

2009 Stormwater Needs Assessment Program

Upper Burnt Bridge Creek/Middle Burnt Bridge Creek Subwatershed Needs Assessment Report

Clark County Public Works Clean Water Program

March 2010



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Responsible County Officials

Program Name: Stormwater Needs Assessment Program
Project Code: SNAP
Department: Clark County Public Works Water Resources
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Client: Ron Wierenga, Clean Water Program Manager

SNAP Lead: Jeff Schnabel, Natural Resources Specialist III
Contact: 360-397-6118 x4583
jeff.schnabel@clark.wa.gov

Subwatershed Lead: Jeff Schnabel

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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

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Executive Summary

Study Area

This Stormwater Needs Assessment report includes the Middle and Upper Burnt Bridge Creek subwatersheds in southern Clark County.

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 two study area subwatersheds including water quality, biological health, habitat, hydrology, and the stormwater system.

Ongoing Projects and Involvement

The City of Vancouver, Vancouver Watersheds Council, Vancouver-Clark Parks and Recreation, Clark County, and Ecology are actively involved in improving and protecting middle and upper Burnt Bridge Creek through riparian and wetland enhancements, parks development, stormwater management, and TMDL development. The Vancouver Lake Watershed Partnership is also interested in Burnt Bridge Creek as a significant tributary to Vancouver Lake.

The two study subwatersheds lie mostly within the City of Vancouver, with only the northern fringes falling in unincorporated Clark County. The City is actively working on restoration projects within the Burnt Bridge Creek Greenway, including the Burnt Bridge Creek Regional Wetland Bank and Greenway Trails Project, a joint project between the City of Vancouver and Vancouver-Clark Parks and Recreation.

In the unincorporated areas, Clark County Clean Water Program has no stormwater projects planned or listed in the CWP Capital Planning database as of December 2009. There are no major road projects in this area under the 2010-2015 Transportation Improvement Program.

Ecology recently completed data gathering for the development of a multi-parameter TMDL (fecal coliform, temperature, and dissolved oxygen) in the Burnt Bridge Creek watershed. Clark County will participate in ongoing TMDL adaptive management when the TMDL is complete. Clark County meets its TMDL obligations through implementation of the Stormwater Management Program, which will be modified to address any specific requirements set by the Burnt Bridge Creek TMDL.

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Category	Status
<p>Water Quality</p> <p>Overall</p> <p>Fecal coliform bacteria</p> <p>Temperature and Dissolved oxygen</p>	<ul style="list-style-type: none"> • Poor to Very Poor; most 303(d) listings for Clark County stream • TMDL under development; widespread sources of bacteria • TMDL under development
<p>Biological</p> <p>Benthic macroinvertebrates</p> <p>Anadromous fish</p>	<ul style="list-style-type: none"> • No recent data in unincorporated areas. Historical data suggest poor biological integrity throughout • Coho and winter steelhead use (presumed). Low regional recovery priority; limited spawning and marginal rearing habitat
<p>Habitat</p> <p>NOAA Fisheries criteria</p> <p>Riparian</p> <p>Wetland</p>	<ul style="list-style-type: none"> • Forest cover, percent impervious area, and road density metrics are in the Non-Functioning category by wide margins • Stream crossing density is within the Properly Functioning category • Forest cover is minimal (4%) and is typically confined to parks • Large woody debris recruitment potential and shade are low overall, somewhat higher in parks and restored areas • Large expanses of potential wetlands; primarily within the riparian corridor and floodplain. • Upper reach wetlands are ditched and disconnected from floodplain • Ecology watershed characterization recommends Restoration as the management approach for this area
<p>Hydrology and Geomorphology</p> <p>Overall hydrology</p> <p>Future condition</p>	<ul style="list-style-type: none"> • Ecology data from three TMDL gages (not yet analyzed) • High infiltration capacity; stormwater often infiltrated • Projected impervious area and forest cover suggest very unstable stream channels
<p>Stormwater (unincorporated areas)</p> <p>System description</p> <p>Inventory status</p> <p>System adequacy</p> <p>System condition</p> <p>Source control</p>	<ul style="list-style-type: none"> • Primarily piped system; heavily developed • Approximately 95 public facilities and 150 private facilities • High percentage of drywells and infiltration trenches • Complete; 11,500 stormwater infrastructure features mapped • Inadequate flow control and treatment; retrofit opportunities are limited • Largely undocumented; five facilities inspected had 94% compliance with maintenance standards • Of 169 businesses visited, 43 had source control problems; 41 resolved successfully • Needs regular inspection: large number of businesses with potential source control issues

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Opportunities

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

- Potential retrofits of three County-owned stormwater facilities for improved flow control and/or treatment

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 participate in Burnt Bridge Creek TMDL development (fecal coliform, stream temperature, and dissolved oxygen) and implementation
- Coordinate and leverage opportunities with groups and agencies active in the Burnt Bridge Creek watershed
- Focus additional maintenance effort on bioswales, particularly with regard to sediment accumulation
- Keep this area on a regular rotation of Source Control inspections; a high percentage of businesses in these subwatersheds engage in activities that rank highly for potential stormwater contamination issues.

Introduction

This Stormwater Needs Assessment includes the Upper and Middle Burnt Bridge Creek 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 is also needed by county programs implementing critical areas protection and salmon recovery planning under the state GMA and the federal ESA.

Scope

This report summarizes and incorporates new information collected for the 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: Department of Environmental Services Clean Water, Stormwater Capital Planning, Legacy Lands, and ESA; Public Works Operations, Development Engineering, and CIP; Community Planning and; Public Health. Potential project or leveraging opportunities are also referred to local agencies, groups, and municipalities as appropriate.

Assessment Approach

Priorities for Needs Assessment in Upper and Middle Burnt Bridge Creek

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, several smaller drainage areas categorized as “Urban Subwatersheds Largely Within Cities” have been grouped into the Upper and Middle Burnt Bridge Creek subwatersheds.

Subwatersheds in this category are for the most part inside cities and parts of UGAs where urban development permits are controlled by cities. In these areas, county stormwater management is limited and tends to focus on management of interconnected storm sewer systems.

Assessment activities and project development are focused primarily on the unincorporated areas.

Assessment Tools Applied in Upper and Middle Burnt Bridge Creek

The SNAP utilizes 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 county-wide.

Table 1 lists the set of tools available for use in the 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 where available.

Table 1: Stormwater Needs Assessment Tools

Outreach And Involvement *	Geomorphology And Hydrology Assessment
Coordination with Other Programs *	Riparian Assessment
Drainage System Inventory and Condition*	Floodplain Assessment
Source Control *	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 Modeling
Physical Habitat Assessment	Hydraulic Modeling

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Assessment Actions

Outreach Activities

SNAP outreach activities in 2009 focused primarily on raising awareness about the SNAP effort and following up on issues discovered in 2008. Letters were sent to landowners regarding trash accumulations and various agriculture management issues observed on their property during the 2008 SNAP effort.

The following activities were completed:

- July 2009 -- Press release to local media.
- The Clean Water Program E-Newsletter is distributed to 265 subscribers. SNAP articles and updates were included in three E-Newsletter editions in 2009:
 - April 2009 – 2008 SNAP reports available
 - August 2009 – 2009 SNAP update
 - December 2009 – Article highlighting SNAP landowner litter pick-up success.
- April 2009 -- SNAP information distributed with Clean Water Program information at Small Farm Expo: 69 participants.
- August 2009 – Letters were sent to sixty-two landowners with accumulations of trash in or near the stream on their property. Twenty-two landowners responded with phone calls to the SNAP coordinator for more information or to inform the CWP that cleanup activities had been completed. One landowner reported removing 1200 pounds of trash and another picked up three garbage bags and four five-gallon buckets or litter, six tires, three washing machines, drain pipe, and aluminum siding.
- August 2009 – Information on the SNAP was distributed at the 10-day Clark County Fair.
- November 2009 – Letters were sent to twenty-one landowners with identified agriculture-related issues on their property. The letters described the problem found (improper manure storage, livestock access to the stream, etc.) and identified a suggested management practice to lessen negative impacts on water quality (cover manure piles, fence livestock from the stream). A list of local resources and a brochure highlighting small acreage best management practices were included in the mailing. No follow-up calls or questions from landowners were received by the SNAP coordinator resulting from these letters and it is unknown whether other agencies listed as resources were contacted by property owners for technical advice.
- Clean Water Program SNAP web pages were updated as needed on an on-going basis; (note, no web visitor/download statistics are available as Clark County had (has) no tracking software during this timeframe).
- A description of the SNAP was included in Clark County's annual stormwater management program plan submitted to Ecology.

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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

Coordination with Other Programs

Purpose

Coordination with other county departments and with local agencies or organizations helps to explore potential cooperative projects and ensure that the best available information is used to complete the assessment.

Coordination is a two-way relationship; in addition to bringing information into the needs assessment process, coordinating agencies may use needs assessment results to inform and enhance their programs.

Methods

The CWP maintains a list of potential coordinating programs for each subwatershed area. Coordination takes the form of phone conversations, meetings, or electronic correspondence, and is intended to solicit potential project opportunities, encourage data and information sharing, and promote program leveraging.

Potential opportunities for coordination exceeded the scope of CWP and SNAP resources; therefore, not all potentially relevant coordination opportunities were pursued. Coordination was prioritized to include departments and groups most likely to contribute materially to identifying potential projects and compiling information to complete the needs assessment.

Results

See Analysis of Potential Projects for an overall list and locations of potential projects identified during the needs assessment process. Projects suggested or identified through coordination with other agencies are included.

The following list includes departments, agencies, and groups contacted for potential coordination in the Upper and Middle Burnt Bridge Creek needs assessment area:

- Vancouver Lake Watershed Partnership
- Clark County Transportation Improvement Program

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- Clark County Legacy Lands Program
- Vancouver/Clark County Parks and Recreation
- Washington Department of Ecology
- Vancouver Watersheds Council

Review of Existing Data

Data and information review is 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 those listed below:

- Ecology 303(d) list
- Ecology Watershed Characterization and Analysis of Clark County (2009)
- Ecology EIM data
- Clark County 2004 Subwatershed Characterization
- Clark County 2004 Stream Health Report

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 describes many subwatershed characteristics such as topography, geology, soils, hydrology, land cover, land use, and GMA critical areas. A standard GIS workspace, including shape files for over 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, and 4) Orthophoto. These maps are printed out for tabletop evaluations.

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General Conditions and Subwatershed Metrics

General Geography

The study area comprises two subwatersheds in the Vancouver urban growth area: Middle Burnt Bridge Creek and Upper Burnt Bridge Creek. Most of the study area is inside the City of Vancouver with only the northern fringes in unincorporated Clark County. The study area includes the Burnt Bridge Creek Watershed above Andresen Street. Burnt Bridge Creek originates as a drainage ditch in peat marshes upstream of 112th Avenue. The only other stream channels are manmade ditches Peterson Ditch and Burton Channel flowing west into Burnt Bridge Creek West of I-5. The area is on the relatively level Willamette Valley floor (Figure 1). Land use is urban and continuing to develop within the Vancouver Urban Growth Area. Areas of open space remain chiefly as parks and undeveloped fields in extensive marshes along Burnt Bridge Creek.

Topography

The study area is generally low flat to slightly terraced hills between 200 and 300 feet in elevation and a high point of about 320 feet along Mill Plain ridge. Burnt Bridge Creek lies in a thousand-foot wide channel formed by Cataclysmic Flood waters running between Camas and Vancouver Lake. Mill Plain ridge parallels the creek to the south, while north of Burnt Bridge Creek the land surface gradually rises to the north.

Geology and Soils

The entire study area is underlain by Late Ice Age Cataclysmic Flood deposits of sand and gravel, with some finer sand deposits in the northwestern part of Middle Burnt Bridge Creek subwatershed. Peat deposits and marshes are formed in depressions left by the Cataclysmic Floods along the channel followed by Burnt Bridge Creek.

Mill Plain Ridge is a large gravel bar apparently formed as flood waters swept north across the Vancouver area. The gravel deposits are very permeable and are capable of infiltrating much if not all of the rainfall. Coarse sand and gravel extend north of Burnt Bridge Creek.

Hydrology

Geology and topography play the main role in determining study area hydrologic framework. The relatively flat lying sedimentary deposits are capable of retaining relatively large amounts of rainfall as recharge. This groundwater recharge returns to the streams in summer months from seeps and springs.

One of the key hydrologic features of the study area is that much of the stormwater runoff is routed to drywells and infiltration trenches. This promotes stream hydrology slow to respond to storms with a long period of elevated flow after storms.

Ecology is operating three gauges on Burnt Bridge Creek as part of a TMDL study; however, summary data from these gauges is not yet available.

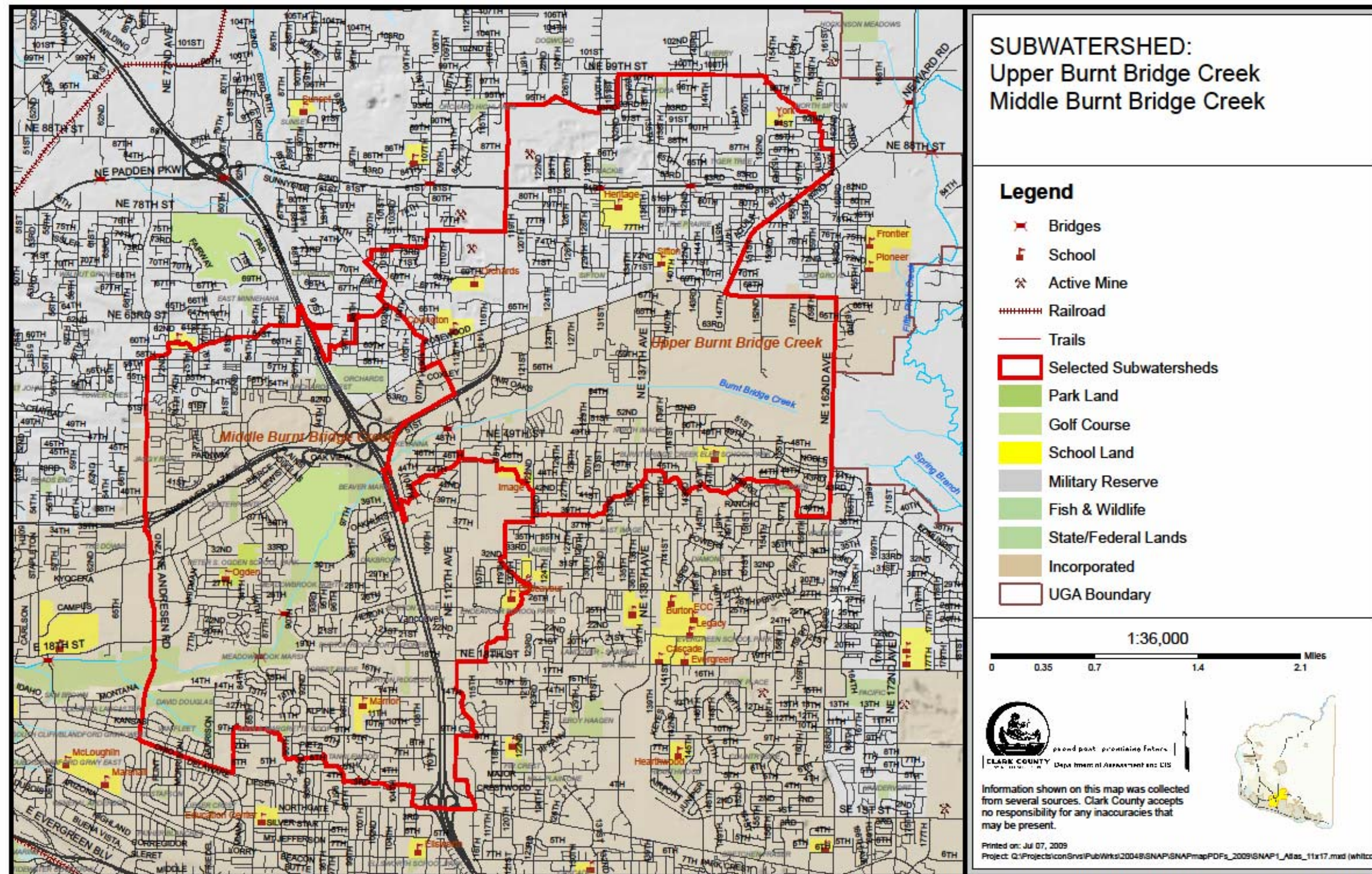


Figure 1: Subwatershed Map: Middle and Upper Burnt Bridge Creek Subwatersheds

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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 study area has non-functioning stream habitat (Table 2).

Table 2: Watershed Scale Metrics

Metric	Middle BBC	Upper BBC	Functioning	Non-functioning
Percent Forested (2000 Landsat)	4	4	> 65 %	< 50 %
Percent TIA (2000 Landsat)	50	58	< 5 %	> 15 %
Road Density 2007 data (miles/mile ²)	21	18	< 2	> 3
Stream Crossing Density (crossings per stream mile)	3.3	2.3	< 3.2/mile	> 6.4/mile
Percent EIA estimated from the Comprehensive Plan	43	47	< 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.

The study area encompasses one of the most heavily developed areas of Clark County, primarily residential and commercial. Forest cover is minimal and typically confined to parks.

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 five percent as fully functional and greater than 15 percent as non-functioning. Values for both subwatersheds are well beyond the threshold for non-functioning habitat.

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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 are approximately six-times as dense as the threshold for non-functioning (>3 road miles/mi²).

Stream Crossing Density

Stream crossing densities are easily measured using available road and stream channel data. The salmon protection standard considers larger fills over 60 feet wide, which would be approximately five to ten foot high road fill. The study area subwatersheds have stream crossing densities within or slightly above the functioning criteria (<3.2 /stream mile).

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 2008 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 study area well beyond the threshold for non-functioning.

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 (Figure 2). According to this figure, streams in both subwatersheds would be expected to have very unstable channels.

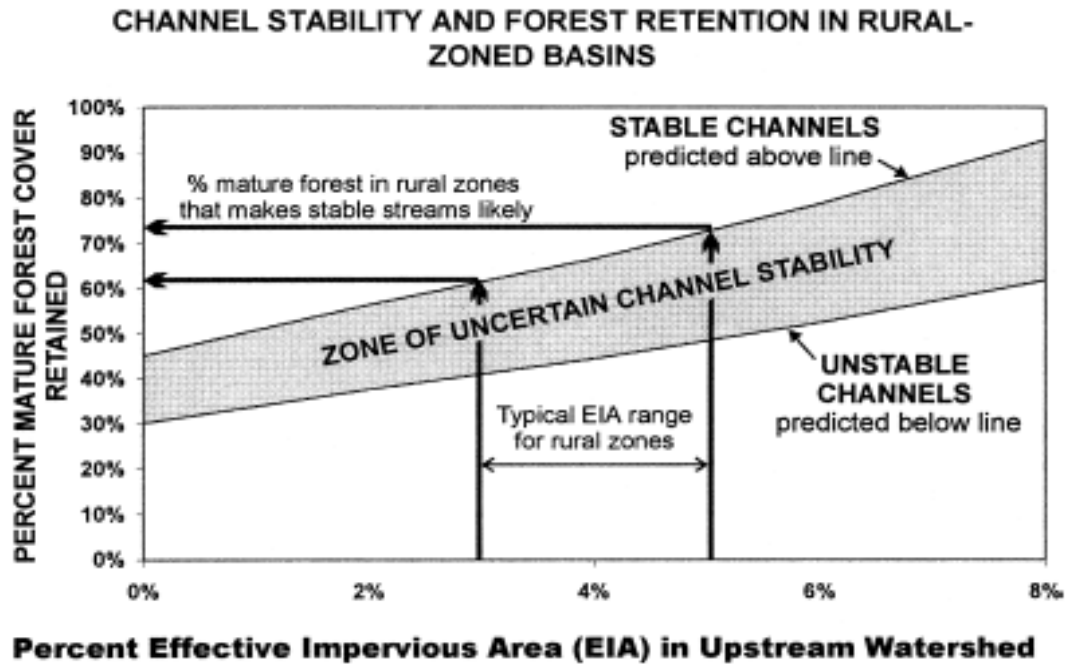


Figure 2: Channel stability in rural areas (Booth, Hartley, and Jackson, June 2002)

Water Quality Assessment

This section briefly summarizes and references available water quality data from the Upper and Middle Burnt Bridge Creek) 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, Burnt Bridge Creek is to be protected for the designated uses of: “Spawning/Rearing; 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.

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Table 3: Applicable Water Quality Criteria for Upper and Middle Burnt Bridge Creek Subwatersheds

Characteristic	Ecology criteria
Temperature	≤ 17.5 °C (63.5 °F)
Dissolved Oxygen	≥ 8.0 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>

Various segments of Burnt Bridge Creek are Category 5 listed (polluted waters that require a TMDL) for fecal coliform bacteria, pH, dissolved oxygen, and temperature, and Category 2 listed (Waters of Concern) for pH and temperature. Overall, Burnt Bridge Creek owns the distinction of having more 303(d) listed segments (25 Category 5 listings and 5 Category 2 listings) than any other water body in Clark County.

Ecology is currently developing a multi-parameter TMDL for fecal coliform bacteria, dissolved oxygen, and temperature in the Burnt Bridge Creek watershed.

Clark County Stream Health Report

In 2004, the CWP compiled available data and produced the first county-wide assessment of general water quality.

Based on the available dataset including fecal coliform bacteria, general water chemistry (temperature, pH, and dissolved oxygen), and benthic macroinvertebrate scores, overall stream health in the Upper Burnt Bridge Creek subwatershed scored in the poor to very poor range, while the Middle BBC subwatershed scored very poor.

The 2004 Stream Health Report may be viewed on the county website at:

<http://www.clark.wa.gov/water-resources/stream.html>.

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Available Data

Burnt Bridge Creek has been studied extensively since at least the early 1970s. A thorough summary of existing information is beyond the scope of this report. Without exception, monitoring reports for BBC cite significant and ongoing water quality issues. For an overview and summary of historical data, see Ecology's Quality Assurance Project Plan: Burnt Bridge Creek Fecal Coliform Bacteria, Dissolved Oxygen, and Temperature Total Maximum Daily Load- Water Quality Study Design (2008) at: <http://www.ecy.wa.gov/biblio/0803110.html>

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

Table 4: Data Sources

Source	Data and/or Report
Ecology	2008 QAPP for TMDL Water Quality Study Design Provisional data
Clark County Clean Water Program	2004 Stream Health Report

Water Quality Summary

Clark County has no active monitoring stations in the assessment area.

Periodic monitoring conducted by the City of Vancouver between 1998 and 2006 indicate that fecal coliform, dissolved oxygen, and temperature violated state water quality criteria at most sampling stations throughout the watershed. The area within the lower Burnt Bridge Creek subwatershed had consistent temperature and fecal coliform problems but violated dissolved oxygen criteria less often than the middle and upper watershed.

A microbial source tracking study in 1999 indicated humans, pets, migratory birds, urban wildlife, and livestock as the primary sources of bacterial pollution in Lower Burnt Bridge Creek.

Available data indicate dissolved oxygen, fecal coliform and temperature did not change significantly from 1972 through 2007.

TMDL data collection by Ecology ended in August 2009 at 19 monitoring stations throughout the entire Burnt Bridge Creek watershed. Provisional data and interim reports are available at: <http://www.ecy.wa.gov/programs/wq/tmdl/burntbridge/BurntBrtml.html>

Beneficial Use Impacts

Observed levels of fecal coliform bacteria, temperature, and dissolved oxygen are sufficient to have significant impacts on existing beneficial uses for Burnt Bridge Creek.

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In particular, fecal coliform bacteria limit primary contact recreation, while both elevated temperatures and low dissolved oxygen pose serious concerns for salmonid spawning, rearing, and migration.

Implications for Stormwater Management

Table 5 lists general water quality concerns in Middle and Upper Burnt Bridge Creek and potential solutions for each. Solutions listed in bold indicate areas where CWP activities can have a positive impact.

It should be noted that very little of Middle and Upper Burnt Bridge Creek subwatersheds lie within unincorporated Clark County. CWP activities, though important, are not likely to achieve water quality improvement goals on their own. Other county departments, the City of Vancouver, local agencies, and not least of all, the public, must all contribute to water quality improvement.

Among the Clean Water Program activities most likely to have a positive impact on water quality are:

- Effective stormwater system designs, retrofitting, and maintenance;
- Source detection and removal projects; and
- Public education programs.

Stormwater system design, retrofitting, and maintenance include a range of activities that can address specific pollutants of concern. Source detection and removal projects help eliminate specific contributions of pollutants and also identify areas where County stormwater outfalls connect to City of Vancouver stormwater drainage. Education programs, though they rarely have a direct impact on water quality, are a critical element in modifying behavior and promoting better public stewardship of water resources.

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Table 5: Known Water Quality Concerns, Sources, and Solutions for Upper and Middle Burnt Bridge Creek

Characteristic	Beneficial Use Affected	Potential Sources	Mechanism	Solutions (bold indicates direct Clean Water Program involvement)
Fecal coliform bacteria	Primary contact recreation	failing septic systems	groundwater seeps storm sewers	Storm sewer screening for source identification and removal Education programs Agricultural Best Management Practices Septic and sanitary sewer system inspection and maintenance
		sanitary sewer leaks	groundwater seeps storm sewers	
		livestock, pets, wildlife	overland runoff storm sewers/ditches direct access	
Water temperature	Salmonid spawning, rearing, and migration	vegetation removal	direct solar radiation	Stormwater infiltration to increase baseflow Streamside planting/vegetation enhancement/riparian preservation through acquisition Education programs
		low summer flows	decreased resistance to thermal inputs	
Dissolved Oxygen	Salmonid spawning, rearing	elevated water temperature	see above	Stormwater infiltration to increase baseflow Streamside planting/vegetation enhancement/riparian preservation through acquisition
		stagnant or low flow	dry climate cycles water withdrawals limited mixing (low gradient)	
		Excessive algal or plant growth	elevated nutrients (overland flow or groundwater) respiration processes	

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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 Department of Assessment and GIS, or viewable on the internet through the Digital Atlas located at:

<http://gis.clark.wa.gov/imf/imf.jsp?site=mapsonline>

Drainage system inventory is an ongoing CWP work effort focused on updating the StormwaterClk database to include all existing stormwater drainage infrastructure. During 2008 and 2009, the inventory was a significant priority for the CWP, with a major work effort focused on identifying and mapping previously unmapped infrastructure and reviewing existing records for completeness and accuracy.

Table 6 indicates the number of features inventoried in StormwaterClk as of December 2009. Of the total 314 stormwater facilities, ninety-three are identified as publicly owned and operated. The majority of the infrastructure listed below is in unincorporated Clark County; however, a considerable number of the listed features have been annexed into the City of Vancouver.

Table 6: Drainage System Inventory Results, Upper and Middle Burnt Bridge Creek

Database Feature Category	Inventoried prior to 2007	Added during 2007-2009	Total Features
Inlet	2308	740	3048
Discharge Point (outfall)	21	6	27
Flow Control	38	16	54
Storage/Treatment	808	321	1129
Manhole	819	212	1031
Filter System	46	21	67
Channel	346	224	570
Gravity Main	4063	1212	5275
Facilities	221	93	314

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

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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 the following facility components: detention ponds, treatment wetlands, wet ponds, pre-settling cells, open filters, or bioswales; and discharge to surface waters or to the 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 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 July 2009, there were 15 mapped public stormwater facilities in the Middle Burnt Bridge subwatershed and 78 mapped public stormwater facilities in the Upper Burnt Bridge subwatershed.

Twenty percent (3) of the mapped public stormwater facilities in the Middle Burnt Bridge subwatershed were evaluated for retrofit opportunities. In the Upper Burnt Bridge subwatershed, three percent (2) of the mapped public stormwater facilities were evaluated for retrofit opportunities.

Figure 3 summarizes notable retrofit evaluation activities in the Middle and Upper Burnt Bridge subwatersheds, including general facility location, evaluated facilities, and referrals for retrofit opportunities.

As listed in Table 7, three public stormwater facilities were referred for further evaluation as Capital Improvement Projects in the Middle and Upper Burnt Bridge subwatersheds.

The Middle Burnt Bridge subwatershed generated two referrals for further evaluation as Capital Improvement Projects; both of which included an increase for potential storage as part of the project description. The average age of the facility referred was 28.0 years. Both facilities referred had large lots that contained little storage or minimum treatment abilities.

The Upper Burnt Bridge subwatershed generated one referral for further evaluation as Capital Improvement Project; which included an increase for potential storage and treatment as part of the project description.

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No major defect and hazardous condition was discovered in the Middle and Upper Burnt Bridge subwatersheds.

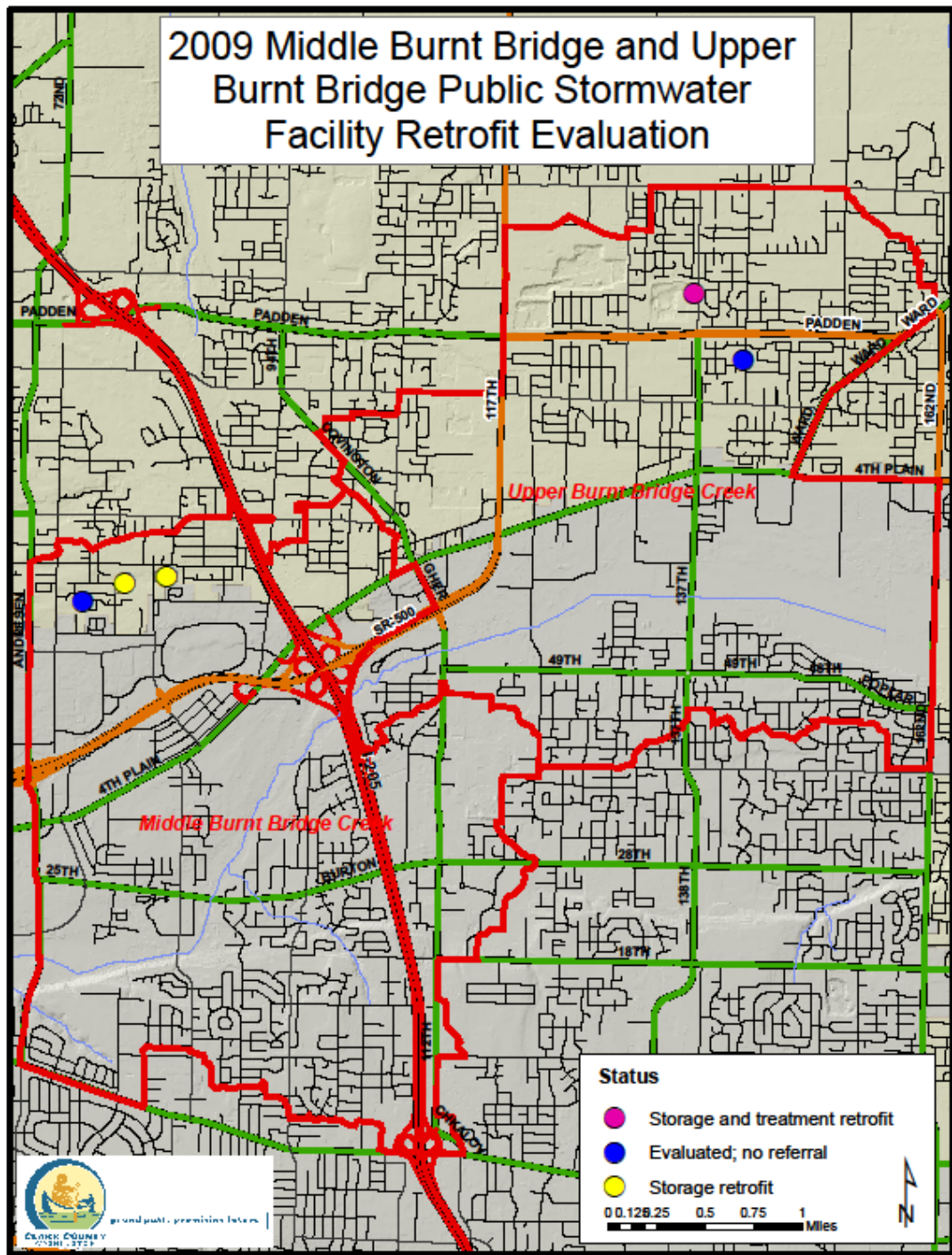


Figure 3: Summary of 2009 Retrofit Evaluation Activities in the Middle and Upper Burnt Bridge Creek subwatersheds

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Table 7: Description of Potential Retrofit Opportunities in Middle and Upper Burnt Bridge subwatersheds

Identifier	Facility Name	ID	Install Date	Basis for Project	Project Description	Subwatershed
OS-132	Glenwood I	99	05-Mar-95	Large lot with little infrastructure	Potential storage retrofit	Middle Burnt Bridge Creek
OS-133	Glenwood II	786	01-Oct-67	Large lot with little infrastructure	Potential storage retrofit	Middle Burnt Bridge Creek
CIP-64	Pebble Creek - A	1001	01-Aug-96	Site is affected by construction activities; biofiltration swale not functioning. Large lot with little infrastructure.	Potential storage and treatment retrofit.	Upper Burnt Bridge Creek

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 that contain the following facility components are evaluated: detention ponds, treatment wetlands, wet ponds, pre-settling cells, open filters, or bioswales; and discharge to surface waters or to the 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 are typically 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 of Volume V of the 2005 Stormwater Management Manual for Western Washington. The standards list the part or component of the facility, the condition when repair or maintenance is needed, and the results expected when maintenance is performed. 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

Figure 4 summarizes notable inspection and maintenance evaluation activities in the Middle and Upper Burnt Bridge Creek subwatersheds, including general facility location, compliant facilities, and referrals of noncompliant facilities.

Five public stormwater facilities were inspected in the Middle and Upper Burnt Bridge Creek subwatersheds. Two facilities were found to be out of compliance and three facilities were found to be in compliance. As listed in Table 8, these facilities included a total of 35 facility objects, of which 33 (94 percent) were in compliance.

The inspection process in the Middle and Upper Burnt Bridge Creek subwatersheds generated 2 referrals to Public Works Maintenance and Operations for needed maintenance activities.

No major defects or hazardous conditions were discovered in the Middle and Upper Burnt Bridge Creek subwatersheds; non-compliant issues included excess sediment depth and lack of signage.

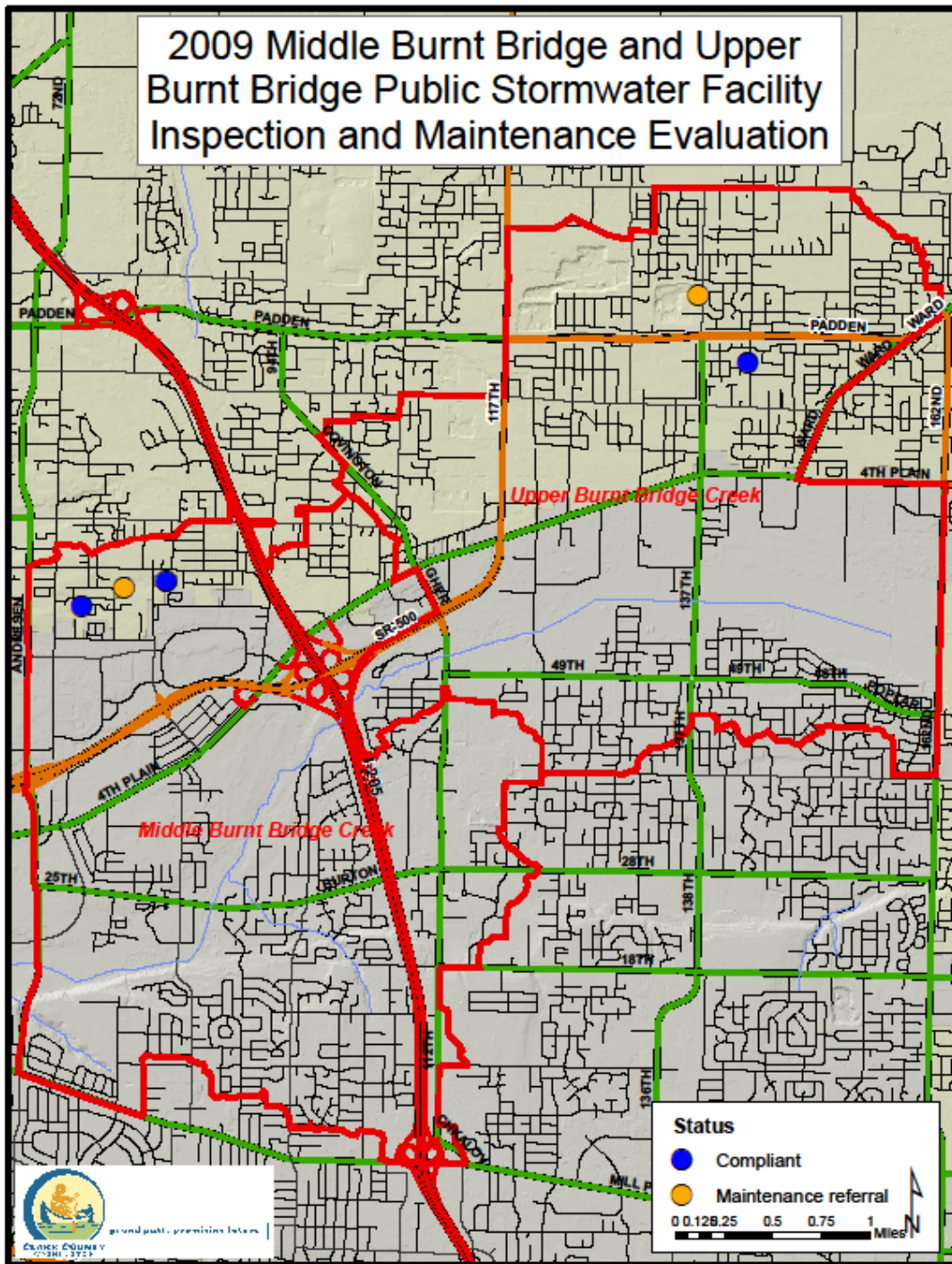
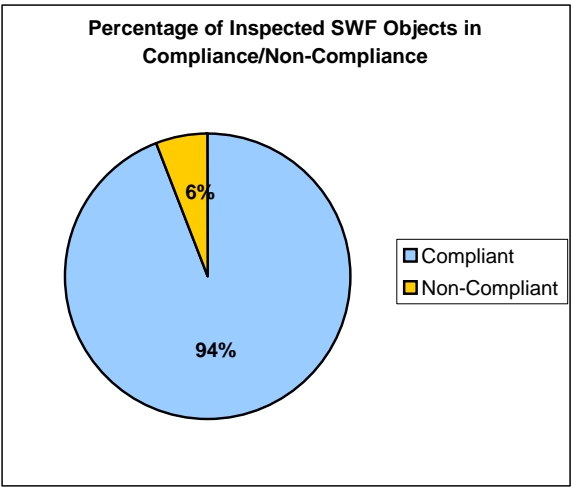


Figure 4: Summary of 2009 Public Stormwater Facility Inspection and Maintenance Evaluation Activities in the Middle and Upper Burnt Bridge Creek subwatersheds

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Table 8: 2009 Public Stormwater Facility Inspection and Maintenance Evaluation Activity in the Middle and Upper Burnt Bridge Creek subwatersheds

SNAP Public Stormwater Facility Maintenance and Inspection Evaluation		Percentage of Inspected SWF Objects in Compliance/Non-Compliance 		
Subwatershed: Middle Burnt Bridge Creek and Upper Burnt Bridge Creek				
Public SWF Inspected	5			
Stormwater Facility Objects Inspected	35			
% Compliant SWF Objects	94			
% Non-Compliant SWF Objects	6			
Facility Objects Inspected	Initial Inspections		Most Common Defect	Maintenance Trigger
	Compliant	Non-Compliant		
Access Road or Easement	5	0	n/a	n/a
Catch Basin	2	0	n/a	n/a
Control Structure / Flow Restrictor	1	0	n/a	n/a
Conveyance Stormwater Pipe	7	0	n/a	n/a
Detention Pond	5	0	n/a	n/a
Energy Dissipater	3	0	n/a	n/a
Facility Discharge Point	1	0	n/a	n/a
Fence, Gate or Water Quality Sign	2	1	sign unreadable	water quality sign is missing or 20% of the surface is unreadable
Field Inlet	2	0	n/a	n/a
Open Channel	1	0	n/a	n/a
Sediment Trap	1	0	n/a	n/a
Typical Biofiltration Swale	1	1	sediment	sediment depth exceeds 2 inches on grass
Wetpond	2	0	n/a	n/a
Total	33	2		

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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 can also 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 referred as potential Capital Projects.

Results

Based on the county's StormwaterClk database, as of June 2009 there were 9 mapped outfalls in the Middle and Upper Burnt Bridge Creek subwatersheds; one Priority 1 outfalls, no Priority 2 outfalls, and eight Priority 3 outfalls.

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Table 9 summarizes offsite assessment results from the Middle Burnt Bridge Creek subwatershed. There were five mapped outfalls discharging to critical areas; all mapped outfalls were Priority 3 outfalls and were not assessed.

Table 9: 2009 Off-site Assessment Project Activity Summary for Middle Burnt Creek subwatershed

Metric	Number of Outfalls		
	Priority 1	Priority 2	Priority 3
Total number of mapped outfalls	0	0	5
# 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 10 summarizes offsite assessment results from the Upper Burnt Bridge Creek subwatershed. There were four mapped outfalls discharging to critical areas. One Priority 1 outfalls was assessed and found to be in compliance. No Priority 3 outfalls were assessed.

Table 10: 2009 Off-site Assessment Project Activity Summary for Upper Burnt Creek subwatershed

Metric	Number of Outfalls		
	Priority 1	Priority 2	Priority 3
Total number of mapped outfalls	1	0	3
# 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

Potential Projects

The offsite assessment project yielded no potential project opportunities.

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Management Recommendations

Retrofit evaluations conducted at five public stormwater facilities generated three referrals for further evaluation as Capital Improvement Projects. The most common treatment BMP across facilities referred was a detention pond. All facilities referred had large lots with minimum stormwater infrastructure and included an increase for potential storage as part of the project description. The average age of the facility referred in the Middle and Upper Burnt Bridge Creek subwatersheds was 23.0 years old. Further evaluations of other stormwater facilities with similar age and stormwater infrastructure may identify additional referrals for further evaluation as Capital Improvement Projects.

The inspection and maintenance evaluation is conducted at public stormwater facilities in conjunction with retrofit evaluations. Two facility objects were found to be out of compliance and included sedimentation issues and lack of stormwater facility signage. Correcting facility sedimentation issues and adding appropriate signage will bring facilities into compliance.

Outfall assessments generated no potential project opportunities. Maintaining the frequency of offsite assessment activities may reduce downstream erosion problems by discovering potential issues before they become a more serious erosion problem.

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 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 the activities performed by the business may impact their subwatershed.

Most importantly, the purpose of the source control visit is to find, then eliminate or change, business activities that are negatively impacting stormwater runoff.

Methods

Under the County's 2007 NPDES municipal stormwater permit, each year staff is required to visit 20% 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% of all county businesses each year.

To determine which specific businesses will be inspected each year, the Stormwater Needs Assessment Program (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).

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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 they are 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.

Results

In 2009, staff visited 100% of the businesses required under the NPDES permit in the Upper and Middle Burnt Bridge Creek subwatersheds. Some, but not all, multi-family complexes were also visited in these subwatersheds. Table 11 summarizes source control activities.

Table 11: Source Control Project Summary, Upper and Middle Burnt Bridge Creek subwatersheds

Metric	Number
Number of sites visited	169
Number of sites with source control issues	43
Number of repeat visits	50
Number of sites with issues successfully resolved	41
Number of sites referred to other agencies	3

Overview

Upper Burnt Bridge Creek subwatershed includes businesses just south of the Eastridge Business Park. This subwatershed contains concentrated areas of light industrial businesses. Most are small companies with less than ten employees. Many of the businesses are located in older strip mall-like industrial complexes. However there are also stand alone businesses on very large parcels with complicated source control issues like gravel pits and yard debris recycling yards.

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Many businesses within Upper Burnt Bridge Creek subwatershed engage in activities that rate highly for potential stormwater contamination issues, such as automotive maintenance related shops. However, once the owners were given technical assistance, their increased awareness of potential stormwater pollution typically led to BMPs being implemented. A few businesses required capital expenditures to come into compliance.

Upper Burnt Bridge Creek is a subwatershed that should be kept on a regular inspection rotation to ensure the large number of businesses with potential source control issues remain in compliance.

Middle Burnt Bridge Creek subwatershed has mostly been annexed by the City of Vancouver. It does include a couple auto dealerships with potential source control issues but no specific cases currently requiring follow up.

Success stories

The following success stories highlight project activities at locations where significant discharges to surface and/or groundwater were discovered.

Case 1:

- While initially touring the facility, the site manager told staff all the fluids on the maintenance shop floor were hosed into an interior drain which was piped to a septic tank. Washing commercial or industrial wastewater into the septic system is a prohibited discharge.
- Staff also found de-icing chemicals stored outside in plastic drums. The drums had deteriorated and were leaking on a gravel lot.
- Washington Department of Ecology and Clark County Health Department were contacted, and the CWP coordinated a return visit during which all agencies met with the site manager for a thorough reinspection.
- Washington Department of Ecology took the lead with the disposal and cleanup of the leaking chemicals.
- Clark County Health Department took the lead with Ecology's backup to locate the septic system. Tests of the soil and groundwater around the septic system confirmed contamination. The site manager is cooperating with Ecology and Clark County Health Department to clean up the site.
- Clean Water Program worked with the City of Vancouver's Wastewater staff to connect the floor drain at the site to the City of Vancouver's sanitary sewer.

Case 2:

- While touring the outside of a restaurant, staff noticed the stormwater catch basin was full of what appeared to be cooking grease. The restaurant owner confirmed that when the grease barrel filled up the employees were dumping the excess grease into the catch basin.
- Staff requested that the catch basin be pumped clean, and the owner complied.

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- Upon a return visit, staff again found grease in the catch basin.
- The City of Vancouver Wastewater Grease trap inspectors were contacted to investigate a possible cross connection with the grease trap. None was found.
- Further investigation found that although restaurant employees were no longer dumping grease into the catch basin, the private company hired to empty the barrel was spilling grease into the catch basin during the process
- After confirming the new source and contacting the grease collection company, the problem was eliminated. City of Vancouver grease trap staff will continue to visit the catch basin and contact the CWP if problems recur.

Illicit Discharge Detection and Elimination Screening

Illicit Discharge Detection and Elimination Screening was not conducted.

Stream Reconnaissance and Feature Inventory

A stream reconnaissance and feature inventory was not conducted.

Physical Habitat Assessment

A physical habitat Assessment was not conducted

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 within 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 exceeds 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, the Washington State University (WSU) Watershed Stewards Program, and the Clark Conservation District for possible implementation.

This section focuses on opportunities likely to be considered by the CWP SCIP, which are primarily 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, primarily the Habitat Assessment reports prepared for the Lower Columbia Fish Recovery Board (R2 Resource Consultants, Inc., 2004). 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 such as Burnt Bridge Creek where no data exists 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.

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

Results

Because Burnt Bridge Creek was not included in the 2004 LCFRB Habitat assessment, LWD recruitment potential and shade rating analyses were based on site visits by staff and a qualitative review of 2007 orthophotographs.

Riparian (Large Woody Debris (LWD) Delivery)

Review of the Middle Burnt Bridge Creek and Upper Burnt Bridge Creek subwatersheds, including the main stem of Burnt Bridge Creek as well as its tributaries, indicated relatively low LWD recruitment levels. Burnt Bridge Creek may have localized areas of slightly higher LWD recruitment where it flows through forested vegetation at Beaver Marsh Natural Preserve and Kevanna Park. In general, Burnt Bridge Creek flows through areas where herbaceous vegetation is dominant, which does not present an opportunity for LWD production. Portions of Burnt Bridge Creek within the Meadowbrook Marsh area have been recently enhanced with native woody tree and shrub species (see “Potential Projects” section below). As those installed plants mature, they will provide more opportunity for LWD recruitment at Meadowbrook Marsh.

Shade

The Middle and Upper Burnt Bridge Creek subwatersheds shade ratings were not included in the 2004 LCFRB Habitat Assessment. Review of these subwatersheds, including the main stem of Burnt Bridge Creek as well as its tributaries, indicated relatively low levels of shade. The main channel of Burnt Bridge Creek is estimated to have low shade levels, based on a site visit and orthophotography review.

Burnt Bridge Creek may have localized areas of slightly higher shade where it flows through forested vegetation at Beaver Marsh Natural Preserve and Kevanna Park. In general, Burnt Bridge Creek flows through areas where herbaceous vegetation is dominant, which does not

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present an opportunity for high levels of shading. Portions of Burnt Bridge Creek within the Meadowbrook Marsh area have been recently enhanced with native woody tree and shrub species (see “Potential Projects” section below). As those installed plants mature, they will provide more opportunity for shade at Meadowbrook Marsh.

Management Recommendations

Overall recommended management activities for the Middle and Upper Burnt Bridge Creek subwatersheds include riparian forest restoration in degraded areas, restoration of sinuosity in channelized reaches, and invasive species removal.

Potential Projects

Potential riparian restoration projects for the Middle and Upper Burnt Bridge Creek subwatersheds were identified during site visits and analysis of orthophotography.

In the Middle Burnt Bridge Creek subwatershed, within the Meadowbrook Marsh area, enhancement projects have recently been completed which will increase the capacity of the riparian zone of Burnt Bridge Creek and a tributary (“Burton Channel”) to provide LWD and shade. According to the Vancouver-Clark Washington Parks & Recreation’s Park Planning and Design website:

Burnt Bridge Creek Regional Wetland Bank & Greenway Trails Project is a joint project of Surface Water Management of the City of Vancouver Public Works Department and the Vancouver-Clark Parks and Recreation Department. The project is funded by Surface Water Management enterprise funds and an Interagency Committee for Outdoor Recreation (IAC) grant. Improvements will include:

- surface water treatment
- native tree and shrub plantings to enhance habitat and nesting areas for fish and wildlife
- creek connected to new wetlands
- three new trail links which will add 3.5 miles of trail

The Meadowbrook North area, between Burton Road and Royal Oaks Drive, would benefit from riparian forest restoration (planting native trees and shrubs), restoration of sinuosity, and exotic species removal (reed canary grass). This area is owned by the City of Vancouver.

The Beaver Marsh area would benefit from riparian forest restoration (planting native trees and shrubs), and exotic species removal (reed canary grass). This area is owned by the City of Vancouver.

In the Upper Burnt Bridge Creek subwatershed, the City of Vancouver either owns land or has rights to easements along the mainstem of Burnt Bridge Creek in several locations. With a few exceptions these areas are largely unforested and channelized, and would benefit from enhancement projects involving planting native trees and shrubs, removing invasive vegetation, and restoring sinuosity.

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Reforestation of these areas would provide both improved riparian LWD recruitment and stream channel shading.

There are several potential project areas within the Middle and Upper Burnt Bridge Creek subwatersheds, along the mainstem of Burnt Bridge Creek that are located on publicly owned land. These projects are identified and described in Table 12.

Table 12: Tax Exempt Parcels Overlapping Potential Riparian Restoration Areas

ASSR_SN	ASSR_AC	OWNER	PT1DESC	Description
109976-000 109952-000 163470-000 163594-000 163481-000	35.39 acres	City of Vancouver	Unused vacant land – no improvements	“Meadowbrook North” Areas of potential reforestation and sinuosity restoration and invasive species removal on the mainstem of Burnt Bridge Creek from Burton Road to Royal Oaks Drive
159542-000	32 acres	City of Vancouver	Unused land timbered	“Beaver Marsh” Although most of this parcel is forested, the immediate riparian area is dominated by reed canary grass. Potential for reforestation and invasive species removal on the mainstem of Burnt Bridge Creek from approx. 39 th St to I-205.
159851-000 159857-000 159852-000 159853-000 159854-000 159855-000 159856-000 157532-000 158354-000 158457-002 158419-000 158352-000 158409-000	TBD	Multiple private owners. Easements allow access	Unused or Vacant Land - No improvements, Prime Developable Ground	“Burnt Bridge Creek Greenway & Trail” Areas of potential reforestation, invasive species removal, and sinuosity restoration on the mainstem of Burnt Bridge Creek from I-205 to 112 th Ave, and also from Oakbrook Way to approx. NE 127 th Ave. Potential projects should be reviewed by drainage district to ensure consistency with drainage goals.

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Geomorphology and Hydrology Assessment

A geomorphology and hydrology assessment was not completed.

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, Draft Watershed Characterization of Clark County Version 3 (Ecology, 2007), 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, schools, or churches where large parcel sizes and opportunities for leveraging may exist. Potential wetlands were overlaid with tax-exempt parcels and with county vacant buildable lands model (VBLM) information to identify possible wetland enhancement opportunities.

Results

Figure 5 shows potential wetland areas within the Upper Burnt Bridge Creek/Middle Burnt Bridge Creek subwatershed based on data from the county wetlands atlas, including the Clark County wetland model, National Wetlands Inventory, and high-quality wetlands layer.

The Upper Burnt Bridge Creek/Middle Burnt Bridge Creek subwatershed has large expanses of potential wetland areas associated with the Burnt Bridge Creek riparian corridor and floodplain. The majority of these wetlands have been identified as riverine wetlands, however the large wetland complex along the upper reaches of the creek has been highly modified by ditching of

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the main channel and drainage of adjacent floodplain areas with a combination of ditches and drain tiles. The result is that there is a mix of wetlands and uplands in this area. Many of the wetlands in the upper reaches have been isolated from the creek and thereby converted to depressional or slope wetlands. Wetlands associated with the creek and its floodplain constitute approximately 70% of the total wetland area in the subwatershed. The remaining 30% of wetlands in the subwatershed are located outside of the channel and floodplain areas. These wetlands also provide important functions, improving water quality and retaining or attenuating surface water. Table 13 shows the total area and proportion of wetland classes estimated to be present in the subwatershed.

Table 13 Distribution of Wetlands by Hydrogeomorphic Class

HGM Class	Area (ac.)	% of Sub-basin*	% of total wetland
Slope Wetlands	16	0.2%	3%
Depressional Wetlands	162	1.9%	28%
Riverine Wetlands	411	4.9%	70%
All Wetlands	588	7.0%	

*Subwatershed area 8455 Ac.

The City of Vancouver has completed a significant amount of restoration of the riverine wetlands in the lower reaches of the subwatershed (between NE Andresen and NE Burton roads) as part of the Burnt Bridge Creek Enhancement Project and has a work crew dedicated to maintaining native plantings and managing invasive vegetation within the project limits. This project included a number of enhancements for water quality and flood reduction by reconnecting riverine wetlands to the creek.

Though there are large areas in the upper reaches where wetlands could be reestablished and reconnected to the creek, a majority of the land is in private ownership and is likely to be developed to the extent that existing wetland conditions will allow. This will create opportunities for the City of Vancouver to direct wetland mitigation toward designs that will improve or restore watershed scale processes. However, the County holds an easement for drainage maintenance along the upper reaches of the creek and requires land owners to maintain vehicular access along the north bank; this limits the ability to reconnect wetlands adjacent to the north banks to the creek. Without a land acquisition program, there are limited opportunities for further public projects.

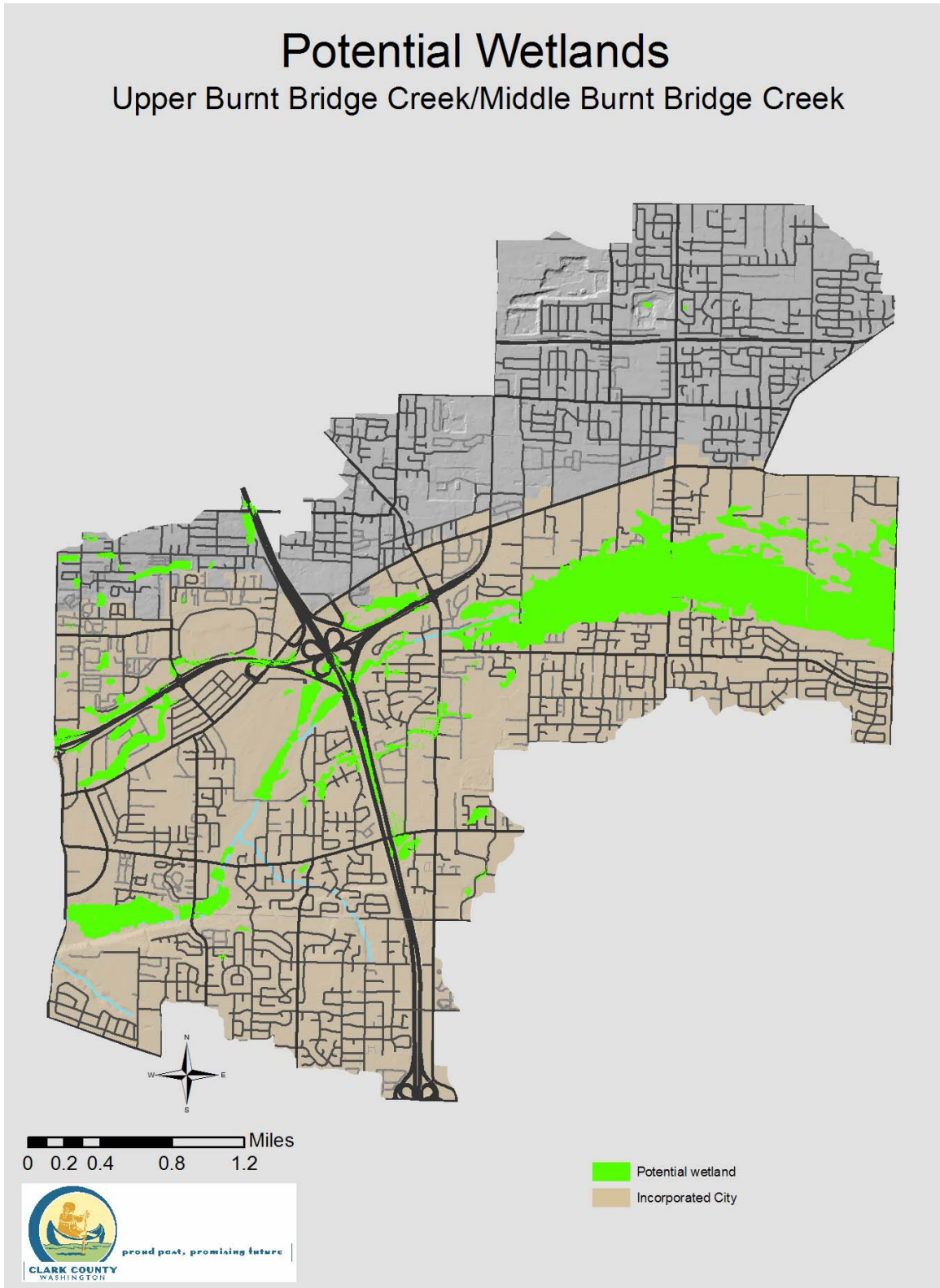


Figure 5: Upper Burnt Bridge Creek/Middle Burnt Bridge Creek Potential Wetlands

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Watershed Characterization

The Washington Department of Ecology completed a prototype watershed assessment to assist in planning wetland and riparian habitat restoration and preservation projects. The Watershed Characterization and Analysis of Clark County (Washington Department of Ecology, 2009) may be found on the Ecology website at:

http://www.ecy.wa.gov/mitigation/docs/09-06-019_small.pdf

Results pertaining to the Upper Burnt Bridge Creek and Middle Burnt Bridge Creek subwatersheds are summarized below.

Both subwatersheds are part of the Terrace hydrogeologic unit. This unit is dominated by rain; has a westward to southwestern trending groundwater flow pattern; a large delta (now a terrace) formed by glacial floods consisting of gravels, sand, silts and clay; and a relatively level to moderately steep topography in the foothills and slopes above the Columbia River (Ecology, 2009).

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

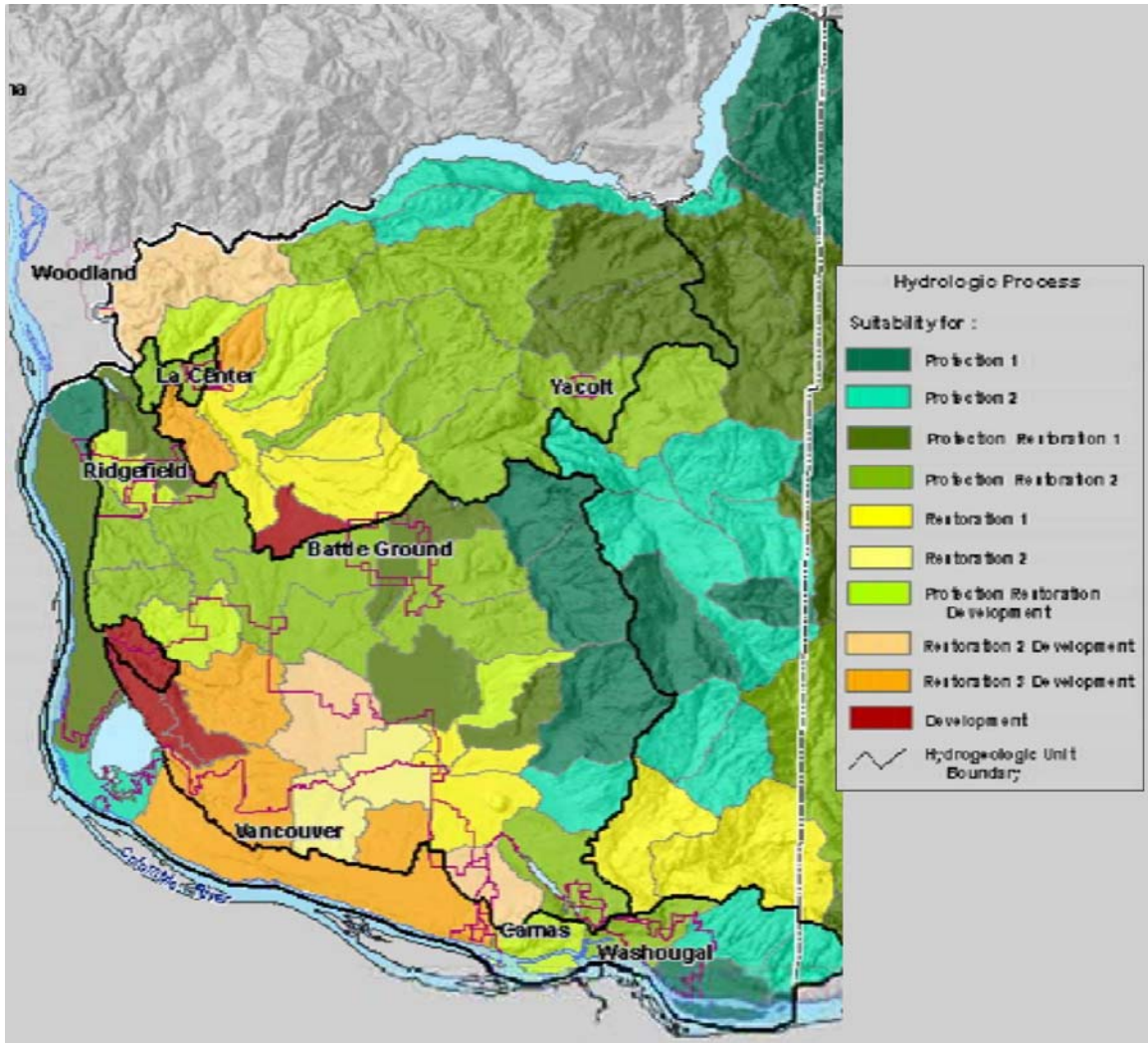


Figure 6: Priorities for suitability of areas for protection and restoration for the hydrogeologic process (from Watershed Characterization and Analysis of Clark County (Ecology, 2009))

In general, blue and green 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. Orange to red areas have lower levels of importance for watershed processes and higher levels of alteration and should be considered as more suitable for development. Because orange areas represent a transition from restoration areas, planning measures employing both restoration and appropriately sited development should be considered (Ecology, 2009).

Restoration 2 (light yellow) is the hydrologic process priority for the Upper Burnt Bridge Creek/Middle Burnt Bridge Creek subwatershed.

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Potential Projects

Potential project locations for further exploration based on this wetland assessment include those listed in Table 14 and Table 15.

Table 14: Tax Exempt Parcels Overlapping Potential Wetlands

ASSR_SN	ASSR_AC	OWNER	PT1DESC	Description
A) 109779-928 109773-130	20.4 acres	City of Vancouver	bio-filtration swales/ponds	Depressional wetlands adjacent to the upper reaches the creek partially affected by a power line corridor.
B) 109976-000 109952-000 163470-000 163594-000 163481-000	35.39 acres	City of Vancouver	Unused vacant land – no improvements	Riverine wetlands along the creek and wetland creation opportunities in adjacent uplands
C) 159542-000	32 acres	City of Vancouver	Unused land timbered	Riverine wetland/ beaver complex along creek dominated by Reed Canary grass.

Table 15: Description of Potential Project Opportunities

ID	Basis for Project	Project Description
A) N/A	Large low lying areas adjacent to, but isolated from the straightened channel of the creek. Opportunity for headwater storage	Reconnect the channel to a naturally functioning flood plain. Possibly meander the channel through the site and re-establish native vegetation.
B) N/A	Lack of native wetland vegetation and widespread invasive plant species areas adjacent to the creek. Straightened channel reaches with reduced floodplain.	Re-establish forest and shrub vegetation and create additional off-channel wetlands to improve flood storage and water quality function.

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 Middle and Upper Burnt Bridge Creek subwatersheds is mapped from existing GIS information in the WDFW SalmonScape database, and is available at <http://wdfw.wa.gov/mapping/salmonscape/>

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

- WDFW passage barrier database.
- 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

The available evidence suggests that anadromous fish use within the Middle and Upper Burnt Bridge Creek subwatersheds includes Coho salmon and winter steelhead (Figure 7). These reaches mainly function as possible rearing habitat for these species.

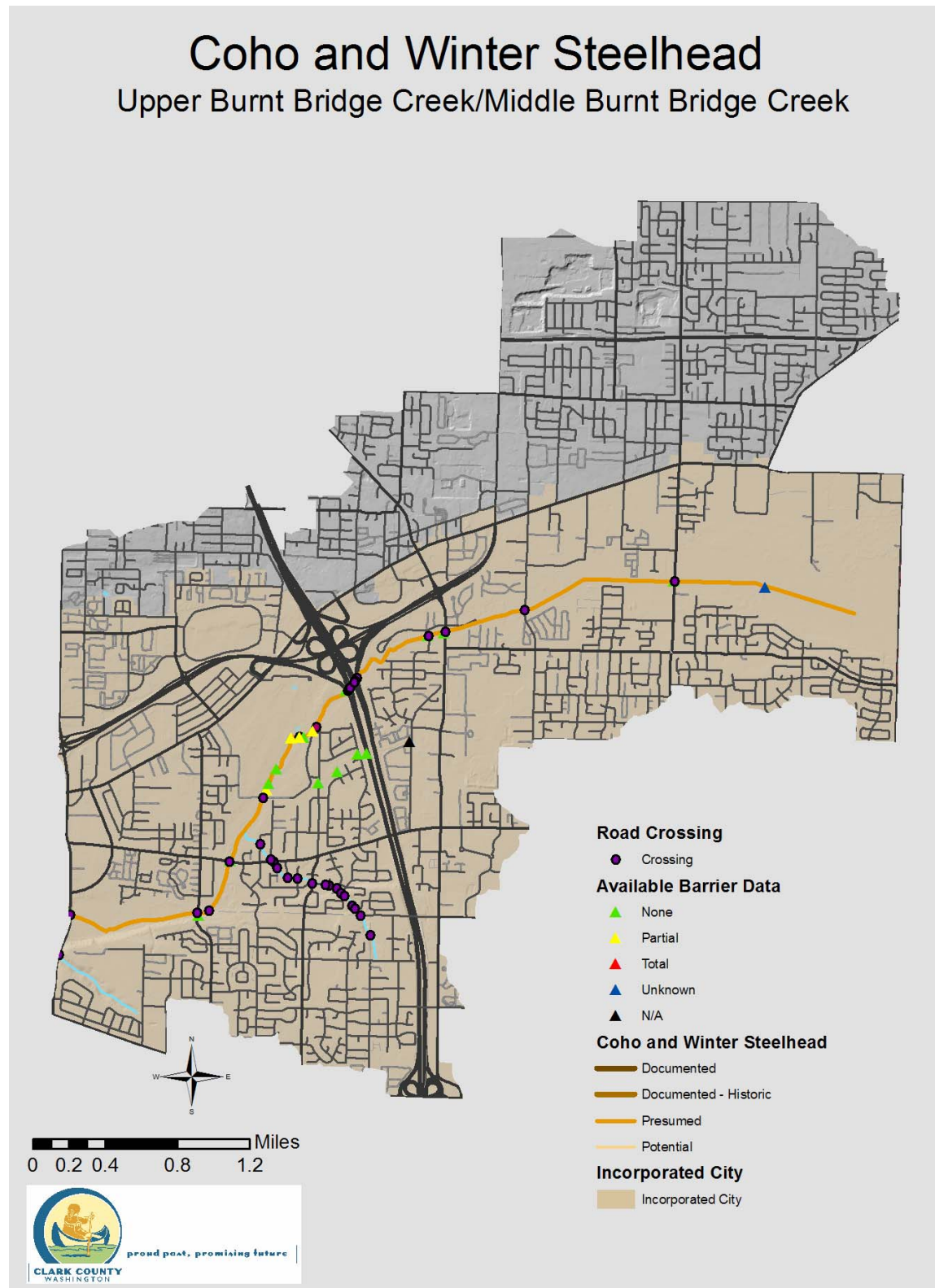


Figure 7: Middle and Upper Burnt Bridge Creek Fish Distribution and Barriers

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Barriers

The WDFW barrier database provides the most complete assessment of barriers in the Middle and Upper Burnt Bridge subwatersheds (Figure 7.)

There are four partial barriers within the Middle Burnt Bridge Creek subwatershed and none in the Upper Burnt Bridge Creek subwatershed. The four partial barriers within the Middle Burnt Bridge Creek subwatershed are associated with the Royal Oaks golf course. Some of these barriers appear to be road/cart paths that act as partial barriers during high flow events.

Recommendations

Improvement or replacement of the partial barriers within the Middle Burnt Bridge Creek subwatershed is considered a low priority, since minimal spawning habitat exists upstream and rearing habitat is considered marginal. From a WRIA perspective, financial resources would be better spent on sites with higher potential for significant benefits to listed species. Additionally, the four partial barriers within the Middle Burnt Bridge Creek subwatershed are privately owned.

No recommendations are proposed for Upper Burnt Bridge Creek since no barriers have been identified at this time.

Hydrologic and Hydraulic Models

H and H modeling was not conducted

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 also to utilize 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 subwatersheds in this assessment area lie primarily within the City of Vancouver, with only the northern fringes in unincorporated Clark County. The City of Vancouver and Vancouver Watersheds Council direct considerable resources to implementing stormwater and water quality programs in the incorporated areas. The Burnt Bridge Creek Greenway is a significant community asset and the focus of numerous rehabilitation and parks development projects. Ecology is developing a TMDL for several water quality parameters and will coordinate local agency implementation actions and adaptive management. The Clean Water Program regularly communicates with all of these entities.

There are no road improvement projects in the unincorporated areas of BBC in the 2010-1015 Clark County Transportation Improvement Program, and as of December 2009 no potential stormwater management capital projects listed in the CWP Capital Planning database.

Broad-Scale Characterization

The study area is highly urbanized and is drained by small streams and manmade ditches. Areas of open space remain primarily in parklands and marshes along the mainstem of Burnt Bridge Creek. Burnt Bridge Creek lies in a wide channel formed by Ice-Age floods; topography is generally low and flat with slightly terraced hills typical of the relatively level floor of the Willamette valley. Geology consists of sedimentary gravel and sand deposited by the ancestral Columbia River floods, with peat deposits and marshes formed in remnant depressions. The

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sedimentary deposits are capable of infiltrating and storing relatively large amounts of rainfall; much of the stormwater in this area is routed to drywells and infiltration trenches, promoting stream hydrology that is relatively slow to respond to storms and is then followed by a lengthy period of elevated flow.

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 not properly functioning. This assessment area is among the most heavily developed areas in Clark County.

Water Quality Assessment

Multiple stream segments within middle and upper Burnt Bridge Creek are included on the 2008 303(d) Ecology list of impaired water bodies. Both subwatersheds are included in ongoing TMDL development for fecal coliform, dissolved oxygen, and water temperature.

Burnt Bridge Creek has been studied since at least the early 1970s, with results consistently pointing to significantly degraded water quality.

Recent data collection by Ecology as part of TMDL development indicates that water quality remains poor, with fecal coliform bacteria, temperature, and dissolved oxygen all representing significant impacts to beneficial uses.

Drainage System Inventory and Condition

Stormwater infrastructure is extensive in this area. Significant updates to the drainage mapping database were completed in 2008 and 2009. Approximately 2,845 previously un-mapped infrastructure features were added to the database in Upper and Middle Burnt Bridge Creek, bringing the total to nearly 12,000 mapped features.

As of December 2009, the StormwaterClk database contained 314 stormwater facilities in this assessment area, 93 of which were shown as publicly owned, and some of which have been annexed into the City of Vancouver.

Five public stormwater facilities were evaluated for potential retrofit opportunities, three of which were referred for further project evaluation. Thirty-three of the 35 facility objects making up these facilities (94%) were in compliance with standards in the *2005 Stormwater Management Manual for Western Washington Volume V*. Two referrals were generated for maintenance.

Non-compliant issues were relatively minor and consisted of excessive sedimentation of bioswales and missing signage. No major defects or hazards were discovered.

An off-site evaluation was conducted at one outfall discharging to a critical area. The outfall was in compliance.

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Source Control

Source control inspections were conducted at 169 businesses in this assessment area. Forty-three sites had source control problems; 41 were successfully resolved through technical assistance, re-visits, or referral to other agencies (3).

This area should be kept on a regular rotation of source control inspections; a high percentage of businesses in these subwatersheds engage in activities that rank highly for potential stormwater contamination issues.

Illicit Discharge Screening

Illicit discharge screening was not conducted.

Stream Reconnaissance Feature Inventory

A Stream Reconnaissance Feature Inventory was not conducted.

Physical Habitat

A physical habitat assessment was not conducted.

Geomorphology and Hydrology

A geomorphology and hydrology assessment was not conducted.

Riparian Assessment

Burnt Bridge Creek was not included in the 2004 LCFRB Habitat Assessment. Based on site visits and aerial photo review, overall riparian conditions provide limited LWD recruitment potential and low levels of shade. Localized areas, including the Beaver Marsh Natural Preserve and Kevanna Park, have somewhat better riparian condition. Ongoing restoration work by the City of Vancouver in the Burnt Bridge Creek Greenway should result in improved riparian conditions over time.

Wetland Assessment

There are large expanses of potential wetland areas associated with the Burnt Bridge Creek riparian corridor and floodplain, representing approximately 70% of the wetland area in these subwatersheds. In the upper reaches, many historic wetlands have been ditched and remaining pockets of wetland are separated from the stream channel.

The City of Vancouver has completed a significant amount of riverine wetland rehabilitation in the lower reaches of the assessment area. In the upper watershed, most land is privately owned and restoration project opportunities are limited in the absence of land acquisition. The City may have opportunities to direct wetland mitigation toward designs that improve watershed-scale processes as future land development takes place.

Ecology's watershed characterization of Clark County places the assessment area in the Restoration 2 category, due to a higher level of regional importance and higher level of current alteration from historical conditions.

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Macroinvertebrate Assessment

A macroinvertebrate assessment was not conducted

Fish Use and Distribution

The available information suggests that anadromous fish use in the assessment area includes Coho salmon and winter steelhead. Streams in these subwatersheds function primarily as possible rearing habitat, with limited spawning habitat.

There are four partial barriers identified in the Middle BBC subwatershed, associated with Royal Oaks golf course. Barrier removal is a low priority in this assessment area; there is minimal spawning habitat upstream, and rearing habitat is considered marginal.

Recently Completed or Current Projects

As of December 2009, there are no stormwater projects listed in the CWP Capital Projects database within this assessment area.

In the incorporated areas, the City of Vancouver is actively working on restoration projects within the Burnt Bridge Creek Greenway, including the Burnt Bridge Creek Regional Wetland Bank and Greenway Trails Project, a joint effort between City of Vancouver Public Works and Vancouver-Clark Parks and Recreation. This project includes surface water treatment, native plantings, wetland reconnection, and 3.5 miles of additional trails.

Analysis Approach

Purpose

The Analysis of Potential Projects narrows the initial list of possible opportunities to a manageable subset of higher priority potential projects. Listed opportunities in sections of the SNAP report include sites requiring immediate follow-up, possible stormwater capital improvement projects, referrals to ongoing programs, and potential projects for referral 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 SCIP process. Referrals to 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 program areas. Referrals 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 CWP scope.

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.

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In general, potential capital projects are evaluated by CWP staff considering problem severity, estimated cost and benefits, 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 projects are recommended for further consideration by the CWP.

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 Facility Capital Improvement Projects

Identifier	Issue	Project	Action
OS-132	Facility (Glenwood I) sits on a large parcel with room for potential expansion	Retrofit for increased storage	Refer to CWP Capital Planning
OS-133	Facility (Glenwood II) sits on a large parcel with room for potential expansion	Retrofit for increased storage	Refer to CWP Capital Planning
CIP-64	Site (Pebble Creek-A) is affected by construction activities; bioswale not functioning. Large parcel with room for potential expansion	Retrofit for increased storage or treatment	Refer to CWP Capital Planning

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 Habitat Preservation

No projects of this type were discovered.

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Follow-up Activities for Referral within CWP

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

CWP Infrastructure Inventory

No projects of this type were identified

CWP Illicit Discharge Screening

No projects of this type were identified

Projects for Referral to Other County Departments, Agencies, or Groups

Several project opportunities were noted by staff developing the Riparian and Wetland chapters of this report. All of these opportunities are on property owned by the City of Vancouver or accessible by easement, and most are already known to City of Vancouver and Vancouver-Clark Parks and Recreation staff. Table 12, Table 14, and Table 15 of this report describe the opportunities on these parcels that SNAP staff felt were most advantageous from a stormwater management and habitat restoration perspective.

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

- None

Coordination of Stormwater Activities

- Encourage coordination between Clark County and City of Vancouver in this area, particularly at stormwater connection points between the County and City systems.

Mechanisms for public involvement

- Publish SNAP reports on CWP web page

Development Regulations for Stormwater and Erosion Control

- None

Stormwater Source Control Program for Existing Development

- None

Operation and Maintenance Actions to Reduce Pollutants

- Focus additional effort on maintenance of bioswales, particularly excessive sediment conditions

Education and Outreach to Reduce Behaviors that Contribute Stormwater Pollution

- None

TMDL Compliance

- Continue involvement in Burnt Bridge Creek TMDL development and adaptive management. Clark County fulfills its TMDL compliance obligations through ongoing implementation of the Stormwater Management Program

Monitoring Stormwater Program Effectiveness

- None

References

- Booth, D.B. and C.R. Jackson. (1997). Urbanization of Aquatic Systems: Degradation Thresholds, Stormwater Detention, and the Limits of Mitigation: *Journal of the American Water Resources Association*, vol. 33, no. 5, p. 1077-1090.
- Booth, D.B., Hartley, D., and Jackson, R. (June 2002). Forest Cover, Impervious-Surface Area, and the Mitigation of Stormwater Impacts: *Journal of the American Water Resources Association* vol. 38, no. 3. p. 835-845.
- Booth, D. B., et al. (October 2004). Reviving Urban Streams: Land Use, Hydrology, Biology, and Human Behavior: *Journal of the American Water Resources Association*, pp. 1351-1364.
- Center for Watershed Protection (March 2003). Impacts of Impervious Cover on Aquatic Systems: *Watershed Protection Monograph No. 1*.
- City of Vancouver – Surface Water Management (May 2007). Burnt Bridge Creek Watershed Program. Vancouver, WA
- Clark County Public Works Water Resources (June 2003). Standard Procedures for Monitoring Activities, pp. 46-48.
- Clark County Public Works Water Resources (December 2003). Long-Term Index Site Monitoring Project: 2002 Physical Habitat Characterization, pp. 35.
- Clark County Public Works Water Resources (2004). Clark County Stream Health, A comprehensive overview of the condition of Clark County’s streams, rivers, and lakes, pp 46.
- Clark County (2004). Regional wetland inventory and strategy: 51 pages.
- Collyard, S. (2009). Salmon Creek Nonpoint Source Pollution Total Maximum Daily Load: Water Quality Effectiveness Monitoring Report. Washington Department of Ecology. Publication No. 09-03-042.
- Cornelius, L. (July 2006). Gee Creek Watershed Restoration Background Report: WSU Clark County Extension.
- Cornelius, L. and J. Finley (January, 2008). Gee Creek Watershed Restoration Project 2007 Annual Report: WSU Clark County Extension.
- Cramer, S.P. & Associates, Inc. (January 2005). Chapter 4: East Fork Lewis River Basin – Habitat Assessment, report prepared for the Lower Columbia Fish Recovery Board under contract to Clark County Water Resources.

2009 Stormwater Needs Assessment Program

Cude, C. (2001). Oregon Water Quality Index: A Tool for Evaluating Water Quality Management Effectiveness. *Journal of the American Water Resources Association*. Vol. 37, No.1.

Everts, Russel C. (2004). Geologic map of the Ridgefield 7.5' quadrangle, Washington: U.S. Geological Survey Scientific Investigations Map 2834, scale 1:24,000. (<http://pubs.usgs.gov/sim/2004/2844>).

Fore, L.S., City of Bellevue (March 1999). Measuring the Effects of Urbanization on Bellevue Streams, pp. 24.

Hill, K., and M.C. Bidwell (January 2003). A Rapid Land Cover Classification for Clark County: Washington: Department of Landscape Architecture and Urban Ecology Lab, College of Architecture and planning, University of Washington, Seattle, Washington.

Hoxeng, C. (2009). Salmon Creek Focused Assessment: Fecal Coliform and Turbidity. Clark County Clean Water Program, Vancouver, Washington.

Hutton, R., and C. Hoxeng (April 2007). Clark County Long-term Index Site and Salmon Creek Monitoring Projects' Status and Trends Based on Oregon Water Quality Indices and Turbidity: Clark County Water Resources Program, Vancouver, Washington.

Karr, J.R. (1998). Rivers as Sentinels: Using the Biology of Rivers to Guide Landscape Management, *River Ecology and Management: Lessons from the Pacific Coastal Ecosystems*. Springer, NY, pp. 502-528.

Law, A.W. (1994). The effects of watershed urbanization on stream ecosystem integrity. Masters Thesis. University of Washington, Seattle Washington.

Lower Columbia Fish Recovery Board. (Dec. 2004). Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan. Volume II, Subbasin Plan Chapter G, North Fork and East Fork Lewis.

Lower Columbia Fish Recovery Board. (Dec. 2004). Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan. Volume II, Subbasin Plan Chapter H, Lower Columbia Tributaries Bonneville and Salmon.

Lower Columbia Fish Recovery Board. (Dec. 2004). Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan. Volume II, Subbasin Plan Chapter I, Washougal.

Lower Columbia Fish Recovery Board. (2007). Regional Culvert Inventory, Project #02-1658N, Final Report.

Lower Columbia Fish Recovery Board. (2008). East Fork Lewis River Community Habitat Restoration Plan and Project Design – Draft Technical Memorandum 1 and 2.

Lower Columbia Fish Recovery Board. (2009) Lower Columbia Salmon Recovery 6-Year Habitat Work Schedule and Lead Entity Habitat Strategy.

2009 Stormwater Needs Assessment Program

Montgomery, David R. and John M Buffington (1997). Channel-reach morphology in mountain drainage basins: GSA Bulletin; May 1997; v. 109; no. 5; p. 596–611.

National Marines Fisheries Service (August 1996). Making Endangered Species Act Determinations of Effect for Individual or Grouped Actions at the Watershed Scale: Environmental and Technical Services Division, Habitat Conservation Branch.

National Marines Fisheries Service (March 2003). ESA Guidance for Analyzing Stormwater Effects: NOAA Fisheries Service, Northwest Region.

Pacific Groundwater Group and Fishman Environmental Services LLC. (October 2002). Salmon Creek Watershed Assessment. Prepared for Clark Public Utilities.

Parametrix, Inc. (2002). Burnt Bridge Creek Riparian Habitat Assessment. Prepared for the City of Vancouver, 37 pp.

R2 Resource Consultants, Inc. (December 2004). Kalama, Washougal, Salmon, and Lewis River Habitat Assessments Chapter 1: Introduction and Methods, report prepared for the Lower Columbia Fish Recovery Board under contract to Clark County Water Resources.

R2 Resource Consultants, Inc. (December 2004). Kalama, Washougal, Salmon, and Lewis River Habitat Assessments Chapter 3: The North Fork Lewis River Basin, report prepared for the Lower Columbia Fish Recovery Board under contract to Clark County Water Resources.

R2 Resource Consultants, Inc. (December 2004). Kalama, Washougal, Salmon, and Lewis River Habitat Assessments Chapter 5: The Salmon Creek Basin, report prepared for the Lower Columbia Fish Recovery Board under contract to Clark County Water Resources

R2 Resource Consultants, Inc. (December 2004). Kalama, Washougal, Salmon, and Lewis River Habitat Assessments Chapter 6: The Washougal River Basin, report prepared for the Lower Columbia Fish Recovery Board under contract to Clark County Water Resources.

Schnabel, J. (December 2003). Long-Term Index Site Monitoring Project: 2002 Physical Habitat Data Summary: Clark County Public Works Department, Water Resources Program, Vancouver, Washington.

Schnabel, J. (September 2004). Salmon Creek Watershed: Summer 2003 Stream Temperature. Clark County Public Works Department, Water Resources Program, Vancouver, Washington.

Schnabel, J. (2005). Technical Report: Salmon Creek NE 167th Avenue to Risto Road Temperature Survey. Clark County Water Resources, Clark County, Washington.

Schueler, T. (1999). Microbes and Urban Watersheds: Ways to Kill ‘em. Watershed Protection Techniques. 3(1): 566-574.

2009 Stormwater Needs Assessment Program

S.P. Cramer & Associates, Inc. (January 2005). Chapter 4: East Fork Lewis River Basin – Habitat Assessment, report prepared for the Lower Columbia Fish Recovery Board under contract to Clark County Water Resources.

State of Oregon Department of Environmental Quality (July 2004). Draft Lower Willamette Subbasin TMDL.

Swanson, R.D. (July 2006). Prioritizing Areas for Stormwater Basin Planning: Clark County Public Works, Water Resources Program.

Vancouver Lake Watershed Partnership Technical Group. Technical Foundation for Future Management of Vancouver Lake (November 2008).

Turney, G.L. (1990). Quality of Groundwater in Clark County, Washington: US Geological Survey Water Resource Investigation Report 90-4149, 97 p.

United States Environmental Protection Agency (1986). Quality Criteria for Water 1986: EPA 440/5-86-011, Office of Water Regulations and standards, Washington, DC.

US Army Corps of Engineers (November 2007). Review of Biological Research on Juvenile and Adult Salmonid use of Vancouver Lake. Portland District.

U.S.G.S. (2002). Hydrologic Trends Associated with Urban Development for Selected Streams in the Puget Sound Basin: Western Washington (Water-Resources Investigations Report 02-4040), Tacoma, WA, pp. 40.

Washington State Department of Ecology. Watershed Characterization and Analysis of Clark County (July 2009). Publication Numbers 09-06-019.

Washington Department of Ecology (November 2006). Water Quality Standards for Surface Waters of the State of Washington: Chapter 173-201A WAC. Publication # 06-10-091.

Washington Department of Ecology (April 2005). O'Brien, Ed. 2005 Stormwater Management Manual for Western Washington: Volume I -- Minimum Technical Requirements and Site Planning, Report 05-10-029, Olympia, WA.

Washington State Department of Ecology. Stormwater Management Manual for Western Washington (February 2005). Publication Numbers 05-10-029 through 05-10-033.

Washington Department of Ecology (April 2007). Draft Watershed Characterization of Clark County, Version 3: Shorelines and Environmental Assistance Program.

Washington Forest Practices Board Manual (March 2000).

2009 Stormwater Needs Assessment Program

Washington State University Vancouver (2009). Bollens, Stephen and Gretchen Rollwagen-Bollens. Year One Annual Report: Biological Assessment of the Plankton in Vancouver Lake, WA.

Wierenga, R., Clark County Water Resources, (January 2005). Technical Report: Subwatershed Characterization and Classification: Clark County Washington, pp. 17.

Wierenga, R. (2005.) Benthic Macroinvertebrate and Water Temperature Monitoring for Clark County Watershed Assessments in 2004. Clark County Public Works Department – Water Resources Program. Washington Department of Ecology Grant number G0300020 and Clark County Clean Water Program.