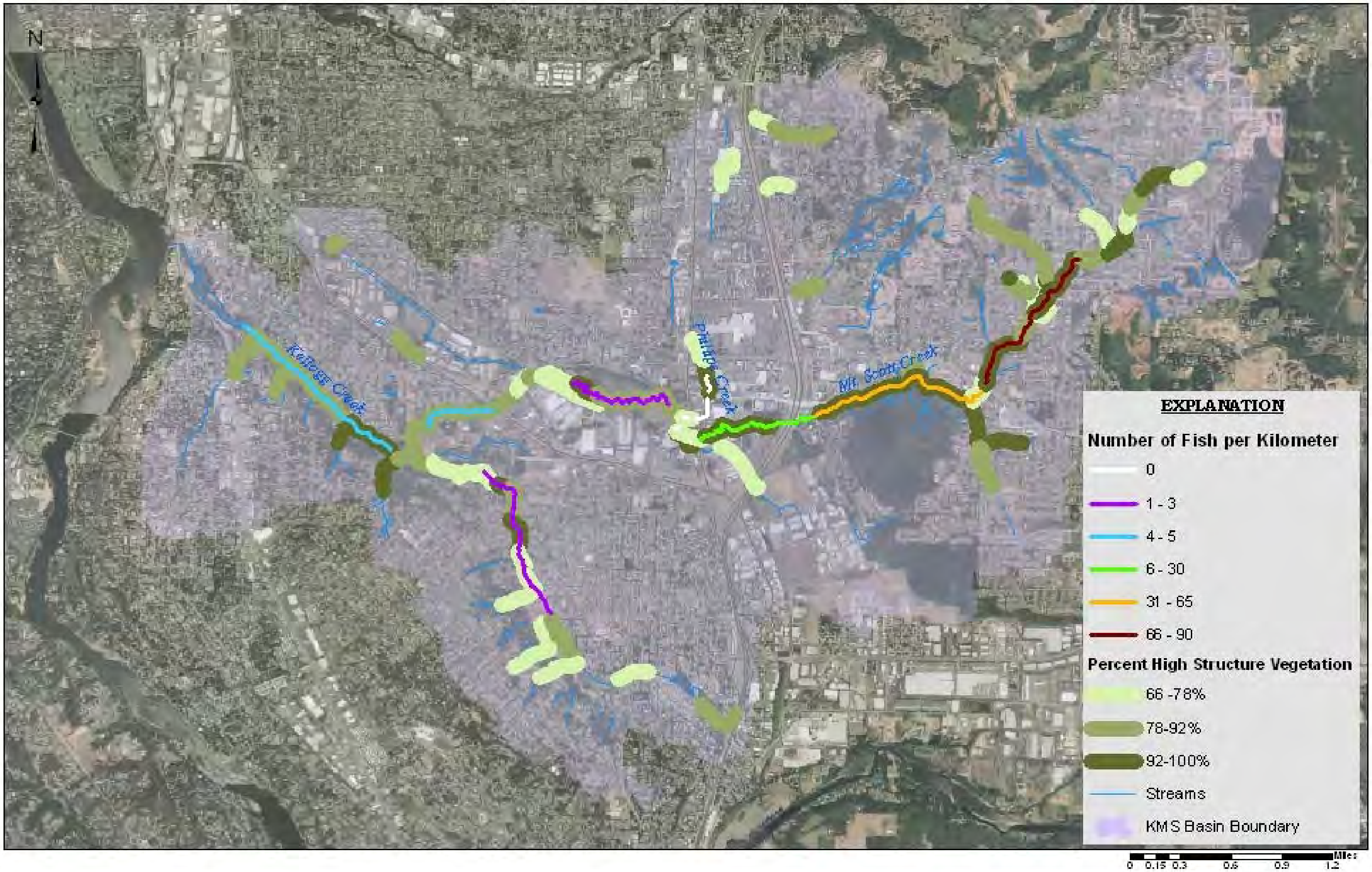


Figure 4-3
Relative Salmonid Abundance vs Composition of 25ft Riparian Buffer
WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES

BROWN AND CALDWELL

Swanson Hydrology + Geomorphology

Ellis Ecological Services, Inc.

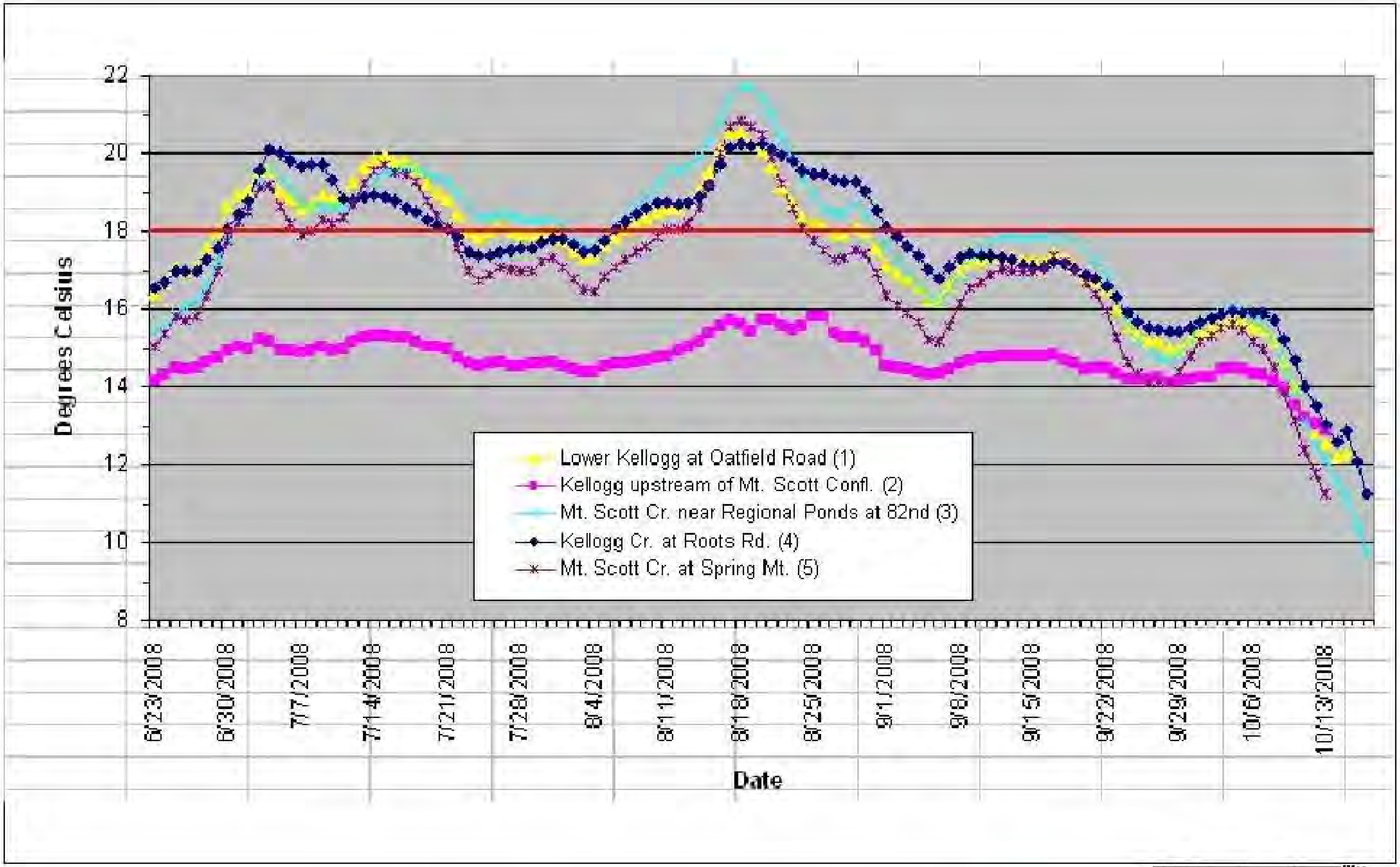


Figure 4-4

Kellog-Mt Scott Creeks 7-Day Running Average Maximum Temperatures

WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES

BROWN AND CALDWELL

Ellis Ecological Services, Inc.

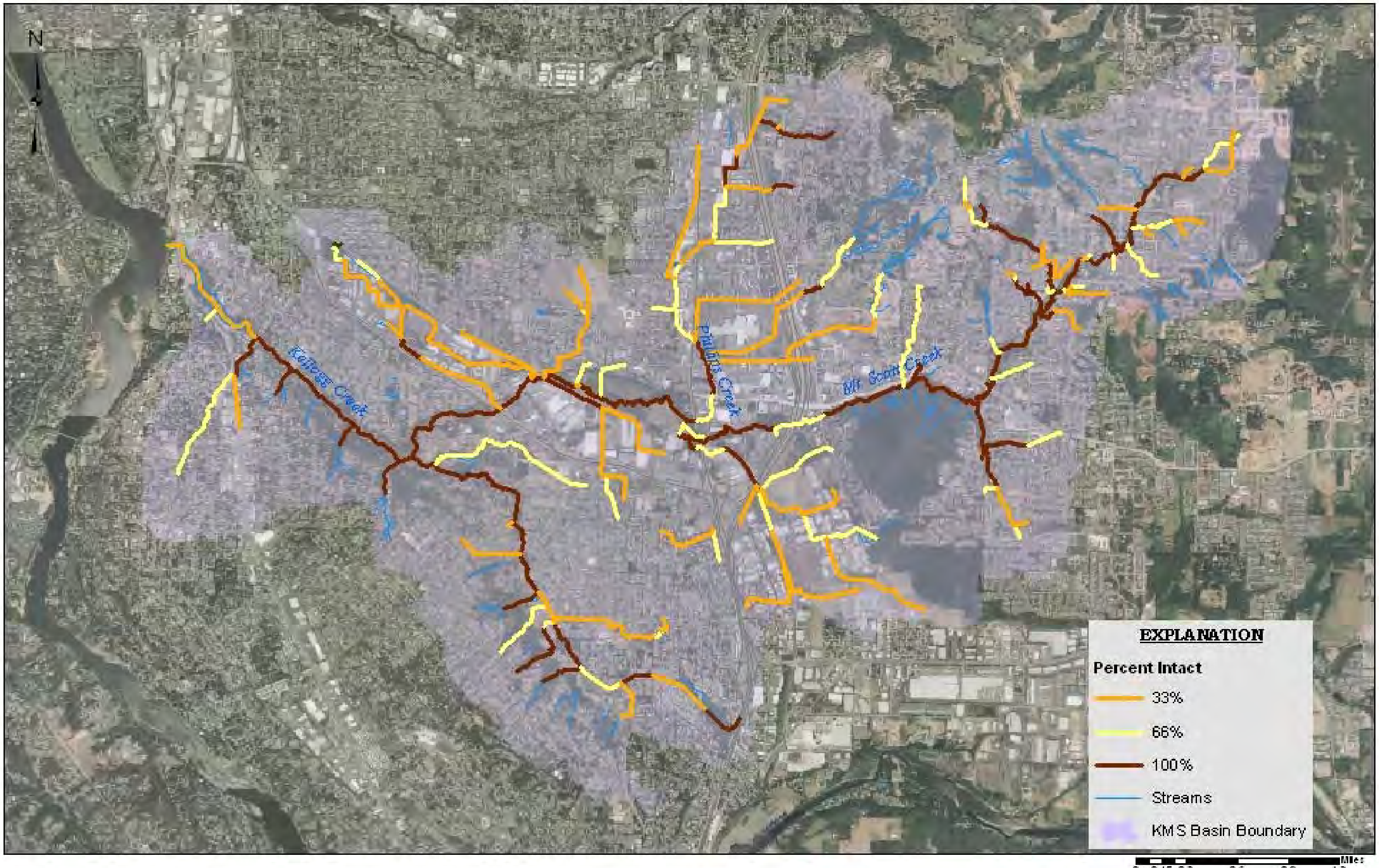


Figure 4-5
Relative Integrity of 25 ft Riparian Buffers
WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES

BROWN AND CALDWELL

Ellis Ecological Services, Inc.

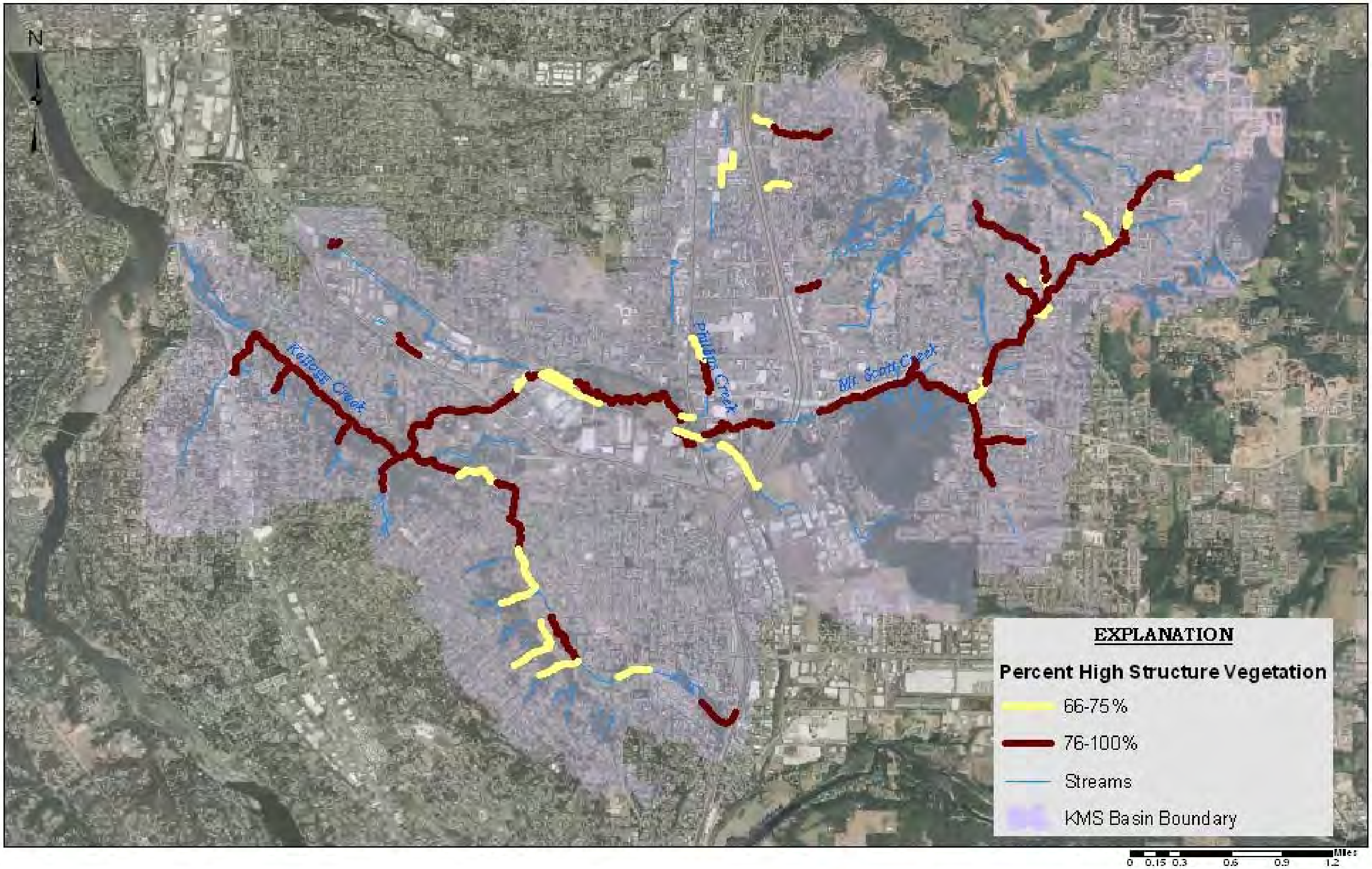


Figure 4-6
Composition of the100 Percent Intact 25ft Riparian Buffers
WES WATERSHED ACTION PLAN

Water Environment Services

Brown and Caldwell

Ellis Ecological Services, Inc.

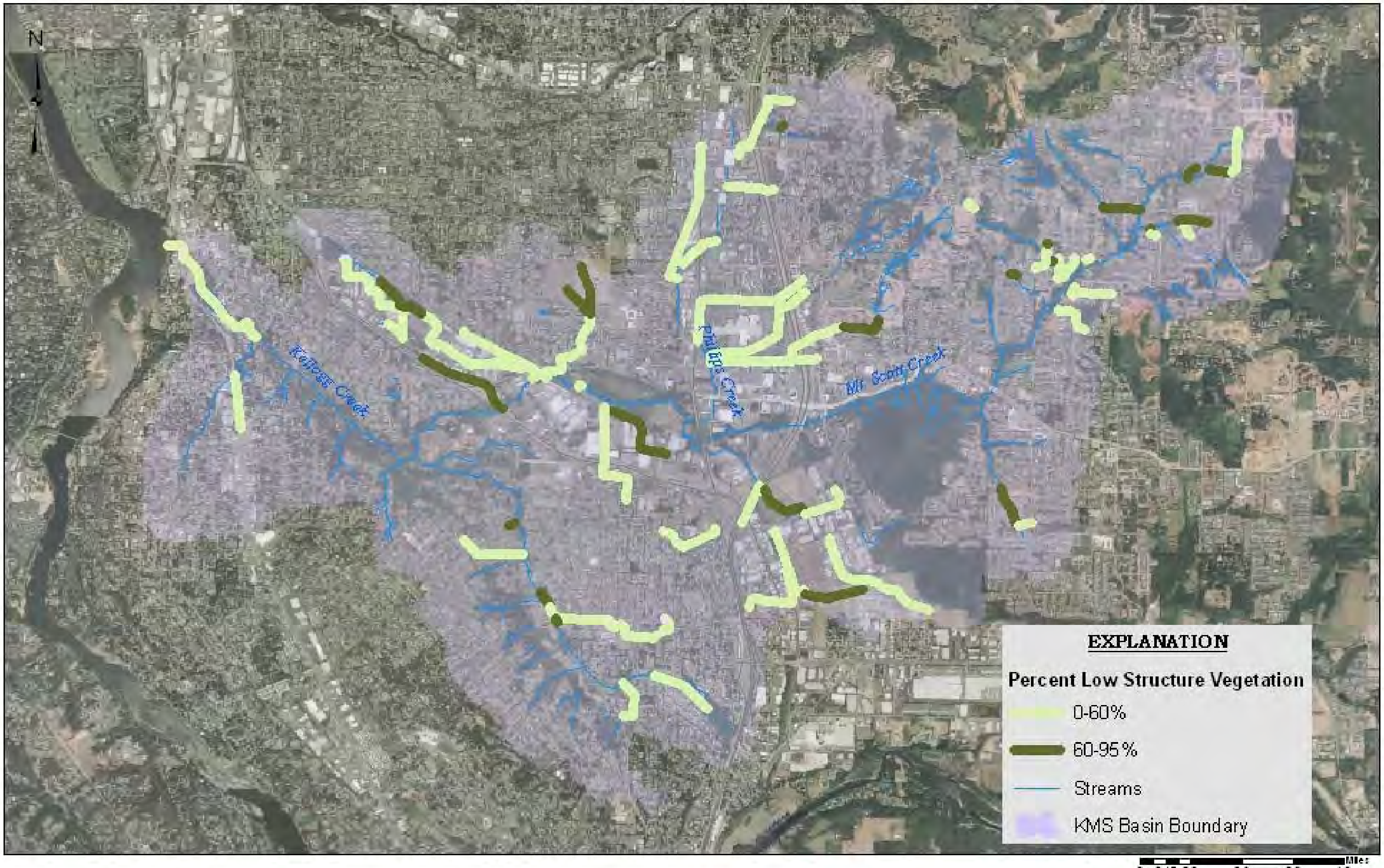


Figure 4-7
Composition of the33 Percent Intact 25ft Riparian Buffers
WES WATERSHED ACTION PLAN

Water Environment Services

Brown and Caldwell

Swanson Hydrology + Geomorphology

Ellis Ecological Services, Inc.

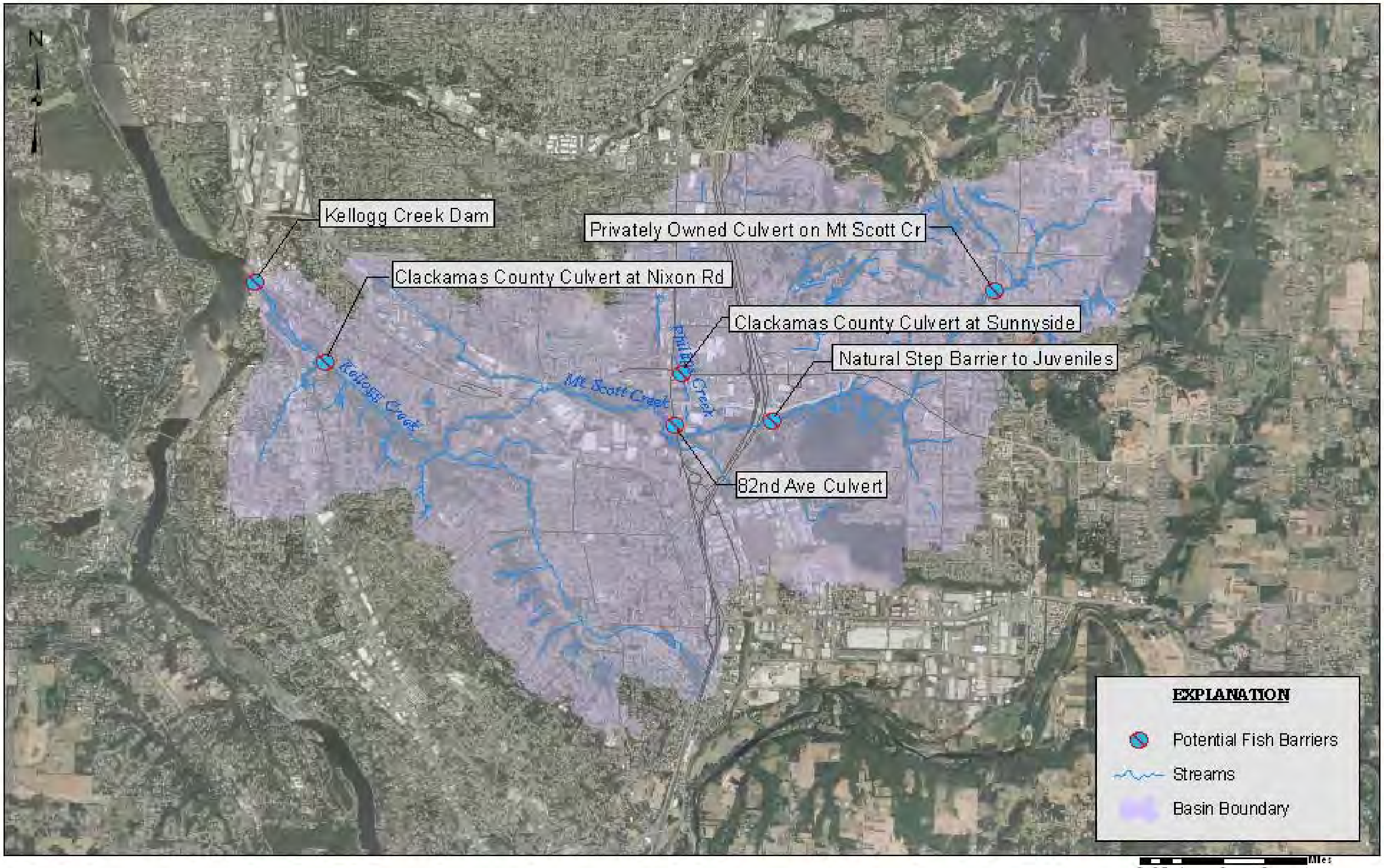


Figure 4-8
Potential Barriers to Fish Within the Kellogg-Mt. Scott Watershed
WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES

BROWN AND CALDWELL

Ellis Ecological Services, Inc.

CHAPTER 5 – WATERSHED ASSESSMENT AND RECOMMENDED MANAGEMENT STRATEGIES

Overview

As discussed in Chapter 1, the Kellogg-Mt. Scott (KMS) Watershed Action Plan (Action Plan) includes a Characterization Report, an Assessment Report, and an Action Plan summary. Chapters 1 to 4 comprise the Characterization Report, an inventory of existing information about the watershed conditions and Water Environment Services (WES) activities. This chapter is the Assessment Report. Chapter 6 summarizes the Action Plan.

The Assessment Report includes an assessment of watershed conditions based on the Characterization Report results and identifies WES surface water programs, projects, and activities that could efficiently and effectively improve watershed health. The Assessment Report begins with a summary of watershed-wide issues and opportunities to enhance watershed health. Input provided by the Stakeholder Group on watershed enhancement actions is then summarized. Following this, the Assessment Report includes a reach-by-reach analysis of factors limiting watershed health organized by the major sub-basins. Within the reach analysis, recommended management strategies and potential actions to enhance watershed conditions in specific stream reaches and contributing areas to reaches are described. Recommended early action projects to pursue to enhance watershed health during early 2009 are summarized at the end of the chapter.

In Chapter 6, the potential actions described in the Assessment Report are analyzed further and organized into near-term actions and longer-term actions based on feasibility, expected impact, urgency, and other criteria. Near-term actions are described in greater detail to identify implementation steps and planning-level cost estimates, then prioritized using an asset management Level of Service (LOS)-based evaluation process. Specific programs, projects, and activities will be sequenced for implementation by WES.

Watershed Analysis

The KMS watershed is a highly developed urban watershed. The 2007 Metro aerial photography analysis indicates that 39 percent of the watershed is covered by impervious features such as roofs, roads, and parking areas; 31 percent of the watershed contains tree canopy; and 29 percent of the watershed contains grass, shrubs, and other low-structure vegetation. Aerial photographs and key stream reach features are shown for the major sub-basins within the KMS watershed in Figures 5-1 through 5-8.

The land use in the watershed includes 56 percent single-family residential (SFR), 10 percent commercial, nine percent industrial, six percent multi-family residential (MFR), and 1 percent farmland. Approximately 17 percent of the watershed is classified as tract land or is undefined in the Clackamas County Tax Assessor data. Tract land includes institutional land uses such as schools and parks as well as undeveloped parcels. The extent of development in the tract and undefined land uses in the watershed is unknown at this time. As much as 10 percent of the watershed may still be available for further development based on the buildable lands assessment conducted by WES. Approximately 23 percent of the watershed is treated with structural Best Management Practices (BMPs) such as stormwater detention ponds and biofiltration swales.

Based on the results of the Characterization Report, key stressors in the watershed include the following:

- Loss of infiltration of rainwater and efficient delivery of runoff to streams due to impervious surfaces and the piped storm drainage system
- Loss of tree canopy in riparian corridors and uplands
- Untreated runoff from impervious surfaces
- Floodplain development
- Land management practices

In addition to these key stressors identified in the Characterization Report, there may be other key stressors affecting watershed health that are not fully understood due to data gaps. Examples of other potential stressors include man-made lakes (e.g., Kellogg Lake and Leona Lake), water withdrawals, and channel modifications. Further data collection and analysis of these potential stressors would be valuable.

Key responses to these stressors in the watershed include the following:

- Increased flow volume and duration during storm events
- Channel instability including bank erosion and channel widening
- Flooding affecting infrastructure
- Lower flow during summer
- Streams exceeding water quality standards for temperature and bacteria as well as other pollutants
- Reduction in populations of sensitive aquatic species
- Increase in populations of aquatic species tolerant of poor water quality conditions and habitat
- Reduction in quality of aquatic habitat through fine sediment accumulation and loss of in-stream structure such as deep pool habitat and large woody debris

Watershed-wide opportunities to address these stressors and responses are described below, along with opportunities to fill data gaps to better understand watershed health and guide future management activities. The Reach Assessment section further describes locations of reach-specific and sub-basin-specific issues and opportunities to address those issues. Early Action Items recommended to address watershed-wide opportunities and reach-specific opportunities are summarized following the Reach Assessment.

Hydrology Issues and Opportunities

The hydrology of the KMS watershed has been altered significantly from pre-development conditions due to land use changes, loss of native vegetation, the development of the piped stormwater drainage network, and the lack of hydrologic controls on older development. Prior to 1993, the treatment of stormwater in new developments with structural stormwater BMPs was not required by design standards, and these developments generally lack hydrologic controls. From 1993 through 2002, WES required new development to detain runoff from a 25-year storm event and release it at a rate equivalent to the runoff from a 5-year storm event under pre-developed conditions. From 2002 to the present, WES has required new development and significant re-development to detain runoff from a 2-year storm event and release it at a rate equivalent to the runoff from one-half of a 2-year storm event.

The effects of hydrologic changes on stream channels are known as "hydromodification." In the KMS watershed, hydromodification has likely had a significant impact on water quality, stream habitat, and channel conditions during the last 100 years. Hydromodification impacts may be reduced in the future as the stream system reaches a new equilibrium under relatively stable land use conditions.

Based on the characterization phase results described in Chapter 2, many of the mainstem portions of the KMS watershed stream system appear to be stabilizing and reaching a new equilibrium as development activity in the watershed decreases. However, relatively little is known about the conditions of the upper tributaries to the stream system and these areas may be prone to instability if future development does not adequately protect drainage areas and mitigate runoff.

The apparent stability in the mainstem of the KMS watershed system is likely due to relatively consistent flows in the stream channels in recent years, reduced sediment loads, grade control throughout the lower reaches, and channel conditions in the middle and upper reaches. Although overall stream flow volume has increased significantly during storm events due to development, the watershed is reaching a point where year-to-year flows will be somewhat consistent with rainfall patterns due to less new development and land clearing. Based on field observations of stream conditions by a project team biologist, the slowing of development activity along with the WES Erosion Prevention and Sediment Control program appears to have reduced the annual sediment load, reducing scour and fine sediment buildup. The lower KMS watershed also has many culvert crossings and armored banks along the channel, which provide grade control throughout the reaches and limit how much the channel can meander or down cut. The middle and upper reaches of the Mt. Scott Creek system consist of a steep channel system with relatively intact riparian buffers, a coarse substrate with large cobbles and good roughness along the channel. The mainstem channel along these reaches appears to be stable and efforts should be concentrated on maintaining these conditions.

Specific areas of potential risk or concern to hydrology include reaches where 5 percent or more of the banks are eroding and reaches with overall risk to channel stability based on low gradient conditions, high entrenchment ratios, and stream beds with less than 30 percent coarse substrate. Reaches where 5 percent or more of the banks are currently eroding based on the Oregon Department of Fish and Wildlife (ODFW) habitat analysis are Lower Mt. Scott Creek and the portion of Upper Kellogg Creek upstream of the confluence with Mt. Scott Creek. Reaches with risk to overall channel stability include the mainstem of Mt. Scott Creek from the Three Creeks Natural Area up through the Interstate 205 (I-205) and Sunnyside corridors (see Figure 5-7).

The most at risk areas for erosion were mapped based on slopes steeper than 30 percent underlain by highly erodible soils. Erodible soils are identified in soil maps by the Natural Resources and Conservation Service (NRCS) and U.S. Department of Agriculture (USDA). Erodible soils are measured by the k-factor, which represents the susceptibility of soil to erosion and the rate of runoff according to NRCS-USDA standards. The high risk areas for soil erosion appear to be the immediate area adjacent to stream channels, specifically Lower Kellogg Creek, the terrace bluffs, and the buttes associated with the Boring Lavas. Additional development is expected around Mt. Scott, which presents a relatively high risk of mass failure.

There are incidents of flooding in the KMS watershed that affect infrastructure, which includes roads, residences, and businesses, as well as surrounding property. The floodplain of the KMS watershed stream system is developed in some areas, which places structures in those areas at a high risk for flooding. WES addresses flooding directly related to WES infrastructure such as stormwater detention ponds and provides emergency-driven maintenance of the storm sewer system. The Clackamas County Department of Transportation and Development (DTD) addresses road flooding and is responsible for land use planning decisions such as whether to permit development in the floodplain. If development is allowed, DTD also sets mitigation requirements for the developed land.

Potential Actions

Returning the KMS watershed stream system to a significantly more natural hydrologic flow regime is likely not feasible due to the extent of development in the watershed. However, as the stream system stabilizes under the new equilibrium land use and hydrology conditions, it has the opportunity to serve as functioning aquatic habitat if managed appropriately.

Appropriate WES management activities to reduce hydromodification impacts are recommended to focus on establishing and maintaining a hydrologic equilibrium throughout the watershed, proactively addressing risk factors, and filling data gaps. The following potential actions will support this management strategy:

- Update stormwater design standards to promote low impact development (LID) techniques for new development and re-development areas; implement hydrologic control of runoff from small and large storm events for new development, as well as re-development when feasible.
- Ensure that the replacement of structures (e.g., road culverts and bridges) at upstream locations does not change the high flow conditions downstream (or appropriately mitigate for such impacts) and address the potential for channel migration during structure replacement.
- Maintain, and where possible, improve, the riparian buffer conditions around stream channels.
- Maintain, and where possible, increase, the upland tree canopy in the watershed.
- Evaluate and prioritize opportunities to retrofit older detention ponds to provide flow control and water quality treatment for smaller storm events.
- Track stream channel conditions and bank stability in at-risk areas for erosion and instability in the mainstem and upper tributaries; compare periodically to lower risk areas.
- Implement strong Erosion Prevention and Sediment Control practices in areas at high risk for erosion based on steep slopes and erodible soils, including conducting frequent high priority site inspections and periodically reviewing site inspection data to continually improve process.
- Continue to track flooding complaints and issues related to WES infrastructure. Evaluate opportunities to assist DTD in addressing other flooding issues as appropriate in support of overall watershed health.
- Where feasible, provide additional off-channel flood storage and enhanced wetlands with connections to streams.
- Where feasible, improve in-stream habitat using designs appropriate for the current flow regime.
- Investigate use of water rights and active water withdrawals in areas where low summer flow is a concern, such as in Upper Kellogg Creek.

Water Quality Issues and Opportunities

Water quality in the KMS watershed has been significantly degraded from pre-development conditions in some areas due to land use changes, hydromodification, and untreated runoff from impervious surfaces. Key water quality parameters evaluated in this assessment include benthic macroinvertebrate abundance and diversity, BMP treatment areas, water temperature, dissolved metals, nutrients, suspended solids, *E. coli*, future land development and forested cover in the contributing area.

Key water quality issues in the KMS watershed include the following:

- Stream temperatures exceed water quality criteria for summer conditions.

  Riparian canopies and forests have been altered and removed in portions of the watershed, leaving the streams open to increased heat gain from solar radiation. Installation of impervious surfaces has likely reduced infiltration and aquifer recharge, resulting in less groundwater discharge to streams during the summer. Less groundwater discharge can increase stream temperatures because groundwater tends to be cooler than surface runoff during the summer, and less total flow in the stream allows solar radiation to affect a greater proportion of the water column. Enhanced stream shading through riparian buffer plantings is expected to improve water temperature conditions over time. Implementation of LID practices in areas of new development and re-development may also provide incremental improvements in groundwater discharge to the streams.

- Benthic macroinvertebrate and fish population surveys indicate that the streams in the watershed primarily support moderately to severely impaired biological communities.

The benthic macroinvertebrate communities surveyed in 2007 are largely comprised of organisms that are able to tolerate elevated sediment loads, increased water temperatures, periods of sustained high or low flows, and other characteristics of urbanized streams. According to the Watershed Health Index assessment of benthic macroinvertebrate communities as a biological index, the KMS watershed stream system at the sites where benthic macroinvertebrate data have been collected is far below its biological potential even considering the level of development in the watershed.

Table 5-1 compares the biological index for four sites in the KMS watershed with the predicted biological potential for those sites based on the level of urbanization in the contributing area. Site SD1-M13, on Upper Kellogg Creek near the confluence with Mt. Scott Creek in the Three Creeks area (Figure 5-2), is at 12 percent of its biological potential. Site SD1-M3, located on Mt. Scott Creek downstream of Southeast 82nd Avenue (Figure 5-3), is at 24 percent of its biological potential. Site SD1-M5, on Phillips Creek upstream of Southeast 82nd Avenue (Figure 5-4), is at just 4 percent of its biological potential. Site SD1-M2, on Upper Mt. Scott Creek (Figure 5-7), is at 21 percent of its biological potential.

The causes for the poor biological index results in the KMS watershed are not fully known at this time, although potential contributing factors include hydrologic regime disturbances, erosion and sedimentation in streams, and increased water temperatures. Water quality pollutants such as pesticides, dissolved metals, and other toxic materials could also be contributing to the reduced biological quality in the streams. Additional surveys of stream conditions and targeted water quality monitoring efforts may provide further insight into the contributing factors and help guide WES management activities intended to improve the biological index results.

Table 5-1. Watershed Health Index – Biological Index Results

Creek	Site number	Biological index	Biological potential (90th quantile)	Percent of biological potential
Mt. Scott	SD1-M2	12	55	21
Mt. Scott	SD1-M3	12	50	24
Phillips	SD1-M5	2	46	4
Kellogg	SD1-13	6	49	12

- Elevated levels of *E. coli* bacteria, a key indicator of water contact human health issues, were found throughout the watershed.

A Total Maximum Daily Load (TMDL) has been established for *E. coli* in Kellogg, Phillips, and Mt. Scott Creeks. The TMDL requires a 78-percent reduction in in-stream *E. coli* concentrations. *E. coli* is an indicator of fecal matter, which can contain a wide range of pathogenic organisms. There are many potential sources of *E. coli* in streams including from wildlife, pets, livestock, and humans. The sources of *E. coli* in the KMS watershed are not well understood at this time. Increased understanding of sources would be helpful to guide management activities to address this issue.

- Changing National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit requirements and Underground Injection Control (UIC) management may require additional water quality monitoring and retrofits to the existing storm system to improve water quality.

The NPDES MS4 permit is being modified by the Oregon Department of Environmental Quality (DEQ). The new requirements of the permit are not fully known at this time; however there may be required changes to WES' monitoring program or other activities.

WES and DTD jointly applied for an area-wide Water Pollution Control Facility (WPCF) permit from DEQ for stormwater UIC devices (e.g., drywells) on December 19, 2001. As of 2009, this WPCF permit had not been issued; however there may be required changes to WES' monitoring program or other activities in the future to address UIC management.

Potential Actions

A continued active management strategy to improve water quality in the KMS watershed is recommended for watershed health and to comply with NPDES MS4, TMDL, and UIC requirements. Many of the potential actions described above for addressing hydrologic issues also serve to address water quality issues. Additional potential actions that will support the active management strategy to improve water quality include the following:

- Develop an integrated monitoring plan that addresses key questions and provides a framework for organizing and analyzing data from all sources (water quality sampling, flow measurement, biological surveys, and special studies).
- Expand benthic macroinvertebrate sampling locations and frequency for compiling the Watershed Health Index.
- Consider a Microbial Source Tracking project to increase understanding of *E. coli* bacteria sources.
- Develop a stormwater quality retrofit program for WES stormwater treatment ponds. Over 30 ponds in Clackamas County Service District No. 1 and the Surface Water Management Agency of Clackamas County (the Districts) have been identified by WES staff as potential opportunities to retrofit to function better.
- Develop a stormwater quality structural BMP retrofit program for streets in coordination with DTD.
- Develop a stormwater quality retrofit technical assistance program aimed at institutional landowners (e.g., churches and schools) and commercial landowners with large parking areas to reduce pollutant loads from existing development.
- Continue implementing the private water quality facility cleaning and inspection program.
- Evaluate opportunities to enhance street sweeping effectiveness in reducing pollutant loads from high volume streets through increased frequency and enhanced technology. Evaluate areas in the watershed where enhanced street sweeping may cost-effectively benefit water quality.
- Continue investigating the water quality impacts of man-made lakes in the watershed including Leona and Kellogg Lakes.
- Develop monitoring protocols, data quality objectives, and evaluation processes to analyze the effectiveness and results associated with non-structural BMPs.

Aquatic Habitat and Biological Communities Issues and Opportunities

Similar to the hydrologic conditions and water quality in the KMS watershed, aquatic habitat and biological communities have been altered significantly from pre-development conditions. Criteria for the assessment of aquatic habitat and biological communities were developed for habitat complexity, in-stream structure, substrate in riffle habitat, overhead shade, riparian buffer shade, summer flow, fish diversity and abundance and migration access. Assessment of these parameters illustrated that many of the issues related to hydrology and water quality also impact aquatic habitat and biological communities.

Additional key aquatic habitat and biological community issues in the KMS watershed that have not been raised in the hydrology and water quality sections include the following:

- Native fish populations are present, although limiting factors within and beyond the watershed affect population size and diversity.

  Adult salmon, steelhead, and cutthroat trout have been documented in Kellogg and Mt. Scott Creeks. The Kellogg Dam at the confluence of Kellogg Creek with the Willamette River has created a potential impediment for upstream migrating salmonids. There is a fish passage ladder at the dam that has been determined to be a partial (temporal) fish passage barrier by ODFW. The presence of adult salmon and steelhead above the ladder is evidence that it is passable at some times of the year. Limiting factors for fish populations may include elevated summer stream temperatures, other water quality issues, degraded aquatic habitat and passage impediments to upstream movement of adults and downstream movement of juveniles.

- Opportunities for improvements to aquatic habitat.

  In the analysis of aquatic habitat conditions in Chapter 4, there were far more moderate and low scores on the habitat parameters than there were high scores throughout the watershed study area. This suggests that there is opportunity for improvement of aquatic habitat conditions within the watershed.

  The Kellogg Creek reaches are extremely lacking in Large Woody Debris (LWD), shade, and large boulders, and have excess fine sediment, indicating that habitat complexity may be limiting. High water temperatures are also a problem, although monitoring data throughout the system are lacking, and adequate cold water is present in at least one area of the watershed (Kellogg Creek upstream of the Mt. Scott Creek confluence). During a site visit conducted on August 13, 2008, much of Upper Kellogg Creek had very low flow with nearly stagnant pool conditions at several locations. Low summer flow is probably a major limiting factor during dry summers in Upper Kellogg Creek.

  On the whole, habitat survey reaches within Mt. Scott Creek scored poorly on the deep pools per kilometer, slackwater pools metrics, and on the LWD metrics. This suggests that the habitat within Mt. Scott Creek could be improved through the installation of large wood (and the improvement of the riparian zone which would result in greater future LWD recruitment), although more analysis is necessary. The installation of large wood would also likely result in the development of deep pools and slackwater areas. Sedimentation does not appear to be a significant issue in Mt. Scott Creek.

- Fish passage barriers.

  Presently, there are only two known partial barriers to adult salmonid movements between the mouth of Kellogg Creek and known spawning habitat in Upper Mt. Scott Creek, although ODFW identified other potential barriers during the 2008 habitat survey that may require further investigation. The fish passage facility at the outlet of Kellogg Lake in the City of Milwaukie is a partial barrier to migration. Further analysis of this facility and alternatives for improving access and habitat at the mouth of Kellogg Creek will be valuable, since all returning adults must pass over the fish ladder and returning juveniles must pass through Kellogg Lake. The other partial barrier is located at the culvert under Southeast 82nd Avenue and probably represents a relatively minor obstacle for returning adults. However, it may represent a low flow barrier to upstream migrating juveniles during the summer months. There is also one culvert on private land just upstream of the uppermost ODFW fish sampling reach that may be blocking access to the uppermost reaches of Mt. Scott Creek. Information is lacking about the condition of this culvert.

  Clackamas County lists two culverts for replacement in the KMS watershed on minor tributaries. Clackamas County's list of culverts for replacement provides a priority rating of low or high based on potential biological benefits and the cost and logistics of replacement. Both of the culverts identified for potential replacement in the KMS Creek watershed are rated as low priority. ODFW also has a list of culverts identified for replacement and provides priority ratings for those identified. Prioritization for replacement of culverts through the Watershed Action Plans will require additional site-specific information on the condition of the culverts, the species affected, and quality and availability of upstream habitat.

Potential Actions

A management strategy aimed at targeted investments to enhance aquatic habitat and biological communities is recommended. Many of the potential actions described above for addressing hydrologic issues and water quality issues also pertain to aquatic habitat and biological community issues. Additional potential actions that will support the targeted management strategy to enhance aquatic habitat and biological communities include the following:

- Continue partnering with non-profits and volunteer groups to make strategic, targeted improvements in aquatic habitat and biological communities.
- Engage in targeted outreach with private landowners to improve aquatic habitat and stream conditions through LWD placement, bank stabilization, and buffer enhancements.
- Evaluate areas lacking shade and engage in buffer enhancements on public land and private land (where feasible) to support aquatic habitat and Temperature TMDL implementation.
- Continue participation in Kellogg for Coho initiative and evaluation of Kellogg Lake and Dam impacts on watershed health.
- Collaborate with DTD and other agencies to further evaluate fish barrier removal priorities.
- Integrate ODFW recommendations on habitat improvement opportunities into partnering efforts and Capital Improvement Program (CIP) planning as appropriate.

Stakeholder Input

A stakeholder group was convened in the fall of 2008 to participate in the Watershed Action Planning process and provide feedback on the results of the study to the Clackamas County Citizens Advisory Committee (CAC). Stakeholders met in October and November 2008 and in March, April and June 2009. At the March 2009 stakeholder meeting, stakeholders discussed a list of possible watershed management actions. The list was developed using previous stakeholder input from the November 2008 meeting and supplemented by the project team. Potential actions were divided into "policy-oriented" and "project-oriented" actions. Stakeholder received 8 dots each. They were asked to identify the most important strategies to emphasize in the next 3 to 5 years in the KMS watershed given what they now know about KMS issues. Stakeholders then placed their dots on their action preferences among a list of 23 possible actions. The results are as follows:

Policy-oriented actions

Highest ranking

- Tree protection ordinance for uplands
- Riparian buffer size increase
- Updated stormwater design standards
- Infiltration program—retrofits

Medium ranking

- Private property awareness and private landowner incentives
- LID incentives
- Water quality monitoring, site specific, tracking LID results
- Inter-agency cooperation and coordination

Low ranking

- Historic records
- Inventory management
- Water quality trading and credits

Project-oriented actions

Highest ranking

- Wetlands restoration
- Property acquisition
- Fish access

Medium ranking

- Daylight streams
- In-stream restoration of habitat
- Plant trees
- Stormwater treatment systems

Low ranking

- Grey water and composting toilets
- Septic systems
- Metro habitat areas expanded and connected
- Street sweeping
- Maintenance of public storm system
- Require maintenance of private storm systems

It was noted that there were no dots on historic records, street sweeping, inventory management, water quality trading and credits, grey water and composting toilets, septic systems, maintenance of public storm systems, and requirements for maintenance of private storm system. Stakeholders emphasized that just because something did not get a dot does not mean it is not important or that it is not perceived to be a problem. The priority above is based on selecting actions that seem most important to focus on early in Watershed Action Plan (WAP) implementation because they address key stressors and supplement what WES is already doing.

Stakeholders did not mean to imply by their priorities that WES should stop actions now underway. Septic systems were an example in that they are already being addressed. Street sweeping was also mentioned as important, but it is already being done. If it became known that an existing management activity was not effective enough, then priorities would likely change.

Reach Analysis

The reach analysis included the following three components:

- Rating of reach conditions using assessment criteria
- Identification of threats and opportunities based on reach ratings and contributing area conditions
- Development of management strategies and potential actions for reaches and contributing areas to address threats and opportunities

The process used for each component of the reach analysis is described below, followed by the results of the reach analysis. The management strategies and potential actions for reaches and contributing areas described below are identified as potential opportunities to supplement the watershed-wide strategies identified earlier in the Assessment Report.

Assessment Criteria

Assessment criteria were developed to evaluate the range of stressors, responses, and key indicators in the watershed at the reach level. The assessment criteria are summarized in Table 5-2. Thresholds for the assessment criteria were developed to rate stream reaches in a Good (3), Fair (2), and Poor (1) rating system.

The assessment ratings provide an overview of reach conditions based on available data. As new data are collected, the reach ratings can be updated and compared to ratings from prior years to evaluate changing conditions in the watershed. Changes in reach ratings can be evaluated in conjunction with Watershed Health Index results and other watershed data to track in-stream responses to the implementation of new management activities. The reach ratings can also be used to track in-stream conditions as a part of the evaluation of LOS and goals for the watersheds.

Threats and Opportunities

The results of the assessment rating as well as other available information on stream conditions and contributing area conditions were used to evaluate threats and opportunities in the watershed. Threats to watershed health were identified based on areas rated poor in the assessment ratings as well as additional information about stressors in the contributing areas. Opportunities to improve or protect watershed health were identified based on locations where management strategies and potential actions could be undertaken by WES to address the causes of poor conditions or preserve and enhance good conditions in the watershed. Constraints were also considered in the evaluation of opportunities, such as available undeveloped land and land ownership.

Stressors, responses, and indicators that were evaluated to identify threats include the following:

- Current land use
  - High volume roads and parking areas lacking structural BMP treatment for water quality
  - Industrial areas lacking structural BMP treatment for water quality
  - Areas lacking structural BMPs for flow control
  - Areas lacking upland forest canopy
- Projected future land use
  - Areas likely to develop significantly in the future
  - Areas at risk for hydromodification
- Riparian conditions
  - Areas lacking riparian forest and shade
  - Areas with invasive vegetation
- In-stream conditions
  - Areas lacking LWD, pools, and other characteristics of good habitat
  - Areas subject to bank erosion
  - Fish passage barriers
  - Poor water quality conditions

Opportunities and constraints evaluated include the following:

- Type of property ownership adjacent to streams (public and private)
- Available undeveloped land in the contributing area
- WES management responsibility

- Partnering organizations
- Level of investment

Table 5-2. Assessment Criteria Developed for KMS Action Plan

Reach assessment criteria	Assessment category (factors limiting watershed health)	Assessment criteria	Poor (1)	Fair (2)	Good (3)	References for criteria
Hydrology and channel morphology						
Hydrology	Flood risk	Number of structures in 100-year floodplain	> 2	1	0	Professional judgment
		Flooding complaints	> 5	1 to 5	0	Professional judgment
	Hydromodification	Ratio of 2-year future to 2-year existing	> 3	1.5 to 3	< 1.5	Professional judgment
	Hydromodification	Ratio of 10-year future to 10-year existing	> 2	1.5 to 2	< 1.5	Professional judgment
Channel morphology	Access to and quality of floodplain	Entrenchment ratio	< 1.5	1.5 to 2.2	> 2.2	Professional judgment
		Roads in 25-foot buffer area (percent of buffer area)	> 25	10 to 25	< 10	Professional judgment
		Frequency of overbank flow	> 10 year	2 year to 10 year	2 year	Professional judgment
	Channel and bank stability	Percent of banks eroding	> 25	5 to 25	< 5	Professional judgment
		Percent coarse substrate	< 15	15 to 30	> 30	Professional judgment
Water quality						
Water quality	Biological indicators of water quality	Benthic macroinvertebrate bioassessment score (percent of biological potential)	< 30	30 to 75	> 75	Water Environment Research (WERF) bioassessment study, professional judgment
	BMP treatment	Percent contributing area treated by structural stormwater BMPs	< 30	30 to 75	> 75	Professional judgment

Table 5-2. Assessment Criteria Developed for KMS Action Plan						
Reach assessment criteria	**Assessment category (factors limiting watershed health)**	**Assessment criteria**	**Poor (1)**	**Fair (2)**	**Good (3)**	**References for criteria**
Water quality	Water temperature	7 day running average maximum temperature during summer and/or during spawning/incubation period	Frequently exceeds DEQ guidelines for cold water streams (> 20 percent)	Occasionally exceeds DEQ guidelines for cold water streams (10 to 20 percent of the time)	Generally meets DEQ guidelines for cold water streams (exceeds criteria < 10 percent of the time)	DEQ
	Dissolved metal contaminants	Percent dissolved metals exceeding acute DEQ criteria	> 10	0 to 10	0	DEQ
	Nutrients	Percent total phosphorus (TP) and nitrate samples exceeding guidance levels	> 20	10 to 20	< 10	Oregon Watershed Enhancement Board (OWEB) and U.S. Environmental Protection Agency (USEPA) maximum contaminant levels
	Suspended solids	Percent total suspended solids (TSS) exceeding guidance levels	> 20	10 to 20	< 10	Professional judgment
	Water contact human health indicator (*E. coli* bacteria)	Percent *E. coli* bacteria samples exceeding DEQ standards at monitoring sites within reach	> 50	10 to 50	< 10	DEQ
	Risks to water quality from land use	Dominant land uses in areas lacking BMPs	High-volume roads, industrial, large commercial parking areas, poorly managed agriculture	Roads, commercial, residential, agricultural	Low-density residential	Professional judgment

Table 5-2. Assessment Criteria Developed for KMS Action Plan						
Reach assessment criteria	**Assessment category (factors limiting watershed health)**	**Assessment criteria**	**Poor (1)**	**Fair (2)**	**Good (3)**	**References for criteria**
	Forested cover in contributing area	Percent forested land cover in contributing area	< 20	20 to 50	> 50	Professional judgment
Aquatic habitat and biological communities						
Aquatic habitat and biological communities	Percent pools	Percent of the primary channel area represented by pool habitat	< 7 or > 90	7 to 40 and 60 to 90	> 40 and ≤ 60	ODFW
	Deep pools per kilometer	Number of pools greater than 1 meter deep per kilometer of the primary channel	< 2	≥ 2 and < 4	≥ 4	ODFW
	Winter refuge habitat	Percent of the total channel area including alcoves and side channels that provides refuge habitat during winter high flow events	< 2	≥ 2 and < 4	≥ 4	ODFW
	Percent fines in riffles	Percent of the substrate in riffles < 2 millimeters in diameter	> 20	> 10 and ≥ 20	≤ 10	ODFW
	Percent gravel in riffles	Percent of the substrate in riffles 2 to 64 millimeters in diameter	< 20	≥ 20 and < 49	≥ 49	ODFW
	Pieces of LWD per 100 meters	Pieces of large woody debris > 0.15 meter in diameter by 3 meters in length per 100 meters of channel length	< 7	≥ 7 and < 21	≥ 21	ODFW
	Percent shade	Percent direct overhead shade from ODFW	< 60	60 to 70	> 70	ODFW
	Riparian buffer and shade	Riparian extent—25-foot buffer area based on Metro land classification (percent)	< 33	33 to 67	> 67	Professional judgment and DEQ TMDL to increase shade

Table 5-2. Assessment Criteria Developed for KMS Action Plan						
Reach assessment criteria	**Assessment category (factors limiting watershed health)**	**Assessment criteria**	**Poor (1)**	**Fair (2)**	**Good (3)**	**References for criteria**
Aquatic habitat and biological communities	Riparian buffer and shade	Riparian extent—100-foot buffer area based on Metro land classification (percent)	< 33	33 to 67	> 67	Professional judgment and DEQ TMDL to increase shade
	Low summer flow	Flow conditions during the late summer and early fall	Cessation of flow between riffles, runs, and pools	Very small flow between riffle, runs, and pools (i.e., does not cover low flow channel)	Sufficient flow to cover low flow channel throughout the stream reach	Professional judgment
	Fish diversity and abundance	Fish Index of Biological Integrity (F-IBI) scores	Severely impaired	Moderately impaired	Not impaired	Professional judgment
	Migration access	Upstream access for both adult and juvenile salmonids	Total blockage of upstream migration for adult or juvenile salmonids	Partial obstruction of migration for adult or juvenile salmonids	No obstructions	Professional judgment

Management Strategies

Agencies involved in watershed management have long recognized that the impacts of urbanization are not easily reversed and realistic management strategies are necessary to guide investments to improve watershed conditions. USEPA and OWEB have proposed management strategy frameworks that address the level of disturbance in a watershed and appropriate near- and long-term management strategies to enhance and protect watershed health. The OWEB framework recommends management strategies depending on watershed conditions and opportunities that include protective management (e.g., buffer requirements), active management (e.g., building stormwater treatment systems, in-stream restoration), and passive management (e.g., design standards changes, policy changes).

The project team evaluated a range of management strategy frameworks and developed a framework that addresses existing WES activities and opportunities for future actions to further improve watershed health. The recommended approach is to organize stream reaches into areas suited for moderate, intermediate, and high levels of management. Table 5-3 provides examples of typical actions that may be associated with the recommended management strategy descriptions for the KMS Action Plan.

Recommended management strategies and potential actions for each reach were developed based on the assessment of threats and opportunities. Further analysis of the potential actions was conducted for the Action Plan phase of the project (Chapter 6) to identify near-term and longer-term actions based on feasibility, expected impact, urgency, and other criteria.

Table 5-3. Management Strategies and Examples of Potential Action Opportunities

Management strategy	Upland management opportunities	In-stream restoration opportunities	Riparian corridor opportunities	Programmatic activity opportunities
High	• Targeted larger-scale stormwater BMP retrofits • Enhanced street sweeping	• Larger scale restoration on public land • Targeted restoration with private landowners • Wetland enhancement or creation • Channel modifications	• Projects on existing public land • Targeted riparian plantings • Targeted invasive plant management • Willing-seller land acquisition or conservation easement	• Targeted work with private landowners through outreach • Significant new studies
Intermediate	Non-targeted smaller-scale stormwater BMP retrofits	LWD placement and bank erosion prevention	Riparian plantings and invasive removal (smaller scale on private land)	• New monitoring • New protection measures • General outreach to private landowners
Moderate	Continued application of existing non-structural and structural BMPs	Continued monitoring of in-stream conditions	Continued protection of existing riparian corridor	• Existing monitoring • Existing protection measures

Assessment Results

The following section describes the reach-level assessment findings, including a synthesis of available data related to hydrology and channel morphology, water quality, and aquatic habitat and biological communities. Key data sources for the reach-level assessment include monitoring site data, aerial photography and GIS analysis results. Visual observations are also included to provide qualitative information on watershed conditions. Findings are presented on a sub-basin and reach level basis, followed by potential actions that could improve sub-basin and reach hydrology, water quality, aquatic habitat, and biological communities.

Reaches were developed using existing habitat reach designations provided by the 2008 ODFW survey. Where stream segments were not surveyed by ODFW and lacked reach names, reach names were created. Unsurveyed mainstem channel reaches were identified as "A" reaches, reflecting the location upstream of a named reach. For example, Reach KG3A is an unsurveyed reach upstream of the surveyed Reach KG3. Side channel tributary reaches were identified as "B" reaches. For example, Reach MS11B is an unsurveyed reach that is a tributary to reach MS11. New reach names were developed for major tributaries Dean Creek (DN1), Minthorne Creek (MN1), and Cedar Creek (CD1). The Cedar Creek and Dean Creek sub-basins are shown on Figure 5-6 and Figure 5-5, respectively. Minthorne Creek is located in the Lower Mt. Scott sub-basin, as shown on Figure 5-3.

Table 5-4 provides a summary of the assessment rankings on the reach level, which supplement the following text. The thresholds for the good, fair, and poor ratings are described in Table 5-2. Table 5-5 provides a summary of the recommended management strategies and potential actions for each reach and contributing area.

Lower Kellogg Sub-basin

The Lower Kellogg sub-basin encompasses approximately 1,286 acres surrounding stream reaches KG0, KG1, and KG2, as illustrated in Figure 5-1. Much of the sub-basin is contained within the City of Milwaukie and it is largely built-out. The land use in the sub-basin includes 63 percent SFR, 7 percent MFR, and 6 percent commercial. Industrial land use is less than 1 percent. Twenty-three percent of the sub-basin is of unknown land use and labeled as tract, miscellaneous, or blank. According to 2007 aerial photo analysis of the land cover, approximately 35 percent of the sub-basin is urban/impervious, 35 percent is covered by large trees, and 29 percent is covered by shrubs and grass.

Most of the development in the sub-basin occurred prior to the 1980s and, according to WES GIS analysis, most of the sub-basin lacks structural treatment systems for stormwater quality and quantity. However, there may be stormwater treatment systems in the sub-basin that are not displayed in the WES GIS system because the area is largely within the City of Milwaukie. There are a few areas where Underground Injection Control devices (UICs) are employed to infiltrate stormwater in the sub-basin.

The riparian buffer in the Lower Kellogg sub-basin is somewhat intact. In a 25-foot buffer zone on either side of Kellogg Creek in the sub-basin, approximately 59 percent of the buffer is forested, 10 percent is grass and shrubs, 13 percent is urbanized, and 18 percent is surface water. In a 100-foot buffer zone, approximately 55 percent is forested, 18 percent is grass and shrubs, 16 percent is urbanized, and 11 percent is surface water.

Kellogg Lake, which is a major feature of Kellogg Creek in the Lower Kellogg sub-basin, is contained in reach KG0.

Reach KG0

Reach KG0 begins at the confluence with the Willamette River in Milwaukie and extends upstream to near Southeast Oatfield Road. This reach is in the City of Milwaukie's jurisdiction. Reach KG0 includes water quality monitoring site CC-26 and continuous temperature monitoring site C101, both located near the mouth of Kellogg Lake.

The Kellogg Dam, located at the Highway 99-E/McLoughlin Boulevard Bridge, and Kellogg Lake upstream of the dam are prominent features of this reach. The dam, which was constructed in the mid 1800s, is thought to have been constructed to support commercial use of Kellogg Creek. The dam and Kellogg Lake no longer support an economic purpose.

Kellogg Lake likely contributes to high summer water temperatures in this reach. The 7-day moving average, based on hourly maximum temperature, exceeded the 18 degrees Celsius (C) DEQ requirements over 20 percent of the time. High water temperatures in the lake may discourage some Willamette River juvenile fish from moving upstream into the KMS watershed system for thermal refuge in the summer. In addition, predator fish species in Kellogg Lake, including northern pike minnow and, to a lesser extent, bass, may contribute to the loss of anadromous salmon smolts moving downstream toward the Willamette River in spring. The dam may also pose periodic migration access problems for anadromous salmonids.

To address migration access issues, the repairs to the Kellogg Dam Fish Ladder were proposed in 2003. Proposed repairs that were approved in a 2002 National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) Biological Opinion include the following:

1. Flow control within the ladder
2. Extension of, and reorientation, of the ladder entrance closer to the spillway
3. Excavation of the bedrock at, and along, the new entrance
4. Construction of a debris-deflecting device
5. Raising the sidewalls of the structure
6. Reconstruction of the existing steps to provide uniform step heights

The extent and effectiveness of the proposed repairs on fish passage are not known at this time. Further analysis of fish passage at the fish ladder by ODFW or other agencies would be valuable.

Currently, the fate of the Kellogg Dam is being evaluated by the City of Milwaukie and other stakeholders through the Kellogg for Coho initiative. The City of Milwaukie is interested in improving fish passage in Kellogg Creek as well as enhancing public interaction with Kellogg Creek in its downtown area. Alternatives for removal or retrofit of the dam and habitat restoration of Kellogg Creek in the Kellogg Lake area are being analyzed by the City of Milwaukie. The analysis includes associated capital costs and potential funding sources. The dam is constructed in tight coupling with the Highway 99-E bridge above it, and removal of the dam is being considered in context with potential improvements to the bridge. The U.S. Army Corp of Engineers (USACE) 2002 Kellogg Creek Restoration Project Sediment Quality Evaluation indicated there may also be contaminated sediments in Kellogg Lake. Appropriate methods of addressing potentially contaminated sediments will also be considered in the planning for potential enhancements to Kellogg Creek in this reach.

Potential Actions

The recommended management strategy for this reach is a high level of management focused on additional study and monitoring for the near term with possible coordination on modifications to the lake and channel conditions in the future. Continued study of the Kellogg Dam and Kellogg Lake existing conditions and potential alternatives will provide valuable information to help inform future management of this reach. If the lake continues to exist, it would be helpful to add an additional continuous temperature monitoring location upstream of Kellogg Lake to compare temperatures upstream and downstream of the lake. If the dam continues to exist, it would be helpful to perform an updated analysis of fish passage through the dam.

There may also be opportunities for the City of Milwaukie to retrofit the contributing area for this reach with additional stormwater treatment for water quality. Enhancements to stormwater treatment in this reach will likely be addressed through the City of Milwaukie's NPDES MS4 permit and stormwater management plan implementation.

Reach KG1

Reach KG1 begins near Southeast Oatfield Road and extends upstream to the confluence of Mt. Scott and Kellogg Creeks near North Clackamas Central Park. The reach is surrounded primarily by low-density residential developments in the City of Milwaukie. The contributing area is nearly built out; therefore, future development is not a high-risk factor for this reach.

ODFW has identified a fish passage issue related to the private installation of small dams and impoundments on private property along Kellogg Creek. Such small dams and impoundments can block fish passage at critical times of the year when flow is low and fish are seeking refuge habitat.

Hydrologic analysis of this reach indicates mainly fair to good conditions, with one poor rating for frequency of overbank flow. Overbank flooding during the January 2, 2009 storm event was observed at Southeast Oatfield Road. Water appeared to be 5 to 10 feet below the foundations of the homes closest to the creek near the Oatfield Bridge.

Since this reach lacks a water quality monitoring site, little water quality data are available.

Aquatic habitat and biological community data have been collected for this reach at fish reach KG1, an ODFW fish sampling reach. The F-IBI rating for fish reach KG1-F was fair. This reach lacks deep pools, LWD, and shade directly over the stream.

Potential actions

The recommended management strategy for this reach is a high level of management focused on improving streamside shade, adding a benthic macroinvertebrate monitoring site, and participating in outreach and stream enhancement activities with private landowners. Collaborating with nonprofits and engaging private landowners to add LWD to appropriate locations in Kellogg Creek could improve deep pool habitat in this reach. Engaging private landowners to evaluate and potentially alter small dams and impoundments could also help provide unrestricted fish passage for adult and juvenile salmonids. Increasing streamside riparian forest could improve stream temperatures in this reach.

Upper Kellogg Sub-basin

The Upper Kellogg sub-basin, illustrated in Figure 5-2, begins at the confluence of Mt. Scott Creek and Kellogg Creek near North Clackamas Park and extends upstream to the headwaters of Kellogg Creek near I-205. Kellogg Creek in this sub-basin includes reaches KG3, KG3A, KG4, and KG4A. These reaches include two ODFW fish sampling sites (KG2-F and KG4-F), one benthic macroinvertebrate site (SD1-M13) and two water quality sites (Site #14 and Outfall #19).

The contributing area land use for this sub-basin includes 63 percent SFR and 5 percent MFR. Commercial, farm, forest, and open space land uses total 5 percent. The remaining 27 percent is unknown land use according to the tax designation system and is labeled as tract, miscellaneous, or blank. According to aerial photo analysis of the land cover, approximately 35 percent of the sub-basin is urban/impervious, 34 percent is covered by large trees, and 31 percent is covered by shrubs and grass.

Development in the sub-basin appears to have primarily occurred from the 1960s through the 1990s with some additional development occurring more recently. The older developments in the sub-basin lack structural stormwater BMPs. According to WES GIS analysis, approximately 3 percent of the contributing area is currently treated with structural BMPs. The northeast portion of this sub-basin includes several UICs, which are used to infiltrate stormwater.

The riparian buffer in the Upper Kellogg sub-basin is somewhat intact. In a 25-foot buffer zone on either side of Kellogg Creek in the sub-basin, approximately 53 percent of the buffer is forested, 25 percent is grass and shrubs, and 20 percent is urbanized. In a 100-foot buffer zone, approximately 47 percent is forested, 28 percent is grass and shrubs, and 23 percent is urbanized.

Leona Lake is contained in reach KG4A and is a major feature of the upstream portion of the Upper Kellogg sub-basin.

Low flow conditions during late summer and early fall, which are described as cessation of flow between riffles, runs, and pools exist in reaches KG4A through KG3. Flow conditions and temperatures improve in KG2, which suggests a groundwater input to Kellogg Creek between KG2 and KG3.

Reach KG2

Reach KG2 begins near North Clackamas Park, at the termination of KG1 and continues upstream to approximately 0.2 mile north of Theissen Road. Low-density residential land use lacking structural stormwater treatment BMPs comprises the majority of KG2's contributing area; however, the creek is partially bordered by North Clackamas Park and Alder Creek Middle School.

This reach contains a benthic macroinvertebrate sampling site (SD1-M13), a water quality site (Site No. 14) and an ODFW fish sampling reach (KG2). More data are currently needed on summer and winter fish usage.

Hydrologic analysis indicates fair to good conditions. Water quality data show poor biological indicators of water quality, high nutrient levels, and high *E. coli* bacteria levels. Despite high water temperatures in Upper Kellogg Creek upstream of this reach, the water temperature in KG2 is good, likely due to groundwater input. The channel is lacking LWD and deep pools. Although the analysis of aerial photographs indicates relatively good riparian buffer shade (> 67 percent forested within a 25-foot buffer area), this reach was rated as having poor overhead shade in the stream channel by ODFW.

Potential Actions

The recommended management strategy for this reach is an intermediate level of management focused on improving streamside shade and participating in outreach and stream enhancement activities with private land owners. Collaborating with nonprofit groups and engaging private land owners to add LWD to appropriate locations in Kellogg Creek could improve deep pool habitat in this reach. Increasing streamside riparian forest could improve stream temperatures in this reach.

Reaches KG3 and KG3A

Reach KG3 begins north of Theissen Road approximately 0.2 mile and extends upstream, terminating at Theissen Road and Southeast Aldercrest Road. KG3A is an intermediate reach between KG3 and KG4, which terminates along Southeast Aldercrest Road.

Hydrologic analysis indicates a poor flood risk (more than two structures are located within the 100-year floodplain), and flooding was observed during the January 2, 2009 storm event at the intersection of Theissen Road and Aldercrest Road. The culvert to pass Kellogg Creek flow under Theissen Road was submerged and extensive driveway flooding was also observed along Aldercrest Court. The 2006 Master Plan identifies this culvert as a potential flooding problem, based on the District's 2006 regulatory hydrologic model. A potential flooding problem was identified when model results indicated roadway inundation of 0.5 foot or greater. In the Master Plan, a culvert upgrade is listed as a potential method to address flooding at this culvert. However, the Master Plan also states that the culvert upgrade option does not consider watershed management goals, strategies or other environmental issues, which should be evaluated before final project prioritization.

Water quality data have not been collected for this reach. Aquatic habitat and biological community data indicate that the reach is lacking deep pools and LWD. The substrate in riffles was also found to contain over 20 percent of fine particles, resulting in a poor rating for percent fines in riffles.

Potential Actions

The recommended management strategy for Reaches KG03 and KG03A is a high level of management, focused on targeted instream improvements, upland management activities and monitoring. The replacement of the Theissen Road culvert could improve passage for salmonids and address roadway flooding around the culvert, however enlarging this culvert could move flooding problems downstream if adequate flood storage is not available below the culvert. Further hydraulic analysis of the Theissen Road culvert and downstream conditions in coordination with DTD would be beneficial to inform management decisions for this reach.

Upland management activities, including stormwater retrofit activities in drywell areas (in support of the UIC program management) as well as additional stormwater retrofits in the areas draining to surface water could benefit water quality. Few areas surrounding these reaches are treated with structural stormwater BMPs. There may be opportunities to retrofit existing developed areas such as parking lots with stormwater treatment BMPs. Existing structural BMPs may also be designed using older design standards that focused on hydrologic control of larger storm events. There may be opportunities to retrofit existing BMPs to better function to improve water quality.

To develop an understanding of upstream fish usage, increased monitoring could help determine if the spring-fed lower reach of Kellogg Creek is a thermal refuge for fish in the summer months.

Since the majority of reaches KG3 and KG 3A are bordered by private property, any instream improvements will require coordination and outreach with private land owners. There are large undeveloped areas near Reach KG3A that would benefit from targeted outreach to private land owners to implement riparian buffer improvements and channel enhancements.

Reaches KG4 and KG4A

Reach KG4 begins near the Southeast Molt Street and Southeast Aldercrest Road and extends upstream approximately 1000 feet where KG4A begins. KG4A is the final upstream reach in Upper Kellogg Creek, beginning due west of Southeast 82nd Avenue in Johnson City.

Conditions in the upstream reaches of Kellogg Creek extrapolated from monitoring site data and the hydraulic model for the basin indicate overall fair hydrologic conditions. However, poor conditions exist in portions of the basin during high flow events. Streamside parcels and other areas in the floodplain, including yards and driveways, are occasionally flooded during large storm events. For example, flooding during the January 2, 2009 storm event was observed along Southeast Aldercrest Court in KG4. Flow had left the main channel and was diverting through yards and driveways on the west side of the creek. Yard flooding was also observed around homes past Ann Toni Shrieber Park, and rocks and debris had collected at the intersection of Southeast Stohler Road and Clackamas Road. In KG4A, near Mabel Avenue, the culvert remained surcharged 6 hours following the peak flow period and the road appeared to have been flooded during the peak flow period. A house next to the stream had a flooded yard near Mabel Avenue.

The 2006 Master Plan also identifies the culvert at Mabel Avenue as a potential flooding problem, based on the District's 2006 regulatory hydrologic model. A potential flooding problem was identified when model results indicated roadway inundation of 0.5 foot or greater. In the Master Plan, a willing seller program that would allow increased conveyance at this culvert is listed as a potential method to address the flooding issue. However, the Master Plan also states that the culvert upgrade option does not consider watershed management goals, strategies or other environmental issues, which should be evaluated before final project prioritization.

Water quality data have not been collected for these reaches. Upstream aquatic habitat in reaches KG4 and KG4A is poor. High water temperature in summer, elevated nutrient levels, and elevated *E. coli* bacteria levels are found in downstream reaches. Low summer flows have also been observed in Upper Kellogg Creek, which may contribute significantly to water quality problems such as elevated summer water temperatures.

Leona Lake is a human-made feature in Upper Kellogg Creek, located within Johnson City. The lake contributes to reach KG4A, shown on Figure 5-2. Immediately upstream of Leona Lake is a 17-acre wetland, known as the Hearthwood wetland and owned/managed by the Wetlands Conservancy. Prior to development, the Leona Lake area and portions of Upper Kellogg Creek may have been a wetland environment without channelized flow, although further analysis of geomorphic conditions, historic surveys, and aerial photos would be necessary to fully evaluate the pre-development conditions.

Potential Actions

The recommended management strategy for reaches KG4 and KG4A is an intermediate level of management focused on targeted riparian shade to improve water temperature and continued monitoring of flooding issues associated with WES infrastructure. Further communication between WES and DTD to coordinate the response to flooding issues could improve the understanding of flooding issues in the basin. Further hydraulic analysis of the Mabel Avenue culvert and surrounding conditions in coordination with DTD would be beneficial to inform management decisions for this reach.

In KG4A, an additional potential action is to enhance monitoring of Leona Lake in Johnson City. Installation of temperature gauges upstream and downstream of the lake could help Johnson City and the District develop an understanding of the influence the lake has on low summer flow conditions and high summer water temperatures. Completing a water budget that encompasses the lake could help to determine if the lake is contributing to low flow conditions.

If monitoring results indicate that modification of Leona Lake is needed to improve summer water temperatures and low flow conditions in Kellogg Creek, the strategy for this reach could move from intermediate to a high level of management. The University of Portland is studying options for potential modifications to Leona Lake to improve downstream water quality and Johnson City is cooperating with WES to sample and analyze water quality constituents upstream and downstream of the lake in compliance with a TMDL order by DEQ.

Lower Mt. Scott Sub-basin

The Lower Mt. Scott sub-basin encompasses approximately 1,621 acres surrounding stream reaches MS1, MS2, MN01, MS4, and a portion of MS5, as shown in Figure 5-3. Reach MN01 stands for Minthorne Creek, which is a contributing stream to Mt. Scott Creek that runs along the north side of Highway 224 in the City of Milwaukie. The land use in the sub-basin includes 34 percent SFR, 22 percent industrial, 6 percent commercial, 3 percent farm and 3 percent MFR. The remaining 32 percent is unknown land use according to the tax designation system and is labeled as tract, miscellaneous, or blank. According to aerial photo analysis of land cover, approximately 45 percent of the sub-basin is urban/impervious, 22 percent is covered by large trees, and 33 percent is covered by shrubs and grass.

Land in the Lower Mt. Scott sub-basin appears to have been developed mostly prior to the mid-1990s, as indicated by the lack of structural stormwater BMPs in this area. However, there are still a few large farm parcels that have not yet been developed.

The riparian buffer in the Lower Mt. Scott sub-basin is somewhat intact. In a 25-foot buffer zone on either side of Mt. Scott Creek, approximately 40 percent of the buffer is forested, 28 percent is grass and shrubs, 31 percent is urbanized, and 1 percent is surface water. In a 100-foot buffer zone on either side of Mt. Scott Creek, approximately 33 percent of the buffer is forested, 29 percent is grass and shrubs, 37 percent is urbanized, and 1 percent is surface water.

This sub-basin is generally lacking in structural stormwater BMPs, deep pools, and LWD. Reaches in this sub-basin also experience high summer water temperatures and exceed nitrate guidance levels.

Reach MS1

Reach MS1 begins near North Clackamas Park and extends upstream to Highway 224. This reach is in the City of Milwaukie's jurisdiction. The contributing area for MS1 includes mostly low-density residential development, North Clackamas Park, and some farm land.

Reach MS1 includes a benthic macroinvertebrate monitoring site (SD1-M4), a water quality monitoring location (Site #15), and an ODFW fish sampling reach (MS1-F).

Hydrologic analysis data ranks in the poor category for the number of structures in the 100-year floodplain and for entrenchment ratio. Aerial photographs indicate that the structures in the floodplain are homes. This reach was also rated as having poor overhead shade in the stream channel by ODFW.

There is a non-native bamboo stand that extends several hundred feet along Mt. Scott Creek across from North Clackamas Park. The site is currently being pursued for restoration with the Parks Department in conjunction with private landowners and nonprofit restoration groups. Japanese Knotweed also exists in this reach.

Potential Actions

The recommended management strategy for this reach is a high level of management that includes in-stream restoration and riparian corridor improvements.

In-stream restoration could include management to remove Japanese Knotweed, bamboo and other invasive species and the placement of LWD and boulders to improve in-stream structure and the addition of side channels to provide refuge habitat for fish during high flow events. To enhance the riparian corridor and improve water temperature shade could be added along MS1 in North Clackamas Park.

Reach MN01

Reach MN01 includes the stream channel and piped storm drainage network associated with Minthorne Creek. Reach MN01 begins in the northwest corner of the Lower Mt. Scott sub-basin and continues upstream through the Milwaukie Business-Industrial District before flowing into reach MS2. The contributing area to this reach is mostly commercial and industrial development, and is bordered by Highway 224 in the south and railroad tracks in the north. Due to extensive development in this reach, the majority of Minthorne Creek is piped or ditched.

MN01 does not include any monitoring sites and there is no known water quality or aquatic habitat data; however, based upon aerial photograph analysis the riparian buffer shade appears to be poor. There may be data not shown on the WES GIS system because the area is largely within the City of Milwaukie.

Potential Actions

The recommended management strategy for this reach is a moderate level of management, focused on exploring upland management opportunities and continued coordination with the City of Milwaukie.

In-stream improvements along this reach would require permission from private business owners and could be cost-prohibitive. However, stormwater quality can be improved potentially through coordination with the City of Milwaukie, to determine which industrial land owners have industrial NPDES permits and where stormwater treatment retrofits are appropriate. Underground stormwater treatment units may be the most viable treatment option due to space constraints.

Reach MS2

Reach MS2 begins at Highway 224 and continues upstream through an industrial parcel parallel to Southeast Harmony Road, until terminating at Southeast Railroad Avenue. The contributing area for this reach is comprised of industrial development that is largely lacking structural BMP treatment.

Hydrologic analysis indicates mainly good to fair conditions, with only poor ratings for the number of structures in the 100-year floodplain and the entrenchment ratio. During the January 2, 2009 storm event, flooding was observed along Rusk Road, north of Highway 224. A homeowner in this area reported that the inside of his home had flooded during the event and that water was seen coming over the Rusk Road Bridge. The 2006 Master Plan also identifies the culvert at Rusk Road as a potential flooding problem, based on the District's 2006 regulatory hydrologic model. A potential flooding problem was identified when model results indicated roadway inundation of 0.5 foot or greater. In the Master Plan, a willing seller program that would allow increased conveyance at this culvert is listed as a potential method to address the flooding issue. However, the Master Plan also states that the willing seller option does not consider watershed management goals, strategies or other environmental issues, which should be evaluated before final project prioritization.

There are no water quality monitoring sites along this reach, so water quality data are not available. However, WES GIS analysis indicates that less than 30 percent of the contributing area to MS2 is treated with structural stormwater BMPs.

Aquatic habitat and biological community data for this reach indicate mostly fair to good conditions. However, the reach is lacking deep pools and LWD, resulting in a poor rating for these categories.

Potential Actions

The recommended management strategy for this reach is a moderate level of management focused on communication between WES and DTD to track flooding issues.

Reaches MS3 and MS3B

Reach MS3 begins at Southeast Railroad Avenue, at the end of MS2 and extends upstream to the confluence of Dean, Phillips and Mt. Scott Creeks in the Three Creeks natural area. MS3B is a largely ditched and/or piped tributary that runs through farm and older low-density residential developments before joining reach MS3. Developed contributing area for MS3 lacks structural stormwater treatment. The area includes UICs in the southern portion of the contributing area.

This reach contains SD1-M3, a benthic macroinvertebrate site and a water quality monitoring site at Outfall #12. Despite running through a large area of undeveloped land in the Three Creeks natural area, this reach ranked poorly for water temperature, deep pools, pieces of LWD and overhead shade. Over the past 10 years, the District has completed several instream and riparian restoration projects in this reach which may serve to improve conditions in the reach over time. However, contributions from degraded upstream reaches in Phillips Creek and Mt. Scott Creek impact this area and contribute to poor water quality and aquatic habitat.

A significant feature of this reach is the North Clackamas Regional Flood Control Facility downstream of Southeast 82nd Avenue in the Three Creeks natural area. The structure was constructed by the Clackamas County Development Agency in 2002 to provide flood detention from storms ranging from a 7-year event to a 17-year event, according to the Operations Manual. The facility was designed to release flow during events greater than the 17-year recurrence interval event. The facility was not designed to protect properties within the 100-year floodplain or floodway from flooding during a 100-year event.

Potential actions

The recommended management strategy for this reach is a high level of management focused on instream restoration and upland management. Additional instream structure and side channels in MS3 could provide refuge to fish during high flow events. Water quality retrofits to industrial and commercial land between Highway 224 and Mt. Scott Creek could improve water quality in this reach. The function and effectiveness of the North Clackamas Regional Flood Control Facility could be re-evaluated by DTD, WES, and other partners. There may be opportunities to modify the flood control facility to provide additional storage during large storm events; however, detailed hydraulic modeling would be required to further analyze this opportunity.

To gain a better understanding of how land use impacts water quality in this area, data collected at water quality Site #12 could be compared to water quality data at Site #15 to evaluate conditions upstream and downstream of the Three Creek area. Water quality data at Outfall #12 could also be reviewed to understand the impacts of industrial and commercial land use on water quality in this reach.

Reach MS4

Reach MS4 is a short reach on the east end of the Three Creeks area, which contains benthic macroinvertebrate site SD1-M6 and ODFW fish sampling reach MS2-F. Benthic macroinvertebrate survey results indicate that this area is below its biological potential. Further investigation of the possible stressors that limit the biological conditions in this area would be valuable. The reach includes the confluence of Phillips, Mt. Scott, and Dean Creeks. Bank overflow is an annual occurrence that allows water to flow into the wetland/prairie area of Three Creeks.

Potential Actions

The recommended management strategy for this reach is an intermediate level of management focused on the monitoring of toxics. A fatty tissue surrogate, a device that can be placed in the stream to monitor for toxic accumulations in aquatic life, could be used to further evaluate water quality in this reach.

Phillips Sub-basin

The Phillips Sub-basin encompasses approximately 1,702 acres surrounding stream reaches PH1, PH1A and PH1B, as illustrated in Figure 5-4. Southeast 82nd Avenue and I-205 are two major thoroughfares that run north to south and dissect the basin. The area around Southeast 82nd Avenue is largely commercial, through which Phillips Creek appears to be piped. Areas surrounding commercial development on Southeast 82nd are largely residential. The northeastern portion of the basin includes more low-density residential development and some undeveloped land.

Clackamas Town Center is a large commercial development built in the 1970s that sits between I-205 and Southeast 82nd Avenue, along Southeast Sunnyside Road. The mall includes a large impervious area but is treated by structural stormwater BMPs.

The overall land use includes 35 percent SFR, 9 percent MFR, 25 percent commercial, and 4 percent farm, forest, and industrial. The remaining 26 percent is unknown land use according to the tax designation system and is labeled as tract, miscellaneous, or blank. According to aerial photo analysis of the land cover, approximately 51 percent of the sub-basin is urban/impervious, 27 percent is covered by large trees, and 22 percent if covered by shrubs/grass.

Several of the new developments in the sub-basin include structural stormwater BMPs. According to WES GIS analysis, approximately 18 percent of the contributing area to reach PH1 is treated by structural stormwater BMPs.

The Phillips sub-basin is lacking riparian buffer in some locations, however portions of the stream are underground and the lack of buffer is to be expected in those areas. In a 25-foot buffer zone on either side of Phillips Creek, approximately 32 percent of the buffer is forested, 21 percent is grass and shrubs, and 47 percent is urbanized. In a 100-foot buffer zone on either side of Phillips Creek, approximately 24 percent of the buffer is forested, 22 percent is grass and shrubs, and 54 percent is urbanized.

Hydrologic analysis indicates mostly fair to good conditions in reaches PH1 and PH1A; data are not available for PH1B. Water quality data collected from Site #11 for PH1 near the Three Creeks area indicate poor to fair conditions. Benthic macroinvertebrate survey results indicate that reach PH1 is significantly below its biological potential. Further investigation of the possible stressors that limit the biological conditions in this area would be valuable. Aquatic habitat data collected at ODFW fish habitat reach PH1-F also indicates mainly poor conditions, with the exception of good percent pools and deep pools.

Potential Actions

The recommended management strategy for reaches PH1 and PH1A is a high level of management focused on upland management and monitoring. The recommended management strategy for reach PH1B is a moderate level of management. Though reach PH1 exhibits mostly poor to fair aquatic habitat and water quality, in-stream restoration through current commercial and industrial developments is likely not cost-effective. However, water quality potentially could be improved by upland management techniques, including increasing the frequency and effectiveness of street sweeping along Southeast 82nd Avenue and in parking areas of large commercial developments as well as retrofits to stormwater detention ponds at Southeast 82nd Avenue and other structural BMPs in the contributing area. Detention pond retrofits should be preceded by a retrofit study to evaluate function of the ponds and prioritize retrofit activities. Continued inter-agency cooperation with the Oregon Department of Transportation (ODOT) to evaluate water quality improvements for treating I-205 runoff would also be beneficial.

To understand the cause of poor benthic macroinvertebrate bioassessment scores in Phillips Creek and the impact of Phillips Creek on Kellogg Creek, it is recommended that further data be collected on Phillips Creek near water quality Site #11 and in upstream locations as appropriate for comparison. Identification of potential toxic contamination sources based on land use type could assist in the development of future mitigation techniques. A fatty tissue surrogate, a device that can be placed in the stream to monitor for toxic accumulations in aquatic life, could be used to further evaluate water quality in this reach. A continuous turbidity probe could be installed in this reach to monitor continuous water quality conditions. Additional monitoring of toxic parameters could also be implemented to focus management strategies in this sub-basin. The results of monitoring could be used to target education and outreach to private landowners and businesses to reduce the impacts of land management practices on biological conditions in the streams.

Dean Sub-basin

The Dean sub-basin encompasses approximately 1,079 acres surrounding Dean Creek, as illustrated in Figure 5-5. Approximately 36 percent of the basin is used for industrial purposes, 5 percent for commercial, 17 percent for SFR, 5 percent for MFR, and 0.5 percent for farms. The remaining 33 percent is unknown land use according to the tax designation system and is labeled as tract, miscellaneous, or blank. According to aerial photograph analysis of the land cover, approximately 38 percent of the sub-basin is urban/impervious, 33 percent is covered by large trees, and 30 percent is covered by grass and shrubs.

Mt. Talbert comprises the forested portion of the sub-basin. At the foot of Mt. Talbert, a 234-acre parcel called Camp Withycombe serves as an Oregon National Guard training site and is on the National Register of Historic Places by the Oregon State Historic Preservation Office. Potential for future development of Camp Withycombe is unknown.

I-205 intersects the sub-basin in the north-south direction. The west side of the I-205 comprises the majority of the sub-basin's residential development and the east side includes mostly industrial developments. The western portion of the basin includes several UICs for stormwater. The Sunrise Corridor is proposed transportation project, which if constructed, would add significant infrastructure to this area.

Little data have been collected for Dean Creek. However, aerial photo analysis indicates that Dean Creek is largely piped or ditched and lacks a riparian buffer.

Potential Actions

The recommended strategy for this reach is a high level of management focused on improving channel condition by adding riparian zones in areas where the channel is open and investigating potential for increasing floodplain connectivity and off-channel flood storage, stormwater detention, and water quality treatment options in the sub-basin.

Since the creek is surrounded by large parcels, there may be a potential to improve channel condition with cooperation of a few landowners. Opportunity for stream enhancement is the best in areas where the stream is surrounded by open fields that have not been developed.

Cedar Sub-basin

The Cedar sub-basin encompasses approximately 564 acres surrounding reach CD1, as illustrated in Figure 5-6. Much of the sub-basin is in residential development. However, Mt. Talbert occupies a large portion of the northwestern corner of the sub-basin and is largely forested. The land use in the sub-basin includes 67 percent SFR, 2 percent MFR, and 3 percent commercial. The remaining 28 percent is unknown land use according to the tax designation system and is labeled as tract, miscellaneous, or blank.

Commercial development is located mainly along Sunnyside Road in the northern portion of the sub-basin. According to aerial photo analysis of the land cover, approximately 39 percent of the sub-basin is urban/impervious, 34 percent is covered by large trees, and 27 percent is covered by shrubs and grass.

Much of the development in the sub-basin appears to have occurred relatively recently but prior to stormwater treatment requirements. According to WES GIS data, only a small percentage of the sub-basin is treated with structural stormwater BMPs.

The riparian buffer in the Cedar sub-basin is somewhat intact. In a 25-foot buffer zone on either side of Cedar Creek, approximately 66 percent of the buffer is forested, 20 percent is grass and shrubs, and 13 percent is urbanized. In a 100-foot buffer zone on either side of Cedar Creek, approximately 54 percent of the buffer is forested, 23 percent is grass and shrubs, and 24 percent is urbanized.

One benthic macroinvertebrate monitoring site (SD1-M15) exists in the sub-basin, and there are no ODFW fish sampling reaches or water quality monitoring sites. The sub-basin is lacking monitoring data; hydrologic analysis and aerial photo analysis provide much of the information on this sub-basin. Hydrologic analysis indicates good to fair conditions, however data have not been collected on channel and bank stability. Riparian buffer analysis shows fair conditions and migration access is good.

Potential Actions

The recommended management strategy for this reach is an intermediate level of management focused on upland management and continued sampling and analysis of benthic macroinvertebrate data. Water quality retrofits or enhanced street sweeping in the commercial area along Southeast Sunnyside Road could reduce potential pollution from transportation runoff from parking lots. Analysis of existing benthic macroinvertebrate data from site SD1-M15 could improve understanding of existing biological communities in Cedar Creek.

Middle Mt. Scott Sub-basin

The Middle Mt. Scott sub-basin encompasses approximately 1,082 acres surrounding stream reaches MS5 through MS11, as shown in Figure 5-7. Portions of I-205 and Southeast Sunnyside Road run through this area.

The land use in the sub-basin includes 48 percent single family residential, 14 percent commercial, 7 percent multi-family residential, and 1 percent each of forest and farm land. The remaining 30 percent is unknown land use according to the tax designation system and is labeled as tract, miscellaneous, or blank. According to aerial photo analysis of land cover, approximately 36 percent of the sub-basin is urban/impervious, 38 percent is covered by large trees, 25 percent is covered by shrubs and grass, and 1 percent is surface water.

The contributing area of the Middle Mt. Scott sub-basin includes some undeveloped land in the southern area that surrounds Mt. Talbert. However, this sub-basin has seen heavy residential development in the last decade. Recent developments in the sub-basin include structural stormwater BMPs, which currently cover 20 to 30 percent of the contributing area in the Middle Mt. Scott sub-basin.

The riparian buffer in the Middle Mt. Scott sub-basin is somewhat intact. In a 25-foot buffer zone on either side of Mt. Scott Creek, approximately 79 percent of the buffer is forested, 11 percent is grass and shrubs, and 10 percent is urbanized. In a 100-foot buffer zone on either side of Mt. Scott Creek, approximately 70 percent of the buffer is forested, 15 percent is grass and shrubs, and 15 percent is urbanized. A portion of the riparian buffer along Mt. Scott Creek contains invasive plant species such as Japanese Knotweed and blackberry. Invasive species were not quantified in the assessment, but the existence of these species has been observed visually and noted throughout the watershed.

Reach MS5

Reach MS5 begins in the Three Creeks area, due west of Southeast 82nd Avenue and continues upstream through a relatively narrow corridor to the east side of I-205. The contributing area for this reach is comprised of commercial and industrial development, most of which lacks structural BMP treatment.

Prior to entering the Three Creeks area, Dean and Mt. Scott Creeks combine near the railroad tracks. This area is prone to flooding, which has overtopped the railroad and flooded industrial property downstream.

Water quality monitoring Site #12 is on the downstream end of this reach and monitoring Site #10 is located in the middle of this reach. Water quality data for this reach indicate poor in-stream temperature, low BMP treatment and poor levels of nitrates. Temperature issues partially may be the result of a pond caused by a beaver dam. Beaver dams have been known to be built in this reach on an annual basis over the past 5 years. Typically, the dams are destroyed during wintertime high flow events and are rebuilt between Southeast 82nd Avenue and I-205.

Hydrologic analysis of this reach indicates poor percent coarse substrate and aquatic habitat data show poor percent pools and deep pools. Percent fines and gravel in riffles could not be rated for this reach, because there are no riffles.

Recent improvements to this reach include the replacement of the I-205 culvert to improve fish passage.

Potential Actions

The recommended management strategy for this reach is an intermediate level of management focused on improving streamside shade and potential stormwater detention pond retrofits along Southeast 82nd Avenue.

Prior to altering stormwater detention ponds along Southeast 82nd Avenue, the function of the existing ponds should be evaluated.

Reach MS6

Reach MS6 is a short reach that begins on the east side of I-205 and continues upstream to the northwest end of the Mt. Talbert area at Southeast 97th Avenue. The contributing area to this reach is mainly commercial and industrial to the north of Southeast Sunnybrook Road and low-density residential to the south.

The ODFW fish sampling reach, MS3-F is in reach MS6. Sampling results indicate high fish counts in this area, which could be due to a small natural falls located in reach MS6 acting as a partial fish passage barrier in low flow conditions. High sampling results could also be due to a habitat conditions. ODFW has also identified a potential fish passage barrier due to twin culverts near at the driveway for the State Forensics Lab at Southeast 84th Avenue and Oak Bluff Road.

Hydrologic analysis indicates good to fair conditions, with the exception of a poor rating for the entrenchment ratio. Water quality data were not collected in this reach. Aquatic habitat and biological communities in this reach are generally good to fair, though the reach received a poor rating for pieces of LWD.

Potential Actions

The recommended management strategy for this reach is an intermediate level of management focused on accessibility of upper reaches to anadromous salmonids and maintenance of relatively good existing conditions. If the falls is deemed a fish passage barrier, weirs could be installed to help step up fish. The twin culverts at the State Forensics Laboratory could also be evaluated to determine to what extent they block fish passage. Opportunities to add LWD could be explored as well; however access conditions in this reach may limit the addition of LWD.

Reach MS7

Reach MS7 runs along the northern edge of Mt. Talbert, parallel to Southeast Sunnybrook Road for most of the reach. The contributing area to this reach to the south is the forested land on Mt. Talbert and to the north is mixed commercial and residential development. Much of the commercial development in the contributing area is along Southeast Sunnyside Road.

Available data indicate good to fair conditions in reach MS7, with the exception of a poor entrenchment rating that was determined using hydrologic analysis.

Aerial analysis of the riparian corridor shows good canopy over the stream; however, this reach is lacking understory cover, which was visually observed during a site visit.

Potential Actions

The recommended management strategy for this reach is an intermediate level of management that includes planting vegetation in the riparian corridor to improve ground cover.

Reaches MS8 and MS8A

Reaches MS8 and MS8A begin along Mt. Talbert and continue upstream to the confluence of Cedar Creek and Mt. Scott Creek. The contributing area to these reaches includes forested open space to the south and commercial and residential development to the north.

Available data indicate mainly good to fair conditions, with the exception of a poor entrenchment rating and a lack of LWD.

Potential Actions

The recommended management strategy for these reaches is an intermediate level of management that includes the addition of LWD to improve in-stream structure.

Reach MS9

Reach MS9 begins at Southeast Sunnyside Road and continues upstream to Southern Lites Park near Southeast 122nd Avenue. The contributing area to this reach is mainly comprised of residential development, which largely lacks structural stormwater BMP treatment.

Benthic macroinvertebrate site (SD1-M2) provided data indicating fair biological indicators of water quality. Other aquatic habitat data show that this reach is lacking LWD.

Potential actions

The recommended management strategy for this reach is an intermediate level of management that focuses on in stream and riparian corridor improvements. The addition of LWD could improve in-stream structure. Additional vegetative understory cover could improve channel stability.

Reach MS10

Reach MS10 flows approximately 200 meters between MS9 and MS11 near Southeast 122nd Avenue. Low-density residential development constitutes the contributing area to this reach.

Water quality Site #9 is in the middle of reach MS10 and provides water quality data for this reach. The 7-day moving average of water temperature, based on hourly maximum temperature, exceeded the 18 degrees C DEQ requirements over 20 percent of the time during the summer of 2008 monitoring period.

This reach has fair to good hydrologic conditions, and mixed ratings for water quality and aquatic habitat and biological communities. The reach is lacking percent pools, deep pools, gravel in riffles, pieces of LWD, and overhead shade.

Potential Actions

The recommended management strategy for this reach is an intermediate level of management that includes the addition of LWD to improve in-stream structure and improvement of vegetative cover and buffer enhancement around tributaries.

Reaches MS11 and MS11B

Reach MS11 begins at the end of MS10 and continues upstream to near the intersection of Southeast Mountain Gate Road and Southeast 129th Avenue. The contributing area to this reach is mostly developed low-density residential. MS11B is a tributary that flows from the northwest, through residential developments, into MS11. Recent developments include structural stormwater BMPs, giving these reaches an overall fair rating for these BMPs.

This reach includes the site of the Spring Mountain Dam Removal and Restoration Project, which was conducted by WES. ODFW fish sampling reach, MS4-F, is located on the upstream end of this reach. Fish sampling from site MS4-F indicates relatively high salmonid populations, in comparison to other reaches in Mt. Scott Creek.

ODFW identified culverts in this reach that present a partial barrier to fish, particularly the private drive culvert upstream of Southeast 129th Street.

Hydrologic analysis of this reach indicates a poor entrenchment ratio. Poor ratings were also seen for deep pools, percent gravel in riffles and pieces of LWD.

Temperature data for MS11 indicate water temperatures exceed the 18 degrees C standard for the 7-day moving average, based on the hourly maximum temperature in over twenty percent of data points during the 2008 summer monitoring period.

Potential Actions

The recommended management strategy for this reach is a high level of management that includes instream restoration, riparian corridor and programmatic activity opportunities. In-stream restoration could include the addition of LWD to improve in-stream structure and juvenile salmonid rearing habitat. Other in-stream work could include the evaluation of culverts that are partial fish passage barriers, including the private drive culvert upstream of Southeast 129th Street. Riparian corridor improvements could include the addition of vegetative cover on active tributaries. Programmatic activities could include the addition of a benthic macroinvertebrate survey site to monitor biological health and water quality.

Reach MS12

Reach MS12 begins at reach MS11 and continues upstream to the border between the Middle and Upper Mt. Scott sub-basins. The contributing area to this reach is mainly comprised of low-density residential development with some scattered undeveloped land. Many of the residential developments in this area have been constructed in the last decade and are treated with structural stormwater BMPs.

Hydrologic analysis of the reach indicates a poor entrenchment ratio and that greater than 25 percent of the riparian buffer contains roads.

Aquatic habitat and biological community data show a lack of pool habitat and deep pools.

Potential Actions

The recommended management strategy for this reach is a moderate level of management.

Upper Mt. Scott Sub-basin

The Upper Mt. Scott sub-basin encompasses approximately 1,195 acres surrounding stream reach MS12A, as shown in Figure 5-8. Portions of I-205 and Southeast Sunnyside Road run through this area. The land use in the sub-basin includes 59 percent SFR, and 1 percent each of farm and forest land. The remaining 40 percent is unknown land use according to the tax designation system and is labeled as tract, miscellaneous, or blank. According to aerial photo analysis of land cover, approximately 30 percent of the sub-basin is urban/impervious, 38 percent is covered by large trees, and 32 percent is covered by shrubs and grass.

The contributing area of the Upper Mt. Scott sub-basin includes recent low-density residential developments, a few older residential developments and undeveloped land. Recent developments include structural stormwater BMPs. The sub-basin also includes the 25-acre Happy Valley Nature Park, which includes wetland restoration projects conducted by both WES and the Clackamas County Development Agency as permit mitigation requirements for earlier development and transportation improvement projects.

The riparian buffer in the Upper Mt. Scott sub-basin is somewhat intact. In a 25-foot buffer zone on either side of Mt. Scott Creek, approximately 54 percent of the buffer is forested, 33 percent is grass and shrubs, 11 percent is urbanized, and 2 percent is surface water. In a 100-foot buffer zone on either side of Mt. Scott Creek, approximately 43 percent of the buffer is forested, 41 percent is grass and shrubs, 15 percent is urbanized, and 1 percent is surface water.

Reach MS12A is the only reach within the Upper Mt. Scott sub-basin and generally lacks recent data on in-stream conditions. This reach contains the main stem of Mt. Scott Creek in addition to several other major tributaries. Due to a general lack of data in the area, tributaries and the main stem of the creek were grouped together into reach MS12A. If more data are collected in the future, this area could be split up into smaller reaches.

Hydrologic analysis of the reach showed a poor rating for the number of structures in the floodplain, but no complaints in this area have been identified.

Potential Actions

The recommended management strategy for this reach is an intermediate level of management that includes the addition of LWD to improve in-stream structure, improvement of vegetative cover on active tributaries, and the addition of benthic macroinvertebrate sites to monitor toxics.

Early Action Projects

As a part of the watershed assessment, the project team identified opportunities for early action projects. Early action projects may include both capital projects and programmatic measures. Criteria for potential early action projects include the following:

- Projects that are a high priority for improving watershed conditions.
- Projects that are a high priority to initiate or implement prior to July 2010.
- Projects that could be initiated or implemented prior to completion of the WAPs.

Based on the initial assessment of existing data and field visits to the watersheds, the project team developed a draft list of 13 potential early action projects. Feedback from WES staff was obtained to screen the list of potential early action projects down to the top projects for early implementation. These projects are summarized below.

1. Involvement in the City of Milwaukie's Kellogg-for-Coho initiative

The City of Milwaukie is leading the "Kellogg-for-Coho" initiative, which seeks to replace the Kellogg Lake Bridge, remove the Kellogg Lake dam, and restore the Kellogg Creek stream channel in the City of Milwaukie. The purpose of the project is to enhance Kellogg Creek for native Coho salmon and other threatened fish species while supporting bicycle and pedestrian travel and revitalizing the City of Milwaukie's South Downtown area. Removing Kellogg Lake dam would improve fish access to seven miles of riparian habitat in the KMS watershed.

As a part of the Kellogg-for-Coho initiative, the City of Milwaukie began hosting meetings with stakeholders in the watershed in September 2008 and is planning a lake drawdown study for the summer of 2009. This programmatic measure will include involvement of WES staff with the Kellogg-for-Coho initiative, including attending meetings, reviewing plans for the lake drawdown study, and coordinating information between the

WAPs and the Kellogg-for-Coho initiative. It is anticipated that the WES Environmental Policy will contribute 2 to 4 hours per month to this programmatic measure from September 2008 through September 2009.

2. Update stormwater design standards

The Stormwater Design Standards for the Districts are outdated and do not appear to be serving the stormwater management needs of the Districts as well as they could be. Updating the Stormwater Design Standards could significantly improve or maintain water quality, in the short-term in areas where there will be extensive new development and in the long-term as areas are redeveloped. The Stormwater Design Standards are used within the Districts and by the City of Happy Valley. DTD has also begun applying the Stormwater Design Standards to some development outside the Districts. With the expected growth and development in the East Happy Valley Expansion Area and Damascus, it will be valuable for watershed health to update the Stormwater Design Standards as soon as possible.

It is anticipated that this programmatic measure could require up to 20 to 40 hours per month of combined time for several WES staff members over a period of 6 to 8 months to implement a design standard review and update with the assistance of a consultant. The fee for the consultant would depend on the scope of the project.

3. Temperature TMDL shade analysis

As a part of compliance with the water temperature TMDL for the Clackamas and Willamette Basins, Clackamas County is responsible for identifying areas lacking riparian shade and developing plans to increase riparian shade where feasible. WES is performing a riparian buffer analysis for the KMS and Rock Creek (RC) watersheds as a part of the WAPs. Additional riparian buffer analyses could be performed for other watersheds inside the Districts and outside the Districts in Clackamas County to establish baseline conditions throughout the County. Following this work, a programmatic measure could be developed through the WAPs to develop and implement plans to increase riparian shade where feasible. It is anticipated this measure could require 40 to 60 hours of time by an existing WES GIS staff member.

4. Perform additional benthic invertebrate surveys

WES has contracted with a consultant to perform benthic macroinvertebrate surveys at 12 locations throughout the KMS and RC watersheds. These surveys provide extremely valuable information about long-term aquatic habitat conditions, water quality, and watershed health. In order to expand the areas where the Watershed Health Index (WHI) can be calculated and to expand the data available to use in setting management goals and tracking the effect of WES activities, it would be useful to expand the benthic monitoring program to include additional sites and greater frequency of sampling.

5. Add an erosion control hotline number and signs for construction sites

The Erosion Control group in WES has been working on establishing an erosion control hotline phone number for citizens to report poor erosion control practices at construction sites. Due to the significant sediment impacts and damage to watershed health that can occur from construction site erosion, it is a high priority to improve the effectiveness of erosion control. Establishing the erosion control hotline number and creating signs with the number for construction sites would benefit water quality.

6. Annual Stormwater Treatment Pond Retrofit Fund

WES is currently responsible for maintaining over 260 stormwater treatment ponds in the Districts and Happy Valley. Over 30 ponds in the Districts have been identified by WES staff as potential retrofit opportunities to improve performance. This early action project includes creating a stormwater treatment pond retrofit plan that would allocate annual CIP funds for the retrofit of several ponds each year. Costs will vary depending on the size of the pond and scope of the project at the pond.

The ponds that WES maintains were originally designed and constructed with various functions in mind (e.g., differing levels of flood control and water quality treatment) and at different stages of understanding of stormwater treatment opportunities to improve watershed health. There are opportunities to retrofit existing ponds to improve their function to better meet WES' watershed health goals and improve maintenance. Examples of pond retrofits include adding berms and weirs to slow flow progress through the treatment area and increase treatment detention time, adding native vegetation to improve water quality treatment, making modifications to ensure ponds operate properly to avoid causing stream temperatures to increase, and making modifications to the outflow structures to provide detention for smaller storm events.

Table 5-4. KMS Watershed Reach Assessment Results

Assessment parameters	Assessment criteria	KG0	KG1	KG2	KG3	KG3.a	KG4	KG4.a	MN1	MS1	MS2	MS3	MS4	MS5	MS6	MS7	MS8	MS8.a	CD	MS9	MS10	MS11	MS12	MS12.a	PH1	PH1.a	DN1
Flood risk	Number of structures in 100-year floodplain		Fair	Fair	Poor	Good	Poor	Poor		Poor	Poor	Fair	Good	Poor	Good	Good	Good	Good	Good	Good	Good	Good	Good	Poor	Good		Poor
	Flooding complaints		Fair	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good
Hydromodification	Ratio of 2-year future to 2-year existing		Fair	Fair	Fair	Fair	Fair	Fair	Fair	Good	Good	Good	Fair	Fair	Fair	Fair	Fair	Fair	Good	Fair	Fair	Fair	Fair	Poor	Good	Good	Fair
	Ratio of 10-year future to 10-year existing		Good	Fair	Fair	Fair	Fair	Good	Good	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair
Access to a quality of floodplain	Entrenchment ratio		Fair	Good	Good	Fair	Fair	Fair		Poor	Poor	Fair		Poor	Poor	Poor	Poor			Fair	Fair	Poor	Poor		Poor		
	Roads in 25-foot buffer		Good	Good	Good	Good	Good	Fair		Good	Good	Fair	Good	Poor	Fair	Good	Good	Good	Fair	Good	Good	Good	Poor	Fair	Fair	Poor	Poor
	Frequency of overbank flow		Poor	Good	Good	Good	Good	Good		Fair	Fair	Fair													Fair	Poor	
Channel a bank stability	Percent banks eroding		Good	Fair	Good	Good	Good	Good		Fair	Fair	Fair	Fair	Fair	Good	Good	Fair			Good	Good	Good	Good		Good		
	Percent coarse substrate		Good	Fair	Fair	Poor	Poor	Poor		Good	Good	Fair	Poor	Fair	Good	Good	Good			Good	Good	Good	Good		Good		
Biological indicators of water quality	Benthic macroinvertebrate bioassessment score			Poor								Fair								Fair					Poor		
BMP treatment	Percent contributing area treated by structural BMPs		Poor	Poor	Poor		Poor			Poor	Poor	Poor	Poor	Poor	Fair	Fair	Fair			Poor	Fair	Fair	Fair		Poor		
Water temperature	7-day running average maximum temperature during summer and/or during spawning/incubation period	Poor		Good				Poor		Poor		Poor		Poor							Poor				Poor		Fair
Dissolved metal contaminates	Dissolved metals exceeding acute DEQ criteria			Good						Good		Poor													Good		
Nutrients	TP and nitrate samples exceeding guidance levels			Poor						Poor		Poor		Poor							Poor				Poor		
Suspended solids	TSS exceeding guidance levels			Good						Good		Good		Good							Good				Good		
Water contact human health imitator (*E. coli* bacteria)	*E. coli* bacteria exceedance of DEQ stds at monitoring sites within reach			Poor						Fair		Fair		Fair							Fair				Fair		
Forested cover in contributing area	Percent forested land cover in contributing area		Fair	Fair	Fair		Fair			Fair	Fair	Fair	Fair	Fair	Fair	Fair	Fair			Fair	Fair	Fair	Fair		Fair		
Percent pools	Percent of the primary channel area represented by pool habitat		Fair	Fair	Fair		Good			Good	Good	Fair	Poor	Fair	Fair	Fair	Good			Fair	Poor	Fair	Poor		Good		
Deep pools	Number of pools greater than 1 meter deep per kilometer of the primary channel		Poor	Poor	Poor		Poor			Fair	Poor	Poor	Poor	Fair	Poor	Poor	Good			Poor	Poor	Poor	Poor		Good		
Winter refuge habitat	Percent of total channel area including alcoves a side channels that provide refuge habitat during winter high flow events																										
Percent fines in riffles	Percent of substrate in riffles < 2 millimeters in diameter		Good	Poor	Poor		Poor			Fair	Fair	Fair	no riffles	Fair	Fair	Fair	Fair			Fair	Fair	Good	Fair		Poor		
Percent gravel in riffles	Percent substrate in riffles 2 to 64 millimeters in diameter		Fair	Fair	Good		Poor			Fair	Good	Good	no riffles	Good	Fair	Fair	Fair			Fair	Poor	Poor	Fair		Poor		
Pieces of LWD per 100 meters	Pieces of LWD > 0.15 meter in diameter by 3 meters in length per 100 meters of channel length		Poor	Poor	Poor		Poor			Poor	Poor	Poor	Fair	Poor	Fair	Fair	Poor			Poor	Poor	Poor	Fair		Poor		
Percent shade	Percent shade from ODFW		Poor	Poor	Fair		Poor			Poor	Fair	Good	Good	Fair	Good	Good	Good			Good	Poor	Good	Good		Poor		
Riparian buffer and shade	Riparian extent—25-foot buffer area based on Metro land classification	Poor	Good	Good	Good	Good	Poor	Fair	Poor	Good	Good	Good	Fair	Good	Good	Fair	Good	Good	Fair	Good	Good	Good	Good	Good	Poor	Fair	Poor
Riparian buffer and shade	Riparian extent—100-foot buffer area based on Metro land classification	Poor	Fair	Fair	Fair	Fair	Poor	Fair	Poor	Good	Fair	Good	Fair	Good	Fair	Fair	Good	Fair	Fair	Good	Good	Good	Good	Fair	Poor	Poor	Poor
Low summer flow	Flow conditions during the late summer a early fall			Good	Poor	Poor	Poor	Poor																			
Fish diversity abundance	F-IBI scores		Fair	Fair						Fair	Fair	Fair	Fair												Poor		
Migration access	Upstream access for both adult a juvenile salmonids	Fair	Good	Good	Good	Good	Good	Good	Poor	Good	Good	Good	Good	Fair	Good	Fair	Good	Good	Good	Good	Good	Good	Fair	Good	Good	Fair	Fair

Table 5-5. KMS Watershed Reach Analysis Recommended Management Strategies and Potential Actions

Reach	Recommended management strategy	Upland management opportunities	In-stream restoration opportunities	Riparian corridor opportunities	Programmatic activity opportunities
KG0	High	BMP retrofits or additions (Milwaukie)	Potential to enhance stream if dam is removed or modified		• Additional monitoring of temperature • Analysis of fish passage
KG1	Intermediate		• Evaluate small dams and impoundments for their potential to block fish passage and work with private landowners and partners to alter if necessary • Add LWD with private landowners and partners	Improve riparian shade with private landowners and partners	• Additional benthic monitoring site • Outreach to private landowners
KG2	Intermediate		Add LWD with private landowners and partners	Improve riparian shade with private landowners and partners	Outreach to private landowners
KG3	High	• Stormwater retrofits in UIC area • Stormwater retrofits in surface drainage area	Evaluate Theissen Road culvert replacement options and downstream impacts		• Increased monitoring of upstream fish usage and temperature to determine if this reach is a thermal refuge for fish in summer months • Outreach to private landowners
KG3A	High	• Stormwater retrofits in UIC area • Stormwater retrofits in surface drainage area	Target stream enhancement with private landowners and partners	Target improved riparian shade with private landowners and partners	Targeted outreach to private landowners
KG4	Intermediate		Evaluate Mabel Avenue culvert hydraulics and willing seller program to address flooding	Improve riparian shade with private landowners and partners	Outreach to private landowners
KG4A	Intermediate				• Additional water quality monitoring of Leona Lake • Evaluate opportunities to modify Leona Lake if monitoring results support management strategy modification
MS1	High		Targeted stream enhancement with private landowners and partners, add LWD and boulders	• Targeted invasive species management • Targeted improved riparian shade on public land	

Table 5-5. KMS Watershed Reach Analysis Recommended Management Strategies and Potential Actions

Reach	Recommended management strategy	Upland management opportunities	In-stream restoration opportunities	Riparian corridor opportunities	Programmatic activity opportunities
MN1	Moderate	Stormwater retrofits in coordination with City of Milwaukie and private businesses			Continued coordination with the City of Milwaukie
MS2	Moderate				Continued coordination with DTD to track flooding issues
MS3	High	Evaluation of regional flood control facility in coordination with DTD	Targeted stream enhancement on public land	Targeted enhancement on public land	Detailed comparison of water quality data
MS3B	Moderate				
MS4	Intermediate				New monitoring to evaluate stressors limiting biological conditions, including toxics analysis using a fatty tissue surrogate
PH1	High	Increased frequency and effectiveness of street sweeping on Southeast 82nd Avenue and in commercial parking areas			New monitoring to evaluate stressors limiting biological conditions, including toxics analysis using a fatty tissue surrogate Continued inter-agency cooperation with ODOT to evaluate water quality improvements for I-205 runoff
PH1A	High	Increased frequency and effectiveness of street sweeping on Southeast 82nd Avenue and in commercial parking areas			Continued inter-agency cooperation with ODOT to evaluate water quality improvements for I-205 runoff
PH1B	Moderate				Continued inter-agency cooperation with ODOT to evaluate water quality improvements for I-205 runoff
DN1	High	Evaluation of potential for floodplain connectivity and flood storage, stormwater detention, and water quality treatment BMPs	Targeted stream enhancement with private landowners and partners		Targeted outreach to private landowners
CD1	Intermediate	Stormwater retrofits or enhanced street sweeping in commercial area along Southeast Sunnyside Road			

Table 5-5. KMS Watershed Reach Analysis Recommended Management Strategies and Potential Actions

Reach	Recommended management strategy	Upland management opportunities	In-stream restoration opportunities	Riparian corridor opportunities	Programmatic activity opportunities
MS5	Intermediate	Evaluation of stormwater pond retrofits		Improve riparian shade with private landowners and partners	
MS6	Intermediate		• Evaluation of falls and opportunities to enhance fish passage through the addition of weirs, habitat enhancements with LWD • Evaluation of the twin culverts near the State Forensics Lab		
MS7	Intermediate			Improve riparian shade and ground cover with private landowners and partners	
MS8	Intermediate		Add LWD with private landowners and partners		
MS8	Intermediate		Add LWD with private landowners and partners		
MS9	Intermediate		Add LWD with private landowners and partners	Improve riparian shade and ground cover with private landowners and partners	
MS10	Intermediate		Add LWD with private landowners and partners	Improve riparian shade and ground cover with private landowners and partners	
MS11	High		• Add LWD with private landowners and partners • Evaluation of culverts, including the private drive culvert upstream of Southeast 129th Avenue to determine if they are fish passage barriers	Improve riparian shade and ground cover with private landowners and partners	New monitoring of benthic macroinvertebrates
MS11B	Intermediate		Add LWD with private landowners and partners		
MS12	Moderate				
MS12A	Intermediate		Add LWD with private landowners and partners	Improve riparian shade and ground cover with private landowners and partners	New monitoring of benthic macroinvertebrates

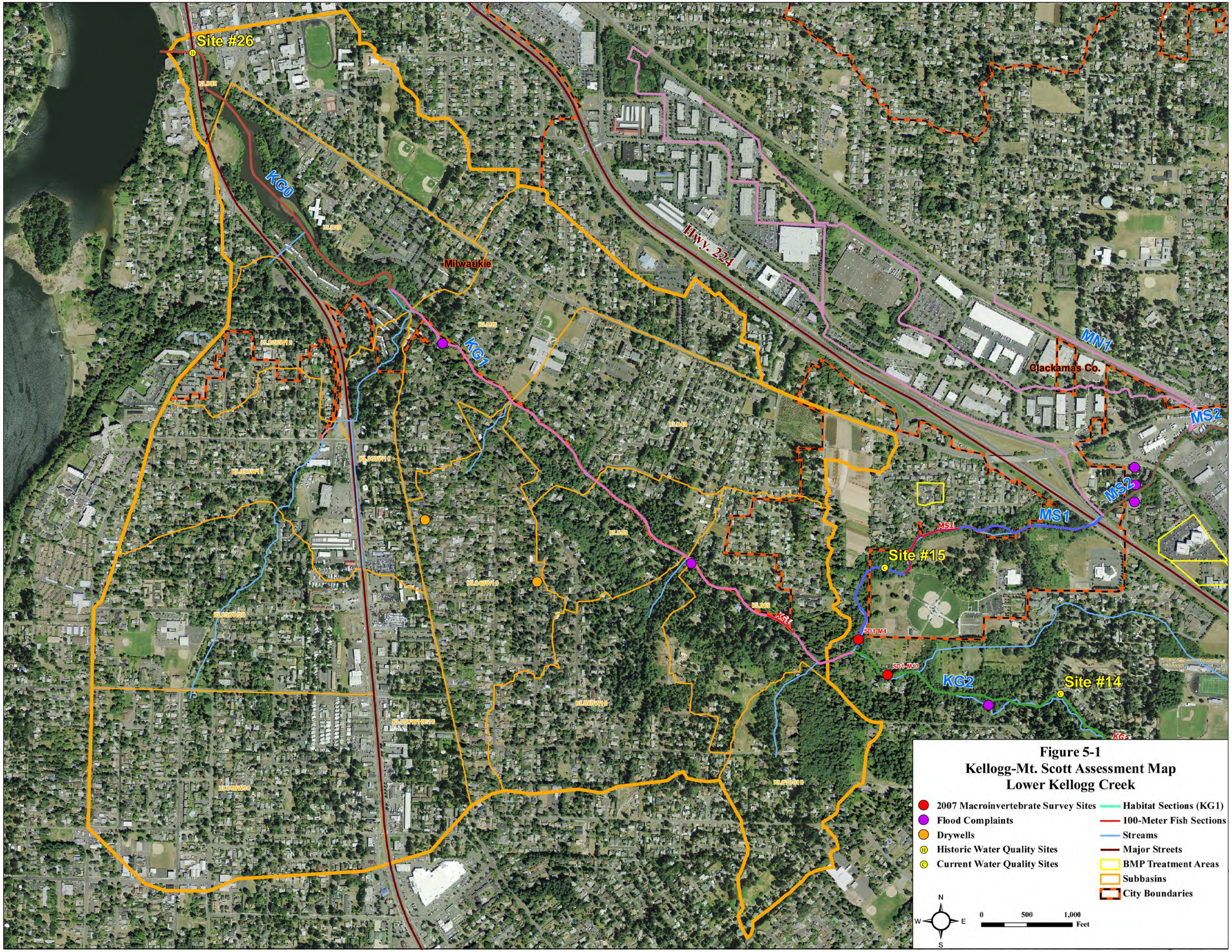


Figure 5-1
Kellogg-Mt. Scott Assessment Map
Lower Kellogg Creek

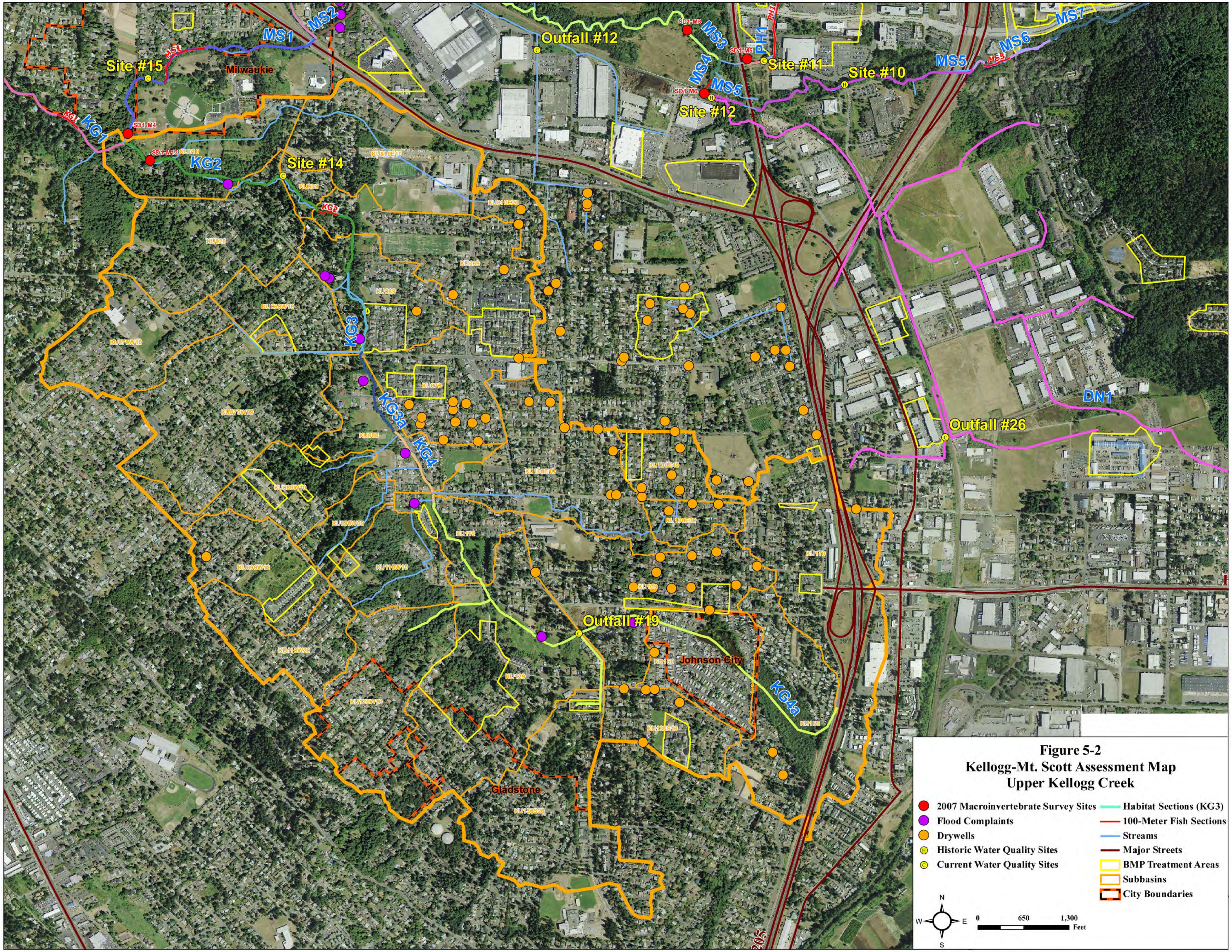


Figure 5-2
Kellogg-Mt. Scott Assessment Map
Upper Kellogg Creek

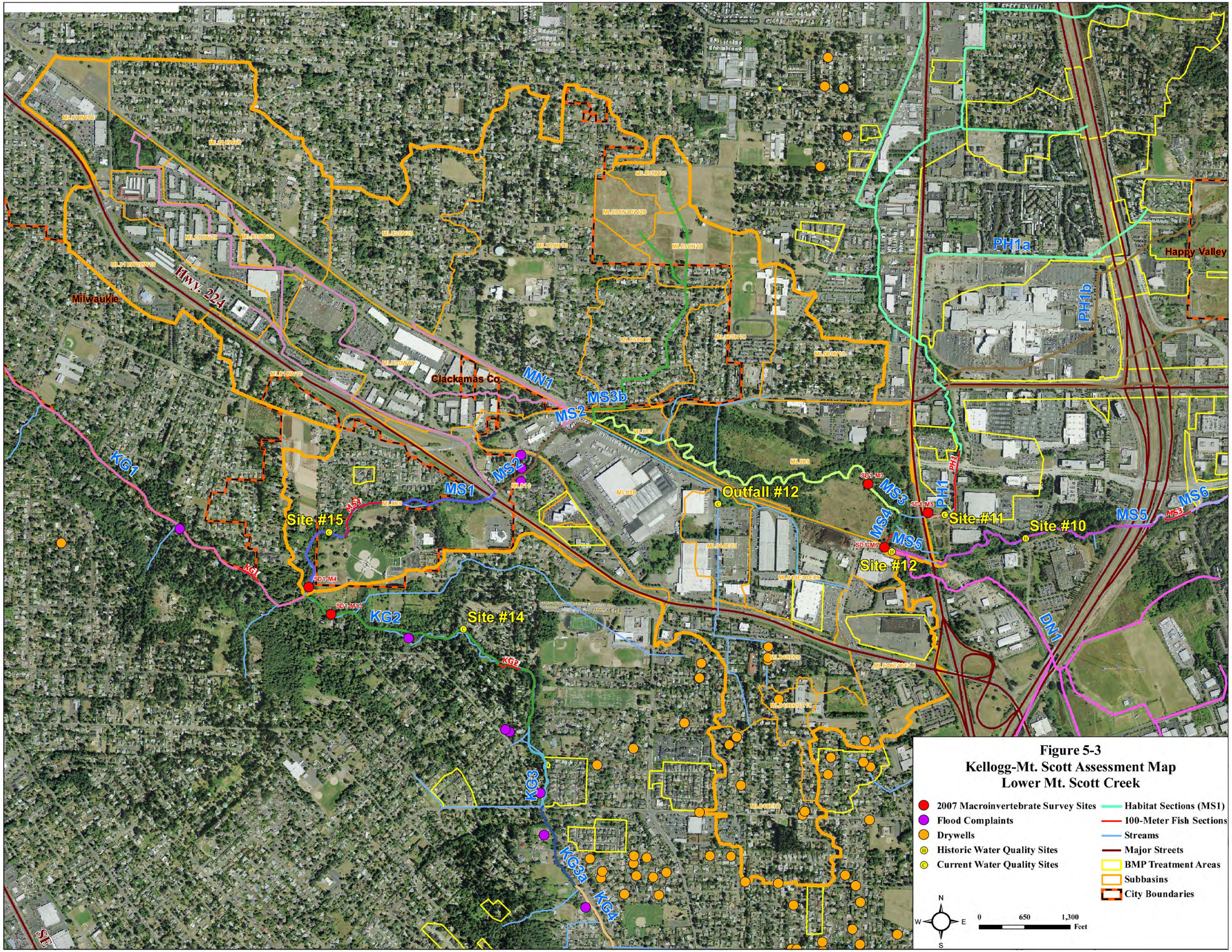


Figure 5-3
Kellogg-Mt. Scott Assessment Map
Lower Mt. Scott Creek

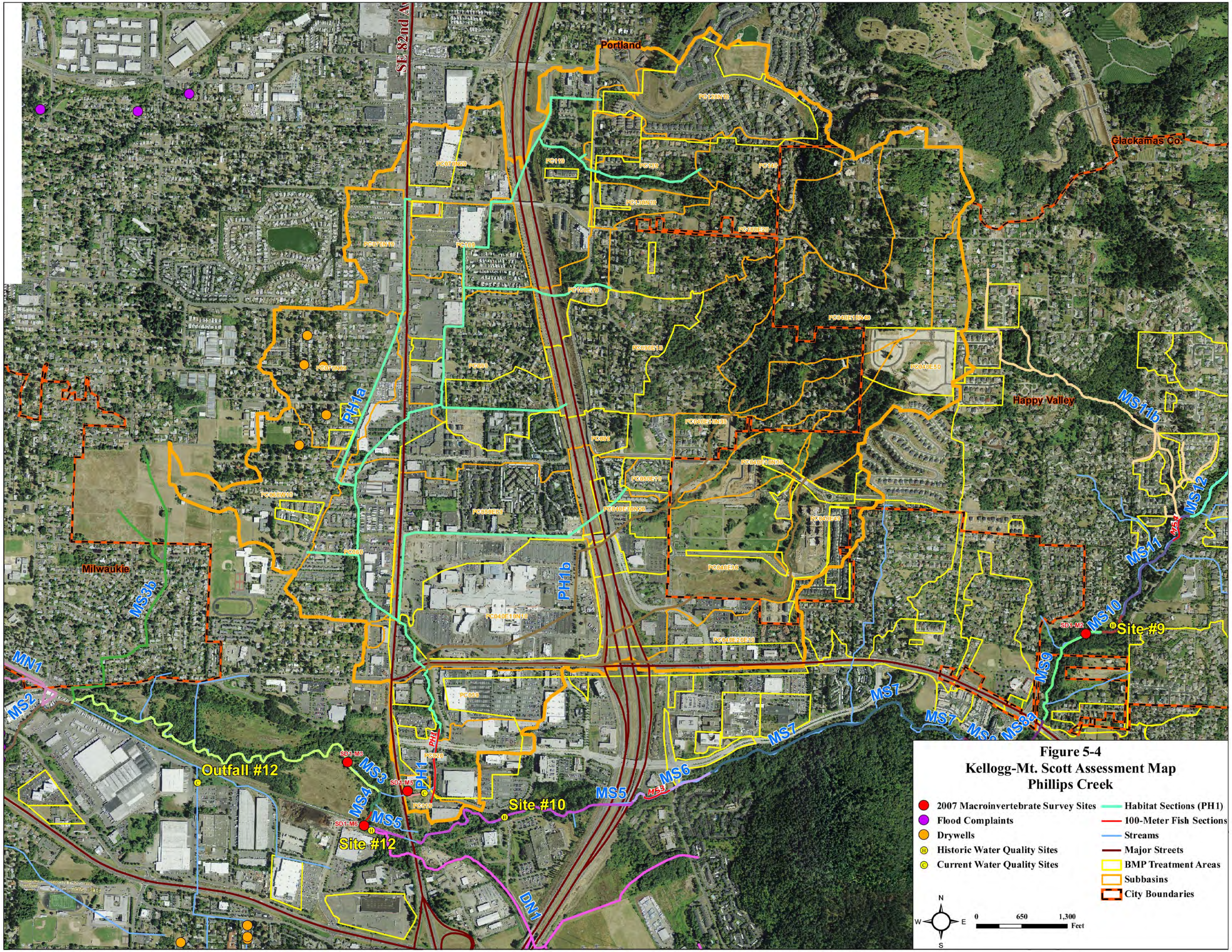


Figure 5-4
Kellogg-Mt. Scott Assessment Map
Phillips Creek

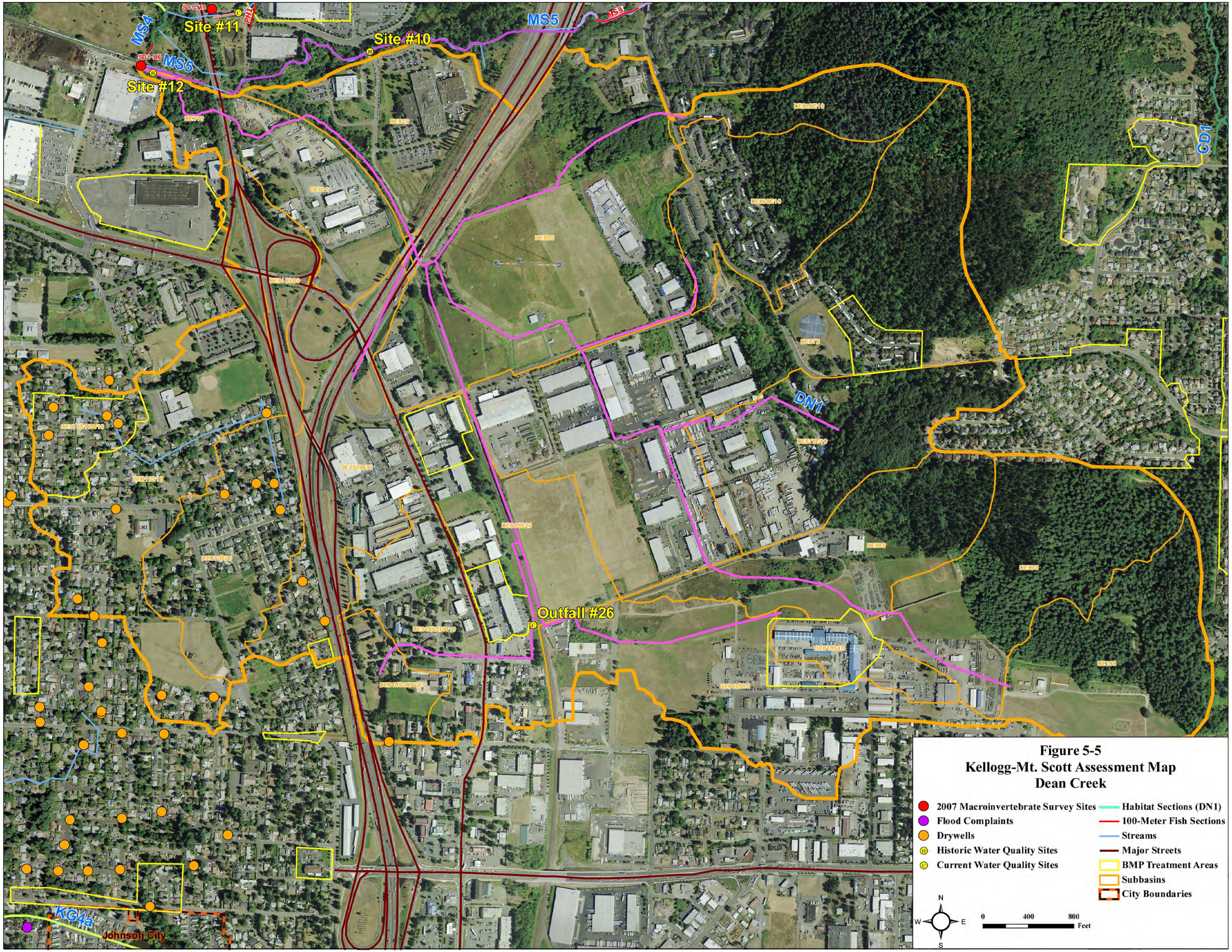


Figure 5-5
Kellogg-Mt. Scott Assessment Map
Dean Creek

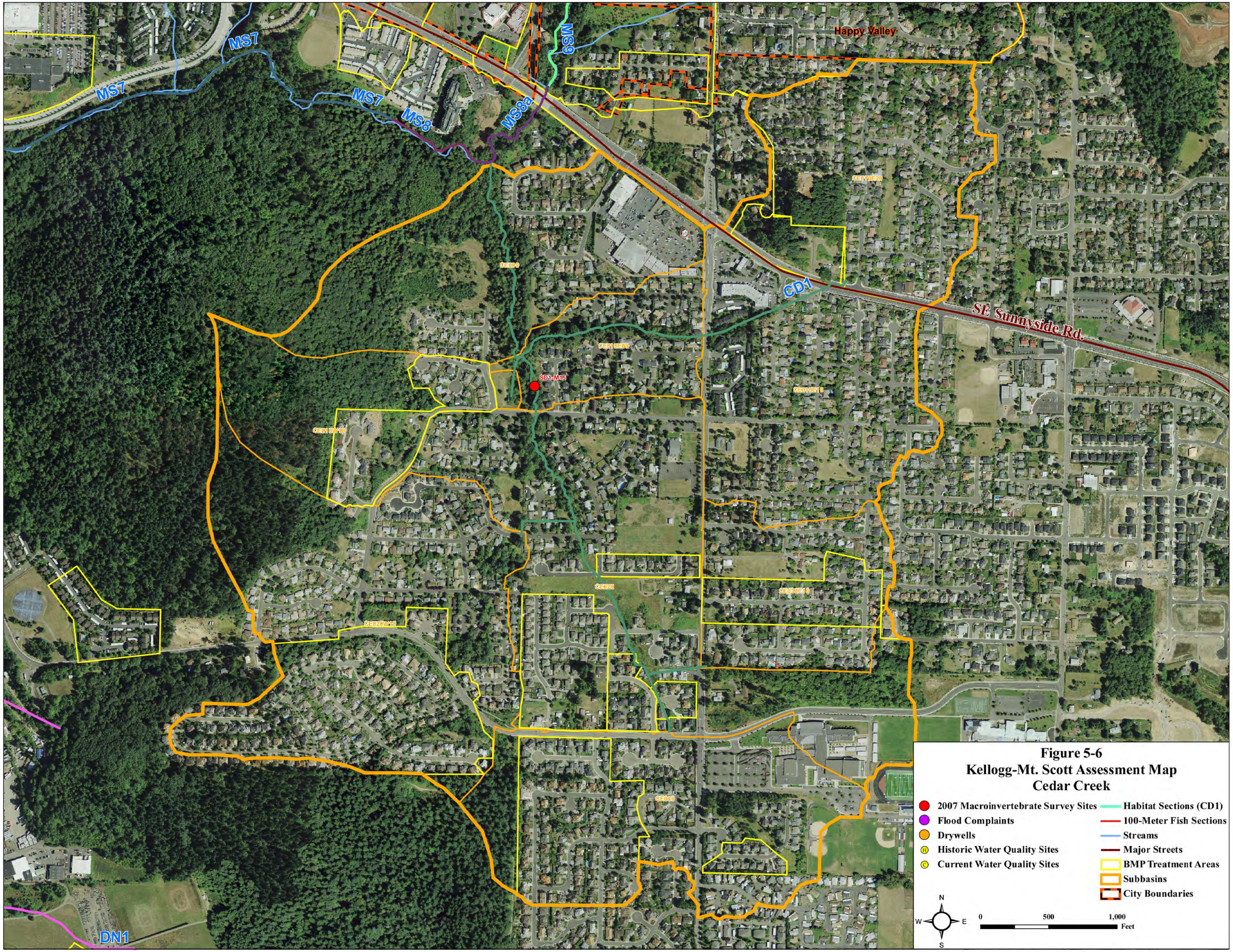


Figure 5-6
Kellogg-Mt. Scott Assessment Map
Cedar Creek

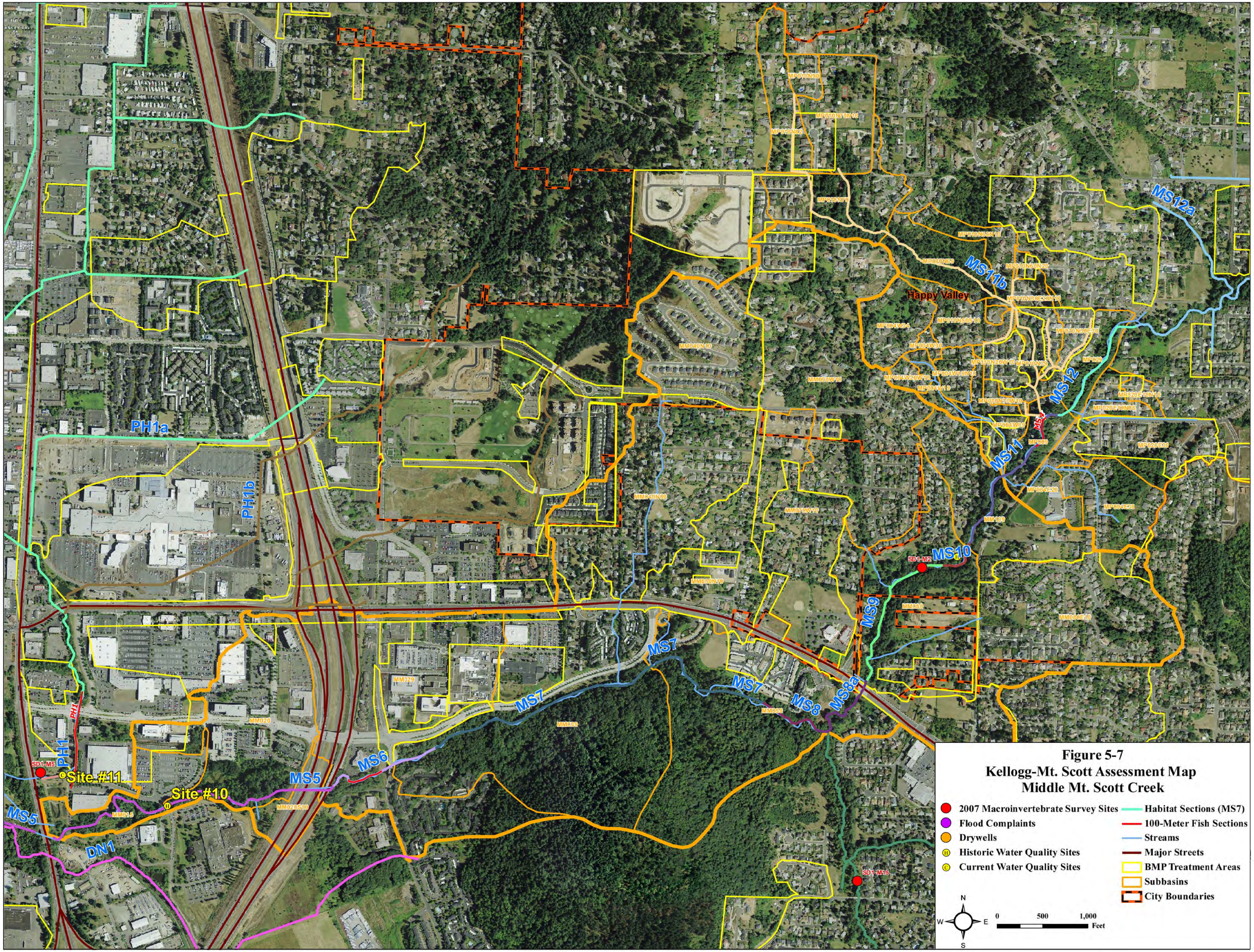


Figure 5-7
Kellogg-Mt. Scott Assessment Map
Middle Mt. Scott Creek

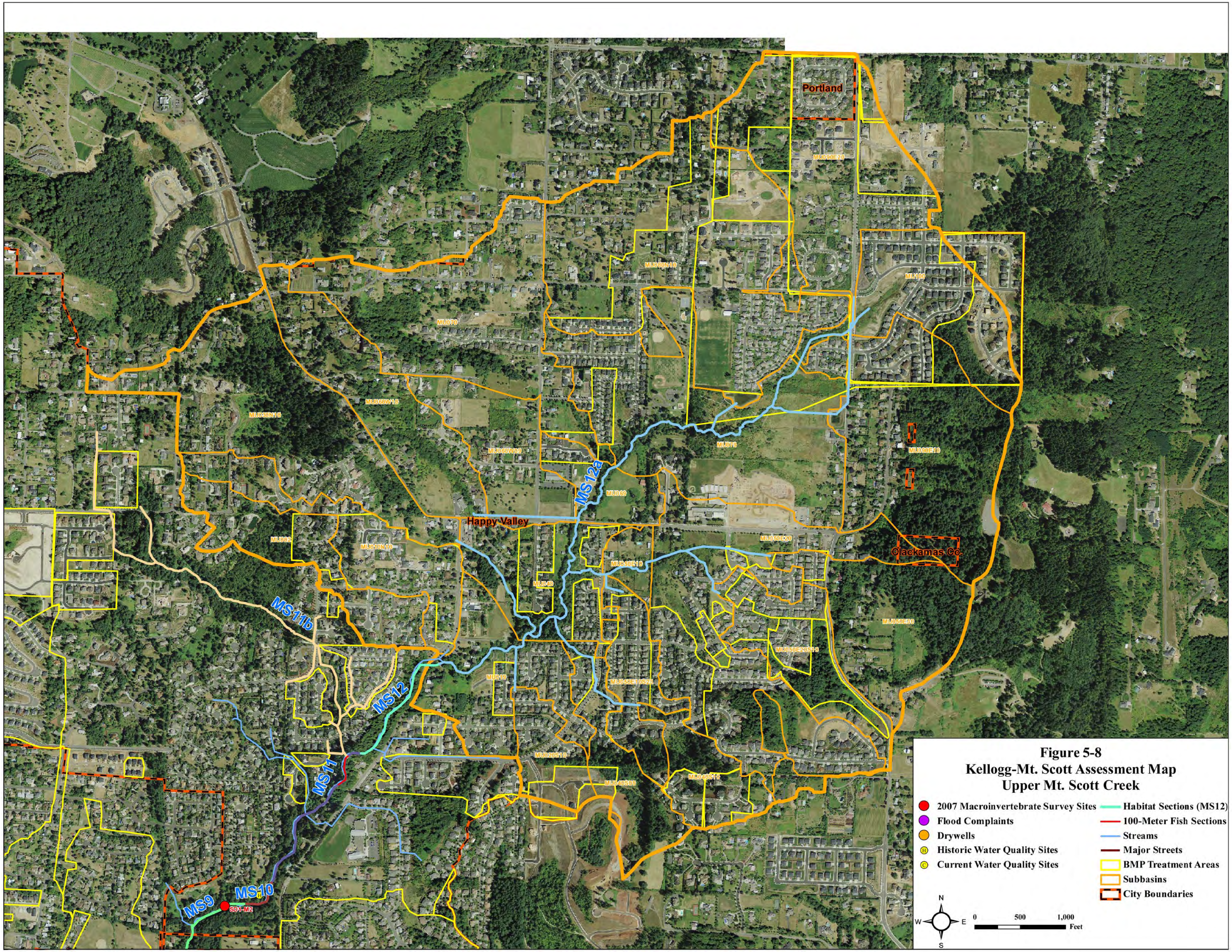


Figure 5-8
Kellogg-Mt. Scott Assessment Map
Upper Mt. Scott Creek

CHAPTER 6 – ACTION PLAN SUMMARY

Overview

As discussed in Chapter 1, the Kellogg-Mt. Scott (KMS) Watershed Action Plan (Action Plan) includes a Characterization Report, an Assessment Report, and an Action Plan Summary. Chapters 1 to 4 comprise the Characterization Report and Chapter 5 contains the Assessment Report. The Action Plan Summary is contained within this chapter.

Chapter 6 builds upon information presented in previous reports and develops potential actions to address issues and opportunities that were described in the Assessment Report. The actions developed include programs, projects, and activities intended to protect or improve watershed health and assist Water Environment Services (WES) in meeting its Level of Service (LOS) goals.

The actions are described in the Action Description Sheets attached to this chapter. The Action Description Sheets identify implementation steps and planning-level cost estimates. The actions have been analyzed and prioritized using scientifically-based criteria and an asset management Level of Service-based evaluation process. In the future, WES will develop an implementation approach for the actions based on feasibility, expected impact, urgency, and other criteria. The implementation approach will sequence the actions for implementation and identify near-term actions and longer-term actions.

Action Plan Goals and Objectives

WES' over-arching surface water management program goals are to improve and protect water quality and reduce the impacts of urbanization on hydrology. The objective of the Watershed Action Plans is to develop basin-specific plans to prioritize District activities and future investments for watershed management.

WES developed Levels of Service in 2009 to guide its program management and activities. The Level of Service (LOS) goals for the surface water management program elements are shown below. Further information on the LOS goals and performance measures for the goals is described in Appendix D.

- Environmental Permit Program Management
  - Meet Permit Requirements
  - Reduce Pollutant Loads through Structural Best Management Practices (BMPs)
  - Reduce Pollutant Loads through Non-Structural BMPs
- Environmental Policy and Watershed Health
  - Support Functioning Aquatic Ecosystems
  - Improve Water Quality
  - Improve Aquatic Habitat and Biology
  - Improve Hydrology and Geomorpology

- Erosion Prevention and Sediment Control
  - Conduct Inspections Based on Priority
  - Reduce Water Quality Impacts of Construction
- Program Management
  - Engage in Effective Partnering
  - Ensure Staff Understand Roles; Skills and Resources Meet Needs
  - Collect Monitoring Data Used for Decision-Making
  - Program Evaluation and Effectiveness
- Development Plan Review and Permitting
  - Ensure Development Needs Are Met and Ecosystem Services Protected
- Asset Management
  - Maximize Cost/Benefit of Service
  - Fully Implement the Asset Management Program
  - Ensure the Storm System is Reliable
- Customer Service
  - Implement Sustainability Action Plan
  - Conduct Effective Public Outreach Program
  - Maintain Employee Health and Safety
- Business Management
  - Maximize Use of Alternative Funding Sources
  - Full Capital Improvement Program Implementation
  - Ensure Rate Adequacy
  - Budget Management Effectiveness
  - Maintain Appropriate Policies for WAPs
- Stormwater Maintenance
  - Regularly Scheduled Maintenance Addressed
  - Scheduled versus Non-Scheduled Maintenance Balanced
  - Request-Driven Maintenance Addressed

Plan Approach

The WAP actions were developed based on the recommended management strategies and potential actions described in the Assessment Report, input provided by Stakeholders during Stakeholder Meetings, and input provided by WES staff. There are many potential actions that WES could undertake as a part of its surface water management program. The project team developed a list of actions that are most likely to assist WES in meeting its LOS goals in the near term. Additional potential actions that are not included in the current Action Plan may be incorporated by WES into longer term actions in the future.

The attached Action Description Sheets provide details on the actions. The Action Description Sheets include the following information:

- **Action Extent and Location.** Actions are categorized by action extent. Action extents include District wide (D), Kellogg-Mt. Scott, and Rock Creek (RC). These abbreviations are the first part of each action number, which is followed by a number. The final combination gives a unique identifier to each action.
- **Potential Lead and Partner Entities.** WES may lead some actions, whereas other actions may be led by the Clackamas County Department of Transportation and Development or other agencies.
- **District Lead Group and Supporting Groups.** Within WES, there will be functional work groups that lead each action, and other groups that support the action implementation.
- **Potential Funding Sources.** The potential funding sources listed are anticipated to provide the majority of funding for implementation of an action; additional funding sources may also be used for the actions.
- **Action Description.** The description includes a statement of need, a description of the proposed action and implementation steps, and a summary of the benefits of the action.
- **Planning Level Cost Estimate.** The planning level cost estimate assumptions are described and the initial year costs and ongoing costs are summarized. Costs include full time equivalent staff time as programmatic costs and other implementation costs as capital costs.

Summary of Actions

The Watershed Action Plan contains recommended capital improvement projects, programmatic measures and capital improvement programs that address watershed issues and opportunities identified in the Assessment Report. The Watershed Action Plan includes recommendations for both the Kellogg-Mt. Scott and Rock Creek watersheds, because those watersheds were evaluated at the same time.

Capital Improvement Projects

Capital improvement projects recommended in this plan include stream channel and restoration work in Dean, Mt. Scott, and Rock Creeks as well as construction of a regional decant facility. These actions are listed as capital projects because they are focused primarily on implementation of specific construction activities.

Programmatic Measures

The Action Plan proposes a variety of programmatic measures. Programmatic measures developed for this action plan include the continuation of current District programs and implementation of new programs, which are directed toward regulations, design standards, studies and monitoring, watershed enhancement, policy and practices, customer service, and coordination with other entities.

Capital Improvement and Programmatic Measures

The Action Plan proposes a variety of measures that include both capital improvements and programmatic elements within a larger program effort. The purpose of this approach is to provide the District with programs that will develop, implement, and monitor projects to improve basin hydrology, water quality, and aquatic habitat while also providing capital improvement funding for the implementation of those projects. There are many specific locations in the watersheds where capital projects could be implemented as a part of the combined capital improvement and programmatic measures, as described further in Chapter 5.

A summary table of the actions is provided in Table 6-1. Actions that include elements related to specific Stakeholder Group recommendations are noted. A more detailed summary table is provided at the end of this chapter, along with Action Description Sheets that provide detailed information on each action.

Prioritization

Actions were prioritized based on the action's capacity to meet the District LOS goals in a workshop setting with WES staff, using an LOS prioritization tool. The LOS prioritization tool is a decision-support tool for WES. The prioritization score for actions that results from the LOS prioritization process is one of the key factors considered in the implementation sequencing of the Action Plan. Other important considerations included current District opportunities, needs, and planned projects. Table 6-1 summarizes the high priority actions for 2009-2010 based on the LOS analysis and current District opportunities and needs.

The process for prioritizing the actions included the following steps:

1. Develop LOS goals and performance measures (described in Appendix D)
2. Evaluate current and anticipated future metrics for WES activities against LOS goals and performance measures. Determine the LOS gap for each performance measure (described in Appendix D).
3. Evaluate actions in terms of action's capacity to close the LOS gap for each performance measure using consistent LOS prioritization tool that provides scores for prioritization of each action.
4. Evaluate prioritization scores for each action as well as other factors such as current District opportunities, needs, and currently planned projects. Develop list of High Priority Actions for 2009-2010 implementation.
5. Adaptively manage Action Plan prioritization as needed to reflect changing priorities and opportunities.

Implementation

To implement the Action Plans, the WES Surface Water Management Steering Committee is conducting the following activities:

- Organizing work into Program Categories
- Developing multi-year budgeting outlook
  - Under current funding
  - Under proposed LOS funding

Implementation of the Action Plan will depend on the available resources. WES operates the Clackamas County Service District No. 1 (CCSD No. 1) and Surface Water Management Agency of Clackamas County (the Districts) and provides wastewater and surface water management services using revenue from several sources. The Surface Water Management Program for CCSD No. 1 is funded through three primary sources: monthly SWM utility fees, system development charges (SDCs), and permit fees. WES currently spends approximately $0.5 million annually on the existing programmatic elements of the Surface Water Management Program. These program elements are described in Appendix A. The amount of capital expenditures made by WES each year varies.

The recommended actions summarized in Table 6-1 describe programmatic activities and capital expenditures that will move WES toward meeting its LOS goals. It is anticipated that as part of implementing the WAPs, WES will evaluate resources and funding to support the Action Plans and to meet future LOS goals.

The estimated cost for implementing all recommended actions over a 5-year period is approximately $22.4 million, an average of approximately $4.5 million per year. The estimated cost for implementing the Action Plans over a 5-year period is presented in 2009 dollars. Of the approximately $4.5 million per year in expenditures recommended in the Action Plans, approximately $1.0 million (20 percent) is for programmatic elements and approximately $3.5 million (80 percent) is for capital expenditures.

Table 6-1. WES Watershed Action Plan Summary

Action name[1]	5-year cost (2009 dollars[2])	High priority 2009-2010	Stakeholder Rec's[3]
D-19 Stakeholder Communication Plan	$200,000	X	X
D-7 Update Erosion Control Protocol	$72,000	X	
RC-2 Regional Detention Prop Ac	$3,540,000	X	
D-3 Integrated Monitoring Program	$354,000	X	X
D-10 Benthic Macro Surveys	$390,750	X	X
D-4 Channel Morph Monitoring	$315,000	X	
D-11 Microbial Source Study	$106,000	X	
D-1 Update SW Design Standards	$355,200	X	X
D-5 Improve Riparian Buffer	$600,000	X	X
D-2 SW Detention Retrofit	$412,000	X	X
KMS-1 Enhanced Street Sweeping	$572,000	X	X
RC-1 Wetlands Reach RK5	$1,434,238		X
RC-5 Pilot Graham Ck Basin	$500,000		X
D-13 WET Retrofit Program	$1,400,000		X
KMS-3 Dean Creek Wetlands	$741,000		X
D-8 Erosion Control Hotline	$33,800		X
KMS-4 Mt. Scott in 3 Creeks	$253,692		X
D-20 Regional SW Task Force	$40,000		X
KMS-5 Flood-prone Culverts	$417,500		
KMS-6 Willing-seller Program	$2,048,000		X
D-12 Street Retrofit Program	$1,032,000		X
KMS-8 WQ Man-made Lakes	$43,375		X
D-14 Private WQ Inventory	$560,000		X
RC-4 Riparian Buffer Acq RC5	$270,000		X
RC-3 Riparian Buffer RK1 RK2	$76,000		X
KMS-9 Kellogg-for-Coho Init	$3,200		X
D-9 Track Flood Complaints	$20,000		
D-16 LWD w Partners	$133,750		X
KMS-2 Evaluate Low Summer Flow	$16,000		X
D-18 Improve fish passage	$1,667,000		X
D-17 Invasive Species Mgmt	$140,000		X
D-6 Upland Tree Canopy	$165,000		X
D-15 Riparian Buffer Analysis	$20,000		X
D-21 Regional Decant Facility	$2,000,000		

Table 6-1. WES Watershed Action Plan Summary			
Action name[1]	**5-year cost (2009 dollars[2])**	**High priority 2009-2010**	**Stakeholder Rec's[3]**
D-22 (AEX) Erosion Control	$330,145	X	
D-23 (AEX) Sampling/WQ	$170,960	X	
D-24 (AEX) Spills/Illicit Discharges	$68,435	X	
D-25 (AEX) Planning & Projects	$463,300	X	
D-26 (AEX) On-Site Maintenance	$885,165	X	
D-27 (AEX) Regulatory	$234,570	X	
D-28 (AEX) Customer Service Coordination	$102,035	X	
D-29 (AEX) Intergovernmental Coordination	$99,495	X	
D-30 (AEX) SWM Program Admin	$133,340	X	

[1] In the Action Names, "D" signifies a District-wide action, "KMS" signifies an action in the Kellogg-Mt. Scott watershed, "RC" signifies an action in the Rock Creek watershed, and "AEX" signifies an existing program element.

[2] Five-year cost estimates are in 2009 dollars and do not include inflation or the cost of capital.

[3] Denotes actions that include specific recommendations provided by Stakeholder Group.

ACTION PLAN SUMMARY
ACTION PLAN DESCRIPTION SHEETS

WES Watershed Action Plan - Summary of Actions
6-26-09

Action Number	Action Name	Action Type	Total Years Implemented (1-5)	Total Cost Unadjusted (2009 dollars)	Total Cost with combined Cost of Capital and Inflation of 3.2% (2009 dollars)
D-1 (EAP)	Update stormwater design standards	Programmatic	3	$ 355,200	$ 373,082
D-2 (EAP)	Evaluate and prioritize retrofit of stormwater detention facilities	Programmatic	5	$ 412,000	$ 459,827
D-3	Develop Integrated Monitoring Program	Programmatic	5	$ 354,000	$ 392,606
D-4	Channel Morphology monitoring	Programmatic	5	$ 315,000	$ 346,971
D-5	Improve riparian buffer with private landowners and partners	Programmatic and Capital	5	$ 600,000	$ 660,117
D-6	Improve upland tree canopy with private landowners and partners	Programmatic and Capital	5	$ 165,000	$ 181,532
D-7	Update Erosion Prevention and Sediment Control protocol	Programmatic	5	$ 72,000	$ 79,760
D-8 (EAP)	Add an erosion control hotline number and signs for construction sites	Programmatic	5	$ 33,800	$ 36,859
D-9	Track flooding complaints with DTD	Programmatic	5	$ 20,000	$ 22,004
D-10 (EAP)	Perform additional benthic macro-invertebrate surveys	Programmatic	5	$ 390,750	$ 429,901
D-11	Microbial Source Tracking study	Programmatic and Capital	1	$ 106,000	$ 109,392
D-12	Stormwater quality retrofit program for streets and street-related drainage	Programmatic and Capital	5	$ 1,302,000	$ 1,431,636
D-13	Stormwater quality retrofit program for institutional, commercial, and residential landowners	Programmatic and Capital	5	$ 1,400,000	$ 1,540,274
D-14	Private Water Quality facility inventory and inspections	Programmatic	5	$ 560,000	$ 618,837
D-15 (EAP)	Riparian buffer analysis and prioritization for enhancement	Programmatic	1	$ 20,000	$ 20,900
D-16	Add LWD with private landowners and partners	Programmatic and Capital	5	$ 133,750	$ 147,151
D-17	Targeted invasive species management	Programmatic and Capital	5	$ 140,000	$ 154,027
D-18	Improve Fish Passage	Programmatic	5	$ 1,667,000	$ 1,859,463
D-19	Stakeholder Involvement and Communications Plan Implementation	Programmatic	5	$ 200,000	$ 220,039
D-20	Regional Stormwater Task Force	Programmatic	5	$ 40,000	$ 44,008
D-21	Regional Decant Facility	Capital	1	$ 2,000,000	$ 2,064,000

WES Watershed Action Plan - Summary of Actions
6-26-09

Action Number	Action Name	Action Type	Total Years Implemented (1-5)	Total Cost Unadjusted (2009 dollars)	Total Cost with combined Cost of Capital and Inflation of 3.2% (2009 dollars)
KMS-1	Enhanced street sweeping	Programmatic	5	$ 572,000	$ 607,489
KMS-2	Investigate water rights and water withdrawals	Programmatic	1	$ 16,000	$ 16,512
KMS-3	Enhance Dean Creek wetlands and stream channel	Capital	3	$ 741,250	$ 787,608
KMS-4	Enhance Mount Scott Creek channel in Three Creeks Area	Capital	3	$ 253,692	$ 261,995
KMS-5	Evaluate flood-prone culverts and options for reducing impacts	Programmatic	2	$ 417,500	$ 442,881
KMS-6	Willing-seller property acquisition program	Programmatic and Capital	5	$ 2,048,000	$ 2,286,753
KMS-8 (EAP)	Evaluate water quality impacts of human-made lakes	Programmatic	1	$ 43,375	$ 44,763
KMS-9 (EAP)	Involvement in City of Milwaukie's Kellogg-for-Coho initiative	Programmatic	2	$ 3,200	$ 3,355
RC-1	Enhance Rock Creek wetlands in Reach RK5	Capital	3	$ 1,167,307	$ 1,240,504
RC-2	Evaluate regional detention needs and opportunities	Programmatic	5	$ 3,540,000	$ 3,894,692
RC-3	Enhance riparian buffer in reach RC1 and RC2	Programmatic and Capital	5	$ 76,000	$ 84,570
RC-4	Riparian buffer acquisition or conservation easements in reach RC5	Programmatic	5	$ 270,000	$ 297,053
RC-5	Pilot improvement basin in Graham Creek basin	Programmatic	5	$ 500,000	$ 550,098
D-22 (AEX)	Erosion Control - Existing Program Elements	Programmatic	5	$ 330,145	$ 363,224
D-23 (AEX)	Sampling/WQ - Existing Program Elements	Programmatic	5	$ 170,960	$ 188,089
D-24 (AEX)	Spills/Illicit Discharges - Existing Program Elements	Programmatic	5	$ 68,435	$ 75,292
D-25 (AEX)	Planning & Projects - Existing Program Elements	Programmatic	5	$ 463,300	$ 509,721
D-26 (AEX)	On-Site Maintenance - Existing Program Elements	Programmatic	5	$ 885,165	$ 973,855
D-27 (AEX)	Regulatory - Existing Program Elements	Programmatic	5	$ 234,570	$ 258,073
D-28 (AEX)	Customer Service Coordination - Existing Program Elements	Programmatic	5	$ 102,035	$ 112,258
D-29 (AEX)	Intergovernment Coordination - Existing Program Elements	Programmatic	5	$ 99,495	$ 109,464
D-30 (AEX)	SWM Program Admin - Existing Program Elements	Programmatic	5	$ 133,340	$ 146,700
	Total			$ 22,422,300	$ 24,447,300

Action Name:	Update Stormwater Design Standards						**Action #**	D-1 (EAP)
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**		
Action Location:	Multiple	-	-	-	-	-	-	- - -

Potential lead entity:	WES			**WES Lead:**	Asset Management	**Potential funding sources:**	WES (Rates)
Partner entities:	DTD Clackamas Co.	**Partner entities:**		**WES Support:**	Development Review	**Potential funding sources:**	
Partner entities:	City of Happy Valley	**Partner entities:**		**WES Support:**	Env. Policy & Watershed Health	**Potential funding sources:**	
Partner entities:	City of Damascus	**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Stormwater Design Standards for the Districts are used within the Districts and by the City of Happy Valley. DTD has also begun applying the Stormwater Design Standards to some development outside the Districts. The Stormwater Design Standards for the Districts are not serving the stormwater management needs of the Districts. To address the Districts interest in the application of Low Impact Development (LID), sustainable stormwater management techniques, and other enhancements to development practices to further protect water quality and ecosystem services the Stormwater Design Standards should be updated.

Proposed Action - Implementation Steps: Updating the Stormwater Design Standards would include developing updated guidance on stormwater technologies and design criteria to serve the needs of the Districts. Components of the revision typically include revising documents, revising standard detail drawings, stakeholder involvement, updating rules, regulations and ordinances, developing a sizing tool, and workshops for WES staff and developer design engineers. Other options include developing a graphically-focused handbook on LID specific to Clackamas County conditions to increase successful application of LID techniques by developers in the County.

Items to address during the update include:

1) Design storms - Determine if Districts will continue to use existing design storms or evaluate new design storms for water quality and quantity volume management
2) Volume requirements - Evaluate the benefits and costs of requiring control for a) small water quality storms and b) larger flood control storms
3) LID - Develop standard details and guidance for implementing on-site vegetated SW facilities in a variety of soil and slope conditions
4) Thresholds for new development - Determine if threshold for requiring SW treatment will be reduced from current requirements to increase re-developed areas adding SW treatment
5) Design guidance - Enhance standard details and design guidance to include additional guidance for attractive and functional pond design, process for creating SW facilities as neighborhood amenities, and providing adequate maintenance access
6) Buffer enhancement - Evaluate the benefits and costs of requiring riparian buffer enhancement during development linked to Title 13 requirements (similar to CWS requirements), and inspection and enforcement of buffers during infrastructure acceptance inspections
7) Design standards use and exemptions - Evaluate process for exemptions/exceptions, work with DTD to implement policy requiring use of design standards for all public and private projects, evaluate in-lieu-of fee options for regional flood detention.

Benefits of Action: Updating the Stormwater Design Standards could significantly improve or maintain water quality, reduce development-related flooding, and reduce hydromodification, in the short term in areas where there will be extensive new development and in the long term as areas are re-developed. The Happy Valley area and Damascus are two areas that could see short term results if anticipated development in these areas occurs.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.3	**Initial Programmatic FTE Cost:**	$ 24,000	**Initial Capital Cost Summary:**	$150,000	*$ 174,000*
Ongoing Programmatic FTE estimate:	0.20	**Ongoing Programmatic FTE Cost:**	$ 15,600	**Annual Ongoing Capital Cost (year 2 only)**	$150,000	*$ 165,600*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*2*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 355,200*

Action Name:	Update Stormwater Design Standards					**Action #**	D-1 (EAP)		
Action Type:	Programmatic		**Action Extent:**	District-wide		**Priority Ranking:**	-		
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued): Implementation includes the following steps:

1) Select WES project manager and project team, develop RFP for consultants
2) Review consultant proposals, select consultant team
3) Conduct meetings and workshops with consultant team and project team to address items listed on page 1 of action description
4) Develop new standards and design guidance
5) Conduct internal and external workshops to explain new standards and address questions

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: The estimated cost for this project will depend on the scope of the project including the level of modifications the Districts decide to make to the existing design standards, the complexity of the sizing tool, and the tasks the Districts decide to perform in-house. A high range cost estimate is provided below to reflect the upper end of the scope of the project. Assumes WES Project Manager - 1 staff 20 hours/month, 12 months; WES Project Review Team - 6 staff meet 24 times for 2 hours; Workshops - 12 staff meet 4 times for 2 hours;

Ongoing Cost Assumptions: Ongoing staff training - 6 staff meet 12 times for 2 hours per year during years 2 and 3 to review submitted/completed projects and evaluate benefits and drawbacks of design alternatives, discuss opportunities for improvements and lessons learned. Ongoing developer training - 3 staff meet with developers and development engineers 12 times per year for 3 hours during years 2 and 3 to educate developers on changes in the design standards and discuss opportunities for improvements and lessons learned. Preparation and materials for the developer trainings include 152 hours for staff to develop training program. An additional $150,000 was added for a consultant to continue more detailed work on the SW Design Standards in year 2, which could include development of a sizing tool.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.3	FTE	$ 80,000	$ 24,000
Consultant	1	each	$ 150,000	$ 150,000
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 174,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 174,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 174,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 2

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.07	FTE	$ 80,000	$ 5,600
Developer Training	0.125	FTE	$ 80,000	$ 10,000
Additional Consultant Work	1	each	$ 150,000	$ 150,000
				$ -
				$ -
Raw Cost				$ 165,600
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 165,600
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 165,600
Total Ongoing Cost Over Project Life (2009 dollars)				$ 181,200

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Evaluate and Prioritize Retrofit of SW Detention Facilities					**Action #**	D-2 (EAP)
Action Type:	Programmatic	**Action Extent:**	District-wide			**Priority Ranking:**	-

	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Asset Management	**Potential funding sources:**	WES (Rates)
Partner entities:	City of Happy Valley	**Partner entities:**		**WES Support:**	Stormwater Maintenance	**Potential funding sources:**	City of Happy Valley
Partner entities:	City of Damascus	**Partner entities:**		**WES Support:**		**Potential funding sources:**	City of Damascus
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	Grants

Action Description (see backside of sheet for more details)

Statement of Need: WES is currently responsible for maintaining over 260 stormwater treatment ponds in the Districts and Happy Valley. Over 30 ponds in the Districts have been identified by WES staff as potential opportunities to retrofit to function better. The ponds that WES maintains were originally designed and constructed with various functions in mind (e.g., differing levels of flood control and water quality treatment), and at different stages of understanding of stormwater treatment opportunities to improve watershed health. There are opportunities to retrofit existing ponds to improve their function to better meet WES' watershed health goals and improve maintenance.

Proposed Action - Implementation Steps: Create a stormwater treatment pond retrofit plan that would allocate annual CIP funds for the retrofit of several ponds each year. The estimated cost for retrofitting ponds ranges from $10,000 to $50,000 or more per pond for smaller scale projects. The recommended budget of $100,000 per year would provide funds to retrofit approximately 1-5 ponds per year, depending on the scope of the projects.

1. Identify employees with knowledge of SW dention retrofit needs and select WES project manager
2. Set project goals - goals should include amount of money to be spent annually on SW detention retrofit and detention pond performance
3. Prioritize detention pond retrofit projects
3. Identify partners and funding sources
4. Develop design and detailed cost estimate for projects - includes modeling to determine impacts on flooding
5. Secure project funding
6. Annually implement CIPs
7. Develop effectiveness monitoring element

See attached for a list of detention ponds in need of retrofit that was compiled by WES staff.

Benefits of Action:

Improvement of detention ponds could significantly improve stormwater quality and riparian conditions in the Districts

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.07	**Initial Programmatic FTE Cost:**	$ 5,600	**Initial Capital Cost Summary:**	$ -	$ 5,600
Ongoing Programmatic FTE estimate:	0.02	**Ongoing Programmatic FTE Cost:**	$ 1,600	**Annual Ongoing Capital Cost**	$100,000	$ 101,600
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		4
				Total Estimated 5-year Programmatic and Capital Cost		$ 412,000

Action Name:	Evaluate and Prioritize Retrofit of SW Detention Facilities					**Action #**	D-2 (EAP)		
Action Type:	Programmatic		**Action Extent:**	District-wide		**Priority Ranking:**	-		
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? Yes

Pathway for attachment(s): See attached figures and retrofit write up

Proposed Action - Implementation Steps (continued):

Examples of pond retrofits include adding berms and weirs to slow flow progress and create a low flow channel through the treatment area and increase treatment detention time, adding native vegetation to improve water quality treatment, making modifications to ensure ponds operate properly to avoid causing stream temperatures to increase, and making modifications to the outflow structures to provide detention for smaller storm events.

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

The first year cost includes design and prioritization of detention pond retrofits, capital improvements will follow in years 2-5

Ongoing Cost Assumptions:

1-5 detention ponds are retrofitted per year at an average annual cost of $100,000/year. Ongoing costs are annualized

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE Summary	0.07	FTE	$ 80,000	$ 5,600
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 5,600
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 5,600
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 5,600

Ongoing Cost Estimate: Project Lifetime (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE Summary	0.02	FTE	$ 80,000	$ 1,600
Annual Retrofit Budget	1	yr	$ 100,000	$ 100,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 101,600
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 101,600
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 101,600
Total Ongoing Cost Over Project Life (2009 dollars)				$ 406,400

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Develop and Implement Integrated Monitoring Program						**Action #**	D-3	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Monitoring & Regulatory	**Potential funding sources:**	WES (Rates)
Partner entities:	City of Happy Valley	**Partner entities:**		**WES Support:**	Env. Policy & Watershed Health	**Potential funding sources:**	
Partner entities:	City of Damascus	**Partner entities:**		**WES Support:**	Asset Management	**Potential funding sources:**	
Partner entities:	Nonprofit Groups	**Partner entities:**		**WES Support:**	Public Information	**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: WES conducts a variety of environmental monitoring activities including water quality (in-stream, outfall, special studies), continuous flow, benthic macroinvertebrate, fish monitoring, in-stream habitat, and erosion control program monitoring at locations throughout the KMS and RC watersheds as well as other watersheds in the Districts. Figure 3-1 in both Characterization Reports illustrates the current monitoring sites in the KMS and RC watersheds. There is an opportunity to enhance the effectiveness and usefulness of monitoring activities and analysis of monitoring data and studies to target questions regarding progress toward meeting level of service goals, environmental conditions, trends, and the proposed Watershed Health Index (WHI) metrics, and program effectiveness.

Proposed Action - Implementation Steps:
The WES Stormwater Steering Committee began evaluating the monitoring program in 2009. This action includes recommended steps for the Steering Committee monitoring program development as well as implementation cost estimates to use for planning purposes until a more detailed plan is developed.
1) Determine objectives and questions to be answered through monitoring program
2) Evaluate monitoring options for meeting objectives - on-going monitoring (hand sampling vs. automated sampling, wireless data collection), special studies, literature reviews, etc.
3) Prioritize monitoring program elements and develop schedule for program implementation
4) Identify staffing needs and consultant budgets for in-house and external monitoring implementation, sampling protocols, and data analysis
5) Implement integrated monitoring program, track results and annually evaluate effectiveness and potential improvements

Benefits of Action: Developing an integrated monitoring program will support informed stormwater management decision-making and meeting LOS service, as well as NPDES MS4 permit compliance.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.05	**Initial Programmatic FTE Cost:**	$ 4,000	**Initial Capital Capital Cost Summary:**	$ 30,000	*$ 34,000*
Ongoing Programmatic FTE estimate:	0.5	**Ongoing Programmatic FTE Cost:**	$ 40,000	**Annual Ongoing Capital Cost**	$ 40,000	*$ 80,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 354,000*

Action Name: Develop and Implement Integrated Monitoring Program
Action # D-3
Action Type: Programmatic **Action Extent:** District-wide **Priority Ranking:** -

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume WES Steering Sub-Committee forms and meets weekly to address monitoring questions and develop integrated monitoring program. Assume additional WES staff time of 18 hours per month for 6 months to assist in detailed program development. Assume consultant hired to assist in development of integrated monitoring program following completion of Watershed Action Plans.

Ongoing Cost Assumptions: Assume additional 0.5 FTE WES staff required to oversee monitoring program and analyze results. Assume lump sum for additional budget required to implement additional water quality monitoring. This action does not include cost to implement additional benthic macroinvertebrate, channel morphology, and microbial source tracking studies - those costs are addressed in actions D-4, D-10, and D-11, respectively.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.05	FTE	$ 80,000	$ 4,000
Consultant	200	hrs	$ 150	$ 30,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 34,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 34,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 34,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.5	FTE	$ 80,000	$ 40,000
Water quality monitoring	1	LS	$ 40,000	$ 40,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 80,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 80,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 80,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 320,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Channel Morphology Monitoring				**Action #**	D-4
Action Type:	Programmatic	**Action Extent:**	District-wide		**Priority Ranking:**	-

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	WES (Rates)
Partner entities:	City of Happy Valley	**Partner entities:**		**WES Support:**	Env. Monitoring & Regulatory	**Potential funding sources:**	
Partner entities:	City of Damascus	**Partner entities:**		**WES Support:**	GIS	**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Stormwater runoff affects watershed hydrology and stream hydraulics. Conducting channel cross-section monitoring to evaluate changing channel morphology conditions in a variety of locations throughout the watersheds will provide valuable information to WES about hydromodification impacts and channel stability. The ODFW surveys of streams has included some qualitative assessment of channel stability, however more detailed and quantitative data is needed.

Proposed Action - Implementation Steps:

Implementing a channel morphology monitoring program will include the following steps.

1) Select WES Project Manager, develop RFP for consultants, select consultant

2) Select monitoring sites (sections of channel 10-20 bankfull widths [500-1000 feet]); obtain landowner permission for access; Monument sites for permanent monitoring identification

4) Conduct monitoring • Longitudinal profile: Measurement of thalweg profile. Start and end locations should be identified clearly and photo points established.

• Cross sections: 3-5 per monitoring site. Cross-sections end points should be monumented out of the 100-year floodplain and photo points established.

• Pool depths: Maximum pool depth and residual pool depth should be measured in each pool throughout the monitoring reach. Repeat measurements, averaged will give you a sense of sedimentation within the reach.

• Pebble Counts: Surficial substrate conditions (Wolman, 1954) should be measured at a pool tail and within a riffle for each reach. Used to calculate D16, D50, and D84.

• Bulk sample: A bulk sample of bed conditions in a representative pool tail out should be taken according to McNeil and Ahnell (1964).

• Bank erosion: Bank conditions within the project reach should be assessed for active erosion. Changes in bank conditions is an important metric for understanding the impacts of geomorphic instability (e.g. – observed downcutting, etc).

5) Analyze monitoring results and develop recommended actions to address problems identified

6) Repeat monitoring at sites at every year and more frequently if significant development activity is occurring upstream.

Benefits of Action: Understanding hydromodification impacts and channel stability will assist in informed stormwater management decision-making, in assessing and meeting LOS, and potentially in compliance with future NPDES MS4 permit requirements.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.04	**Initial Programmatic FTE Cost:**	$ 3,200	**Initial Capital Cost Summary:**	$ 55,000	*$ 58,200*
Ongoing Programmatic FTE estimate:	0.04	**Ongoing Programmatic FTE Cost:**	$ 3,200	**Annual Ongoing Capital Cost**	$ 61,000	*$ 64,200*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 315,000*

Action Name: Channel Morphology Monitoring — **Action #** D-4

Action Type: Programmatic — **Action Extent:** District-wide — **Priority Ranking:** -

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued): Monitoring Site Recommendations:

Kellogg – Mt Scott: Lower Kellogg (confined reach) (KG1), Upper Kellogg (above Thiessen Road) (KG3a), Three Creeks Area (MS3), Mt. Scott (downstream of Sunnyside) (MS8.a), Mt Scott (steep reach) (MS10), Upper Mt. Scott (MS12.a), 2 Tributaries to compare to mainstem (MS11.b and PH1)

Rock Creek: Lower Rock Creek (below 224/212) (RK1), Middle Rock (below Sunnyside)(RK4), Middle Rock (between Sunnyside & Foster) (RK7), Tributary in Golf Course above Sunnyside (Unnamed trib of RK6), Upper Rock (RK7.a), Northern Branch of Rock Creek (RK6.b), 2 Tributaries to compare to mainstem (RK3.b and unnamed trib to east of RK6.a)

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume WES project manager provides 80 hours for project oversight and analysis. Assume consultant performs surveys and analysis for 20 sites (16 in KMS and RC, 4 in other watersheds), estimated cost of $2,000 per site which includes 2-person field crew and $250 lab fee to analyze bulk sample of soil. Assume consultant provides assistance with analysis and reporting for 20 sites, estimated cost of 100 hours.

Ongoing Cost Assumptions: Assumes monitoring performed every year, for four additional surveys during 5-year period after initial survey. Assume consultant provides assistance with analysis and reporting for 20 sites, with additional effort to compare results to prior surveys, estimated cost of 140 hours.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.04	FTE	$ 80,000	$ 3,200
Consultant - surveys	20	sites	$ 2,000	$ 40,000
Consultant - reporting	100	hours	$ 150	$ 15,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 58,200
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 58,200
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 58,200

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.04	FTE	$ 80,000	$ 3,200
Consultant - surveys	20	sites	$ 2,000	$ 40,000
Consultant - reporting	140	hours	$ 150	$ 21,000
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 64,200
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 64,200
Land Costs		acre	$100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 64,200
Total Ongoing Cost Over Project Life (2009 dollars)				$ 256,800

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Improve Riparian Buffer with Private Landowners and Partners					**Action #**	D-5
Action Type:	Programmatic & Capital	**Action Extent:**	District-wide			**Priority Ranking:**	-

	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	Grants
Partner entities:	DTD Clackamas Co.	**Partner entities:**	City of Happy Valley	**WES Support:**	Env. Monitoring & Regulatory	**Potential funding sources:**	WES (Devel. Fees)
Partner entities:	Parks Clackamas Co.	**Partner entities:**	City of Damascus	**WES Support:**	GIS	**Potential funding sources:**	
Partner entities:	City of Milwaukie	**Partner entities:**	PGE	**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Riparian canopies and upland forests have been altered and removed in portions of the watershed, leaving the streams open to increased heat gain from solar radiation. Increasing riparian buffer is recommended in reaches that have poor temperature, percent shade, and/or riparian buffer shade. Preservation and enhancement of streams generate ongoing, appreciating benefits to water quality, water quantity, and aquatic habitat. Increasing riparian buffer will support the TMDL implementation plan. The District has existing partnerships with Friends of Trees, Portland Revegetation Program, SOLV, Clackamas County CCSWCD, Clackamas River Basin Council, Tsunami Crew and others.

Proposed Action - Implementation Steps: Improving riparian buffer shade will require a coordinated effort between the District and private landowners and partners. This action will include continuation of existing partnerships for riparian planting targeted in reaches identified in the Assessment Report. The programmatic portion of this project will include prioritization of reaches where riparian buffer shade is to be added on an annual basis, measured in linear feet of riparian corridor. Planning this program will likely include coordination with one or more volunteer organization that would provide volunteer hours for implementation. The capital expense will include the purchase of trees, vegetation, revegetation supplies, permitting costs (if applicable) and staff's hours for supervison of planting and long-term maintenance work. Main responsibilities include:

(1) Identify willing landowners by working with non-profit watershed groups and Public Outreach staff. Target highest priority areas first but realize that it's important to take advantage of willing partners and landowners. Develop agreements for long-term access for maintenance.

(2) Prioritize reaches identified in Assessment Report based on physical factors such as temperature, fish habitat, and willing landowners. RK3B, RK5-7A, KG1-2, KG3A, KG4, MS1, MS5, MS7, MS9-11, MS12A are reaches identified in the Assessment Report. Also see Figures 2-11, 2-14, and 2-16 in the Rock Creek Assessment.

(3) Identify resources to help in the restoration, e.g., recruit volunteers, hire contractors, order supplies, and publicize planting events or completed projects.

(4) Develop restoration plans using Oregon Watershed Enhancement Board guidance or similar resources; coordinate with staff in the Parks Department for oversight and guidance, as appropriate.

(5) Plant new sites and manage existing sites, e.g., remove non-native plants and replace plants that didn't survive.

(6) Track planting locations in GIS.

Benefits of Action: The project provides the following benefits: helps meet permit requirements, reduce pollutant loads with structural BMPs, supports functioning aquatic ecosystems, improves water quality, improves aquatic habitat and biological communities, and builds effective partnering.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.25	**Initial Programmatic FTE Cost:**	$ 20,000	**Initial Capital Cost Summary:**	$100,000	*$ 120,000*
Ongoing Programmatic FTE estimate:	0.25	**Ongoing Programmatic FTE Cost:**	$ 20,000	**Annual Ongoing Capital Cost**	$100,000	*$ 120,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 600,000*

Action Name:	Improve Riparian Buffer with Private Landowners and Partners					**Action #**	D-5
Action Type:	Programmatic & Capital	**Action Extent:**	District-wide			**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**	
Action Location:	Multiple	-	-	-	-	-	- - - -

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Support of the Watershed Enhancement Technical Assisstance (WET) program would include funding of riparian enhancement projects. In addition, the District would form partnerships with volunteer groups and other organizations such as SOLV, Friends of Trees, Soil and Water Conservation District, Clackamas River Basin Council, streamside homeowners, Friends of Kellogg and Mt. Scott Creek Watersheds, and Tsunami Crew to implement planting projects. The District would also maintain its Inter-governmental agreement with City of Portland BES Revegetation Program for technical assistance. This program would be conducted in coordination with Actions D6-Improve upland tree canopy with private landowners and partners, D16-Add LWD with private landowners and partners, and D17-Targeted invasive species management.

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: 0.25 FTE per year to establish and run the program including maintaining GIS records of completed projects. $100,000 per year to fund riparian planting through WET and continue agreements with up to 12 existing groups including Friends of Trees, SOLV, SWCD, BES Reveg Program Intergovernmental Agreement.

Ongoing Cost Assumptions: 0.5 FTE and $100,000 per year to continue Initial Year approach.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.25	FTE	$ 80,000	$ 20,000
WET Funding	1	LS	$ 25,000	$ 25,000
PSA's with non-profits	1	LS	$ 75,000	$ 75,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 120,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 120,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 120,000

Ongoing Cost Estimate: Project Lifetime (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.25	FTE	$ 80,000	$ 20,000
WET Funding	1	LS	$ 25,000	$ 25,000
PSA's with non-profits	1	LS	$ 75,000	$ 75,000
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 120,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 120,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 120,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 480,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Improve Upland Tree Canopy with Private Landowners and Partners					**Action #**	D-6
Action Type:	Programmatic & Capital	**Action Extent:**	District-wide			**Priority Ranking:**	-

	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	Grants
Partner entities:	Parks Clackamas Co.	**Partner entities:**		**WES Support:**	Env. Monitoring & Regulatory	**Potential funding sources:**	Other
Partner entities:	Nonprofit Groups	**Partner entities:**		**WES Support:**	GIS	**Potential funding sources:**	WES (Rates)
Partner entities:	CCSWCD	**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Conversion of land to impervious surfaces has resulted in hydrologic changes including reduced evapotranspiration, increased stormwater runoff, and changes to stream channels, also known as hydromodification. Maintaining, and where possible increasing, upland tree canopy in the watershed will likely decrease stormwater runoff and associated hydromodification impacts and may also improve upland habitat quality and connectivity. There is an opportunity to develop a Tree Protection Ordinance to preserve existing trees and provide mitigation for tree removal. There is also an opportunity to increase upland tree canopy by providing assistance the public to plant trees on private property.

Proposed Action - Implementation Steps: This action will inlcude work with the County on developing a Tree Protection Ordinance and work with willing landowners on planting additional trees. Recommended steps include:

(1) Set project goals - how many trees in how many years and where. For example, focus on a targeted area such as Upper Kellogg Subbasin, Lower Mt. Scott Subbasin, Phillips Subbasin or the Cedar Subbasin every two years.

(2) Recommend type of plants to be used. For example, use bare-root and 1-gallon and larger (1-inch caliper) native trees and shrubs provided through the District, and plant the densities and composition outlined in the District's stormwater standards (or another source), as appropriate.

(3) Determine how to implement. For example, use non-proft groups, contractors or work crews provided through or approved by the District to conduct site preparation and maintenance. Have the District coordinate technical aspects of site preparation, revegetation, and maintenance and monitoring activities.

(4) Conduct outreach. For example, coordinate neighborhood and community involvement and media for event-based streamside projects on public land.
Assist private landowners with technical and material assistance from the District.

(5) Financial considerations. For example, collaborate with cities and Metro to provide financial, community awareness, and pre-event mobilization support. Individual cities may choose to participate in additional project elements as appropriate.

(6) Track planting locations in GIS.

The professional services agreement with Friends of Trees (FOT) currently in place for riparian plantings should be expanded to include upland areas. This program would be conducted in coordination with D5-Improve riparian buffer with private landowners and partners, D16-Add LWD with private landowners and partners, and D17-Targeted invasive species management.

Benefits of Action: This action will benefit watershed health by improving hydrology and geomorphology.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.1	**Initial Programmatic FTE Cost:**	$ 8,000	**Initial Capital Cost Summary:**	$ 25,000	*$ 33,000*
Ongoing Programmatic FTE estimate:	0.1	**Ongoing Programmatic FTE Cost:**	$ 8,000	**Annual Ongoing Capital Cost**	$ 25,000	*$ 33,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 165,000*

Action Name:	Improve Upland Tree Canopy with Private Landowners and Partners						**Action #**	D-6		
Action Type:	Programmatic & Capital		**Action Extent:**	District-wide			**Priority Ranking:**	-		
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: 0.10 FTE in first year to develop goals and program and track progress in GIS; 0.10 FTE in later years to maintain program. Expand professional services agreemen (PSA) with Friends of Trees (FOT) currently in place for riparian plantings to include upland areas. Public outreach costs. One large volunteer event coordinated by Friends of Trees is approximately $6,500 and includes coordination, public outreach, plants, and supplies.

Ongoing Cost Assumptions: Assumed costs are the same in subsequent years.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
FOT PSA	1	year	$ 25,000	$ 25,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 33,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 33,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 33,000

Ongoing Cost Estimate: Project Lifetime (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
FOT PSA	1	years	$ 25,000	$ 25,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 33,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 33,000
Land Costs		acre	$100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 33,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 132,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Update Erosion Prevention and Sediment Control (ERCO) protocol						**Action #**	D-7	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Erosion Prevention & Control	**Potential funding sources:**	WES (Devel. Fees)
Partner entities:	DEQ	**Partner entities:**		**WES Support:**	Env. Monitoring & Regulatory	**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**	WES GIS	**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**	Development Review	**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: ERCO improves water quality and habitat by reducing sediment loading; minimizes maintenance problems in the storm drainage system from sediment deposition in pipes, and reduces land loss from erosion. In addition, ERCO is part of the County's compliance efforts with their stormwater NPDES permit. Updating the ERCO protocol will prioritize inspections on projects with the highest potential for erosion problems.

Proposed Action - Implementation Steps: This project will explore the following steps to enhance the ERCO protocol:
- Keep erosion control in permit preconsultation process and prioritize inspections by rating sites when permit application is submitted. This includes identifying areas at high risk for erosion based on steep slopes and erodible soils (slopes > 30% *or* soils with a soil erodibility k-factor of 0.25 or greater) using GIS and considering time of year, developer history, seasonal impact, watershed, complaints, site severity, and phase.
- Consider requiring an erosion control permit be issued before other permits are issued and complete a field check prior to permit issuance. Require Owners Rep call District to schedule field visit.
- Develop inspection frequency schedule based on site priority rating. For example, sites with slopes > 30% have inspections conducted pre-construction to discuss BMPs, at the start of construction to check BMPs, during or after major rainfall events, and post-construction.
- Document inspections. For example, develop a report card with a checklist for BMPs that can be provided to the contractor and kept by the District for reference. Track information in Permits 2008 or IVR.
- Implement enforcement actions. For example, consider a fine or stop work order for Owners who start construction without erosion control inspection. Establish ongoing fees if the erosion control permit is not closed.
- Review site inspection data to continually improve process. For example, monitor whether or not site visits improve BMP performance.
- Establish level of service for erosion and grading control.

Benefits of Action: This action will provide the following watershed benefits: reduce pollutant loads with structural BMPs, improve water quality, reduce water quality impacts of construction, monitor data used for decision-making, meet development needs, and protect ecosystem services.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.1	**Initial Programmatic FTE Cost:**	$ 8,000	**Initial Capital Cost Summary:**	$ -	*$ 8,000*
Ongoing Programmatic FTE estimate:	0.2	**Ongoing Programmatic FTE Cost:**	$ 16,000	**Annual Ongoing Capital Cost**	$ -	*$ 16,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 72,000*

Action Name: Update Erosion Prevention and Sediment Control (ERCO) protocol **Action #** D-7

Action Type: Programmatic **Action Extent:** District-wide **Priority Ranking:** -

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: During the first year of implementation, the project will need to complete GIS analysis, develop new protocol, and train staff. Estimated effort of 200 hours or 0.10 FTE From July 2007 through June 2008 there were 817 erosion control permits issued. If there is an average of 1 more inspection per site, at 2 hours per inspection, and another 20 minutes for additional documentation, the additional inspections and documentation come to 1,904 hours or 0.92 FTE. However, due to the recent lag in development activity, the estimated FTE estimate is 0.1 for year one and 0.2 for the following years. This cost will need adjustment when development activitiy increases.

Ongoing Cost Assumptions: Assume 0.2 additional FTE per year needed for additional site inspections.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 8,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 8,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 8,000

Ongoing Cost Estimate: Project Lifetime (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.2	FTE	$ 80,000	$ 16,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 16,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 16,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 16,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 64,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Erosion Control Hotline and Signs for Construction Sites						**Action #**	D-8 (EAP)
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**		
Action Location:	Multiple	-	-	-	-	-	-	- - -

Potential lead entity:	WES			**WES Lead:**	Erosion Prevention & Control	**Potential funding sources:**	WES (Devel. Fees)
Partner entities:		**Partner entities:**		**WES Support:**	Public Information	**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: A hotline phone number for citizens to report poor erosion control practices at construction sites will make contractors accountable to the public. It will encourage contractors to install and maintain erosion control best management practices which reduce sediment load to stormwater stystems and local waterways. Due to the significant cost in maintaining stormwater systems and the sediment impacts and damage to watershed health that can occur from construction site erosion, it is a high priority to improve the effectiveness of erosion control.

Proposed Action - Implementation Steps: This project requires WES staff time to implement and additional funds to create signs for construction sites. Steps include the following:

- Communicate with other jurisdictions that have an erosion control hotline to review signs and hear lessons learned.
- Research costs related to a 1-800 number by calling the local phone company and researching potential providers. Costs range from less than a nickel to more than a quarter per minute.
- Determine if hotline will use new 1-800 number, existing WES number, or new WES number.
- Create a template for the District.
- Update Stormwater Standards and Erosion Control Manual to require sign placement on construction sites that are visible by the public.
- Develop plan for receiving calls (recorded system, live receptionist with after-hours recorded system) and a response plan to phone calls. For example, develop process for determining if it is a priority site and whether it warrants a site visit, enforcement action, etc.
- Develop database to log calls that can be cross-referenced with Grading Permits.
- Educate Erosion Control Inspectors and administration staff about new system.

Benefits of Action: This action will reduce pollutant loads, improves water quality, reduce water quality impacts of construction, provide data for decision making, and assist with effective public outreach.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.07	**Initial Programmatic FTE Cost:**	$ 5,600	**Initial Capital Cost Summary:**	$ 5,000	*$ 10,600*
Ongoing Programmatic FTE estimate:	0.06	**Ongoing Programmatic FTE Cost:**	$ 4,800	**Annual Ongoing Capital Cost**	$ 1,000	*$ 5,800*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 33,800*

Action Name:	Erosion Control Hotline and Signs for Construction Sites					**Action #**	D-8 (EAP)
Action Type:	Programmatic		**Action Extent:**	District-wide		**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**	
Action Location:	Multiple	-	-	-	-	-	- - - -

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Includes one-time cost for staff or consultants to develop the sign format and create 1,000 waterproof signs for distribution. In the first year this is assumed at 0.02 FTE, and 0.01 FTE in subsequent years. The existing WES service request phone number could be used as an erosion control hotline number and costs are not included for an additional phone number. An additional 0.05 FTE will be needed on an ongoing basis for response to phone calls.

Ongoing Cost Assumptions: Replace 200 signs per year for wear and tear.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.07	FTE	$ 80,000	$ 5,600
Signs	1000	sign	$ 5	$ 5,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 10,600
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 10,600
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 10,600

Ongoing Cost Estimate: Project Lifetime (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.06	FTE	$ 80,000	$ 4,800
Signs	200	signs	$ 5.00	$ 1,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 5,800
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 5,800
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 5,800
Total Ongoing Cost Over Project Life (2009 dollars)				$ 23,200

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Track Flooding Compliants with DTD						**Action #**	D-9	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Asset Management	**Potential funding sources:**	WES (Rates)
Partner entities:	DTD Clackamas Co.	**Partner entities:**	Co. Emergency Mangmer	**WES Support:**	Customer Service	**Potential funding sources:**	
Partner entities:	City of Happy Valley	**Partner entities:**		**WES Support:**	Stormwater Maintenance	**Potential funding sources:**	
Partner entities:	City of Damascus	**Partner entities:**		**WES Support:**	Public Information	**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Localized and regional flooding occurs periodically in flood-prone areas of the KMS and RC watersheds. Flooding has been observed in the past associated with culverts and bridges at road crossings of the streams, in developed areas adjacent to or near streams, and in areas where stormwater infrastructure requires emergency maintenance. DTD responds to roadway flooding in some areas. Some customer complaints about flooding are reported to the WES Customer Service phone number, where they are logged and maintenance crews respond as appropriate. However, during large storm events in January 2009, many areas experienced flooding and there were very few customer flooding complaints reported to WES. With limited customer complaint information, it is difficult to evaluate flooding issues that WES and DTD may have opportunities to address. There is an opportunity for WES and DTD to track flooding complaints in a coordinated effort to identify flood-prone areas and potential solutions for implementation.

Proposed Action - Implementation Steps:

Implementation of this action includes the following steps:

1) WES and DTD meeting to discuss known flood-prone areas, current methods of receiving flooding complaints, and potential enhancements to coordinate tracking of flooding complaints
2) WES and DTD assign flooding-response coordination team (including maintenance, engineering, and asset management staff) to track flooding problems and meet periodically to review problems and identify potential solutions for implementation
3) WES and DTD develop Captial and Programmatic projects as appropriate to implement feasible solutions

Benefits of Action: Identifying and tracking flooding complaints provides useful information about flood-prone areas and flooding frequencies and severity.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.05	**Initial Programmatic FTE Cost:**	$ 4,000	**Initial Capital Cost Summary:**	$ -	*$ 4,000*
Ongoing Programmatic FTE estimate:	0.05	**Ongoing Programmatic FTE Cost:**	$ 4,000	**Annual Ongoing Capital Cost**	$ -	*$ 4,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 20,000*

Action Name:	Track Flooding Compliants with DTD					**Action #**	D-9
Action Type:	Programmatic		**Action Extent:**	District-wide		**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**	
Action Location:	Multiple	-	-	-	-	-	- - - -

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume combined WES staff time of 18 hours per month for 6 months per year for flooding-response coordination team to track and review information on flooding complaints, meet periodically, and develop potential solutions with DTD. DTD staff time will be additional. Implementation of solutions will require additional staff time and capital and/or programmatic budget.

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.05	FTE	$ 80,000	$ 4,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 4,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 4,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 4,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.05	FTE	$ 80,000	$ 4,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 4,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 4,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 4,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 16,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Additional Benthic Macroinvertebrate Surveys						**Action #**	D-10 (EAP)	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	WES (Rates)
Partner entities:	City of Milwaukie	**Partner entities:**		**WES Support:**	Env. Monitoring & Regulatory	**Potential funding sources:**	
Partner entities:	City of Happy Valley	**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:	City of Damascus	**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Benthic macroinvertebrate surveys provide extremely valuable information about long-term aquatic habitat conditions, water quality, and watershed health. WES contracted with a consultant to perform benthic macroinvertebrate surveys at 24 locations in the SWACC and CCSD No. 1 Districts in 2008. Seven (7) of these sites are located in the KMS watershed and three (3) are in the RC watershed. Of these sites, only five sites are in riffles and were appropriate to use for the Watershed Health Index (WHI). In order to expand the areas where the WHI can be calculated and to expand the data available to use in setting management goals and tracking the effect of WES activities, it would be useful to expand the benthic macroinvertebrate monitoring program to include additional sites and greater frequency of sampling.

Proposed Action - Implementation Steps:
Implementation of this action includes the following steps:
1) Contract with a consultant to perform benthic macroinvertebrate surveys at 35 riffle sites in the Districts, including 11 sites in the KMS watershed, 7 sites in the RC watershed, and 17 sites in additional watersheds.
See attached map for recommended survey locations in KMS and RC watershed *(Map to be provided by Ellis)*
Consultant to provide taxonomic analysis of macroinvertebrates, including chironomidae to subfamily level. Consultant to assist WES with development of WHI based on benthic macroinvertebrate sampling results.
2) Conduct benthic macroinvertebrate surveys at same locations every year (5 times total in 5-year period).

Benefits of Action: Performing additional benthic macroinvertebrate surveys will support the evaluation of watershed health through the Watershed Health Index (WHI) and support informed stormwater management decision-making and meeting LOS service.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.08	**Initial Programmatic FTE Cost:**	$ 6,400	**Initial Capital Cost Summary:**	$ 71,750	*$ 78,150*
Ongoing Programmatic FTE estimate:	0.08	**Ongoing Programmatic FTE Cost:**	$ 6,400	**Annual Ongoing Capital Cost**	$ 71,750	*$ 78,150*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 390,750*

Action Name: Additional Benthic Macroinvertebrate Surveys **Action #** D-10 (EAP)

Action Type: Programmatic **Action Extent:** District-wide **Priority Ranking:** -

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? Yes

Pathway for attachment(s): *Map to be provided by Ellis with recommended locations*

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume WES project manager provides 160 hours for project oversight and analysis. Assume consultant performs surveys and analysis for 35 sites, estimated cost of $1,750 per site. Assume consultant provides assistance with WHI calculation for 35 sites, estimated cost of 70 hours.

Ongoing Cost Assumptions: Assume surveys, analysis, and WHI calculations performed annually for four years after year 1.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.08	FTE	$ 80,000	$ 6,400
Consultant - surveys	35	sites	$ 1,750	$ 61,250
Consultant - WHI assista	70	hours	$ 150	$ 10,500
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 78,150
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 78,150
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 78,150

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.08	FTE	$ 80,000	$ 6,400
Consultant - surveys	35	sites	$ 1,750	$ 61,250
Consultant - WHI assistance	70	hours	$ 150	$ 10,500
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 78,150
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 78,150
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 78,150
Total Ongoing Cost Over Project Life (2009 dollars)				$ 312,600

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Microbial Source Tracking Study						**Action #**	D-11	
Action Type:	Programmatic & Capital		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Monitoring & Regulatory	**Potential funding sources:**	WES (Rates)
Partner entities:	City of Milwaukie	**Partner entities:**	CCSWCD	**WES Support:**	Env. Policy & Watershed Health	**Potential funding sources:**	City of Milwaukie
Partner entities:	City of Happy Valley	**Partner entities:**	OSU	**WES Support:**		**Potential funding sources:**	City of Happy Valley
Partner entities:	City of Damascus	**Partner entities:**		**WES Support:**		**Potential funding sources:**	City of Damascus

Action Description (see backside of sheet for more details)

Statement of Need: Elevated levels of E. coli bacteria, a key indicator of water contact human health issues, have been found throughout the RC and KMS watersheds. Additionally, a TMDL has been established in the watersheds which requires in-stream reductions of E. coli. Although there are many potential sources of E. coli in streams, including wildlife, pets, livestock, and humans, the actual sources of E. coli in the watersheds are not well understood at this time. WES currently collects E. coli samples at 8 sites in the KMS and RC watersheds.

Proposed Action - Implementation Steps: Use microbial source tracking (MST) methods for source identification and BMP targeting. MST methods can help identify the sources of fecal contamination in surface waters, such as humans, wildlife, pets, or livestock. Action plan includes the following steps:

1. Select site and sampling plan based on contributing area land use and known E. coli exceedances within the watersheds. The watershed assessment reports found high concentrations of E. coli bacteria in the Mt. Scott, Phillips, and Kellogg Creek subbasins. For example, high E. coli levels were found in reaches KG2, KG4 and KG4A of the Upper Kellogg Subbasin.
2. Select type of MST analysis method. MST methods can be grouped into library dependent methods (LDMs) and library independent methods (LIMs). LDMs require databases of genotypic or phenotypic fingerprints for bacterial strains isolated from suspected fecal sources, i.e., cows, birds, dogs, cats and humans. LIMs do not depend on the isolation of a targeted source identifier but instead depend on identifying the bacteria and viruses grown in collected water samples in a lab environment, which are traced to specific hosts or sources of fecal contamination.
Typically, taking a multi-tiered approach, moving from general to specific and from less to more expensive testing is most efficient and economical. After each step, progress can be assessed before deciding to move to the next one. For example, the first step could simply involve visual inspection followed by sampling and analysis of E. coli upstream and downstream of a potential source. If the results are inconclusive, additional MST analysis could be performed.
3. Implement sampling plan, review results and identity potential E. coli sources.
4. Target BMPs and develop outreach program to identified sources.

Benefits of Action: With a better understanding of E. coli sources, BMP can be targeted to reducing E. coli contamination from specific sources. Reduction in E. coli assists Districts in TMDL implementation, in meeting District's benchmark for the Lower Willamette River and improves stream water quality.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.1	**Initial Programmatic FTE Cost:**	$ 8,000	**Initial Capital Cost Summary:**	$ 98,000	*$ 106,000*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ -	*$ -*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*0*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 106,000*

Action Name:	Microbial Source Tracking Study					**Action #**	D-11
Action Type:	Programmatic & Capital	**Action Extent:**	District-wide			**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**	
Action Location:	Multiple	-	-	-	-	-	- - - -

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

Assume project is conducted by consultant with WES project management. Assume WES project manager will spend 20 hours per month on project for 8 months. Assume consultant will spend 40 hours per month on project for 8 months. Assume 500 samples collected for MST analysis in accordance to selected sampling plan.

Ongoing Cost Assumptions: Assume project is completed in one year and no ongoing costs.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
MST Method Samples	500	Sample	$ 100	$ 50,000
Consultant	320	Hour	$ 150	$ 48,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 106,000
Engineering, Administration, Contingency*			35%	
Sub-total				$ 106,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 106,000

Ongoing Cost Estimate: Project Lifetime (yrs) 0

Item	Quantity	Unit	Unit Cost	Estimated Cost
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ -
Total Ongoing Cost Over Project Life (2009 dollars)				$ -

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Stormwater Quality Retrofit Program for Streets and Street-Related Drainage						**Action #**	D-12	
Action Type:	Programmatic & Capital		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	DTD Clackamas Co.			**WES Lead:**	Asset Management	**Potential funding sources:**	WES (Devel. Fees)
Partner entities:	WES	**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:	Private	**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Although stormwater treatment is required for new development, many existing roads lack adequate structural stormwater treatment facilities. Uncontrolled runoff from imperious surfaces contributes to a variety of water quality problems and is therefore an important watershed stressor to evaluate.

Proposed Action - Implementation Steps: In collaboration with DTD and WES, this action will develop a stormwater quality BMPs retrofit and prioritization program for existing roads within the watersheds. Action includes the following steps:

1. Identify areas within known impaired watersheds where retrofits would improve water quality. For example, assessment reports suggested retrofits in the contributing areas to reaches KG3, KG3A, MN1, and CD1 would improve water quality. Action would focus primarily on streets with adequate space for BMP retrofits, higher traffic volumes, and opportunities for improvements during planned repair or other construction.
2. DTD staff and WES staff meet to periodically to coordinate stormwater retrofits into future road repair projects in previously identified areas. Retrofits can coincide with scheduled road repairs. In addition to the retrofit of structural treatment systems, non-structural BMPs in the watershed can also be implemented.
3. Each identified area will have a unique stormwater retrofit to match the conditions of the site and water quality issues. For example, ditches can be converted into water treatment swales that meet the current infiltration requirements and adjacent drainage can be directed into the new swales to improve water quality from a greater area. Curb cuts and planter boxes can also be installed during street improvements.

Benefits of Action: Stormwater treatment from imperious surfaces, such as highly traveled roads, can decrease pollutant transport into the streams, improving water quality and stream health.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.25	**Initial Programmatic FTE Cost:**	$ 20,000	**Initial Capital Cost Summary:**	$250,000	*$ 270,000*
Ongoing Programmatic FTE estimate:	0.1	**Ongoing Programmatic FTE Cost:**	$ 8,000	**Annual Ongoing Capital Cost**	$250,000	*$ 258,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 1,302,000*

Action Name:	Stormwater Quality Retrofit Program for Streets and Street-Related Drainage						**Action #**	D-12	
Action Type:	Programmatic & Capital		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume WES 0.25 FTE includes coordination with DTD staff in assisting in site selection, project design, implementation, and evaluation of effectiveness. Assume WES to provide up to $250,000 per year in capital funding to assist DTD in implementation, funding 2-10 projects per year (implementation assistance). This assumes implementation will support construction costs as well as engineering and administration. Cost estimation assumes DTD to provide staff for project coordination, engineering design and construction management.

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.25	FTE	$ 80,000	$ 20,000
Implementation Assistar	1	yr	$ 250,000	$ 250,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 270,000
Engineering, Administration, Contingency*			35%	
Sub-total				$ 270,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 270,000

Ongoing Cost Estimate: Project Lifetime (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
Implementation Assistance	1	yrs	$ 250,000	$ 250,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 258,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 258,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 258,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 1,032,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Stormwater Quality Retrofit Program for Institutional, Commercial, and Residential Landowners						**Action #**	D-13	
Action Type:	Programmatic & Capital		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Asset Management	**Potential funding sources:**	WES (Devel. Fees)
Partner entities:	City of Happy Valley	**Partner entities:**	Nonprofit Groups	**WES Support:**	Stormwater Maintenance	**Potential funding sources:**	City of Milwaukie
Partner entities:	City of Milwaukie	**Partner entities:**	Private	**WES Support:**	WES GIS	**Potential funding sources:**	City of Happy Valley
Partner entities:	City of Damascus	**Partner entities:**	CCSWCD	**WES Support:**	Public Information	**Potential funding sources:**	City of Damascus

Action Description (see backside of sheet for more details)

Statement of Need: Untreated runoff from impervious surfaces contributes to a variety of water quality problems. In general, older developments in the KMS and RC lack structural stormwater BMPs. This results in only small portions of the watersheds which currently treat stormwater runoff from residential, commercial or institutional land. The existing Watershed Stewardship Program recently ended due to lack of public participation and interest as well as limited WES staff availability to promote the program. There is a need to develop a new technical assistance program to help private landowners identify and implement stormwater retrofit projects as well as other watershed enhancement projects. This new program should work in the conjunction with the CCSWCD Low Impact Development Program.

Proposed Action - Implementation Steps: This action includes a recommendation to develop a new technical assistance program for watershed improvement called the Watershed Enhancement Technical Assistance Program (WET). This program would include technical assistance and capital funding to support stormwater retrofits. Other program elements of the proposed WET program are described in Action D-5. This action would also include collaborating with nonprofit groups and engaging private landowners to participate the WET program. Action includes the following steps:

1. Define and prioritize areas to focus WET program efforts. Areas with high levels of imperviousness, which lack stormwater treatment systems, are areas to consider for high prioritization. These areas would be retrofitted with site design modifications to allow more stormwater runoff to be stored, treated, and infiltrated within vegetated areas or other treatment systems. For example, churches, schools, and commercial areas could install swales and vegetated stormwater treatment facilities in parking lots. Residential landowners could install swales or other vegetated stormwater facilities near their homes or adjacent to roads.
2. Develop an outreach program to target locations based on prioritization, as well as seek out participants which would be able to assist in implementation. For example, members of HOAs, schools, churches, and rotary clubs may desire to help improve water quality in their local watersheds. Watershed councils and nonprofit groups could also assist in promoting the WET program and help engage the surrounding communities.
3. Develop technical materials, 'how to' manuals, and guidelines to help assist participants. For example, materials could include explanations and examples of techniques to reduce runoff and improve water quality from impervious surfaces, such as how to implement low impact development (LID) techniques.
4. Review WET program applications, select participants, assist in implementation of projects and monitor effectiveness.

Benefits of Action: Improve watershed water quality by localized stormwater treatment. Retrofitting developed areas with LID techniques and regional stormwater treatment systems where feasible can help reduce the effective imperviousness of a watershed and improve watershed health.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	1	**Initial Programmatic FTE Cost:**	$ 80,000	**Initial Capital Cost Summary:**	$200,000	*$ 280,000*
Ongoing Programmatic FTE estimate:	1	**Ongoing Programmatic FTE Cost:**	$ 80,000	**Annual Ongoing Capital Cost**	$200,000	*$ 280,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 1,400,000*

Action Name: Stormwater Quality Retrofit Program for Institutional, Commercial, and Residential Landowners **Action #** D-13

Action Type: Programmatic & Capital **Action Extent:** District-wide **Priority Ranking:** -

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume WET program will sponsor up to 10 stormwater retrofit projects per year at a cost of approximately $20,000 per project. Assume 1.0 FTE WES staff coordination, planning, outreach, technical assistance, and implementation. Assume watershed council and other nonprofits provide volunteers support for outreach and implementation.

Ongoing Cost Assumptions: Assume WET will sponsor up to 10 stormwater retrofit projects per year at a cost of approximately $20,000 per project. Assume 1.0 FTE WES staff coordination, planning, outreach, technical assistance, and implementation. Assume watershed council and other nonprofits provide volunteers support for outreach and implementation.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	1	FTE	$ 80,000	$ 80,000
Implementation	10	each	$ 20,000	$ 200,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 280,000
Engineering, Administration, Contingency*			35%	
Sub-total				$ 280,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 280,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	1	FTE	$ 80,000	$ 80,000
Implementation	10	each	$ 20,000	$ 200,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 280,000
Engineering, Administration, Contingency*			35%	
Sub-total				$ 280,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 280,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 1,120,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Private Water Quality Facility Inventory and Inspections						**Action #**	D-14	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Stormwater Maintenance	**Potential funding sources:**	WES (Rates)
Partner entities:	Private	**Partner entities:**		**WES Support:**	Customer Service	**Potential funding sources:**	
Partner entities:	DTD Clackamas Co.	**Partner entities:**		**WES Support:**	WES GIS	**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Maintenance for private water quality facilities varies based on type of ownership. Private residential water quality facilities are maintained by either private homeowners or by WES staff through maintenance agreements. Private commercial water quality facilities are required to maintain their facilities, however, few of these accounts actively maintain their facilities. WES has maintenance agreements for approximately 260 private stormwater facilities, mostly in residential areas. Currently, only 5 to 10 percent of the residential systems have been inspected through the preventative maintenance program for stormwater assets. WES is developing a maintenance management system to increase regular maintenance inspection. Currently, more time is often spent in response to emergency maintenance activities than with scheduled or routine maintenance efforts. Private water quality treatment facilities without a maintenance agreement are not inspected and there is no assurance to WES that they are properly functioning or maintained. Poorly maintained facilities may not provide adequate treatment.

Proposed Action - Implementation Steps:

1. Continue with preventative maintenance program for stormwater assets for residential customers and with the Storm Drain Cleaning Assistance Program for commercial and industrial customers. Residential program to continue to transfer maintenance from residential customers to WES and commercial/industrial program to transfer maintenance to private companies. WES may be requiring a letter from each potential landowner that proves that the required maintenance was performed by an outside contractor. WES maintenance staff involvement could be minimized for these facilities.
2. Improve inspection and tracking of residential stormwater assets with the computerized maintenance management system (CMMS) and integrate GIS tools to help better manage and link water quality facilities to watershed health. Refine database of applicable properties.
3. Investigate enforcement of non-compliance residential and commercial customers.
4. Revaluate both residential and commercial/industrial programs in 5 years.

Benefits of Action: Maintaining and tracking private water quality systems can assist in ensuring facilities are functioning properly and treating localized runoff.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	1	**Initial Programmatic FTE Cost:**	$ 80,000	**Initial Capital Cost Summary:**	$ -	*$ 80,000*
Ongoing Programmatic FTE estimate:	1.5	**Ongoing Programmatic FTE Cost:**	$ 120,000	**Initial Capital Capital Cost Summary:**	$ -	*$ 120,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 560,000*

	Private Water Quality Facility Inventory and Inspections							**Action #**	D-14	
Action Type:	Programmatic			**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume existing effort level includes 1 FTE Surface Water Technician, a portion of Maintenance Manager staff time and WES maintenance staff time for coordination and tracking. Action assumes additional WES maintenance staff time for inspection of facilities brought under new maintenance agreements and to perform more inspections through preventative maintenance program of existing facilities. Assuming approximatly 10 hours per facility to inspect and perform minor maintenance. Assume additional 1.0 FTE required to perform 200 residential structures per year and assume additional 0.5 FTE required in years 2-5 for inspecting and maintaining up to 100 additional residential structures.

Cost assumes at least 200 residential structures will be inspected over a one year time period by WES staff and a minimum charge of $3/month/home, based on existing rates, to include inspection, repair and maintenance of residential stormwater systems would be added to each stormwater bill. Cost also assumes WES will continue to bid cleaning contracts with private contractors and commercial/industrial customers will continue to coordinate directly with the contractors to pay for cleaning services. Additionally, cost assumes coordination with DTD to continue street sweeping in targeted areas within the watersheds.

Ongoing Cost Assumptions: Cost assumes program will continue similar to year one structure with the addition of 0.5 FTE as maintenance agreements increase.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	1	FTE	$ 80,000	$ 80,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 80,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 80,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 80,000

Ongoing Cost Estimate: Project Lifetime (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	1.5	FTE	$ 80,000	$ 120,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 120,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 120,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 120,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 480,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Riparian Buffer Analysis and Prioritization for Enhancement						**Action #**	D-15 (EAP)	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Monitoring & Regulatory	**Potential funding sources:**	DTD
Partner entities:	DTD Clackamas Co.	**Partner entities:**		**WES Support:**	Env. Policy & Watershed Health	**Potential funding sources:**	Grants
Partner entities:	Parks Clackamas Co.	**Partner entities:**		**WES Support:**	WES GIS	**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: There are water temperature TMDLs (Total Maximum Daily Load) for the Clackamas and Willamette Basins. As designated management agencies (DMAs), Clackamas County and the Districts are responsible for identifying possible sources of increased water temperature in the watershed and potential management strategies that can be undertaken to reduce stream temperatures to meet water quality criteria. This includes identifying areas lacking riparian shade and developing prioritized implementation plans to increase riparian shade where feasible. Additional riparian buffer analyses is needed.

Proposed Action - Implementation Steps: WES is performing a riparian buffer analysis for the KMS and RC watersheds as a part of the Watershed Action Plans. Additional riparian buffer analyses for other portions of Clackamas County are needed.

Conduct riparian buffer analysis inside the Districts (by WES) and outside the Districts in Clackamas County (by DTD) to establish baseline conditions in the watersheds throughout the County that are under a TMDL order. In addition to GIS analysis, ground-truth conditions in the field using WES, DTD, and CCSWCD staff. Utilize consultant assistance to analyze results. Following analysis, implement a programmatic measure through the WAPs to develop and implement plans to increase riparian shade.
Once areas lacking riparian buffer are identified, Action D-5 should be updated and implemented to increase planting of trees in riparian buffer areas on both public land and private land with willing landowners.
Grants from Metro or other sources could be sought to assist in implementation of this Action.

Benefits of Action: Performing riparian buffer analysis will assist in supporting the evaluation of watershed health and support informed watershed management decision-making and meeting LOS levels; identify areas with opportunities to increase riparian buffer shading of streams to address stream temperatures; and contribute to fulfilling responsibilities as DMAs.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.1	**Initial Programmatic FTE Cost:**	$ 8,000	**Initial Capital Cost Summary:**	$ 12,000	*$ 20,000*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ -	*$ -*
(Programmatic Cost Summary is the FTE estimate translated into dollars)				**Years of Ongoing Cost Past Yr 1 included**		*0*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 20,000*

Action Name:	Riparian Buffer Analysis and Prioritization for Enhancement				**Action #**	D-15 (EAP)
Action Type:	Programmatic	**Action Extent:**	District-wide		**Priority Ranking:**	-

	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: It is estimated to require approximately 200 hours of time for a WES staff member and 200 hours of time for a DTD staff member (with GIS skills and riparian analysis field skills) to perform the riparian buffer analyses and up to 80 hours of consultant time to assist in analyzing the results. Development and implementation of plans to increase riparian shade to address opportunities identified in the analysis will require additional time of WES staff or a consultant working with WES staff; this additional cost is not included in this Action.

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
Consultant	80	hours	$ 150	$ 12,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 20,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 20,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 20,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 0

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary - WES		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ -
Total Ongoing Cost Over Project Life (2009 dollars)				$ -

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Add LWD with Private Landowners and Partners							**Action #**	D-16	
Action Type:	Programmatic & Capital			**Action Extent:**	District-wide			**Priority Ranking:**		-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	RK4	RK5	RK6	RK7	see below

Potential lead entity:	ODFW			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	Grants
Partner entities:	CRBC	**Partner entities:**		**WES Support:**	Env. Monitoring & Regulatory	**Potential funding sources:**	WES (Rates)
Partner entities:	Nonprofit Groups	**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:	Private	**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Most streams in the KMS watershed are lacking LWD, as shown in Table 5-4 of the Kellogg-Mt. Scott and Rock Creek reach assessment results. Large woody debris is important for aquatic habitat, improves the system hydraulics, and also provides refuge habitat during winter high flow events. This project will support efforts by Oregon Department of Fish and Wildlife, Columbia River Basin Council, and others.

Proposed Action - Implementation Steps:

The goal of this project is to support other entities efforts to add LWD to streams, primarily for fish habitat in partnership with ODFW, USDA-NRCS, Columbia River Basin Council, landowners, non-profits, such as the local watershed council, and others to implement LWD placement projects.

This project should also involve coordination and prioritization of project sites. Work will need to be conducted in coordination with willing landowners and effort should be made to select easily accessible sites that provide the greatest benefit to aquatic habitat. Initial efforts should consider focusing on reaches RK4 through RK6, and RK7 which scored poor on LWD metrics. In addition, KG1, KG2, MS1, MS6, and MS8 through MS12A could benefit from LWD placement. Also see Figures 2-11, 2-14, and 2-16 in the Rock Creek Assessment.

This project should work with DTD and co-develop a LWD reclamation program. This would involve working with developers to reclaim LWD from project sites and transporting LWD to a County storage facility. This project would need to secure a site for LWD storage, develop a program to provide the wood to project applicants working on stream restoration, and monitor whether or not project goals are achieved.

The following components are part of projects, but not necessarily within WES' purview. WES would need to determine their contribution on a project-by-project basis. These components include: outreach to landowners adjacent to the reaches identified as high priority; prioritizing areas for LWD placement based on assessment results and opportunities with willing landowners; partnering with non-profits and applying for grant funding; permitting; design of project; locating materials, e.g. LWD; construction; and monitoring the project for desired objectives.

Benefits of Action: This action will support functioning aquatic ecosystems, improve aqautic habitat and biological communities, and improve hydrology and geomorphology.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.25	**Initial Programmatic FTE Cost:**	$ 20,000	**Initial Capital Cost Summary:**	$ 6,750	*$ 26,750*
Ongoing Programmatic FTE estimate:	0.25	**Ongoing Programmatic FTE Cost:**	$ 20,000	**Annual Ongoing Capital Cost**	$ 6,750	*$ 26,750*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 133,750*

Action Name:	Add LWD with Private Landowners and Partners						**Action #**	D-16	
Action Type:	Programmatic & Capital		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	RK4	RK5	RK6	RK7 see below

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued): This program would be conducted in coordination with D5-Improve riparian buffer with private landowners and partners, D6-Improve upland tree canopy with private landowners and partners, and D17-Targeted invasive species management.

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assumes partnering with other agencies and groups to support them in LWD placement projects. Capital costs are for acquiring and transporting LWD. Assumes existing County property can be used for LWD storage.

Ongoing Cost Assumptions: Same as above.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.25	FTE	$ 80,000	$ 20,000
Transporting LWD	10	tree	$ 500	$ 5,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 25,000
Engineering, Administration, Contingency*			35%	$ 1,750
Sub-total				$ 26,750
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 26,750

Ongoing Cost Estimate: Project Lifetime (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.25	FTE	$ 80,000	$ 20,000
Transporting LWD	10	tree	$ 500	$ 5,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 25,000
Engineering, Administration, Contingency*			35%	$ 1,750
Sub-total				$ 26,750
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 26,750
Total Ongoing Cost Over Project Life (2009 dollars)				$ 107,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Targeted Invasive Species Management						**Action #**	D-17		
Action Type:	Programmatic & Capital			**Action Extent:**	District-wide		**Priority Ranking:**	-		
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Potential lead entity:	CCSWCD			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	WES (Rates)
Partner entities:	WES	**Partner entities:**		**WES Support:**		**Potential funding sources:**	Grants
Partner entities:	Parks Clackamas Co.	**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:	Nonprofit Groups	**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Invasive and non-native plants decrease habitat quality, reduce recreational and aesthetic qualities of rivers and streams, and sometimes increase erosion potential. This action would involve continued invasive species identification and removal in areas identified in the Assessment Report. The District has been working with a multitude of watershed and environmental groups to remove invasives and this project would continue to build on that work. The Clackamas County Soil and Water Conservation District has recently initiated a County Weed Board. This program will be coordinated and implemented with assistance from the District's WeedWise Program Manager.

Proposed Action - Implementation Steps: This project will prioritize areas for invasive plant removal, provide baseline information on invasive plants in the Rock Creek and Kellogg-Mt.Scott watersheds, develop a plan for removal (hand pulling, mechanical harvesting, and herbicides as appropriate), and work with contractors and non-profits to remove the invasive species. Targeted invasive species in the KMS watershed include Japanese Knotweed, Himalayan blackberry, bamboo, reed canary grass, Canada thistle, and others. In KMS, the invasive species management program could first target reach MS1, which is located in North Clackamas Park where one bank within a selected reach is dominated by invasive bamboo and Japanese Knotweed. After removal, the invasive species management program will purchase and plant native vegetation and monitor native vegetation to prevent reoccurrence of invasive species. Coordination with private landowners and volunteer organizations will significantly reduce the expense of this program. RC1 and 2 are also high priority reaches to start in.

This program would be conducted in coordination with D5-Improve riparian buffer with private landowners and partners, D6-Improve upland tree canopy with private landowners and partners, and D16-Add LWD with private landowners and partners.

Benefits of Action: Projects that preserve stream health or enhance stream condition generate ongoing, appreciating benefits to water quality, water quantity, and aquatic habitat.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.1	**Initial Programmatic FTE Cost:**	$ 8,000	**Initial Capital Cost Summary:**	$ 20,000	*$ 28,000*
Ongoing Programmatic FTE estimate:	0.1	**Ongoing Programmatic FTE Cost:**	$ 8,000	**Annual Ongoing Capital Cost**	$ 20,000	*$ 28,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 140,000*

Action Name:	Targeted Invasive Species Management						**Action #**	D-17	
Action Type:	Programmatic & Capital		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	- -

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: 0.1 FTE per year for ongoing volunteer organization and implementation. This action assumes partnering with other agencies and use of volunteer hours to complete projects.

Ongoing Cost Assumptions: 0.1 FTE per year as discussed above.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
Supplies	1	year	$ 20,000	$ 20,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 28,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 28,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 28,000

Ongoing Cost Estimate: Project Lifetime (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
Supplies	1	year	$ 20,000	$ 20,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 28,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 28,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 28,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 112,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Improve Fish Passage							**Action #**	D-18	
Action Type:	Programmatic			**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Potential lead entity:	DTD Clackamas Co.			**WES Lead:**	Asset Management	**Potential funding sources:**	WES (Devel. Fees)
Partner entities:	WES	**Partner entities:**	City of Happy Valley	**WES Support:**	Env. Policy & Watershed Health	**Potential funding sources:**	Grants
Partner entities:	ODFW	**Partner entities:**	City of Damascus	**WES Support:**	Stormwater Maintenance	**Potential funding sources:**	
Partner entities:	City of Milwaukie	**Partner entities:**	Nonprofit Groups	**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Adults of both anadromous and resident salmonids in the KMS and RC watersheds require barrier free access to suitable spawning habitat. Although poorly studied, it is also likely that unobstructed access to tributaries may be important in allowing access to refuge habitat during winter high flow events. Data on the presence of human-made and natural fish passage barriers was collected and compiled from ODFW, the County, and the project team biologist for the characterization reports, and is illustrated on Figure 4-8 of the KMS Characterization Report and Figure 4-9 of the Rock Creek Characterization Report. However, further evaluation is needed to create a priority ranking of fish passage barrier replacement/retrofit.

Proposed Action - Implementation Steps: The replacement/retrofit of fish passage barriers should be prioritized following the collection and analysis of additional site-specific information on the condition of the barriers, species and life stages affected, quality and availability of upstream habitat and flooding potential. The steps outlined below begin with goal setting and follow the project through implementation. See attachment for more detailed implementation steps.

1. Select WES project manager
2. Set Goals
3. Collect Data
4. Evaluate extent of barrier using collected data, KMS and RC Characterization and Assessment Reports, ODFW Culvert Assessment, Clackamas County culvert inventory.
5. Identify preferred retrofit/replacement method and lower cost alternatives. Hydraulic modeling should be completed in this stage to identify impacts of design on surrounding hydraulics, especially when flood conditions exist in the area.
6. Develop a fish passage barrier retrofit prioritization and rank projects
7. Develop an implementation program to improve a number of fish passage barriers annually, working from downstream to upstream
8. Design of fish passage improvements. The design phase will coordinate funding, partnering agencies, engineering, permitting, construction, and monitoring.

Benefits of Action: The replacement/retrofit of fish passage barriers in KMS and RC would improve habitat for anadromous and resident salmonids in the watershed. Barrier replacement/retrofit in some instances also has potential to reduce flooding and improve water quality.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.25	**Initial Programmatic FTE Cost:**	$ 20,000	**Initial Capital Cost Summary:**	$ 15,000	*$ 35,000*
Ongoing Programmatic FTE estimate:	0.1	**Ongoing Programmatic FTE Cost:**	$ 8,000	**Annual Ongoing Capital Cost**	$400,000	*$ 408,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 1,667,000*

Action Name:	Improve Fish Passage						**Action #**	D-18		
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-		
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? Yes

Pathway for attachment(s): Fish passage barrier locations, Implementation steps, ODFW 1999 Culvert Assessment Summary

Proposed Action - Implementation Steps (continued):

The ODFW data resources website contains links to GIS information on fish passage barriers: http://rainbow.dfw.state.or.us/nrimp/default.aspx?p=259. Data presented from this website was use to create Figure 4-8 of the KMS Characterization Report and Figure

DTD is listed at a lead entity for this project, however since they are a transportation department, they may not take the lead on projects that do not involve roadway culvert crossings, WES could parter with DTD to facilitate these other barriers. DTD has a list of passage barriers to address that should be evaluated and integrated with this effort.

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

Initial implementation includes WES staff time to complete the evaluation of potential fish passage barriers and a contracted consultant to conduct hydraulic modeling associated with the project. Evaluation could be completed in one year.

Ongoing Cost Assumptions:

Ongoing costs cover implementation step 8. Assume 2 passage barriers are retrofitted/replaced every year for year 2-5 of this project. Costs are for replacement of culverts with 3-sided concrete box culverts, assuming existing culverts are 24" in diameter on average.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.25	FTE	$ 80,000	$ 20,000
Hydraulic Modeling	100	hrs	$ 150	$ 15,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 35,000
Engineering, Administration, Contingency*			35%	
Sub-total				$ 35,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 35,000

Ongoing Cost Estimate: Project Lifetime (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
Culvert replacement	2	each	$ 200,000	$ 400,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 408,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 408,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 408,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 1,632,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Stakeholder Involvement and Communications Plan Implementation					**Action #**	D-19
Action Type:	Programmatic	**Action Extent:**	District-wide			**Priority Ranking:**	-

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Public Information	**Potential funding sources:**	WES (Rates)
Partner entities:	Nonprofit Groups	**Partner entities:**	City of Damascus	**WES Support:**	Env. Policy & Watershed Health	**Potential funding sources:**	Other
Partner entities:	City of Happy Valley	**Partner entities:**	DTD Clackamas Co.	**WES Support:**	Asset Management	**Potential funding sources:**	
Partner entities:	City of Milwaukie	**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: WES is developing a communications plan that will include opportunities for further stakeholder involvement in implementation of the Watershed Action Plans. The purpose of the communications plan is to provide watershed-specific information to stakeholders, to re-orient the WES SWM program, and to build a constituency to champion the integrated watershed health SWM approach.

Proposed Action - Implementation Steps:

It is recommended that WES develop an intneral outreach and communications task force comprised of WES staff. The WES task force will identify activities to implement for each of the following categories as a baseline annual program and for unique additional program elements as needed to meet level of service goals and implement the WAPs:

- Informational materials – print and web pieces, interpretative signage, press releases
- Education and citizen contact– seminars, brown bags, workshops, tours, presentations, booths and events tabling, call tracking
- Volunteer campaign – watershed enhancement, stewardship, clean-up, planting, inventory and monitoring activities
- Recognition and incentive – awards, certifications, fee and tax reductions, grants
- Meetings and communication - ongoing stakeholder meetings and outreach

Benefits of Action: Effective stakeholder outreach will affirm and/or initiate working partnerships between key stakeholders and WES; deepen and broaden understanding of the social value of watershed health; address challenges and threats generated by the new direction; assure that a broad range of perspectives are included in the action planning process; provide a stakeholder-based reality check for watershed health recommendations; develop support for watershed action plan implementation and SWM program re-orientation; and provide stakeholders with tools to improve watershed health through their actions.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.5	**Initial Programmatic FTE Cost:**	$ 40,000	**Initial Capital Cost Summary:**	$ -	*$ 40,000*
Ongoing Programmatic FTE estimate:	0.5	**Ongoing Programmatic FTE Cost:**	$ 40,000	**Annual Ongoing Capital Cost**	$ -	*$ 40,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 200,000*

Action Name:	Stakeholder Involvement and Communications Plan Implementation			**Action #**	D-19
Action Type:	Programmatic	**Action Extent:**	District-wide	**Priority Ranking:**	-

	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

Assume 0.5 FTE required to implement Communications Plan. More detail to be included later as WES fully develops Communications Plan implementation process.

Ongoing Cost Assumptions: Assume 0.5 FTE required to implement Communications Plan.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.5	FTE	$ 80,000	$ 40,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 40,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 40,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 40,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.5	FTE	$ 80,000	$ 40,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 40,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 40,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 40,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 160,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Regional Stormwater Task Force						**Action #**	D-20	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Asset Management	**Potential funding sources:**	WES (Rates)
Partner entities:	City of Damascus	**Partner entities:**	DTD Clackamas Co.	**WES Support:**	Env. Policy & Watershed Health	**Potential funding sources:**	City of Damascus
Partner entities:	City of Happy Valley	**Partner entities:**		**WES Support:**	Development Review	**Potential funding sources:**	City of Happy Valley
Partner entities:	City of Milwaukie	**Partner entities:**		**WES Support:**		**Potential funding sources:**	City of Milwaukie

Action Description (see backside of sheet for more details)

Statement of Need: There is an opportunity for continued coordination between the Cities in and around the Districts and WES in implementation of the Watershed Action Plans and development of regional stormwater management strategies. The ACWA Stormwater Committee and Phase 1 MS4 Permittee Subcommittee provide excellent coordination opportunities on state-wide stormwater issues, however there are some issues that would be helpful to address with a regional group comprised of the Cities in and around the WES service area, DTD, and WES.

Proposed Action - Implementation Steps:

Developing and implementing the Clackamas Regional Stormwater Task Force will include the following steps:
1) Identify WES staff members to be involved in Task Force.
2) Identify Cities and City staff members as well as DTD staff members to be involved in Task Force (e.g., Damasucs, Happy Valley, Milwaukie, etc.).
3) Set regular meeting time and place for Task Force meetings, starting with quarterly meetings and adjusting the meeting schedule as needed to address issues.
4) Identify items to address on a regular basis (updates/coordination) and items to address with specific project timeframes. Agenda items will generally be limited to specific stormwater and watershed coordination issues in the WES service area and adjacent cities. The Clackamas Regional Stormwater Task Force is intended to supplement other regional coordination efforts such as the ACWA Stormwater Committee meetings, and not replace the content of those meetings.
5) Meet, distribute notes from meetings to all participants, regularly update agenda items as needed.

Benefits of Action: Continued coordination between the Cities in and around the Districts and WES will improve the implementation of the Watershed Action Plans and assist in development of regional stormwater management strategies, which will benefit the watershed health elements of water quality, water quantity control, and habitat.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.1	**Initial Programmatic FTE Cost:**	$ 8,000	**Initial Capital Cost Summary:**	$ -	*$ 8,000*
Ongoing Programmatic FTE estimate:	0.1	**Ongoing Programmatic FTE Cost:**	$ 8,000	**Annual Ongoing Capital Cost**	$ -	*$ 8,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 40,000*

Action Name:	Regional Stormwater Task Force						**Action #**	D-20
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**		
Action Location:	Multiple	-	-	-	-	-	-	- - -

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

Assume WES staff provide coordination and implementation for Clackamas Regional Stormwater Task Force, at an effort level of 200 hours per year (0.1 FTE).

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 8,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 8,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 8,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 8,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 8,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 8,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 32,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Regional Decant Facility						**Action #**	D-21	
Action Type:	Capital			**Action Extent:**	District-wide		**Priority Ranking:**		-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Asset Management	**Potential funding sources:**	WES (Rates)
Partner entities:	DTD Clackamas Co.	**Partner entities:**	City of Damascus	**WES Support:**	Stormwater Maintenance	**Potential funding sources:**	City of Milwaukie
Partner entities:	City of Milwaukie	**Partner entities:**	Other	**WES Support:**		**Potential funding sources:**	City of Happy Valley
Partner entities:	City of Happy Valley	**Partner entities:**		**WES Support:**		**Potential funding sources:**	City of Damascus

Action Description (see backside of sheet for more details)

Statement of Need:

The District and DTD currently use a decant facility to collect catch basin waste. The facility is currently undersized and does not meet the needs of the District and DTD.

Proposed Action - Implementation Steps:

1. Select WES project manager.
2. Conduct a cost/benefit analysis to determine benefits of decant facility.
3. Contact other jurisdictions (DTD, ODOT, Gresham, Portland, Milwaukie, Happy Valley, Oregon City, etc.) to identify potential interested partners in the facility siting study and facility operation.
4. Complete a siting study to determine decant facility location. Develop partnership agreements with parters.
5. Design and construct decant facility.
6. Designate a manager and staff for the decant facility.

Benefits of Action:

A strategically located decant facility could provide the County with a cost effective method for disposing of wastes collected from catch basins. The facillity could also serve sanitary sewer pump stations.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0	**Initial Programmatic FTE Cost:**	$ -	**Initial Capital Cost Summary:**	$ 2,000,000	*$ 2,000,000*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ -	*$ -*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*0*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 2,000,000*

Action Name:	Regional Decant Facility						**Action #**	D-21
Action Type:	Capital			**Action Extent:**	District-wide		**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**		
Action Location:	Multiple	-	-	-	-	-	- - - -	

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

An estimated $2 million dollars for siting study, land, building and materials.

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
Decant Facility	1	LS	$ 2,000,000	$ 2,000,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 2,000,000
Engineering, Administration, Contingency*			35%	
Sub-total				$ 2,000,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 2,000,000

Ongoing Cost Estimate: Project Lifetime (yrs) 0

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ -
Total Ongoing Cost Over Project Life (2009 dollars)				$ -

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Enhanced Street Sweeping						**Action #**	KMS-1	
Action Type:	Programmatic		**Action Extent:**	Multiple reaches			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	KMS	Cedar	-	-	-	PH1	PH1A	-	-	-

Potential lead entity:	DTD Clackamas Co.			**WES Lead:**	Asset Management	**Potential funding sources:**	DTD
Partner entities:	WES	**Partner entities:**		**WES Support:**	Stormwater Maintenance	**Potential funding sources:**	WES (Rates)
Partner entities:		**Partner entities:**		**WES Support:**	Public Information	**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**	WES GIS	**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Increased frequency and effectiveness of street sweeping is needed on targeted high volume streets such as SE 82nd, along Sunnyside Road (Cedar and Phillips subbasin), other major arterials with average daily traffic over 1,000 vehicles, and in high traffic commercial parking areas. Street sweeping is one of the most cost-effective ways to remove the sediments and associated pollutants, such as metals and petroleum products, that accumulate on streets before they wash into streams in areas lacking structural stormwater quality facilities. Erosion, sedimentation, pesticides, dissolved metals, and other toxic materials contribute to reduced biological quality in streams. Increased street sweeping would assist DTD and WES in meeting NPDES MS4 permit requirements.

Proposed Action - Implementation Steps:

The goal of this project is to enhance street sweeping effectiveness in reducing pollutant loads from high volume roads by coordinating with DTD. Tasks include the following:

• Coordinate with DTD to increase the frequency of street sweeping on SE 82nd, Sunnyside Road, and in high traffic areas (Cedar subbasin and reaches PH1 and PH1A). Using the regenerative air sweeper on a monthly basis has shown to reduce total solids (TS) by 22%, total phosphorus (TP) by 4%, and total nitrogen (TN) by 4%. Weekly use of the regenerative air sweeper has shown a pollutant removal efficiency of 31% for TS, 8% for TP, and 7% for TN (see reference on next page).
• Consider additional areas for enhanced street sweeping by using GIS to map high pollutant accumulation and washoff areas (commercial, industrial, multi-family, highways, and major arterials with average daily traffic greater than 1,000 vehicles) and areas lacking pre-treatment facilities.
• Track frequency of sweeping by street locations in GIS.
• Track volume of pollutants removed per street to assess sweeping effectiveness.
• Assess the costs of increased sweeping relative to the benefits observed.

Benefits of Action: This action will assist in meeting permit requirements, reduce pollutant loads through use of structural BMPs, and improve water quality.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0	**Initial Programmatic FTE Cost:**	$ -	**Initial Capital Cost Summary:**	$370,400	*$ 370,400*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ 50,400	*$ 50,400*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 572,000*

Action Name:	Enhanced Street Sweeping						**Action #**	KMS-1	
Action Type:	Programmatic		**Action Extent:**	Multiple reaches			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	KMS	Cedar	-	-	-	PH1	PH1A	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Reference for street sweeping study: N.L. Law, K. DiBlasi, and U. Ghosh., Center for Watershed Protection, September 2008, "Deriving Reliable Pollutant Removal Rates for Municial Street Sweeping and Storm Drain Cleanout Programs in the Chesapeake Bay Basin" U.S. EPA Chesapeake Bay Program grant CB-973222-01

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assumes puchase of 1 regenerative air street sweeper. Assumed currently sweeping 1x per year. Increased to bi-weekly sweeping. Dispoal and vehicle maintenance costs and the driver time are included in the cost per mile sweeping costs from DTD. Since FTE costs are included in the cost per mile, no additional FTE costs are included.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0	FTE	$ 80,000	$ -
Regenerative air sweeper	1	truck	$ 320,000	$ 320,000
Sweep SE 82nd Ave	150	mile	$ 84	$ 12,600
Sweep Sunnyside Rd	75	mile	$ 84	$ 6,300
Other areas TBD	375	mile	$ 84	$ 31,500
				$ -
				$ -
Raw Cost				$ 370,400
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 370,400
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 370,400

Ongoing Cost Estimate: Project Lifetime (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0	FTE	$ 80,000	$ -
Sweep SE 82nd Ave	150	mile	$ 84	$ 12,600
Sweep Sunnyside Rd	75	mile	$ 84	$ 6,300
Other areas TBD	375	mile	$ 84	$ 31,500
				$ -
				$ -
Raw Cost				$ 50,400
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 50,400
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 50,400
Total Ongoing Cost Over Project Life (2009 dollars)				$ 201,600

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Investigate Water Rights and Water Withdrawls Where Low Summer Flow is a Concern						**Action #**	KMS-2	
Action Type:	Programmatic		**Action Extent:**	Multiple reaches			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	KMS	-	-	-	-	-	-	-	- -

Potential lead entity:	WES			**WES Lead:**	Public Information	**Potential funding sources:**	WES (Rates)
Partner entities:	Nonprofit Groups	**Partner entities:**	OWRD	**WES Support:**	Asset Management	**Potential funding sources:**	
Partner entities:	Private	**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Low flow in summer months in the upper Kellogg subbasin could be a result of possible withdrawals from private stream withdrawals or private wells that lower groundwater tables. However, little information is known about the capacity or current use of these withdrawals and if they are linked to private owners with water rights.

Proposed Action - Implementation Steps:

1. Conduct a record search of state water rights within basin.
2. Partner with local watershed councils, Friends of Kellogg-Mt. Scott Watershed and other outreach groups to gather information about water withdrawals from watershed. Use group contacts to educate private owners about impacts of water withdrawals on overall watershed and stream health.
3. Develop outreach programs to address withdrawals and potential purchase of waterights with focus on private owners.

Benefits of Action: Identifying potential causes of lower summer flow could assist in development actions to improve water quality.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.2	**Initial Programmatic FTE Cost:**	$ 16,000	**Initial Capital Cost Summary:**	$ -	*$ 16,000*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ -	*$ -*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*0*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 16,000*

Action Name:	Investigate Water Rights and Water Withdrawls Where Low Summer Flow is a Concern					**Action #**	KMS-2
Action Type:	Programmatic	**Action Extent:**	Multiple reaches			**Priority Ranking:**	-

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	KMS	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume one-year project. Assume partnership with local watershed groups for promotion of program. Assume 0.2 FTE WES staff effort to organize and create database of known water rights.

Ongoing Cost Assumptions: Ongoing Cost Assumptions: Assume project is completed in one year and no ongoing costs.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.2	FTE	$ 80,000	$ 16,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 16,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 16,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 16,000

Ongoing Cost Estimate: Project Lifetime (yrs) 0

Item	Quantity	Unit	Unit Cost	Estimated Cost
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ -
Total Ongoing Cost Over Project Life (2009 dollars)				$ -

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Enhance Dean Creek Wetlands and Stream Channel					**Action #**	KMS-3
Action Type:	Capital	**Action Extent:**	Single reach			**Priority Ranking:**	-

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	KMS	DN	-	-	-	DN1	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	Grants
Partner entities:	ODOT	**Partner entities:**		**WES Support:**		**Potential funding sources:**	WES (Rates)
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: The Dean Creek Subbasin lacks hydrologic, water quality and aquatic habitat data. Aerial photo analysis indicates that Dean Creek is largely piped or ditched and lacks a riparian buffer. Dean Creek currently flows through undeveloped area to the west of Mt. Talbert, which presents opportunity for wetlands and focused stream channel enhancement projects.

Proposed Action - Implementation Steps:

1. Select WES project manager
2. Set project goals and determine if project will be completed in-house or contracted out
3. Identify areas for wetlands restoration and for stream channel restoration, coordinate with the Sunrise Corridor Project and other development projects.
4. Survey project site and complete hydraulic modeling to determine project impacts on flooding and analyze capacity of project to meet project goals
5. Perform a cost/benefit analysis based on preliminary design information
6. Develop conceptual design and a more detailed cost estimate. Conceptual design includes flow management strategy.
7. Identify partners and funding sources for CIP
8. Secure project funding
9. Coordinate engineering, permitting and project schedule based on the in-stream work window
10. Develop monitoring plan to determine project success
11. Implement CIP
12. Monitor results according to specifications in monitoring plan

Benefits of Action: Wetlands and stream channel improvements could improve the hydrologic conditions, water quality and/or aquatic habitat in the creek. Dean Creek contributes to Mt. Scott Creek at Three Creeks; improvements made to Dean Creek will positively affect Mt. Scott Creek.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.2	**Initial Programmatic FTE Cost:**	$ 16,000	**Initial Capital Cost Summary:**	$ 48,000	*$ 64,000*
Ongoing Programmatic FTE estimate:	0.1	**Ongoing Programmatic FTE Cost:**	$ 8,000	**Annual Ongoing Capital Cost**	$661,250	*$ 669,250*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*2*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 741,250*

Action Name:	Enhance Dean Creek Wetlands and Stream Channel						**Action #**	KMS-3	
Action Type:	Capital		**Action Extent:**	Single reach			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	KMS	DN	-	-	-	DN1	-	-	- -

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? Yes

Pathway for attachment(s): Map of Potential Areas for Dean Creek Enhancement

Proposed Action - Implementation Steps (continued): The attached map identifies taxlots in the Dean Creeks area that are owned by Clackamas County or the State of Oregon. These areas were identified because it may be easier for the District to complete the restoration project on publically owned land.

The Sunrise Corridor Project is a transportation project beging undertaken by ODOT, depending on the chosen alignment the project could intersect with wetlands or stream enhancement project. Coordination with ODOT is an important component of this recommendation.

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Initial costs include project management, WES staff time for design, and a consultant to complete modeling and design of channel modificaiton and wetlands restoration. All restoration work is done on county owned property.

Ongoing Cost Assumptions: Assume 2,000 LF of channel modification, which includes permitting, grading, erosion control, flow management and post-construction plantings. Assume wetlands restoration includes mostly plantings with minor grading. Monitoring occurs for two years following implementation and includes visual observation of channel modification and vegetation planted in the riparian corridor. Visual observation and subsequent write-up occupies two FTE's for 4 hrs every two months.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE Summary	0.20	FTE	$ 80,000	$ 16,000
Modeling & Design	320	hrs	$ 150	$ 48,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 64,000
Engineering, Administration, Contingency*			35%	
Sub-total				$ 64,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 64,000

Ongoing Cost Estimate: Project Lifetime (yrs) 2

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE Summary	0.10	FTE	$ 80,000	$ 8,000
Channel Modification	2000	lf	$ 200	$ 400,000
Wetlands Restoration	0.5	acre	$ 150,000	$ 75,000
Land easement coordination	1	LS	$ 20,000	$ 20,000
				$ -
				$ -
				$ -
Raw Cost				$ 503,000
Engineering, Administration, Contingency*			35%	$ 166,250
Sub-total				$ 669,250
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 669,250
Total Ongoing Cost Over Project Life (2009 dollars)				$ 677,250

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Enhance Mt. Scott Creek channel in the Three Creeks Area						**Action #**	KMS-4
Action Type:	Capital		**Action Extent:**	Single reach			**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**		
Action Location:	KMS	LMS	-	-	-	MS4	-	- - -

Potential lead entity:	WES			**WES Lead:**	Asset Management	**Potential funding sources:**	WES (Rates)
Partner entities:	Clackamas Co. Parks	**Partner entities:**		**WES Support:**	Env. Policy & Watershed Health	**Potential funding sources:**	Grants
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: The stream channel of Mt. Scott Creek in the Three Creeks Area has been modified from previous development and is constrained on one side by RR tracks. Enhancing the stream channel would increase floodplain storage and hydraulic connectivity, and enhance aquatic habitat in the Three Creeks Area.

Proposed Action - Implementation Steps:

1. Select WES project manager
2. Set project goals and determine if project will be completed in-house or contracted out. Coordinate with the Parks Department Master Plan and Harmony Projects.
3. Complete survey and hydraulic modeling to determine project impacts on flooding and analyze capacity of project to meet project goals
4. Perform a cost/benefit analysis based on preliminary design information
5. Develop a detail design and more detailed cost estimate. Detail design includes a flow management strategy for construction
6. Identify partners and funding sources for CIP
7. Secure project funding
8. Coordinate permitting and project schedule based on in-stream work window
9. Develop monitoring plan to determine project success
10. Implement CIP
11. Monitor results according to specifications in the monitoring plan

Benefits of Action: Enhance aquatic habitat and improve hydrology in Three Creeks. Improved floodplain storage and hydraulic connectivity could reduce downstream flooding problems.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.25	**Initial Programmatic FTE Cost:**	$ 20,000	**Initial Capital Cost Summary:**	$ 230,000	*$ 250,000*
Ongoing Programmatic FTE estimate:	0.02	**Ongoing Programmatic FTE Cost:**	$ 1,846	**Annual Ongoing Capital Cost**	$ -	*$ 1,846*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*2*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 253,692*

Action Name:	Enhance Mt. Scott Creek channel in the Three Creeks Area					**Action #**	KMS-4
Action Type:	Capital		**Action Extent:**	Single reach		**Priority Ranking:**	-

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	KMS	LMS	-	-	-	MS4	-	-	-	-

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? Yes

Pathway for attachment(s): Map of Mt. Scott Creek in Three Creeks

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: The area requires surveying prior to modeling, which is included in the modeling cost. Assume that modeling and the design of the channel is contracted to a consultant. Channel modification cost includes channel grading, flow management, erosion control, and post-construction plantings.

Ongoing Cost Assumptions: Monitoring occurs for two years following implementation and includes visual observation of channel modification and vegetation planted in the riparian corridor. Visual observation and subsequent write-up occupies two FTE's for 4 hrs every two months.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE Summary	0.25	FTE	$ 80,000	$ 20,000
Modeling & Design	200	hrs	$ 150	$ 30,000
Channel Modification	1000	LF	$ 200	$ 200,000
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 250,000
Engineering, Administration, Contingency*			35%	
Sub-total				$ 250,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 250,000

Ongoing Cost Estimate: Project Lifetime (yrs) 2

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE Summary	0.02	FTE	$ 80,000	$ 1,846
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 1,846
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 1,846
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 1,846
Total Ongoing Cost Over Project Life (2009 dollars)				$ 3,692

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Evaluate Flood Prone Culverts and Options for Reducing Impacts, Modify Culverts						**Action #**	KMS-5	
Action Type:	Programmatic		**Action Extent:**	Multiple reaches			**Priority Ranking:**		-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	KMS	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Stormwater Maintenance	**Potential funding sources:**	WES (Rates)
Partner entities:	DTD Clackamas Co.	**Partner entities:**		**WES Support:**	Asset Management	**Potential funding sources:**	Other
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: The SE Theissen Road, Parmenter Road, Mabel Avenue, Clackamas Road, and Rusk Road culverts in the Upper Kellogg subbasin were identified in the 2006 Master Plan as potential flooding problems. Upsizing culverts could result in exacerbating flooding conditions downstream. Hydraulic analysis of the culverts will allow the District to identify deficiencies in the culverts, assess the impacts of potential culvert improvements, and prioritize future culvert improvements. Setting aside capital funds to address undersized culverts in coordination with DTD would assist in implementing the preferred alternatives.

Proposed Action - Implementation Steps:

1. Select WES project manager and identify DTD liaisons
2. Set Goals and Levels of Service related to roadway and property flooding
3. Collect Site-Specific Data
   a. Review maintenance records and flooding complaints to identify all flood-prone culverts
   b. Physical dimensions
   c. Flows through culvert
   d. Culvert type and installation year
4. Conduct hydrualic modeling to evaluate the effect of the culverts on upstream and downstream flooding
5. Identify alternatives and a preferred culvert replacement/retrofit methods, or determine if problem would be better addressed through "willing seller" program for flood prone properties (Action KMS-6).
6. Develop an implementation program to improve culverts in coordination with DTD. Coordinate improvements with fish passage barrier enhancements in Action D-18.
7. The next phase would involve the design and implementation of culvert improvements. The design phase may have a new project manager and will coordinate funding, partners, engineering, permitting and construction. Capital funding for the replacement of two culverts identified in the 2006 Master Plan (Thiessen Road and Parmenter Road) is included in this Action as a placeholder for future culvert replacement projects.

Benefits of Action: Evaluation of flood prone culverts will allow the District address flooding issues effectively in coordination with DTD.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.2	**Initial Programmatic FTE Cost:**	$ 16,000	**Initial Capital Cost Summary:**	$ 37,500	***$ 53,500***
Ongoing Programmatic FTE estimate:	0.1	**Ongoing Programmatic FTE Cost:**	$ 8,000	**Annual Ongoing Capital Cost**	$ 356,000	***$ 364,000***
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		***1***
				Total Estimated 5-year Programmatic and Capital Cost		***$ 417,500***

Action Name:	Evaluate Flood Prone Culverts and Options for Reducing Impacts, Modify Culverts						**Action #**	KMS-5	
Action Type:	Programmatic		**Action Extent:**	Multiple reaches			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	KMS	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

Initial implementation includes WES staff time to complete the evaluation of culverts prone to flooding and a contracted consultant to conduct hydraulic modeling associated with 6 culverts under existing conditions and alternative future scenarios. Evaluation could be completed in one year.

Ongoing Cost Assumptions:

Ongoing cost assumes WES staff time to implement 2 culvert replacement projects and capital funding for 2 culverts identified in 2006 Master Plan for replacement (Thiessen Road and Parmenter Road). Costs are shown as lump sum for each culvert based on 2006 Master Plan CIP Fact Sheets with 5% additional cost added to account for inflation.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.2	FTE	$ 80,000	$ 16,000
Hydrologic modeling	250	hrs	$ 150	$ 37,500
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 53,500
Engineering, Administration, Contingency*			35%	
Sub-total				$ 53,500
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 53,500

Ongoing Cost Estimate: Project Lifetime (yrs) 1

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
Thiessen Rd culvert	1	LS	$ 120,000	$ 120,000
Parmenter Rd culvert	1	LS	$ 236,000	$ 236,000
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 364,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 364,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 364,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 364,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Willing-seller Property Acquisition Program						**Action #**	KMS-6	
Action Type:	Programmatic & Capital		**Action Extent:**	Watershed			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	KMS	-	-	-	-	-	-	-	- -

Potential lead entity:	WES			**WES Lead:**	Asset Management	**Potential funding sources:**	WES (Rates)
Partner entities:	DTD Clackamas Co.	**Partner entities:**		**WES Support:**	Env. Policy & Watershed Health	**Potential funding sources:**	Grants
Partner entities:	Parks Clackamas Co.	**Partner entities:**		**WES Support:**	Development Review	**Potential funding sources:**	Other
Partner entities:	Other	**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: There may be opportunities for WES to purchase properties from willing sellers in areas of the KMS watershed where the property purchase would improve watershed health and meet LOS goals. The 2006 Master Plan identified several areas around SE Lake Road, Rusk Road, Clackamas Road, and Mabel Road that could be included in a 'willing seller' approach.

Proposed Action - Implementation Steps: 1. Select WES project manager and identify DTD, Parks, and County Emergency Management liaisons

2. Set Goals and Levels of Service related to willing seller land acquisition
3. Collect Site-Specific Data on properties with willing sellers
   a. Review maintenance records, habitat data, riparian data, and other data to identify potential areas of interest
   b. Identify any existing properties for sale in areas of interest, monitor future real estate listings to determine if additional properties are listed
4. Conduct outreach with landowners to determine intersted landowners and willing sellers
5. As willing sellers are identified, conduct hydrualic modeling as needed to evaluate benefits of acquiring properties
6. Prioritize available properties for acquisition based on location, size, value, and likely benefits from acquisition
7. Develop an implementation program in coordination with DTD, Parks and Emergency Management that includes property acquistion process and long-term management plans for properties. Evaluate grant funding opportunities.
8. Capital funding for the purchase of properties is included in this Action as a placeholder.
9. The next phase after property acquistion would involve the design and implementation of watershed improvements to properties.
   The design phase may have a new project manager and will coordinate funding, partners, engineering, permitting and construction.

Benefits of Action: Purchasing property from willing sellers has many potential benefits. The reclaimed property may become part of a habitat, stream or wetland enhancement project, improving water quality, habitat and hydrology. There may also be opportunities for paths and trails.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.2	**Initial Programmatic FTE Cost:**	$ 16,000	**Initial Capital Cost Summary:**	$ -	*$ 16,000*
Ongoing Programmatic FTE estimate:	0.1	**Ongoing Programmatic FTE Cost:**	$ 8,000	**Annual Ongoing Capital Cost**	$ 500,000	*$ 508,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 2,048,000*

Action Name:	Willing-seller Property Acquisition Program					**Action #**	KMS-6
Action Type:	Programmatic & Capital		**Action Extent:**	Watershed		**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**	
Action Location:	KMS	-	-	-	-	-	- - - -

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume 400 hours of WES staff time to coordinate and implement the Willing Seller Program in Year. Additional staff time provided by DTD, Parks, and Emergency Management. Additional WES staff time may be required to coordinate and implement higher complexity property transactions and plan for modifications to properties.

Ongoing Cost Assumptions: Assume 200 hours of WES staff time to coordinate and implement the program in Years 2-5. Assume $500,000 per year incapital funding for the purchase properties as a placeholder for future acquisitions. The total cost of property acquistions estimated in the 2006 Master Plan is over $12.5 million ($5.6 million for SE Lake Rd properties, $3.3 million for Rusk Rd properties, $3.2 million for Clackamas Rd properties, and $0.5 million for Mabel Rd properties). It is unlikely that all of these properties will be available from willing sellers during a 5-year period.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.2	FTE	$ 80,000	$ 16,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 16,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 16,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 16,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
Property Acquisitions	1	LS	$ 500,000	$ 500,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 508,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 508,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 508,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 2,032,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Evaluate Water Quality Impacts of Human-made Lakes and Ponds							**Action #**	KMS-8 (EAP)	
Action Type:	Programmatic		**Action Extent:**	Multiple reaches				**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	KMS	KU	-	-	-	KG4	KG4A	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Monitoring & Regulatory	**Potential funding sources:**	WES (Rates)
Partner entities:	City of Johnson City	**Partner entities:**		**WES Support:**	Env. Policy & Watershed Health	**Potential funding sources:**	City of Johnson City
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: There are two significant human-made lakes in the KMS watershed. Kellogg Lake is in reach KG0 and is in the City of Milwaukie's jurisdiction. The Kellogg for Coho initiative is currently underway to investigate the feasibility of removing the lake. Leona Lake is in reach KG4.a in the City of Johnson City. Leona Lake may contribute to low summer flow, pollutant loads and high temperatures downstream in Kellogg Creek. However, extensive monitoring data is not currently available in this area. A study of Leona Lake was completed by University of Portland students in 2009 that evaluated limited field data and proposed potential alternatives for improving water quality in Leona Lake. The study identified additional monitoring data that would be useful, including flow data from the lake into Kellogg Creek. It is unknown at this time how much summer flow the lake contributes to the creek. WES is currently implementing a new monitoring program with Johnson City. Further evaluation of the water quality and hydrology impacts of Leona Lake is needed to determine the capacity for water quality improvement through lake management or enhancement.

Proposed Action - Implementation Steps:

1. Select WES project manager - see backside for more detail
2. Set project goals and determine if project will be in-house of contracted out
3. Identify partnering agencies and funding sources
4. Review existing studies and project examples
   a. CCSD#1 and City of Johnson City Water Quality Monitoring Program
   b. Leona Lake water quality and lake morphometry study by University of Portland (2009)
   c. Tanasbrook Lakes/Bronson Creek Enhancement by Clean Water Services (2007)
   d. Willow Creek Pond Enhancement by Clean Water Services (2006)
5. Develop a monitoring scheme that identifies monitoring sites and targeted water quality parameters and hydrology
6. Collect and analyze data
7. Conduct cost/benefit analysis of Leona Lake retrofit or management alternatives (e.g., flow management)
8. Recommend alternative for Leona Lake

Benefits of Action: Evaluation of water quality impacts will allow the District and Johnson City to quantify the cost and benefit of potential improvements to Leona Lake.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.1	**Initial Programmatic FTE Cost:**	$ 8,000	**Initial Capital Cost Summary:**	$ 35,375	*$ 43,375*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ -	*$ -*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*0*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 43,375*

Action Name:	Evaluate Water Quality Impacts of Human-made Lakes and Ponds						**Action #**	KMS-8 (EAP)	
Action Type:	Programmatic		**Action Extent:**	Multiple reaches			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	KMS	KU	-	-	-	KG4	KG4A	-	-	-

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? Yes

Pathway for attachment(s): CCSD#1 and Johnson City WQ Monitoring Plan

Proposed Action - Implementation Steps (continued):

Step 1 Note: WES is currently coordinating with the City of Johnson City to implement a water quality monitoring program. The WES project manager for this project should be familiar with work already being done with the City of Johnson City and coordinate with the manager of the water quality monitoring program, which is being run by the WES Environmental Monitoring Manager. The University of Portland report on the lake should also be evaluated.

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume the project is completed internally, with exception of the water quality analysis and hydrologic modeling. It is assumed that a consultant will be hired to conduct hydrologic modeling and analyze flow monitoring results. Water quality analysis will include the 4 storm-event samples taken for the CCSD#1 and City of Johnson City Water Quality Monitoring Project, in addition to 4 dry weather samples. Hydrologic analysis will include a rain gage and flow monitoring at the lake outlet.

Ongoing Cost Assumptions:

There are no ongoing costs. Retrofit of Leona Lake if deemed beneficial will be a separate captial project. As an example, captial projects involving creation of a side channel while maintaining pond aesthetics have been completed in the Tualatin River Basin by Clean Water Services and could potentially cost $600,000 depending on the level of effort required.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
Hydrologic modeling	150	hrs	$ 150	$ 22,500
Lab analysis	8	each	$ 500	$ 4,000
Flow monitoring & rain gage	1	each	$ 1,000	$ 1,000
				$ -
				$ -
				$ -
Raw Cost				$ 35,500
Engineering, Administration, Contingency*			35%	$ 7,875
Sub-total				$ 43,375
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 43,375

Ongoing Cost Estimate: Project Lifetime (yrs) 0

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ -
Total Ongoing Cost Over Project Life (2009 dollars)				$ -

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Involvement in City of Milwaukie's Kellogg-for-Coho Initiative						**Action #**	KMS-9 (EAP)	
Action Type:	Programmatic		**Action Extent:**	Watershed			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	KMS	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	WES (Rates)
Partner entities:	City of Milwaukie	**Partner entities:**		**WES Support:**	Asset Management	**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: The City of Milwaukie is leading the "Kellogg-for-Coho" initiative, which seeks to replace the Kellogg Lake Bridge, remove the Kellogg Lake dam, and restore the Kellogg Creek stream channel in the City of Milwaukie. As a part of the Kellogg-for-Coho initiative, the City of Milwaukie began hosting meetings with stakeholders in the watershed in September 2008. The City of Milwaukie has recently secured federal grant funds to begin studies and other necessary tasks to evaluate options for the dam. WES regularly coordinates with other juridictions and agencies on projects and initiatives to address watershed health issues in the Districts' watersheds. The fish ladder at Kellogg Lake dam has been identified as a partial barrier to fish passage at the mouth of Kellogg-Mt. Scott Creek. Removing Kellogg Lake dam would improve fish access to seven miles of riparian habitat in the KMS watershed.

Proposed Action - Implementation Steps: This programmatic measure will include involvement of WES staff with the Kellogg-for-Coho initiative, including attending meetings, reviewing plans for studies associated with the initiative, and coordinating information between the WAPs and the Kellogg-for-Coho initiative.

Benefits of Action:

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.02	**Initial Programmatic FTE Cost:**	$ 1,600	**Initial Capital Cost Summary:**	$ -	*$ 1,600*
Ongoing Programmatic FTE estimate:	0.02	**Ongoing Programmatic FTE Cost:**	$ 1,600	**Annual Ongoing Capital Cost**	$ -	*$ 1,600*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*1*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 3,200*

Action Name:	Involvement in City of Milwaukie's Kellogg-for-Coho Initiative					**Action #**	KMS-9 (EAP)
Action Type:	Programmatic		**Action Extent:**	Watershed		**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**	
Action Location:	KMS	-	-	-	-	-	- - - -

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

It is anticipated that a WES staff member will contribute 3-4 hours per month to this programmatic measure for two years.

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.02	FTE	$ 80,000	$ 1,600
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 1,600
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 1,600
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 1,600

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 1

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.02	FTE	$ 80,000	$ 1,600
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 1,600
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 1,600
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 1,600
Total Ongoing Cost Over Project Life (2009 dollars)				$ 1,600

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Enhance Rock Creek Wetlands in Reach RK6						**Action #**	RC-1	
Action Type:	Capital		**Action Extent:**	Single reach			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	KMS	RC	-	-	-	RK6	-	-	- -

Potential lead entity:	WES			**WES Lead:**	Development Review	**Potential funding sources:**	Grants
Partner entities:	Nonprofit Groups	**Partner entities:**		**WES Support:**		**Potential funding sources:**	WES (Rates)
Partner entities:	Private	**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Reach RK6 is located within the Pleasant Valley Golf Course, which could be sold and re-developed in the future. Several hydrologic and aquatic habitat parameters analyzed in the assessment report were ranked poor throughout this reach. Due to the potential re-development, an opportunity exists in this reach to do a large scale restoration project that will restore functions and protect the reach from further degradation.

Proposed Action - Implementation Steps:

1. Select WES project manager
2. Set project goals and determine if project will be completed in-house or contracted out
3. Identify areas for wetlands restoration and for stream channel restoration
4. Survey project site and complete hydraulic modeling to determine project impacts on flooding and analyze capacity of project to meet project goals
5. Perform a cost/benefit analysis based on preliminary design information
6. Develop conceptual design and a more detailed cost estimate. Conceptual design includes flow management strategy.
7. Identify partners and funding sources for CIP
8. Secure project funding
9. Coordinate engineering, permitting and project schedule based on the in-stream work window
10. Develop monitoring plan to determine project success
11. Implement CIP
12. Monitor results according to specifications in monitoring plan

Benefits of Action: Wetlands and stream channel improvements could improve the hydrologic conditions, water quality and/or aquatic habitat in the creek.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.2	**Initial Programmatic FTE Cost:**	$ 16,000	**Initial Capital Cost Summary:**	$ 75,000	*$ 91,000*
Ongoing Programmatic FTE estimate:	0.11	**Ongoing Programmatic FTE Cost:**	$ 8,769	**Annual Ongoing Capital Cost**	$ 1,050,000	*$ 1,058,769*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		2
				Total Estimated 5-year Programmatic and Capital Cost		*$ 1,167,308*

Action Name:	Enhance Rock Creek Wetlands in Reach RK6						**Action #**	RC-1	
Action Type:	Capital		**Action Extent:**	Single reach			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reaches)**			
Action Location:	KMS	RC	-	-	-	RK6	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Initial costs include project management, WES staff time for design, and a consultant to complete modeling and design of channel modification and wetlands restoration.

Ongoing Cost Assumptions: Assume 1500 LF of channel modification in year 2, which includes permitting, grading, erosion control, flow management and post-construction plantings. Assume 3 acres of wetland restoration, which includes mostly plantings with minor grading. In year two, supervision coordination and supervision of construction occupies one staff for 15 hours a week for 3 months. Monitoring occurs for two years following implementation and includes visual observation of channel modification and vegetation planted in the riparian corridor. Visual observation and subsequent write-up occupies two FTE's for 4 hrs every two months.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE Summary	0.20	FTE	$ 80,000	$ 16,000
Modeling & Design	500	hrs	$ 150	$ 75,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 91,000
Engineering, Administration, Contingency*			35%	
Sub-total				$ 91,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 91,000

Ongoing Cost Estimate: Project Lifetime (yrs) 2

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE Summary	0.11	FTE	$ 80,000	$ 8,769
Channel Modification	1500	lf	$ 200	$ 300,000
Wetlands Restoration	3	acre	$ 150,000	$ 450,000
				$ -
				$ -
				$ -
Raw Cost				$ 758,769
Engineering, Administration, Contingency*			35%	
Sub-total				$ 758,769
Land Costs	3	acre	$ 100,000	$ 300,000
Annual Ongoing Costs (2009 dollars)				$ 1,058,769
Total Ongoing Cost Over Project Life (2009 dollars)				$ 1,067,569

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2. Total includes monitoring for 2 years.

Action Name:	Evaluate Regional Detention Needs and Opportunities, Purchase Land						**Action #**	RC-2	
Action Type:	Programmatic & Capital		**Action Extent:**	Watershed			**Priority Ranking:**		-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	RC	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	SWM Program Management	**Potential funding sources:**	WES (Devel. Fees)
Partner entities:	City of Damascus	**Partner entities:**	Parks Clackamas Co.	**WES Support:**	Stormwater Maintenance	**Potential funding sources:**	City of Damascus
Partner entities:	City of Happy Valley	**Partner entities:**		**WES Support:**		**Potential funding sources:**	City of Happy Valley
Partner entities:	DTD Clackamas Co.	**Partner entities:**		**WES Support:**		**Potential funding sources:**	Other

Action Description (see backside of sheet for more details)

Statement of Need: Hydrologic modeling indicates that streams in Rock Creek already exhibit the "flashy" conditions of higher peak flows over longer duration during storm events which are typically characteristic of urbanized watersheds, despite the relatively low proportion of impervious surfaces in the watershed. Infiltration of stormwater is challenging in areas of the watershed due to poorly infiltrating soils. Coordinating with Damascus, Happy Valley, and DTD to purchase land to use for future regional detention facilities is a prudent step for managing stormwater in this rapidly devleoping area. Damascus is developing a Stormwater Master Plan that may identify areas for stormwater management focus areas.

Proposed Action - Implementation Steps:

1. Select WES project manager and identify Damascus, Happy Valley, DTD, and Parks liaisons
2. Set Goals and Levels of Service related to regional detention
3. Collect Site-Specific Data
   a. Review property information and identify potential properties for future regional detention based on location, size, value and other likely benefits. The 2006 Master Plan identified several potential regional detention facility areas. These areas and other areas should be evaluated in coordination with the Damascus Stormwater Master Plan.
   b. Determine current market value of identified properties
   c. Identify any existing identified properties for sale, monitor future real estate listings to determine if additional properties are listed
4. Conduct outreach with landowners to determine intersted landowners and willing sellers
5. As willing sellers are identified, conduct hydrualic modeling to evaluate the effect of developing the sites as regional detention facilities
6. Prioritize properties for acquisition based on location, size, value, and likely benefits from acquisition
7. Develop an implementation program in coordination with Damascus, Happy Valley, DTD, and Parks that includes property acquistion process and long-term management plans for propertie
8. Capital funding for the purchase of properties and the construction of facilities is included in this Action as a placeholder.

Benefits of Action: Installation of regional detention facilities in the Rock Creek watershed could serve to enhance water quality performance while maximizing flow control for the 2 and 5-year storm events. Setting aside funding now for opportunistic purchase of properties that could be used for regional detention facilities will enhance regional stormwater management efforts over time. Properties may also serve as parks.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.1	**Initial Programmatic Cost Summary:**	$ 8,000	**Initial Capital Cost Summary:**	$ 700,000	*$ 708,000*
Ongoing Programmatic FTE estimate:	0.1	**Ongoing Programmatic Cost Summary:**	$ 8,000	**Annual Ongoing Capital Cost**	$ 700,000	*$ 708,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 3,540,000*

Action Name:	Evaluate Regional Detention Needs and Opportunities, Purchase Land						**Action #**	RC-2	
Action Type:	Programmatic & Capital		**Action Extent:**	Watershed			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	RC	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

9. The next phase would involve the detailed design and construction of regional detention facilities on purchased properties. The design phase may have a new project manager and will include coordinating funding, partners, engineering, permitting and construction.

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume 200 hours of WES staff time to coordinate and implement the Regional Detention Property Acquisition Program per year. Additional staff time provided by Damascus, Happy Valley, DTD, and Parks. Additional WES staff time may be required to coordinate and implement higher complexity property transactions. This staff time could be coordinated with Action KMS-6 (Willing Seller Acquisition Program). $1,000,000 was set aside in FY 09-10 budget for addressing regional detention needs.

Ongoing Cost Assumptions: Assume 200 hours of WES staff time to coordinate and implement the program in Years 2-5. Assume $500,000 per year in additional capital funding for the purchase of properties as a placeholder for future acquisitions. Assume $200,000 per year in additional capital funding set aside for future regional facility design and construction. Assume the cost of constructing regional facilities will also be addressed through regional development fees and other funding sources coordinated between WES, Damascus, Happy Valley, DTD, and Parks. The total cost of constructing 3 regional facilities estimated in the 2006 Master Plan is approximately $5 million ($2.6 million for 162nd Ave, $1.3 million for North 172nd Ave, $0.9 million for South 172nd Ave).

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
Property Acquisition	1	LS	$ 500,000	$ 500,000
Future design & construction	1	LS	$ 200,000	$ 200,000
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 708,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 708,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 708,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
Property Acquisition	1	LS	$ 500,000	$ 500,000
Future design & construction	1	LS	$ 200,000	$ 200,000
				$ -
				$ -
				$ -
Raw Cost				$ 708,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 708,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 708,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 2,832,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Enhance Riparian Buffer in Reach RK1 and RK2							**Action #**	RC-3	
Action Type:	Capital			**Action Extent:**	Multiple reaches			**Priority Ranking:**		-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	RC	RC	-	-	-	RK1	RK2	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	WES (Rates)
Partner entities:	Other Clackamas Co.	**Partner entities:**		**WES Support:**	Stormwater Maintenance	**Potential funding sources:**	Grants
Partner entities:	Nonprofit Groups	**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:	ODFW	**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Reaches RK1 and RK2 were identified as areas that would benefit from targeted riparian and upland enhancement in the Assessment Report. WES and other partners co-own and manage a large undeveloped property adjacent to these reaches. There are opportunities to remove invasive vegetation (blackberry, etc.) and enhance native vegetation (including planting additional riparian trees to improve shade and temperature) in this area.

Proposed Action - Implementation Steps:
This action includes developing restoration plans for the site and coordination with County staff and one or more volunteer organizations for implementation. The capital expense will include the purchase of trees and vegetation as well as WES staff hours for supervison of planting work.
Volunteer groups and organizations such as SOLV, Friends of Trees, Soil and Water Conservation District, and the Clackamas River Basin Council could serve as partners in this Action.
This program would be conducted in coordination with Action D-17, targeted invasive species management.

Benefits of Action: Improving riparian and upland vegetation on publicly owned land will enhance aquatic and upland habitat and improve water qualtiy.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.05	**Initial Programmatic FTE Cost:**	$ 4,000	**Initial Capital Cost Summary:**	$ -	*$ 4,000*
Ongoing Programmatic FTE estimate:	0.1	**Ongoing Programmatic FTE Cost:**	$ 8,000	**Annual Ongoing Capital Cost**	$ 10,000	*$ 18,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 76,000*

Action Name:	Enhance Riparian Buffer in Reach RK1 and RK2						**Action #**	RC-3	
Action Type:	Capital		**Action Extent:**	Multiple reaches			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	RC	RC	-	-	-	RK1	RK2	-	-	-

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assumes 100 hours WES staff time (0.05 FTE) in first year to develop restoration plan and coordinate with partners.

Ongoing Cost Assumptions: Assumes 200 hours WES staff time (0.1 FTE) in Years 2 - 5 to implement enhancements with volunteer group assistance. Captial costs include expanding professional services agreement with Friends of Trees or SOLV to include targeted projects this area, which includes cost for plants and volunteer coordination.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.05	FTE	$ 80,000	$ 4,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 4,000
Engineering, Administration, Contingency*			35%	
Sub-total				$ 4,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 4,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.1	FTE	$ 80,000	$ 8,000
Capital costs	1	LS	$ 10,000	$ 10,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 18,000
Engineering, Administration, Contingency*			35%	
Sub-total				$ 18,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 18,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 72,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Riparian buffer acquisition or conservation easements in Reach RK5						**Action #**	RC-4	
Action Type:	Programmatic & Capital		**Action Extent:**	Single reach			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	RC	-	-	-	-	RK5	-	-	- -

Potential lead entity:	WES			**WES Lead:**	Asset Management	**Potential funding sources:**	WES (Rates)
Partner entities:	City of Damascus	**Partner entities:**	Parks Clackamas Co.	**WES Support:**	Env. Policy & Watershed Health	**Potential funding sources:**	City of Damascus
Partner entities:	City of Happy Valley	**Partner entities:**	ODFW	**WES Support:**		**Potential funding sources:**	City of Happy Valley
Partner entities:	DTD Clackamas Co.	**Partner entities:**	Nonprofit Groups	**WES Support:**		**Potential funding sources:**	Other

Action Description (see backside of sheet for more details)

Statement of Need: There are good quality riparian buffer areas in Reach RK5. Watershed health would benefit from protecting these good quality riparian buffer areas from future development or degradation. Clackamas County Soil and Water Conservation District (CCSWCD) could assist in coordinating with landowners for potential acquisitions or easements.

Proposed Action - Implementation Steps:

1. Select WES project manager and identify CCSWCD, Damascus, Happy Valley, and DTD liaisons
2. Set Goals and Levels of Service related to buffer protection
3. Collect Site-Specific Data
   a. Review property information and identify potential properties for potential acquistion/easement based on location, size, value and other likely benefits.
   b. Determine current market value of identified properties and of conservation easements
   c. Identify any existing identified properties for sale, monitor future real estate listings to determine if additional properties are listed
4. In coordination with CCSWCD, conduct outreach with landowners to determine intersted landowners and willing sellers or easement participants
5. As willing sellers or easement participants are identified, prioritize properties for acquisition based on location, size, value, and likely benefits from acquisition
6. Develop an implementation program in coordination with CCSWCD, Damascus, Happy Valley, DTD, and Parks that includes property acquistion process and long-term management plans for properties. Evaluate grant funding opportunities.
7. Capital funding for the purchase of properties and easements is included in this Action as a placeholder.

Benefits of Action: Protection of existing good riparian buffer areas improves water quality and aquatic habitat, and may also preserve hydrologic functions.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0.05	**Initial Programmatic FTE Cost:**	$ 4,000	**Initial Capital Cost Summary:**	$ 50,000	*$ 54,000*
Ongoing Programmatic FTE estimate:	0.05	**Ongoing Programmatic FTE Cost:**	$ 4,000	**Annual Ongoing Capital Cost**	$ 50,000	*$ 54,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 270,000*

Action Name:	Riparian buffer acquisition or conservation easements in Reach RK5				**Action #**	RC-4
Action Type:	Programmatic & Capital	**Action Extent:**	Single reach		**Priority Ranking:**	-

	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	RC	-	-	-	-	RK5	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Assume 100 hours of WES staff time to coordinate and implement the Buffer Acquisition and Easement Program per year. Additional staff time provided by CCSWCD and other partners. Additional WES staff time may be required to coordinate and implement higher complexity property transactions. This staff time should be coordinated with Action KMS-6 (Willing Seller Acquisition Program) and RC-2 (Regional Detention Acquisition Program). Assume $50,000 per year in capital funding for the purchase of properties and easements as a placeholder for future acquisitions.

Ongoing Cost Assumptions: Assume 100 hours of WES staff time to coordinate and implement the program in Years 2-5. Assume $50,000 per year incapital funding for the purchase of properties and easements as a placeholder for future acquisitions.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.05	FTE	$ 80,000	$ 4,000
Property Acquisition	1	LS	$ 50,000	$ 50,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 54,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 54,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 54,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0.05	FTE	$ 80,000	$ 4,000
Property Acquisition	1	LS	$ 50,000	$ 50,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 54,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 54,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 54,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 216,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Pilot Improvement Basin in Graham Creek Basin						**Action #**	RC-5	
Action Type:	Programmatic & Capital		**Action Extent:**	Multiple reaches			**Priority Ranking:**		-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	RC	-	-	-	-	RK1	RK2	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	WES (Rates)
Partner entities:	Nonprofit Groups	**Partner entities:**		**WES Support:**	Asset Management	**Potential funding sources:**	Grants
Partner entities:	ODFW	**Partner entities:**		**WES Support:**	Env. Monitoring & Regulatory	**Potential funding sources:**	
Partner entities:	DTD Clackamas Co.	**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: The Graham Creek basin is a small residential basin that drains into Reach RK02, a valuable habitat area. There are opportunities to conduct targeted stormwater and watershed enhancement projects in the Graham Creek basin and to track the water quality benefits of these projects.

Proposed Action - Implementation Steps:

This action would be implemented as a targeted effort under the proposed new technical assistance program for watershed improvement called the Watershed Enhancement Technical Assistance Program (WET). This program would include technical assistance and capital funding to support stormwater retrofits. Other program elements of the proposed WET program are described in Action D-5. This action would also include collaborating with nonprofit groups and engaging private landowners to participate the WET program. Action includes the following steps:

1. Define and prioritize areas to focus WET program efforts in Graham Creek basin. Areas with high levels of imperviousness, which lack stormwater treatment systems, are areas to consider for high prioritization. These areas would be retrofitted with site design modifications to allow more stormwater runoff to be stored, treated, and infiltrated within vegetated areas or other treatment systems. For example, churches, schools, and commercial areas could install swales, curb cuts, and vegetated stormwater treatment facilities in parking lots. Residential landowners could install swales, raingardens, or other vegetated stormwater facilities near their homes or adjacent to roads. Riparian buffer plantings could be targeted in this area as well.
2. Develop an outreach program to target locations based on prioritization, as well as seek out participants which would be able to assist in implementation. For example, members of HOAs, schools, churches, and rotary clubs may desire to help improve water quality in their local watersheds. Watershed councils and nonprofit groups could also assist in promoting the WET program and help engage the surrounding communities.
3. Develop technical materials, 'how to' manuals, and guidelines to help assist participants. For example, materials could include explanations and examples of techniques to reduce runoff and improve water quality from impervious surfaces, such as how to implement low impact development (LID) techniques.
4. Review WET program applications, select participants, assist in implementation of projects.
5. Monitor effectiveness of projects and monitor water quality and geomorphic conditions in downstream reaches of Graham Creek and Rock Creek.

Benefits of Action: Targeted enhancement of small basins with improved stormwater quality feature retrofits of existing impervious areas improves water quality, hydrology, and aquatic habitat.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0	**Initial Programmatic FTE Cost:**	$ -	**Initial Capital Cost Summary:**	$ 100,000	*$ 100,000*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ 100,000	*$ 100,000*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 500,000*

Action Name:	Pilot Improvement Basin in Graham Creek Basin						**Action #**	RC-5	
Action Type:	Programmatic & Capital		**Action Extent:**	Multiple reaches			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	RC	-	-	-	-	RK1	RK2	-	-	-

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Action D-13 provides funding for WET program (1 FTE and $200,000 capital funding per year). Assume additional capital funding for WET program to sponsor up to 5 additional stormwater retrofit projects per year in the Graham Creek pilot improvement basin at a cost of approximately $20,000 per project. Assume watershed council and other nonprofits provide volunteers support for outreach and implementation.

Ongoing Cost Assumptions: Action D-13 provides funding for WET program (1 FTE and $200,000 capital funding per year). Assume additional capital funding for WET program to sponsor up to 5 additional stormwater retrofit projects per year in the Graham Creek pilot improvement basin at a cost of approximately $20,000 per project. Assume watershed council and other nonprofits provide volunteers support for outreach and implementation.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0	FTE	$ 80,000	$ -
Implementation	1	LS	$ 100,000	$ 100,000
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 100,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 100,000
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 100,000

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary	0	FTE	$ 80,000	$ -
Property Acquisition	1	LS	$ 100,000	$ 100,000
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 100,000
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 100,000
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 100,000
Total Ongoing Cost Over Project Life (2009 dollars)				$ 400,000

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Erosion Control (Existing Program Elements)					**Action #**	D-22 (AEX)
Action Type:	Programmatic		**Action Extent:**	District-wide		**Priority Ranking:**	-

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Erosion Prevention & Control	**Potential funding sources:**	WES (Rates)
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Erosion prevention and sediment control protects streams from development-related erosion, which can be a major source of water quality degradation if uncontrolled.

Proposed Action - Implementation Steps:

WES currently provides erosion control services for development in CCSD No. 1, SWMACC, Boring, Hoodland, Gladstone, and in and out of district 1200c permits.

From July 2007 through June 2008, 817 erosion control permits were issued and 2,046 inspections were performed by CCSD No. 1 with 1.5 FTE.

Happy Valley took over responsibility for administering the erosion control program within their city limits in 2005. Happy Valley performed 215 erosion control inspections from July 2007 to June 2008.

Benefits of Action:

Erosion prevention and sediment control are very important to watershed health. Uncontrolled erosion at construction sites can contribute heavily to water quality problems including poor water clarity, high pollutant loads, damage to aquatic habitat, and maintenance problems in the storm drainage system from sediment deposition in pipes, catchbasins, culverts, outfalls, ponds, and swales.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0	**Initial Programmatic FTE Cost:**	$ -	**Initial Capital Cost Summary:**	$ 66,029	*$ 66,029*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ 66,029	*$ 66,029*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 330,145*

Action Name:	Erosion Control (Existing Program Elements)			**Action #**	D-22 (AEX)
Action Type:	Programmatic	**Action Extent:**	District-wide	**Priority Ranking:**	-

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Current annual cost for program is estimated at $66,029 by WES.

Ongoing Cost Assumptions: Assume existing cost.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
LS for ERCO	1	LS	$ 66,029	$ 66,029
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 66,029
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 66,029
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 66,029

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
LS for ERCO	1	LS	$ 66,029	$ 66,029
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 66,029
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 66,029
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 66,029
Total Ongoing Cost Over Project Life (2009 dollars)				$ 264,116

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Sampling/Water Quality (Existing Program Elements)						**Action #**	D-23 (AEX)	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	WES (Rates)
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: The WES Environmental Monitoring program is responsible for tracking, reporting, and in some cases, managing environmental conditions associated with surface water, stormwater, and treated wastewater in order to meet regulations and permits as well as WES program objectives. The Environmental Monitoring program includes environmental permit program management, laboratory operation, non-residential waste management, and a biosolids program.

Potential improvements to the monitoring program are evaluated in Action D-3, Develop and Implement an Integrated Monitoring Program.

Proposed Action - Implementation Steps:

The Environmental Monitoring Program includes the following staff.

- 0.2 FTE Program Manager
- 0.6 FTE Water Quality Analyst
- 0.2 FTE Sample Collection (through Compliance Services)
- 0.2 FTE Additional staff performs spill response, laboratory analysis on samples and maintains continuous surface water monitoring equipment

As part of the MS4 permit requirements, WES, and other Clackamas County co-permittees are required to develop and implement a stormwater monitoring program. WES currently administers a routine and storm-event related water quality and flow monitoring program within CCSD No. 1. The monitoring program activities include:

• Water quality sample collection, • Flow measurement, • Laboratory and field analysis of water samples, • Water quality data management reporting

Benefits of Action:

Water Quality monitoring provides valuable information about watershed health conditions.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0	**Initial Programmatic FTE Cost:**	$ -	**Initial Capital Cost Summary:**	$ 34,192	*$ 34,192*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ 34,192	*$ 34,192*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 170,960*

Action Name:	Sampling/Water Quality (Existing Program Elements)				**Action #**	D-23 (AEX)
Action Type:	Programmatic	**Action Extent:**	District-wide		**Priority Ranking:**	-

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Current annual cost for program is estimated at $34,192 by WES.

Ongoing Cost Assumptions: Assume existing cost.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
LS for Monitoring	1	LS	$ 34,192	$ 34,192
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 34,192
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 34,192
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 34,192

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
LS for ERCO	1	LS	$ 34,192	$ 34,192
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 34,192
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 34,192
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 34,192
Total Ongoing Cost Over Project Life (2009 dollars)				$ 136,768

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Spills/Illicit Discharges (Existing Program Elements)						**Action #**	D-24 (AEX)	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Monitoring & Regulatory	**Potential funding sources:**	WES (Rates)
Partner entities:	DTD Clackamas Co.	**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: The Spills/Illicit Discharges program is a part of the environmental permit program management element of WES. The environmental permit program management element is responsible for managing several permits, including the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit and the Underground Injection Control (UIC) requirements. The MS4 permit program is one of the key regulatory tools used to address the stormwater impacts from urban development. The UIC program regulates the discharge of stormwater below ground.

Proposed Action - Implementation Steps: According to the federal Clean Water Act, MS4 permittees must implement a program to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and systems, and design and engineering methods. The program varies by municipality and is intended to be developed in a flexible manner in consideration of site-specific conditions to optimize reductions in stormwater pollutants. The program includes BMPs, monitoring, and other available and reasonable controls, which are then documented as requirements in the permit and SWMP. SWMPs can be revised using adaptive management to improve overall program effectiveness. The proposed 2008 SWMP includes a Program to Detect and Remove Illicit Discharges and Improper Disposal Into the Storm Sewer System, which encompasses the following activities:

− Conducting dry weather inspections
− Implementing the spill response program
− Facilitating public reporting of illicit discharges and spills
− Controlling infiltration and cross connections to the storm sewer system.

Benefits of Action:

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0	**Initial Programmatic FTE Cost:**	$ -	**Initial Capital Cost Summary:**	$ 13,687	*$ 13,687*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ 13,687	*$ 13,687*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 68,435*

Action Name:	Spills/Illicit Discharges (Existing Program Elements)						**Action #**	D-24 (AEX)	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 13,687

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 13,687
Total Ongoing Cost Over Project Life (2009 dollars)				$ 54,748

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Planning and Projects (Existing Program Elements)						**Action #**	D-25 (AEX)	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	SWM Program Management	**Potential funding sources:**	WES
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: The Capital Improvement Program plans, designs and builds major capital facilities in the three area Districts, so that operating divisions can serve district customers' wastewater and surface water needs**.**

Proposed Action - Implementation Steps: CIP project management includes design and construction of capital facilities and provides project controls in terms of cost, schedule, scope, program development and long range forecasting. Examples of CIP projects that affect watershed health include regional stormwater detention and treatment systems and public stormwater infrastructure projects including pipes and bioswales.

Benefits of Action:

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	**0**	**Initial Programmatic FTE Cost:**	**$ -**	**Initial Capital Cost Summary:**	**$ 92,660**	***$ 92,660***
Ongoing Programmatic FTE estimate:	**0**	**Ongoing Programmatic FTE Cost:**	**$ -**	**Annual Ongoing Capital Cost**	**$ 92,660**	***$ 92,660***
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		***4***
				Total Estimated 5-year Programmatic and Capital Cost		***$ 463,300***

Action Name:	Planning and Projects (Existing Program Elements)						**Action #**	D-25 (AEX)	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 92,660

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 92,660
Total Ongoing Cost Over Project Life (2009 dollars)				$ 370,640

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	On-Site Maintenance (Existing Program Elements)						**Action #**	D-26 (AEX)		
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-		
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Stormwater Maintenance	**Potential funding sources:**	WES
Partner entities:	DTD Clackamas Co.	**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: The WES Stormwater Maintenance program is responsible for the maintenance of all stormwater assets within the public right-of-way in the Districts, with the exception of assets that are the responsibility of the Clackamas County Department of Transportation and Development (DTD) or the Oregon Department of Transportation (ODOT). The WES Stormwater Maintenance program is responsible for inspecting and maintaining detention ponds, and pipes, vortex separators, pollution control systems, catch basins, manholes, open channels including natural drainage features, and public underground injection controls (UIC) systems. The stormwater maintenance crew primarily inspects sites and prescribes maintenance work. Most field maintenance is performed by the sanitary maintenance crew.

Proposed Action - Implementation Steps: As of 2008, WES stormwater maintenance is currently responsible for:

- 304 miles of stormwater pipe
- 23,000 storm structures including catch basins and manholes
- 262 detention ponds
- 700 detention pipes
- 31 treatment facilities (swales and underground devices)

Maintenance Staff and Equipment Statistics:

- 0.2 FTE Program Manager
- 2.0 FTE Surface Water Technicians
- 3.3 FTE Collection System Technicians
- 1.2 FTE Seasonal Employees
- 1.0 FTE contracted with DTD
- Use of 2 Fully Equipped Maintenance Utility Trucks
- Use of combination Vacuum/Hydrocleaner trucks (“Vactor trucks”)
- Use of regenerative air sweepers (for street sweeping)
- Use of pipe video equipment

Benefits of Action:

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0	**Initial Programmatic FTE Cost:**	$ -	**Initial Capital Cost Summary:**	$177,033	*$ 177,033*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$177,033	*$ 177,033*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 885,165*

Action Name:	On-Site Maintenance (Existing Program Elements)						**Action #**	D-26 (AEX)
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**		
Action Location:	Multiple	-	-	-	-	-	-	- - -

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 177,033

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 177,033
Total Ongoing Cost Over Project Life (2009 dollars)				$ 708,132

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Regulatory (Existing Program Elements)							**Action #**	D-27 (AEX)
Action Type:	Programmatic		**Action Extent:**	District-wide				**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Erosion Prevention & Control	**Potential funding sources:**	WES (Rates)
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: The environmental permit program management element of WES is responsible for managing several permits, including the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit and the Underground Injection Control (UIC) requirements. The MS4 permit program is one of the key regulatory tools used to address the stormwater impacts from urban development. The UIC program regulates the discharge of stormwater below ground.

Proposed Action - Implementation Steps:

The Environmental Monitoring Program includes the following staff.
- 0.2 FTE Program Manager
- 0.6 FTE Water Quality Analyst
- 0.2 FTE Sample Collection (through Compliance Services)
- 0.2 FTE Additional staff

Benefits of Action:
Environmental Permit Program Management helps maintain and improve watershed health conditions.

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0	**Initial Programmatic FTE Cost:**	$ -	**Initial Capital Cost Summary:**	$ 46,914	*$ 46,914*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ 46,914	*$ 46,914*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 234,570*

Action Name:	Regulatory (Existing Program Elements)								**Action #**	D-27 (AEX)	
Action Type:	Programmatic			**Action Extent:**	District-wide				**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**					
Action Location:	Multiple	-	-	-	-	-	-	-	-	-	

Proposed Action - Implementation Steps (continued): Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions: Current annual cost for program is estimated at $46,914 by WES.

Ongoing Cost Assumptions: Assume existing cost.

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
LS for Monitoring	1	LS	$ 46,914	$ 46,914
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 46,914
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 46,914
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 46,914

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
LS for ERCO	1	LS	$ 46,914	$ 46,914
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ 46,914
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ 46,914
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 46,914
Total Ongoing Cost Over Project Life (2009 dollars)				$ 187,656

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Customer Service Coordination (Existing Program Elements)						**Action #**	D-28 (AEX)	
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**			
Action Location:	Multiple	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Customer Service	**Potential funding sources:**	WES (Rates)
Partner entities:	DTD Clackamas Co.	**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: WES provides customer service to ratepayers.

Proposed Action - Implementation Steps: Customer service includes taking information, fielding questions, and directing customers to resources via phone calls and in-person visits to the WES office.

Benefits of Action:

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0	**Initial Programmatic FTE Cost:**	$ -	**Initial Capital Cost Summary:**	$ 20,407	***$ 20,407***
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ 20,407	***$ 20,407***
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		***4***
				Total Estimated 5-year Programmatic and Capital Cost		***$ 102,035***

Action Name:	Customer Service Coordination (Existing Program Elements)							**Action #**	D-28 (AEX)	
Action Type:	Programmatic		**Action Extent:**		District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 20,407

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 20,407
Total Ongoing Cost Over Project Life (2009 dollars)				$ 81,628

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	Intergovernment Coordination (Existing Program Elements)					**Action #**	D-29 (AEX)
Action Type:	Programmatic	**Action Extent:**	District-wide			**Priority Ranking:**	-

	Watershed	Basin	Lat	Long	Modeling Subbasin	Reach(es)				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Potential lead entity:	WES			**WES Lead:**	Env. Policy & Watershed Health	**Potential funding sources:**	WES
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Multiple government agencies and departments have jurisdictions in the watersheds in the Districts, including cities, state agencies, and additional departments within Clackamas County. Intergovernment Coordination between WES and these agencies and departments is an important aspect of managing watershed health.

Proposed Action - Implementation Steps: WES employs 1.0 FTE as an environmental policy specialist in the Environmental Policy and Watershed Health functional program element. This element is a part of WES Administration. The responsibilities of the environmental policy specialist include developing partnerships with other agencies and nonprofit groups in the implementation of watershed improvement projects, assessing watershed conditions in the Districts in coordination with state and local agencies, assisting in developing management strategies to improve or protect environmental conditions in coordination with state and local agencies, assisting in public information and outreach efforts, reviewing WES and other County projects for permit compliance, and serving as a representative of WES on a wide variety of committees and advisory bodies addressing watershed health issues. The Environmental Policy and Watershed Health functional program element addresses numerous environmental regulatory programs including the Endangered Species Act (ESA).

Benefits of Action:

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0	**Initial Programmatic FTE Cost:**	$ -	**Initial Capital Cost Summary:**	$ 19,899	*$ 19,899*
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ 19,899	*$ 19,899*
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		*4*
				Total Estimated 5-year Programmatic and Capital Cost		*$ 99,495*

Action Name:	Intergovernment Coordination (Existing Program Elements)							**Action #**	D-29 (AEX)	
Action Type:	Programmatic			**Action Extent:**	District-wide			**Priority Ranking:**	-	
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**				
Action Location:	Multiple	-	-	-	-	-	-	-	-	-

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 19,899

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 19,899
Total Ongoing Cost Over Project Life (2009 dollars)				$ 79,596

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

Action Name:	SWM Program Admin (Existing Program Elements)						**Action #**	D-30 (AEX)
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**		
Action Location:	Multiple	-	-	-	-	-	-	- - -

Potential lead entity:	WES			**WES Lead:**	SWM Program Management	**Potential funding sources:**	WES
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	
Partner entities:		**Partner entities:**		**WES Support:**		**Potential funding sources:**	

Action Description (see backside of sheet for more details)

Statement of Need: Administration of the Surface Water Management (SWM) Program is needed to operate an efficient and effective program.

Proposed Action - Implementation Steps: SWM Program Administration includes management and direction of program elements and outcomes.

Benefits of Action:

Action Cost Summary (see backside for detailed cost estimate)

						Subtotal
Initial Programmatic FTE estimate:	0	**Initial Programmatic FTE Cost:**	$ -	**Initial Capital Cost Summary:**	$ 26,668	***$ 26,668***
Ongoing Programmatic FTE estimate:	0	**Ongoing Programmatic FTE Cost:**	$ -	**Annual Ongoing Capital Cost**	$ 26,668	***$ 26,668***
		(Programmatic Cost Summary is the FTE estimate translated into dollars)		**Years of Ongoing Cost Past Yr 1 included**		***4***
				Total Estimated 5-year Programmatic and Capital Cost		***$ 133,340***

Action Name:	SWM Program Admin (Existing Program Elements)						**Action #**	D-30 (AEX)
Action Type:	Programmatic		**Action Extent:**	District-wide			**Priority Ranking:**	-
	Watershed	**Basin**	**Lat**	**Long**	**Modeling Subbasin**	**Reach(es)**		
Action Location:	Multiple	-	-	-	-	-	-	- - -

Proposed Action - Implementation Steps (continued):

Attachments to describe Implementation Steps further? No

Pathway for attachment(s):

Proposed Action - Implementation Steps (continued):

Detailed Cost Breakdown

Initial Implementation Cost Assumptions:

Ongoing Cost Assumptions:

Initial Implementation Cost Estimate:

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Total Estimated Initial Implementation Costs (2009 dollars) *				$ 26,668

Ongoing Cost Estimate: Project Life Past Yr 1 (yrs) 4

Item	Quantity	Unit	Unit Cost	Estimated Cost
FTE summary		FTE	$ 80,000	$ -
				$ -
				$ -
				$ -
				$ -
				$ -
				$ -
Raw Cost				$ -
Engineering, Administration, Contingency*			35%	$ -
Sub-total				$ -
Land Costs		acre	$ 100,000	$ -
Annual Ongoing Costs (2009 dollars)				$ 26,668
Total Ongoing Cost Over Project Life (2009 dollars)				$ 106,672

* Contingency and engineering mark-ups for capital projects only. Mark-ups linked to action type in cell C2

ACTION PLAN D-2

DETENTION POND WRITE-UP
KMS DETENTION POND SITE MAP
RC DETENTION POND SITE MAP

Action D-2: Evaluate and Prioritize Retrofit of SW Detention Facilities

WES is currently responsible for maintaining over 260 stormwater treatment ponds in the Districts and Happy Valley. Over 30 ponds in the Districts have been identified by WES staff as potential opportunities to retrofit to function better. The ponds were originally designed and constructed with various functions in mind (e.g., differing levels of flood control and water quality treatment), and at different stages of understanding of stormwater treatment opportunities to improve watershed health.
The following table shows design standards used by the District for detention facilities since 1993. According to the District, it typically takes 2 years after the design standards are changed before the changes are fully implemented in new facilities. For example, ponds built before 1995 would likely follow the standard in effect prior to 1993.

Detention Pond Design Standard History		
Date	**Detention Design Standard**	**Record of Change in Design Standard**
October, 1993	25-year developed runoff rate to the 5-year pre-developed rate	
June 1, 1999	25-year to 5-year and 2-year to ½ the 2-year	Detention
May 1, 2000	25-year to 5-year and 2-year to ½ the 2-year	25-foot buffer requirements to a 50-foot buffer requirement
August 1, 2002	2-year to ½ the 2-year	Detention
February 1, 2005	2-year to ½ the 2-year	Redevelopment clause

In order to map the detention ponds by date and location, the District compiled as-built records and assigned 189 ponds that were built between 1976 and 2008 with a date. The date used for mapping was the earliest date found on the as-builts, so that it would correspond with the design standard in effect during design of the pond. The maps attached to action D-2(EAP) display the ponds by period of design standard and identify maintenance responsibility (e.g., WES-maintained ponds and privately maintained ponds).

Due to the large number of ponds in need of retrofit, retrofit activities must be prioritized. The first priority is to retrofit ponds that were built prior to 1995, which includes 19 ponds in the KMS watershed. No ponds were built prior to 1995 in the Rock Creek watershed.

Ponds built prior to 1995 should be retrofitted to treat flow from smaller storms, such as storms with a recurrence interval of 2-years and less. Storms at this recurrence are the channel forming storms and therefore more geomorphically significant. A “one size fits all” recommendation cannot be made to address every pond, due to varying basin and site conditions. The variables include changes in the watershed area, modifications to the original pond design, and changes in rainfall patterns throughout the watershed and over time as we see affects from climate change.

Because of these variables we are recommending “low tech” modifications or retrofits to the existing ponds. The recommended retrofits are intended to keep the implementation process simple, and will thus not require intense modeling or extensive design in an effort to match the hydraulics to a new design storm. The following are our recommendations based on our assessment of the watersheds and our discussion with WES staff.

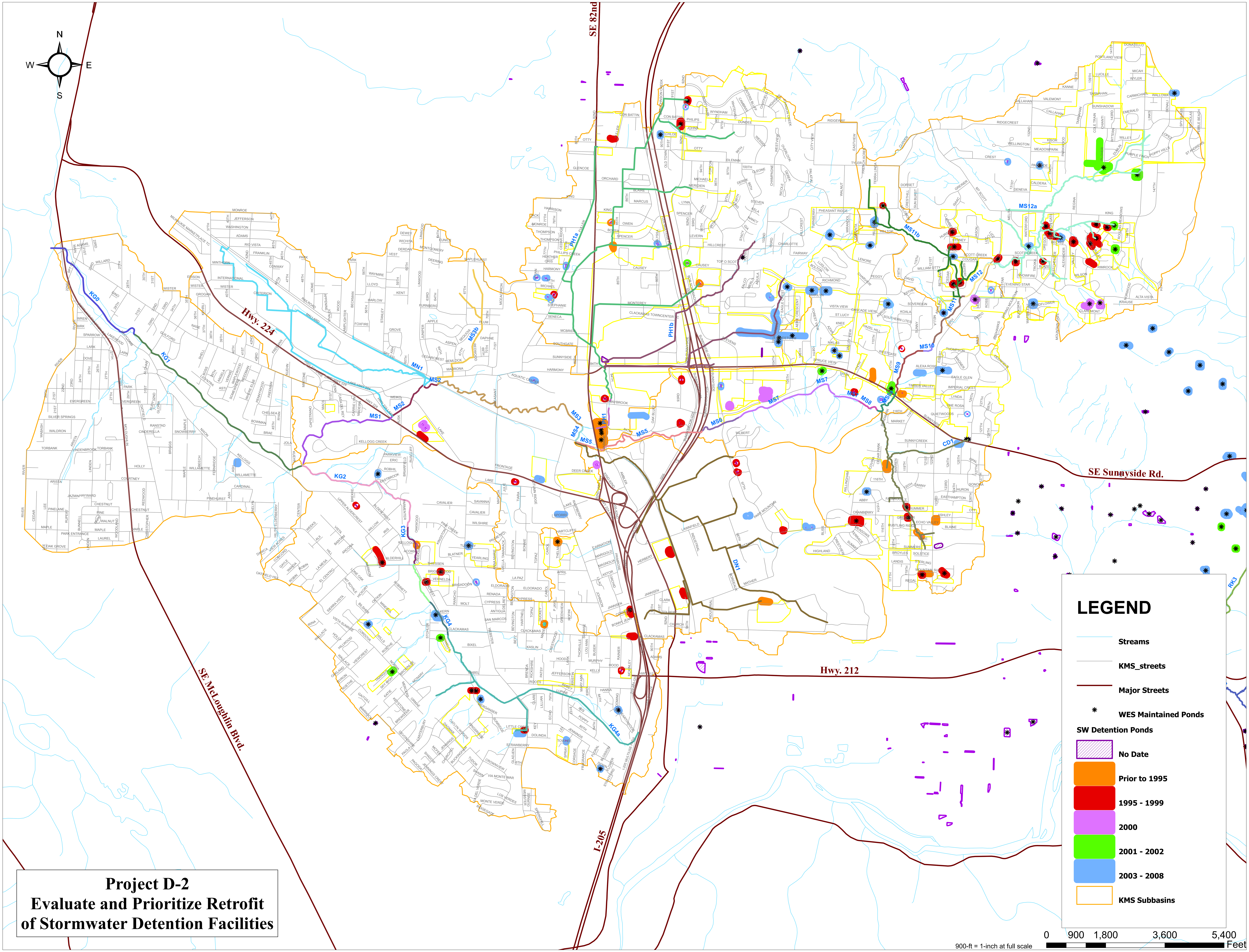
Recommendations for ponds built prior to 1995:

- If short circuiting is occurring, construct berms and a low flow channel to provide a longer flow path for the flow through the pond.
- If sediment is apparent at the inlet to the pond remove sediment and if room is available place a small rock weir to pool water and allow sediment to drop out prior to entering the main part of the pond. For many of the ponds observed the room might not be available to construct this sediment forebay.
- Place a rock weir around the outlet structure that will back smaller storms into the pond and provide more detention for smaller storms. This rock weir should be less than 30-inches tall and should not exceed 1/3 the overall pond depth.
- The length of the outlet weir should be a minimum of 3-feet per acre in the drainage basin.
- WES should experiment with placing a sand berm within the rock berm to provide water quality treatment. Sand filtering is very effective at removing TSS, Oils and Grease and Bacteria. It is moderately effective on metals and other pollutants. The construction and maintenance will require some experimenting and observing by WES. The sand berm within the rock berm should be 18” in width and be made of sand particles between 0.02 and 0.04 inches in diameter.
- Sand bags might be a simple approach to holding the sand in place and covering up with rocks for aesthetics.
- A plant management program should be implemented that includes removing non-native plants and installing a diverse assemblage of native plants including groundcovers, shrubs and trees to support water quality and habitat improvements. The basic planting detail for ponds can be used as a guide, where appropriate. Plant selection and placement will depend on maintenance access and should not obstruct maintenance activities. Mowed grass ponds should be enhanced with more diverse vegetation, unless the facilities serve other purposes such as a sports field.

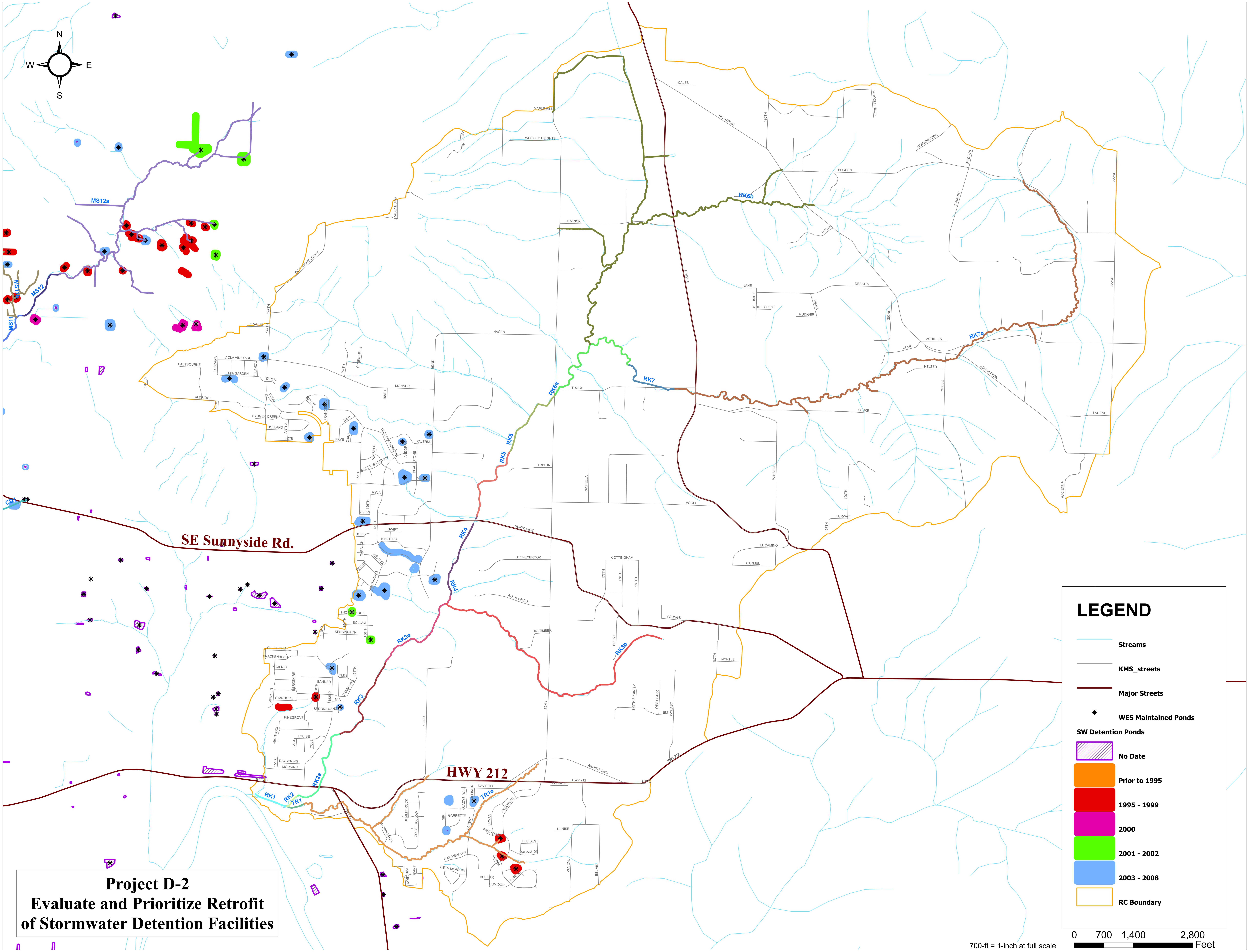
Recommendations for ponds built after 1995:

- If ponds appear to be holding back water for smaller storm events no modification to the outfall structure may be required. However, opportunities for implementing the plant management program and a sediment forebay should still be evaluated.
- If the pond is not holding back water for smaller storm events all of the recommendations for ponds constructed prior to 1995 should be implemented.

Detention pipes will need to be inspected and evaluated, with a retrofit solution determined following the evaluation.



Project D-2
Evaluate and Prioritize Retrofit
of Stormwater Detention Facilities



Project D-2
Evaluate and Prioritize Retrofit of Stormwater Detention Facilities

ACTION PLAN D-10

KMS BENTHIC SITE MAP
RC BENTHIC SITE MAP

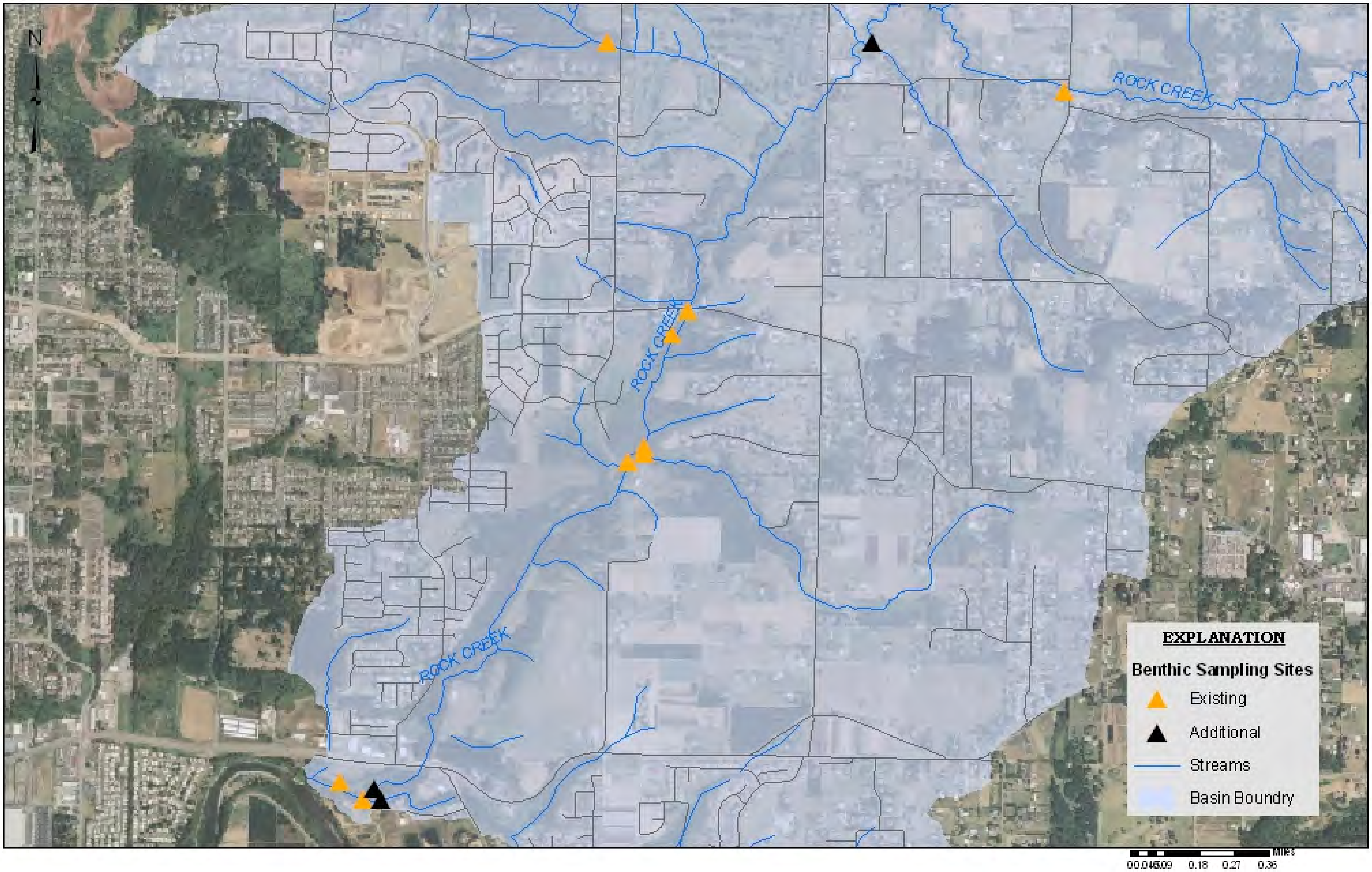
Kellogg/ Mt. Scott Creek
Benthic Sampling Sites
WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES

BROWN AND CALDWELL

Swanson Hydrology + Geomorphology

Ellis Ecological Services, Inc.



Rock Creek
Benthic Sampling Sites
WES WATERSHED ACTION PLAN

WATER ENVIRONMENT SERVICES
BROWN AND CALDWELL
Ellis Ecological Services, Inc.

ACTION PLAN D-18

1999 ODFW CULVERT ASSESSMENT
FISH PASSAGE IMPLEMENTATION STEPS
KMS CHARACTERIZATION FIGURE 4-8
RC CHARACTERIZATION FIGURE 4-9

Assessment of Road Culverts for Fish Passage Problems on State- and County-Owned Roads

Statewide Summary Report

September, 1999

Prepared by:
Albert H. Mirati, Jr.

Oregon Department of Fish and Wildlife

Preface

Between mid-1996 and mid-1999, the Oregon Department of Fish and Wildlife (ODFW) conducted assessments of fish passage conditions at State- and county-owned road culverts. At the conclusion of each phase of the assessments, the Department produced and distributed a limited number of reports for the Oregon Department of Transportation (ODOT) and the counties which summarized road culvert assessment activities by river basin.

Public interest in these reports was underestimated. Each month, ODFW and ODOT receive numerous requests for these reports that can not be filled because the reports are out of print.

In order to meet the current and future demand for this information, ODFW is offering this summary report as a substitute for the original reports. This report contains all the basic information contained in the original reports plus all the inventory data collected over the 3-year assessment project. Where the original reports were tailored for either State or county road authority use, this report contains information for both.

At some point in the near future, this summary report and all database tables will be offered electronically on the Oregon Department of Fish and Wildlife Home Page via the Internet. Contact the ODFW Fish Passage Coordinator at the ODFW headquarters office in Portland for progress on this posting.

Albert H. Mirati, Jr.
Fish Passage Coordinator
Oregon Department of Fish and Wildlife
September, 1999

Introduction

Human activities have created impediments to fish passage in Oregon streams that have reduced the number of stream miles available to salmonids (CSRI 1997). An undetermined number of road culverts present barriers to upstream migration of adult and juvenile salmonids on essentially all Oregon streams. These barriers seriously limit fish production in an unknown number of miles of historic habitat. Based on limited survey information, the problem appears to be significant and warrants investigation.

Botkin et al (1994) and the National Research Council (1996) concluded that migration barriers have substantially impacted fish populations. The extent to which culverts impede or block fish migration appears to be substantial. During fish presence surveys conducted in coastal basins during 1995, 96% of the barriers identified were culverts associated with road crossings (CSRI 1997).

Movement of salmonids throughout a watershed is necessary to meet a number of life history needs:

< Upstream migration of anadromous and resident adults to access suitable spawning areas;

< Juvenile and resident adult fish must be able to move upstream and downstream to adjust to changing habitat conditions (i.e., temperature fluctuations, high or low flows, competition for available food and cover);

< Resident fish need continuity of stream networks to prevent population fragmentation which decreases gene flow and genetic integrity;

< Catastrophic events can displace entire resident fish populations. Barriers can prevent the recolonization of these habitats.

Because there is no comprehensive inventory of in-channel obstructions on which to base a fish passage improvement program, the logical first step to improve fish passage at road culverts is to collect the required assessments. In mid-1996, the Oregon Department of Transportation (ODOT) and the Oregon Department of Fish and Wildlife (ODFW) entered into a contract (see Appendix 1) which committed ODFW to inventory, assess and prioritize for repair, all culverts associated with State- and county-owned roadways in the coastal river basins. These surveys did not include private (i.e., forest lands, residential property, etc.), federal or city roads. The contract was subsequently amended several times to include all river basins in the State.

The contract and culvert assessment effort responded to two primary incentives:

< Oregon Revised Statutes (Chapters 498 and 509) which require any person, municipal corporation or government agency placing an artificial obstruction across a stream to provide and maintain fish passage for anadromous, food and game fish species where these are present; and

< The Oregon Plan for Salmon and Watersheds (formerly the Oregon Coastal Salmon

Restoration Initiative) which identifies restoration of fish passage at artificial in-channel barriers as a high priority.

This project summary report describes:

< the inventory and assessment process in general;
< specific assessment methods used;
< criteria used to determine which culverts potentially impede passage; and
< the priority-setting process;

Process Overview
Prior to actual field surveys, possible culvert crossings were located on black-and-white copies (where available) of USGS 7.5-minute quadrangle maps obtained from the Oregon Department of Forestry, Salem. These maps had been previously modified with information from ODFW to indicate known or suspected (unverified) fish presence. Points where Afish-bearing≅ streams intersected with State or county roads (possible culverts) were marked for field inspection.[1] Project personnel then conducted on-site assessments of each intersection identified.

For each culvert failing to meet established fish passage criteria, information collected included:

UTM Coordinates	Culvert Type	Drop to Pool Below
Road Number or Name	Culvert Length	Depth of Pool Below
Road Mile (if known)	Culvert Diameter	Meets Criteria: Yes/No
Roadway Owner	Culvert Slope	Additional Comments
Stream Name and Basin	Stream Slope Above	
	Stream Slope Below	

For culverts judged to be fish-passable, only name and location were recorded in the database

Information regarding fish species present, stream habitat quality and miles of stream above (to end of fish distribution or another blockage) were not determined at this time; these data were obtained later with assistance from ODFW field staff most familiar with the stream systems.

Methods

UTM Coordinate System
The geographic location of each culvert was fixed in two ways: (1) using Universal Transverse Mercator (UTM) coordinates (see Appendix 2 for an explanation of this system) and (2) by roadway number or name and road mile (where established). UTMs were chosen because the

[1] In many instances, culverts were selected for assessment on streams not marked as fish-bearing if the stream appeared to the surveyor to have the potential to support fish.

degree of accuracy obtained using available maps was far superior to that obtainable using latitude-longitude or township-range-section systems. UTM coordinates are also completely compatible with GIS (Geographic Information System). Culvert locations were usually recorded in UTMs to the nearest 25 meters unless their location could be reasonably established to a closer tolerance.

State roads are usually identified by state route (highway) number and ODOT road number. County roads are usually identified by the number assigned by the subject county. In a few cases, road names were used. Whenever possible road miles were recorded to the nearest one hundredth of a mile as established in the ODOT straight-line charts or county atlas of roads. Occasionally, a stream crossing was not listed in either document, or it was unclear exactly which small tributary listed was the one in question. In these cases, road miles were approximated to the nearest 0.1 mile using odometer readings.

Fish Passage Criteria

Culverts on fish-bearing streams were evaluated against established passage criteria[2] for juvenile and adult salmonids. Parameters measured or estimated and recorded were:

< culvert diameter (inches) and length (feet);
< culvert slope (percent);
< presence/absence of a pool at the culvert outlet;
< distance (inches) of drop, if any, to the streambed or pool at the culvert outlet;
< pool depth, if present, in inches

Culvert diameter was usually measured. Where culverts were not entirely round (distended) or were arched pipe configurations, the width was recorded.

Water velocity, although a critical factor for upstream fish passage, was not measured directly. At the time of survey, flows were generally much lower than those typically encountered by adults moving upstream to spawning areas. Culvert slope is used as a surrogate indicator for possible velocity barriers in culverts.

Culvert slope was established using a clinometer whenever possible. Because this method requires a fixed point at eye level to sight on, it was occasionally impractical to use. Experience measuring many culverts, coupled with regular measurements where possible, gave the surveyors the ability to estimate slope where direct measurements were not practical. Also noted was whether slope was constant throughout the culvert length.

Generally, non-embedded metal and concrete culverts are considered impassable if the slope exceeds 0.5 to 1.0 per cent. At slopes greater than this, water velocities within the culvert are likely to be excessive and hinder passage, especially for juveniles fish.

[2]See Appendix 3; ODFW Guidelines and Criteria for Stream-Road Crossings

Conditions at the culvert outlet were evaluated for drop (distance from culvert invert to stream below) and the presence or absence of a jump pool. If a pool was present, its depth was recorded. The general criteria for pool depth is 1.5- to 2.0-times the height of the jump (drop) into the culvert; pools shallower than this are considered inadequate for fish needing to jump to enter a culvert.

If the height of the jump (pool surface to water level in the culvert) into a culvert would exceed 12 inches during the period of adult migration, the culvert was judged inadequate for adult fish passage and listed as needing attention. If the jump was judged to be greater than 6 inches during juvenile migration periods, the culvert was judged to be a passage problem for juvenile. In many cases, estimating the effect of moderate to high flows on the height of the jump was difficult and based on limited knowledge of the particular stream in question. Seasonally passable culverts, when noted, were listed as such in the comments section of the database.

Other culvert-related factors, recorded as miscellaneous comments, include:

< whether the culvert was embedded into the streambed or contained natural substrate;
< whether water ran beneath (outside) the culvert at the upstream end (a problem for downstream migration of juvenile fish in low water) or the downstream end (often caused by holes in the culvert bottom, due to corrosion)
< fish size (juvenile, adult or both) likely to be hindered or blocked;
< other features bearing on the culvert=s condition and ability to pass fish. (presence of baffles, debris jams, trash racks, fishways, etc.)

All culverts surveyed were placed in one of 2 categories; *passable* or *deficient*, as indicated in the AOK?≅ field of the database. Culverts meeting ODFW fish passage criteria were judged to be passable (OK = Yes). Culverts failing one or more criteria were judged deficient (OK = No) and in need of maintenance or remedial construction.

Assigning Priority for Repair

Ranking deficient culverts for repair is a difficult task. Several approaches were explored with all but one rejected because one or more critical information elements were missing. In the end, each listed culvert was rated as HIGH, MEDIUM or LOW priority for repair by ODFW field staff most familiar with fish populations and habitat in each stream. The ratings indicated in the database are generally based on:

< the number and status of species present;
< population size and condition; and
< the estimated quantity and quality of habitat blocked.

No effort was made to include factors such as estimated cost of repair, proportion of passage improvement or estimated increase in production; there were too many unknowns associated with these elements.

In most cases, staff were sufficiently familiar with the relevant factors to assign a priority for repair. In some cases (usually small unnamed tributaries or headwater areas), ratings are based on uncertain knowledge and are no more than Abest estimates≅.

Data Summaries

All information collected pertaining to each culvert assessed was input into a Microsoft8 Access8 7.0 database for storage, sorting, display, analysis, summarization, reporting and distribution to interested parties. Summary tables appearing at the end of this report contain information on both good and problem culverts; those that meet passage criteria as well as those that do not. Electronic copies of database information are also available from the ODFW Fish Passage Coordinator.

Microsoft Access8 7.0 Database

The following is a listing of the database fields in the culvert database printouts at the end of this report. Each parameter (units of measure, source of data, process of collection, etc) is explained below along with important limitations as to the accuracy and use of the information.

OK?--Does the culvert meet fish passage standards; YES or NO?

A ANO≅ does not mean that all fish are blocked at all flows; only that the culvert does not meet accepted fish passage criteria. The culvert probably inhibits or blocks adult and/or juvenile fish passage at some or all flows.

OWNER--the entity responsible for maintaining the culvert.

ZONE--the Universal Transverse Mercator (UTM) zone in which the culvert is located. Oregon contains 2 zones; zone 10 is to the west of 120° longitude, zone 11 to the east.

EASTING--the location of the culvert in meters east of 126° longitude.

NORTHING--the location of the culvert in meters north of the Equator.

ROAD--the State (ODOT) or county highway number (or name if unnumbered).

RM--Road mile of the culvert=s location listed in ODOT Bridge Log, ODOT straight-line chart or county road atlas. Odometer readings were used where stream crossings were not listed in these references. Points of origin for these are noted in the Acomments≅ section.

STREAM--the name of the stream containing the culvert. Names are taken from USGS quadrangle maps and information supplied by ODFW fish district personnel.

SUBBASIN--the stream or river into which STREAM flows.

BASIN--the stream or river into which SUBBASIN flows.

TYPE--the material that the culvert is composed of and the culvert=s shape. Where shape is not indicated, culverts are round. Codes used are standard ODOT abbreviations and are summarized in Appendix 6.

LENGTH--length of culvert in feet; determined from ODOT Bridge Log, ODOT straight-line chart, county road atlas or estimated by striding over the road surface.

DIAM--culvert diameter (or width if not round) in inches; determined from ODOT Bridge Log, county atlas, tape measure, or estimated.

DROP--measured or estimated distance in inches between water surface in culvert to the water surface of the stream below at the time of the survey.

DEPTH--measured or estimated depth, in inches, of the pool below the culvert (if present) during the period of migration.

SLOPE--measured or estimated slope of the culvert from horizontal, in per cent.
.
SPECIES--fish species present in the subject stream. Species suspected to be present (not verified) are enclosed in parentheses. Abbreviations used are summarized in Appendix 7.

STMMILE--estimated miles of stream above the subject culvert to (1) the verified end of fish distribution, (2) next known upstream passage barrier or (3) the end of stream as indicated on USGS 7.5 quadrangle maps. The maps used were previously modified to indicate known or suspected (unverified) fish presence. Since fish presence was not absolutely known in all cases, these figures should be considered estimates only, giving a general indication of how much stream is blocked by the culvert. Stream miles do not necessarily reflect miles of fish habitat.

HABQUAL--assessment of habitat quality by ODFW field personnel. Possible ratings are *Good, Fair*, *Poor*, and *Unknown* In some cases, the rating reflects firsthand knowledge of the stream. In others, the streams are not known individually and are ranked based on the raters knowledge of the area in general. When the rater was uncomfortable assigning rating because of uncertainty, a rating of *unknown* was used.

PRIORITY--ODFW district personnel rated each culvert as *High, Medium* or *Low* priority for repair based on personal knowledge of fish populations present and habitat conditions.

Disclaimer

Although we made every effort to trap and eliminate errors at each phase of this project, some undoubtedly were missed. With 5,500 culverts assessed, recorded and summarized in this effort, some undetected errors in determining, recording and transcribing UTM coordinates and other data are likely. If apparent errors are encountered, we wish to be informed so our records can be updated and improved. Please report any questionable data to the ODFW Fish Passage Coordinator, PO Box 59, Portland, OR 97207.

References

Botkin, D., K. Cummins, T. Dunne, H. Regier, M. Sobel, and L. Talbot. 1994. *Status and future of salmon of western Oregon and northern California: findings and options.* Report #8. the Center for the Study of the Environment, Santa Barbara, CA.

CSRI (Oregon Coastal Salmon Restoration Initiative) Plan, Draft Revision, February 24, 1997. State of Oregon, Salem, Oregon.

NRC (National Research Council). 1996. *Upstream--Salmon and Society in the Pacific Northwest*, National Academy Press, Washington, D.C.

Project: D-18: Evaluate and prioritize retrofit of potential fish passage barriers

Project Implementation Steps:

1. Select WES project manager
2. Set Goals
3. Collect Data
    a. Condition of barrier
        i. Year of installation
        ii. Purpose
        iii. Culvert Specific
            1. Diameter, length, slope
            2. Presence/absence of pool at culvert outlet
            3. Distance of drop to streambed or pool at culvert outlet
            4. Pool depth
        iv. Dam Specific
            1. Dimensions of dam and upstream reservoir
            2. Type of fish passage structure, if any
            3. Water quality and flow data upstream of reservoir and downstream of dam.
    b. Identify species and life stages affected
    c. Quality and availability of upstream habitat
        i. Review hydrologic, water quality and aquatic habitat data to determine if upstream habitat is suitable for identified species.
    d. Flooding hazards
        i. Evaluate downstream flooding effects of barrier replacement/retrofit
4. Evaluate extent of barrier using collected data, KMS and RC Characterization and Assessment Reports, ODFW Culvert Assessment, Clackamas County culvert inventory.
5. Identify preferred replacement/retrofit method and lower cost alternatives
6. Develop a fish passage barrier retrofit prioritization and rank projects
    a. Factors Affecting Prioritization – which could include cost, habitat improvements, species affected, location relative to unobstructed downstream access, potential to affect flood conditions.
7. Develop an implementation program to improve two fish passage barriers annually, working from downstream to upstream.
8. The next project would involve design of fish passage improvements. The design phase may have a new project manager and will coordinate funding, partners, engineering, permitting and construction.

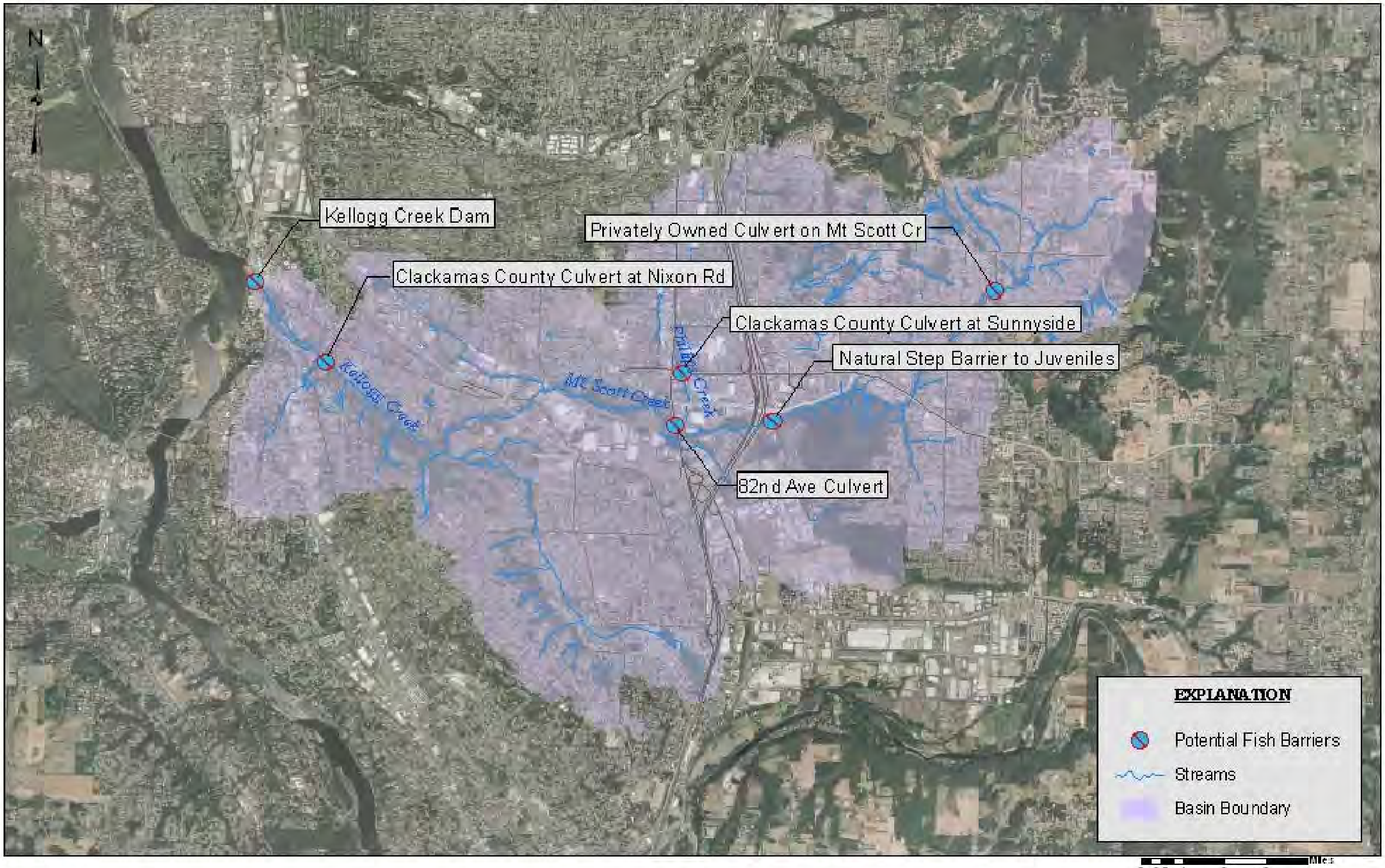


Figure 4-8
Potential Barriers to Fish Within the Kellogg-Mt. Scott Watershed
WES WATERSHED ACTION PLAN

Water Environment Services

Brown and Caldwell

Ellis Ecological Services, Inc.

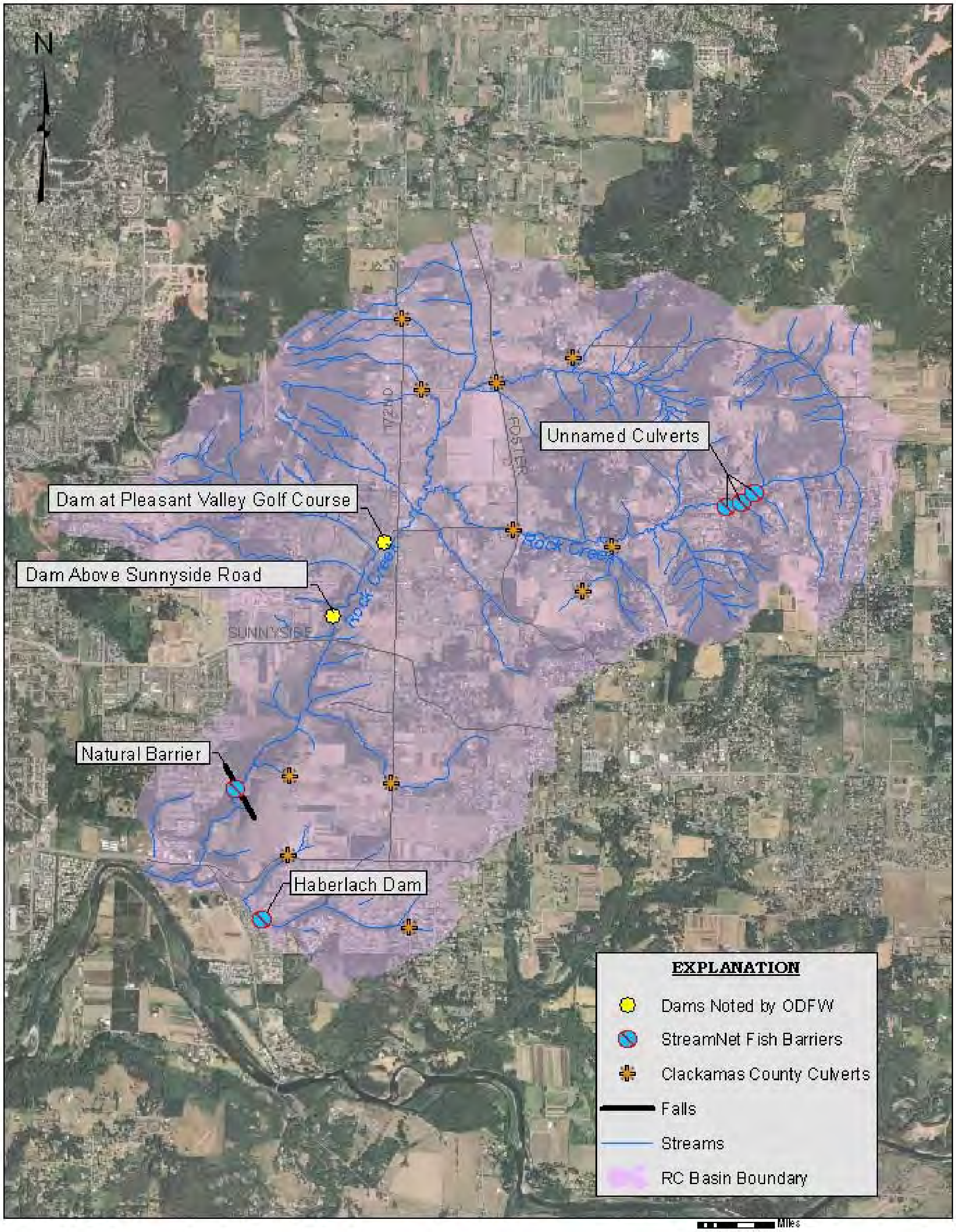


Figure 4-9
Potential Fish Barriers
WES WATERSHED ACTION PLAN

Water Environment Services

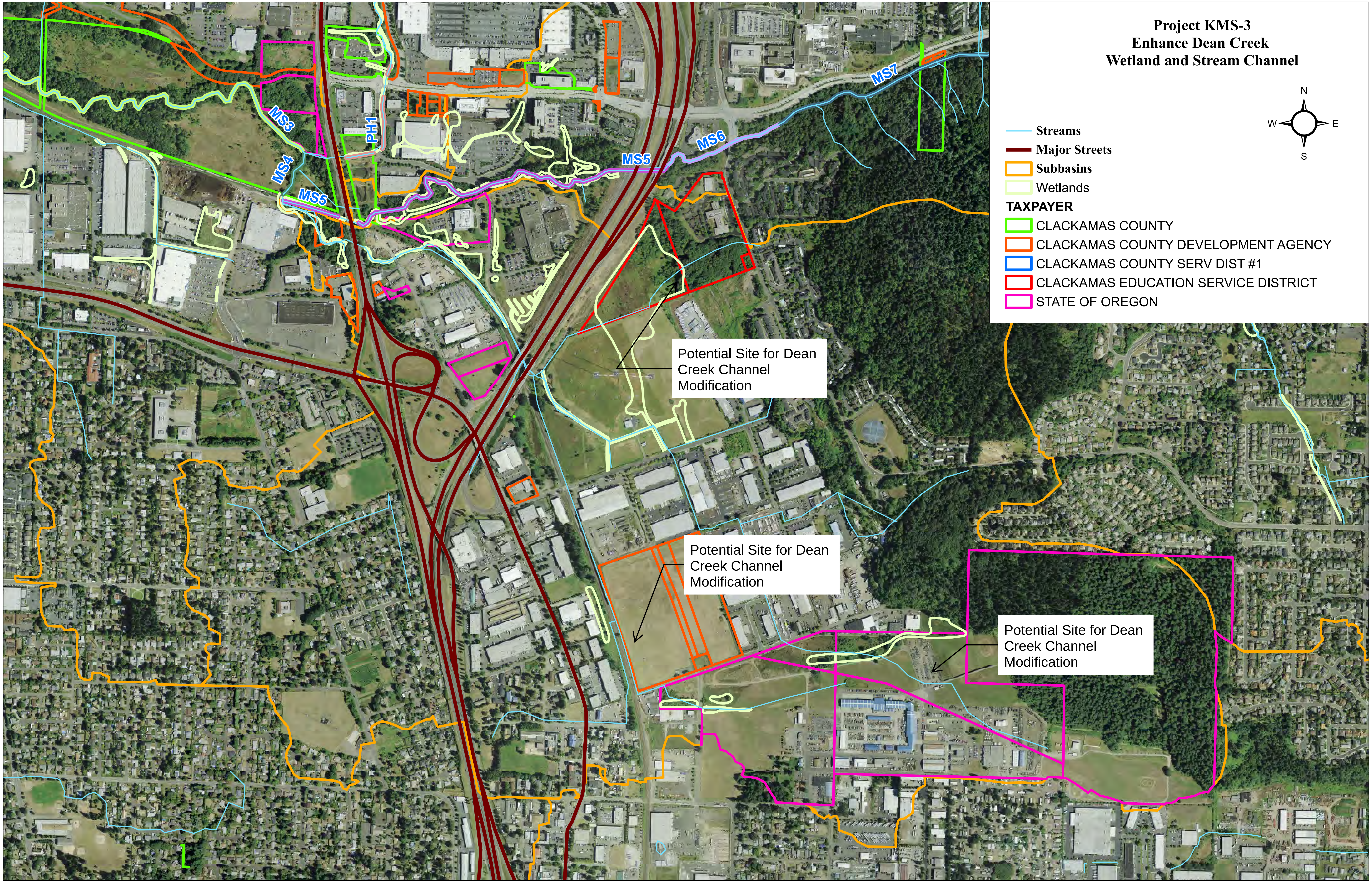
Brown and Caldwell

Swanson Hydrology + Geomorphology

Ellis Ecological Services, Inc.

ACTION PLAN KMS-3

ENHANCE DEAN CREEK WETLAND AND STREAM CHANNEL MAP


Project KMS-3
Enhance Dean Creek
Wetland and Stream Channel
N
S
E
W
Streams
Major Streets
Subbasins
Wetlands
TAXPAYER
CLACKAMAS COUNTY
CLACKAMAS COUNTY DEVELOPMENT AGENCY
CLACKAMAS COUNTY SERV DIST #1
CLACKAMAS EDUCATION SERVICE DISTRICT
STATE OF OREGON
MS3
MS4
MS5
MS5
MS6
MS7
PH1
Potential Site for Dean Creek Channel Modification
Potential Site for Dean Creek Channel Modification
Potential Site for Dean Creek Channel Modification

ACTION PLAN KMS-4

ENHANCE MT. SCOTT CREEK CHANNEL IN THREE CREEKS AREA MAP


Project KMS-4
Enhance Mt. Scott Creek
Channel in Three Creeks Area
Streams
Major Streets
Subbasins
Wetlands
SW Detention Ponds
N
W
E
S
MS2
MS3
MS4
MS5
PH1
Potential Area for
stream
restoration

ACTION PLAN KMS-8

CCSD NO. 1 AND CITY OF JOHNSON CITY WATER QUALITY MONITORING PROJECT

ATTACHMENT #1
Clackamas County Service District #1 and City of Johnson City
Water Quality Monitoring Project

PURPOSE

The purpose of this attachment is to define the responsibilities of the City of Johnson City (Johnson City) and Clackamas County Service District No. 1 (District).

Johnson City desires to obtain water quality monitoring services from District in order to comply with their *Willamette Total Maximum Daily Load Implementation Plan* monitoring requirements.

PROJECT DESCRIPTION AND LOCATION

The project (Project) involves the collection of samples for field and laboratory analyses from two monitoring sites located in the City of Johnson City. The monitoring locations are representative of the flow at outflow of Leona Lake and a site on the west side of the city.

PROJECT COSTS

The cost of the project will be based upon time and materials and established laboratory fees. This data will be captured through the Water Environment Services Time Card and Financial Systems. Rates are adjusted annually and effective July 1.

RESPONSIBILITIES

The District Shall:

1. Collect field and lab samples at the Johnson City outfall site for 4 storm events prior to June 30, 2010. District will attempt to collect these samples during the same events when they are collecting their own samples to meet MS4 NPDES permit requirements.
2. An attempt should be made to collect lab samples represents the characteristics of the source. The time and date when these samples are collected should also be documented.
3. Analyze the composite samples in the lab for total copper, total lead, total zinc, alkalinity, total hardness, E. Coli, ammonia, nitrate and nitrite as N, total phosphorus and total suspended solids.
4. Analyze discharges in the field for specific conductivity, pH, temperature, dissolved oxygen, and turbidity. The time and date when these samples are collected should also be documented.
5. Collect adequate samples such as field blanks and duplicates in order to conduct the required quality assurance and quality control reviews of the data.
6. Provide hard copy and digital copy results of the field and laboratory analyses to Johnson City.

Johnson City Shall:

1. Submit payment to the District for Johnson City's share of the Project cost within 30 days of receipt of invoice from the District and all deliverables as described in Responsibilities above.

DISCLAIMER

Johnson City shall not be responsible for costs associated with this Project that are not specifically stated in this agreement.
Johnson City is and remains responsible for compliance with their TMDL Implementation Plan obligations; District assumes no liability regarding any fees, fines, or other costs by entering into this Agreement.

APPENDIX A

POLICIES AND PRACTICES

WES Policies and Practices

WES is a department within Clackamas County that conducts and manages wastewater and stormwater management services in several districts including CCSD No. 1, the Surface Water Management Agency of Clackamas County (SWMACC), and the Tri-City Service District. CCSD No. 1 includes an agreement with and encompasses portions of the City of Happy Valley as shown in Figure 1-2.

WES has retooled its surface water management program and is transitioning from a utility-based, regulatory driven program to an approach focused on watershed health focus and integrated watershed management. WES' vision is to improve watershed health by managing its surface water program efficiently and effectively, using financial resources to provide the most benefit through prioritized activities and investments. An organizational chart for WES is provided in Figure A-1.

Functional program elements within WES that relate to surface water management as shown in the current organizational chart are summarized below. It is important to note that as WES implements its vision to improve watershed health by managing its surface water program efficiently and effectively, changes may be made to the current organizational structure described below.

- Asset management
  - Development plan review and permitting
  - Erosion prevention and sediment control
- Water quality services
  - Stormwater system maintenance
  - Program management
- Environmental monitoring
  - Environmental permit program management
  - Laboratory operation
- Administration
  - Environmental policy and watershed health
  - Public information and outreach
- Business services
  - Customer service
- Financial services
  - Utility billing
  - Asset management reporting

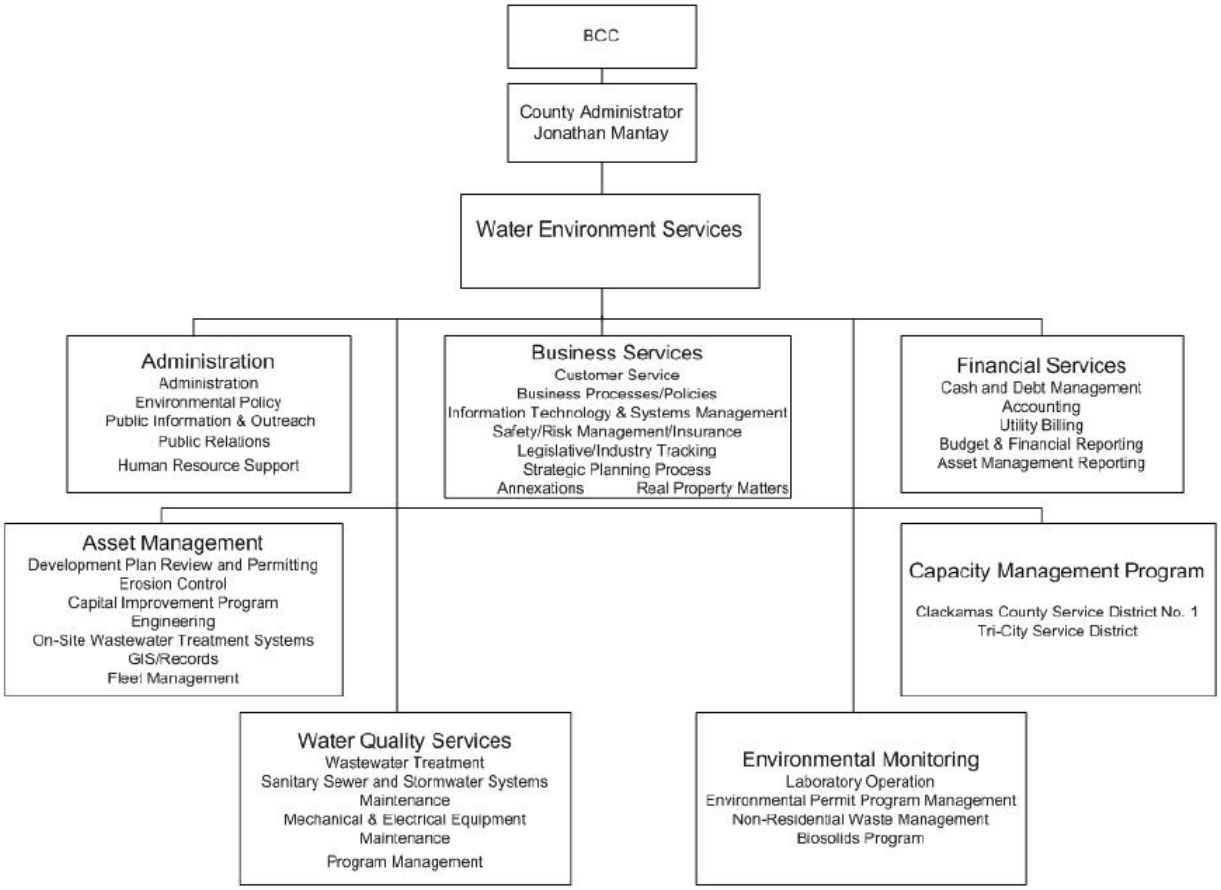


Figure A-1. WES Organizational Chart

WES currently provides stormwater management and development review services in the CCSD No. 1 service area and the western portions of Happy Valley served through an inter-governmental agreement (IGA). The purpose of the following section is to summarize existing policies and practices implemented by WES that affect watershed conditions and identify opportunities for potential improvements that will help WES to more efficiently and effectively improve and protect watershed health. These opportunities for potential improvements will be evaluated further during the assessment phase of the project, with WES staff input.

Asset Management

Asset management at WES includes the following program components: development plan review and permitting (Development Review), erosion prevention and sediment control (ERCO), Capital Improvement Program (CIP), engineering, on-site wastewater treatment systems, Geographic Information Systems (GIS)/records, and fleet management.

The Capital Improvement Program plans, designs and builds major capital facilities in the three area Districts, so that operating divisions can serve district customers' wastewater and surface water needs. CIP project management includes design and construction of capital facilities and provides project controls in terms of cost, schedule, scope, program development and long range forecasting. Examples of CIP projects that affect watershed health include regional stormwater detention and treatment systems and public stormwater infrastructure projects including pipes and bioswales.

The annual process for developing CIP activities is illustrated in Figure A-2. The WES program elements submit projects to the candidate project list. Candidate projects include capacity management projects for the sewer system, surface water maintenance projects, and other projects. The need for projects is often evaluated using a criticality analysis, which is a process used to determine the potential impacts associated with completing or nor completing a given project. The candidate projects are then rated using prioritization criteria. Certain projects also go through a Business Case Evaluation (BCE) to determine the optimal alternative to address a problem or issue based on life cycle costs and benefits. Once the final project list is developed, funding options and availability are evaluated and the prioritized CIP is developed to guide project implementation.

The GIS/records program element is also an important element of asset management for watershed health. GIS is a useful tool for tracking watershed health metrics and management activities as well as analyzing information about watershed conditions. The WESworks GIS system is used by WES staff for data display and queries, such as to identify the location of stormwater assets. ArcGIS is used for data input, storage, and analysis. Opportunities are being identified to improve the efficiency and usefulness of the data that is collected by WES staff related to environmental monitoring, development review, maintenance, and erosion control. The collection, storage, display, and analysis of this data could potentially be improved with assistance from the GIS staff using capabilities in WESworks and ArcGIS.

The asset management program element includes the following WES staffing levels expressed as Full Time Employee Equivalents (FTE) engaged in development review, capital projects, planning, and erosion control.

- 0.2 FTE Program Manager
- 0.5 FTE Surface Water Coordinator
- 0.2 FTE Soils Program Supervisor
- 0.2 FTE Development Review Supervisor
- 1.0 FTE Administrative Support
- 0.5 FTE Senior Civil Engineer
- 0.5 FTE Civil Engineer
- 1.0 FTE Surface Water Technician
- 1.5 FTE Plan Reviewer
- 1.5 FTE Erosion Control Inspectors
- 0.5 FTE Single Family Plan Reviewer
- 2.5 FTE for WES-related GIS work.
- Additional staff through DTD for floodplain and miscellaneous land use issues.

Development review and ERCO are discussed in more detail below.

Development Plan Review and Permitting

WES reviews development plans for installation of public sewers and storm water systems within CCSD No. 1 and SWMACC. The development plan review and permitting process is performed by WES Development Review staff in conjunction with development review and permitting conducted by Clackamas County DTD and the Land Use Planning division (Planning) within DTD. The development review process includes subdivisions, partition plats, commercial and industrial development, single family residential, and other facilities that discharge into the public sanitary sewer or storm water system. WES provides sewer and stormwater development review services for the City of Happy Valley areas within CCSD No. 1.

The development review process is a critical element of WES policies and practices that affects watershed health. The design standards and requirements for stormwater management applied by WES Development Review staff for the permitting of new development in the Districts have long-term consequences on water quality and hydrology in developed areas. These direct impacts also contribute to secondary impacts on aquatic habitat and biological communities.

This section describes the current development review process so that potential improvements to the process can be identified that may enhance WES efficiency and effectiveness in maintaining and improving watershed health. Following the discussion of the processes and the potential opportunities for improvements, this section includes a summary of the current design standards for stormwater, which are used by developers to guide the design of stormwater treatment systems included with new development.

The WES development review processes for subdivision/partition, commercial, and single family permit approval was discussed by WES staff during two workflow mapping workshops, held on October 30 and November 19, 2008. At the workshops WES staff collaborated to revise the existing process map to reflect the actual processes for permit approval. The revised process maps are shown on Figures A-3 through A-5, and a summary of the current process follows.

Support Tools

DTD and Planning utilize Permits Plus to track permits. WES utilizes Permits Plus to approve their areas of responsibility in the permit process. For internal tracking prior to Permit Plus approval, WES utilizes Permits 2008 (or “Donworks”).

Permit Process – Planning and Plan Review

WES processes sewer and stormwater permits for subdivisions, partitions, and commercial development properties in CCSD No. 1. All of these processes go through the same initial planning and review process as shown in Figure A-3. However, when the permit is ready for approval the process for subdivisions and partitions differs from that of the commercial process. The subdivision/partition process is shown on Figure A-5, and the commercial process is shown on Figure A-4. These processes are explained in separate sections below.

The permit process starts in one of three ways:

1. An applicant (or owner’s representative) requests a pre-application meeting from DTD or Planning.
2. An applicant will skip the pre-application meeting request and submit a preliminary plan for feasibility directly to Development Review.
3. An applicant will just submit a construction plan if there is no approval needed for land use.

Items 2 and 3 are sub-processes within the first process. Most applicants request a pre-application meeting with County Planning, at which time County Planning will coordinate the meeting and distribute applicant information between the applicant, County Planning, and WES Development Review. At the same time, the Technical Services Assistant (TSA) will create a WES log for the permit.

After the pre-application meeting, the applicant will utilize the information obtained at the pre-application meeting to develop a preliminary plan for feasibility. This plan will be submitted to WES Development Review. If the plan is not feasible, the applicant will be informed of its deficiencies and will resubmit when complete. If the plan is feasible, the applicant will be asked to submit a land use application to County Planning. County Planning will then review the application, and once Planning deems the application is complete, Planning will send out requests to County departments for comments and conditions. WES Development Review will then review the application and recommend permit conditions related to stormwater and sewer.

Planning will then take WES' conditions and select which conditions to incorporate into an overall set of conditions for the applicant. At this time, Planning can choose to accept or deny the application. If Planning denies at this time, the applicant must start the process over. If Planning approves the application with the conditions, the applicant can submit a construction plan. The construction plan is routed to the TSA. The TSA will determine if the submittal package for the construction plan is complete, if it is not complete, the TSA will request the needed information from the applicant. If it is complete, TSA will log the submittal, pass it onto Development Review, and request fees from the applicant.

WES Development Review will then review the sanitary, storm, natural resources, ERCO, conditions of approval, conservation, easement, collections sewer charge, and maintenance agreement portions of the construction plan and determine if it is ready for approval. The stormwater portions of the construction plan are designed based on the WES Design Standards for Stormwater, which require stormwater treatment systems to address both water quality and water quantity. These are discussed in detail at the end of this section.

WES Development Review previously conducted a buffer review process during the construction plan review to implement the natural resource buffers requirements in the design standards. This responsibility is being transitioned to Planning in early 2009 and the buffer requirements are being updated to be consistent with new requirements from METRO.

If the construction plan is not ready for approval, the applicant will be notified to address deficiencies. If it is ready for approval, separate processes will be followed depending on whether it is a subdivision/partition project or a commercial project. Detailed descriptions for both are provided below.

Subdivision/Partition Permit Process

If the applicant is developing a subdivision or partition, after the construction plan is ready for approval, the TSA will schedule a pre-conference meeting, issue an approval letter and sanitary permit, and approve the permit in Permits Plus. Meanwhile, the applicant will submit a Plat to Planning. The Plat process will occur concurrently with the construction process.

After the pre-conference meeting, ERCO will conduct the initial ERCO inspection (see ERCO process below). The applicant will then construct the project and ask for an engineering inspection once complete. Once complete, the applicant will submit a package to WES including a completion certificate, as-builts, and testing information. Development Review will review the submittal for completeness. If it is not complete, the applicant will be asked to address the deficiencies. Once complete, Development Review will perform an on-site inspection and review the file. If the information is not complete or the project was not constructed as designed and permitted, the applicant will again be asked to address deficiencies. Once complete, Development Review will send an acceptance letter to the applicant, and send mylars to GIS as well as field and asset information to the Finance department. At this time the warranty bond release will be established.

Concurrent with the construction process, the applicant will submit a Plat for review. WES' Development Review staff will review the Plat including the maintenance agreement, conservation, easement, and collection sewer charge. If the Plat is not complete, the applicant will be asked to supply needed information. Once the Plat is complete, WES will determine if it is acceptable. If it is not acceptable, the applicant will bond the project or complete it to WES' acceptance level. Once accepted, the Plat will be approved in Permits Plus and the maintenance agreement will be forwarded to a surveyor. At this time the infrastructure will be inspected for completeness. If the infrastructure is complete, the developer is ready to start the single family permit process (see Single Family Permit Process below). If the infrastructure is not complete, WES will hold the permit until construction is completed and accepted per the construction process described previously.

Commercial Permit Process

If the applicant is developing a commercial project, after the construction plan is ready for approval, the TSA will approve the permit in Permits Plus and set up a customer account. A pre- conference meeting is not currently required.

At this point, ERCO will conduct the initial ERCO inspection (see ERCO process below). The applicant will then construct the project and ask for an engineering inspection once complete. Once complete, the applicant will submit a package to WES including a completion certificate, as-builts, and testing information. Development Review will review the submittal for completeness. If it is not complete, the applicant will be asked to address the deficiencies. Once complete, Development Review will perform an on-site inspection and review the file. If the information is not complete or the project was not constructed as designed and permitted, the applicant will again be asked to address deficiencies. Once complete, Development Review will approve the certificate of occupancy in Permits Plus and send mylars to GIS as well as field and asset information to the Finance department. At this time the TSA will bill the applicant and archive the associated files.

Single Family Permit Process

WES processes permits for single family home construction in the Districts and for Happy Valley. The single family permit process for the Districts is shown in Figure A-6. The single family permit process for Happy Valley is shown in Figure A-7. The process described below is for single family development in the Districts. The Happy Valley process is similar, however, there is further coordination between WES and Happy Valley and Happy Valley is responsible for administering erosion control within the city limits.

Single family applicants can come in as individual land owners or as part of a subdivision/partition development. The single family applicant or owner's representative will submit the permit to WES through the DTD, this will then be routed through the TSA who will set up and account for the permit and file the permit application request in the unpaid file. The TSA will then do an initial check to see if the permit looks complete.

If the TSA finds the application package is not complete, the Development Review staff review the permit application for completeness. Items reviewed include the lot of record, sanitary, storm, ERCO/1200c, easements, and natural resources. If the application is not complete, the applicant will be told about the deficiencies and be asked to complete the application. If the application is complete the applicant will be informed and asked to pay the permit fees. Once paid, DTD will issue the permit in Permits Plus and provide receipts to the finance and WES files. At this time the application is put in the paid file and the initial ERCO inspection are performed (see ERCO process below).

After construction, DTD will perform plumbing inspections and WES performs final ERCO and stormwater inspections. If the site does not meet inspection requirements, WES will provide feedback to the applicant and the applicant makes the adjustments to the site. If the site passes the inspections, an acceptance report is developed along with associated drawings. A copy of the report and associated drawings are sent to both the applicant and to the TSA for final filing.

Current Issues/Problems

Current issues and problems with the Development Review processes identified by staff members at the October 30 and November 19 workshops are:

- Permit process is not consistently performed throughout the County causing inconsistency in permit application completeness.
- Permits Plus system is good for Plats and other systems, but WES cannot use it for its internal tracking and therefore uses Permits 2008.

- Planning does not consistently check the GIS to see if application is in or out of District boundaries and thus sometimes WES is not involved in process early enough.
- Additionally, the City of Happy Valley has identified a concern about the buffer review process no longer being conducted by WES during the development review process. This process is being transitioned to County Planning for development in the Districts in early 2009. Happy Valley is concerned about the length of time it may take for Planning to conduct the buffer review process for development in the City.

Opportunities for future improvements of updated design review processes were discussed by WES staff during the workflow mapping sessions. In addition, opportunities for future improvements were proposed in the 2006 Master Plan. Potential opportunities for process improvements to be evaluated further in the Assessment Report include:

- Set thresholds for development size, location, or other factors that establish when pre-application process is required
- Update design standards and rules, create simpler standards where feasible
- Consider creating a stormwater design guidance manual
- Address LID in design standards and encourage site design BMPs
- Clarify the infiltration policy in the design standards and address exemptions to the policy to meet the intent of the policy
- Discourage the use of underground treatment technologies as the sole treatment approach where there is sufficient above-ground area to implement vegetated treatment
- Institute a process for better coordination between WES and DTD
- Consider a process mapping session with DTD
- Develop a routing system with points of contact for each project
- Develop a simpler way to determine if projects are in WES boundary
- Improve clarity around as-built standards
- Institute a process that all commercial permits are reviewed by WES
- Provide training and education for Planning on WES' requirements
- Review alternatives for coordination systems between WES and Planning
- Determine appropriate information to share on-line such as as-builts
- Include WES inspection during construction
- Review plan review fee for appropriateness
- Consider a grading approval requirement for single family development
- Consider more electronic processes in future
- Add a pre-design meeting following land use decision

Stormwater Design Standards

As discussed above, the development review process is a critical element of WES policies and practices that affects watershed health. The design standards and requirements for stormwater management applied by WES Development Review staff for the permitting of new development in the Districts have long-term consequences on water quality, hydrology, aquatic habitat, and biological communities. The creation of impervious surfaces, removal of vegetation, and modification of topography during development alters hydrology and creates pathways for pollutants to enter waterbodies. The requirements for stormwater treatment, site design, and site construction in the design standards are a key aspect of WES' work to protect and improve watershed health.

This section summarizes the current design standards in the Districts, which are used by developers, engineers, and contractors to guide the design of sites and the stormwater treatment systems included with new development. This summary is focused on elements of the design standards that affect watershed health, and is not intended to be a complete documentation of the current standards. In the assessment phase of the project, potential improvements to these design standards will be evaluated and recommendations will be developed to include in the Action Plan.

As a part of the 2006 Master Plan, an evaluation of the WES Stormwater Regulations and Design Standards was conducted. Technical Memorandum No.8 "Stormwater Regulations and Design Standards Review" of the Master Plan (Pacific Water Resources, August 23, 2005) reviewed the current regulations and implementation of the development review process.

Several of the key recommendations from the Master Plan included:

- Develop stormwater design guidance manuals
- Utilize Low Impact Development (LID) techniques in stormwater design standards
- Discourage or prohibit the use of underground treatment technologies as the sole treatment approach where there is sufficient above-ground area to implement vegetated treatment
- Clarify the District policy on infiltration of stormwater to address varying soil conditions and exemptions to the policy more fully in order to meet the intent of the policy
- Review detention facility design and outlet criteria to better control smaller storms
- Review the hydrologic design criteria and consider using a flow-duration based standard instead of a single-event based standard

The recommendations and conclusions from the Master Plan will be incorporated into assessment of the watersheds as appropriate along with additional recommendations developed during the assessment. Some recommendations from the technical memorandum will be moved forward and others may not be incorporated into the Action Plans.

Stormwater is managed by WES using two documents: the Surface Water Management Agency of Clackamas County Rules and Regulations (December 15, 2002) and the Surface Water Management Rules and Regulations for Clackamas County Service District No. 1 (February 1, 2005). These are referred to as the SWMACC Standards and CCSD No.1 Standards.

The Standards for both Districts are largely the same. Key elements of the Standards include:

- Under 5.2.4 Onsite Detention Design Criteria, CCSD No. 1 requires detention of the 25-year 24-hour post development flow to the 2-year 24-hour flow in areas with limited downstream capacity in the storm sewer system.
- CCSD No. 1 Standards contains Section 5.3 Water Quality Standards that requires treatment of 2/3 of a 2-year, 24-hour post development storm. The SWMACC Standards contains a larger Section 6 on Permanent Onsite Water Quality Facilities.
- All development and redevelopment must include a system for controlling storm/surface water within the development without causing harm to the natural environment or to property or persons (§5.1.1.3). Some exemptions are provided for SFR development.

- Infiltration systems are required for all new development and redevelopment. Infiltration systems must be able to infiltrate runoff from storm events up to one-half inch of rainfall in 24 hours (§5.2.6). Treatment must be provided prior to or concurrent with the infiltration system; for example infiltration can be incorporated into detention facilities. Exceptions to the infiltration requirement are allowed where soil conditions are not adequate for infiltration.
- Water quality treatment using vegetated treatment systems is required for all new development and redevelopment (§5.2.6). Acceptable vegetated treatment facilities are: swales, filter strips, wetlands, wet ponds, and extended detention basins. Design criteria for these facilities are given in Appendix D of the CCSD No. 1 Standard Surface Water Specifications.
- Propriety "mechanical" stormwater treatment systems may also be used with approval from the District. Currently approved propriety systems include Stormceptor, CDS, Downstream Defender, Vortechnics, and Stormgate Separator.

Following is a more detailed bulleted summary of the Standards for both Districts.

General Requirements

- Introduction of pollutants to public system at or above state levels is prohibited.
- Failure to abide by terms of NPDES permit is prohibited.
- Discharge of non-stormwater spills is prohibited.
- Unpermitted connection or methods of conveyance are prohibited.
- Any discharge that will violate water quality standards is prohibited.
- Discharge to Creeks or Drainageways are not prohibited or encroachment into buffer areas. Non SFR development shall provide approved water quality facility prior to any discharge.
- Pretreatment facilities can be required prior to water quality facilities.
- A connection permit is required to connect to any public storm drain or system.

Erosion Control

- Temporary and permanent erosion control measures are required for all construction projects.
- Temporary measures must remain in place until permanent measures are in place.
- Erosion control rules apply to all parcels within the District.
- Maintenance and repair of existing facilities are responsibility of the owner.
- Any activity accelerating erosion and introducing sediment into the public system including development, construction, grading, filling, excavating, and clearing must abide by these rules.
- No visible or measurable erosion shall leave the property during activity.
- Owner is responsible for cleanup including creeks and drainageways impacted from project.
- Erosion Control permits are required for all earth altering activities impacting 800 square feet or greater.
- All sites shall submit an Erosion Control Plan. Requirements for Erosion Control Plans are contained within the Standards.
- Site Plans are required for all activities that meet OAR 340-41-445 through 340-41-470.
- Site Specific Plans are required if the site meets one of the following conditions; greater than 5 acres, on 15 percent slope or greater, contain highly eroded soils, adjacent to sensitive areas, activities between October 1 and April 30.
- All activities greater than 5 acres must obtain a 1200C permit.

- Applicant must submit bond, cashiers check or irrevocable letter for performance.
- Discount if responsible party is certified for erosion control.
- Applicant is responsible for maintenance and inspection of erosion control measures.
- Discounts are available for owners whose responsible individuals are certified by the District.
- Construction must be initiated within 1 year of the date of issuance and permit will become null and void 24 months after the date of issuance unless extended by the Director.
- 1200C permits must be renewed annually as per the schedule set forth by Oregon DEQ.

Maintaining Water Quality

- Construction of new facilities shall be pursuant to permits issued by state and federal permits.
- Pollutants shall not be discharged to any watercourse or storm drainage system.
- The use of water from a stream or impoundment, wetland or sensitive area, shall not result in altering the temperature or water quality.
- All sediment-laden water shall be treated before release into the surface water system.
- Construction shall be done in a manner to minimize adverse effects on wildlife and fishery resources.
- Natural vegetation shall be protected as far is practicable and trees shall be protected.
- The use of pesticides, fertilizers and chemicals must adhere to restrictions and must be covered at the site and delivered in a method that will not pollutant groundwater or surface water.
- If contaminated soils are discovered the remediation actions must meet all local, state, and federal regulations.

General Standards

- All development shall be planned, designed, constructed, and maintained to; protect natural drainage areas, protect property from flood hazards, provide a stormwater management system that controls surface water without causing harm to the natural environment.
- Easements shall be provided for all natural drainageways on a development site.
- Channel obstructions are not allowed except with approval.
- Facilities shall be constructed in a manner consistent with the subbasin management plan.
- All facilities shall be built to district's specifications.
- Inspection of surface water facilities and approval of shop drawings shall be provided by the developer's engineer. Engineer shall submit document indicating all facilities are inspected.
- A maintenance program must be approved by district.
- As-builts, easements, and approved maintenance programs must be provided to district.
- All surface water facilities shall have adequate easements for construction, operation and maintenance. Commercial or industrial users must maintain facilities.
- Proof of maintenance shall be annually submitted. District can perform maintenance and charge owner.
- All plans and calculations must be stamped and signed by a licensed civil engineer.
- The performance bond is released when a maintenance bond of 25 percent of construction cost is submitted. The maintenance bond can be released after 1 year.
- All developments and redevelopments must meet requirements.
- Development properties cannot be phased to avoid rules and regulations.

Water Quantity Standards

- All facilities up to 10-acres of land must be sized for the 10-year storm using the rational method.
- Storm sewer and outfall pipes serving less than 640 acres shall be designed to the 25-year, 24-hour design storm.
- Storm sewer and outfall pipes serving 640 acres or greater shall be designed to the 50-year, 24-hour design storm.
- Creek or stream channels draining less than 250 acres shall be designed to the 25-year, 24-hour design storm.
- Creek or stream channels draining 250 acres or greater shall be designed to the 50-year, 24-hour design storm.
- Creek or stream channels draining 640 acres or greater shall be designed to the 100-year, 24-hour design storm.
- Rational method shall be used for areas 10 acres and less. Alternative method may be used for larger areas.
- The drainage system shall be designed for all water on site including water entering the site.
- No drainage will be allowed into the street where a drainage system is available without connecting to the drainage system.

Onsite Detention Design Criteria

- Storm water Quantity detention facilities shall be designed so the 2-year, 24-hour post developed runoff rate matches 1/2 of the 2-year, 24-hour pre-developed discharge rate.
- Downstream analysis shall demonstrate adequate conveyance capacity where the project site contributes less than 15 percent of the upstream area or 1,500 feet downstream, which ever is greater. Owner must notify other jurisdictions if this analysis crosses a boundary.
- For residential subdivisions and partitions of parcels with the potential to create more than two or more than 5,000 square feet of impervious surface, on-site stormwater detention, treatment, and infiltration is required. For 2 and 3 lot partitions that cannot be further portioned under current zoning, detention and treatment is not required.
- Infiltration facilities are required where soil permits.
- Open detention facilities shall be planted per Metro Native Plant List.

Onsite Detention Design Method

- Designer should use King County Surface Water Design Manual for sizing procedures.
- Sizing shall be based on the amount of impervious surface.
- Redevelopment shall require detention for all area impacted by construction.
- Subregional facilities are encouraged and can serve more than one development.
- The drainage system shall be designed for all water on site including water entering the site.
- Infiltration facilities are required where soil permit, volume must be available again in 96 hours.

Natural Resource Protection

- A study to identify sensitive areas can be required by the district when a parcel may contain sensitive lands or the parcel has inventoried sensitive areas.
- New development adjacent to sensitive areas shall maintain an undisturbed buffer to protect the water quality function. The buffer width is shown in Table A-1. *(Note: The buffer requirements are currently being re-evaluated by County Planning to be consistent with METRO requirements).*

- Starting point for measurement is either the bankfull stage or 2 year storm level for streams; and the Oregon Division of State Lands approved delineation for wetlands.
- No construction, outfalls, or energy dissipation can occur in buffer area.
- The only activities that can be conducted in sensitive areas but must be approved by the district and State Agencies are; removing non-native vegetation, a road crossing to provide access over sensitive areas, utility crossing, a walkway, or bike path.
- A home owner may protect property from erosion if within the limits of State and Federal regulations.
- The district may require fencing of buffer areas.

Table A-1. Buffer Area Requirements in 2008

Sensitive area	Upstream drainage area	Slope adjacent to sensitive area	Width of disturbed buffer, feet
Intermittent creek, rivers, streams	Less than 50 acres	Any slope	25
Intermittent creek, rivers, streams	50 to 100 acres	<25 percent	25
Intermittent creek, rivers, streams	50 to 100 acres	≥25 percent	50
Intermittent creek, rivers, streams	Greater than 100 acres	<25 percent	50
Intermittent creek, rivers, streams	Greater than 100 acres	≥25 percent	100 to 200
Perennial creeks, rivers, streams	Any upstream area	<25 percent	50
Perennial creeks, rivers, streams	Any upstream area	≥25 percent	100 to 200
Wetlands, lakes (natural), springs	Any drainage	<25 percent	50
Wetlands, lakes (natural), springs	Any drainage	≥25 percent	100 to 200

Erosion Prevention and Sediment Control

The erosion prevention and sediment control program (ERCO) is intended to prevent erosion and improve sediment control at construction sites and existing stormwater facilities within WES jurisdiction, including CCSD No. 1, SWMACC, Boring, Hoodland, Gladstone, and all 1200-C permit sites in Clackamas County. 1200-C permit sites are sites where construction activities disturb one or more acres of land, including smaller sites that are less than one acre that are part of a larger common plan of development.

Erosion prevention and sediment control are very important to watershed health. Uncontrolled erosion at construction sites can contribute heavily to water quality problems including poor water clarity, high pollutant loads, damage to aquatic habitat, and maintenance problems in the storm drainage system from sediment deposition in pipes, catchbasins, culverts, outfalls, ponds, and swales.

The following documents provide information on erosion control and prevention programs, rules, regulations and processes:

- Erosion Prevention and Sediment Control Design and Planning Manual, 2000
- CCSD No. 1 Surface Water Management Rules and Regulations (CCSD No. 1 Standards discussed above)
- SWMACC Surface Water Management Rules and Regulations (SWMACC Standards discussed above)
- Section 2 of the Surface Water Management Administrative Procedures

- New Construction Erosion Control Permit Process Map
- Grading Process Map

The WES process for erosion control permitting and inspecting for new construction sites was discussed by WES staff during two erosion control workflow mapping workshops, held on October 31 and November 19, 2008. At the workshops WES staff collaborated to revise the existing process map to reflect the actual process for new construction permits. The revised process map is shown in Figure A-8, and a summary of the current process follows.

Grading permits are also an element of the erosion control permitting process; in that erosion control inspections are completed as enforcement for grading permits. Figure A-9 shows the current grading permit process. The grading permit process regulates and controls excavation, grading and earthwork construction, including fills and embankments for issuance of permits. It also provides for approval of plans and inspection of grading construction. Whether or not a permit is required, all excavation and grading must conform to Clackamas County Code requirements, and must control erosion and protect adjacent properties.

Support Tools

The Internal Voice Recognition (IVR) system is a tool used by WES inspectors to schedule and update the status of erosion control permits, the process of which is described in the following section.

New Construction Erosion Control Permit Process

WES currently provides erosion control services for development in CCSD No. 1, SWMACC, Boring, Hoodland, Gladstone, and in and out of district 1200c permits. From July 2007 through June 2008, 817 erosion control permits were issued and 2,046 inspections were performed by CCSD No. 1 with 1.5 FTE. Happy Valley took over responsibility for administering the erosion control program within their city limits in 2005. Happy Valley performed 215 erosion control inspections from July 2007 to June 2008.

The erosion control permit process is initiated when the owner or owner's representative sends permit information to ERCO personnel in Development Review. Following receipt of the application, a permit specialist identifies the type of permit needed, and depending on the location of construction and site size, issues a local erosion control permit or a 1200C permit.

Erosion control inspectors enter the process once the permit has been issued. When invited by Development Review, inspectors attend a preconstruction meeting to discuss appropriate erosion control measures. If in attendance at the preconstruction meeting, the inspectors make a field visit to verify site conditions with the owner's representative. If not invited, their first inspection is triggered by approval of the ERCO plan. All inspection results are recorded using IVR.

Following the initial site visit, erosion control inspectors make a mental note of site conditions, and have the option to make future unannounced site visits as they see fit. Site conditions of consideration include the time of year, developer history, location, seasonal impact, watershed, complaints, site severity, and phase.

If the developer is not meeting erosion control permit requirements, an inspector can request improvements and re-inspect to determine if improvements have been made. If the developer fails to meet the permit requirements again, an inspector can call for a stop of work and require reinspection fees. Erosion prevention and sedimentation control measures must be approved before work is allowed to restart.

Once the developer has completed work, a final inspection is conducted by a WES erosion control inspector. Results of the inspection are entered into IVR. If the final inspection does not pass, corrections must be made to the site. After passing the final inspection, the developer is issued a final permit and is asked to close out the project. Currently permits have no set expiration date, and if a permittee does not close their permit, it stays in the WES database as an open permit indefinitely.

Complaint Driven Inspection and Maintenance

To maintain quality service to its customers, WES accepts call-in and over-the-counter complaints from the public with regard to erosion problems. Following receipt of a complaint, the receiver updates the WES maintenance management system. WES does not currently have an "erosion control hotline" phone number that is posted at construction sites to facilitate public reporting of erosion control problems, although such a hotline posting requirement is being considered for the future.

More information on the maintenance process is below.

Current Issues/Problems

Current issues and problems with the erosion control process, identified by staff members at the October 31 and November 19 workshops are:

- Ground breaking sometimes occurs prior to erosion control plan review and/or initial inspection.
- Erosion control plans submitted to WES do not always match site conditions, which are thought to be the consequence of the erosion control plan designer lacking familiarity with site conditions.
- No occupancy permit is required for single family housing.
- The Owner's representative (permittee) does not close the erosion control permit.
- When are Sewer and Storm System Development Charges (SDC) collected? When is the water fee collected?

Opportunities for future improvements of the New Construction Erosion Control Permit Process were discussed by WES staff during the workflow mapping sessions. Potential opportunities for process improvements to be evaluated further in the Assessment Report include:

- Institute erosion control hotline
- Keep erosion control in preconsultation process
- Have erosion control inspection prior to groundbreaking with Owners Representative
- Have as precursor to issuing the permit
- Consider a fine for Owners who start construction without erosion control inspection
- Do a field check of the erosion control plan prior to permit issuance
- Erosion control permit sunset - enforce limit
- Issue a permit instead of a receipt for local permit
- Forgo minor revisit step
- Develop formal rating system for site monitoring schedule based on criticality/geographical sensitivity
- Tie erosion control to grading permit, if applicable
- Establish level of service for erosion and grading control
- Perform field visit on all non-single family projects prior to initial inspection
- Track more information about inspections and conditions in Permits 2008 and/or IVR
- Consider having owners rep call to schedule field visit

Stormwater System Maintenance

The WES Stormwater Maintenance program is responsible for the maintenance of all stormwater assets within the public right-of-way in the Districts, with the exception of assets that are the responsibility of the Clackamas County Department of Transportation and Development (DTD) or the Oregon Department of

Transportation (ODOT). The WES Stormwater Maintenance program is responsible for inspecting and maintaining detention ponds, and pipes, vortex separators, pollution control systems, catch basins, manholes, open channels including natural drainage features, and public underground injection controls (UIC) systems.

The stormwater maintenance crew primarily inspects sites and prescribes maintenance work. Most field maintenance is performed by the sanitary maintenance crew.

As of 2008, WES stormwater maintenance is currently responsible for:

- 304 miles of stormwater pipe
- 23,000 storm structures including catch basins and manholes
- 262 detention ponds
- 700 detention pipes
- 31 treatment facilities (swales and underground devices)

Maintenance Staff and Equipment Statistics:

- 0.2 FTE Program Manager
- 2.0 FTE Surface Water Technicians
- 3.3 FTE Collection System Technicians
- 1.2 FTE Seasonal Employees
- 1.0 FTE contracted with DTD
- Use of 2 Fully Equipped Maintenance Utility Trucks
- Use of combination Vacuum/Hydrocleaner trucks (“Vactor trucks”)
- Use of regenerative air sweepers (for street sweeping)
- Use of pipe video equipment

Maintenance is performed primarily for cleaning and to ensure structural integrity. Catch basins, pollution control manholes and other “debris capturing” structures are cleaned periodically to remove sediment, pollutants, debris and other materials before they gain entrance into the storm system pipes and discharge to receiving waters. WES is directly responsible for maintenance in the maintenance agreement areas (generally all subdivisions constructed since 1998, including a large number in Happy Valley) and the storm sewer pipe network in the District. WES also began additional maintenance in the CCSD No. 1 road rights-of-way several years ago, although there is a lack of clarification of the responsibilities for stormwater infrastructure maintenance on County roads.

In the maintenance agreement areas, which include over 240 subdivisions, WES collects a maintenance fee in addition to the standard surface water management fee from property owners. In other areas, the owners of stormwater treatment facilities and equipment are responsible for stormwater maintenance. However, WES has in the past stepped in and cleaned or serviced stormwater equipment or treatment systems in emergency cases even when they are not responsible for the asset.

Below is a summary of the maintenance activities conducted in CCSD No. 1 and Happy Valley as reported in the July 2007 to June 2008 Annual Report for the NPDES MS4 permit.

- 1,206 structures 108 ponds, and 275 feet of storm line were inspected and/or cleaned
- 14.69 tons of material was removed from the non-pipe storm drainage components and 2.75 tons of material was removed from the storm drain pipes.
- 3,801 feet of storm drain ditches were maintained and 546.6 tons of material was removed.

- Street sweeping of 757 miles of streets in the KMS watershed by DTD (1,292 miles of streets swept and 840 cubic yards of material removed in all of CCSD No.1).
- Street sweeping of 83 miles of streets in the RC watershed by DTD
- Street sweeping of 105 miles of streets and removal of 50 cubic yards of material by Happy Valley.

Currently maintenance activity is generated in two methods: 1) Compliant or service request generated activity and 2) maintenance activity generated from the inspection of facilities. Other responsibilities of the maintenance staff are the inspection of facilities, the review of new development submittals for maintenance feasibility, and the acceptance of the facilities associated with new development.

WES is just beginning to develop its preventative maintenance (PM) program for stormwater assets. Data has been populated in the computerized maintenance management system (CMMS) for the past 14 months and an inspection system has been started. Currently, only 5 to 10 percent of the residential systems have been inspected through this program, although the stormwater ponds are inspected each spring. WES also has a 4-year-old cleaning program. Every maintenance agreement subdivision for which WES has responsibility for has been cleaned at least once in this time frame, and vortex separators are cleaned every 6 months.

WES stormwater maintenance is in the process of developing predictive maintenance (PdM) programs for pond condition assessment and vortex cleaning. The maintenance staff also wants to develop predictive methods for refurbishment and replacement (R&R) of assets.

Street sweeping is contracted with DTD; and WES provides requests to DTD on occasion if they know of a troubled area. Major arterial curbed streets are swept on a regular basis. The frequency varies depending on a variety of factors such as traffic volumes. In the KMS watershed, approximately 757 miles of streets were swept by DTD in 2007. Street sweeping within the City of Happy Valley is the responsibility of the City. In October 2008, Happy Valley began sweeping all city streets once per month.

The WES processes for existing work orders, reactive requests, and new system acceptance were discussed by WES staff during two maintenance workflow mapping workshops, held on October 30 and November 19, 2008. At the workshops WES staff collaborated to revise the existing process map to reflect the actual maintenance processes. The revised process maps are shown on Figures A-10, 1-11, and 1-12 and a summary of the current processes follows.

Support Tools

WES utilizes the GBA master series computerized maintenance management system (CMMS) to manage assets and the maintenance program. The system is 14 months old, and WES is in the process of fully populating the system. The CMMS is linked to the WES works GIS which provides the location for the stormwater assets. Work codes are in the CMMS, preventative maintenance (PM) work orders are currently being populated in the system. WES currently has unique identification numbers for 80 percent of their assets and an asset hierarchy that can report assets at the basin level.

Existing Work Order Process

WES develops work orders for maintenance reactively during system inspections. As seen in the attached workflow in Figure A-10, WES stormwater maintenance staff will perform a facility inspection. If the facility looks fine, a work order will be developed documenting the inspection. If the facility has a problem, stormwater maintenance will inform the sanitary maintenance crew. This is currently done via a written request or note. The sanitary maintenance will then perform the needed work and create a work order documenting the specific asset and work that was performed. Stormwater maintenance will then review the work order and close it in the CMMS.

Reactive Request Process

WES stormwater maintenance staff performs work on a reactive basis in response to customer requests as shown in Figure A-12. In this case, a customer will call WES. The TSA will log the request in the CMMS and collect appropriate information. If the problem is not WES' responsibility, the TSA will document the call and inform the responsible party. Stormwater maintenance will receive the request and first check to determine if WES is responsible for the asset. If WES is not responsible they will document the request in the CMMS and inform the responsible party. If they are responsible WES stormwater maintenance will inspect the site. If corrective action is required, the sanitary maintenance crew will perform the corrective action and create a work order. Sanitary maintenance will document the action in the CMMS.

Note the process documented is not currently followed in all situations. TSA will often send the request to maintenance to determine the responsibility and WES maintenance staff will perform the corrective action work first regardless of responsibility and then inform the responsible party after the correction is in place. This occurs in situations where streets or parking lots are flooded and it is easier to just clean the stormwater asset while at the site.

New System Acceptance Process

WES stormwater maintenance is also responsible for inspecting and accepting new stormwater assets into their system from new development. In this process, graphically depicted in Figure A-11, Development Review will inform stormwater maintenance of a new system. At the same time, Development Review will document the start of a two-year warranty period.

Stormwater maintenance will perform an acceptance inspection. If the system is not acceptable the applicant will be informed and asked to address deficiencies. If the system is acceptable, as-builts will be submitted to Development Review and GIS will assign an asset number, scan as-builts and document information in the CMMS. If the system is commercial or private, WES is no longer responsible for maintenance. Otherwise, as-builts are sent to stormwater maintenance and a work order is set up to notify maintenance to do an inspection after the two year warranty has elapsed.

After two years, stormwater maintenance performs a warranty inspection. If the asset is clean and ready for acceptance, WES maintenance will accept the asset and notify Development Review. If not, the applicant will be asked to clean and/or repair the asset until it is ready for acceptance.

Current Issues/Problems

Current issues and problems with the maintenance processes identified by staff members at the October 30 and November 19 workshops are:

- Current maintenance is reactive; PMs are being developed but are not complete yet.
- Responsibilities have not been fully defined for various maintenance activities including street sweeping. It is unclear what facilities in the roadways DTD is responsible for and what facilities WES is responsible for.
- Some private systems are in the CMMS and not distinguished as being private versus WES.
- Many stormwater treatment systems are mapped in GIS, but there is no current way to tell which systems are WES'.

Opportunities for future improvements of the updated maintenance processes were discussed by WES staff during the workflow mapping sessions. Potential opportunities for process improvements to be evaluated further in the Assessment Report include:

- Should proactively set up PM for structure/system upon the inspection after the warranty period.
- Consider tying commercial maintenance plan to assets in the CMMS/GIS.

- Consider enforcement for the commercial and other maintenance agreements that WES is not responsible for.
- ID which catch basins are associated with UICs in CMMS or GIS.
- Do a criticality assessment on structures and systems for prioritizing the new PM program.
- List, map, and prioritize wet weather flow areas.
- List and map emergency response areas.
- Develop projections for a long-term R&R program.
- Consider revising inspection to 2 year warranty or 90 percent build out.
- Revise the detail of the planting plan standards.
- Consider limiting planting around ponds and surface water structures to non-problematic trees - develop appropriate planting list (no cottonwood, poplar).
- Need better irrigation and replanting at end of warranty period.
- Consider a zoning system for where to plant the selected list of plants and trees.
- Have detailed list for the inspection.
- Involve maintenance further in the design standards process to review access issues, flow/diversion considerations, hatches versus manholes, and address asset ownership issue. Maintenance currently has an opportunity to comment on submitted construction plans, but due to resource limitations as well as issues with lack of notification about plans they generally are not able to review plans in a timely fashion.
- Create work orders for sanitary for storm drain inspection.
- Utilize inspection to create PM schedule.
- Track Warranty Bond Period in CMMS and enter Warranty when as-builts are received.

Environmental Monitoring

The WES Environmental Monitoring program is responsible for tracking, reporting, and in some cases, managing environmental conditions associated with surface water, stormwater, and treated wastewater in order to meet regulations and permits as well as WES program objectives. The Environmental Monitoring program includes environmental permit program management, laboratory operation, non-residential waste management, and a biosolids program.

The Environmental Monitoring Program includes the following staff.

- 0.2 FTE Program Manager
- 0.6 FTE Water Quality Analyst
- 0.2 FTE Sample Collection (through Compliance Services)
- 0.2 FTE Additional staff performs spill response, laboratory analysis on samples and maintains continuous surface water monitoring equipment

The Environmental Monitoring program staff have conducted internal workflow mapping exercises during 2008. The following figures illustrate the process maps developed during these internal exercises:

- Figure A-13: Sampling and water quality monitoring
- Figure A-14: Source control inspections and complaint driven inspections of industrial and commercial stormwater facilities.
- Figure A-15: MS4 and TMDL annual report

- Figure A-16: Illicit Discharge, Spill Response, and Non-stormwater Discharges process
- Figure A-17: MS4 Permitting, 1200Z, UIC permit renewal process
- Figure A-18: Storm Drain Cleaning Assistance Program

These processes are part of the environmental permit program management element within WES. The environmental permit program management element is an important part of WES' work to comply with the Clean Water Act (CWA), other regulations, and for the protection and improvement of watershed health. This element is discussed in detail below.

Environmental Permit Program Management

The environmental permit program management element of WES is responsible for managing several permits, including the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit and the Underground Injection Control (UIC) requirements. The MS4 permit program is one of the key regulatory tools used to address the stormwater impacts from urban development. The UIC program regulates the discharge of stormwater below ground. This section includes a summary of the evolution of the MS4 discharge permit program requirements and of the watershed management activities and monitoring implemented by WES as a part of the MS4 permit program, as well as a summary of the UIC program. Most of the KMS watershed is included in the MS4 permit area.

Most parts of the MS4-permitted surface-discharging storm sewer system are comprised of piped storm sewers, but some swales and open ditches are also present. Many privately owned surface discharging storm sewer systems are present near the District's MS4-permitted systems. These privately-owned surface-discharging storm sewer systems are not regulated by the District's MS4 permit.

NPDES MS4 Permit Background. In the early 1990s, the Federal Clean Water Act (CWA) required municipalities with populations greater than 100,000 to apply for and obtain a NPDES permit for their stormwater discharges under Phase 1 of the MS4 permit program. In Oregon, this program was delegated to the Oregon Department of Environmental Quality (DEQ). As a result, DEQ directed six Oregon jurisdictions and associated co-permittees to apply for and obtain a municipal NPDES stormwater permit.

CCSD No. 1 and SWMACC (the Districts), Oak Lodge Sanitary District, Clackamas County (including DTD), and the Cities of Happy Valley, Rivergrove, Gladstone, Johnson City, Lake Oswego, Milwaukie, Oregon City, West Linn, and Wilsonville are Phase 1 co-permittees on a NPDES MS4 permit that is referred to as the Clackamas County MS4 permit. Clackamas County co-permittees are classified as Phase 1 communities because they meet the threshold of greater than 100,000 in population collectively, though not separately. Only the Portland metro area subunit of CCSD No. 1 is regulated by the MS4 permit. This subunit is known as CCSD No. 1-urban growth boundary (UGB). The developed area of the City of Happy Valley lies within CCSD No. 1-UGB, and the remainder of Happy Valley will be annexed to CCSD No. 1 as it is developed.

The Clackamas County MS4 permit was issued by DEQ on December 15, 1995, was renewed by DEQ on March 3, 2004, and was modified by DEQ on July 27, 2005. As a part of the initial MS4 permit application, a joint Stormwater Management Plan (SWMP) was developed in 1993 for CCSD No. 1 and SWMACC. The SWMP included the requirement to develop specific categories of Best Management Practices (BMPs) to address specific sources of pollutants. However, the requirements did not specify the number or type of BMPs that should be implemented. Instead, the federal requirement states that BMPs should be implemented to reduce the discharge of pollutants to the "maximum extent practicable" (MEP). The 1993 SWMP was updated in 2000.

During the 2000-2004 permit renewal process, third-party environmental groups expressed significant concern that the permits should include numeric discharge limits at stormwater outfalls as opposed to the more general requirement to implement BMPs to the maximum extent practicable as stated in the Clean

Water Act. This concern was also linked to another Clean Water Act requirement related to the development of Total Maximum Daily Loads (TMDLs) for creeks, rivers, and streams that are currently in violation of water quality standards.

With respect to numerical water quality standards in the 2004 NPDES permit, DEQ attempted to balance the demands of the third-party groups with the needs of larger municipalities such as the Districts as well as the abilities of the smaller co-permittees. For some jurisdictions that discharge to water bodies currently exceeding water quality standards, the 2004 permits set new requirements. Where TMDLs are established, jurisdictions must attempt to quantify the effectiveness of their SWMPs, set pollutant load reduction benchmarks for performance of SWMPs, check in on progress towards meeting those benchmarks, and apply an adaptive management process to continue to work towards achieving benchmarks.

The 2004 NPDES permit required the submission of an Interim Evaluation Report (IER), which CCSD No. 1 and SWMACC submitted separately on May 1, 2006. These IERs included the Districts' most recently approved SWMPs. In August 2008, WES submitted a permit renewal application to DEQ which included an updated SWMP. The 2008 permit renewal also included pollutant load estimates based on land use, an evaluation of trends in stormwater monitoring results, pollutant load reduction benchmarks, a MEP determination, and a fiscal evaluation of the WES SWM program (WES 2008).

To ensure that the SWMP continues to meet the MEP standard, the effectiveness of the SWMP is revisited annually. Each year, Clackamas County and co-permittees are required to submit an annual compliance report for their MS4 NPDES permit. The annual report is required to describe the status of implementing the components of the storm water management program; proposed changes to the SWMP; and water quality monitoring results. The annual report provides an overall assessment of the permittees' actions to minimize pollutants in MS4 regulated stormwater systems. The annual reports contain a wealth of information about stormwater management activities undertaken in the Districts' in the reporting year.

NPDES MS4 Program Implementation. According to the federal Clean Water Act, MS4 permittees must implement a program to reduce the discharge of pollutants to the maximum extent practicable, including management practices, control techniques and systems, and design and engineering methods. The program varies by municipality and is intended to be developed in a flexible manner in consideration of site-specific conditions to optimize reductions in stormwater pollutants. The program includes BMPs, monitoring, and other available and reasonable controls, which are then documented as requirements in the permit and SWMP. SWMPs can be revised using adaptive management to improve overall program effectiveness.

WES' proposed 2008 SWMP is similar to the 2006 SWMP, which is the currently approved SWMP until the new permits are issued by DEQ. As a part of the 2008 permit renewal submittal, a comprehensive review of the SWMPs and an evaluation of program effectiveness, local applicability, and program resources was performed. As a result of this review, several changes were made to the 2008 SWMP including updating the monitoring plan to include a plan for sampling for selective pesticides and implementing a new BMP related to inspecting and maintaining private stormwater systems for new development. Further changes to the SWMP may be required during the permit negotiation process in 2009.

The proposed 2008 SWMP includes the following components with key BMPs listed beneath each component:

- Component #1: Structural and Source Control BMPs to Reduce Pollutants from Commercial and Residential Areas
  - Stormwater system maintenance
  - Planning procedures for new development
  - Street sweeping
  - Water quality and flood management projects
  - Public education to reduce discharge of pesticides, herbicides and fertilizers

- Component #2: A Program to Detect and Remove Illicit Discharges and Improper Disposal Into the Storm Sewer System
  - Conducting dry weather inspections
  - Implementing the spill response program
  - Facilitating public reporting of illicit discharges and spills
  - Controlling infiltration and cross connections to the storm sewer system.
- Component #3: A Program to Monitor and Control Pollutants from Industrial Facilities
  - Addressing runoff from hazardous waste treatment, disposal and recovery facilities and other non-1200Z permitted industrial facilities
- Component #4: A Program to Reduce Pollutants in Stormwater Discharges from Construction Sites
  - Implementing requirements for structural and non-structural BMPs at construction sites
  - Identifying priorities for inspecting sites and conducting enforcement actions
  - Conducting training for construction site operators

Each BMP in the SWMP includes measurable goals and tracking measures appropriate for the BMP. Progress toward measurable goals and the results of tracking of the BMPs are reported in the annual reports.

The BMPs in the SWMP encompass most of the policy and practice areas described in this report. Several of the key BMPs have already been described in the earlier sections in this report on development review, erosion prevention and sediment control, and maintenance. Following is a summary of the water quality monitoring and illicit discharge detection and elimination performed as a part of the MS4 permit program, and a discussion of the UIC program.

Water Quality Monitoring. As part of the MS4 permit requirements, WES, and other Clackamas County co-permittees are required to develop and implement a stormwater monitoring program. Specific stormwater monitoring requirements and objectives are defined in Schedule B of the Clackamas County NPDES MS4 permit. The NPDES stormwater monitoring programs require two components. The first component is program monitoring, which involves the tracking and assessment of programmatic activities, as described in the individual permittees' SWMP, through the use of performance indicators or metrics. The second component is environmental monitoring which includes the actual collection and analysis of samples.

As a part of the 2008 permit renewal submittal, WES submitted an updated monitoring plan to DEQ (URS 2008). Given the magnitude of effort associated with implementing an effective monitoring program that will adequately meet permit requirements and objectives, eight Clackamas County co-permittees agreed to consolidate efforts and prepare one comprehensive stormwater monitoring plan. The co-permittees include CCSD No. 1, SWMACC, and the cities of Gladstone, Milwaukie, Oregon City, West Linn, Happy Valley, and Rivergrove.

WES currently administers a routine and storm-event related water quality and flow monitoring program within CCSD No. 1. The monitoring program activities include:

- Water quality sample collection
- Flow measurement
- Laboratory and field analysis of water samples
- Water quality data management reporting

In addition to monitoring conducted for the MS4 permit program, WES also conducts periodic monitoring of other environmental conditions that are related to water quality, including benthic macroinvertebrate sampling and fish sampling and associated habitat surveys. This monitoring is typically conducted under direction of the Environmental Policy Specialist as part of the Watershed Health functional element of WES (described below) and is not performed by the WES Environmental Monitoring program.

Parameters currently measured as a part of the MS4 permit monitoring include dissolved and total metals (copper, lead and zinc), hardness, E. coli bacteria, nutrients (nitrogen and phosphorus), solids (total, dissolved, volatile), and field measurements of conductivity, pH, temperature, flow, and dissolved oxygen.

In the proposed 2008 Monitoring Plan, WES has proposed monitoring for selective pesticides as requested by DEQ. It is likely that many of the other Clackamas County co-permittees will conduct this monitoring jointly in a single coordinated study. An initial meeting with USGS was held in June 2008, and it appears likely that the USGS will be able to serve as a partner in this study. If a formal agreement is established, the USGS' role will likely include, at minimum, creation of the study's design, the provision of laboratory analytical services, data interpretation, and final report writing. At least two storms, one in spring and one in summer or early fall, will be captured at each selected monitoring location during this coordinated study. The pesticides to be analyzed have not yet been selected, but both herbicides and insecticides will be chosen. The monitoring locations have also not been selected, but no less than six will be selected in representative locations in the study area.

The monitoring program is discussed further in Chapter 3 - Water Quality.

Illicit Discharge Detection and Elimination. Twenty-nine (29) major outfalls are located in the portion of CCSD No. 1 regulated by the MS4 permit program (CCSD No. 1-UGB). Major outfalls include pipes greater than 36" diameter, conveyance from lands zoned for industrial activity, and conveyance from lands serving a drainage area of more than 50 acres. In an effort to identify and control illicit discharges of non-stormwater substances to the stormwater system, each major outfall receives at least one dry-weather inspection per year.

Underground Injection Control Devices. Discharges from injection-type storm sewer systems that discharge stormwater below ground are regulated by the federal Safe Drinking Water Act under a program called Underground Injection Control (UIC). Due to the program name, injection-type storm sewer devices are often called UIC devices or UICs. Discharges from injection-type storm sewer systems are not regulated by any MS4 permit as they convey stormwater to the subsurface rather than through an MS4 conveyance system into surface water bodies.

DTD and WES jointly manage about 150 injection-type storm sewer systems that are in or near CCSD No. 1. DTD and WES also jointly manage about 50 injection-type storm sewer systems near the SWMACC District's MS4-permitted area. Nearly all of these stormwater injection devices are drywells, which are essentially perforated manhole shafts that discharge stormwater below the ground surface to infiltrate into the surrounding soil.

WES and DTD jointly applied for an area-wide Water Pollution Control Facility (WPCF) permit from DEQ for these devices on December 19, 2001. As of 2008, this WPCF permit had not been issued. A separate stormwater management plan guides WES' and DTD's stormwater management programs in the geographic areas that drain to drywells.

Currently, CCSD No. 1, SWMACC, and the City of Milwaukie are involved in an ongoing monitoring program in Oregon related to UIC devices. Coordination of this program is the result of UIC permit requirements, not MS4 permit requirements, and the monitoring program is expected to continue on an annual basis. The monitoring that is being conducted for this program is evaluating the effluent from structural BMPs prior to its discharge into a UIC. There are seven BMPs that are currently being evaluated including sedimentation manholes, catchbasin inserts, a Stormceptor, an oil-water separator, a StormFilter, and sumped catchbasins. Over five years of samples have been collected from each site. Sampling of these sites is conducted on a storm basis only. One of the sites is located within Clackamas County.

Current Issues/Problems

A workshop with WES staff to identify current issues/problems and potential opportunities for improvements in the environmental monitoring program has not yet been conducted. The 2006 Master Plan identified several potential opportunities for improvements. Further analysis of this program element will be conducted during the assessment phase of the project. Initial findings from the characterization phase include the following observations:

- The WES GIS layer for the water quality monitoring sites does not have a consistent naming convention for the monitoring sites. There is an opportunity to clarify the location, name, and associated data for each historic and current monitoring site.
- The water quality monitoring sites, benthic macroinvertebrate monitoring sites, and fish monitoring sites are generally not located together. It may be more useful to evaluate the combination of data from these monitoring efforts if the monitoring sites are located together in the future.
- There may be opportunities to re-evaluate the location of water quality monitoring sites in order to help answer questions about program effectiveness and changes in watershed conditions in the upper tributaries. Stormwater monitoring of MS4 discharges could be targeted to specific land use types of interest, such as commercial and industrial areas, and residential areas of varying density, type and age.
- There may be opportunities to perform more continuous monitoring of in-stream conditions and stormwater outfalls in order to help answer questions about program effectiveness.
- There may be opportunities to improve the coordination between water quality monitoring data collection and continuous flow and temperature monitoring data collection.
- To support TMDL compliance efforts, additional monitoring of TMDL constituents could be conducted. Additional and more frequent land use based E. coli monitoring could be conducted for source identification and BMP targeting. The District could consider special studies to identify animal versus human sources of *E. coli,* and/or studies that directly measure levels of human pathogens.
- Changes to the water quality monitoring program elements, including site locations, are possible through the adaptive management process for the SWMP but could prove challenging due to the coordinated monitoring plan in place for multiple co-permittees.

These issues and potential opportunities for improvement will be evaluated further with WES staff during the assessment phase.

Environmental Policy and Watershed Health

WES employs 1.0 FTE as an environmental policy specialist in the Environmental Policy and Watershed Health functional program element. This element is a part of WES Administration. The responsibilities of the environmental policy specialist are varied and include assessing watershed conditions in the Districts, assisting in developing management strategies to improve or protect environmental conditions, assisting in public information and outreach efforts, reviewing WES and other County projects for permit compliance, and serving as a representative of WES on a wide variety of committees and advisory bodies addressing watershed health issues. The Environmental Policy and Watershed Health functional program element addresses numerous environmental regulatory programs including the Endangered Species Act (ESA). The Environmental Policy program element conducts periodic monitoring of environmental conditions that are related to water quality, including benthic macroinvertebrate sampling, fish sampling, and habitat surveys.

The Environmental Policy Specialist is responsible for all of WES' biological monitoring programs, developing and tracking watershed health performance metrics, and development of a Watershed Health Index. This staff person also is responsible for developing partnerships with other agencies and nonprofit groups in the implementation of watershed improvement projects.

Public Information and Outreach

WES administers a public education program which provides information that attempts to motivate residents and workers in the County to reduce stormwater pollution and improve watershed health. WES employs 1.0 FTE as a public information and outreach specialist. This staff member is responsible for conducting public information and outreach related to both the sewer program and the surface water management program.

Educational information is shared with the public through the use of:

- Articles in WES newsletters (StreamLines in CCSD#1-UGB). These newsletters are mailed to all customers along with billing statements.
- WES's website
- U.S. Geological Survey publications. WES funds have been contributed towards the generation and publication of several relevant reports that help to educate the public and staff, including Report 2003-4145, titled "Pesticides in the Lower Clackamas River Basin, Oregon, 2000-2001", and Report 2004-5061, titled "Organochlorine Pesticides in the Johnson Creek Basin, Oregon, 1988-2002."
- Through local public involvement campaigns. A recent example of a relevant public involvement campaign is one that has been launched annually over the past several years throughout the Portland Metro area by many municipal partners, including the Districts. This group is called the Regional Coalition for Clean Rivers and Streams.
- Brochures (disseminated at the WES booth at fairs, for example)

WES was also recently approached by KOIN NEWS 6 to participate with seven other agencies in an on-air campaign entitled, "Promoting Clean and Healthy Watersheds – Do the Right Thing." The purpose is to provide awareness, education, and motivation to change behaviors. A series of commercials, promos, and news stories will be aired. It is expected that 360 commercials will be aired annually; reaching 564,000 adults, each adult being reached will have seen the campaign an average of 11 times each. The following five issues will be initially addressed: 1) pesticides/fertilizers; 2) automotive care; 3) pet waste; 4) healthy lawns; and 5) native plants/noxious weeds.

Public survey results

In 2008 WES contracted with a research firm to conduct a telephone survey of residents in cities of Gladstone, West Linn, Oregon City and Milwaukie, the Oak Lodge Sanitary District and the Damascus area of Clackamas County. The research objectives were to assess community values regarding local rivers and streams, determine awareness of capacity issues facing Clackamas County's sewage treatment systems, measure support for plans to increase capacity and funding for expansion, and assess support for increasing collaboration for sewer system management and financing (CFM Research 2008).

A stratified sample was used for the survey, with seventy-five interviews completed in each area, among residents age eighteen years and older. For the geographic areas used in the survey, the percentages are statistically valid to a margin of error of ±11.5% at the 95% confidence level.

Rivers and streams are an important aspect of Clackamas County.

- Roughly nine in ten residents from all areas say they are very or somewhat interested in issues related to the Clackamas River, the Willamette River and local streams. Forty-six percent are very interested and 43% are somewhat interested.
- Overall, 39% say they are very or somewhat involved with water sports, activities and issues.

Perceptions of key problems are similar in all communities.

- Overall, maintaining clean rivers and streams for fish and wildlife is the highest rated problem. Among eight problems facing Clackamas County, the largest share of residents rate maintaining clean rivers and streams for healthy fish and wildlife (50% major problem) as a major problem.

More than four in ten rate four other issues as major problems:

- Maintaining a strong economy (45% major problem);
- Human health and safety (44% major problem);
- Maintaining clean rivers and streams for human recreational use (43% major problem); and,
- Adequate and efficient sewage treatment facilities and maintenance (42% major problem).

Less than four in ten considered three other issues major problems:

- Adequate clean drinking water (39% major problem);
- Residential growth (38% major problem); and,
- Industrial and commercial growth (22% major problem).

Issues identified in the survey vary somewhat by community.

- Clean rivers for wildlife and the economy are equally important to residents in Oregon City, Milwaukie and Damascus.
- Adequate and efficient sewage treatment facilities, and health and safety are top rated problems among Milwaukie residents.
- Residential growth is the top concern in Damascus.

Financial Services

WES operates the Districts and provides wastewater and surface water management services using revenue from several sources. The Surface Water Management (SWM) Program for CCSD No. 1 is funded through three primary sources: monthly SWM utility fees, systems development charges (SDCs), and permit fees.

The SWM fee is based on the amount of impervious surface on each site. The monthly surface water management fee is based on the Equivalent Service Unit (ESU). One ESU equals 2,500 square feet of impervious surface.

The current SWM rate is $6.00 per month per ESU in CCSD No. 1 and $4.00 per month per ESU in SWMACC. Single family residences are charged for 2500 square feet of impervious service area or 1 ESU (shown as "1.00 unit" on your billing) per month, based on this average measurement. Single-family residential customers who live in development built since 1998 also pay a monthly maintenance agreement fee of $3.00 per ESU which is dedicated for maintenance of local subdivision storm water conveyance, detention, treatment, and infiltration facilities.

Non-single family properties, including businesses, schools, governments and industrial areas, pay based on their measured impervious area. For example, a business with 10,000 square feet of impervious surface (4 ESUs) would be charged $16.00 per month ($4.00 X 10,000 sq. ft. ÷ 2,500 sq. ft. = $16.00). Through this approach, properties that contribute more to the need for surface water management pay a greater proportion of the program costs.

SDCs are collected from new development and dedicated to planning, design, and construction of additional storm water infrastructure capacity needed to accommodate growth. The current SDC rate is $205 per ESU.

Table 1-4 compares the number of ESUs in July 2005 and 2006 for residential and commercial/ industrial land uses. Excluding roadways, the amount of impervious area in CCSD No. 1 increased by 44 acres (749 ESUs) during this period from 2005 to 2006. Based on aerial mapping, new roadways (not reflected in customer billing records) are estimated to account for an additional 22 acres of impervious surface added in CCSD No. 1 from 2005 to 2006.

Table 1-4. Equivalent Service Units in CCSD No. 1 2005-2006

ESUs	July 2005	July 2006	Change
Residential	14,213	14,972	759
Commercial/Industrial	29,112	29,112	0
Total	43,325	44,084	759

Based on the period from 2003 to 2007, the average annual growth rate for the ESUs was calculated to be 3 percent which is generally considered to be a reliable predictor of average future revenue, although current economic conditions could result in a slower growth rate in the near future. Table 1-5 summarizes WES's projected surface water rate revenues for CCSD No. 1. This estimate uses the current surface water rate of $6.00 per ESU for CCSD No. 1. The surface water rate is held constant for estimating future revenue. The estimate also does not include revenue from System Development Charges.

In the fiscal evaluation as a part of the 2008 MS4 permit renewal, WES anticipates that the annual surface water budgets for CCSD No. 1 will continue to grow in order to meet regulatory requirements, system expansion, and to refurbish and enhance existing system facilities. In the permit renewal, it is noted that it is likely that future budgets may require rate increases and possibly additional staffing.

Table 1-5. CCSD No. 1 Surface Water Rate Revenue Forecast

Year	ESUs	Rate revenue, dollars
2008	45,504	3,432,372
2009	46870	3,535,343
2010	48,276	3,641,403
2011	49,724	3,750,646
2012	51,216	3,863,165
2013	52,752	3,979,060

SWM fees are used to fund:

- Maintenance of stormwater facilities
- Response to customer service enquiries
- Monitoring of water quality
- Planning and design of regional water quality and flood reduction projects
- Providing long-term watershed planning
- Providing public outreach and partnerships for pollution prevention

Other Clackamas County Departments

The following Clackamas County departments and divisions also implement policies and practices that affect watershed health:

- Department of Transportation and Development (DTD)
- Sustainability
- Development Agency
- Engineering
- Planning
- Parks Department
- North Clackamas Parks and Recreation District

Department of Transportation and Development (DTD). DTD is responsible for a broad range of County services involving land use planning and permitting, building permits, county code enforcement, sustainability, road construction and maintenance, surveying, plat approvals, public land corner restoration and dog services. The county's urban renewal programs are also under the DTD umbrella.

These programs and services are managed through eight divisions that report to the department director: Building Codes, Community Environment, Development Agency, Dog Services, Engineering, Land Use Planning, Surveyor and Transportation Maintenance. Of these divisions, Community Environment (which includes Sustainability), Development Agency, Engineering, and Land Use Planning have the most impact on watershed health.

Sustainability. Clackamas County is committed to sustainability, to "using, developing and protecting resources at a rate and in a manner enabling people to meet their current needs and also provides that future generations can meet their own needs." The Clackamas County Office of Sustainability supports and coordinates sustainability activities within and throughout Clackamas County, and is a resource for the community. In November 2008, the Sustainable Clackamas County Advisory Task Force submitted to the County Commissioners the "Action Plan for a Sustainable Clackamas County." The action plan framework includes seven goals for the year 2050 with associated actions and tasks for the next three to five years.

Development Agency. Using urban renewal authority, the Development Agency implements programs that provide for economically, socially and environmentally sound development and redevelopment to revitalize blighted areas; building the County's property tax base and creating jobs for the citizens of Clackamas County. The Clackamas County Development Agency currently administers four urban renewal areas.

- Clackamas Town Center Area
- Clackamas Industrial Area
- Government Camp
- North Clackamas Revitalization Area

Engineering. Engineering includes engineering inspections, transportation infrastructure improvements, including design and construction, development review oversight, and traffic safety and operations.

Planning. Planning includes land use permit approval, the development review process, long-range planning, land use regulations, and the capital improvement program (CIP).

Parks Department. The County Parks Department manages the following areas: Barton Park, Boones Ferry Marina, Carver Park, Eagle Fern Park, Feyrer Park, Hebb Park, Metzler Park, and Hoodland Park.

North Clackamas Parks and Recreation District. North Clackamas Parks and Recreation District (NCPRD) is a service district of Clackamas County government. It offers about 50 parks and greenspaces to about 100,000 residents in the north portion of the county. Stretching from the Clackamas River on the south to the Multnomah County border on the north, the Willamette River on the west and reaching to the 1979 urban growth boundary on the east, NCPRD includes the City of Milwaukie, the City of Happy Valley and unincorporated areas.

Cities

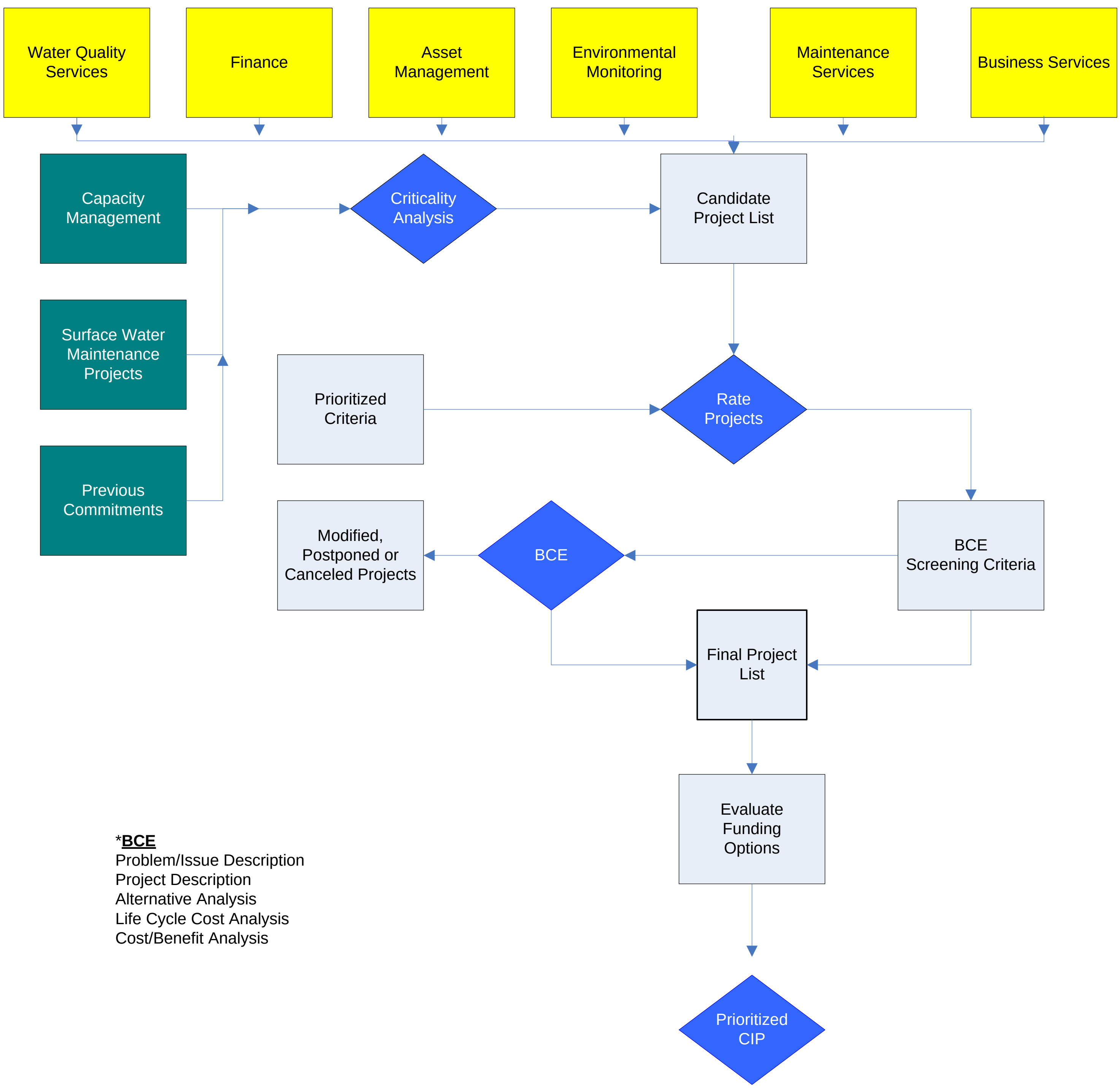
The Kellogg-Mt. Scott watershed encompasses the Cities of Milwaukie, Happy Valley, Gladstone, and Johnson City as described earlier. CCSD No. 1 includes a service agreement with Happy Valley to provide stormwater management services.

The City of Milwaukie is currently undertaking an initiative called Kellogg for Coho, which is evaluating options to improve fish passage through the dam on Kellogg Creek at Highway 99 and restore Kellogg Lake to a free-flowing section of the stream. The primary option being evaluated is to remove Kellogg Dam during replacement of the Highway 99 bridge. The City of Milwaukie has held several public and stakeholder meetings on this project and has obtained some limited grant funds. The City has partnered with the U.S. Army Corps of Engineers and has conducted a few preliminary environmental studies. WES is a current partner (limited at this time to staff support and study review and attendance at meetings) in the project and has been invited to all of these meetings. The City and Corps are planning additional surveys and analysis of the project. The City of Milwaukie is continuing to look for additional partners and funding opportunities in association with their downtown and redevelopement plans in this area.

Other Agencies and Organizations

There are a wide variety of other agencies and organizations that implement policies and practices that affect watershed health in the KMS watershed, including state and federal agencies, Metro, local service providers, watershed groups, community groups, and others.

WES PRIORITIZED CAPITAL IMPROVEMENT PROGRAM PROCESS



*__BCE__
Problem/Issue Description
Project Description
Alternative Analysis
Life Cycle Cost Analysis
Cost/Benefit Analysis

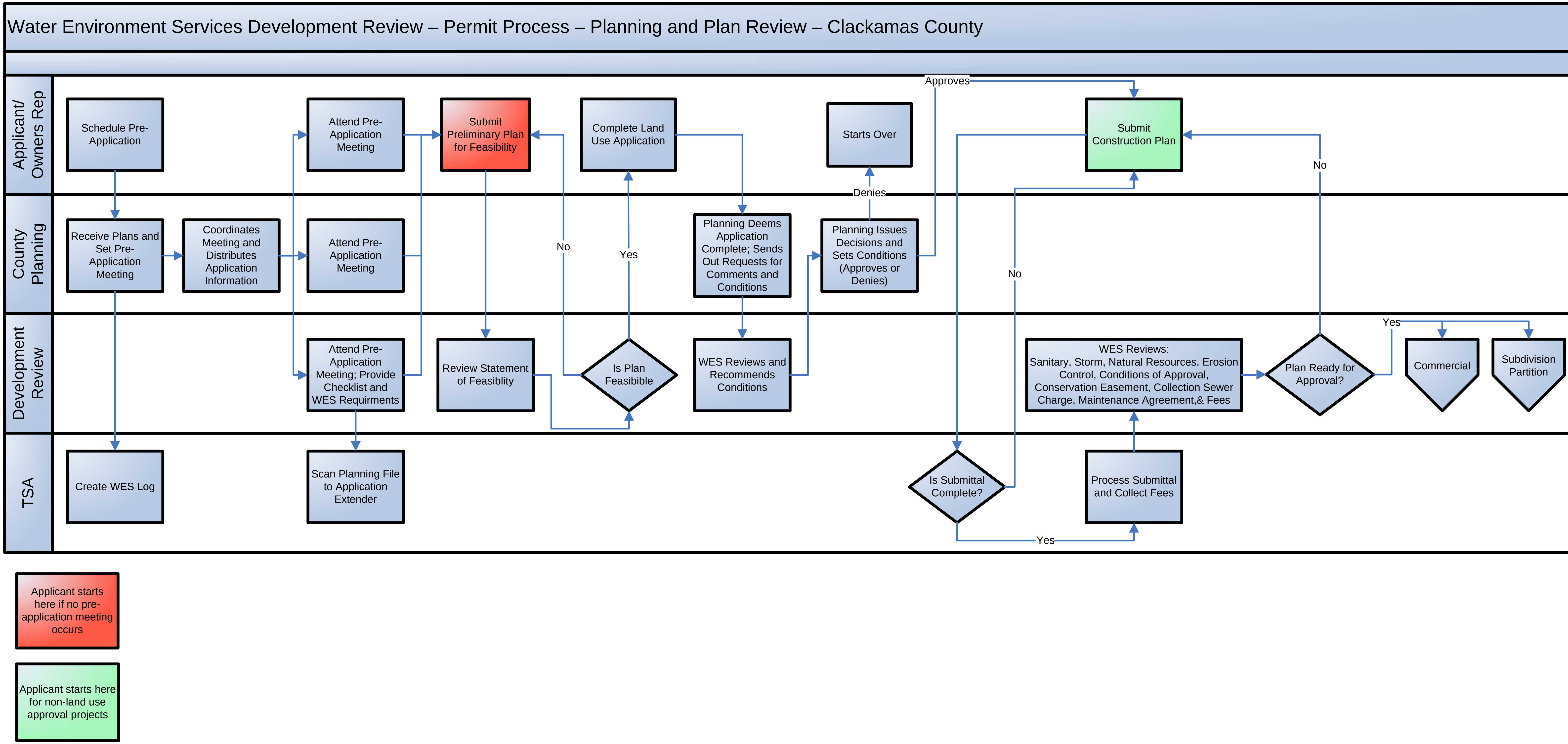

Water Environment Services Development Review – Permit Process – Planning and Plan Review – Clackamas County
Applicant/ Owners Rep
County Planning
Development Review
TSA
Schedule Pre-Application
Attend Pre-Application Meeting
Submit Preliminary Plan for Feasibility
Complete Land Use Application
Starts Over
Submit Construction Plan
Approves
Denies
No
Receive Plans and Set Pre-Application Meeting
Coordinates Meeting and Distributes Application Information
Attend Pre-Application Meeting
No
Yes
Planning Deems Application Complete; Sends Out Requests for Comments and Conditions
Planning Issues Decisions and Sets Conditions (Approves or Denies)
No
Attend Pre-Application Meeting; Provide Checklist and WES Requirments
Review Statement of Feasiblity
Is Plan Feasibible
WES Reviews and Recommends Conditions
WES Reviews: Sanitary, Storm, Natural Resources. Erosion Control, Conditions of Approval, Conservation Easement, Collection Sewer Charge, Maintenance Agreement,& Fees
Plan Ready for Approval?
Yes
Commercial
Subdivision Partition
Create WES Log
Scan Planning File to Application Extender
Is Submittal Complete?
Process Submittal and Collect Fees
Yes
Applicant starts here if no pre-application meeting occurs
Applicant starts here for non-land use approval projects

Figure A-3a

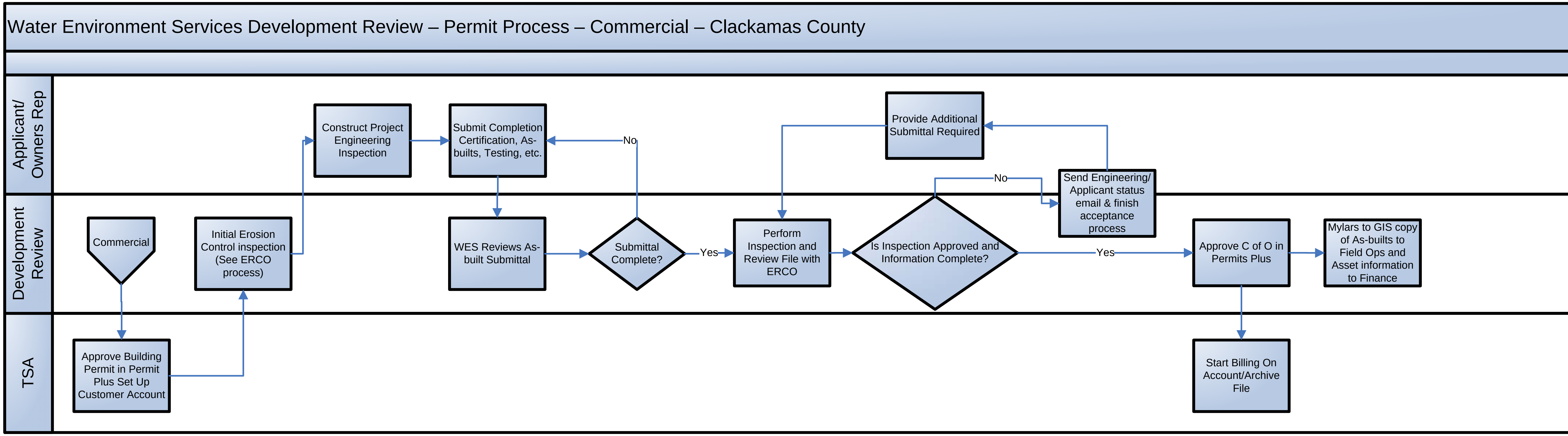

Water Environment Services Development Review – Permit Process – Commercial – Clackamas County
Applicant/ Owners Rep
Development Review
TSA
Commercial
Approve Building Permit in Permit Plus Set Up Customer Account
Initial Erosion Control inspection (See ERCO process)
Construct Project Engineering Inspection
Submit Completion Certification, As-builts, Testing, etc.
WES Reviews As-built Submittal
Submittal Complete?
No
Yes
Perform Inspection and Review File with ERCO
Is Inspection Approved and Information Complete?
No
Provide Additional Submittal Required
Send Engineering/ Applicant status email & finish acceptance process
Yes
Approve C of O in Permits Plus
Mylars to GIS copy of As-builts to Field Ops and Asset information to Finance
Start Billing On Account/Archive File

Figure A-4a

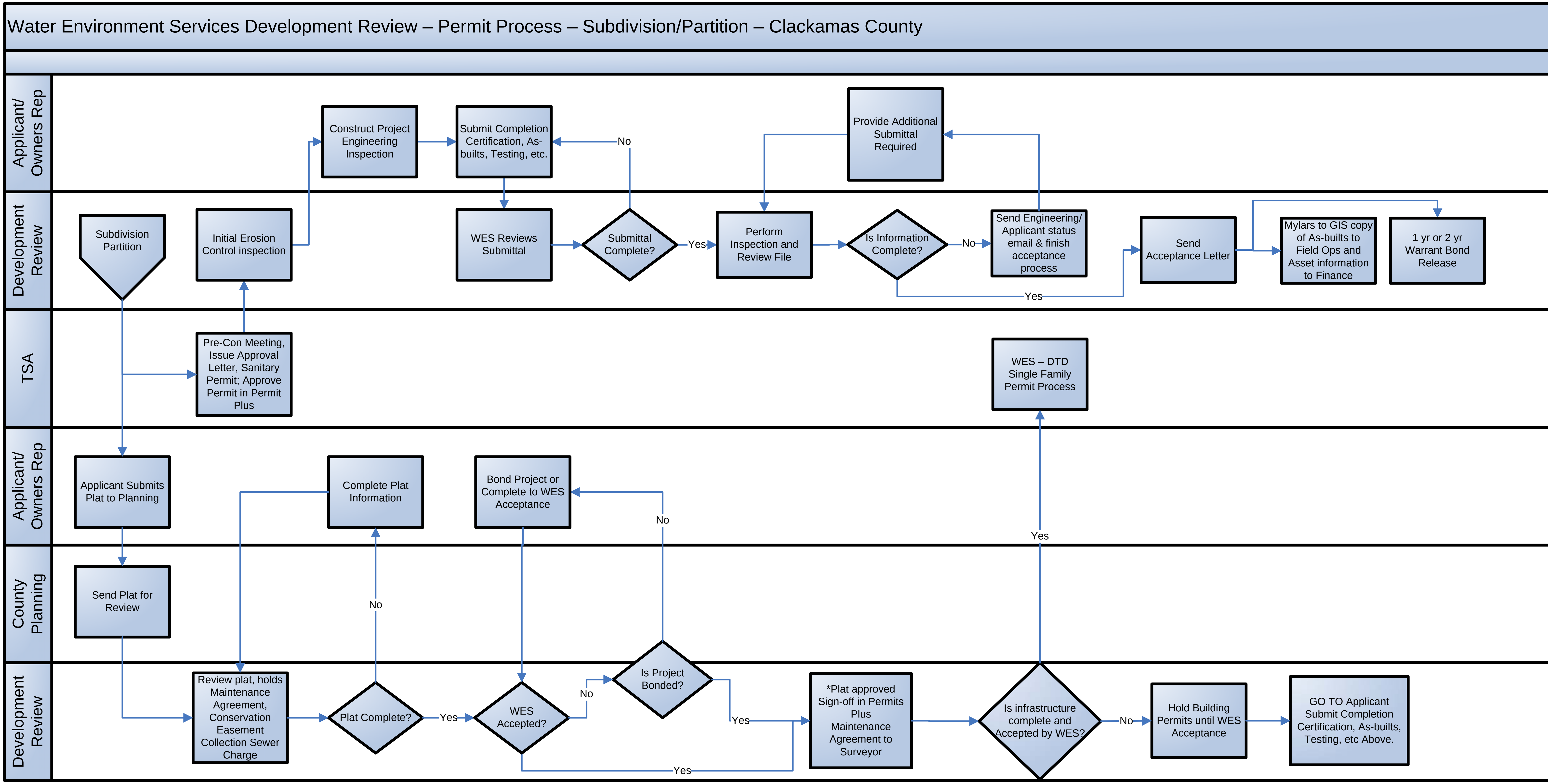
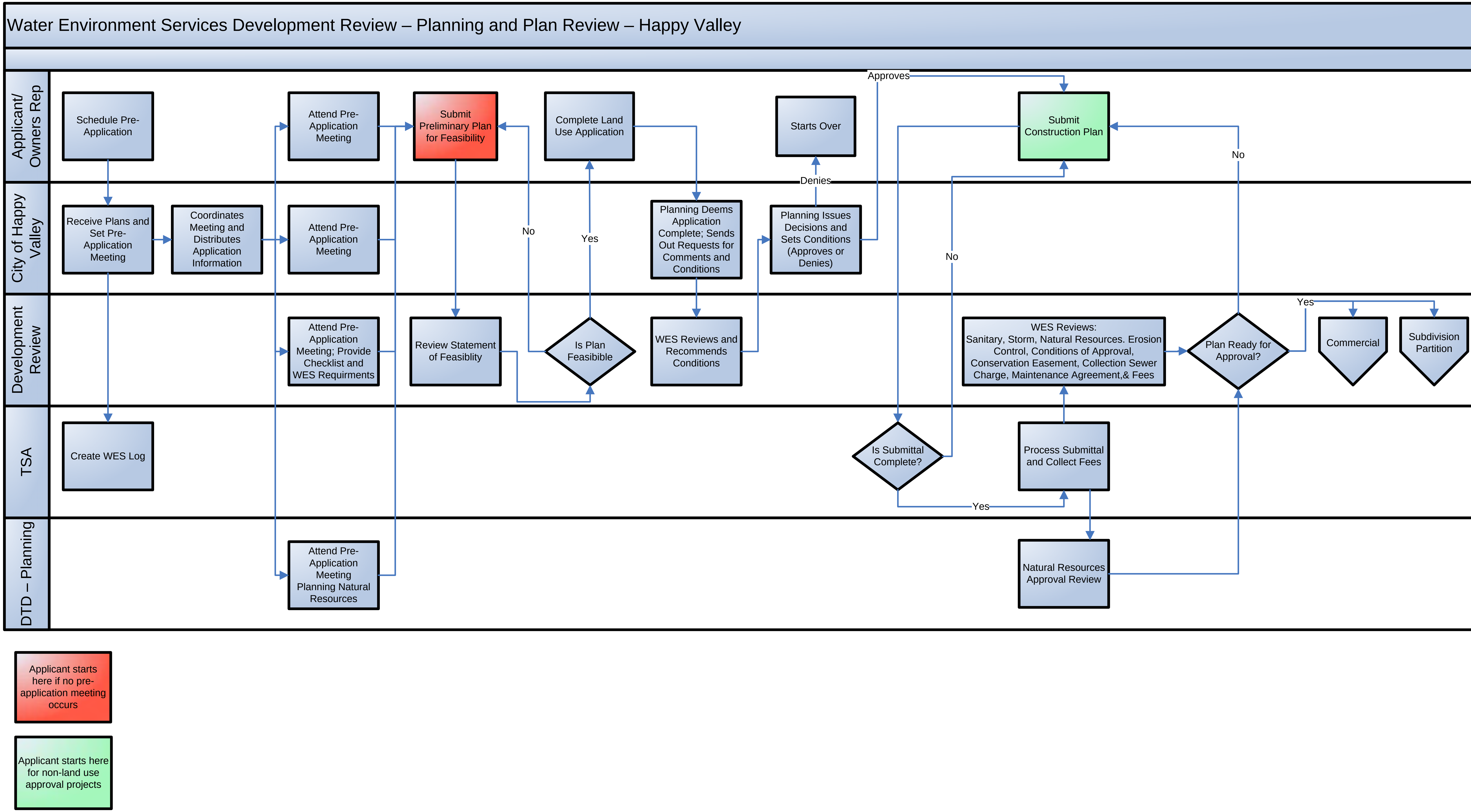

Water Environment Services Development Review – Permit Process – Subdivision/Partition – Clackamas County
Applicant/ Owners Rep
Development Review
TSA
Applicant/ Owners Rep
County Planning
Development Review
Subdivision Partition
Initial Erosion Control inspection
Construct Project Engineering Inspection
Submit Completion Certification, As-builts, Testing, etc.
WES Reviews Submittal
Submittal Complete?
No
Yes
Perform Inspection and Review File
Provide Additional Submittal Required
Is Information Complete?
No
Yes
Send Engineering/ Applicant status email & finish acceptance process
Send Acceptance Letter
Mylars to GIS copy of As-builts to Field Ops and Asset information to Finance
1 yr or 2 yr Warrant Bond Release
Pre-Con Meeting, Issue Approval Letter, Sanitary Permit; Approve Permit in Permit Plus
WES – DTD Single Family Permit Process
Applicant Submits Plat to Planning
Complete Plat Information
Bond Project or Complete to WES Acceptance
No
Yes
Send Plat for Review
No
Review plat, holds Maintenance Agreement, Conservation Easement Collection Sewer Charge
Plat Complete?
Yes
WES Accepted?
No
Is Project Bonded?
Yes
Yes
*Plat approved Sign-off in Permits Plus Maintenance Agreement to Surveyor
Is infrastructure complete and Accepted by WES?
No
Hold Building Permits until WES Acceptance
GO TO Applicant Submit Completion Certification, As-builts, Testing, etc Above.

Figure A-5a



Water Environment Services Development Review – Planning and Plan Review – Happy Valley
Applicant/ Owners Rep
City of Happy Valley
Development Review
TSA
DTD – Planning
Schedule Pre-Application
Attend Pre-Application Meeting
Submit Preliminary Plan for Feasibility
Complete Land Use Application
Starts Over
Approves
Submit Construction Plan
No
Denies
Receive Plans and Set Pre-Application Meeting
Coordinates Meeting and Distributes Application Information
Attend Pre-Application Meeting
No
Yes
Planning Deems Application Complete; Sends Out Requests for Comments and Conditions
Planning Issues Decisions and Sets Conditions (Approves or Denies)
No
Attend Pre-Application Meeting; Provide Checklist and WES Requirments
Review Statement of Feasiblity
Is Plan Feasible
WES Reviews and Recommends Conditions
WES Reviews: Sanitary, Storm, Natural Resources. Erosion Control, Conditions of Approval, Conservation Easement, Collection Sewer Charge, Maintenance Agreement,& Fees
Plan Ready for Approval?
Yes
Commercial
Subdivision Partition
Create WES Log
Is Submittal Complete?
Yes
Process Submittal and Collect Fees
Attend Pre-Application Meeting Planning Natural Resources
Natural Resources Approval Review
Applicant starts here if no pre-application meeting occurs
Applicant starts here for non-land use approval projects

Figure A-3b

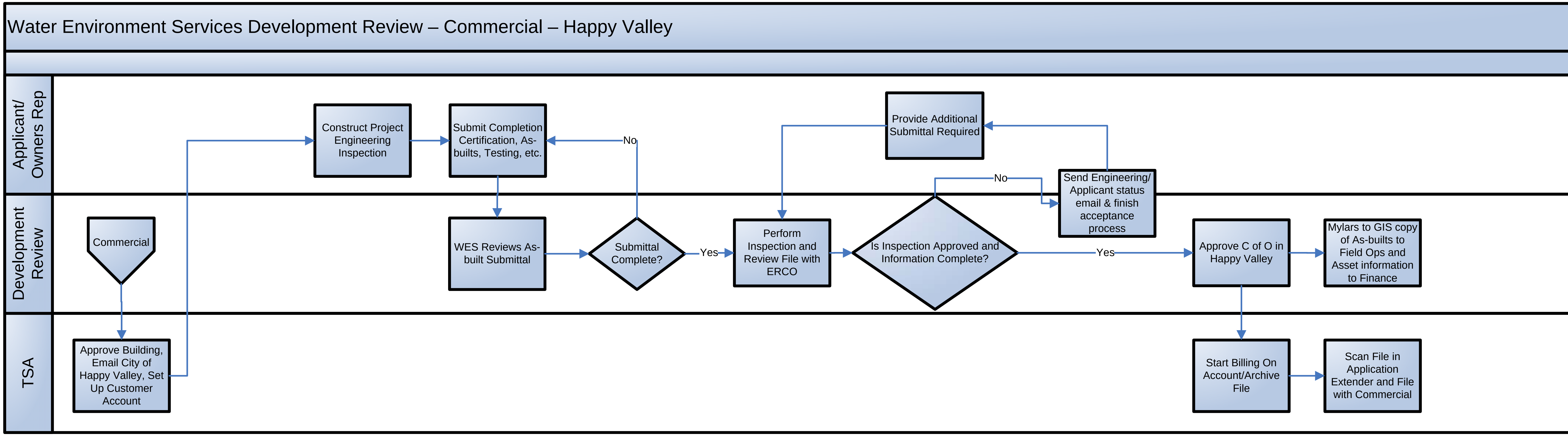
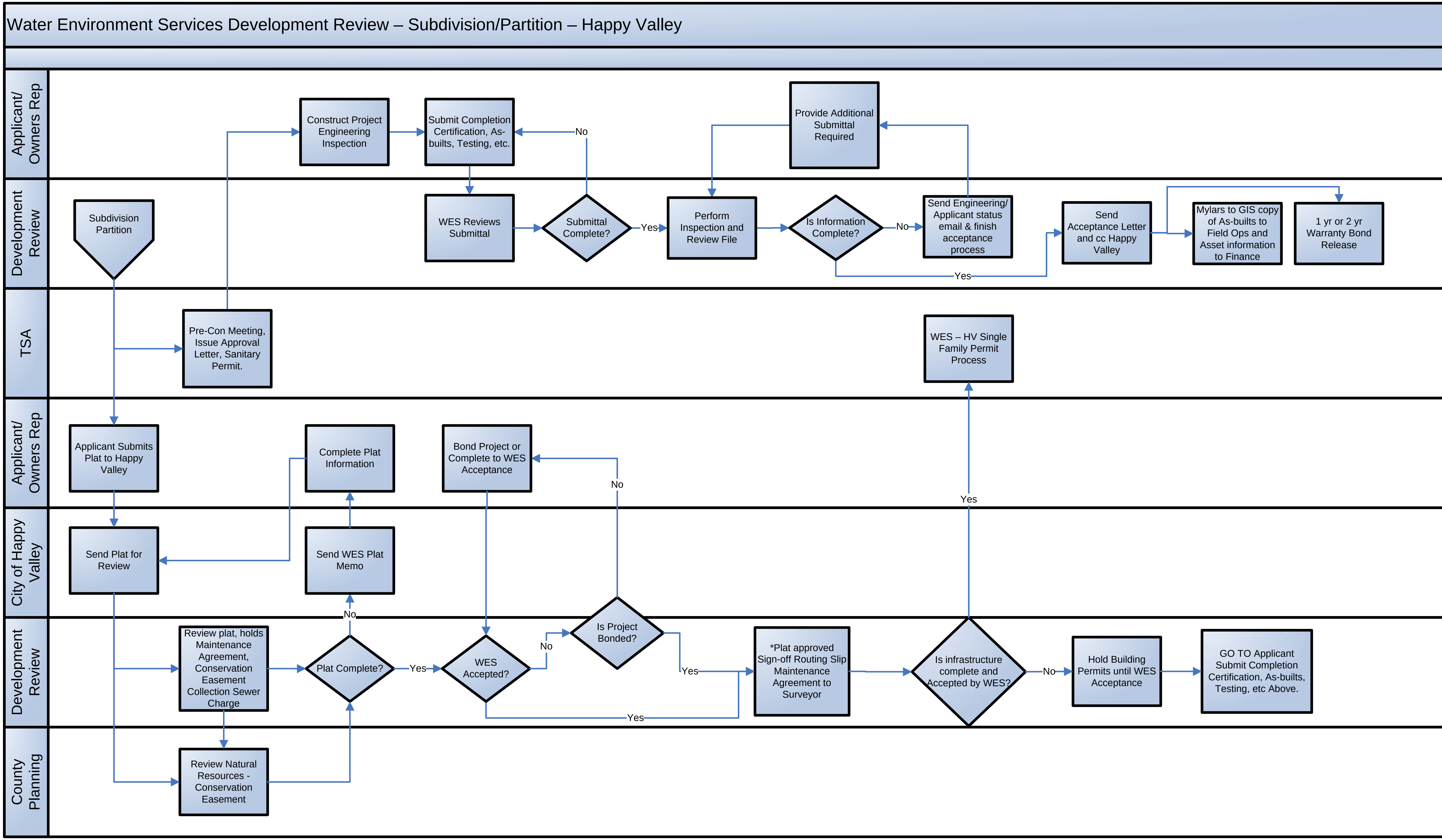
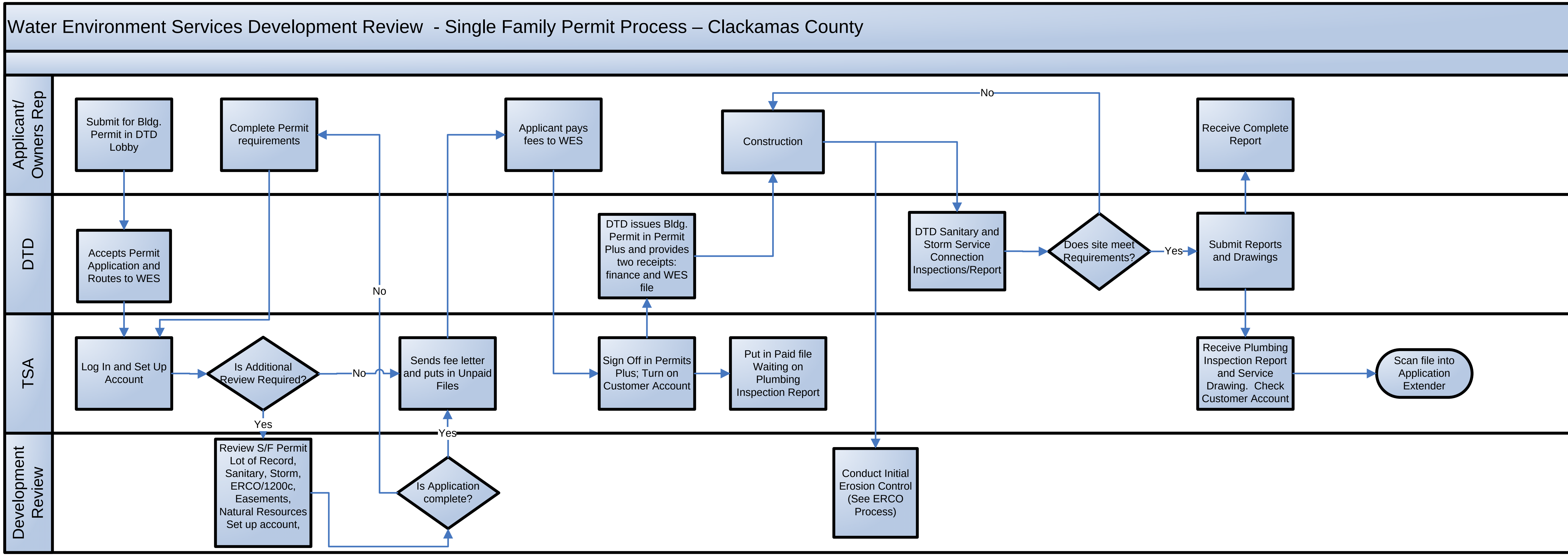

Water Environment Services Development Review – Commercial – Happy Valley
Applicant/ Owners Rep
Development Review
TSA
Commercial
Approve Building, Email City of Happy Valley, Set Up Customer Account
Construct Project Engineering Inspection
Submit Completion Certification, As-builts, Testing, etc.
WES Reviews As-built Submittal
Submittal Complete?
No
Yes
Perform Inspection and Review File with ERCO
Provide Additional Submittal Required
Is Inspection Approved and Information Complete?
No
Yes
Send Engineering/ Applicant status email & finish acceptance process
Approve C of O in Happy Valley
Mylars to GIS copy of As-builts to Field Ops and Asset information to Finance
Start Billing On Account/Archive File
Scan File in Application Extender and File with Commercial

Figure A-4b



Water Environment Services Development Review – Subdivision/Partition – Happy Valley
Applicant/ Owners Rep
Development Review
TSA
Applicant/ Owners Rep
City of Happy Valley
Development Review
County Planning
Construct Project Engineering Inspection
Submit Completion Certification, As-builts, Testing, etc.
No
Provide Additional Submittal Required
Subdivision Partition
WES Reviews Submittal
Submittal Complete?
Yes
Perform Inspection and Review File
Is Information Complete?
No
Send Engineering/ Applicant status email & finish acceptance process
Yes
Send Acceptance Letter and cc Happy Valley
Mylars to GIS copy of As-builts to Field Ops and Asset information to Finance
1 yr or 2 yr Warranty Bond Release
Pre-Con Meeting, Issue Approval Letter, Sanitary Permit.
WES – HV Single Family Permit Process
Applicant Submits Plat to Happy Valley
Complete Plat Information
Bond Project or Complete to WES Acceptance
No
Yes
Send Plat for Review
Send WES Plat Memo
No
Review plat, holds Maintenance Agreement, Conservation Easement Collection Sewer Charge
Plat Complete?
Yes
WES Accepted?
No
Is Project Bonded?
Yes
*Plat approved Sign-off Routing Slip Maintenance Agreement to Surveyor
Is infrastructure complete and Accepted by WES?
No
Hold Building Permits until WES Acceptance
GO TO Applicant Submit Completion Certification, As-builts, Testing, etc Above.
Yes
Review Natural Resources - Conservation Easement

Figure A-5b



Water Environment Services Development Review - Single Family Permit Process – Clackamas County
Applicant/ Owners Rep
DTD
TSA
Development Review
Submit for Bldg. Permit in DTD Lobby
Complete Permit requirements
Applicant pays fees to WES
Construction
Receive Complete Report
Accepts Permit Application and Routes to WES
DTD issues Bldg. Permit in Permit Plus and provides two receipts: finance and WES file
DTD Sanitary and Storm Service Connection Inspections/Report
Does site meet Requirements?
Submit Reports and Drawings
Log In and Set Up Account
Is Additional Review Required?
Sends fee letter and puts in Unpaid Files
Sign Off in Permits Plus; Turn on Customer Account
Put in Paid file Waiting on Plumbing Inspection Report
Receive Plumbing Inspection Report and Service Drawing. Check Customer Account
Scan file into Application Extender
Review S/F Permit Lot of Record, Sanitary, Storm, ERCO/1200c, Easements, Natural Resources Set up account,
Is Application complete?
Conduct Initial Erosion Control (See ERCO Process)
No
Yes

Figure A-6

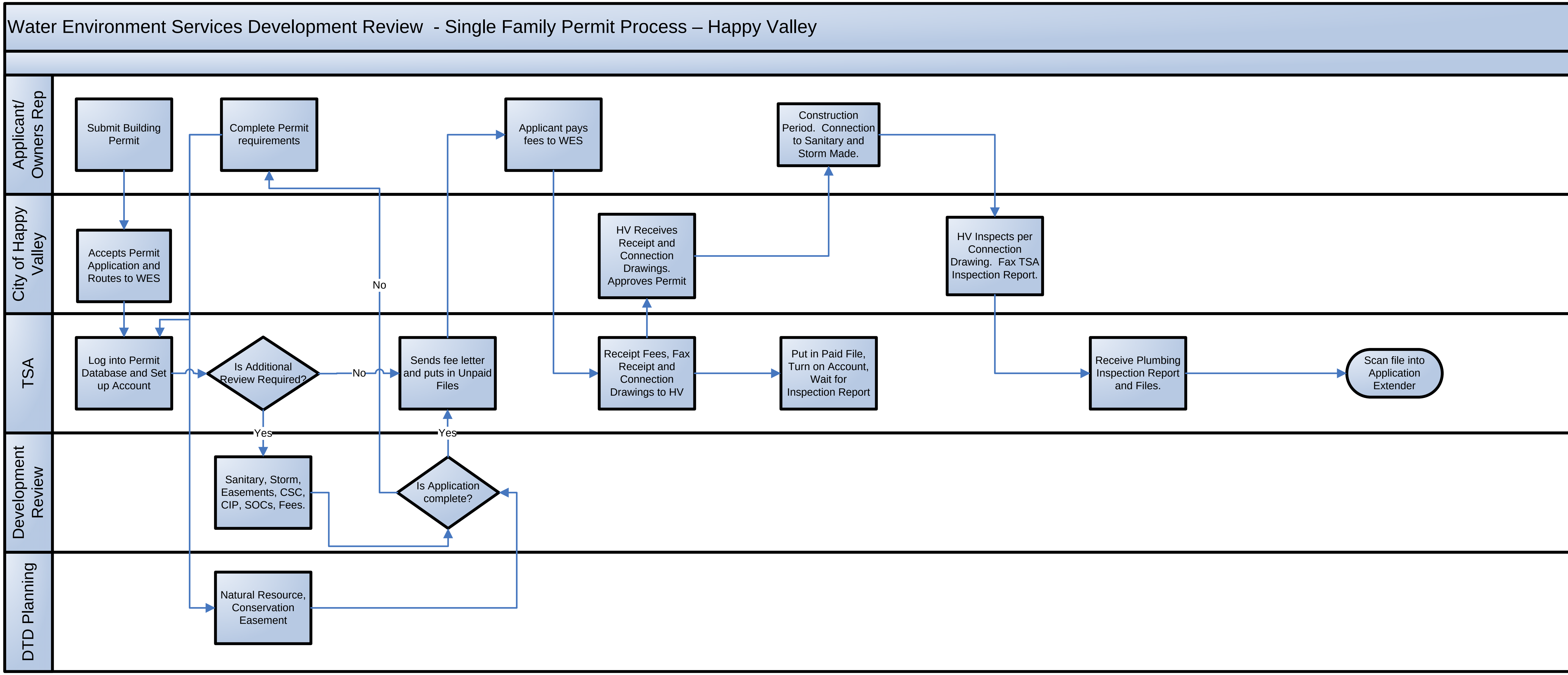
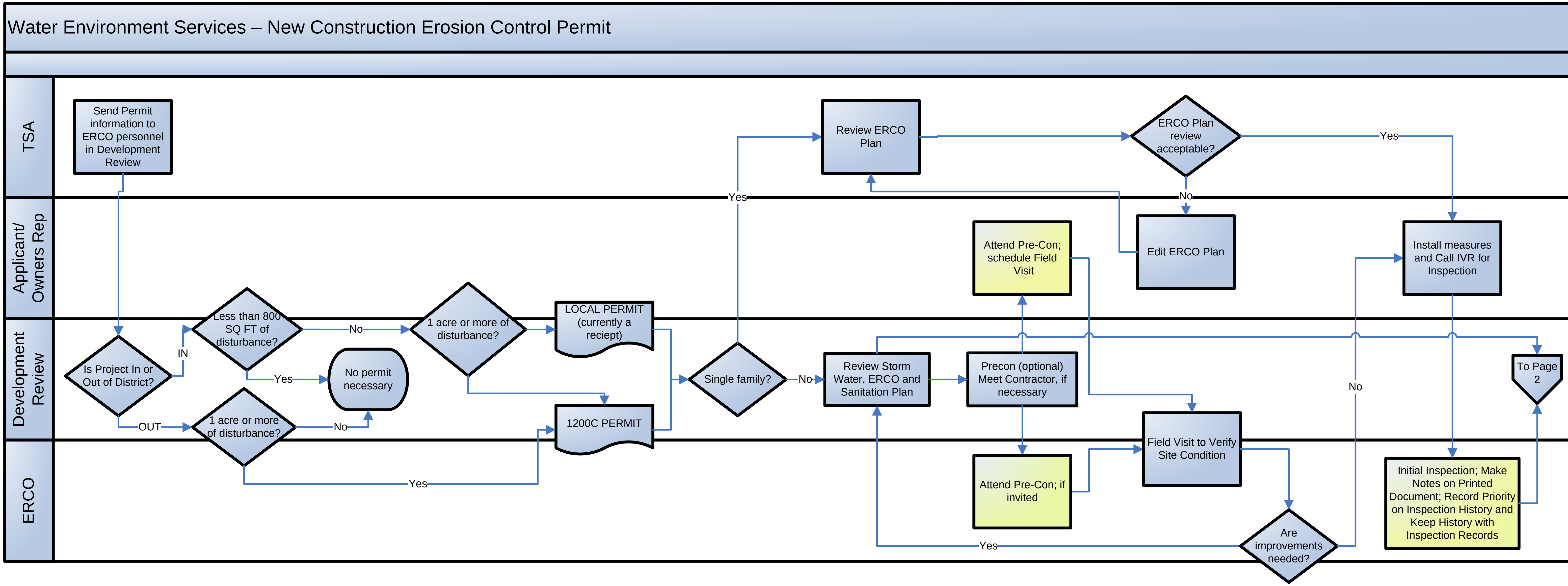

Water Environment Services Development Review - Single Family Permit Process – Happy Valley
Applicant/ Owners Rep
City of Happy Valley
TSA
Development Review
DTD Planning
Submit Building Permit
Complete Permit requirements
Applicant pays fees to WES
Construction Period. Connection to Sanitary and Storm Made.
Accepts Permit Application and Routes to WES
HV Receives Receipt and Connection Drawings. Approves Permit
HV Inspects per Connection Drawing. Fax TSA Inspection Report.
Log into Permit Database and Set up Account
Is Additional Review Required?
No
Sends fee letter and puts in Unpaid Files
Receipt Fees, Fax Receipt and Connection Drawings to HV
Put in Paid File, Turn on Account, Wait for Inspection Report
Receive Plumbing Inspection Report and Files.
Scan file into Application Extender
Yes
Yes
No
Sanitary, Storm, Easements, CSC, CIP, SOCs, Fees.
Is Application complete?
Natural Resource, Conservation Easement

Figure A-7



Yellow shading denotes potential "To Be" process

Figure A-8 (page1)

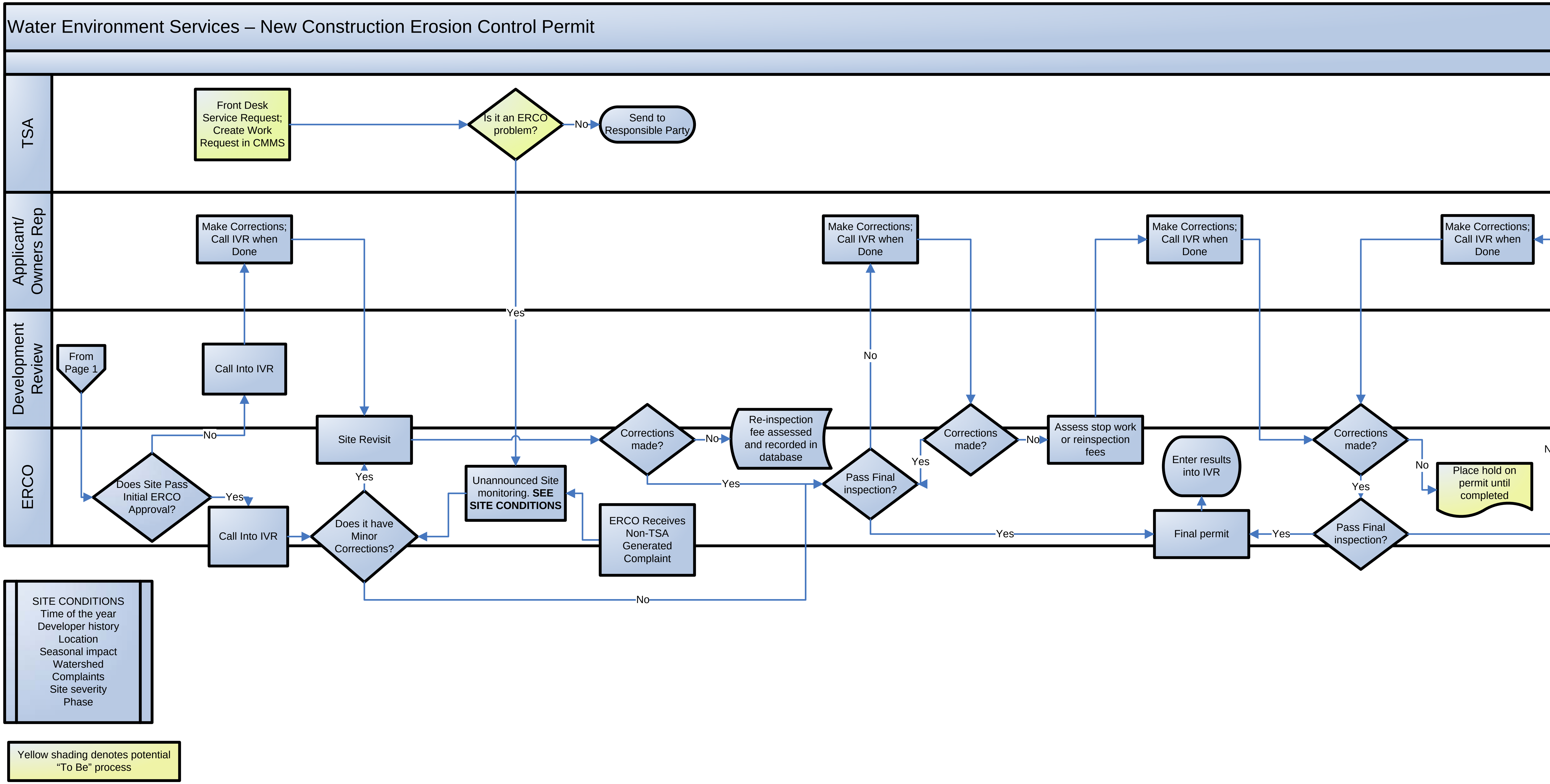


Figure A-8 (page 2)

WES SOILS PROGRAM

GENERAL GRADING PERMIT
FLOW CHART

1/28/2008

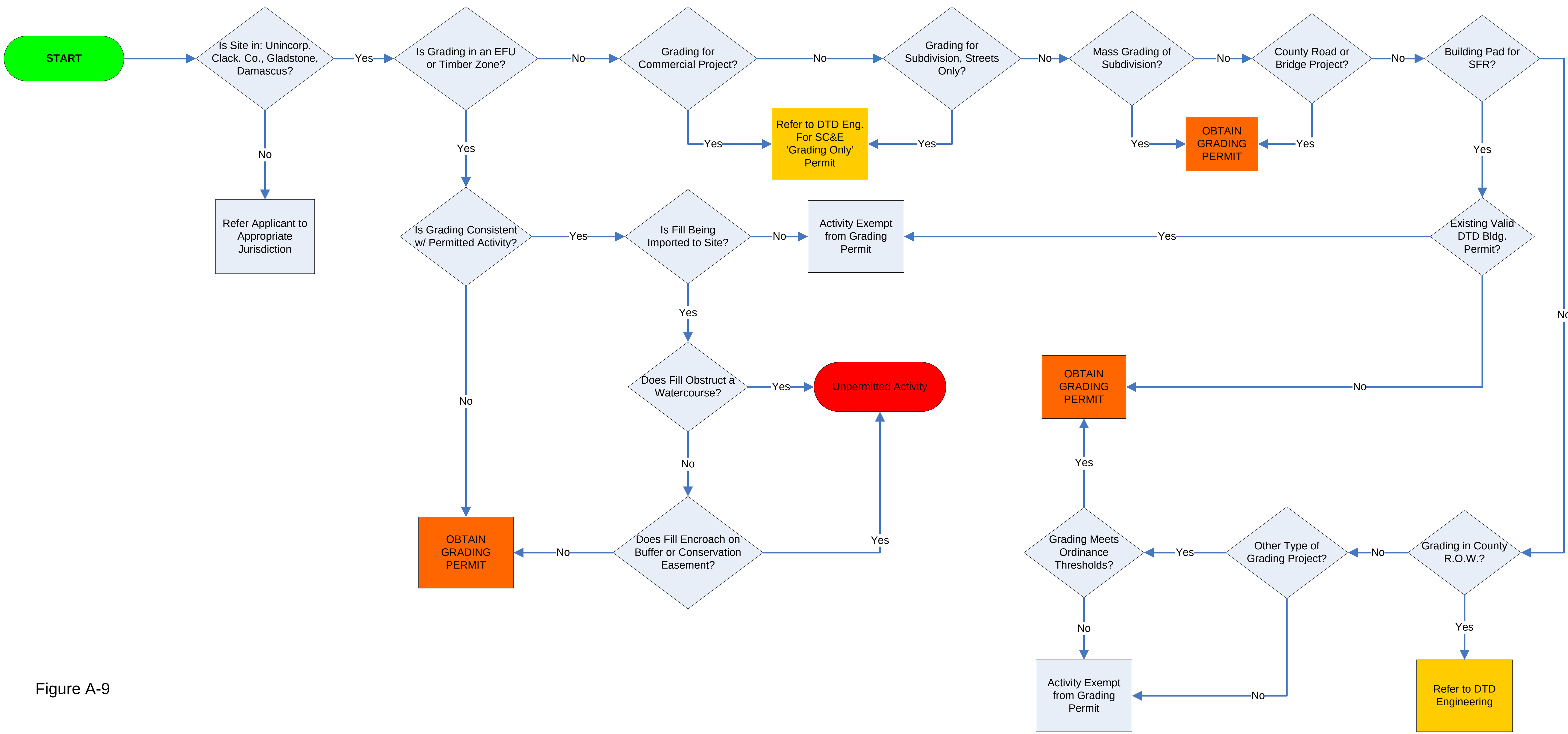


Figure A-9

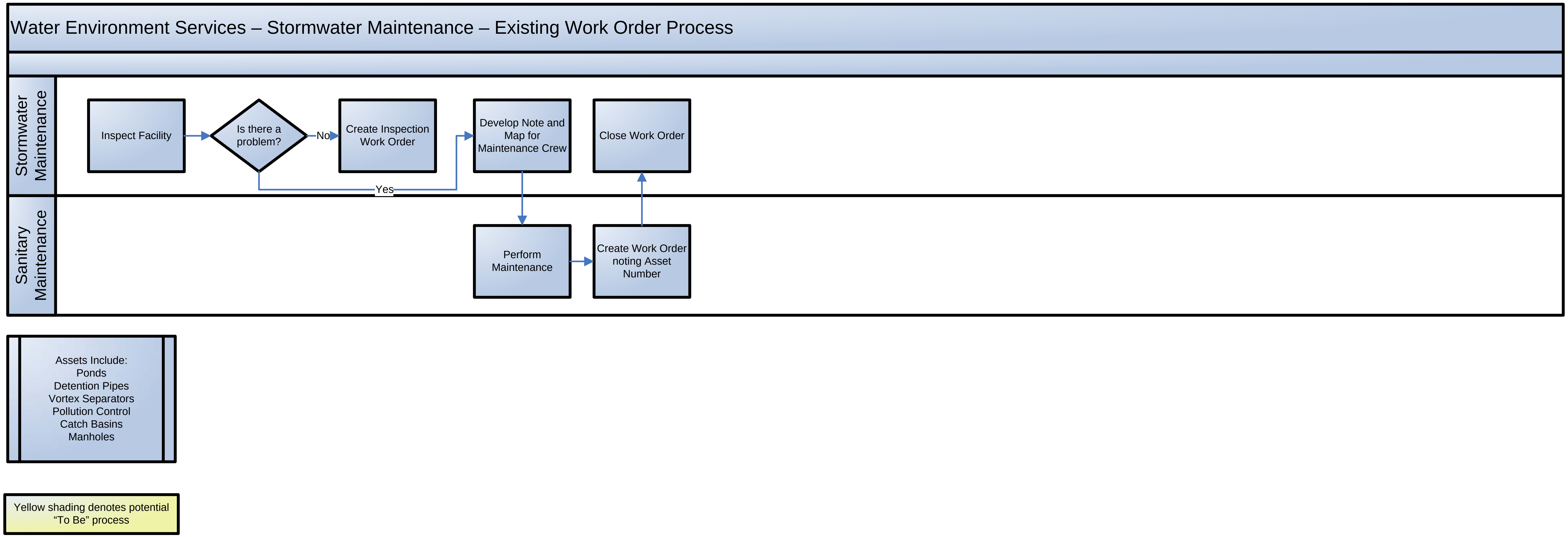

Water Environment Services – Stormwater Maintenance – Existing Work Order Process
Stormwater Maintenance
Sanitary Maintenance
Inspect Facility
Is there a problem?
No
Yes
Create Inspection Work Order
Develop Note and Map for Maintenance Crew
Close Work Order
Perform Maintenance
Create Work Order noting Asset Number
Assets Include:
Ponds
Detention Pipes
Vortex Separators
Pollution Control
Catch Basins
Manholes
Yellow shading denotes potential "To Be" process

Figure A-10

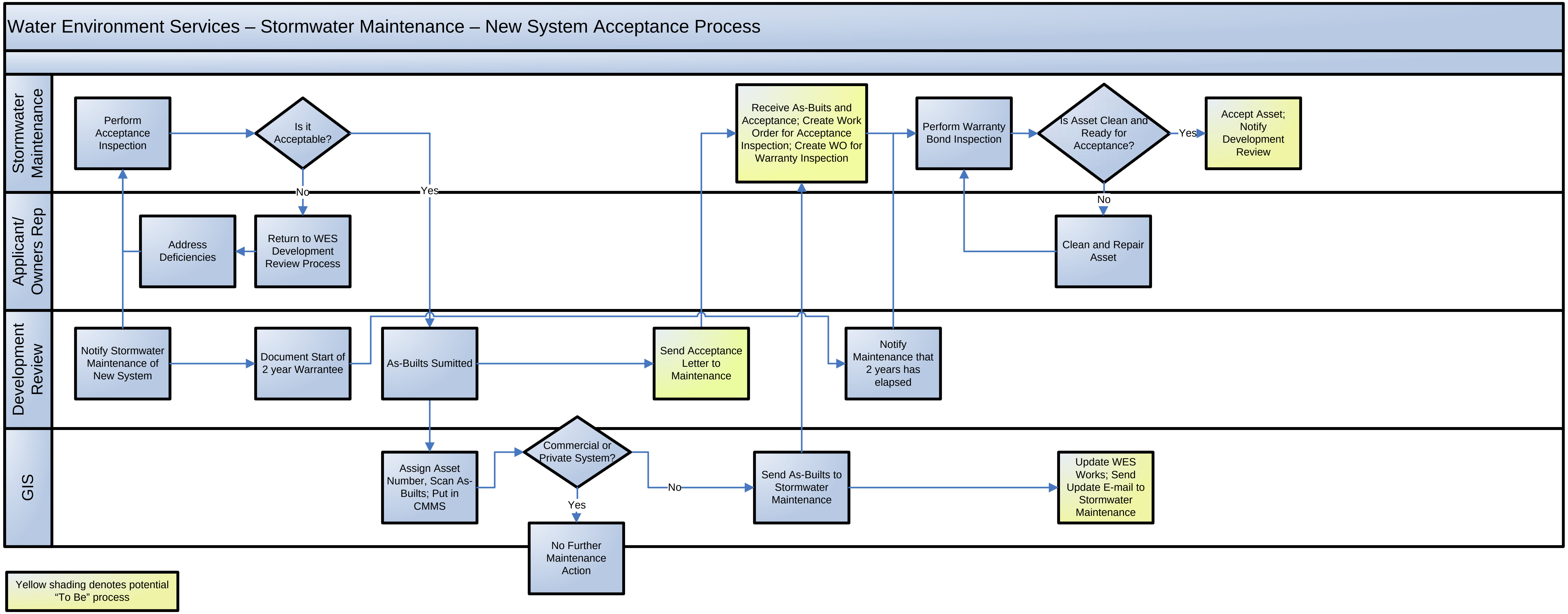

Water Environment Services – Stormwater Maintenance – New System Acceptance Process
Stormwater Maintenance
Applicant/ Owners Rep
Development Review
GIS
Perform Acceptance Inspection
Is it Acceptable?
No
Yes
Return to WES Development Review Process
Address Deficiencies
Notify Stormwater Maintenance of New System
Document Start of 2 year Warrantee
As-Builts Sumitted
Assign Asset Number, Scan As-Builts; Put in CMMS
Commercial or Private System?
Yes
No
No Further Maintenance Action
Send As-Builts to Stormwater Maintenance
Send Acceptance Letter to Maintenance
Receive As-Buits and Acceptance; Create Work Order for Acceptance Inspection; Create WO for Warranty Inspection
Notify Maintenance that 2 years has elapsed
Perform Warranty Bond Inspection
Is Asset Clean and Ready for Acceptance?
Yes
No
Accept Asset; Notify Development Review
Clean and Repair Asset
Update WES Works; Send Update E-mail to Stormwater Maintenance
Yellow shading denotes potential “To Be” process

Figure A-11

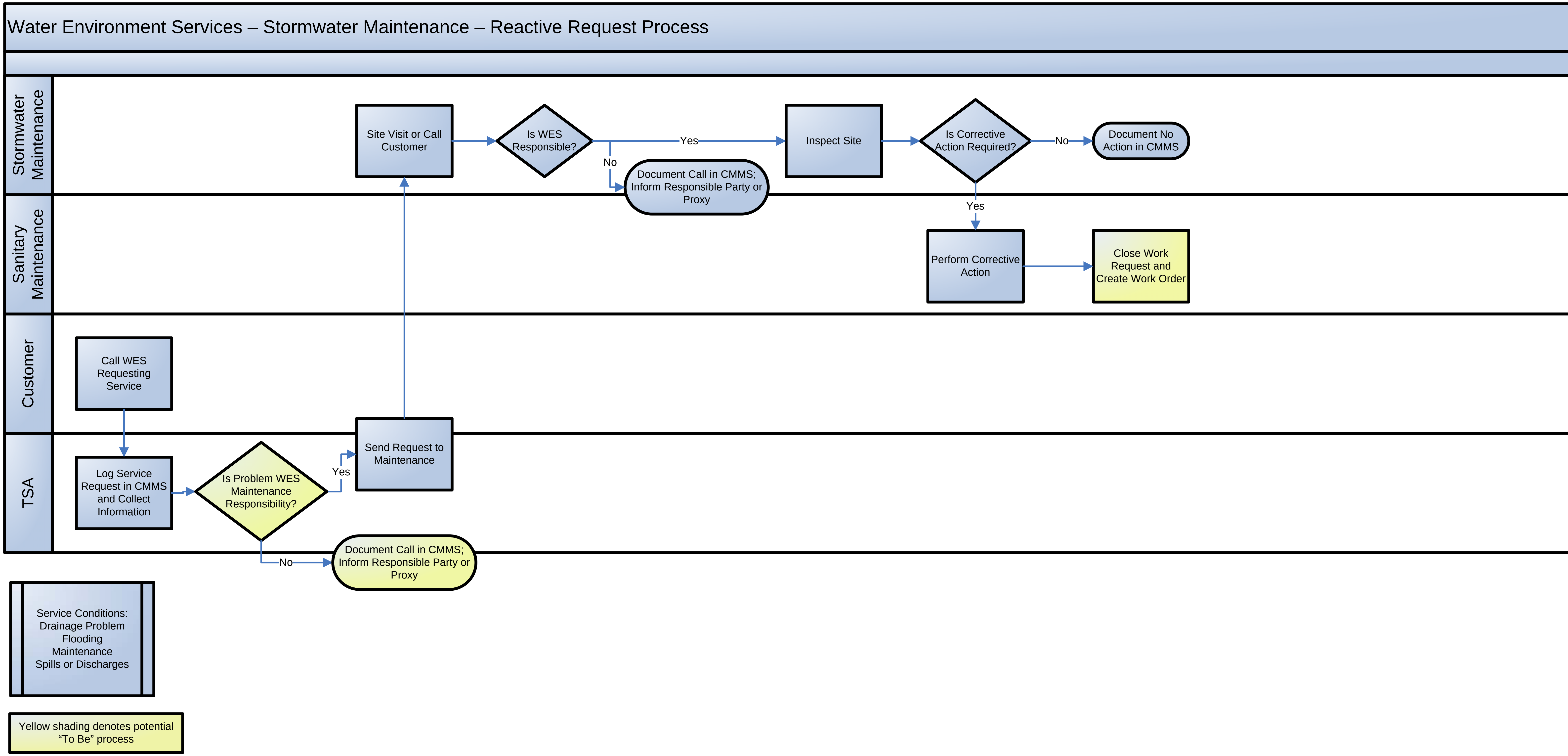

Water Environment Services – Stormwater Maintenance – Reactive Request Process
Stormwater Maintenance
Sanitary Maintenance
Customer
TSA
Site Visit or Call Customer
Is WES Responsible?
Yes
No
Document Call in CMMS; Inform Responsible Party or Proxy
Inspect Site
Is Corrective Action Required?
No
Document No Action in CMMS
Yes
Perform Corrective Action
Close Work Request and Create Work Order
Call WES Requesting Service
Log Service Request in CMMS and Collect Information
Is Problem WES Maintenance Responsibility?
Yes
Send Request to Maintenance
No
Document Call in CMMS; Inform Responsible Party or Proxy
Service Conditions: Drainage Problem Flooding Maintenance Spills or Discharges
Yellow shading denotes potential “To Be” process

Figure A-12

10/16/2008

Environmental Monitoring Division

Subtitle

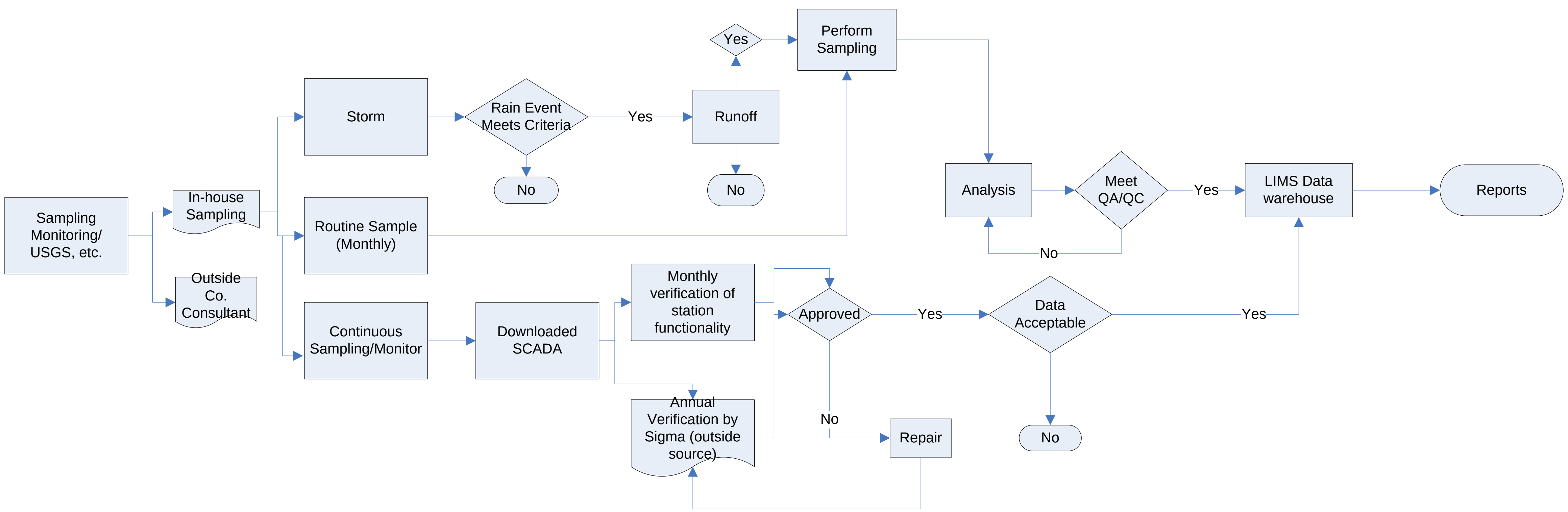


Figure A-13

Revised 10/16/08

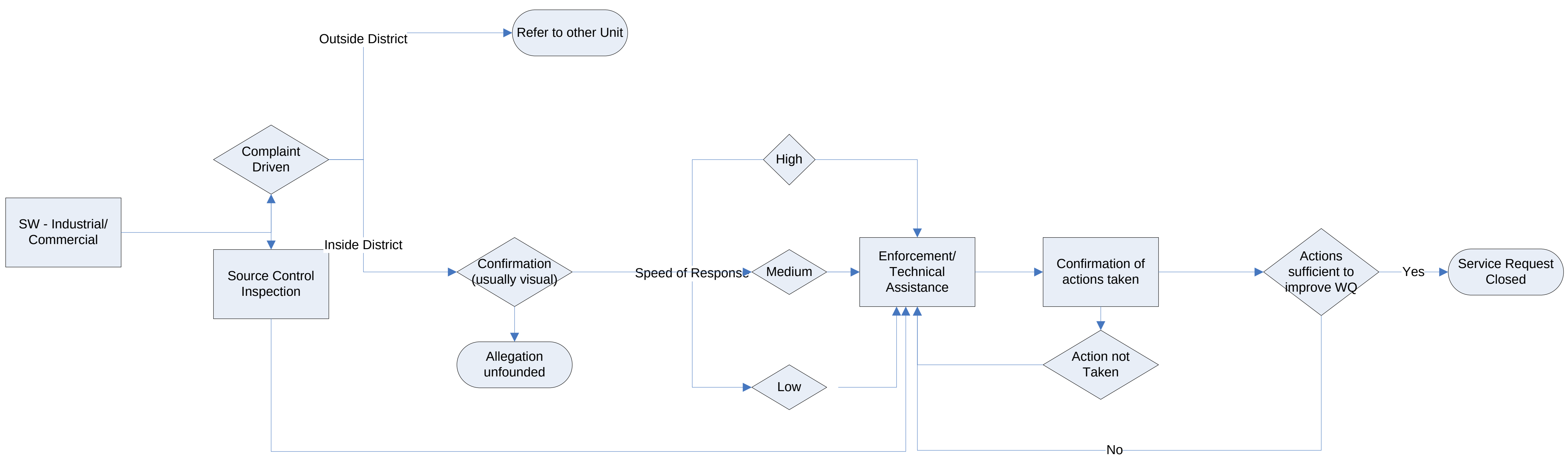


Figure A-14

Revised 10/16/08

Figure A-15

Revised 10/16/08

10/16/2008

Environmental Monitoring Division

Subtitle

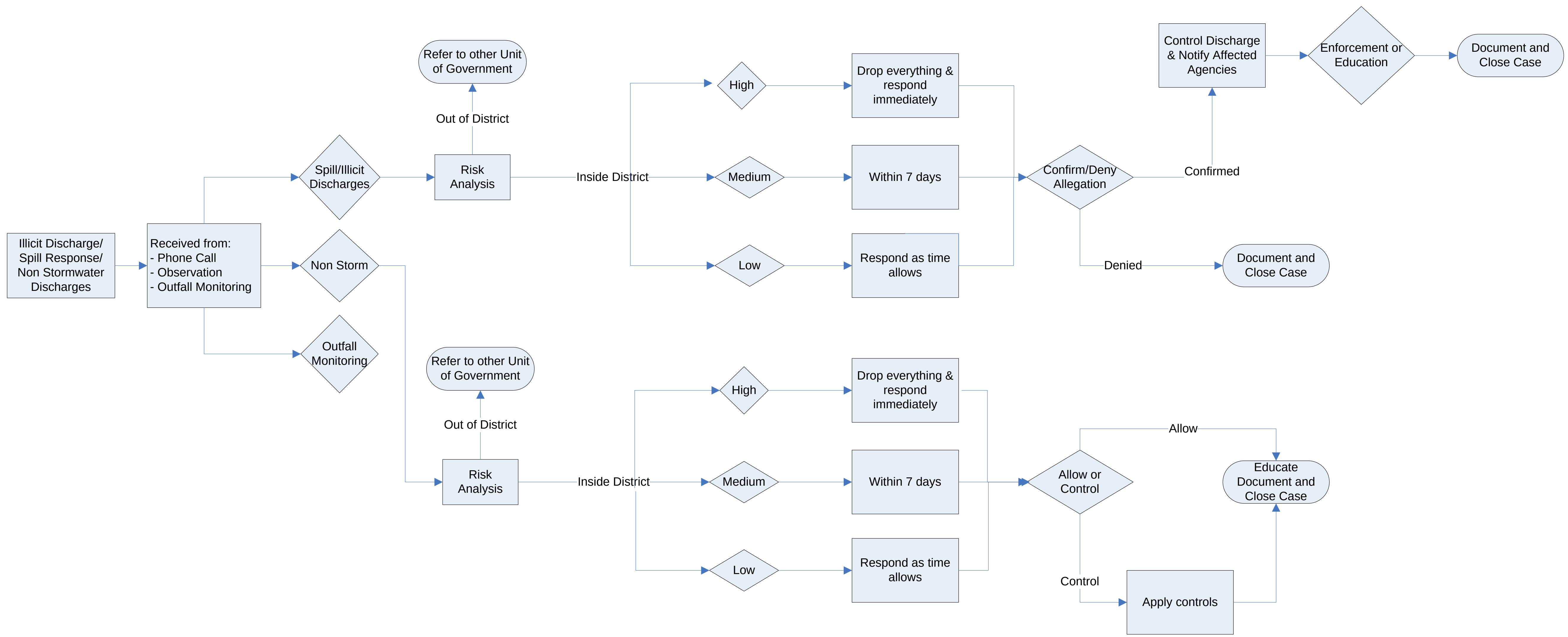


Figure A-16

Revised 10/16/08

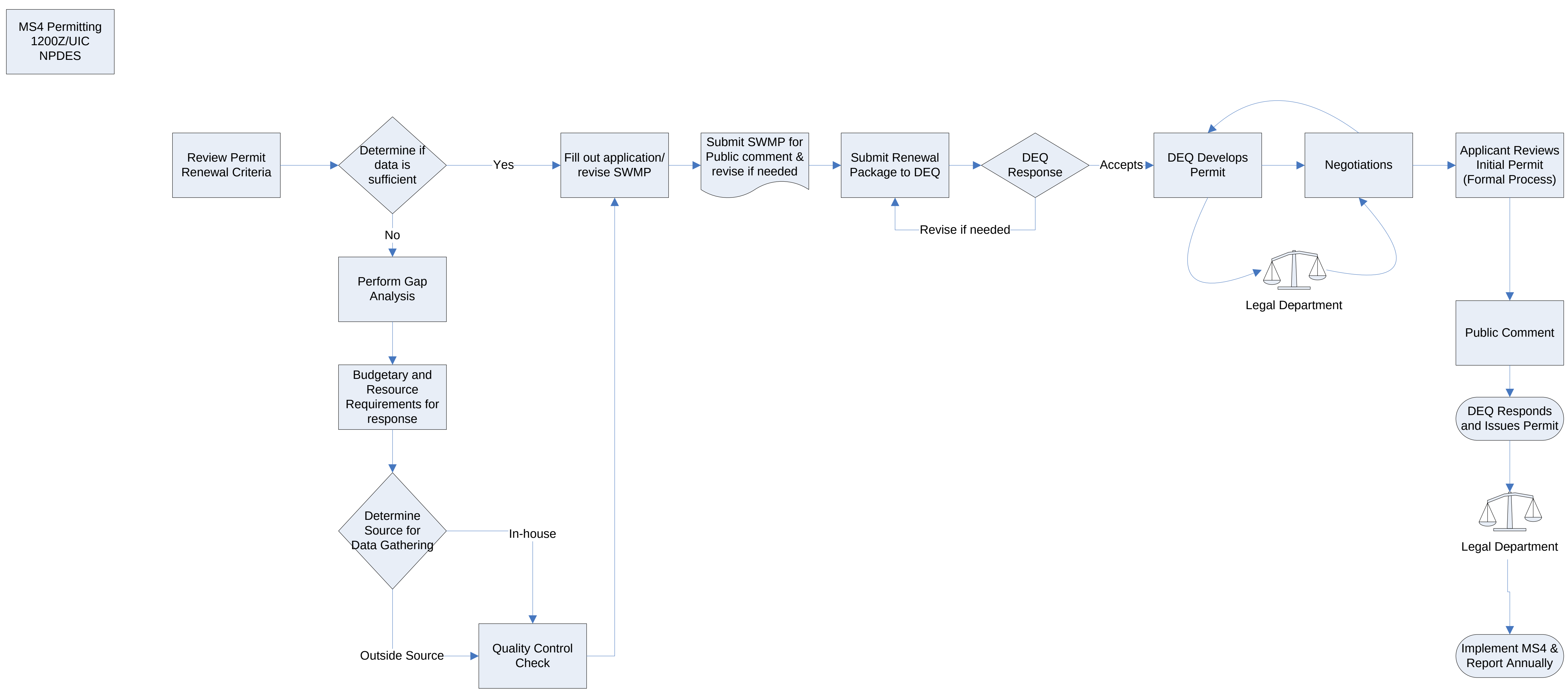


Figure A-17

Revised 10/16/08

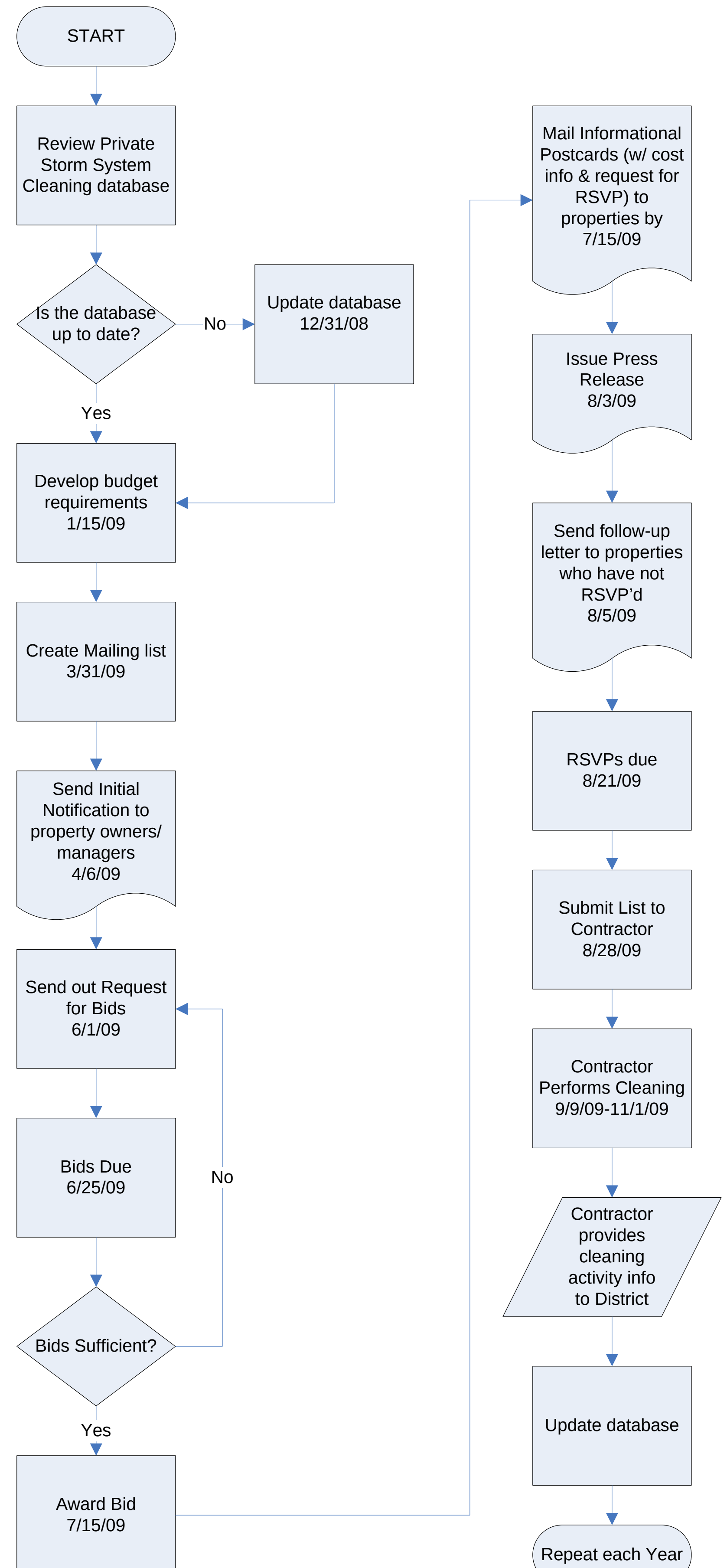


Figure A-18 (page 1)

Revised 10/16/08

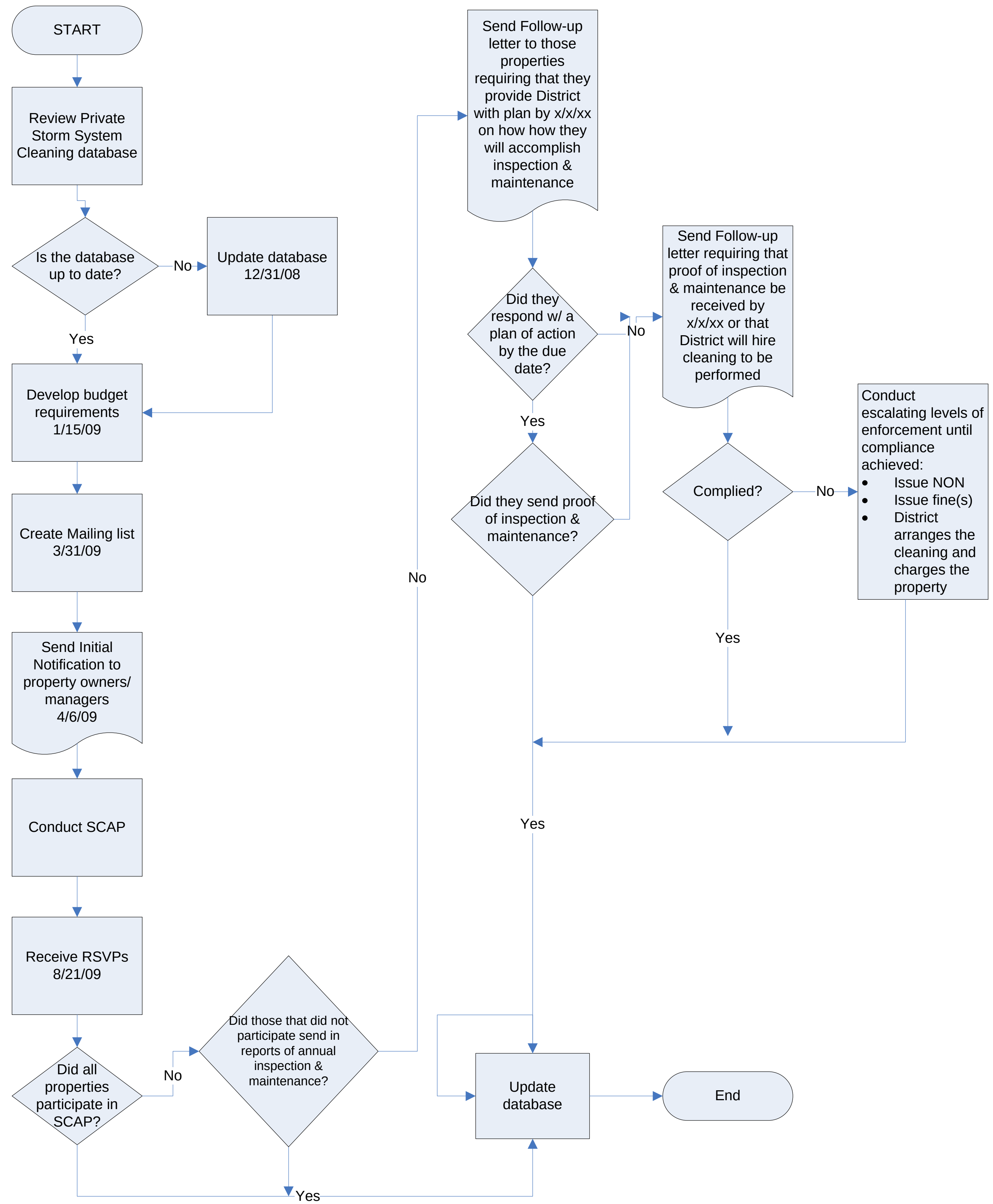


Figure A-18 (page 2)

APPENDIX B

WES EXISTING DATA INVENTORY

Document Name	Prepared By	Year Completed	Comments
Macroinvertebrate Communities in Streams of the CCSD#1 Area of Clackamas County	ABR, Inc	2008	Similar to the 2002 study, the 2007 study involved the collection and evaluation of habitat, water quality and benthic community data for CCSD#1. All streams were impaired, however, a few improved from moderately impaired in 2002 to slightly impaired in 2007. Additional studies are required to determine if the stream health improvement is a trend. The study also compared the RIVPACS analysis method with the mutimetric index, the two agreed in this study.
Macroinvertebrate Communities in Streams of the SWMACC Area of Clackamas County	ABR, Inc	2008	Not in our area of study, but similar to the CCSD#1 Macroinvertebrate study in scope. CCSD#1 is document number 90.
Clackamas County Wetland Mitigation Monitoring Report (Happy Valley Nature Park), 6th Monitoring Event	amec	2008	6th and final monitoring report for the Sunnybrook West Clackamas County transportation project. Monitoring results indicate that goals of the wetland mitigation have been reached.
Clackamas County Wetland Mitigation Monitoring Report (Sunnyside Road Improvements, Phase 1), 5th event at Mt. Scott Creek and 6th event at Valley View Church	amec	2008	Some mitigation goals were not met; the unmet goals were related to required native plant survirorship and percent cover and percent cover of non-native species. Vandalization of plants under the bridge of the Mt. Scott Creek site was noted as a reason for reduced plant survivorship.
Nature-friendly Development Practices: City of Happy Valley Policies, Code, and Procedures Audit	Angelo Planning Group	2008	A planning memo summarizing how the draft City of Happy Valley Development Code and related documents addresses the Title 13 program (Nature in Neighborhoods, compliance required by 01/05/2009), what current barriers to meeting Title 13 are and recommendations to incorporate more nature friendly standards into the code.
Clackamas County Sustainability Action Plan	Board of County Commisioners	2008	
Water Quality Data Trend Analysis 1995 - 2008 (for NPDES MS4 Permit Renewal)	Brown and Caldwell	2008	
Telephone survey about sewage management	CFM Research	2008	
Action Plan Framework for a Sustainable Clackamas County, Action Plan Data Request from Robert Storer, Action Plan Framework Related E-mails.	Clackamas County	2008	Email: Contains a list of WES departmental areas, the employees associated with them and the information they should provide. Table: Breaksdown the 2050 goals, the needed actions and subsequent tasks.
Clackamas River Water Providers Annual Report, Fiscal Year 2007-08	CRWP	2008	Created in September 2007, the CRWP is a new organization including the City of Lake Oswego, Clackamas River Water, the North Clackamas County Water Commission, South Fork Water Board, Sunrise Water Authority. Staff members include a Water Resource Manager and a Water Conservation Program Coordinator. Plans, projects and programs are summarized as part of the annual report.
City of Damascus Pilot Scale Stormwater Master Planning	Damascus and CH2MHill	2008	
Flood Insurance Rate Maps (FIRMS)	FEMA	2008	Flood Insurance Rate Maps (FIRMS). Individual maps for each panel shown on the paper index map.

Document Name	Prepared By	Year Completed	Comments
Flood Insurance Study (FIS)	FEMA	2008	The flood insurance study for Clackamas Co. and incorporated areas, covering the same area as the FIRMS. The document discusses past flooding and hydrologic conditions for specific panels.
FISH SPECIES DISTRIBUTION AND ABUNDANCE AND HABITAT ASSESSMENT OF STREAMS IN CLACKAMAS COUNTY SERVICE DISTRICT	ODFW	2008	
Exhibit A: Statement of Work, CCSD#1 Abundance and Distribution of Fish Species in Streams of Clackamas County	ODFW	2008	Outlines what will be included in the 2008 survey. There are six objectives for the 2008 survey, the 5th identifies the goal of the survey: Identify and prioritize streams and/or stream reaches that are valuable to native fish and prepare a list of actions to protect and restore priority areas within the CCSD#1
Kellogg and Mt. Scott Water Temps	ODFW	2008	
ODFW CCSD1 Fish IBI 2008 vers 2003 Preliminary	ODFW	2008	One page document listing IBI scores for specific stream reaches. Of the reaches where 2003 and 2008 data is available, 8 reaches improved, 2 reaches declined. One of the thirteen reaches is acceptable (rock creek).
ODFW Fish Survey	ODFW	2008	Data is available in Access database. Data has not yet been linked to GIS files. WES would like guidance on level of detail (specific fields from database) to add to GIS.
ODFW Progress Report: Abundance and Distribution of Fish in Streams of CCSD#1	ODFW	2008	Objective one has been completed. Appendicies contain record of data collection. Reaches are identified.
FINAL Hydrologic Flashiness Index	Pacific Water Resources, Inc	2008	The basins studied lack long-term flow data, which elimiates the use of some indicies. The $Q_{10/2}$ Index is recommended. This index is a ratio of the 10-year forested peak flow over the 2-year existing peak flow, it is recommended because it can be used without waiting for more flow data to be collected and verified.
DRAFT Hydrologic Flashiness Index	Pacific Water Resources, Inc.	2008	The memo provides a brief literature review for proposals of various hydrologic flashiness indicies and proposes an index for use by WES.
Pesticide Occurrence and Distribution in the Lower Clackamas River Basin, Oregon, 2000-2005 (No. 2008-5027)	USGS	2008	Provides pesticide concentrations, outlines pesticide sources based on land use and indicates possible biological effects from pesticide exposure. An updated version of the 2000-01 report (No. 03-4145), 1,500 additional pesticides were registered between the two reports.
Capital Improvements Program, Five Year Plan, Fiscal Years 2009-2013	WES	2008	The purpose of the report is to outline needed facilities and infrastructure upgrades. The recommended CIPs are meant to reflect a shift from a utility based management approach to a watershed management philosophy. SWM is a component of the report, which aims to meet regulatory requirements, provide flood protection and adequate drainage, while supporting water quality, wildlife habitat enhancement and recreations opportunities. The bulk of the planned dollars to be spent on SWM CIPs are targeted for 2010-2012.
CCSD#1 and SWMACC Annual Report Draft	WES	2008	Report on SW compliance and Tualitin basin TMDL
GIS data	WES	2008	WES has extensive GIS data for review. Brown and Caldwell has reviewed layers available and requested a list of maps.

Document Name	Prepared By	Year Completed	Comments
MS4 2008 Maintenance	WES	2008	List of maintenance activities
Table 2: Clackamas County WES (SWMACC, CCSD#1, and the Cities of Happy Valley and Rivergrove) MS4 Annual Report Submittal 2007-2008	WES	2008	
UIC (Underground Injection Control) WPCF permit application	WES	2008	Permit requirements will include a monitoring plan. Andrew Swanson is working on application currently. DEQ plans to develop WPCF permit for multiple cities at the same time during 2008-2009.
Watershed Action Plans (WAP) Pre-proposal meeting	WES	2008	The powerpoint for the pre-proposal meeting that WES had to discuss needs and criteria for selection of a firm to do the watershed assessment work. The folder is labeled #17
CCSD#1 and SWMACC NPDES MS4 Permit Application	WES and URS	2008	
Clackamas County Wetland Mitigation Monitoring Report (Happy Valley Nature Park), 5th Monitoring Event	amec	2007	5th report for Happy Valley Nature Park. Condition 2: *Native wetland species must cover 80% of wetlands in the created depressions in Area E* was **not met**. All other conditions were met or exceeded requirements.
City of Happy Valley Engineering Design Standards Manual	City of Happy Valley Public Works Department	2007	The manual's engineering design standards are written generally for environmental protection during construction, but refer the reader to DEQ, WES, AWWA and USACE standards for more details. Includes CAD standard details for roadwork.
DRAFT Biology Technical Report (Sunrise Project, I-205 to Rock Creek Junction)	ODOT/Clackamas County	2007	The report inventories current wildlife habitat and species located within those habitats. Sensitive plants, mammal and fish species are considered in the selection of a build alternative. Maps show riparian and upland habitat at the sunrise location in addition to the construction/operation boundaries of each project alternative.
DRAFT Water Quality Technical Report (Sunrise Project, I-205 to Rock Creek Junction)	ODOT/Clackamas County	2007	The report describes the potential water quality impacts that the Sunrise Project will have on Dean Creek, Cow Creek, Sieben Creek and Rock Creek. Includes potential alignments and resulting areas of impact. A full EIS has been completed for the project, copies available from Clackamas County upon request.
DRAFT Wetlands and Other Waters of the State and U.S. Technical Report (Sunrise Project, I-205 to Rock Creek Junction)	ODOT/Clackamas County	2007	The report describes potential impacts to wetlands for the various design alternatives of the Sunrise Project and possible wetland mitigation strategies.
Metro Stormwater Ordinance Review	Otak, Inc.	2007	Metro teamed with WES to provide the stormwater ordinance review, which contains current design practices, ordinances, design standards and future plans for five stormwater management agencies (CWS, City of Beaverton, City of Portland, City of Gresham and King County, WA).
Riparian Shade Assessment and Restoration Priorities Analysis in the Damascus Urban Growth Boundary Expansion Area	Robin K. Leferink, PSU	2007	The report objective was to "quantify existing riparian shade levels and identify priority reaches for shade restoration on CRB streams in the Damascus expansion area. GIS data was interpreted for this report. Headwaters in the Rock Creek basin were found to be less shaded than lower stream reaches. Recommendations for restoration planning included in Appendix B.

Document Name	Prepared By	Year Completed	Comments
Rock and Richardson Creek Master Plan Data	URS and WES	2007	SWMM Model Data
City of Happy Valley Stream Riparian Assessment	VIGIL AGRIMIS and Ellis Ecological Services, Inc.	2007	Study limited to East Happy Valley Expansion Area. The purpose of the report is to guide land use planning and regulations, as the area develops, based on stream riparian resources. A specific goal of the report was to verify accuracy of the GIS stream layer used by the County. Stream reaches were identified and photos of each reach provided as Appendix A.
2006-2007 Water Quality and Flow Monitoring Report	WES	2007	The report presents results of water quality investigations for CCSD#1's municipal separate storm sewer system. Section three describes the areas covered by the report and the results from storm event monitoring at outfalls and drywells. Section four focuses on water quality data (field parameters, nutrients, metals and lab parameters).
Water Quality and Flow Monitoring Report for Clackamas County Service District No. 1's Municipal Separate Storm Sewer System Permit No. 101348	WES	2007	Report summarizes water samples and field measurements that were collected on a monthly basis from July 2005 - June 2006. The purpose of the data collection was to provide a representative look at water quality in CCSD#1. Field parameters included temperature, pH, DO, flow, TDS and conductivity. Laboratory parameters included nutrients (ammonia, nitrate, OrthoP, TotP), E. coli bacteria, metals (Cr, Cd, Cu, Pb, Ni, Zn), oil/grease and TSS.
Damascus Natural Features Inventory	Winterbrook Planning	2007	Inclues Hazards Report and Natural Resources Report with maps and appendicies.
Pleasant Valley Stormwater Master Plan Amendment	WRG Design, Inc	2007	Details for 5 addendums to the Pleasant Valley Stormwater Maaster Plan
Clackamas County Wetland Mitigation Monitoring Report (North Clackamas Regional Park and Flood Control Facility), 4th monitoring event	amec	2006	Mitigation goals were met. Mointoring is in Year 4, however, the vegetation has been in for 6 years. Permission to stop monitoring was requested.
Clackamas County Wetland Mitigation Monitoring, 5th and Final Report	amec	2006	The report shows results of the 5th and final year of wetland mitigation monitoring. Previous monitoring was conducted by Pacific University; amec was hired because Pacific University was not available. Wetland vegetation density has increased from planting density and Himalayan blackberry is the only one of three nuissance species that have been observed on the site. The mitigation site meets permit conditions based on the final year of monitoring.
Sunnyside Road Rock Creek Wastewater Conveyance Project	Bob Storer at WES	2006	One photo in each group is generally labelled, none are individually labelled. One folder of pictures is of the Rock Creek Interceptor.
Damascus Boring Concept Plan	Clackamas Co., Metro, City of Damascus, City of Happy Valley, OTAK, ODOT	2006	Folder includes report and figures
ODOT Cover letter containing: Biology Mitigation Monitoring Report Kellogg Creek Fish Ladder Improvements Project ODOT Key No. 12522	MB&G	2006	Provides recommendations for fish ladder improvements and monitoring observations.

Document Name	Prepared By	Year Completed	Comments
NPDES Storm Water Regulations for Construction Projects	ODEQ	2006	NPDES #1200-C Permit Application Form, Land Use Compatibilty Statement Form, and Erosion and Sediment Control Plan Narrative.
Resident Poll	Riley Research Associates	2006	Results and original survey used to poll WES customers about awareness and satisfaction. Folder #15
CCSD#1 SWMP MASTER PLAN	Shaun Pigott Associates, LLC, Pacific Water Resources, Inc., GeoSyntec Consultants, Norton Arnold & Company	2006	Much of Damascus development has not occured, called the "expansion area" in the report. Large and comprehensive report, including identification of needs, a public incentives plan, study area characterisitics, hydrologic and hydraulic analysis, surface water management plan, water quality management plractives, stream reach quality evaluation and recommended projects. Appendices, technical memos and issue papers contain more detailed information, mostly related to hydraulics and hydrology.
Annual NPDES MS4 report 2006	WES	2006	Report on SW compliance and Tualitin basin TMDL
Rock Creek Large Woody Debris (LWD) Mitigation	WES	2006	Pictures of installation of logs
RFP and Proposal for Happy Valley Local Wetland Inventory (LWI) and Stream Riparian Assessment and map	WES and VIGIL AGRIMIS and Ellis Ecological Services, Inc.	2006	The RFP and proposal for the Happy Valley LWI and stream riparian assessment. Project was scheduled to be complete in December 2007. One of the main project goals was to identify sensitive habitats and subsequently protect those areas from urbanization. Comes with the LWI full size map.
DRAFT Damascus/Boring Concept Plan	Clackamas County	2005	The folder contains materials used for an open community forum to discuss the Damascus/Boring Concept Plan. Land use mapping and planning is included.
Environmental Baseline at Providence Happy Valley Site	DEA, INC	2005	General information related to obtaining necessary permits to move forward with Providence Health Systems Happy Valley site.
Oregon DEQ Water Quality Limited Streams Database in Clackamas Basin	DEQ	2005	The hardcopy list is dated 2005. The following links to a DEQ database, which contains information on water bodies in Oregon currently on the 303(d) and recently removed from the 303(d) list. http://www.deq.state.or.us/wq/assessment/rpt0406/search.asp
Email from Ed Salminen to Bob Storer Subject: Clackamas Watershed Action Plan Sub-basin Maps.	Ed Salminen	2005	Ed responded to a request by Bob for detailed maps for the Damascus area (Rock Creek). He provided three links: 1) http://www.inforain.org/mapsatwork/rockrichardson 2) http://www.mwcouncil.org/fw/subbasinplanning/willamette/plan 3) http://www.mobrain.com/edt/; follow the link to NW Power & Conservation Council. The full EDT assessment is in the inventory and the first link provided no longer exists. Inforain is a watershed locator, which can be found at www.inforain.org/watershed/index.php
Damascus 2003 Macroinvertebrate Study Sites	Metro	2005	DO NOT disturb or contact property owners on list without checking first with Lori H. (Metro).
Metro's Technical Report for Fish and Wildlife Habitat	METRO	2005	The report is more of a guide that introduces a watershed perspective, followed by a discussion of aquatic and riparian habitat, upland habitat, and restoration in an urban environment. The restoration section begins with basic definitions and ends with specific restoration strategies and watershed assessment activities. There is also an extensive list of cited literature.

Document Name	Prepared By	Year Completed	Comments
Surface Water Management Rules and Regulations for CCSD#1	WES	2005	Includes a declaration of the policy, definition of terms, dishcharge regulations, environmental protection and erosion control rules, additional surface water management standards, rates for surface water service, collection of charges, enforcement, appeals and supplementary rules. Website link http://www.co.clackamas.or.us/wes/rule.jsp.
WES Rates and Charges Effective October 1, 2005	WES	2005	Table of rates. Website link for Customer and Financial Services with current information: http://www.co.clackamas.or.us/wes/financial.htm
Clackamas River Basin Action Plan	WPN	2005	A report that encompasses the entire Clackamas River Basin and includes basin background, basinwide strategies and actions, and geographic area strategies and actions. Rock and Richardson Creeks are included. 91% of the rock creek watershed is in the UGB, so CRBC is focusing efforts to preserve the streams as urbanization occurs.
DRAFT and FINAL 2003 Baseline Assessment of Streat Habitat and Macroinvertebrate Communities in and Adjacent to the Damascus Area UGB Expansion, Oregon	ABR, Inc	2004	Lower reaches of Rock Creek are more heavily forested than upper reaches. Benthic conditions are more favorable in lower reaches. Conclusion: forested riparian areas provide streams with significant protection, resulting in improved benthic communities.
Future Potentially Viable Farmland	Clackamas Co. Soil and Water Conservation District	2004	The map illustrates agricultural use and groundwater limited areas for Damascus and Boring.
Sunrise Project Environmental Baseline Report	DEA	2004	Land use information in the proposed project area, which includes general zoning, specific ownership information, and an inventory of wildlife and wetland areas. Other general corridor conditions covered include socioeconomics, archaeology, historic resources, biology, wetlands and other waters, water quality and geology and soils. The report is aimed to cover environmental issues that will cause design constraints as the Sunrise project goes forth, therefore, possible animal/plant species are listed, but an actual site inventory is not completed.
Summary Report for Clackamas County and CCSD-Owned/Operated Stormwater Injection Devices	Department of Transportation & Development CCSD#1 SWMACC	2004	Report contains eight BMP updates related to UIC and an appendix with more related information.
Chapter 6: Clackamas Sub Basin TMDL of DRAFT Willamette Basin TMDL	DEQ	2004	Report contains sub basin overview followed by temperature and bacteria TMDL summaries, loading capacities, wasteload allocations, surrogate measures, margins of safety and reserve capacities. Portland General Electric (PGE) and Portland State University (PSU) co-developed a 2-D model to evaluate the effects of hydroelectric project operations on stream temperature; their data was used with ODEQ data to compile report. Pages 69-76 are attached TMDL regulation information.
DRAFT EDT Assessment of Aquatic Habitat in the Clackamas Subbasin	Mobrand Biometrics, Inc.	2004	Specific sections of the Clackamas River Subbasin are selected and assessed for salmon habitat; habitat is first evaluated by fish population and secondly by geographic area. General recommendations are made based on assessment results. See page 52 for Lower Clackamas tributaries.

Document Name	Prepared By	Year Completed	Comments
Portland Plant List	Portland Bureau of Planning	2004	List of plants native to Portland, OR. Includes name, description and illustration. Insert includes a list of plants and their preferred habitat, i.e. wetland, forest, etc.
Pesticides in the Lower Clackamas River Basin, Oregon, 2000-01 (No. 03-4145)	USGS	2004	Provides pesticide concentrations, outlines pesticide sources based on land use and indicates possible biological effects from pesticide exposure. Data from this report can be obtained from Clackamas Basin Water-Quality Assessment http://oregon.usgs.gov/clackamas
Customer Satisfaction & Community Values Questionnaire	WES	2004	A report of results from a customer satisfaction and community values survey. The goal of the questionnaire was to determine customer satisfaction and expectations, awareness of services and programs, identify needs and prioritize programs, and provide a framework for measuring the results of our communications efforts.
Summary of Erosion and Pollution Prevention Requirements	WES	2004	Brief one page summary of requirements for inspection approval.
Metro Bug 2003 Habitat Data	Metro	2003	8 compilations of hard copy excel data. Data is unlabeled, the excel file and an acronym key would be needed to use the data.
Abundance and Distribution of Fish in Clackamas County Urban Streams (Final Report 2002-03)	ODFW	2003	The report presents results of investigations of fish communities. Specifically listed and relavent were Mt. Scott watershed, Kellogg watershed and Rock Creek watershed. Much of the stream habitat surveyed was deemed unacceptable, but some improvements in stream quality, believed to be a result of restoration efforts, were noted.
Rock & Richardson Creek FEMA Floodplain Study. Project #W150123. Volumes 1-3	Pacific Water Resources and WES	2003	Volumes 1-3 contain all project related information, from the RFP in Volume 1 to the final deliverable in Volume 3. The final deliverable report from Pacific Water Resources is also in the inventory seperately (Hydrologic Modeling for the Floodplain Mapping of Rock and Richardson Creeks). The objective of the report is to develop flows for the mapping of floodplains in the Rock/Richardson Creeks watershed.
Hydrologic Modelling for the Floodplain Mapping of Rock and Richardson Creeks	Pacific Water Resources, Inc. and DHI Water and Environment	2003	The objective of the report is to develop flows for the mapping of floodplains in the Rock/Richardson Creeks watershed. The MIKE II model with its unit hydrograph module (UHM) was used for modelling.
Surface Water Management Administrative Procedures for CCSD#1 and SWMACC	WES	2003	Admin procedures updated in Jan. 2003 that include 1. Provisions for reduction/credit of the surface water service charge, 2. Erosion control certification program and 3. Application of undisturbed buffer requirements, natural resource assessments and process for requesting a variance on standard buffers.
Subregional Detention Facilities, Happy Valley	WRG	2003	Design report for two regional detention ponds.

Document Name	Prepared By	Year Completed	Comments
Assessment of Macroinvertebrate Communities in Streams of North Clackamas County	ABR (Michael B. Cole)	2002	26 study reaches in North Clackamas County were analyzed for macroinvertebrate communities, physical habitat and water chemistry. The report objective is to use macroinvertebrate communities as an indicator of watershed health. In CCSD#1 only Richardson Creek scored high enough to be classified as only slightly impaired. In SWMACC, only Fields Creek scored high enough to only be in the slightly impaired range.'
North Clackamas Regional Flood Control Facility Operations Manual	Kurahashi & Associates, Inc	2002	Operations Manual. 2 CD's were attached to binder. One has pictures from benthic surveys and the other is pictures of CCSDI Storm Events 2005-2007
2002 Kellogg Creek Restoration Project: Section 206: Sediment Quality Evaluation	Milwaukie	2002	Restoration Plan for the Kellogg Dam Removal
Clackamas County and County Service District-Owned/Operated Storm Water Injection Devices	Department of Transportation & Development CCSD#1 SWMACC	2001	Contents include WPCF Permit Application and Facility Plan Report, Evaluation of Potential Groundwater Impact from Storm Water Injection, and Rule-Authorized Certification.
Mt. Scott Screek Fish Passage & Stream Restoration Decision Recommendation Report	KPFF	2001	Report details five options to restore a dam to allow for fish passage near Scott Creek Park Subdivision. Cost included. No recommendations for the best option.
A Watershed Assessment of Kellogg and Mt. Scott Creeks	MWH	2001	The report objective was to assess the watershed to determine current fish habitat, evaluate potential barriers to fish passage in Kellogg basin and develop restoration recommendations.
Clackamas County Service District No. 1 Sanitary Sewer Rules and Regulations	WES	2001	http://www.co.clackamas.or.us/wes/rules.jsp
Registration of Underground Injection Systems which are Owned and/or Operated by Clackamas County	Department of Transportation & Development CCSD#1 SWMACC	2000	Appendix A, maps of Clackamas County, missing from report.
Rock and Richardson Creek Watershed Assessment	Ecotrust	2000	A general report wrtitten for Rock Creek and Richardson Creek watersheds, which provides information on the basin history, future land use, wildlife habitat and flow information. http://www.clackamasriver.org/basins/rockRichardson/rr.html
Upper Kellogg Creek Flood Hazard Reduction Projects Report	Harper houf Righellis, Inc.	2000	The report investigated the feasibility of CIPs suggested in the Kellogg-Mt.Scott Creeks Watershed Surface Water Master Plan (July 1997), specifically the effectiveness of channelizing Kellogg Creek vs. using detention. Channelization of Kellogg Creek was deemed physically possible, but not feasible from a permitting or cost standpoint.
Rock and Richardson Creek Landscape and Natural Resource Assessment	METRO	2000	A wholistic report focused on Rock/Richardson Creek watershed, which touches on existing conditions and landscape ecology and subsequently provides recommendations and suggests further studies.

Document Name	Prepared By	Year Completed	Comments
Rock & Richardson Creek SWMP	URS	2000	An analysis of Rock Creek watershed followed by recommendations for improvement. Also includes Richardson.
Erosion Prevention and Sediment Control Planning and Design Manual	WES, Unified Sewerage Agency of WA County, City of West Linn	2000	http://www.co.clackamas.or.us/wes/designmanual.htm
Distribution of Fish and Crayfish and Measurement of Available Habitat in Streams of the North Clackamas County (Final Report- 1997-1999)	ODFW	1999	The report provides an overview of current fish and crayfish populations in the Kellogg, Mt. Scott, and Rock Creek watersheds. Conclusions and recommendations about fish/crayfish populations are also made; in general the habitat is poor and fish populations are significantly lower than historic populations.
SWM Work in Happy Valley (January-Present)	WES	1999	A record of maintenance requests and repairs. Most issues are related to drainage and flooding in subdivisions.
The Functions of Riparian Buffers in Urban Watersheds	Jennifer Leavitt (M.S. University of Washington)	1998	A general report on the functions of riparian buffers with a specific case study for Rock Creek and Richardson Creek. The original report contained soil maps, temperature data and riparian buffer information that was appendicized but not included with this hard copy.
Kellogg-Mt. Scott Creeks Watershed SWMP Main Report	Montgomery Watson	1997	Focused on flooding and meeting permit requirements.
E.S.E.E Analysis of Conservation Wetland Sites	Clackamas County Department of Transportation and Development	1996	A record of wetland resource sites within clackamas county.
DRAFT Kellogg-Mt. Scott Creeks Watershed SWMP Volume 3- Plan Report	Montgomery Watson	1996	DRAFT Milwaukie section of the Kellogg-Mt. Scott Creeks Watershed SWMP Main Report (1997)
Clackamas Towncenter Area Drainage Study	Otak, Inc.	1982	Drainage study and recommendations. Could be useful in comparing drainage characteristics then vs. now. Hydraulic modelling was conducted with SWMM and 100-year hydrographs included.
Kellogg Creek Storm Drainage	CH2M	1970	Purpose of the study was to develop a drainage plan that would prevent and remediate problem areas in the drainage system where land use is imparied by local flooding and poor drainage.
Clackamas River Watershed	Ecotrust		A list of documents for the Clackamas River Watershed and a list of watershed assessments done, including a Rock and Richardson Creek Watershed Assessment (http://www.clackamasriver.org/basins/rockRichardson/rr.html). The assessment was done in October of 2000 and prepared by Ecotrust. It includes channel stability, soil types, water supply, water quality, hydrology, land use and salmonid distribution.
1996 Flood Map	WES		1996 Inundation map with possible willing sellers program locations.

Document Name	Prepared By	Year Completed	Comments
CCSD#1 Surface Water Management Maintenance Agreement Program Q&A	WES		Describes the shift from a subdivision paying for their own maintenance of their storm system through a Homeowner's Association to the District collecting fees and performing the maintenance. WES Home: http://www.co.clackamas.or.us/wes
Natural Resource Assessments	WES		Section 3.3, 3.3.1 Introduction states: This section presents methodologies for determining the location, size, and condition of sensitive areas, vegetated corridors, and steep slopes in project areas, as well as the definitions and data required for these determinations.
Rules and Specifications for Grading: County Code Title 9, section 9.03 Excavation and Grading	WES		Standard specification for excavation and grading. Website link for current information: http://www.co.clackamas.or.us/wes/rules.jsp#grading
Section 3: Application of Undisturbed Buffer Requirements and Process for Requesting a Variance on Standard Buffers	WES		Guidelines on buffer requirements and the application to request a variance on standard buffers.
Standard Surface Water Specifications, Sections 1-4, Appendicies A-D	WES		Standard surface water specs. Website link for current information: http://www.co.clackamas.or.us/wes/specifications.htm
SWMP Stream Reach Evaluation Tool Notes	WES		Compilation of various handwritten and word processed notes for reaches of Rock Creek.
Kellogg Lake Section 206 Sediment Volume and Characteristics	Milwaukie		
LIDAR Data in GIS	WES		SH+G has begun review.
Happy Valley Information	Happy Valley and consultants	Varies	Happy Valley Hazards Map, 2008 Transpo Plan, Zoning Map, PSU report, Rock Creek Comprehensive Plan, Steep Slopes
Studies for SG Group Webiste	Various authors	Varies	Various studies evaluating methodology for watershed assessment and the effectiveness of BMPs and restoration techniquies. Summary of each article in the folder.
Student Watershed Research Project (SWRP): Clackamas Sites	SWRP	Ongoing	SWRP is a program at Portland State University in the department of Environmental Sciences and Resources. A table suggests the site contains watershed information including a regional map, hydrology, geology, land use, water quality and a list of test sites. http://www.swrp.org
Watershed Health Index	Brown and Caldwell	2008 (pending)	Brown and Caldwell is preparing the WHI
Work Process Mapping for WES Functions	WES and Brown and Caldwell	2008 (pending)	WES has recently developed draft Work Process Flows for Erosion Control and Inspections, Soils Evaluation for Grading, Natural Resource Buffer Review, Happy Valley Single Family Res. Permitting, Maintenance, and CIP Development. Brown and Caldwell will review and then meet with WES work groups to discuss gaps, opportunities, and other issues.
Shierman Portion 2007-08 MS-4 Report	WES	2007-08	WES data on storm system maintenance
Comparison of B-IBI vs TIA and Hydrologic Flashiness Index	WES	2007	A table containing hydrologic flashiness, IBI and TIA scores for eight reaches in the watershed.

APPENDIX C

RATIONALE FOR SELECTION OF KEY HABITAT PARAMETERS

Percent Primary Channel Area Represented by Pool Habitat. Pools are important holding habitat for upstream migrating adult fish and important rearing habitat for juveniles. For the north Cascades, streams with at least 24 percent of their primary channel as pools were considered to be good relative to undisturbed reference conditions, and those with less than 7 percent pools were considered to be poor (Kavanaugh et al., 2006). However, for Coho salmon, optimal habitat is from 40 to 60 percent pools (McMahon, 1983), and Foster et al. (2001) identified less than 10 percent pools and greater than 35 percent pools as undesirable and desirable respectively. Furthermore, it follows, that as the percentage of pools increases above 60 percent, other habitat types decrease proportionally, reducing the habitat complexity. This suggests that an upper boundary is also needed for a high score on the percentage of habitat as pools parameter. Because of the interest in providing Coho salmon habitat within the study area streams we utilized a combination of the Coho habitat suitability index and the Kavanaugh et al. data and established high habitat quality with respect to pools from 40 to 60 percent. Moderate habitat quality ranges from 7 to 40 percent and from 60 to 90 percent pools. Habitats with greater than 90 percent or less than 7 percent pools were considered poor.

Number of Deep Pools per Kilometer. Not only is the absolute number of pools important, but the quality of those pools is key to salmonid growth and survival. Deep pools can provide summer low flow habitat, cold water refugia, cover, and simply more volume for rearing and holding, thereby accommodating more fish and increasing the carrying capacity of a particular reach. The Oregon Department of Fish and Wildlife (ODFW) considered more than four deep pools per kilometer (defined as those greater than 1 meter deep) to be high quality habitat (Kavanaugh et al., 2006). No number was provided for low values. We assigned high scores to reaches with ≥ 4 pools per kilometer, moderate score to reaches with 2 to 4 deep pools per kilometer and low scores to reaches with less than 2 pools per kilometer.

Percent Slackwater Pools. Slackwater pools include beaver ponds, alcoves, dammed ponds and backwaters and are important rearing habitat and refugia during flashy high water events. ODFW considered greater than 0.5 percent of the main channel as slackwater pools to be a high value. As is the case with any habitat unit (riffle, glide, pool, etc.) percentage increases in one habitat unit logically decrease the percentage of others. Therefore it is necessary to put an upper boundary on amount of slackwater pools that is desirable. We considered high quality habitat to be from 0.5 to 30 percent slackwater pools, moderate habitat to be from 0.25 to 0.5 percent slackwater pools, and low quality habitat to contain less than 0.25 percent slackwater pools. From 0.5 to 30 percent for optimal habitat quality is admittedly a very large range. The percentage of the reaches as slackwater pools in the study area ranged from 0 to 67.54 percent and there were no reaches that had between 6.81 and 57.2 percent slackwater pools. Thirty percent was selected as the upper boundary for high quality habitat somewhat arbitrarily; with the thinking being that a particular reach could have roughly one-third slackwater and still provide high quality habitat provided other habitat units (riffle, glide, and pool) were also represented.

Percent Secondary Channels. Secondary channels are also important as rearing habitat and refugia during high flows. Channels with a small percentage of slackwater may make up for this lack of habitat if they have secondary channels available. Secondary channels are reported as the percentage of the total channel area (primary plus secondary). ODFW considered values greater than 4 percent to be high (Kavanaugh et al., 2006). We assigned habitats with less than 2 percent secondary channel habitat a low score; those with from 2 to 4 percent a moderate score and those with > 4 percent a high score.

Percent Fines in Riffles. Excessive fines (silt, organics, and sand particles smaller than 2 millimeters in diameter) can fill the interstices between gravel and cobble substrates that are critical for salmonid spawning and incubation. High amounts of fines in riffles also reduce the habitat available for macroinvertebrates, an important salmonid food source. ODFW (Kavanaugh et al., 2006) considered greater than 19 percent fines in riffles to be excessive. However, Foster et al. (2001) stated that in streams with volcanic parent material, fines percentages greater than 15 percent were undesirable and less than 8 percent were desirable. Maximum Coho habitat suitability occurs when fines are less than or equal to 10 percent and the suitability of the habitat then declines rapidly between 10 and 20 percent fines in riffles. Therefore, we chose 10 percent fines in riffles as the upper boundary for high scores, 10 to 20 percent fines as the range for moderate scores, and > 20 percent fines as the range for low scores.

Percent Gravel in Riffles. Appropriately-sized gravel is important for salmonid spawning and incubation. ODFW (Kavanaugh et al., 2006) considered greater than 49 percent gravel in riffles to be ideal and less than 25 percent to be undesirable. However, Foster et al. (2001) stated that gravel percentages greater than or equal to 35 percent were desirable and less than 15 percent were undesirable. Maximum Coho habitat suitability occurs when gravel is greater than or equal to 60 percent. Taking each of these data sources into account, we assigned high scores to habitat reaches with > 49 percent gravel, moderate scores to those with 20 to 49 percent gravel in riffles, and low scores to those with less than 20 percent gravel.

Pieces of Large Woody Debris (LWD) per 100 meters; Volume of LWD per 100 meters; and Key Pieces of LWD per 100 meters. LWD provides cover directly for salmonids; directs water flow resulting in scour, which shapes the stream bed; and traps gravel important for spawning and incubation. Decomposition of LWD provides organic inputs to the stream at the base of the food chain. Different aspects of LWD are all important, including the number of pieces, volume, and number of key (very large) pieces. The number of pieces and volume are important in that a large number of smaller pieces of LWD would return a high score for that parameter, but a few larger pieces (which would increase the volume) could be just as biologically significant (especially if those larger pieces included root wads). Key pieces of large wood are important because they resist downstream transport and persist in the stream for longer periods, leading to long-term retention of wood (and likely gravel) in the stream. Table A-1 provides ODFW benchmarks for each of the wood parameters from Kavanaugh et al. (2006) and Foster et al. (2001), and the selected benchmarks.

Table C-1. Fish Habitat Scores

Study	Parameter					
	Pieces LWD per 100 meters		Volume LWD per 100 meters		Key Pieces LWD per 100 meters	
	Low	High	Low	High	Low	High
Kavanaugh et al. (2006)	< 7	> 20	< 23	> 68	< 1	> 4
Foster et al. (2001)	< 10	> 21	< 20	> 30	< 1	> 3
Selected benchmarks	< 7	> 21	< 20	> 30	< 1	> 3

Percent Shade. Shade is important in regulating stream temperature. Foster et al. (2001) stated that the low (undesirable) benchmark for west side Cascade streams less than 12 meters in width was < 60 percent and the high (desirable) benchmark was > 70 percent. Kavanaugh et al. provided low and high benchmarks of 80 percent and 92 percent respectively. Because of the greater specificity provided by Foster et al. (2001) in regard to the regional applicability, we selected the 60 and 70 percent low and high benchmarks for use in our rankings.

Number of Large Boulders per 100 Square Meters of Channel. The habitat reaches within the study area are generally lacking in large wood, with none of the reaches in Kellogg, Mt. Scott, or Phillips Creeks receiving a high score on any of the three LWD parameters. However, in stream cover is not only provided by large wood; rather, boulders too can contribute to the development of pools and provide cover both from predators and during high flows. In order to account for another aspect of in stream cover, we included a boulder metric. Previous studies have not provided guidance on benchmarks for boulders in streams, but large differences were apparent in the data for the study reach. We selected benchmarks of 0.1 boulders per 100 meters as the lower benchmark for poor quality habitat and 0.25 boulders per 100 meters as the upper benchmark, above which represented high quality habitat.

APPENDIX D

WES LEVEL OF SERIVCE-BASED PRIORITIZATION TOOL FOR WATERSHED ACTION PLANS

Clackamas County Water Environment Services (WES)
Level of Service-based Prioritization Tool for Watershed Action Plans (6/12/09)

Program Elements	WES Goals	Performance Measures	Performance Measure Goal
Environmental permit program management	Meet Permit Requirements	Percent compliance	Full NPDES TMDL UIC implementation
	Reduce pollutant loads through structural BMPs	Percent land treated with BMPs	60% developed land treated with structural BMPs or LID
	Reduce pollutant loads through non-structural BMPs	Percent implementation of non-structural BMPs	100% implementation of NPDES TMDL non structural BMP programs
Environmental policy and watershed health	Support Functioning aquatic ecosystems	See Reach Assessment Criteria	90% reaches Good or Fair average rating for all assessment parameters
	Improve Water Quality	See Reach Assessment Criteria	70% reaches Good or Fair average rating
	Improve Aquatic Habitat and Biological Communities	See Reach Assessment Criteria	90% reaches Good or Fair average rating for Aquatic Habitat & Biological Com.
	Improve Hydrology and Geomorphology	See Reach Assessment Criteria	90% reaches Good or Fair average rating for Hydrology & Geomorphology
Erosion prevention and sediment control	Prioritized Erosion Control (ERCO) site inspections tied to surface water program to preseve ecosystem services	Number of ERCO site inspections done based on priority	100% Inspections Based on Priority
		Reduce Water Quality Impacts of Construction	Full Implementation of WQ BMPs
Program Management	Effective Partnering	Partnering aligned with WES goals	100% Partnering Strategic; Aligned with WES Goals
	Staff understand roles and skills, resources, and abilities meet needed services	Understanding of goals and skill alignment	More than 95% Understand Roles and Skills Aligned
	Monitoring activities increase understanding of ecosystem functions and/or measure progress toward surface water program goals	Data results used to inform management decisions	80% WES Activities Data-Driven

Program Elements	WES Goals	Performance Measures	Performance Measure Goal
Program Management	Program Evaluation and Effectiveness	Program result in better understanding of watershed	Fully Increases Understanding of Management Activities and/or Watershed Conditions
Development Plan Review & Permitting	Development policy allows development while protecting ecosystem services	Maintain existing ecosystem; improve future development sites	90% reaches Good or Fair maintained, Poor Improved to Fair or Good average rating for all assessment parameters
Asset Management	Maximize Cost/Benefit Service	Services for SWM program within revenue base	>80% LOS Implemented, Expenses Met with Revenue
	AM Program Implmentation	SW Program incorporates AM Initiatives	100% SW Projects in alignment with AM Program
	System Reliability	Number of unplanned repairs to assets defined as critical	90% Maintenance & Repairs to Critical Systems Planned
Customer Service	Implement Clackamas County Sustainability Action Plan	Sustainability Action Plan goals and tasks are incorporated in WES activities	SWM program provides full support for relevant Action Items
	Effective Public Outreach Program	Customers recognize WES Services	70% Customers Recognize WES Services
	Maintain Employee Health and Safety	Employee health and safety	0 reportable OSHA incidents
Business Management	Maximize use of alternative funding sources	% funding from alternative sources	5% of funding comes from alternative sources
	Full CIP implementation	CIP Budget Spending	90% Planned CIP Budget spent
	Rate Adequecy	Rates adequate to cover needs	Actual rates in alignment with rate model prediction
	Budget Management Effectiveness	Budget is managed in an effective manner	Actual budgets within 10% of predicted budgets
	Appropriate Polices for Watershed Action Plans	Policies align with goals of Watershed Action Plans	Fully correllated with Watershed Action Plans
Stormwater system maintenance	Regularly scheduled maintenance	Meet inspection goals, set maintenance based on inspection	Meet inspection goals, set maintenance based on inspection
	Sheduled maintenance versus non-scheduled	Maintenance is performed on a scheduled basis not an emergency or non-scheduled basis	80% Maintenance scheduled
	Request-driven maintenance	Request-driven maintenance respond within 72 hours of request	100% request-driven maintenance respond within 72 hours of request

WES Surface Water Program - Level of Service Performance Measures and Gap Analysis, 2009

Notes:

The score of 0 represents the Level of Service goal.

Current score refers to WES staff evaluation of current program metrics.

Anticipated score refers to WES staff evaluation of future program metrics, assuming existing activities are continued and no new activities are undertaken.

The LOS prioritization process evaluates the ability of an action to close the LOS "gap" between the LOS goal and the current and anticipated scores.

Environmental permit program management

Meet Permit Requirements

0	Full NPDES TMDL UIC implementation
1	Full NPDES UIC, Partial TMDL implementation
2	Full NPDES, Partial UIC TMDL implementation
3	Partial NPDES UIC TMDL implementation
4	Partial NPDES, No UIC TMDL implementation
5	No NPDES UIC TMDL implementation
Current:	2
Anticipated:	2

Reduce Pollutant Load Structural BMPs

0	60% developed land treated with structural BMPs or LID
1	50% developed land treated with structural BMPs or LID
2	30% developed land treated with structural BMPs or LID
3	40% developed land treated with structural BMPs or LID
4	20% developed land treated with structural BMPs or LID
5	10% developed land treated with structural BMPs or LID
Current:	4
Anticipated:	4

Reduce Pollutant Load Non-Structural BMPs

0	100% implementation of NPDES TMDL non-structural BMP programs
1	80% implementation of NPDES TMDL non-structural BMP programs
2	60% implementation of NPDES TMDL non-structural BMP programs
3	40% implementation of NPDES TMDL non-structural BMP programs
4	20% implementation of NPDES TMDL non-structural BMP programs
5	0% implementation of NPDES TMDL non-structural BMP programs
Current:	1
Anticipated:	1

Environmental Policy and Watershed Health

Support Functioning Aquatic Ecosystems

0	90% reaches Good or Fair average rating for all assessment parameters
1	75% reaches Good or Fair average rating for all assessment parameters
2	60% reaches Good or Fair average rating forall assessment parameters
3	45% reaches Good or Fair average rating for all assessment parameters
4	30% reaches Good or Fair average rating for all assessment parameters
5	<30% reaches Good or Fair average rating for all assessment parameters
Current:	3
Anticipated:	3

Improve Water Quality

0	70% reaches Good or Fair average rating for Water Quality
1	60% reaches Good or Fair average rating for Water Quality
2	50% reaches Good or Fair average rating for Water Quality
3	40% reaches Good or Fair average rating for Water Quality
4	30% reaches Good or Fair average rating for Water Quality
5	<30% reaches Good or Fair average rating for Water Quality
Current:	3
Anticipated:	3

Improve Aquatic Habitat and Biological

0 90% reaches Good or Fair average rating for Aquatic Habitat & Biological Communities
1 75% reaches Good or Fair average rating for Aquatic Habitat & Biological Communities
2 60% reaches Good or Fair average rating for Aquatic Habitat & Biological Communities
3 45% reaches Good or Fair average rating for Aquatic Habitat & Biological Communities
4 30% reaches Good or Fair average rating for Aquatic Habitat & Biological Communities
5 <30% reaches Good or Fair average rating for Aquatic Habitat & Biological Communities
Current: 3
Anticipated: 3

Improve Hydrology & Geomorphology

0 90% reaches Good or Fair average rating for Hydrology & Geomorphology
1 75% reaches Good or Fair average rating for Hydrology & Geomorphology
2 60% reaches Good or Fair average rating for Hydrology & Geomorphology
3 45% reaches Good or Fair average rating for Hydrology & Geomorphology
4 30% reaches Good or Fair average rating for Hydrology & Geomorphology
5 <30% reaches Good or Fair average rating for Hydrology & Geomorphology
Current: 1
Anticipated: 1

Erosion prevention and sediment control

Number Inspections Done on Priority

0 100% Inspections Based on Priority
1 80% or Greater Based on Priority
2 60% Based on Priority
3 40% Based on Priority
4 20% Based on Priority
5 0% Based on Priority
Current: 4
Anticipated: 4

Reduce Water Quality Impacts of Construction

0 Full Implementation of WQ BMPs
1 80% Implementation of WQ BMPs
2 60% Implementation of WQ BMPs
3 40% Implementation of WQ BMPs
4 20% Implementation of WQ BMPs
5 10% Implementation of WQ BMPs
Current: 3
Anticipated: 3

Program Management

Effective Partnering

0 100% Partnering Strategic; Aligned with WES Goals
1 80% Partnering Strategic; Aligned with WES Goals
2 60% Partnering Strategic; Aligned with WES Goals
3 40% Partnering Strategic; Aligned with WES Goals
4 20% Partnering Strategic; Aligned with WES Goals
5 Ad Hoc Partnering only, 0% Strategic
Current: 3
Anticipated: 3

Staff Understand Roles and Skills, Resources, and Abilities meet Needs

0 More than 95% Understand Roles and Skills Aligned
1 More than 90% Understand Roles and Skills Aligned
2 More than 80% Understand Roles and Skills Aligned
3 More than 70% Understand Roles and Skills Aligned
4 More than 60% Understand Roles and Skills Aligned
5 Less than 60% Understand Roles and Skills Aligned
Current: 2

Anticipated: 2

Monitoring Activities Data Used for Decision-making

0 80% WES Activities Data-Driven
1 65% WES Activities Data-Driven
2 50% WES Activities Data-Driven
3 35% WES Activities Data-Driven
4 20% WES Activities Data-Driven
5 All Activities Reactive; Not Data-Driven
Current: 4
Anticipated: 4

Program Evaluation and Effectiveness

0 Fully Increases Understanding of Management Activities and/or Watershed Conditions
1
2
3 Partially Increases Understanding of Management Activities and/or Watershed Conditions
4
5 Does Not Increases Understanding of Management Activities and/or Watershed Conditions
Current: 3
Anticipated: 3

Development Plan Review and Permitting

Develop Needs Met and Ecosystem Services Protected

0 90% reaches Good or Fair maintained, Poor Improved to Fair or Good ave. rating for all assessm. parameters
1 75% reaches Good or Fair maintained, Poor Improved to Fair or Good ave. rating for all assessm. parameters
2 60% reaches Good or Fair maintained, Poor Improved to Fair or Good ave. rating for all assessm. parameters
3 45% reaches Good or Fair maintained, Poor Improved to Fair or Good ave. rating for all assessm. parameters
4 30% reaches Good or Fair maintained, Poor Improved to Fair or Good ave. rating for all assessm. parameters
5 15% reaches Good or Fair maintained, Poor Improved to Fair or Good ave. rating for all assessm. parameters
Current: 3
Anticipated: 3

Asset Management

Maximize Cost/Benefit Service

0 >80% LOS Implemented, Expenses Met with Revenue
1 >60% LOS Implemented, Expenses Met with Revenue
2 >50% LOS Implemented, Expenses Met with Revenue
3 >30% LOS Implemented, Expenses Met with Revenue
4 <30% LOS Implemented, Expenses Exceeded Revenue
5 <20% LOS Implemented, Expenses Exceeded Revenue
Current: 3
Anticipated: 3

AM Program Implemented

0 100% SW Projects in alignment with AM Program
1 80% SW Projects in alignment with AM Program
2 60% SW Projects in alignment with AM Program
3 40% SW Projects in alignment with AM Program
4 20% SW Projects in alignment with AM Program
5 0% SW Projects in alignment with AM Program
Current: 4
Anticipated: 4

Reliability: Number of Unplanned Maintenance and Repairs to Critical Systems

0 90% Maintenance & Repairs to Critical Systems Planned
1 75% Maintenance & Repairs to Critical Systems Planned
2 60% Maintenance & Repairs to Critical Systems Planned
3 45% Maintenance & Repairs to Critical Systems Planned
4 30% Maintenance & Repairs to Critical Systems Planned
5 0% Maintenance & Repairs to Critical Systems Planned

Current: 2
Anticipated: 2

Customer Service

Implement Sustainability Action Plan

0 SWM program provides full support for relevant Action Items
1 SWM program provides 80% support for relevant Action Items
2 SWM program provides 60% support for relevant Action Items
3 SWM program provides 40% support for relevant Action Items
4 SWM program provides 20% support for relevant Action Items
5 SWM program provides no support for relevant Action Items
Current: 2
Anticipated: 0

Effective Public Outreach

0 70% Customers Recognize WES Services
1 50% Customers Recognize WES Services
2 30% Customers Recognize WES Services
3 20% Customers Recognize WES Services
4 10% Customers Recognize WES Services
5 Zero Customer Recognition
Current: 4
Anticipated: 3

Maintain Employee Safety

0 0 reportable OSHA Incidents
1 1 incident
2 2 incidents
3 3 to 5 incidents
4 6 to 10 incidents
5 More than 10 incidents
Current: 0
Anticipated: 0

Business Management

Maximize Use of Alternative Funding Sources

0 5% of Funding Comes from Alternative Source
1 4% of Funding Comes from Alternative Source
2 3% of Funding Comes from Alternative Source
3 2% of Funding Comes from Alternative Source
4 1% of Funding Comes from Alternative Source
5 0% of Funding Comes from Alternative Source
Current: 5
Anticipated: 5

Full CIP Implementation

0 90% Planned CIP Budget spent
1 75% Planned CIP Budget spent
2 60% Planned CIP Budget spent
3 45% Planned CIP Budget spent
4 30% Planned CIP Budget spent
5 15% Planned CIP Budget spent
Current: 1
Anticipated: 2

Rate Adequecy

0 Actual rates in alignment with rate model prediction
1
2
3 Actual rates somewhat above/below rate model prediction
4

5 Actual rates significantly above/below rate model prediction
Current: 4
Anticipated: 4

Budget Management Effectiveness

0 Actual budget within 10% of predicted budget
1
2
3 Actual budget within 10-20% of predicted budget
4
5 Actual budget within 20-30% of predicted budget
Current: 6
Anticipated: 4

Appropriate Polices for Watershed Action Plans

0 Fully correlated with WAPs
1
2
3 Somewhat correlated with WAPs
4
5 No correlation with WAPs
Current: 6
Anticipated: 4

Stormwater System Maintenance

Regularly Scheduled Maintenance

0 More than 90% Inspection Goals Met; 60% Maintenance Planned
1 More than 80% Inspection Goals Met; 50% Maintenance Planned
2 More than 70% Inspection Goals Met; 40% Maintenance Planned
3 More than 60% Inspection Goals Met; 30% Maintenance Planned
4 More than 50% Inspection Goals Met; 20% Maintenance Planned
5 Less than 50% Inspection Goals Met; less than 20% Maintenance Planned
Current: 2
Anticipated: 2

Scheduled vs. Non-Scheduled Maintenance

0 80% Maintenance is Scheduled
1 65% Maintenance is Scheduled
2 50% Maintenance is Scheduled
3 40% Maintenance is Scheduled
4 20% Maintenance is Scheduled
5 No Maintenance is Schedule
Current: 2
Anticipated: 2

Request-Driven Maintenance

0 100% WES Request-Driven Maintenance performed in 72 hours
1 90% WES Request-Driven Maintenance performed in 72 hours
2 80% WES Request-Driven Maintenance performed in 72 hours
3 70% WES Request-Driven Maintenance performed in 72 hours
4 60% WES Request-Driven Maintenance performed in 72 hours
5 50% WES Request-Driven Maintenance performed in 72 hours
Current: 2
Anticipated: 2