

# 2010 Stormwater Needs Assessment Program

## Washougal (Middle)/Washougal (Lower)/Cougar Creek (Washougal) Subwatershed Needs Assessment Report

Clark County Department of Environmental Services

March 2011





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## Responsible County Officials

Program Name: Stormwater Needs Assessment Program  
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## Acronyms and Abbreviations

B-IBI	Benthic Macroinvertebrate Index of Biological Integrity
BOCC	Board of County Commissioners
BMP	Best Management Practices
CCD	Clark Conservation District
CIP	Capital Improvement Program
CPU	Clark Public Utilities
CRFPO	Columbia River Fisheries Program Office
CWA	Clean Water Act
CWC	Clean Water Commission
CWP	Clean Water Program
DNR	Department of Natural Resources
EDT	Ecosystem Diagnostic and Treatment model
EIA	Effective Impervious Area
EIM	Environmental Information Management
EMAP	Environmental Mapping and Assessment
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FPIA	Focused Public Investment Area
FWS	Fall, Winter, Spring
GCEC	Gee Creek Watershed Enhancement Committee
GIS	Geographic Information System
GMA	Growth Management Act
GPS	Geographic Positioning System
HPA	Hydraulic Project Approval
IDDE	Illicit Discharge Detection and Elimination
LCFEG	Lower Columbia Fish Enhancement Group
LCFRB	Lower Columbia Fish Recovery Board
LID	Low-Impact Development
LiDAR	Light Detection and Ranging
LISP	Long-term Index Site Project
LWD	Large Woody Debris
MS4	Municipal Separate Storm Sewer System
MOP	Mitigation Opportunities Project
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NTU	Nephelometric Turbidity Unit
NWIFC	Northwest Indian Fisheries Commission
ODEQ	Oregon Department of Environmental Quality

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OWQI	Oregon Water Quality Index
PFC	Properly Functioning Condition
RM	River Mile
SCIP	Stormwater Capital Improvement Program
SCIPIT	Stormwater Capital Improvement Program Involvement Team
SCMP	Salmon Creek Monitoring Project
SCWC	Salmon Creek Watershed Council
SNAP	Stormwater Needs Assessment Program
SWMP	Stormwater Management Program
SWMMWW	Stormwater Management Manual for Western Washington
TIA	Total Impervious Area
TIP	Transportation Improvement Program
TIR	Technical Information Report
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
UGA	Urban Growth Area
UIC	Underground Injection Control
USFS	U.S. Forest Service
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VBLM	Vacant Buildable Lands Model
VLWP	Vancouver Lake Watershed Partnership
WAC	Washington Administrative Code
WCC	Washington Conservation Commission
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSDOT	Washington Department of Transportation
WSU	Washington State University

## Executive Summary

### Study Area

This Stormwater Needs Assessment report includes the Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal) subwatersheds in the lower Washougal River basin.

### Intent

Stormwater Needs Assessment reports compile and provide summary information relevant to stormwater management, propose stormwater-related projects and activities to improve stream health, and assist with adaptive management of the county's Stormwater Management Program. Assessments are conducted at a subwatershed scale, providing a greater level of detail related to stormwater management than regional Water Resource Inventory Area (WRIA) or Endangered Species Act (ESA) plans. Stormwater Needs Assessments are not comprehensive watershed plans or stormwater basin plans.

### Findings

#### Watershed Conditions

The table on the following page summarizes conditions in the three study area subwatersheds including water quality, biological health, habitat, hydrology and the stormwater system.

#### Ongoing Projects and Involvement

Current projects sponsored by Lower Columbia Fish Recovery Board (Lower East Fork Lewis River Restoration Plan) include land acquisition, channel restoration, riparian and stream bank revegetation, and aquatic habitat enhancement and restoration. Natural resources in the study area are managed with the help of Clark County under several programs in Environmental Services, Public Works and Vancouver-Clark Parks and Recreation.

In the study area, there are no planned projects included in the Stormwater Capital Program or in the 2010-2015 Clark County Transportation Improvement Program.

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Category	Status
<p><b>Water Quality</b></p> <p>Overall</p> <p>Fecal coliform bacteria</p> <p>Temperature</p> <p>Pesticides, PCBs, PAHs</p> <p>Toxics</p>	<ul style="list-style-type: none"> <li>• Limited data, presumably good</li> <li>• No listing within Clack County; TMDL required within Skamania County</li> <li>• Washougal River exceeds target levels</li> <li>• Nearly compliance with established human health criteria</li> <li>• No detections were recorded.</li> </ul>
<p><b>Biological</b></p> <p>Anadromous fish</p>	<ul style="list-style-type: none"> <li>• Coho, Chum, Fall Chinook, summer and winter steelhead</li> </ul>
<p><b>Habitat</b></p> <p>NOAA Fisheries criteria</p> <p>Riparian</p> <p>Wetland</p>	<ul style="list-style-type: none"> <li>• Forest cover and road density Non-Functioning for Washougal (Middle/Lower); Properly Functioning for Cougar Creek</li> <li>• Percent EIA Properly Functioning for Cougar Creek and Washougal (Middle); Non-Functioning for Washougal (Lower)</li> <li>• Riparian conditions moderately impaired to impaired</li> <li>• Moderate LWD potential</li> <li>• Shade standards currently off-target</li> <li>• Primarily limited to riparian areas</li> </ul>
<p><b>Hydrology and Geomorphology</b></p> <p>Overall hydrology</p> <p>Future condition</p>	<ul style="list-style-type: none"> <li>• Rated as good hydrologic health.</li> <li>• Projected impervious area in Washougal (Lower) will cause increased channel erosion and accelerated channel migration in various areas unless adequate runoff controls are in place</li> </ul>
<p><b>Stormwater (unincorporated areas)</b></p> <p>System description</p> <p>Inventory status</p> <p>System adequacy</p> <p>System condition</p>	<ul style="list-style-type: none"> <li>• Primarily road-side ditches; eleven stormwater facilities</li> <li>• Complete</li> <li>• Adequate treatment is probably provided by vegetation in ditches</li> <li>• Minimal flow control other than infiltration in ditches</li> <li>• Minimal screening was performed</li> <li>• Largely undocumented but presumed functional</li> </ul>

## Opportunities

Opportunities for stormwater-related projects are somewhat limited in this assessment area. Field work and review of existing information identified the following projects and actions that can improve stream conditions:

- Pursue future collaborative stormwater activities with the City of Washougal
- Technical assistance visits to landowners and businesses with potential source control problems and water quality ordinance issues
- Focused stormwater outreach and education to streamside landowners
- Ditch retrofits to provide water quality treatment
- Evaluation of wetland and riparian enhancement projects in areas having conservation covenants
- Small- or large-scale invasive plant removal and riparian restoration projects.
- Continue research and mapping new stormwater infrastructure with the goal of maintaining a complete stormwater infrastructure inventory

Non-project stormwater management recommendations address areas where CWP programs or activities could be modified to better address NPDES permit components or promote more effective mitigation of stormwater problems. Management recommendations relevant to the assessment area include:

- Continue to coordinate with Washington Department of Ecology, Lower Columbia Fish Recovery Board, Clark County Legacy Lands and Vancouver-Clark Parks and Recreation in efforts to improve stream health.
- Replace deteriorated stream name signs at road crossings
- Target technical assistance to minimize impact of surface and groundwater withdrawals in tributary streams
- Educate landowners to discourage disposal of trash and yard debris in streams or other receiving waters
- Develop a system to provide rural landowners education about appropriate ditch maintenance practices
- Provide technical assistance to rural development projects required to implement stormwater controls
- Continue to encourage and support riparian planting efforts by private landowners





## Introduction

This Stormwater Needs Assessment includes the Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal) subwatersheds. The Clean Water Program (CWP) is gathering and assembling information to support capital improvement project (CIP) planning and other management actions related to protecting water bodies from stormwater runoff.

### Purpose

The Stormwater Needs Assessment Program (SNAP), initiated in 2007, creates a system for the CWP to focus activities, coordinate efforts, pool resources and ensure the use of consistent methodologies. SNAP activities assess watershed resources, identify problems and opportunities, and recommend specific actions to help meet the CWP mission of protecting water quality through stormwater management.

The overall goals of the SNAP are to:

- Analyze and recommend the best, most cost effective mix of actions to protect, restore or improve beneficial uses consistent with NPDES permit objectives and the goals identified by the state Growth Management Act (GMA), ESA recovery plan implementation, Total Maximum Daily Load (TMDLs), WRIA planning, floodplain management and other local or regional planning efforts
- Inform county efforts to address the following issues related to hydrology, hydraulics, habitat and water quality:
  - Impacts from current or past development projects subject to lesser or non-existent stormwater treatment and flow control standards
  - Subwatershed-specific needs due to inherent sensitivities or the present condition of water quality or habitat
  - Potential impacts from future development

The CWP recognizes the need to translate assessment information into on-the-ground actions to improve water quality and habitat. Facilitating this process is a key requirement for the program's long-term success.

Results and products of needs assessments promote more effective implementation of various programs and mandates. These include identifying mitigation opportunities and providing a better understanding of stream and watershed conditions for use in planning county road projects. Similar information also is needed by county programs implementing critical areas protection and salmon recovery planning under the state GMA and federal ESA.

### Scope

This report summarizes and incorporates new information collected for SNAP, as well as pre-existing information. In many cases, it includes basic summary information or incorporates by reference longer reports which may be consulted for more detailed information.

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SNAP reports produce information related to three general categories:

- Potential stormwater capital projects for county implementation or referral to other organizations
- Management and policy recommendations
- Natural resource information

Descriptions of potential projects and recommended program management actions are provided to county programs, including: Public Works CWP, Stormwater Capital Improvement Program (SCIP) and Development Engineering; Community Planning; Public Health; Legacy Lands; ESA. Potential project or leveraging opportunities also are referred to local agencies, groups and municipalities, as appropriate.

## Assessment Approach

### Priorities for Needs Assessment in Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal)

Clark County subwatersheds were placed into a five-year schedule for assessment using the procedures described in *Prioritizing Areas for Stormwater Basin Planning* (Swanson, July 2006).

For SNAP purposes, Washougal (Lower) subwatershed is categorized as Unincorporated Urban Growth Area. Washougal (Middle) is categorized as Rural Residential with No UGA and Cougar Creek (Washougal) is categorized as Largely Forested Land

Unincorporated Urban Growth Area subwatersheds typically include significant areas of development and potential re-development inside the Washougal UGA of unincorporated Clark County, where the county controls development permitting. These are high priority subwatersheds for stormwater needs assessment, considering development pressure, subwatershed characteristics and NPDES permit requirements. A wide range of SNAP tools may be used in assessing subwatersheds in this category.

Subwatersheds in the Rural Residential with No UGA category are generally not heavily forested but have limited stormwater management needs due to the lack of urbanization. Assessment efforts for these subwatersheds focus primarily on summarizing existing information to identify potential restoration projects.”

Largely Forested Land subwatersheds contain significant amounts of private land zoned for industrial forestry and DNR forest lands. These areas have few county roads, and stormwater management is limited to mapping and evaluating the area draining to county outfalls and possible habitat protection or restoration to mitigate for stormwater impacts to other parts of the watershed.

### Assessment Tools Applied in Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal)

SNAP uses a standardized set of tools for subwatershed assessment, including desktop mapping analyses, modeling, outreach activities and a variety of field data collection procedures. Tools follow standard protocols to provide a range of information for stormwater management. Though not every tool is applied in every subwatershed, the use of a standard toolbox ensures the consistent application of assessment activities countywide.

Table 1 lists the set of tools available for use in SNAP. Tools with an asterisk (\*) are those for which new data was gathered or new analyses were conducted during this needs assessment. The remaining tools or chapters were completed based on pre-existing information.

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**Table 1: Stormwater Needs Assessment Tools**

Outreach And Involvement *	Riparian Assessment *
Coordination with Other Programs *	Floodplain Assessment
Drainage System Inventory and Condition *	Wetland Assessment *
Review Of Existing Data *	Macroinvertebrate Assessment
Illicit Discharge Screening	Fish Use And Distribution *
Broad Scale GIS Characterization *	Water Quality Assessment *
Rapid Stream Reconnaissance	Hydrologic and Hydraulic Modeling
Physical Habitat Assessment *	Source Control *
Geomorphology And Hydrology Assessment	

## Assessment Actions

### Outreach Activities

Outreach activities were limited and focused primarily on raising awareness about the SNAP effort. The following activities were completed:

- Press release to local media
- April 2010 – article in Clean Water Program E-Newsletter
- August 2010 – information on SNAP distributed at 10-day Clark County Fair
- Clean Water Program web pages updated as needed; 135 visitors to the SNAP web page since June 2010 (Note: these figures are under-reported as tracking software only records top 20 pages and documents monthly)
- A description of SNAP is included in Clark County's annual stormwater management program plan submitted to Ecology

Clark County Clean Water Commission members were updated periodically on SNAP progress.

Actions available to educate in response to identified problem areas include the following:

- Site visits by CWP technical assistance staff
- Letters detailing specific problems and solutions to individual landowners
- General educational mailings to selected groups of property owners
- Workshops on best management practices, including septic maintenance and mud, manure and streamside property management
- Referral to other agencies, such as Clark Conservation District or WSU Extension, for educational follow-up

### Review of Existing Data

Data and information review are incorporated throughout this report in pertinent sections. A standardized list of typical data sources created for the overall SNAP effort is supplemented by subwatershed-specific sources as they are discovered. Data sources consulted for this report include, but are not limited to:

- LCFRB Habitat Characterization (2004)
- LCFRB 6-Year Habitat Work Plan
- Ecology 303(d) list
- WRIA 27/28 Plan
- Ecology EIM data
- Clark County 2004 Subwatershed summary

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- Clark County 2006 Stormwater Basin Planning
- Clark County 2010 Stream Health Report
- Clark County LISP/SCMP/ Project data
- Clark County 6-Year TIP

## Broad-Scale GIS Characterization and Metrics

The broad-scale characterization is a GIS-based exercise providing an overview of the biophysical setting for each subwatershed, background information for use in implementing other SNAP tools, and identification of potential acquisition or project sites. GIS data describe subwatershed characteristics such as topography, geology, soils, hydrology, land cover, land use and GMA critical areas. A standard GIS workspace, including shape files for more than 65 characteristics, forms the basis for the characterization.

GIS data are generally used as a tool to complete the report and not presented in the report itself. Summary metrics are taken from existing reports and data. For example, Wierenga (2005) summarized many GIS characteristics for Clark County subwatersheds. Some of these characteristics are described in greater detail in later sections.

The characterization includes three components:

- A set of four standard map products, as paper maps for SNAP use
- A summary table of selected subwatershed-scale metrics
- A brief narrative including comparison of metrics to literature values, and conclusions about general subwatershed condition and potential future changes

### Map Products

The four standard SNAP map products are: 1) Stormwater Infrastructure and Hydrologic Soil Groups; 2) Critical Areas information; 3) Vacant Buildable Lands within UGAs; 4) Orthophoto. These maps are printed out for tabletop evaluations.

### General Conditions and Subwatershed Metrics

#### *General Geography*

The study area is comprised of three subwatersheds in the Washougal River basin: Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal). Cougar Creek has its headwaters in the Cascade Mountains foothills at an elevation of 1,200 to 1,400 feet and drains southwest to the Washougal River at an elevation of 200 feet (Figure 1). The land use is predominantly forest or rural residential in Cougar Creek subwatershed. Washougal (Middle) subwatershed is mix rural residential and agriculture use. Nearly all of Washougal (Lower) subwatershed encompasses the City of Washougal or the Urban Growth Area.

#### *Topography*

The study area is in the southern part of the Cascade Mountain physiographic province, which consists of a volcanic plateau dissected by numerous streams draining to the Washougal River and its tributaries. Elevations range from 1200 and 1800 feet in the northeastern study area to

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roughly 200 feet elevation at the floodplain of the Columbia River. Within the study area, the Washougal River flows from an elevation of 400 feet to the Columbia River. One notable topographic feature is a relatively flat area between 1,000 and 1,100 feet elevation in upper Cougar Creek underlain by Ice Age lava flows.

### *Geology and Soils*

The study area is underlain mainly by older volcanic rocks of the Western Cascade Mountains and much younger lava flows forming the Bear Prairie area. Topography is strongly influenced by geology, with steep terrain in the older volcanic rocks and the relatively flat plateau formed by the much more recent Bear Prairie lavas.

Soils tend to be relatively well-drained mountain soils of the Olympic-Kinney association formed on volcanic deposits.

### *Hydrology*

Geology and topography play the main role in determining the study area hydrologic framework. Mountain streams such as Cougar Creek are generally higher gradient and have little or no floodplain. Much of the precipitation leaves the area as rainfall runoff or shallow interflow, leaving streams with low flows in summer months. The Bear Prairie area provides a relatively unusual, higher elevation plateau with very low stream gradients. Other than Cougar Creek, Washougal River tributaries are short, high-gradient streams.

The Washougal River is dominated by rainfall, with peak flows occurring in response to large rainstorm events in the fall and winter. Hydrologic conditions across the Washougal River watershed range from functional to impaired. The Washington Department of Ecology maintains a stream gauge at Hathaway Park in Washougal.

Hydrologic conditions in the lower mainstem Washougal River tributaries are rated as impaired based on high road densities, impervious surfaces and poor forest cover associated with development within and surrounding the towns of Camas and Washougal.

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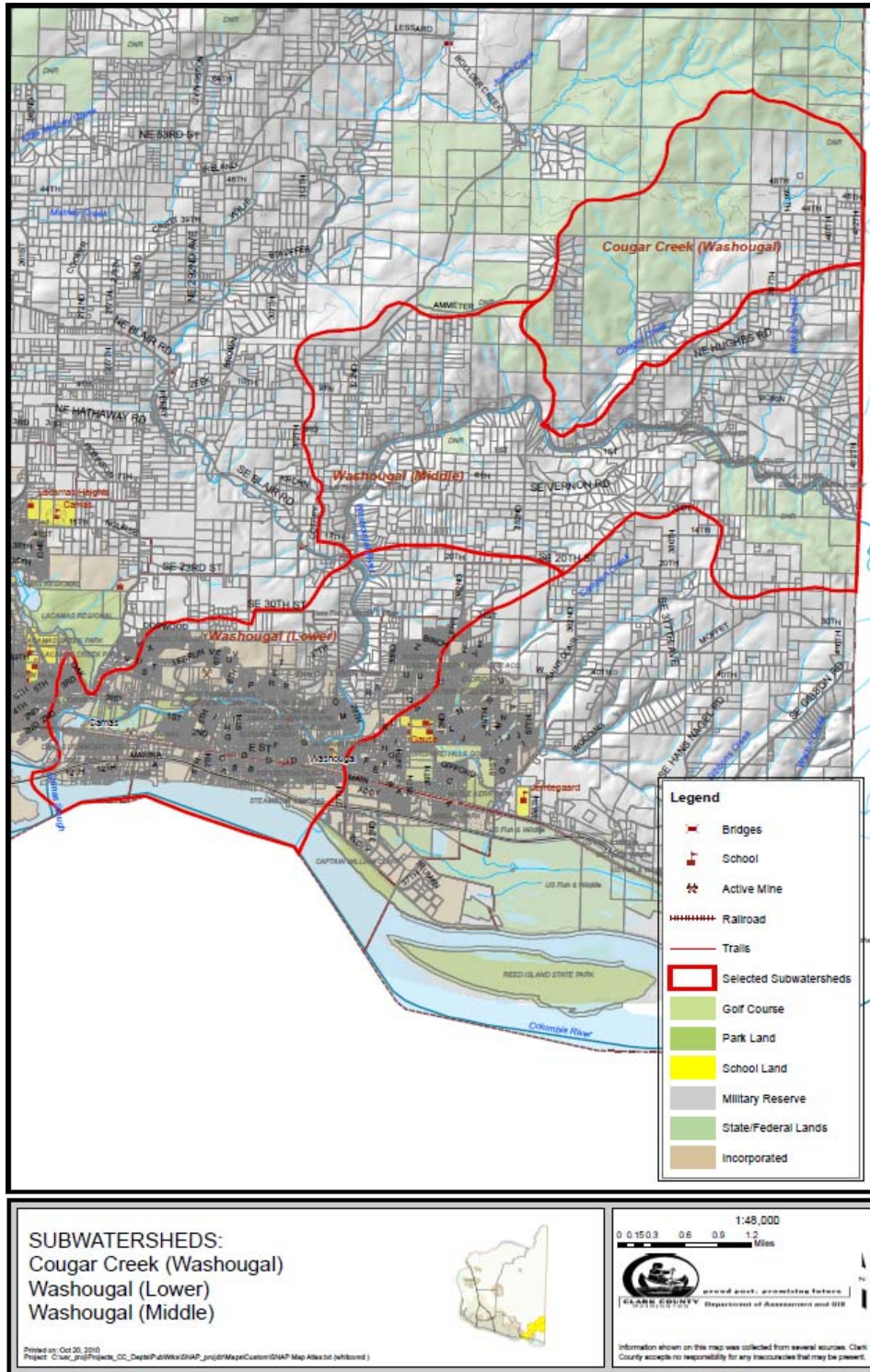


Figure 1: Subwatershed Map: Washougal (Middle), Washougal (Lower), and Cougar Creek (Washougal)



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### *Subwatershed Metrics*

Subwatershed scale metrics provide a simple way to summarize overall conditions. Metrics are calculated from Landsat land cover analysis and current GIS data. Benchmarks for properly functioning and not properly functioning are based on NOAA fisheries standards for salmon protection and restoration (1996 and 2003).

Overall, these metrics suggest that the Cougar Creek (Washougal) subwatershed has functioning stream habitat (Table 2). Washougal (Middle) subwatershed does not completely meet standards due to lost forest and the amount of roads present. Washougal (Lower) subwatershed has characteristics associated with degraded aquatic habitat. The biggest challenge will be to manage stormwater for expected growth in the Washougal and Urban Growth Areas in order to minimize adverse impacts to water quality.

**Table 2: Watershed Scale Metrics**

<b>Metric</b>	<b>Cougar Creek</b>	<b>Washougal (Middle)</b>	<b>Washougal (Lower)</b>	<b>Functioning</b>	<b>Non-functioning</b>
Percent Forested (2000 Landsat)	80.4	48.6	17.7	> 65 %	< 50 %
Percent TIA (2000 Landsat)	5.9	12.5	28.3	< 5 %	> 15 %
Road Density 2007 data (miles/mile <sup>2</sup> )	3.75	6.2	12.3	< 2	> 3
Stream Crossing Density (crossings per stream mile)	1.0	2.0	2.9	< 3.2/mile	> 6.4/mile
Percent EIA estimated from the Comprehensive Plan	1.0	3.3	30.6	< 10 %	> 10 %

### *Forest Cover*

The proportion of a watershed in forest cover is known to have a profound influence on watershed processes. Forest cover estimates are taken from a report summarizing land cover for Clark County (Hill and Bidwell, January 2003). Research in the Pacific Northwest has shown that when forest cover declines below approximately 65 percent, watershed forming processes become degraded (Booth and Jackson, 1997). These include reducing riparian shade, less wood debris delivery to streams, increased stormwater runoff, and increased fine sediment delivery due to mass wasting.

Cougar Creek (Washougal) subwatershed is largely forest tracts in various stages of growth that range from recently cleared to mature forest. Portions on the Bear Prairie area are cleared for

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pasture or residential use. Percent forested values for this subwatershed place Cougar Creek well into the functioning habitat.

The Washougal (Middle) subwatershed has 49 percent forest cover, below the 65 percent NOAA fisheries threshold for functioning watershed processes. The forested areas are dispersed throughout the subwatershed, but much of the canopy cover remains along the riparian corridors. Presumably the level or mildly sloping areas in the Washougal (Middle) subwatershed were cleared for agricultural activities early in the 20<sup>th</sup> century. A comparison of 1955 aerial photographs to present condition suggests that 1955 forest cover is similar to present conditions.

Washougal (Lower) subwatershed is a mix of rural and urban development with little forest remaining outside of wooded ravines and steep hills in Washougal (Lower) subwatershed. Consequently, its low remaining percent forested area suggests non-functioning habitat.

## *TIA (Total Impervious Area)*

Total impervious area is one of the most widely used indicators of urbanization and coincident watershed degradation (Center for Watershed Protection, March 2003). Total impervious areas are estimated from land cover data in Hill and Bidwell (January 2003). While various organizations and publications categorize stream condition based on TIA, the NOAA fisheries standard is less than 5 percent as fully functional and greater than 15 percent as non-functioning. Values for

Cougar Creek (Washougal) and Washougal (Middle) subwatersheds are between the thresholds for functioning (< 5 %) and non-functioning (> 15 %) habitat. Values for Washougal (Lower) subwatershed are well beyond the threshold for non-functioning habitat.

## *Road Density*

Road density, including all public and private roads, is an easily calculated development measure. Based on criteria set by NOAA Fisheries to protect salmon habitat, road densities in the study area exceed the threshold for non-functioning (>3 road miles/mi<sup>2</sup>).

## *Stream Crossing Density*

Stream crossing densities are easily measured using available road and stream channel data. The salmon protection standard considers larger fills more than 60 feet wide, which would be approximately five- to 10-foot high road fill. The study area subwatersheds have stream crossing densities within the functioning category (<3.2 crossings/stream mile NOAA Fisheries criteria).

## *Future Effective Impervious Area*

Effective impervious area is the amount of impervious area that actually drains to a water body. Depending on factors such as soil types and level of development, effective impervious area is about half (lower intensity development) to almost equal (high intensity development) the TIA value.

The Comprehensive Plan guides development for the next few years, and when used to estimate effective impervious area, it can provide a metric for potential hydrologic impacts due to expected development. Expected EIA places the Cougar Creek (Washougal) and Washougal

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(Middle) subwatersheds in the functioning category. Washougal (Lower) is in the non-functioning category.

## *Estimated Channel Stability Based on Forest and EIA*

In a recent publication by Booth, Hartley and Jackson (June 2002), a relationship between forest and percent EIA was presented as a graphic (**Error! Reference source not found.**). According to this figure, streams in the Cougar Creek subwatershed would be expected to have stable channels. The Little Washougal (Middle) subwatershed falls into the ‘zone of uncertain channel stability’ category. This indicates that through protection and restoration activities, it may be possible to increase forest cover and reduce the EIA as approaches to improve stream habitat. Conversely, increased land clearing could result in less stable channel conditions. Based on subwatershed scale conditions, the Little Washougal (Middle) subwatershed is a good candidate for improving forest functions that could have a measurable impact on channel stability. Streams in the Washougal (Lower) subwatershed would be expected to have very unstable channels.

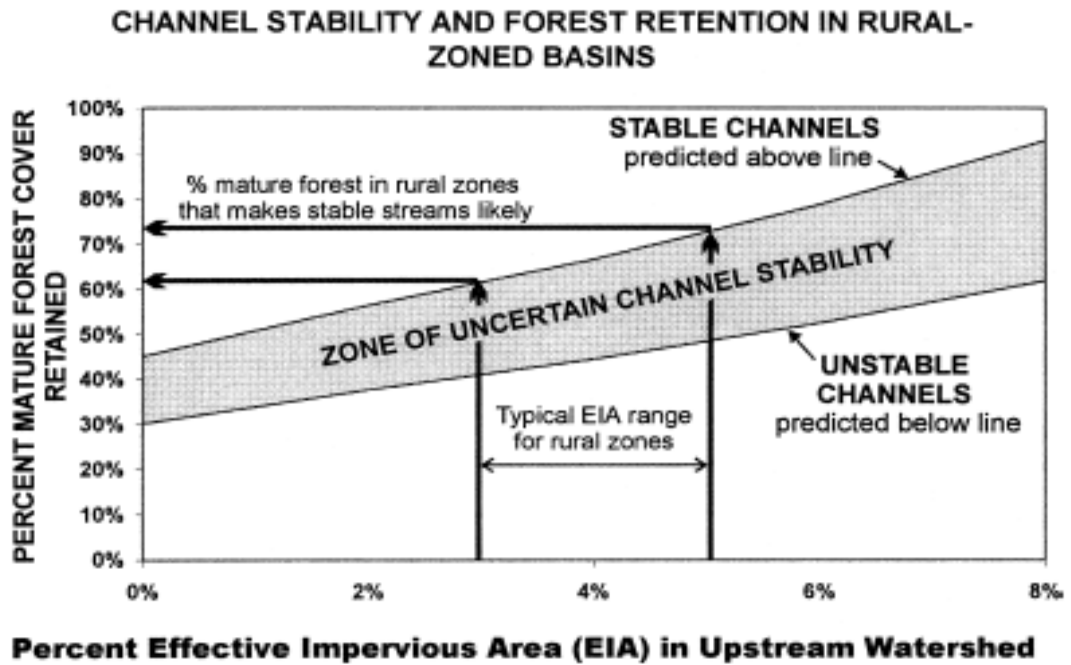


Figure 2: Channel stability in rural areas (Booth, Hartley and Jackson, June 2002)

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## Water Quality Assessment

This section briefly summarizes and references available water quality data from the Washougal (Lower and Middle) and Cougar Creek (Washougal) subwatersheds. A description of applicable water quality criteria is included, along with discussions of beneficial use impacts, likely pollution sources, and possible implications for stormwater management planning.

### Water Quality Criteria

For a full explanation of current water quality standards see the Ecology website at:  
<http://www.ecy.wa.gov/programs/wq/swqs/index.html>

Under Washington state water quality standards, the Washougal River and tributaries from Section 7 T1N R4E is to be protected for the designated uses of: “Core Summer Salmonid Habitat; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values” (WAC 173-201A-600, Table 602).

Table 3 summarizes currently applicable water quality criteria for the assessment area.

**Table 3: Applicable Water Quality Criteria for Washougal (Lower and Middle) and Cougar Creek (Washougal) Subwatersheds**

Characteristic	Ecology criteria
Temperature	≤ 16 °C (60.8° F)
Dissolved Oxygen	≥ 9.5 mg/L
Turbidity	shall not exceed 5 NTU over background when background is 50 NTU or less
pH	6.5 – 8.5 units
Fecal coliform bacteria	Geometric mean fecal coliform concentration not to exceed 100 colonies/100mL, and not more than 10% of samples exceeding 200 colonies/100mL.
Aesthetics	Aesthetic values must not be impaired by the presence of materials or their effects... which offend the senses of sight, smell, touch, or taste
Toxics	Toxic substances shall not be introduced... which have the potential... to adversely affect characteristic water uses, cause acute or chronic toxicity to the most sensitive biota dependent upon those waters, or adversely affect public health

Source: Washington Department of Ecology (<http://www.ecy.wa.gov/programs/wq/swqs/index.html>)

### 303(d) Listed Impairments

The 2008 303(d) list of impaired waters is on the Ecology website at:  
<http://www.ecy.wa.gov/programs/wq/303d/index.html>

There are no listings in Cougar Creek or in the Washougal River in Clark County. The upper Washougal River in Skamania County is Category 5 listed (polluted waters that require a TMDL) for fecal coliform.

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## Clark County Stream Health Report

In 2010, the CWP compiled available data and produced a countywide assessment of general stream health.

Based on the available dataset, including water quality, biological health and stream flow patterns, overall stream health in the Washougal (Middle) and Washougal (Lower) subwatersheds scored in the good range. Sufficient data were not available to score the Cougar Creek (Washougal) subwatershed.

The 2010 Stream Health Report may be viewed on the county website at:  
<http://www.clark.wa.gov/water-resources/stream.html>.

## Available Data

A limited dataset is available for this assessment area. Clark County collected stream temperature data at two locations during 2004 as part of the Lower Columbia Fish Recovery Board habitat characterization study. Ecology sampled one location in the Washougal River in 2003 under the Washington State Toxics Monitoring Program: Exploratory Monitoring, and one location in 2003-2004 under the Pesticides, PCBs and PAHs in Lower Columbia River Drainage study.

Data and information sources reviewed or summarized as part of this water quality characterization are listed in Table 4.

**Table 4: Data Sources**

<b>Source</b>	<b>Data and/or Report</b>
Clark County Clean Water Program	2010 Stream Health Report Benthic Macroinvertebrate and Water Temperature Monitoring for Clark County Watershed Assessments in 2004
Ecology EIM database	Washington State Toxics Monitoring Program: Exploratory Monitoring 2003 (Station Washougal R) Pesticides, PCBs, and PAHs in Lower Columbia River Drainage (Station WASHR)

## Water Quality Summary

### *Pesticides PCBs and PAHs*

The lower Columbia River has numerous listings on the state 303(d) list of contaminated water bodies. In 2003-2004, Ecology conducted a study to identify major source areas and tributaries contributing to these listings. The full report may be viewed at:

<http://www.ecy.wa.gov/pubs/0503006.pdf>

Semipermeable membrane devices were used to monitor chlorinated pesticides (including DDT), polychlorinated biphenyls (PCBs) and polynuclear aromatic hydrocarbons (PAHs) in the lower

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Columbia and tributaries. Five mainstem Columbia sites and eight tributaries were sampled between Bonneville Dam and Columbia River mouth, including the lower Washougal River.

While all measured compounds were detected in the Washougal River, concentrations were consistently lower than most other sites. Among the eight study sites, the Washougal River ranked as follows (1<sup>st</sup> being the most contaminated, 8<sup>th</sup> being the least contaminated):

DDT compounds:	8 <sup>th</sup>
Dieldrin:	5 <sup>th</sup>
PCBs:	5 <sup>th</sup>
PAHs:	8 <sup>th</sup>

In nearly every case, concentrations in the Washougal River were in compliance with established human health criteria. The report concluded that the Washougal River was not a significant source of pollutant loading contributing to the Columbia River listings for these compounds.

## *Toxics*

In 2003, Ecology's Washington State Toxics Monitoring Program collected three samples from Station Washougal R. Samples were analyzed for 115 chlorinated, organophosphorus and nitrogen pesticides. No detections were recorded. The full report may be viewed at:

<http://www.ecy.wa.gov/pubs/0603019.pdf>

## *Stream Temperature*

Stream temperature was recorded continuously during summer 2004 at the following stations:

- WAS020 (Washougal River at 17<sup>th</sup> Street in Camas)
- WAS040 (Washougal R above confl L Washougal R)

## *Stream Temperature*

One summer of continuous temperature monitoring (2004) at Station WAS020 and Station WAS040 indicated that Washougal River water temperature in these segments greatly exceeded target levels. The maximum of the 7-day moving average of daily maximum temperatures (7-DAD Max) at the time of the study was not to exceed 64° F. The 7-DAD Max reached 76.4° F at WAS020 and 74.6° F at WAS040. At both stations, daily temperatures exceeded 64° F on nearly 60 days during July and August. As of 2006, the temperature criterion changed to 60.8° F for these segments of the Washougal River.

## Drainage System Inventory and Condition

### *Inventory*

Clark County's drainage system inventory resides in the StormwaterClk GIS database and is available to users through the county's GIS.

Drainage system inventory is an ongoing CWP work effort focused on updating the StormwaterClk database to include all existing stormwater drainage infrastructure. In 2008-2009, the inventory was a significant priority for the CWP, with a major work effort focused on

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identifying and mapping previously unmapped infrastructure and reviewing existing records for completeness and accuracy.

Table 5 indicates the number of features currently inventoried in StormwaterClk. Of the 11 stormwater facilities, two are publicly owned and operated.

**Table 5: Drainage System Inventory Results, Cougar Creek (Washougal)/Washougal (Lower and Middle)**

<b>Database Feature Category</b>	<b>Inventoried prior to 2007</b>	<b>Added during 2007-2009</b>	<b>Total Features</b>
Inlet	4	13	17
Discharge Point (outfall)	5	419	424
Flow Control	3	3	6
Storage/Treatment	26	104	130
Manhole	0	8	8
Filter System	0	1	1
Channel	124	1332	1457
Gravity Main	138	544	682
Facilities	4	7	11

## *Condition*

Stormwater system condition is assessed based on three components:

- An evaluation of retrofit opportunities at public stormwater facilities
- An inspection and maintenance evaluation at public stormwater facilities
- An off-site assessment to check for outfall-related problems in downstream receiving waters

## *Component 1: Retrofit Evaluation*

### Purpose

The purpose of this component is to identify existing public stormwater facilities that may be retrofitted to provide additional storage or treatment beyond the level intended during original construction.

### Methods

The evaluation is conducted at all public stormwater facilities that contain detention ponds, treatment wetlands, wet ponds, pre-settling cells, open filters or bioswales and discharge to surface waters or stormwater drainage infrastructure that eventually discharges to surface waters.

The retrofit evaluation includes a review of the drainage area, stormwater infrastructure condition, facility lot size, ownership of adjacent parcels, and the functionality of the facility objects listed above. Facilities or parcels with the potential to provide additional storage and/or

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treatment of stormwater are referred as "potential retrofit" opportunities for further evaluation as Capital Improvement Projects.

## Results

Based on the county's StormwaterClk database, as of August 2010, there were no mapped public stormwater facilities in the Cougar Creek (Washougal) subwatershed and one mapped public stormwater facility in each of the Washougal (Lower) and Washougal (Middle) subwatersheds.

One-hundred percent (2) of the mapped public stormwater facilities in both Washougal (Lower) and Washougal (Middle) subwatersheds were evaluated for retrofit opportunities.

No public stormwater facilities were referred for further evaluation as Capital Improvement Projects.

No major defects or hazardous conditions were discovered in the Washougal (Lower) and Washougal (Middle) subwatersheds.

## *Component 2: Inspection and Maintenance Evaluation*

### Purpose

The inspection and maintenance evaluation verifies that maintenance activities are implemented and facilities are properly functioning.

### Methods

The inspection and maintenance evaluation is conducted at public stormwater facilities in conjunction with retrofit evaluations. Public stormwater facilities were evaluated if they contain detention ponds, treatment wetlands, wet ponds, pre-settling cells, open filters or bioswales and discharge to surface waters or stormwater drainage infrastructure that eventually discharges to surface waters.

Public stormwater facilities that contain filter systems, buried detention or retention vaults, and facilities that infiltrate stormwater typically are not included in this evaluation, but may be inspected on a case-by-case basis as resources allow.

The evaluation is conducted using county and state standards equivalent to maintenance standards specified in Chapter 4, Volume V, of the 2005 Stormwater Management Manual for Western Washington. The standards list the part or component of the facility, condition when repair or maintenance is needed, and expected results. Individual components of a facility are referred to as "facility objects."

The inspection and maintenance evaluation process involves inspecting all facility objects to determine if maintenance complies with the standards. If any facility object fails to meet the maintenance standards, the entire facility is not in compliance. Noncompliant stormwater facilities are referred to the appropriate department for repairs or maintenance.



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## Results

Two inspection and maintenance evaluations were conducted; one in the Washougal (Lower) subwatershed and one in the Washougal (Middle) subwatershed. These facilities were found to be out of compliance and included 11 facility objects, of which seven (64 percent) were in compliance.

The inspection process in the Washougal (Lower) and Washougal (Middle) subwatersheds generated two referrals to Public Works Maintenance and Operations for needed maintenance.

No major defects or hazardous conditions were discovered in the Washougal (Lower) or Washougal (Middle) subwatersheds.

## *Component 3: Offsite Assessment*

### Purpose

Discharges from stormwater outfalls can cause moderate to severe erosion as stormwater moves through the riparian zone and to the receiving water. Erosion creates a source of sediment to the stream due to incision and slope failures. It also can increase slope instability problems.

The Offsite Assessment looks for offsite or downstream problems associated with the county's storm sewer system, particularly from facility outfalls that discharge to critical areas.

### Methods

County-owned and operated stormwater outfalls meeting one or more of the following criteria are included in the offsite assessment:

- Within 200 feet of a critical area (e.g. riparian, wellhead protection, landslide hazard, etc)
- Within 300 feet of a headwater stream
- Located on public land
- Originates from a public-dedicated facility currently under the two-year maintenance warranty bond

Stormwater outfalls are prioritized into three categories:

- Priority 1 outfalls are stormwater outfalls that discharge to landslide hazard areas outside of county road rights-of-way
- Priority 2 outfalls are stormwater outfalls that discharge to all other critical areas outside of county road rights-of-way
- Priority 3 outfalls are stormwater outfalls that discharge to critical areas within county road rights-of-way

At a minimum, all Priority 1 outfalls are inspected. As resources allow, Priority 2 and Priority 3 outfalls may be inspected. If an outfall fails to meet the general outfall design criteria or is contributing to a downstream erosion problem, the outfall is not in compliance. Non-compliant outfalls are referred to the appropriate Public Works program for maintenance or repair or, in some cases, as potential Capital Projects.

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### Results

Based on the county's StormwaterClk database, as of August 2010, there were 42 mapped outfalls in the Washougal (Lower) subwatershed discharging to critical areas: one Priority 1 outfall; no Priority 2 outfalls; 41 Priority 3 outfalls.

In the Washougal (Middle) subwatershed, 265 mapped outfalls discharged to critical areas: no Priority 1 or Priority 2 outfalls; 265 Priority 3 outfalls.

In the Cougar Creek (Washougal) subwatershed, there were seven mapped outfalls discharging to critical areas: no Priority 1 or Priority 2 outfalls; seven Priority 3 outfalls.

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Table 6, summarizes results the Washougal (Lower) subwatershed. There were 41 mapped outfalls discharging to critical areas. One Priority 1 outfall was assessed and found to be in compliance. There were no mapped Priority 2 outfalls. Forty-one Priority 3 outfalls were not assessed.

**Table 6: 2010 Off-site Assessment Project Activity Summary for Washougal (Lower) subwatershed**

Metric	Number of Outfalls		
	Priority 1	Priority 2	Priority 3
Total number of mapped outfalls	1	0	41
# of outfalls assessed	1	n/a	0
# of outfalls compliant	1	n/a	n/a
# of noncompliant outfalls	n/a	n/a	n/a
# of referrals initiated	n/a	n/a	n/a
# of referrals ongoing	n/a	n/a	n/a
# of outfalls fixed	n/a	n/a	n/a

Table 7 summarizes results from the Washougal (Middle) subwatershed. There were 265 mapped outfalls discharging to critical areas. All were Priority 3 outfalls and none was assessed.

**Table 7: 2010 Off-site Assessment Project Activity Summary for Washougal (Middle) subwatershed**

Metric	Number of Outfalls		
	Priority 1	Priority 2	Priority 3
Total number of mapped outfalls	0	0	265
# of outfalls assessed	n/a	n/a	0
# of outfalls compliant	n/a	n/a	n/a
# of noncompliant outfalls	n/a	n/a	n/a
# of referrals initiated	n/a	n/a	n/a
# of referrals ongoing	n/a	n/a	n/a
# of outfalls fixed	n/a	n/a	n/a

Table 11 summarizes results from the Cougar Creek (Washougal) subwatershed. There were seven mapped outfalls discharging to critical areas. Seven Priority 3 outfalls were not assessed.

**Table 8: 2010 Off-site Assessment Project Activity Summary for Cougar Creek (Washougal) subwatershed**

Metric	Number of Outfalls		
	Priority 1	Priority 2	Priority 3

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Total number of mapped outfalls	0	0	7
# of outfalls assessed	n/a	n/a	0
# of outfalls compliant	n/a	n/a	n/a
# of noncompliant outfalls	n/a	n/a	n/a
# of referrals initiated	n/a	n/a	n/a
# of referrals ongoing	n/a	n/a	n/a
# of outfalls fixed	n/a	n/a	n/a

### Potential Projects

The offsite assessment project yielded no potential project opportunities.

### *Management Recommendations*

Drainage system inventory, an ongoing CWP work effort, focuses on updating the StormwaterClk database to include all existing stormwater drainage infrastructure. Prior to 2007, stormwater drainage infrastructure in the Cougar Creek (Washougal) and the Washougal (Lower and Middle) subwatersheds included 304 objects. In 2007-2009, an additional 2,431 previously unmapped objects were added to the StormwaterClk database.

A retrofit evaluation and an inspection and maintenance evaluation were conducted at two public stormwater facilities in the Washougal (Lower and Middle) subwatersheds. No referrals were generated for further evaluation as Capital Improvement Projects. Noncompliant facility objects included a bioswale, detention pond, catch basins and sediment trap. Excessive sedimentation was the most common noncompliant defect across facility objects. Multiple vegetation defects were recorded for the detention pond. Correcting facility sedimentation issues and maintenance of the detention pond will bring both facilities into compliance.

Outfall assessments generated no potential project opportunities. Future efforts should be made to assess Priority 3 outfalls, which make up nearly all of the outfalls discharging to critical areas in these subwatersheds. Maintaining the frequency of offsite assessment activities may reduce downstream erosion problems by discovering potential issues before they become more serious erosion problems.

### Illicit Discharge Detection and Elimination Screening

Illicit discharge screening was not conducted.

### Source Control

#### Purpose

Source control visits to Clark County businesses provide both an educational and technical assistance purpose. An initial site visit allows staff to educate owners and employees by

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providing basic information about nearby water resources and Clark County's Water Quality Ordinance (13.26A). The initial site visit also provides information on how Clark County's storm sewer system works, how the site is connected to this storm system, and how activities performed by the business may impact their subwatershed.

Most importantly, the source control visit can find, then eliminate or change, business activities that negatively impact stormwater runoff.

### Methods

Under the County's 2007 NPDES municipal stormwater permit, each year staff is required to visit 20 percent of businesses that perform one of many potential pollution-generating activities listed in the permit. Additionally, the permit requires visits to any business with a paved parking area. To simplify project planning and tracking, the CWP plans to visit 20 percent of all county businesses each year.

To determine which specific businesses will be inspected each year, SNAP prioritizes a list of subwatersheds where source control visits will be performed. Once those subwatersheds are determined, GIS maps are developed to highlight all parcels paying the Type 4 (commercial and industrial property) and Type 3 (Multi-Family property) Clean Water Fee. Each highlighted parcel is labeled with the parcel number (Property Account Number).

At each site, staff asks the business manager or owner to lead a tour of the business, inside and out. By closely observing business activities and asking questions, staff gains information about site-specific conditions and current stormwater best management practices (BMPs).

If any business related activities allow contaminants to enter stormwater runoff, specific BMPs are suggested to the business manager or owner. Following the tour, BMP sheets explaining the issue and required fixes are left with the manager or owner. If the BMP will take some time to implement, a follow up visit date is agreed upon. Letters are sent to businesses when multiple activities require BMPs and/or when a specific BMP may take some time to implement. Letters usually give a deadline for completion of BMP implementation.

Following the deadline date, a follow up visit is made to the business to confirm BMP implementation. As long as some corrective effort has been made, the source control staff will continue working with the business until it is in compliance. However, if the business fails to take any corrective action despite repeated visits, a referral to Clark County Code Enforcement and possibly the Washington Department of Ecology is made to assist with compliance through enforcement.

During or immediately after each site visit, a Business Site Visit Report Form is completed for entry into the Tidemark database.

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## Results

In 2010, staff visited all the businesses required under the NPDES permit in the Washougal (Middle)/Washougal (Lower)/Cougar Creek (Washougal) subwatershed. Table 9 summarizes source control activities.

**Table 9: Source Control Project Summary, Washougal (Middle)/Washougal (Lower)/Cougar Creek (Washougal) subwatershed.**

<b>Metric</b>	<b>Number</b>
Number of sites visited	3
Number of sites with source control issues	0
Number of repeat visits	0
Number of sites with issues successfully resolved	0
Number of sites referred to other agencies	0

## Overview

The study area is located in southeast Clark County and contains many large rural landowners where hobby farms and single family residences dominate the landscape. Within unincorporated Clark County, few Type 4 parcels required source control visits. Most were churches or vacant business buildings, and no source control issues were identified.

## Stream Reconnaissance and Feature Inventory

A stream reconnaissance and feature inventory was not conducted.

## Physical Habitat Assessment

### Purpose

Physical habitat assessments provide direct measurements of stream channel morphology, habitat conditions, and riparian conditions for specific stream reaches. This information can be used for planning projects and interpreting hydrologic, macroinvertebrate, and geomorphologic information at reach and subwatershed scales.

### Methods

Physical habitat measurements were made for multiple reaches of the Washougal River (Washougal 2 extends from the confluence with Lacamas Creek to RM 1.8; Washougal 3, RM 1.8 to the confluence with the Little Washougal River at RM 5.5) by R2 Resource Consultants, Inc. (December 2004) for the Lower Columbia Fish Recovery Board. The project followed modified USFS Level II protocols.

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## Results

The R2 Resource Consultants, Inc. (R2) report includes a good narrative summary of the habitat survey results, including figures and tables, some of which are presented here. The full report may be found on the CWP website at:

<http://www.clark.wa.gov/water-resources/documents-monitoring.html#strmac>

The Washougal 2 survey reach is a low gradient floodplain channel with dune-ripple to pool-riffle bedforms. The reach has a map gradient of less than 1.0 percent and is moderately confined by an incised valley and periodic armored banks. Habitat consists primarily of glide, which represents 59 percent of the survey reach habitat by length followed by small cobble riffle (22 percent) and pool (19 percent). The average maximum depth of pools is 4.9 meters.

R2 noted that the dominate and subdominant substrate classes of streambed riffles are comprised of gravel (56 percent) and cobble (32 percent). Embeddedness is rated in each habitat unit according to four categories (0-25%, 25-50%, 50-75%, 75-100%). The overall mean embeddedness level is 19 percent. Table 10 summarizes habitat evaluations based on Washington Conservation Commission and NOAA Fisheries Properly Functioning Condition standards. Washougal 2 extends from the confluence with Lacamas Creek to RM 1.8.

**Table 10 Summary of Habitat Evaluations of the Washougal River from the confluence with Lacamas Creek to RM 1.8 (Washougal 2 Survey Reach) Based on Washington Conservation Commission and NOAA Fisheries Properly-Functioning Condition Standards**

Parameter	WCC <sup>1</sup>	PFC <sup>2</sup>
% Pool by Surface Area		
Pool Frequency		
Pool Quality	Fair	Properly functioning
LWD		Not properly functioning
Substrate	Good	Properly functioning
Streambank Stability	Good	Properly functioning
Water temperature		
<sup>1</sup> Available Ratings: Good; Fair; Poor		
<sup>2</sup> Available Ratings: Properly Functioning; At Risk; Not Properly Functioning		

The Washougal 3 survey reach exhibits two distinct channel morphologies. From RM 1.8 to RW 4.2, the channel is a low gradient floodplain type with pool-riffle bedforms. Upstream of RW 4.2, the channel becomes a low gradient channel type. The Washougal 3 reach has a map gradient of 0.3 percent and is moderately confined by armored banks in the lower section and incised valley walls in the upper section. Habitat consists primarily of small cobble riffle, which represents 47 percent of the survey reach habitat by length followed by pool (30 percent) and glide (23 percent). The average maximum depth of pools is 4.4 meters.

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R2 noted that the dominate and subdominant substrate classes of streambed riffles are comprised of gravel (42 percent) and cobble (38 percent). The overall mean embeddedness level is 10 percent. Table 11 summarizes habitat evaluations based on Washington Conservation Commission and NOAA Fisheries Properly Functioning Condition standards.

**Table 11: Summary of Habitat Evaluations of Washougal River from RM 1.8 to the confluence of the Little Washougal River at RM 5.5 (Washougal 3 Survey Reach) Based on Washington Conservation Commission and NOAA Fisheries Properly-Functioning Condition Standards**

Parameter	WCC <sup>1</sup>	PFC <sup>2</sup>
% Pool by Surface Area		
Pool Frequency		
Pool Quality	Fair	At Risk
LWD		Not properly functioning
Substrate	Good	Properly functioning
Streambank Stability	Good	Properly functioning
Water temperature		
<sup>1</sup> Available Ratings: Good; Fair; Poor		
<sup>2</sup> Available Ratings: Properly Functioning; At Risk; Not Properly Functioning		

## Geomorphology Assessment

A geomorphology assessment was not conducted.

## Riparian Assessment

### Purpose

The riparian assessment characterizes existing conditions, based on available data, to identify general riparian needs and potential areas for rehabilitation projects. Riparian enhancement projects, such as installation or protection of native plantings in riparian areas, can provide for increased future shading and woody debris recruitment, which can further provide an opportunity for stormwater-related watershed improvement.

The need for riparian rehabilitation tends to be widespread and exceed the scope and resources of the CWP mission of stormwater management. Therefore, potential riparian projects are usually referred to agencies such as the LCFRB, Lower Columbia Fish Enhancement Group (LCFEG), Clark Public Utilities, Fish First, Washington State University (WSU) Watershed Stewards Program and the Clark Conservation District for possible implementation.

This section focuses on opportunities located on publicly owned lands within high priority salmon-bearing stream reaches, as defined by LCFRB salmon recovery priorities.



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## Method

Where possible, the assessment is based on GIS data from existing reports prepared for the Lower Columbia Fish Recovery Board. These include the Habitat Assessment reports (R2 Resource Consultants, Inc., 2004) and the 2010 Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan. Both can be found at <http://www.lcfrb.gen.wa.us/default1.htm>

These reports apply primarily to salmon-bearing stream reaches and therefore do not provide information for many smaller streams. Results are based on aerial photo interpretation using Washington Forest Practices Board methods for LWD delivery and channel shade estimates.

In streams where no data exist from the LCFRB characterization, an examination of current orthophotographs is used to make a general assessment of riparian condition and identify areas where restoration or preservation projects may be appropriate.

Many riparian project opportunities are discovered through other SNAP activities, including Rapid Stream Reconnaissance feature inventories and geomorphological assessments. Potential projects discovered through these activities are discussed in their respective sections, and most are included on a final list for referral to outside agencies.

The 2004 LCFRB Habitat Assessment report and 2010 Subbasin Plan also were reviewed for specific project opportunities in each subwatershed. Potential project sites have been reviewed and verified through field reconnaissance and are detailed in the results.

## Results

Results are based primarily on the 2004 LCFRB Habitat Assessment for the Washougal (Lower), Washougal (Middle) and Cougar Creek (Washougal) subwatersheds. The full characterization report is available on the Clark County website at:

<http://www.clark.wa.gov/water-resources/documents.html#mon>

For areas in the subwatersheds not included in the habitat assessment (tributaries to Washougal River and Cougar Creek, upstream portions of Cougar and Winkler Creeks), LWD recruitment potential and shade rating analyses were based on a qualitative review of 2010 orthophotographs available through Google Earth.

At the subwatershed scale, the LCFRB rated the riparian conditions in the Washougal (Middle) and Cougar Creek subwatersheds as “Moderately Impaired,” and in the Washougal (Lower) subwatershed as “Impaired.”

### *Riparian (Large Woody Debris (LWD) Delivery)*

Figure 3 shows the Washougal (Lower), Washougal (Middle) and Cougar Creek (Washougal) subwatersheds LWD delivery potential. In the Washougal (Lower) subwatershed, the survey includes the mainstem of the Washougal River. Along the approximately 4.9 miles surveyed, the mainstem of the Washougal River is shown as having primarily Moderate LWD recruitment potential, with an area of High potential where it passes through relatively intact forest immediately downstream (south) of the confluence with the Little Washougal River. Review of

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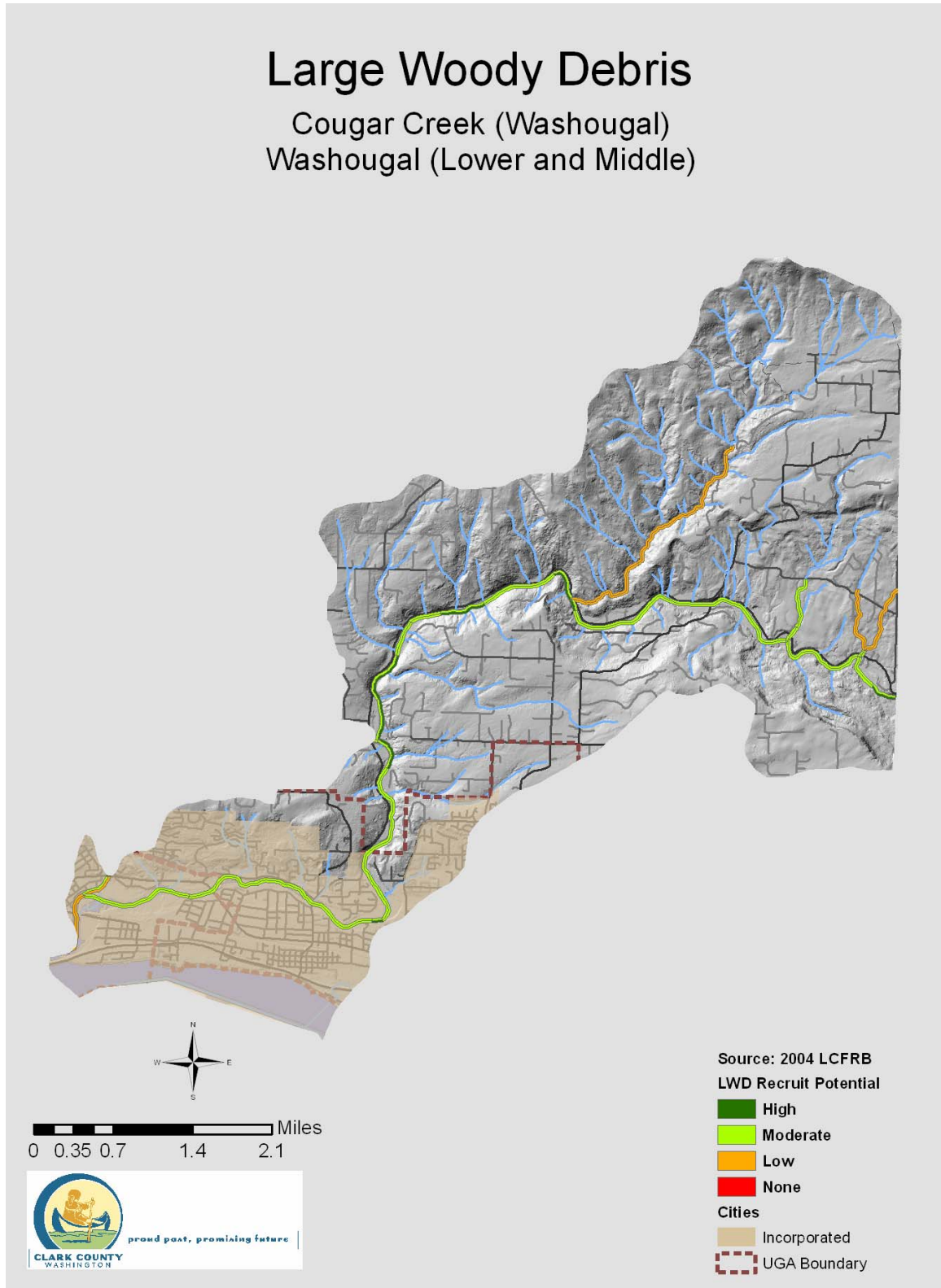
survey data shows “Fair” LWD recruitment for 96 percent of the length surveyed and “Good” for 4 percent (EDT reaches “Washougal 2 tidal” and “Washougal 3”).

In the Washougal (Middle) subwatershed, the survey includes the mainstems of the Washougal River, Winkler Creek and two unnamed tributaries entering the Washougal River from the north.

Along the approximate 6.2 miles surveyed, the mainstem of the Washougal River is shown as having primarily Moderate LWD recruitment potential, with areas of High potential where it passes through relatively intact, steep-sloped forest. The High LWD recruitment potential areas occur immediately upstream (north) of the confluence with the Little Washougal River, further upstream near SE Wood Dr/SE 1<sup>st</sup> St, immediately downstream of the confluence with Cougar Creek, and near the eastern county line. Review of survey data shows “Fair” LWD recruitment for 86 percent of the length surveyed and “Good” for 14 percent (EDT reaches “Washougal 4,” “5,” “6,” and “7”).

Along the approximate 0.6 miles surveyed, Winkler Creek is shown as having Moderate LWD recruitment potential for the entire length. Along the approximate 1.5 miles surveyed, the unnamed tributaries entering the Washougal River from the north are shown as having primarily Low LWD recruitment potential, with an area of Moderate potential closer to the confluence with the Washougal River. Review of survey data shows “Fair” LWD recruitment for 5 percent of the length and “Poor” for 95 percent of the length (EDT reaches “RB trib 1a,” “RB trib 1b,” “RB trib 1c,” and “RB trib 2”).

In the Cougar Creek (Washougal) subwatershed, the survey includes the mainstem of Cougar Creek. Along the approximate 2.4 miles surveyed, Cougar Creek is shown as having Low LWD recruitment potential for the entire length.



**Figure 3: Washougal (Lower), Washougal (Middle) and Cougar Creek (Washougal) LWD Recruitment Potential (adapted from R2 Resource Consultants, Inc., 2004)**

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## *Shade*

The Washougal (Lower), Washougal (Middle) and Cougar Creek (Washougal) subwatersheds shade ratings from the 2004 LCFRB Habitat Assessment are illustrated on Figure 4. In the Washougal (Lower) subwatershed, the survey includes the mainstem of the Washougal River. The mainstem of the Washougal River has shade values of 30 percent for the entire length surveyed.

It should be noted that in the Washougal (Lower) subwatershed, the lower-most mainstem reaches of the Washougal River are wide enough that even if the entire riparian area contained mature forest, the vegetation would not be likely to shade the entire channel. As such, these reaches represented areas with naturally low shade levels and they likely offered historically warm surface water temperatures. The reference temperatures at Washougal 2-tidal would not be expected to comply with aquatic use criteria for anadromous salmonid fishes or interior resident trout under mature riparian stands due simply to the expanse of the channel width and relatively low elevation of the river channel. Similarly, the reference temperature at Washougal 3 would not have been conducive to non-core anadromous salmon spawning and rearing temperatures in the Washougal basin as delineated in the state water temperature regulations (LCFRB 2004, P. 6-27).

In the Washougal (Middle) subwatershed, the survey includes the mainstems of the Washougal River, Winkler Creek and two unnamed tributaries entering the Washougal River from the north. The mainstem of the Washougal River has shade values of 30 percent for the entire length in the Washougal (Middle) subwatershed. Winkler Creek is shown as having a shade value of 10 percent for the entire length surveyed. Unsurveyed reaches of Winkler Creek are estimated to have high levels of shade, based on aerial photography review. The two unnamed tributaries entering the Washougal River from the north have shade values ranging from 10 percent to 30 percent, distributed as follows:

<b>% Shade</b>	<b>% of Reach Length</b>
10	99
30	1

Unsurveyed reaches of these two unnamed tributaries of the Washougal River are estimated to have low to moderate shade levels, based on review of aerial photography. Other unnamed, unsurveyed tributaries to the Washougal River are estimated to have moderate to high shade levels, based on review of aerial photography.

In the Cougar Creek (Washougal) subwatershed, the survey includes the mainstem of Cougar Creek. Cougar Creek has shade values of 30 percent for the entire length surveyed. Unsurveyed reaches of Cougar Creek are estimated to have moderate to high shade values, based on review of aerial photography, with the exception of ponds at the headwaters (appx (45.65684, -122.26079), (45.65833, -122.25740), and (45.66002, -122.25346)), which likely have low shade values.

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The LCFRB habitat assessment for the Washougal (Lower), Washougal (Middle) and Cougar Creek (Washougal) subwatersheds indicated all surveyed reaches are currently off-target with respect to the State Forest Practices shade/elevation screen standards.

### Management Recommendations

Overall recommended management activities for the Washougal (Lower), Washougal (Middle) and Cougar Creek (Washougal) subwatersheds include preservation, off-channel habitat development, floodplain restoration, bank restoration, riparian plantings, hardwood conversion, conifer release, breaching a levee and adding large wood to banks.

### Potential Projects

Potential riparian restoration projects for the Washougal (Lower), Washougal (Middle) and Cougar Creek (Washougal) subwatersheds were identified from review of the 2004 LCFRB Habitat Assessment report, with orthophotography analysis in areas not formally surveyed.

Of all publicly owned land in the Washougal (Lower), Washougal (Middle) and Cougar Creek (Washougal) subwatersheds, the majority is owned by Washington State and managed for forestry operations. A significant amount is owned by the City of Camas, City of Washougal and Clark County, and similarly managed. It is assumed that these lands would be managed with riparian conservation best management practices in place and, as such, would be unavailable for and lack ecological opportunity for county-driven enhancement projects.

Public lands in these subwatersheds are identified in Table 12.

**Table 12: Tax Exempt Parcels Overlapping Potential Riparian Restoration Areas**

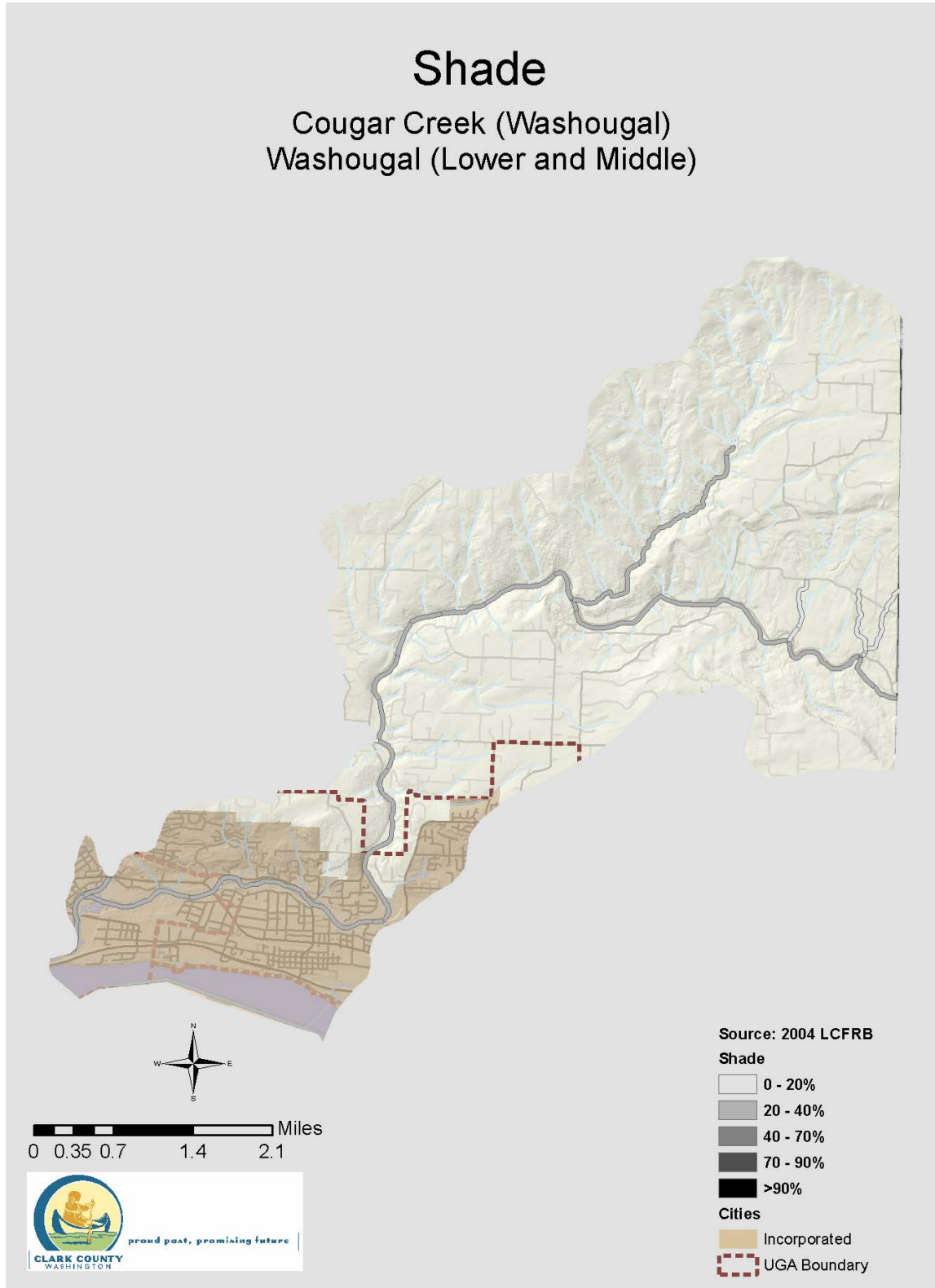
ASSR_SN	ASSR_AC	OWNER	PT1DESC	Description
089873-000	7.43	City of Camas	Unused platted land	Areas of potential preservation/reforestation on the north bank of Washougal River.
089871-000	2.1			
089872-000	2.1			
089800-000	6.05			
089868-000	2.5			
089911-000	6.55			
089890-000	0.79			
089877-000	1.19			
089876-000	2.43	City of Camas	Water towers & reservoirs, pumping station/city well	Areas of potential preservation/reforestation on the south bank of Washougal River.
089866-000	1			
089892-000	2.8			
089887-000	0.93			
089891-000	0.99			
089888-000	1.86			
089932-000	18.24	City of Camas	Rock quarry,	Areas of potential

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ASSR_SN	ASSR_AC	OWNER	PT1DESC	Description
			crushing, sand and gravel pits.	preservation/reforestation on the south bank of Washougal River.
091045-165 091045-063	5 4.39	City of Camas	Unused or vacant land- no improvements, electric power boosters, transformers, sub-stations, right-of-ways	Areas of potential preservation/reforestation on the south bank of Washougal River.
089928-000 089904-000 089930-000 089917-000	0.49 1.51 8.14 1.44	City of Camas	Unused land timbered, unused or vacant land – no improvements	Areas of potential preservation/reforestation on the north bank of Washougal River.
073134-140 073134-173 131167-000 127955-000	6.33 0.12 0.87 1.82	City of Camas, City of Camas- Washougal	Unused or vacant land – no improvements	Preserve forest on the north bank and on an island in the Washougal River.
093210-000	0.94	City of Camas- Washougal	Unused or vacant land – no improvements	Potential reforestation on north bank of Washougal River.
131516-000 131515-000 131384-000	0	Washington State	Unused land	Preserve forest on the north bank of the Washougal River.
071272-010 071262-008 071257-000 073306-000 073305-000 073300-096 073300-084 073300-050 073300-078 073300-052 076516-072 076516-074	0.12 0.34 5 1.38 1.04 1.34 1.43 2 0.22 0.47 0.54 0.25	City of Washougal	Parks with and including playgrounds, ball fields, and picnic areas	Areas of potential preservation/reforestation on the south bank of Washougal River.
095469-110	0.95	Washington State	Unused land,	Preserve forest on the west

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ASSR_SN	ASSR_AC	OWNER	PT1DESC	Description
130351-000 130323-000 142845-000	1.43 0.75 2.73		timbered, no improvements	bank of the Washougal River.
141753-000	40	School Land	Forestry operations	Implement forestry best management practices to ensure protection of Washougal River.
141263-010 141263-015 141397-000 141272-000 141300-000 143468-000 143704-000 143708-000 143707-000	5.4 5.44 4.82 4.14 0.25 75.45 40 35 40	Washington State	Unused or vacant land – no improvements, forestry operations	Areas of potential preservation/reforestation on the south bank of Washougal River.
143679-000 143682-000 143676-000 143686-000 143696-000 143690-000 143692-000 143697-000 143709-000 143683-000	3.16 0.39 0.2 0.1 0.08 0.06 0.06 0.07 0.12 1.82	Washington State	Unused or vacant land – no improvements, forestry operations	Implement forestry best management practices to ensure protection of Washougal River. Areas of potential preservation/reforestation on the east bank of Washougal River. Close to Coyote Creek fish passage replacement culvert project.
141395-000 141266-000 096170-000 143527-000 141056-000 143747-000	0.95 1.12 0.58 1.12 3.79 0.18	Clark County	Unused or vacant land – no improvements	Areas of potential preservation/reforestation on the north bank of Washougal River.
140439-000 140642-000 138737-000 138736-000 138526-000	400 160 320 160 160	Washington State, State Forest Board	Unused or vacant land – no improvements, forestry operations	Implement forestry best management practices to ensure protection of Cougar Creek (Washougal) subwatershed. Areas of potential preservation/reforestation.



**Figure 4: Washougal (Lower), Washougal (Middle) and Cougar Creek (Washougal) Shade Values (adapted from R2 Resource Consultants, Inc, 2004)**



## Floodplain Assessment

A floodplain assessment was not conducted.

## Wetland Assessment

### Purpose

Wetlands perform important hydrologic, water quality and habitat functions. The primary reasons for the wetlands assessments are to:

- Describe wetland conditions related to how they influence hydrology, water quality, and habitat
- Identify priority potential wetland projects to mitigate for stormwater impacts
- Make management recommendations for wetlands related to stormwater management

A primary objective of the wetland assessment is to identify sites containing modestly sized, degraded or ditched wetlands where minor construction projects can be used to improve wetland hydrology. Improved wetland function can reduce peak storm discharges, increase groundwater recharge and improve habitat through increasing biodiversity, species population health and organic input.

### Methods

The assessment includes review of existing GIS data for wetlands. Primary information sources are the county wetlands atlas, the Watershed Characterization and Analysis of Clark County (Ecology Publication # 09-06-019, 2009), and personal communication with other county programs.

Potential project sites have been reviewed and verified through field reconnaissance and are detailed in the results section below.

Tax-exempt parcels often indicate the presence of publicly owned land, school, or churches where large parcel sizes and opportunities for leveraging may exist. Potential wetlands were overlaid with tax-exempt parcels and county vacant buildable lands model (VBLM) information to identify possible wetland enhancement opportunities.

### Results

Figure 5 shows potential wetland areas within the Washougal (Middle)/Washougal (Lower)/Cougar Creek (Washougal) subwatersheds based on data from the county wetlands atlas, including the Clark County wetland model and National Wetlands Inventory.

Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal) subwatersheds have wetlands associated with the main channels of the rivers and creeks and their tributaries, generally characterized as flood influenced riverine and depressional wetlands. There are few large complexes of headwater or floodplain wetlands in this system.

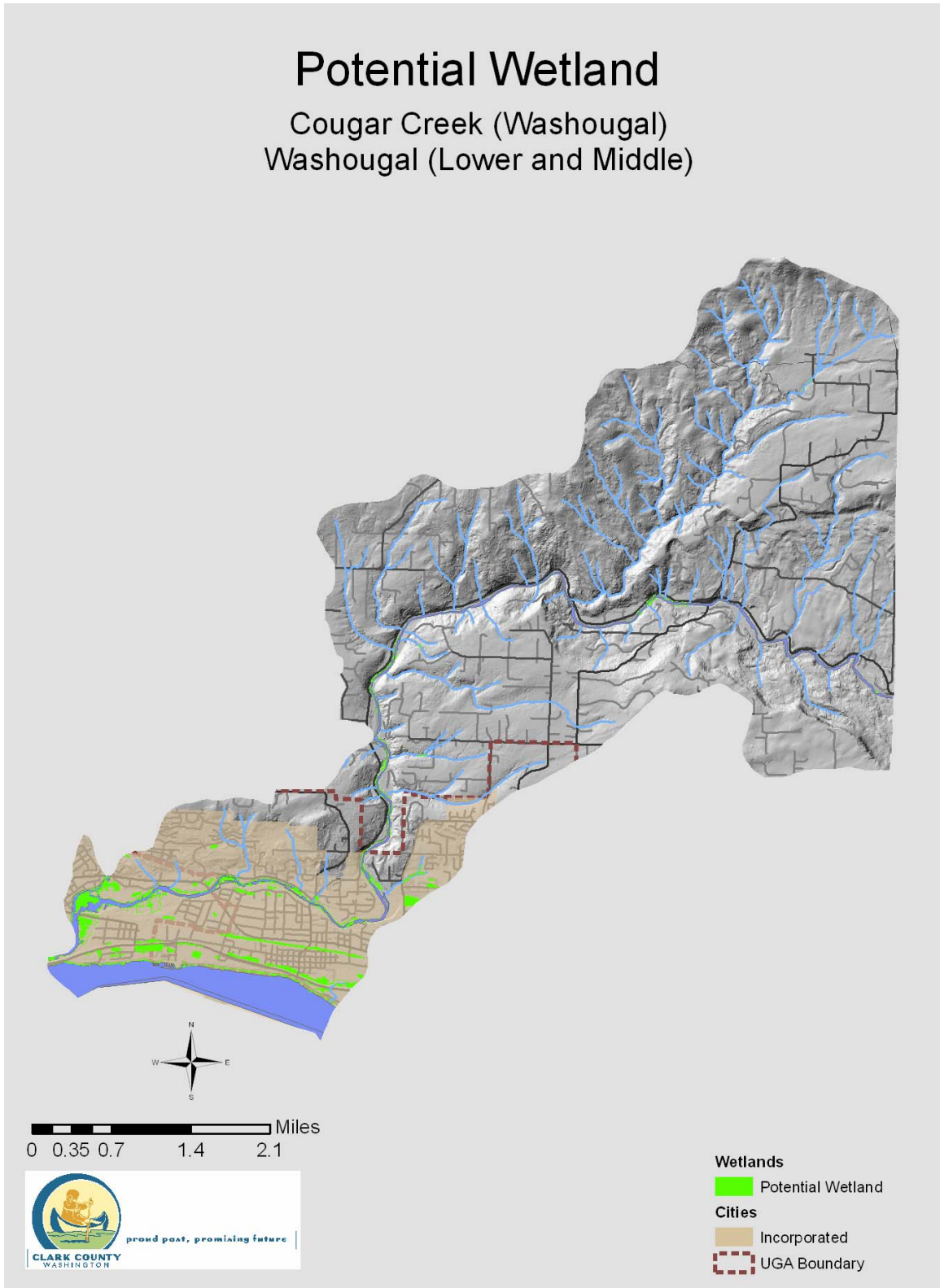
## 2010 Stormwater Needs Assessment Program

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**Table 13: Distribution of Wetlands by Hydrogeomorphic Class**

<b>HGM Class</b>	<b>Area (ac.)</b>	<b>% of Sub-basin*</b>	<b>% of total wetland</b>
Depressional Wetlands	251	1.8	83.6
Riverine Wetlands	50	0.4	16.4
All Wetlands	301	2.2	
*Subwatershed area 13,752 ac.			

The majority of wetlands are located in landscape positions (along stream channels) where there are limited opportunities to improve water quality or hydrologic functions in these subwatersheds. Review of the wetland inventories and studies did not identify any significant project opportunities in publicly held or tax-exempt land. Some of the mapped wetlands are located on state-owned (DNR) forest land, but these areas are in forestry use and are not potential project sites.



**Figure 5: Washougal (Middle)/Washougal (Lower)/Cougar Creek (Washougal) Potential Wetlands**

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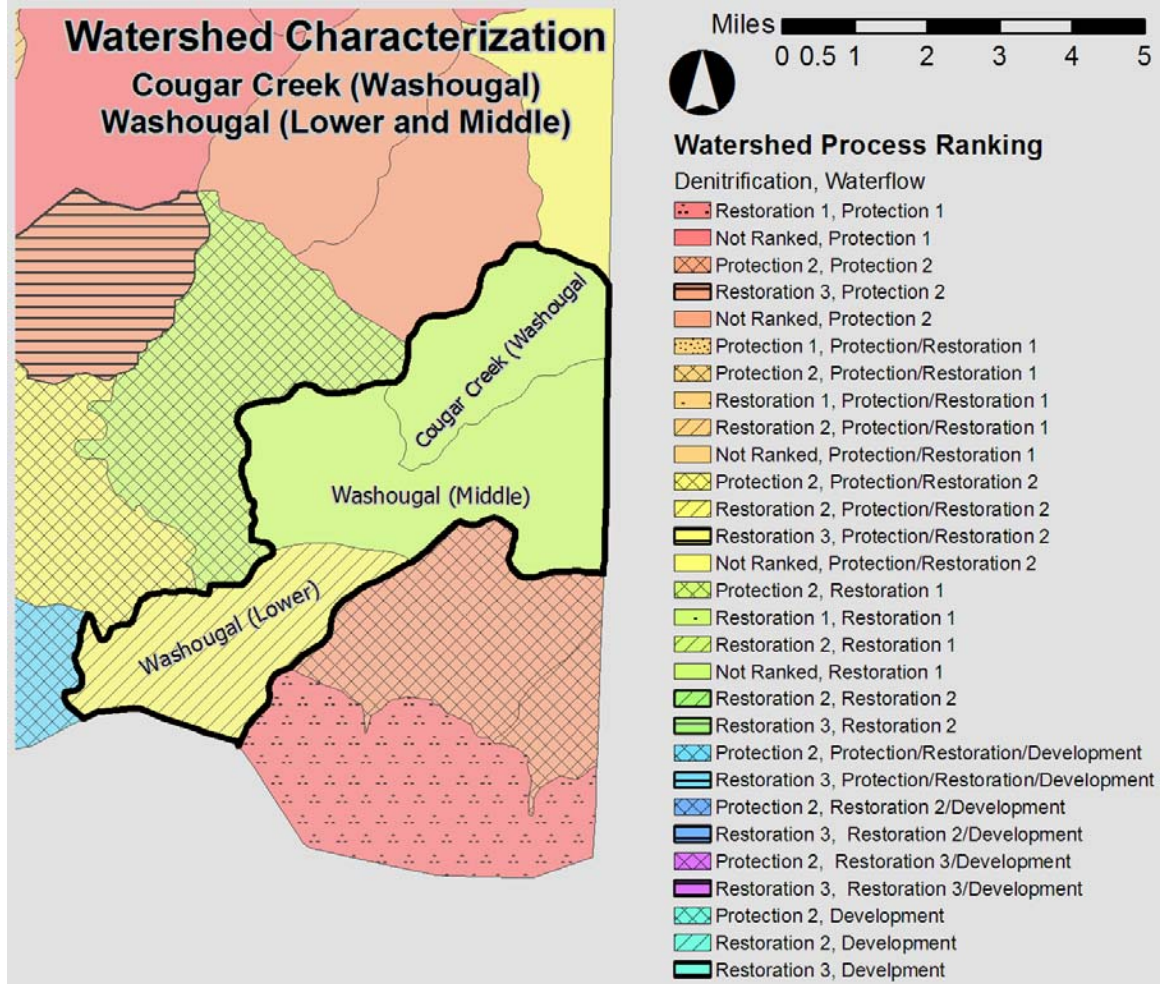
### *Watershed Characterization*

The Washington Department of Ecology completed the Watershed Characterization and Analysis of Clark County (2009) to assist in planning wetland and riparian habitat restoration and preservation projects.

Results pertaining to the Washougal (Middle)/Washougal (Lower)/Cougar Creek (Washougal) subwatersheds are summarized below.

The Washougal (Middle) and Cougar Creek (Washougal) subwatersheds are part of the “Headwater” Rain on Snow and Snow Dominated Mountainous hydrogeologic unit. It is characterized by rain-on-snow and snow dominated precipitation, generally shallow groundwater flow, consolidated bedrock and steep topography. The Washougal (Lower) subwatershed is part of the “Columbia” river hydrogeologic unit. It is located in a rain zone, has sub-surface water flow patterns (influenced by groundwater discharge from the adjacent upland units) and recharge from the river surface waters, geologic deposits consisting primarily of relatively recent river alluvium (sand and silt), and a riverine floodplain and valley walls formed by fluvial action of the river (Ecology, 2009).

Figure 6 depicts priority areas for protection and restoration of hydrologic and denitrification processes countywide based on an analysis of the relative importance and level of alteration in each subwatershed.



**Figure 6: Priorities for suitability of areas for protection and restoration for the hydrogeologic process (from Watershed Characterization and Analysis of Clark County (Ecology, 2009))**

In general, red areas have higher levels of importance for watershed hydrologic processes and limited alteration, and should be considered for protection. Yellow areas have a higher level of importance for watershed processes and a higher level of alteration, and should be considered for restoration unless watershed processes are permanently altered by urban development. Green to blue areas have lower levels of importance for watershed processes and higher levels of alteration, and should be considered as more suitable for development. Because green, purple and blue areas represent a transition from restoration areas, planning measures employing both restoration and appropriately sited development should be considered (Ecology, 2009). Hatch patterns represent the importance of denitrification processes.

Restoration of hydrologic (waterflow) processes is recommended for the Washougal (Middle) and Cougar Creek (Washougal) subwatersheds (green), indicating that hydrologic processes are degraded to the point that protection of existing function is not much of a priority. These subwatersheds are not ranked for denitrification. The Washougal (Lower) is recommended for protection and restoration (yellow) for hydrologic processes and restoration (diagonal line pattern) of denitrification processes.

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## Macroinvertebrate Assessment

A macroinvertebrate assessment was not conducted.

## Fish Use and Distribution

### Purpose

Fish distribution refers to salmon and steelhead use. This information helps to identify stream segments where land-use changes may impact fish populations, informs management decisions, and aids in identifying and prioritizing potential habitat improvement and protection projects.

### Methods

Fish distribution for the Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal) subwatersheds is mapped from existing Clark County GIS information, which reflects data collected and analyzed by the Northwest Indian Fisheries Commission (NWIFC). Fish distribution data for Clark County is available on the County's website.

Several sources of barrier assessment data are available and are briefly summarized here, including:

- WDFW passage barrier database
- SalmonScape (<http://wdfw.wa.gov/mapping/salmonscape/>)
- Clark County 1997 passage barrier data
- Clark Conservation District/LCFRB passage barrier dataset

Many stream crossings have not been assessed for passage barrier potential, and the extent of public and private road crossings is a good indicator of the potential for additional barriers. Road crossings were mapped by overlaying the county road layer with LiDAR-derived stream data.

The barrier assessment data was also reviewed for specific project opportunities within each subwatershed. Potential project sites have been reviewed and verified through field reconnaissance and are detailed in the results section below.

### Results/Summary

#### *Distribution*

For the Washougal (Lower) subwatershed, available fish distribution data identified the known presence of chum (Figure 7), coho (Figure 8), fall Chinook (Figure 9), summer steelhead (Figure 10), and winter steelhead (Figure 11) in the mainstem of the Washougal River. Chum (Figure 7) and coho (Figure 8) are documented as known to be present in the lower reach of Lacamas Creek. Fall Chinook (Figure 9), summer steelhead (Figure 10) and winter steelhead (Figure 11) are presumed to be present in the lower reach of Lacamas Creek. Coho (Figure 8) and winter steelhead are presumed to be present in a tributary discharging into the Washougal River from the east.

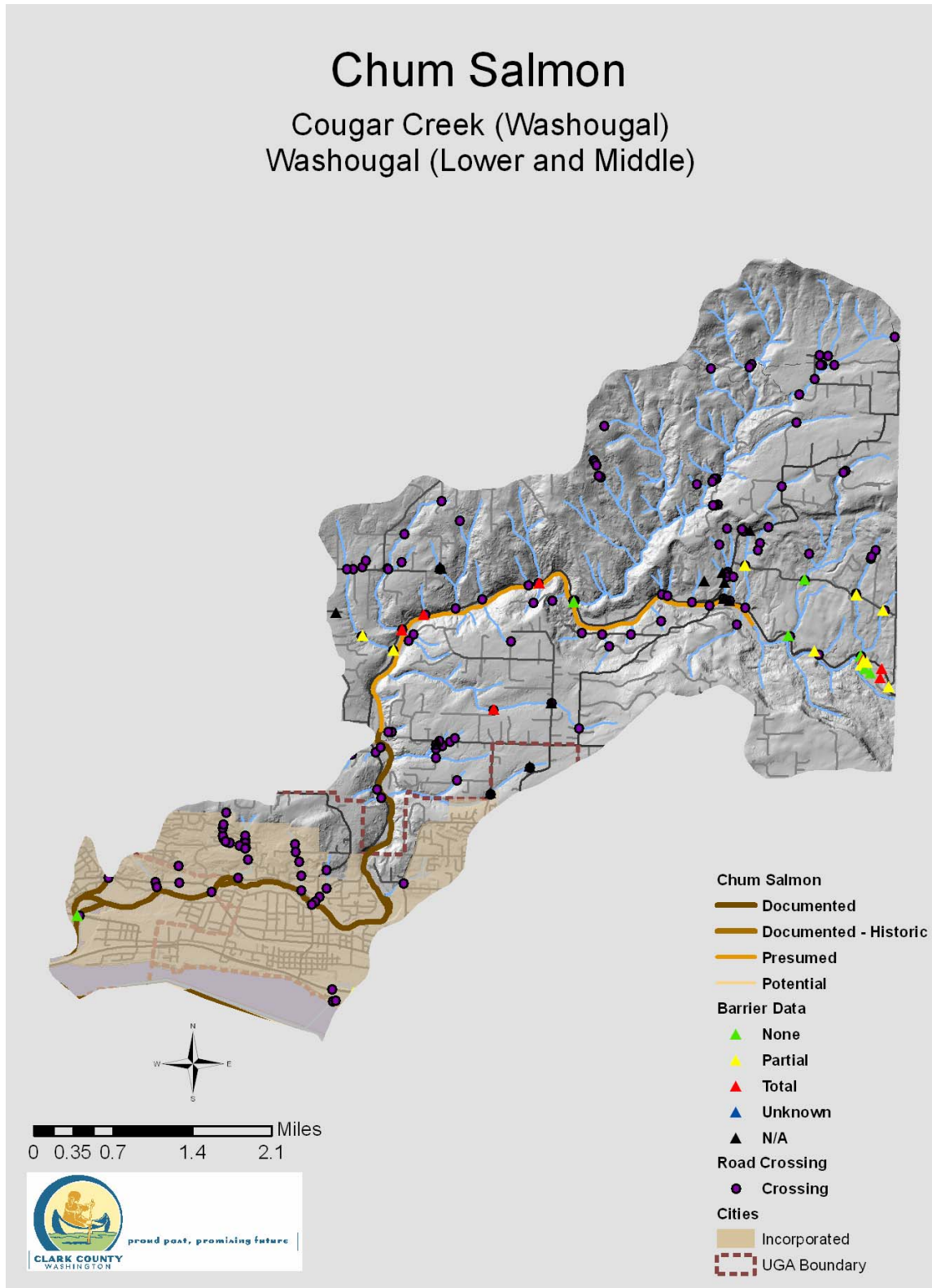
## 2010 Stormwater Needs Assessment Program

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For the Washougal (Middle) subwatershed, available fish distribution data identified the known presence of coho (Figure 8), fall Chinook (Figure 9), summer steelhead (Figure 10) and winter steelhead (Figure 11) in the mainstem of the Washougal River. Chum are presumed to be present in the mainstem of the Washougal River (Figure 7). Coho, summer steelhead and winter steelhead are known to be present in tributaries to the Washougal River such as Winkler Creek (Figure 8, Figure 10, Figure 11).

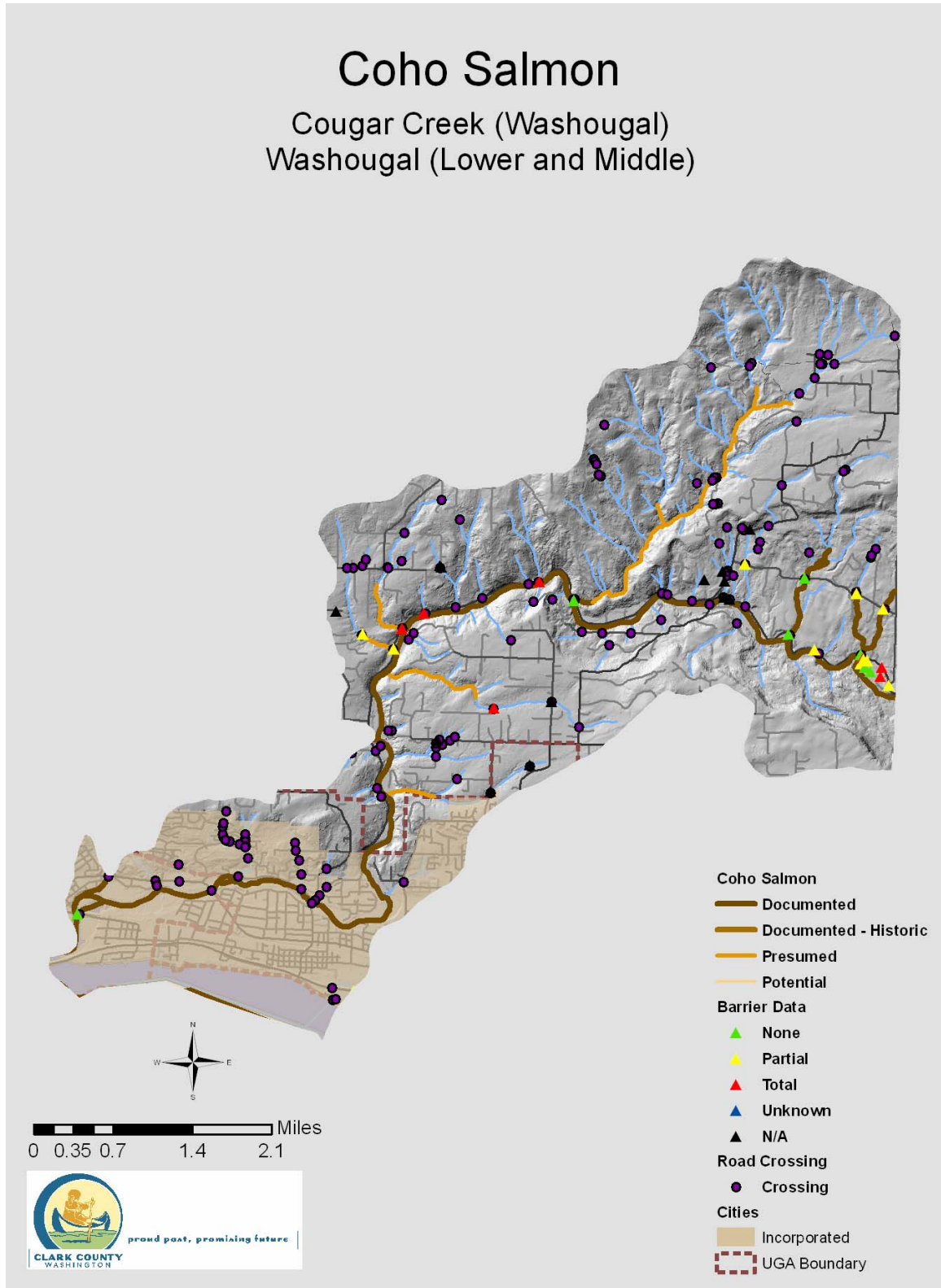
For the Cougar Creek (Washougal) subwatershed, available fish distribution data identified the known presence of summer steelhead (Figure 10) in the mainstem of Cougar Creek. Coho (Figure 8), fall Chinook (Figure 9) and winter steelhead (Figure 11) are presumed present in the mainstem of Cougar Creek.



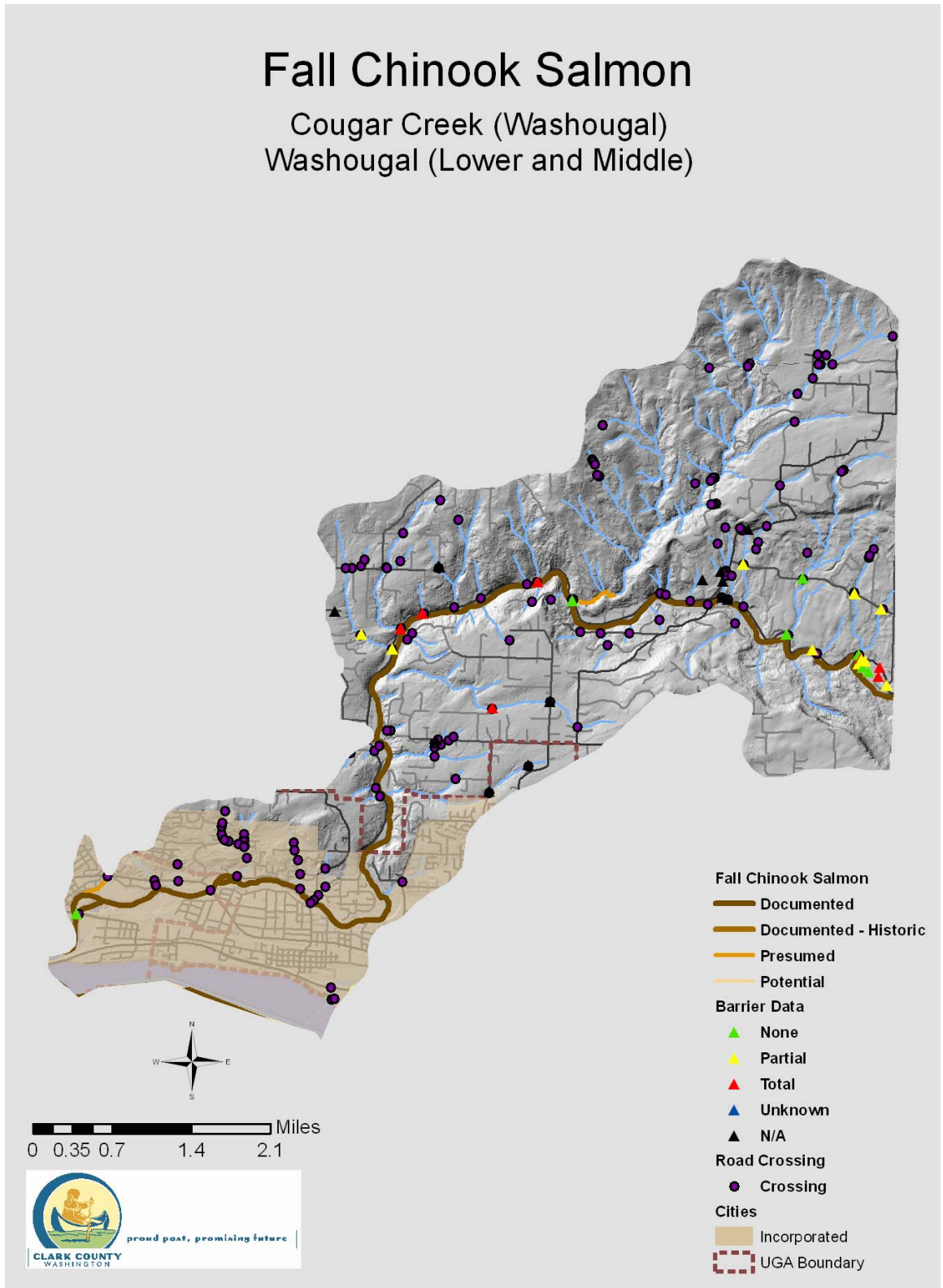


**Figure 7: Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal) Chum Distribution and Barriers**

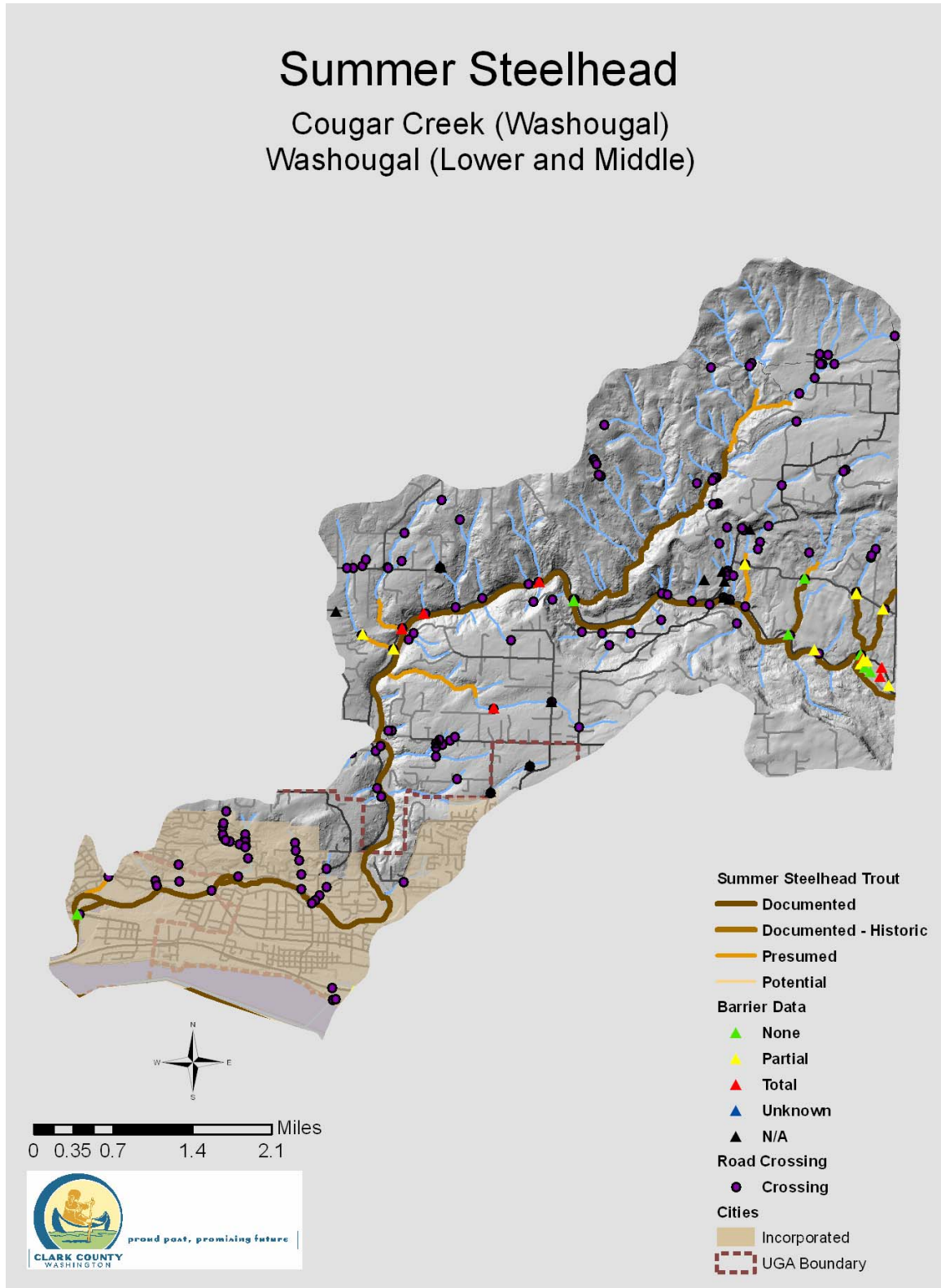




**Figure 8: Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal) Coho Distribution and Barriers**

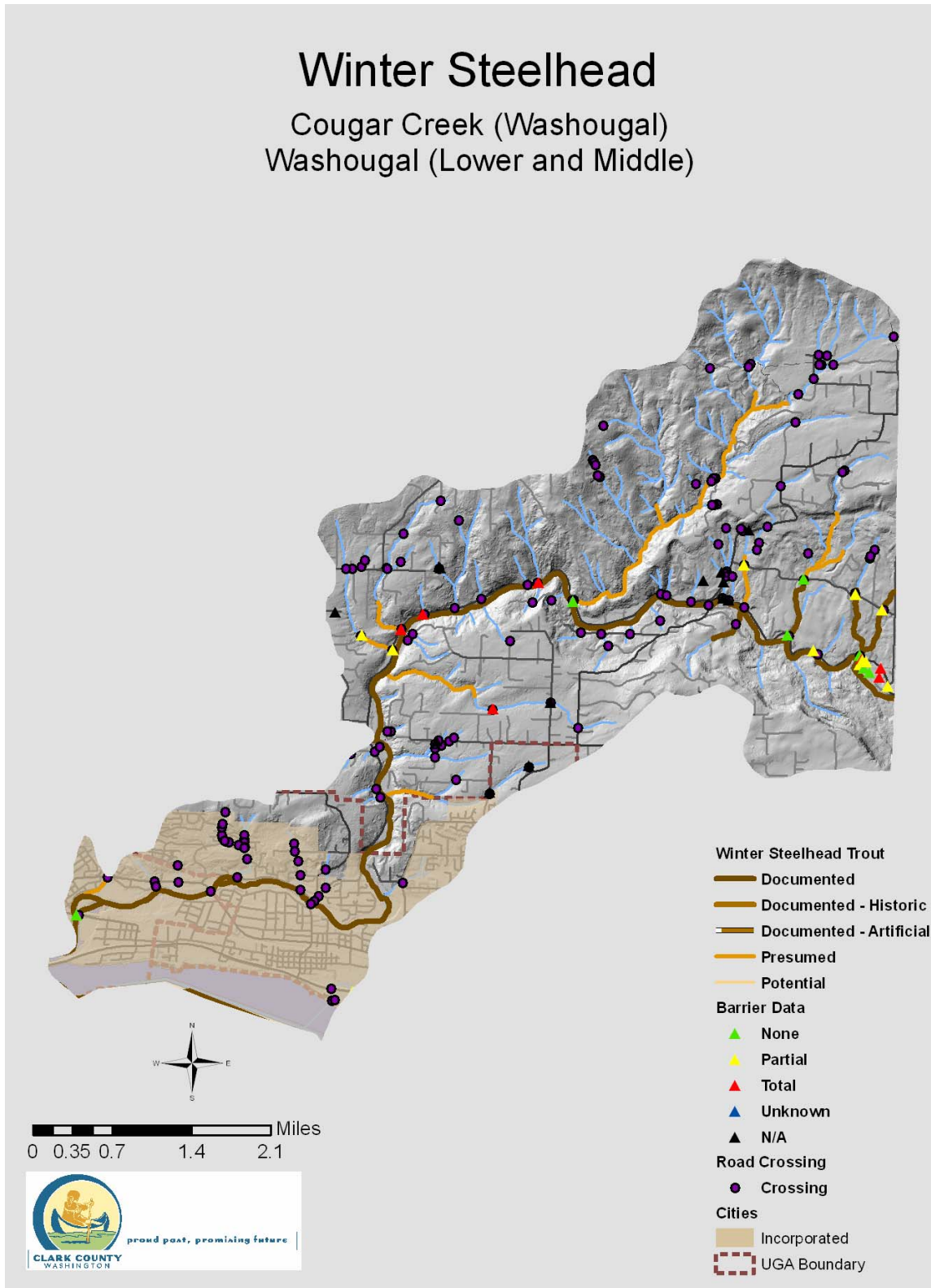


**Figure 9: Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal) Fall Chinook Distribution and Barriers**



**Figure 10: Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal) Summer Steelhead Distribution and Barriers**





**Figure 11: Washougal (Middle), Washougal (Lower) and Cougar Creek (Washougal) Winter Steelhead Distribution and Barriers**

### *Barriers*

The WDFW barrier database provides the most complete assessment of barriers in the Washougal (Lower), Washougal (Middle) and Cougar Creek (Washougal) subwatersheds (Figure 7, Figure 8, Figure 9, Figure 10, and Figure 11). There are no mapped barriers on the mainstems of the Washougal River or Cougar Creek in these subwatersheds. Several total barriers are mapped on tributaries to the Washougal River where they pass through culverts under Washougal River Rd. A few partial barriers also are mapped on tributaries.

### Recommendations

Recommendation of LCFRB do not address fish passage in these subwatersheds, suggesting that it is not a priority for efforts (LCFRB 2004, 2009). Several total barriers, mapped on tributaries to the Washougal River where they pass through culverts under Washougal River Rd, should be removed as stream crossing infrastructure is replaced or upgraded.

### Hydrologic and Hydraulic Models

Hydrologic and Hydraulic models were not assessed.



## Analysis of Potential Projects

The analysis of potential projects:

- Briefly summarizes stormwater conditions, problems and opportunities
- Notes recently completed or current projects within the study area that may be relevant to SNAP project selection
- Describes the analytical approach
- Lists recommended projects and activities for further evaluation

Projects or activities are placed in one of several categories.

Project descriptions summarize more detailed descriptions found in report sections. Project planners are encouraged to reference the longer descriptions and use the information found for each potential project in the SNAP GIS database available from the Clean Water Program. Reference IDs for the database are included in the tables for each project.

## Summary of Conditions, Problems, and Opportunities

### Conditions and Problems

This section briefly summarizes important results from the assessment chapters and identifies overall stormwater-related problems.

### *Coordination with Other Programs*

The CWP actively coordinates with the Washington Department of Ecology, Lower Columbia Fish Recovery Board, Clark County Legacy Lands and Vancouver-Clark Parks and Recreation in efforts to improve stream health. In the study area, there are no planned road improvement projects included in the 2010-2015 Clark County Transportation Improvement Program or Stormwater Capital Program.

### *Broad-Scale Characterization*

The study area ranges from forested lands in the Cougar Creek (Washougal) subwatershed to rural residential land in the Washougal (Middle) subwatershed. The Washougal (Lower) subwatershed is mostly urban and encompasses most of the City of Washougal. The study area is drained by the Washougal River and its tributaries. Areas of open space include portions of forested area in the Yacolt Burn State Forest and Washougal City parks. The topography ranges from 1200 and 1800 feet in elevation in the northeastern study area to roughly 200 feet in elevation at the floodplain of the Columbia River.

Geology consists of several geologic units: older semi-consolidated sandy gravel commonly referred to as the Troutdale Formation or Troutdale gravels; Ice Age volcanic rocks; sandy to gravelly Ice Age catastrophic flood deposits; sandy alluvium on the Columbia River floodplain.

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Standard subwatershed scale metrics such as percent forest, percent total impervious area, road density and effective impervious area, when compared to NOAA fisheries standards, suggest stream habitat is properly functioning in the Cougar Creek (Washougal) subwatershed and somewhat degraded in the Washougal (Middle) and Washougal (Lower) subwatersheds.

## *Water Quality Assessment*

There are no listings in Cougar Creek or the Washougal River in Clark County. The upper Washougal River in Skamania County is Category 5 listed (polluted waters that require a TMDL) for fecal coliform.

Measured water quality data are limited in the study area. Data collected in 2003-2004 by Ecology indicate the Washougal River was not a significant source of organophosphorus, nitrogen pesticides, PCBs or PAHs to the Columbia River.

Continuous stream temperature monitoring by Clark County (2004) at two sites indicated the Washougal River routinely exceeded stream temperature target levels of 64° F. In addition, stream temperatures and time exceeding 64° F increased consistently from upstream to downstream stations. As of 2006, the temperature criterion changed from 64° F to 60.8° F for all these stream segments.

## *Drainage System Inventory*

Significant updates to the drainage mapping database were completed in 2008 and 2009. More than 2,430 stormwater infrastructure features were added during this time. A total of 2,736 features are mapped in this study area, including 11 stormwater facilities, two of which are publicly owned and operated. Capital project retrofit opportunities and maintenance evaluations yielded two referrals to Maintenance and Operations for routine maintenance activities. Off-site evaluations were conducted at one outfall in this study area and it was found to be in compliance.

## *Illicit Discharge Screening*

Illicit discharge detection and elimination screening was not conducted.

## *Source Control*

Only three sites qualified for a source control inspection in this study area. Visits conducted and no source control issues were noted.

## *Stream Reconnaissance Feature Inventory*

A stream reconnaissance feature inventory was not conducted.

## *Physical Habitat*

Physical habitat measurements in this assessment area were made in 2004 (R2 Resource Consultants, Inc., 2004) for multiple reaches of the Washougal River.

The upper survey reach in the Washougal River transitions from a low gradient channel type to a low gradient floodplain type with pool-riffle bedforms. This survey reach has a map gradient of 0.3 percent and is moderately confined by armored banks in the lower section and incised valley walls in the upper section. Habitat consists primarily of small cobble riffle and pool. Habitat



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parameters including substrate and streambank stability are classified as properly functioning; pool quality is classified as at risk; LWD classified as not properly functioning.

The lower end of the survey reach has a gradient of less than 1 percent and is a low gradient floodplain channel with dune-ripple to pool-riffle bedforms. Habitat consists primarily of glide and small cobble riffle. In this reach, parameters including pool quality, substrate and streambank stability are classified as properly functioning and LWD is classified as not properly functioning.

### *Geomorphology and Hydrology*

A geomorphology and hydrology assessment was not conducted.

### *Riparian Assessment*

At the subwatershed scale, the LCFRB rated the riparian conditions in the Washougal (Middle) and Cougar Creek subwatersheds as Moderately Impaired and in the Washougal (Lower) subwatershed as Impaired.

The Washougal (Middle) and Washougal (Lower) subwatersheds are shown as having primarily moderate LWD recruitment potential. The Cougar Creek (Washougal) subwatershed is shown as having primarily low LWD recruitment potential.

The LCFRB habitat assessment for the Washougal (Lower), Washougal (Middle) and Cougar Creek (Washougal) subwatersheds indicated that all the surveyed reaches are currently off-target with respect to the State Forest Practices shade/elevation screen standards.

### *Wetland Assessment*

The study area has wetlands associated with the main channels of the rivers and creeks and their tributaries generally characterized as flood influenced riverine and depressional wetlands. There are few large complexes of headwater or floodplain wetlands in this system.

### *Macroinvertebrate Assessment*

A macroinvertebrate assessment was not conducted.

### *Fish Use and Distribution*

Anadromous fish use in the study area includes chum salmon, fall Chinook, summer steelhead and winter steelhead in the Washougal River.

There are no mapped barriers on the mainstems of the Washougal River or Cougar Creek in these subwatersheds. Several total barriers are mapped on tributaries to the Washougal River where they pass through culverts under Washougal River Rd. A few partial barriers also are mapped on tributaries.

## Recently Completed or Current Projects

There are no stormwater projects planned for any of these four subwatersheds in the Stormwater Capital Program or the 2010-2015 TIP.

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## Analysis Approach

### Purpose

The Analysis of Potential Projects narrows the initial list of possible opportunities to a subset of higher priority items. Listed opportunities in sections of the SNAP report include sites requiring immediate follow-up, possible stormwater capital improvement projects, internal follow-up by DES staff, and in some cases, information to be forwarded to other county departments or outside agencies.

Stormwater capital improvement project opportunities are recommended for further evaluation by engineering staff and potential development into projects for consideration through the capital planning process. Sites flagged for internal action by ongoing programs such as illicit discharge screening, operations and maintenance, and source control outreach receive follow-up within the context and schedules of the individual programs. Information forwarded to other county departments, such as Public Health, or to outside agencies, such as Clark Conservation District and Clark Public Utilities, may lead to additional activities outside the scope of DES work.

### Methods

An initial review is conducted for all potential projects identified during the stormwater needs assessment. Field notes, descriptions, field photos and other associated information are reviewed. In some cases, additional field reconnaissance is performed.

In general, capital project opportunities are initially evaluated by considering problem severity, land availability, access, proximity and potential for grouping with other projects, and potential for leveraging resources. Staff considers supporting data and information from throughout the SNAP report to assist in the initial project review.

Based on this review, lower priority opportunities are removed and higher priority opportunities are recommended for further consideration below.

## Emergency/Immediate Actions

Emergency/Immediate actions may be pursued by Clark County staff or referred to other appropriate agencies. These cases represent a potential or immediate threat to public health, safety or the environment, and require timely follow-up.

No projects of this type were identified.

## Potential Stormwater Capital Projects

Stormwater Capital Improvement Projects include projects that create new or retrofit existing stormwater flow control or treatment facilities, substantial infrastructure maintenance projects, habitat enhancement projects, or property acquisition to mitigate for stormwater impacts. Facility retrofits refer to projects that will increase an existing facility's ability to control or treat stormwater in excess of the original facility's design goals.

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### Stormwater Facility Capital Improvement Projects

No projects of this type were identified.

### Stormwater Infrastructure Maintenance CIPs

No projects of this type were identified

### Stormwater Class V Underground Injection Control (UIC) Projects

No projects of this type were identified

### Habitat Rehabilitation/Enhancement Projects

No projects of this type were identified.

### Property Acquisition for Stormwater Mitigation

ID	Basis for Project	Project Description	Action
<b>Washougal River (Middle)</b>			
OS-239	Parcel contains over 3,000 feet of Winkler Creek with impacted riparian and wetland areas.	Investigate the feasibility of acquiring property for riparian restoration, headwater wetland rehabilitation, and reforestation.	Refer to CWP Capital Planning

### Follow-up Activities for Referral within DES

This category includes opportunities other than capital projects that are dependent on DES programs or oversight. Examples include referrals to: Public Works Operations for public stormwater infrastructure maintenance or private facility inspection; DES Sustainability and Outreach for landowner letters regarding trash pickup or agricultural BMPS; the Illicit Discharge screening project; general reach information forwarded to DES engineers for capital planning purposes. Other opportunities such as possible fish barriers or culvert maintenance issues also may be included.

### Private Stormwater Facilities Maintenance

No projects of this type were identified.

### Public Works Stormwater Infrastructure Maintenance

No projects of this type were identified.

### CWP Outreach/Technical Assistance

No projects of this type were identified.

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### CWP Infrastructure Inventory

No projects of this type were identified

### CWP Capital Planning

No projects of this type were identified.

### CWP Illicit Discharge Screening

No projects of this type were identified.

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## Non-Project Management Recommendations

Non-project stormwater management recommendations address areas where county programs or activities could be modified to better address NPDES permit components or promote more effective mitigation of stormwater problems. Information of this type contributes to adaptive management strategies and more effective stormwater management during the permit term.

Management and programmatic recommendations in the study area subwatersheds, by NPDES permit component, include:

### Storm Sewer Mapping and Inventory

- Continue research and mapping new stormwater infrastructure with the goal of maintaining a complete stormwater infrastructure inventory

### Coordination of Stormwater Activities

- Pursue future collaborative stormwater activities with the City of Washougal in the Washougal (Lower) subwatershed.
- Continue to search for opportunities to coordinate or leverage projects with the Lower Columbia Fish Recovery Board through the 2010 WA Lower Columbia Salmon Recovery and Fish and Wildlife Sub-basin Plan.

### Mechanisms for public involvement

- Publish SNAP reports on CWP web page

### Development Regulations for Stormwater and Erosion Control

- Implement development regulations to minimize impacts, particularly from clearing and grading

### Stormwater Source Control Program for Existing Development

- Continue to expand efforts to design and build runoff reduction strategies in county right-of-way
- Focus on protecting reaches that are currently unstable or sensitive to future disturbance
- Conserve agricultural and forest lands and promote healthy practices

### Operation and Maintenance Actions to Reduce Pollutants

- Focus additional efforts on maintenance standards regarding excessive sedimentation

### Education and Outreach to Reduce Behaviors that Contribute Stormwater Pollution

- Educate landowners to discourage disposal of trash and yard debris in streams or other receiving waters
- Perform targeted technical assistance to minimize impact of surface and groundwater withdrawals in tributary streams
- Perform targeted technical assistance to ensure that timber harvest, land development, and road BMPs are implemented

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- Educate private landowners on importance of native riparian vegetation and intact riparian forests for shading streams and preserving hydrology
- Provide landowners a list of suggested plants for stream re-vegetation and local nurseries that stock them
- Replace missing or deteriorated stream name signs
- Develop a system to provide rural landowners education about appropriate ditch maintenance practices

### TMDL Compliance

None

### Monitoring Stormwater Program Effectiveness

None

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