2008 Stormwater Needs Assessment Program

Rock Creek (North)/East Fork Lewis River (RM 15.75) Subwatershed Needs Assessment Report

Clark County Public Works Clean Water Program

April 2009

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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
OWQI	Oregon Water Quality Index
PFC	Properly Functioning Condition
RM	River Mile
SCIP	Stormwater Capital Improvement Program
SCIPIT	Stormwater Capital Improvement Program Involvement Team
SCMP	Salmon Creek Monitoring Project
SCWC	Salmon Creek Watershed Council
SNAP	Stormwater Needs Assessment Program

SWMP	Stormwater Management Program
SWMMWW	Stormwater Management Manual for Western Washington
TIA	Total Impervious Area
TIP	Transportation Improvement Program
TIR	Technical Information Report
TMDL	Total Maximum Daily Load
TP	Total Phosphorus
UGA	Urban Growth Area
UIC	Underground Injection Control
USFS	U.S. Forest Service
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VBLM	Vacant Buildable Lands Model
VLWP	Vancouver Lake Watershed Partnership
WAC	Washington Administrative Code
WCC	Washington Conservation Commission
WDFW	Washington Department of Fish and Wildlife
WRIA	Water Resource Inventory Area
WSDOT	Washington Department of Transportation
WSU	Washington State University

Executive Summary

Study Area

This Stormwater Needs Assessment report includes the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds in northeastern Clark County. The assessment effort focused on the unincorporated areas within these subwatersheds.

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

Ongoing projects and involvement

The Washington Department of Ecology is developing Total Maximum Daily Loads (TMDL) for bacteria and temperature in the East Fork Lewis River watershed.

This assessment did not identify any major projects in the study area sponsored by regional entities such as the Lower Columbia Fish Recovery Board, Clark County Legacy Lands, and Clark County Transportation Improvement Program.

There are no Clark County Clean Water Program stormwater projects in the assessment area under the 2009 - 2014 Stormwater Capital Improvement Program.

Category	Status
Water Quality	
Overall	• Good (East Fork Lewis River (RM 15.75)); Poor to Fair (Rock Creek (North))
Fecal coliform bacteria	• East Fork Lewis River (RM 15.75) meets fecal coliform standard year-round; Rock Creek fails the standard year-round • Both included in the East Fork Lewis River fecal coliform TMDL
Temperature	• Both fail temperature standard • Both are included in the East Fork Lewis River temperature TMDL
Biological	
Benthic macro-invertebrates	• Moderate biological integrity for both East Fork Lewis River (RM 15.75) and Rock Creek (North)
Anadramous fish	• Known use by fall Chinook and Coho, chum salmon, winter and summer steelhead (East Fork Lewis River (RM 15.75)); Coho salmon and winter steelhead (Rock Creek (North)) • High regional recovery priority (Tier 1) for East Fork Lewis River (RM 15.75); Lower priority (Tier 2) for Rock Creek (North)
Habitat	
NOAA	• Road density falls into Non-Functioning category (both subwatersheds)
Fisheries criteria	• Percent total impervious area (both) and percent forested (Rock Creek (North)) are marginally functioning • Percent forested (EFLR (15.75)), as well as stream crossing density and projected effective impervious area (both subsheds) fall into the Properly Functioning category
Riparian	• Overall shade varies at 20 to 70% (East Fork Lewis River) and 0-90% (Rock Creek (North)) • Large woody debris recruitment potential is moderate to high for East Fork Lewis River (RM 15.75); estimated as low to high for Rock Creek (North)
Wetland	• Limited to riparian areas and stream channel floodplains, and larger areas in the Fargher Lake and Gabriel Road vicinities (Rock Creek (North))
Hydrology and Geomorphology	
Overall hydrology	• No detailed hydrologic assessment available for either subwatershed
Future condition	• Impervious area projected to remain at levels that do not alter hydrology if existing forest cover is retained or expanded
Stormwater (Unincorp. areas)	
System description	• Primarily road-side ditches • No public stormwater facilities; limited number of private facilities
Inventory status	• Complete
System adequacy	• Adequate treatment is probably provided by vegetation in ditches • No flow control other than ditch infiltration
System condition	• Twenty-four outfalls discharging to critical areas; all were in compliance • 193 public outfalls inspected for illicit discharges; none detected

Opportunities

Projects listed in the SNAP report represent only a small part of those needed to protect and restore streams within the study area. Field work and review of existing information identified numerous projects and actions that can improve stream conditions, including the following:

- Focused stormwater outreach and education to streamside landowners based on assessment results.
- Ditch retrofits to provide water quality treatment
- Evaluation of wetland and riparian enhancement projects in areas having conservation covenants
- Evaluation of two culverts for potential modifications to reduce erosion
- Technical assistance visits to landowners with potential source control and water quality ordinance issues.
- Small or large-scale invasive plant removal and riparian restoration projects.
- Evaluation/maintenance of several clogged and undersized culverts
- Exclusion of livestock from the stream in four locations.

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 study area include:

- Continue to coordinate with Washington Department of Ecology during East Fork Lewis River bacteria and temperature TMDL development.
- Develop a system to provide education about appropriate ditch maintenance practices to rural landowners
- Provide technical assistance to rural development projects required to implement stormwater controls
- Replace deteriorated stream name signs at road crossings.
- Continue to encourage and support riparian planting efforts by private landowners
- Consider focusing future assessments on smaller tributary streams which typically have the most severe stormwater problems

Introduction

This Stormwater Needs Assessment includes the Rock Creek (North) and East Fork Lewis River (RM 15.75) 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 and most cost effective mix of improvement actions to protect existing beneficial uses, and to improve or allow for the improvement of lost or impaired beneficial uses consistent with NPDES objectives and improvement goals identified by the state GMA, ESA recovery plan implementation, 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 protections and salmon recovery planning under the state Growth Management Act (GMA) and the federal Endangered Species Act (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.

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 the Public Works CWP and Stormwater Capital Improvement Program (SCIP), several programs within the Department of Community Development, and the county's ESA Program. Potential project or leveraging opportunities are also referred to local agencies, groups, and municipalities as appropriate.

Assessment Approach

Priorities for Needs Assessment in Rock Creek (North) and East Fork Lewis River (RM 15.75)

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, both Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds are categorized as "Rural Residential with No UGA". Subwatersheds in this category are generally not heavily forested but have limited stormwater management needs due to the lack of urbanization. Assessment efforts for these subwatersheds focus primarily on summarizing existing information to identify potential restoration projects.

Assessment Tools Applied in Rock Creek (North) and East Fork Lewis River (RM15.75)

The SNAP utilizes a standardized set of tools for subwatershed assessment, including desktop mapping analysis, modeling, outreach activities, and a variety of field data collection. 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 marked with an asterisk (*) are those for which new data or analyses were conducted during the course of this needs assessment. The remaining tools and chapters were completed based on pre-existing information.

Table 1: Stormwater Needs Assessment Tools

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

Assessment Actions

Outreach Activities

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

- August 2008 -- press release to local media.
- March 2008 & December 2008– articles in Clean Water Program E-Newsletter.
- April 2008 -- SNAP information distributed with Clean Water Program information at Small Farm Expo: 69 participants.
- August 2008 – information on the SNAP program distributed at 10-day Clark County Fair.
- Clean Water Program web pages updated as needed on an on-going basis; 138 visitors to the SNAP Web page and 95 unique downloads of SNAP documents (note, these figures are under reported as tracking software only records top 20 pages and documents monthly).
- A description of the SNAP is included in Clark County's annual stormwater management program plan submitted to Ecology.

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

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

- Site visits by clean water technical assistance staff.
- Letters detailing specific issues 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 improve 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 with departments and groups thought 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 gathered 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 Rock Creek (North) and East Fork Lewis River (RM 15.75) needs assessment area:

- Clark County Endangered Species Act Program
- Lower Columbia Fish Recovery Board
- Lower Columbia Fish Enhancement Program
- Clark County Transportation Improvement Program
- Clark County Legacy Lands Program
- Vancouver/Clark Parks and Recreation
- Washington Department of Ecology
- Washington Department of Transportation

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:

- LCFRB Habitat Assessments
- LCFRB Lower East Fork Lewis River Aquatic Habitat Restoration Plan (Draft)
- Salmon Recovery Plan
- Clark County LISP/SCMP/Project Data
- Clark County and CPU Volunteer Project Data
- Ecology 303D (list)
- Ecology EIM Data
- Clark County 6-year TIP
- Clark County 2005 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, conclusions about general subwatershed condition and potential future changes, and potential mitigation or improvement site identification.

Map Products

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.

General Conditions and Subwatershed Metrics

General Geography

The study area is at the transition from the Willamette Valley to the Cascade Mountains foothills in north central Clark County (Figure 1). There is also a land use change from predominantly rural residential and some agriculture land use of the Willamette valley to a mix of forest and non-forest uses. The area is largely in private lands with some tracts of state forest in upper Rock Creek and along the south side of the East Fork Lewis River above Lucia Falls. There is also extensive parkland along the East Fork Lewis River above Lucia Falls.

Topography

Rock Creek starts on a flat ridge top at about 900 to 1,000 feet above sea level, flows through a broad valley, and then drops into a canyon at about 350 feet in elevation and ends at the East Fork Lewis River at about 200 feet in elevation. The East Fork Lewis River cuts through a northwest-southeast trending ridge between Yacolt Creek and Rock Creek (South) on the east to the Battle Ground area, and Rock Creek (North) to the west. The ridge elevation is roughly 1,100 to 1,400 feet.

Geology and Soils

Older volcanic rocks underlie the area. East of Rock Creek, volcanic rocks are generally covered by sedimentary rocks deposited by the ancestral Columbia and local streams. Ice Age glaciers formed the topography in the upper Rock Creek subwatershed and covered much of the area north of the East Fork Lewis River with 10 to 40 feet of dense glacial till. Late Ice Age volcanoes northeast of Battle Ground covered the southwest part of the study area with a layer of basaltic lava. Ice Age terraces are formed along the East Fork and there is a very limited modern floodplain.

Soils formed on the volcanic andesite lavas and glacial deposits are generally well-drained mountain soils belonging to the Kinney Series and Olympic Series.

Hydrology

Geology and topography play the main role in determining study area hydrologic framework. Mountain streams are generally higher gradient and have little or no floodplain. Much of the precipitation leaves the area as rainfall runoff or shallow interflow, leaving streams with low flows in summer months.

Lower Rock Creek (or Rock Creek (North)) has its headwaters in streams that flow through Fargher Lake. Fargher Lake is actually a peat bog now used as intensively managed cropland. From Fargher Lake, the creek then flows south near the route of State Road 503, emptying into the East Fork Lewis River upstream of Lewisville Park. About half of the basin is forested and about 10 percent is developed land as residential and farmsteads.

No stream gauge data is available for study area.

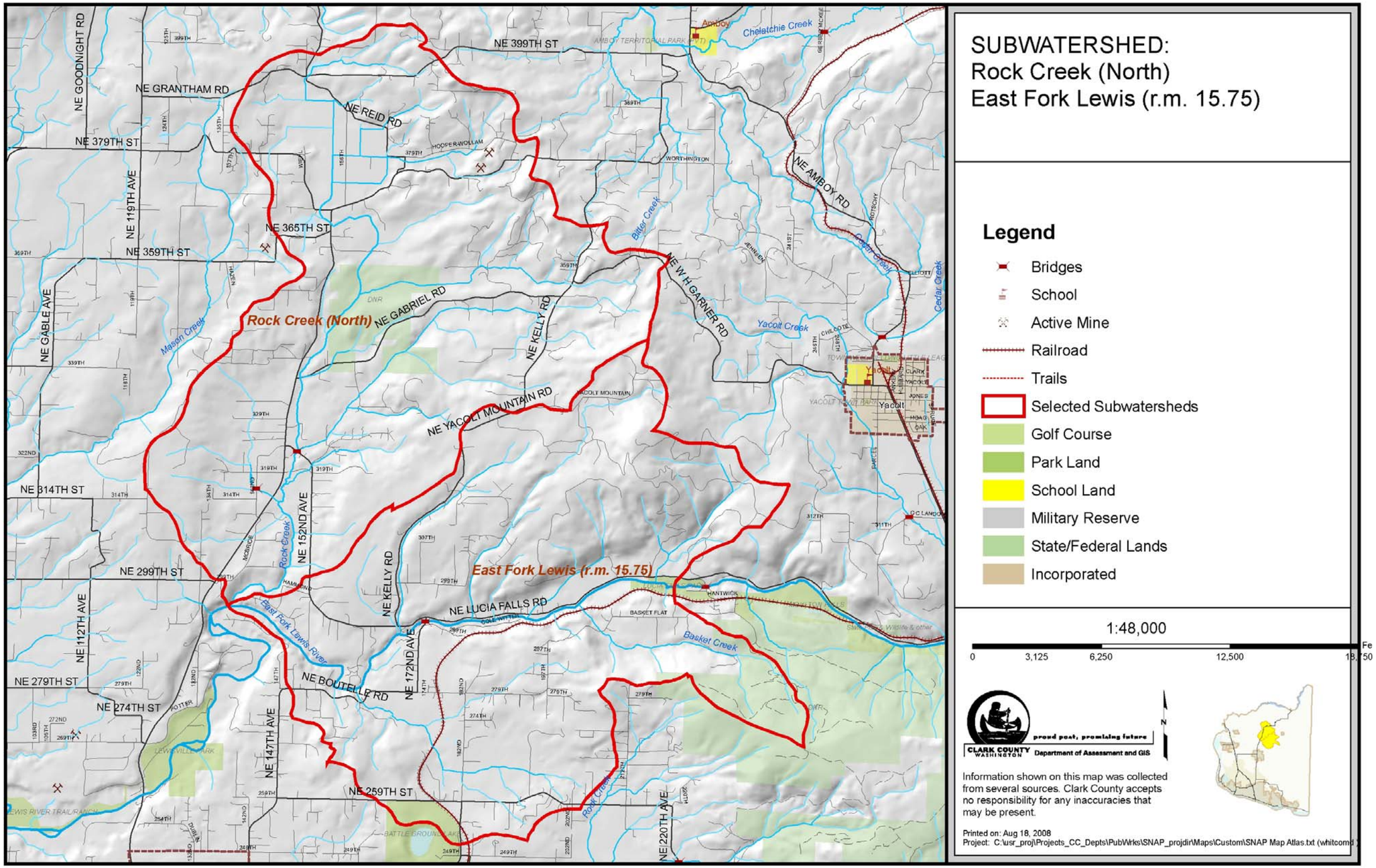


Figure 1: Subwatershed Map: Rock Creek (North) and East Fork Lewis River (RM 15.75)

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 largely functioning stream habitat (Table 2).

Table 2: Watershed Scale Metrics

Metric	Rock Creek (North)	East Fork Lewis River (RM 15.75)	Functioning	Non-functioning
Percent Forested (2000 Landsat)	54	89	> 65 %	< 50 %
Percent TIA (2000 Landsat)	10	9	< 5 %	> 15 %
Road Density 2007 data (miles/mile2)	5.7	6	< 2	> 3
Stream Crossing Density (crossings per stream mile)	2.3	2.2	< 3.2/mile	> 6.4/mile
Percent EIA estimated from the Comprehensive Plan	3	2	< 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.

East Fork Lewis River (RM 15.75) is largely forest tracts in various stages of growth that range from recently cleared to mature forest. Little area is cleared for pasture or residential use.

Agricultural clearing, rural residential use, and pasture are common in Rock Creek (North), as well as significant forested areas in various stages of growth.

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. Impervious area estimates from Hill and Bidwell (March 2003) tend to be higher than expected for forested areas because clear cut areas can incorrectly be categorized as forested urban land cover. This tendency is reflected in the nine to 10 percent TIA in these subwatersheds, where there are many recent clear cuts and partly-forested rural developments.

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 well into the non-functioning (>3 road miles/mi^2) category, suggesting degraded habitat.

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 the functioning category (<3.2 crossings/stream mile NOAA Fisheries criteria).

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

The 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. In the near-term, EIA changes should be minimal in the study area due to forest and large-lot rural zoning, Washington DNR ownership, and being outside of the current Urban Growth Area boundaries.

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 the East Fork Lewis River (RM 15.75) should have stable channels. Rock Creek (North) subwatershed is categorized in the zone of uncertain channel stability due to a higher projected EIA and significantly less intact forest cover.

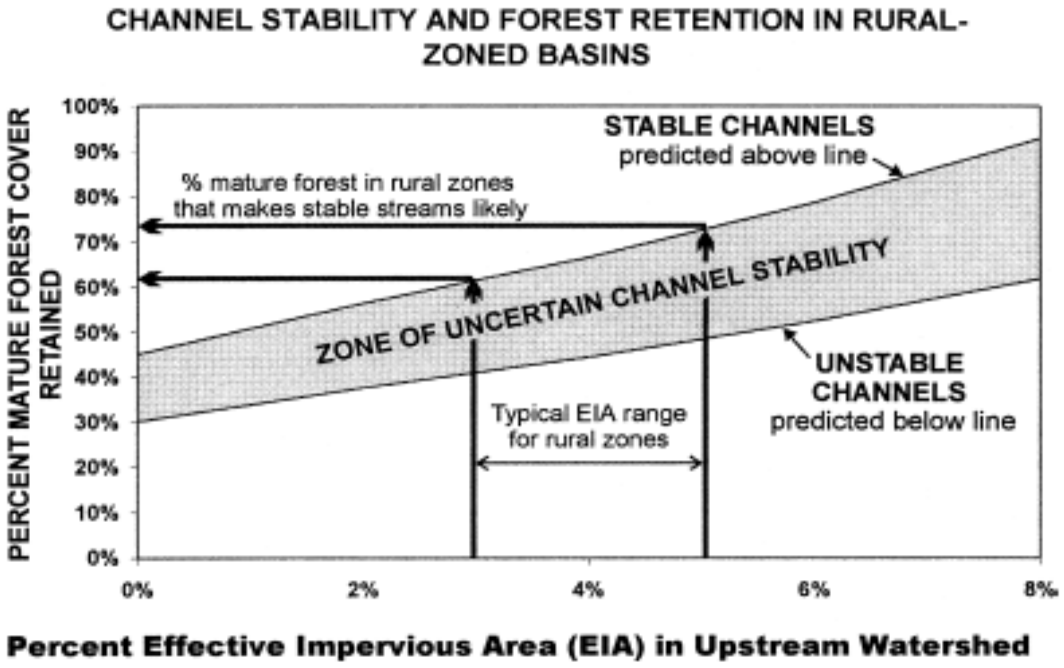


Figure 2: Channel stability in rural areas (Booth, Hartley, and Jackson, June 2002).

Water Quality Assessment

This section briefly summarizes and references available water quality data from the Rock Creek (North) and East Fork Lewis River (RM 15.75) 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 current Washington state water quality standards, the East Fork Lewis River from Mason Creek to Moulton Falls, including tributaries, is to be protected for the designated uses of: core summer Salmonid habitat; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values" (WAC 173-201A-600, Table 602). Both subwatersheds in this assessment fall within that area.

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

Table 3: Applicable Water Quality Criteria for Rock Creek (North) and East Fork Lewis River (RM 15.75) Subwatersheds

Characteristic	2006 Ecology criteria
Temperature	≤ 16 °C (60.8 °F)
Dissolved Oxygen	≥ 9.5 mg/L
Turbidity	shall not exceed 5 NTU over background when background is 50 NTU or less
pH	6.5 – 8.5 units
Fecal coliform bacteria	Geometric mean fecal coliform concentration not to exceed 100 colonies/100mL, and not more than 10% of samples exceeding 200 colonies/100mL.
Aesthetics	Aesthetic values must not be impaired by the presence of materials or their effects which offend the senses of sight, smell, touch, or taste
Toxics	Toxic substances shall not be introduced… which have the potential…to adversely affect characteristic water uses, cause acute or chronic toxicity to the most sensitive biota dependent upon those waters, or adversely affect public health

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

303(d) Listed Impairments

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

Rock Creek (North) is Category 5 listed (polluted waters that require a TMDL) for temperature and fecal coliform bacteria. The East Fork Lewis River in the assessment subwatershed is Category 5 listed for temperature.

Both subwatersheds are included in ongoing TMDL development for both temperature and fecal coliform in the East Fork Lewis River.

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 a limited available dataset including fecal coliform bacteria, general water chemistry (temperature, pH, and dissolved oxygen), and benthic macroinvertebrate scores, overall stream health in the East Fork Lewis River (RM 15.75) subwatershed scored in the good range. Rock Creek (North) scored in the poor to fair range.

The 2004 Stream Health Report may be viewed on the county website at: http://www.clark.wa.gov/water-resources/stream.html.

Available Data

Recent water quality data for the assessment area consists primarily of stream temperature and bacteria data collected by Ecology in 2005 and 2006 during TMDL development, and general water quality data collected by Clark County in Rock Creek (North) from 2002-2007. Complete data and draft summaries for TMDL development may be viewed on the Ecology website at: http://www.ecy.wa.gov/programs/wq/tmdl/EForkLewis/index.html

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

Table 4: Available Data

Source	Data and/or Report
Clark County Clean Water Program	2002-2007 Long-term Index Site Project 2004 Stream Health Report
Ecology	EF Lewis River TMDL technical study for temperature and bacteria

Water Quality Summary

Ecology collected instream flow and fecal coliform data from stations 27-RCN-0.65 (Rock Creek (North) at Hammond Road), 27-RCN-2.8 (Rock Creek (North) at NE Gabriel Road), and 27-EFL-20.3 (East Fork Lewis River at Heisson USGS gauge) during data collection for the East Fork Lewis River (RM 15.75) fecal coliform TMDL.

Continuous temperature data were collected from stations 27EFL20.3 (East Fork Lewis River at USGS gauge) and 27RCN00.6 (Rock Creek (North)) in the assessment area as part of the East Fork Lewis River temperature TMDL.

Clark County has one active monitoring station in the assessment area, on Rock Creek (North) at Gabriel Road (Station RCN050).

Oregon Water Quality Index (OWQI) Scores

The OWQI was developed by the Oregon Department of Environmental Quality (ODEQ) as a way to improve understanding of water quality issues by integrating multiple characteristics and generating a score that describes water quality status (Cude, 2001). It is intended to provide a simple and concise method for expressing ambient water quality.

The OWQI integrates eight water quality variables: temperature; dissolved oxygen; biochemical oxygen demand; pH; ammonia + nitrate nitrogen; total phosphorus; total solids; and fecal coliform. For each sampling event, individual sub-index scores and an overall index score are calculated. Overall index scores are aggregated into low flow (June through September) and high flow (October through May) seasons and a seasonal mean value is then calculated. The final annual OWQI score is reported as the lower of the two seasonal mean scores.

Index scores are categorized as follows:

very poor = 0 to 59; poor = 60 to 79; fair = 80 to 84; good = 85 to 89, and; excellent = 90 to 100.

Figure 3 shows seasonal mean and minimum OWQI scores for station RCN050 from 2002 through 2007. The overall score, based on the lower of the two seasonal means places it in the Fair category. However, very low minimum scores indicate that under some conditions RCN050 had very poor water quality. Prior to 2007 data collection, during the 2002-2006 periods, station RCN050 ranked sixth best in overall water quality among 15 long-term monitoring stations county-wide (Hutton and Hoxeng, 2007).

Monthly OWQI values since 2002 ranged from very poor to excellent, although in nearly two out of three monthly (38 out of 60 months sampled) OWQI values were in the Good or Excellent category. Monthly scores in the Very Poor

category did not follow a clear pattern, with 2 occurring in November, one in December, and one each during July and August.

Monthly sub-index scores for total phosphorus were consistently fair to good, while scores for inorganic nitrogen were typically poor to fair and total solids varied widely. Fecal coliform scores were typically good to excellent, with scattered poor and very poor values. Sub-index scores for water temperature, dissolved oxygen, and pH were consistently good to excellent.

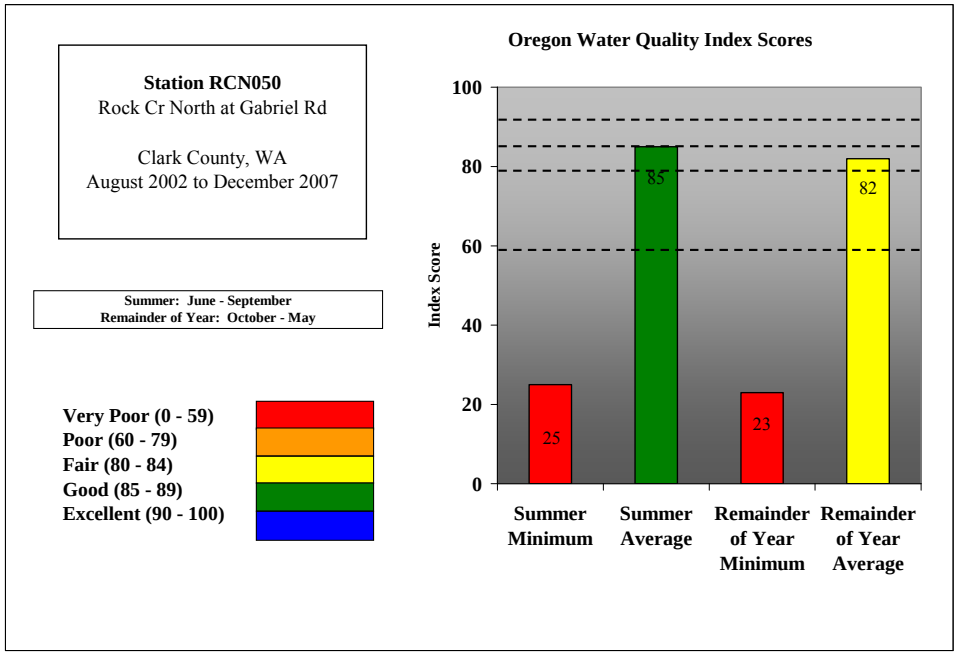


Figure 3: Average Water Quality, Rock Creek (North) Station RCN050, 2002 through 2007, Oregon Water Quality Index

Trends

An analysis of potential statistical trends in OWQI scores based on the 2002 through 2006 dataset found one significant trend at station RCN050 (Hutton and Hoxeng, 2007). An increasing trend (decreasing water quality) was evident in turbidity scores at the 80 percent confidence level. The magnitude of this trend was an increase of approximately 0.33 NTUs per year.

In the 2007 analysis, only nine statistically significant trends were identified county-wide out of 45 potential trends evaluated (15 monitoring stations examined for potential trends in three parameters including overall OWQI, fecal coliform, and turbidity). The fact that one of these nine trends was located in Rock Creek (North), and that the trend indicated degrading water quality, suggests that the stream is at increased risk of immediate water quality degradation compared to most other monitored streams in Clark County.

Fecal Coliform Bacteria

Based on 31 samples collected by Ecology in 2005-2006 (15 wet season and 16 dry season), the mainstem East Fork Lewis River at Station 27-EFL-20.3 met both portions of the state standard for fecal coliform in both seasons.

The two Rock Creek (North) stations met the geometric mean portion of the standard during both seasons. Station 27-RCN-0.65 failed the 10 percent not-to-exceed portion of the standard during both seasons. Station 27-RCN-2.8 met the 10 percent not-to-exceed portion during the wet season but failed in the dry season.

During a dry period sampled during 2005, Rock Creek (North) at Station 27-RCN-0.65 carried approximately 15 percent of the total bacteria load measured in the East Fork Lewis River (RM 15.75) watershed, while Station 27-EFL-20.3 carried nearly 25 percent. During a rain event sampled in the same year, the approximate loads were eight percent and 30 percent, respectively.

Ecology results from the Rock Creek (North) subwatershed were consistent with longer-term results from Clark County at station RCN050 (2002-2007). Overall fecal coliform bacteria values during the County sampling period met the geometric mean portion of the standard but failed the 10 percent not-to-exceed portion during both the wet and dry seasons.

Stream Temperature

In addition to routine monthly temperature readings which are incorporated into OWQI calculations, Clark County continuous temperature loggers recorded hourly temperature values between May and October during 2002 through 2008. Continuous readings provide a more complete picture of temperature dynamics than monthly grab samples.

Table 5 summarizes the continuous temperature data. The 7-Day average maximum value is the maximum of the 7-day moving average of daily maximum temperatures. The Ecology standards utilize this metric to determine temperature compliance (Rock Creek (North) criterion is 60.8° F). Maximum daily ΔT is the maximum daily temperature fluctuation, and gives some indication of the susceptibility of the stream to changes in heat input.

Summer stream temperature at station RCN050 was relatively consistent and exceeded the 60.8 degrees F state criterion by 6 to 10 degrees F in each year monitored.

Ecology monitoring in 2005 also indicated that both of their temperature TMDL monitoring stations exceeded the state criteria. The mainstem station (27EFL20.3) was the cooler of the two, with a 7-DADMax of 68º F compared to over 73 degrees F at tributary station 27RCN00.6.

Table 5: Seasonal Maximum 7-day Moving Average and Maximum Daily Temperature Change at Rock Creek (North) Station RCN050, 2002 through 2008			
7-Day average Date	**Maximum**	**Maximum daily ΔT Date**	**Value**
Station RCN050:			
07/12/02	69.2	07/09/02	12.1
07/21/03	66.6	06/28/03	11.3
07/25/04	70.8	07/12/04	11.8
07/29/05	69.6	07/28/05	10.0
07/23/06	71.9	06/29/06	10.2
07/12/07	70.0	07/07/07	9.3
08/15/08	68.1	07/10/08	9.5

Due to the negative effects of chronic high temperatures on salmonids and other cold-water biota, the amount of time spent with elevated temperatures is also of interest. Figure 4 indicates the number of days on which the *daily* maximum temperature exceeded 64 degrees F at station RCN050. Sixty-four degrees was the Class A criterion prior to the November 2006 rule changes and is a threshold above which salmonids are known to suffer deleterious effects.

The number of days with temperatures exceeding 64 degree F has ranged from 37 to 60. Annual variations are likely attributable to differences in ambient air temperatures and stream flow. Regardless of variations between years and stations, the available Rock Creek (North) data indicates stream temperatures remain elevated over a substantial time period each summer.

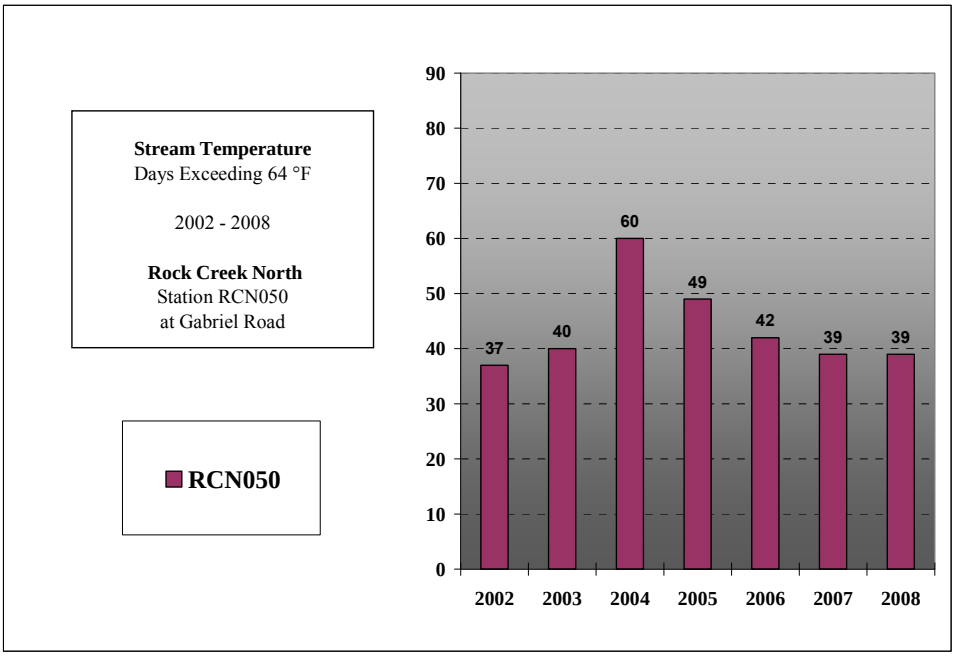


Figure 4: Days Exceeding 64° F, 2002 through 2008, Rock Creek (North) Station RCN050

Nutrients

Nutrient criteria are not established for Washington streams. US EPA suggests a total phosphorus criterion of 0.100 mg/L for most streams, and 0.050 mg/L for streams which enter lakes (EPA, 1986). EPA nitrate criteria are focused on drinking water standards and are not generally applicable to aquatic life issues.

Phosphorus and nitrogen in excess may contribute to elevated levels of algal or plant growth, especially in slower moving, low gradient streams, or in downstream water bodies.

Sixty-six total phosphorus samples from station RCN050 between May 2002 and December 2007 ranged from 0.020 mg/L to 0.108 mg/L, and 98 percent of samples met the EPA criterion. Total phosphorus concentrations typically vary seasonally in many locations; however, seasonal median values in Rock Creek (North) are relatively similar, with slightly higher values during summer:

- Summer median = 0.041 mg/L
- FWS median = 0.028 mg/L

Turbidity

It is difficult to establish an exact background turbidity level for Rock Creek (North) because no data exists from a time when the creek was not impacted by human activities. However, based on data from the least-impacted streams monitored by CWP, we estimate that natural background turbidity in most Clark County streams would have been in the range of 0.5 to 2 NTU. Based on this estimate, the turbidity criterion for Rock Creek (North) is likely between 5.5 and 7 NTU.

Since May 2002, the median of 73 turbidity samples at station RCN050 is 5.6 NTU, with individual samples ranging from 0.9 NTU to 37 NTU. Turbidity varies seasonally, with the FWS median more than double the summer median:

- Summer median = 2.9 NTU
- FWS median = 6.7 NTU

Higher turbidity readings in the 20 to 40 NTU range are common in Clark County streams during storm events. Very high turbidity values (typically 100 or greater) often indicate a specific sediment source. Routine monthly monitoring at RCN050 has not detected turbidity values over 37 NTU since 2002.

Among 15 long-term monitoring stations county-wide, Rock Creek (North) at station RCN050 was in a group of seven subwatersheds having moderate average turbidity from 2002 through 2007. While the available data indicates relatively low turbidity currently, values have shown an increasing trend at station RCN050 since 2002 (see above).

Impacts to Beneficial Uses and Potential Sources

General water quality in Rock Creek (North) is fair according to the overall OWQI and other measures discussed above. Listed beneficial uses appear to be impacted primarily by stream temperature and fecal coliform bacteria. While overall turbidity levels are low, there is an apparent increasing trend in turbidity.

Observed levels of these characteristics may have negative impacts on the listed beneficial uses of: core summer salmonid habitat and primary contact recreation. Table 6 at the conclusion of this section summarizes the primary water quality impacts to beneficial uses in Rock Creek (North), and probable sources of the observed impact.

Fecal Coliform Bacteria

Rock Creek (North) has no developed swimming or wading areas, but it is possible that some local residents, particularly children, utilize the creek for recreation. Although water contact may take place year-round, elevated bacteria counts are of particular concern during the summer months when the majority of water contact recreation occurs.

Despite meeting or partially meeting the state criteria, geometric mean and 90th percentile values from 2002-2008 Clark County monitoring were consistently higher during the summer season than during the remainder of the year. This suggests that when exceedences occur they are likely occurring during the period of highest stream use.

Ecology sampling on the mainstem East Fork Lewis River in this assessment area indicated the mainstem met the Ecology criteria year-round.

Water Temperature

Water temperature may be an impediment to salmonid use in Rock Creek (North). In particular, elevated temperatures have a detrimental impact on salmonid rearing. Migration and spawning tend to occur during cooler times of the year, but juveniles are exposed to elevated summer temperatures during rearing.

Temperature-related impacts to salmonids typically include: decreased or lack of metabolic energy for feeding, growth or reproductive behavior; increased exposure to pathogens; decreased food supply; and increased competition from warm-water tolerant species (ODEQ, 2004 draft).

Rock Creek (North) is consistently among the warmer streams monitored by the CWP, with summer temperatures regularly exceeding 64 degrees F and significantly exceeding the current 60.8 degrees F state criterion. This suggests temperature moderation will be a necessary component in any plan to maintain and/or recover fish populations in Rock Creek (North).

Solar radiation is the primary driver of water temperature. The susceptibility of a stream to solar radiation is influenced by several factors including stream flow, channel form, canopy cover (shade), ponds, and the extent of groundwater influence. Low summer stream flows in several recent years have made the stream more susceptible to temperature impacts.

Turbidity

Rock Creek (North) exhibits relatively low routine turbidity levels based on county-wide monitoring data, but is susceptible to high short-term turbidity during rain events. The increasing trend in turbidity values in recent years is a concern.

The primary sources of turbidity in Rock Creek (North) are probably soil and bank erosion related. Both off-site erosion (development, agriculture, recreational vehicle use) and in-stream erosion (bank scour, slumping, and re-suspension of sediments during high flows) likely contribute significantly to the elevated turbidity during rain events.

Implications for Stormwater Management

Table 6 lists the primary known water quality concerns and potential solutions for each. Solutions listed in bold indicate areas where CWP activities can have a positive impact. It should be noted that CWP activities, though important, are not likely to achieve water quality improvement goals on their own. Other county departments, local agencies, and not least of all, the public must all contribute to water quality improvement.

Among the CWP 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. Education programs are a critical element in modifying behavior and promoting better public stewardship of water resources.

Table 6. Known Water Quality Concerns, Sources, and Solutions for Rock Creek (North)				
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 roadside ditches	**Storm sewer screening for source identification and removal** **Education programs** **Storm water facility designs/retrofits to optimize bacteria reduction (see Schueler, 1999)** Agricultural Best Management Practices Septic and sanitary sewer system inspection and maintenance
		livestock, pets, wildlife	overland runoff roadside ditches direct access	
Water temperature	Core summer salmonid habitat	vegetation removal	direct solar radiation	**Stormwater infiltration to increase baseflow** **Streamside planting/vegetation enhancement/riparian preservation through acquisition** **Education programs** Pond removal or limitation Decreased water withdrawals
		ponds	direct solar radiation stagnation	
		low summer flows	decreased resistance to thermal inputs	
Turbidity	Salmonid spawning, rearing, and migration; Aesthetic enjoyment	erosion *(development projects; land clearing; cropland; channel erosion)*	overland runoff roadside ditches channel dynamics	Erosion control regulations **Storm sewer system cleaning and maintenance** **Storm water facility designs/retrofits to optimize settling and removal of suspended silt/clay** Agricultural Best Management Practices Stream bank stabilization/rehabilitation **Storm water outfall/facility retrofits to reduce flow-induced channel erosion**

Drainage System 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=digitalatlas&CFID=56651&CFTOKEN=98300052

Drainage system inventory is an ongoing CWP work effort focused on updating the StormwaterClk database to include all existing stormwater drainage infrastructure.

The work effort during 2008 in the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds was focused on identifying and mapping previously unmapped discharge points and stormwater conveyance. Table 7 indicates the number of features previously inventoried in StormwaterClk prior to 2008 SNAP work, and the number of features added to the database as a result of 2008 SNAP and mapping project implementation.

The drainage system inventory for these two subwatersheds is generally completed. Inventory is ongoing in 2009 as part of a county-wide inventory update.

Table 7: Drainage System Inventory Results, Rock Creek (North)/ East Fork Lewis River (RM 15.75)

Database Feature Category	Previously Inventoried	Added to Database during 2008
Inlet	27	16
Discharge Point (outfall)	8	436
Flow Control	3	6
Storage/Treatment	32	47
Manhole	7	1
Filter System	0	0
Channel	52	1700
Gravity Main	191	826
Facilities	9	6

Stormwater Facility Inspection

The stormwater facility inspection process includes two components:

- A public stormwater facility inspection using state and county standards.
- An off-site inspection to check for problems such as downstream bank erosion.

Component 1: Public Stormwater Facility Inspection

Based on the county's StormwaterCLK database, as of October 2008, there were no mapped public stormwater facilities in the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds.

Component 2: Offsite Assessment

Purpose

Discharge 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 project detects possible 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 were included in the offsite assessment:

- Within 200 feet of a critical area such as a stream channel,
- Within 300 feet of a headwater stream,
- Located on public land,
- Discharges stormwater from a public-dedicated facility that is currently under the two year private maintenance warranty bond.

The offsite assessment inspects all outfalls that discharge into critical areas, as well as a 300 foot survey downstream of the outfall to look for any adverse impacts that may be caused by stormwater discharges.

If any 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.

Results

Based on the County's StormwaterCLK database, as of June 2008, there were no mapped outfalls in Rock Creek (North) subwatershed that discharged into critical areas. There were 29 mapped outfalls in East Fork Lewis River (RM 15.75)

subwatershed that discharged into critical areas. Five outfalls located along railroad lines were not accessible and not assessed.

Figure 5 summarizes notable outfall assessment activities in the East Fork Lewis River (RM 15.75) including general outfall locations.

As summarized in Table 8, twenty-four outfalls that discharged into critical areas were assessed. All twenty-four outfalls were found to be in compliance.

Potential Projects

No referrals were initiated for the outfall assessment project.

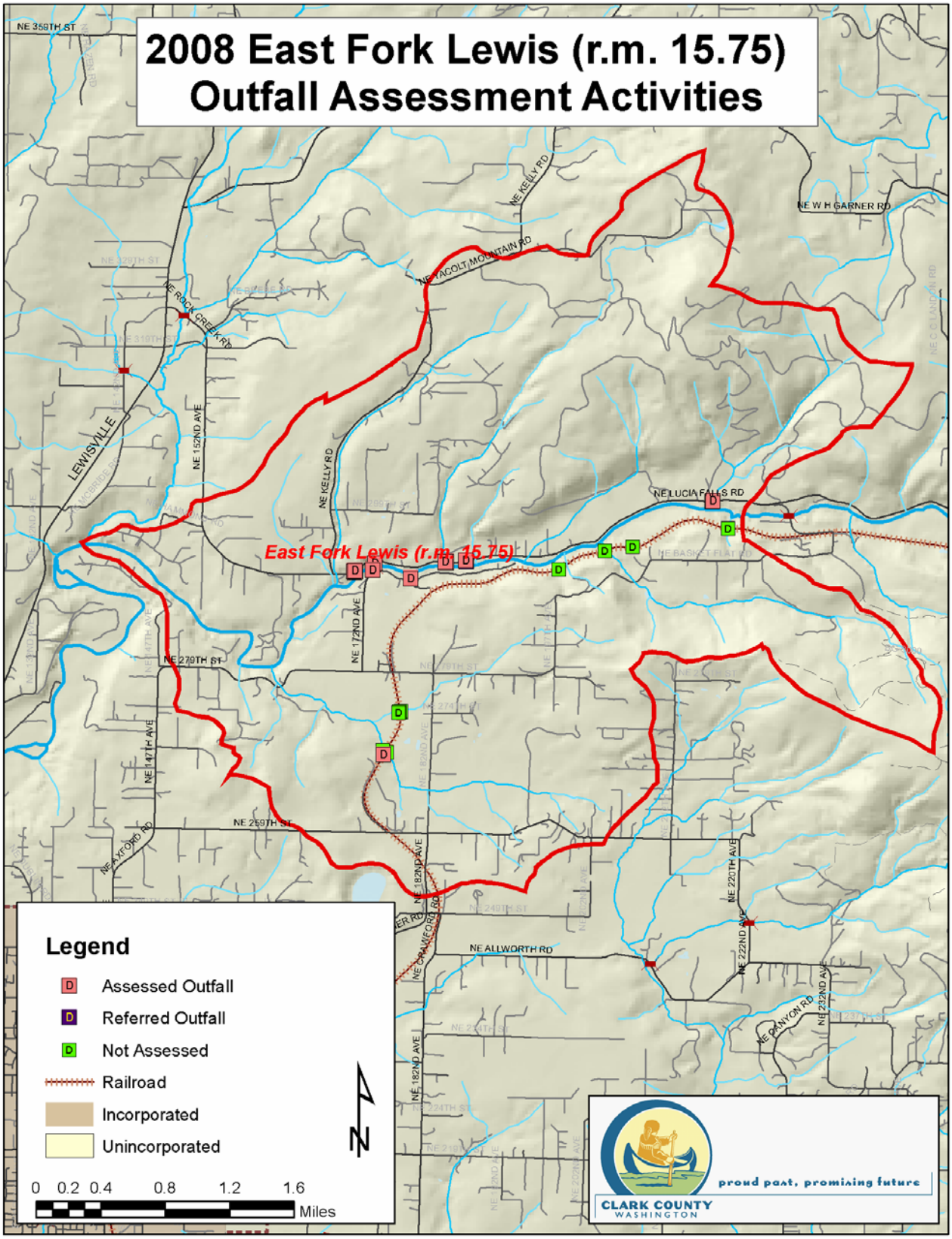


Figure 5: Summary of 2008 Outfall Assessment Activities in East Fork Lewis River (RM 15.75) Subwatershed

Table 8: 2008 Outfall Assessment Project Activity Summary of East Fork Lewis River (RM 15.75) Subwatershed	
Metric	Number
# of outfalls assessed	24
# of outfalls compliant	24
# of noncompliant outfalls	0
# of referrals initiated	0
# of referrals ongoing	0
# of outfalls fixed	0

Illicit Discharge Detection and Elimination Screening

Purpose

The purpose of the IDDE Screening project is to detect, isolate, and eliminate illicit connections and illicit discharges to Clark County's municipal separate storm sewer system (MS4).

The IDDE screening project is designed to meet the requirements of Clark County's 2007 NPDES permit, which requires identifying and removing illicit connections to the County's MS4.

Methods

IDDE screening includes checking every stormwater outfall for potential illicit discharges, conducting follow-up investigations to track down suspected discharges or connections, and referrals to the proper agencies for termination. Field work is primarily conducted during the dry summer season.

IDDE Screening activities were completed in the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds during 2008.

Screening in Rock Creek (North) preceded the drainage inventory effort, as reflected in the low number of outfalls screened. Additional outfalls may be screened in the future.

Results

Based on the county's StormwaterCLK database at the time of the assessment, there were 198 mapped stormwater outfalls in the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds, consisting almost entirely of roadside ditch outfalls.

Figure 6 summarizes notable screening activities including general outfall locations, outfalls where water samples were collected, follow-up investigations performed, referrals made, and sources removed.

As summarized in Table 9, 193 outfalls were screened and samples were collected at three outfalls with sufficient flow. Five mapped outfalls were either not accessible or were mapped incorrectly. The three samples taken all had lab results below the trigger values of the IDDE project and no follow-up investigations were initiated.

Table 9: IDDE Screening Project Activity Summary of Rock Creek (North) and East Fork Lewis River (RM 15.75) Subwatersheds as of December 2008	
Metric	Number
# of outfalls screened	193
# of outfalls with sufficient flow to collect water samples	3
# of suspected illicit discharges	0
# of suspected illicit connections	0
# of investigations initiated	0
# of illicit discharge sources located	0
# of illicit connections identified	0
# of outfalls to be re-visited in 2009	0
# of referrals	0
# of illicit discharges removed	0
# of investigations and referrals ongoing	0
# of illicit connections terminated	0
# of cases closed without resolution	0

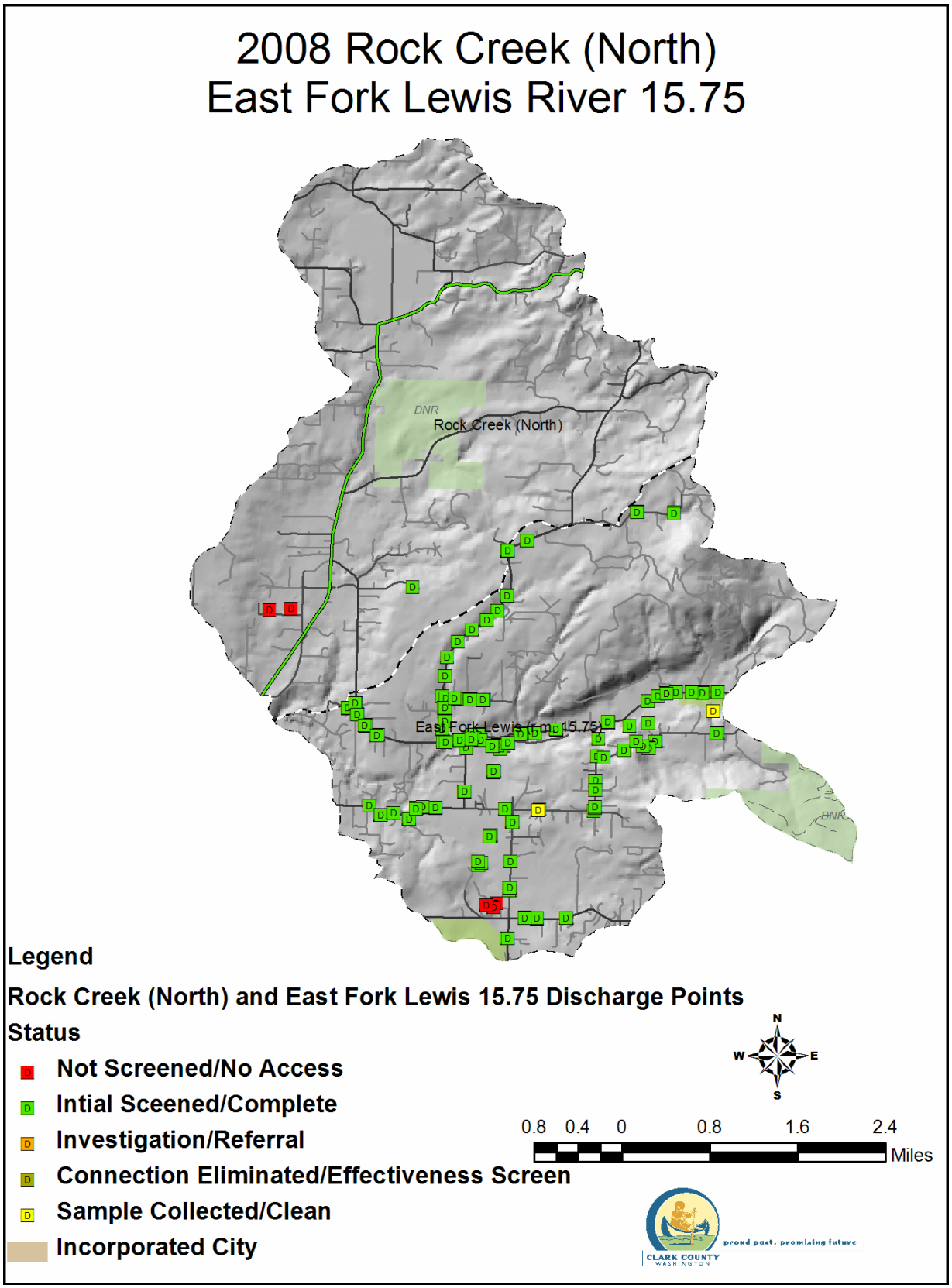


Figure 6: 2008 IDDE Screening Project in Rock Creek (North) and East Fork Lewis River (RM 15.75) Subwatersheds

Stream Reconnaissance and Feature Inventory

Purpose

The Feature Inventory records the type and location of significant stream impairments, potential environmental and safety hazards, and project opportunities in selected stream reaches. Feature Inventory results are used primarily to document conditions and identify potential improvement projects or management actions for implementation by the CWP or other agencies.

Methods/Limitations

Geographic scope of the Feature Inventory was established by the County with input from Herrera Environmental Consultants, taking into consideration projected TIA, DNR water types, stream gradient, zoning, Clark County development permitting authority, and land ownership.

The Feature Inventory recorded significant conditions in the stream corridor relevant to SNAP components. Feature types are listed in Table 10.

The in-stream assessment approach allowed investigators to observe stream corridor features that are not always identifiable through other desk methods such as analysis of existing aerial photographs and GIS data.

A GPS position, one or more digital photos, and relevant attribute information were collected for each logged feature. All data and linked photos are stored in the Feature Inventory Geodatabase located on the Clark County server at: W:\PROJECT\011403, Needs Assessment Planning and Reports\GIS\Data\Geodatabase. Feature data includes field observations, estimated measurements, and/or notes describing important feature characteristics or potential projects.

The Feature Inventory project is not intended to be an exhaustive inventory of all human alterations to the stream corridor. Rather, the project seeks to identify the most significant features pertaining to stormwater management and potential stormwater mitigation projects.

Feature dimensions and other attribute data are estimates, and should not be utilized for quantitative calculations.

For additional information pertaining to the Feature Inventory SNAP tool, see Volume 1 of the SNAP.

Study Area

The extent of the completed Feature Inventory in Rock Creek (North) subwatershed is shown in Figure 7. Approximately 3.3 miles of the stream corridor was assessed in the subwatershed. Also, 17 additional features of interest were collected during a Road Reconnaissance survey of an area in the northeast

corner of the subwatershed. Of the proposed survey extents, only one short reach associated was not accessible due to private property concerns.

Results/Findings

A total of 132 features were identified in the Rock Creek (North) subwatershed. A breakdown of recorded features by type is presented in Table 10. Stream crossings (culvert and bridge) were the most prevalent feature type identified, followed by water quality impacts and stormwater outfalls. A significant number of severe bank erosion features and impacted stream buffers were also identified.

Table 10: Summary of Features Recorded in Rock Creek (North) Subwatershed

Feature Type	Number Recorded
AGR - Aggradation	0
AP – Access point	5
CM – Channel modification	4
ER – Severe bank erosion	13
IB – Impacted stream buffer	12
IW – Impacted wetland	0
MB – Miscellaneous barrier	6
MI – Miscellaneous point	4
OT – Stormwater outfall	21
RR – Road Reconnaissance feature	17
SCB – Stream crossing, bridge	11
SCC – Stream crossing, culvert	14
SCF – Stream crossing, ford	0
TR – Trash and debris	3
UT – Utility impact	0
WQ – Water quality impact	22
Total	**132**

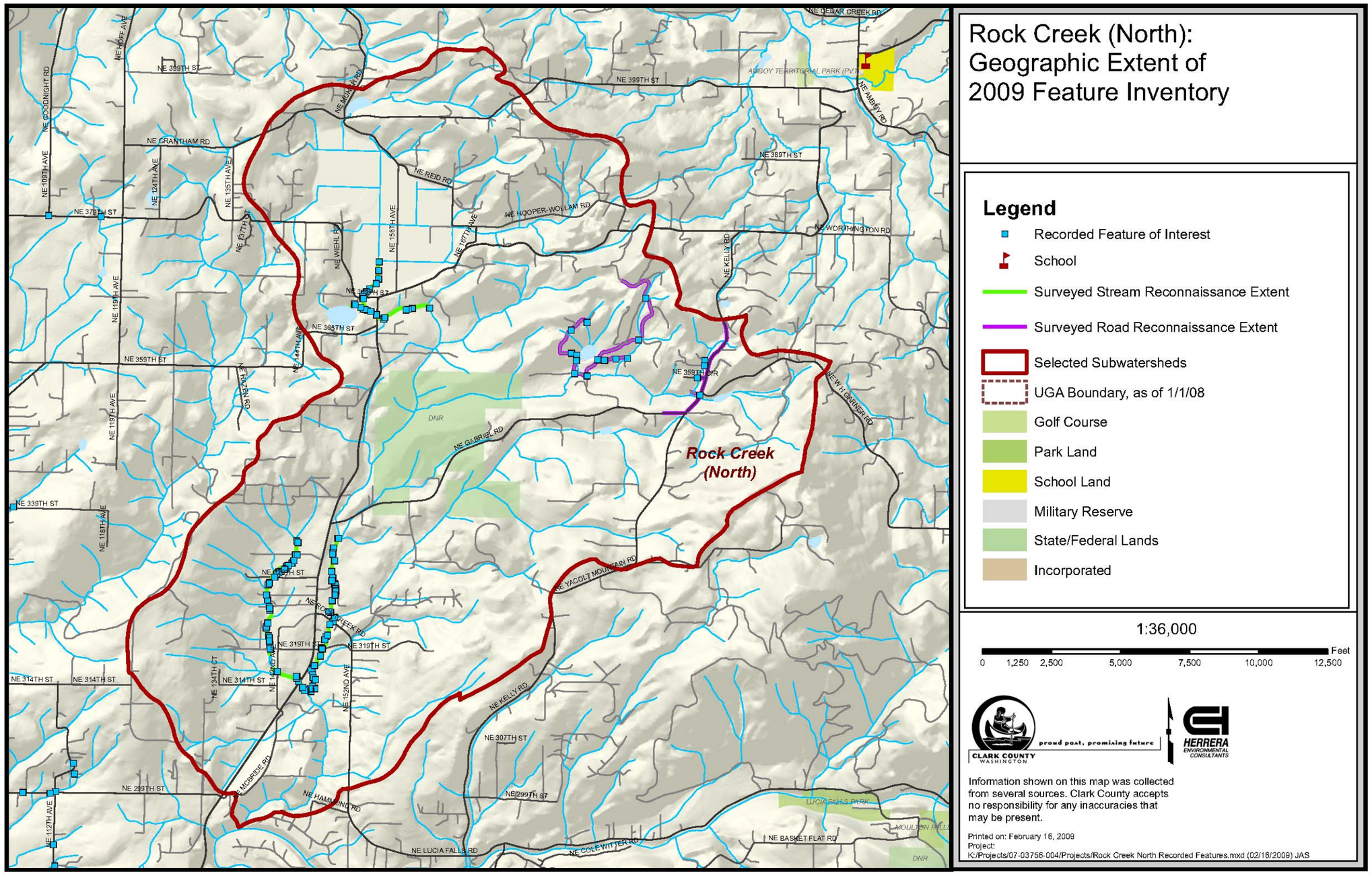


Figure 7: Rock Creek (North) Geographic Extent of 2009 Feature Inventory

The following subsections contain general descriptions of the Rock Creek (North) subwatershed conditions. The descriptions include observations, trends, and issues that were identified either during the field work or during subsequent review of collected information.

Stormwater Infrastructure

The stormwater conveyance to Rock Creek (North) and its tributaries in the surveyed reaches is mainly via agricultural field and roadside ditches. Flow in the subwatershed is predominately north to south for larger tributaries, with first order inputs and smaller drainage pathways (manmade and otherwise) flowing to the primary streams from the east and west. The predominant source of stormwater in the subwatershed appears to be runoff from agricultural land and rural residential developments draining to streams via small open channels such as field drain ditches, grassy swales, and roadside ditches. Very few facilities that treat consolidated stormwater flow were observed in surveyed areas of this subwatershed.

Riparian Vegetation

Impacted stream buffers are prevalent in the Rock Creek (North) subwatershed. Though widespread, invasive plant species are less prevalent than in many other subwatersheds surveyed in the past. A significant portion of surveyed stream reaches have established riparian forest canopy with vegetation communities composed of small to medium sized canopy trees such as alder and various conifers with woody and herbaceous undergrowth. Undergrowth is typically a mix of native species, invasive reed canary grass, and blackberry. In general, blackberry is more common in areas with somewhat dense canopy cover. Reed canary grass is more common in areas with less dense canopy cover and wetter soil conditions. Lack of riparian vegetation due to mowing and landscaping is common in areas where residential development abuts the channel. Agricultural areas in the subwatershed typically have little or no woody riparian vegetation.

Additional Results

Features of interest were discovered when field crews ventured up small, first order tributary channels and manmade drainage ditches that were outside of the area defined by the geographic scope of work. When located, these features were recorded in the same manner as other features. Surveying the full extent of each tributary channel and drainage pathway was not feasible. Whenever possible, field crews noted if tributaries appeared to be of particular concern. These reaches might be surveyed at a later time. The discovery of numerous features of interest on small tributary channels indicates that significant stream impairments, potential environmental and safety hazards, and potential project opportunities may exist outside of the geographic scope of this Feature Inventory.

Two off-channel ponds fed by water diverted from the creek were observed on a short reach of stream that was not surveyed due to landowner access permission

concerns. County staff later obtained permission and walked the property with the landowner to assess and advise on potential stream improvement actions.

Some of the most degraded conditions and poorly functioning infrastructure were observed during the road reconnaissance conducted in the northwest portion of the subwatershed. This area was a private residential development on steep, primarily wooded terrain that receives relatively high amounts of annual precipitation. These private communities, which operate infrastructure with little oversight and maintenance from county departments, may be a more significant source of stream impairments, environmental and safety hazards, and potential project opportunities than originally anticipated.

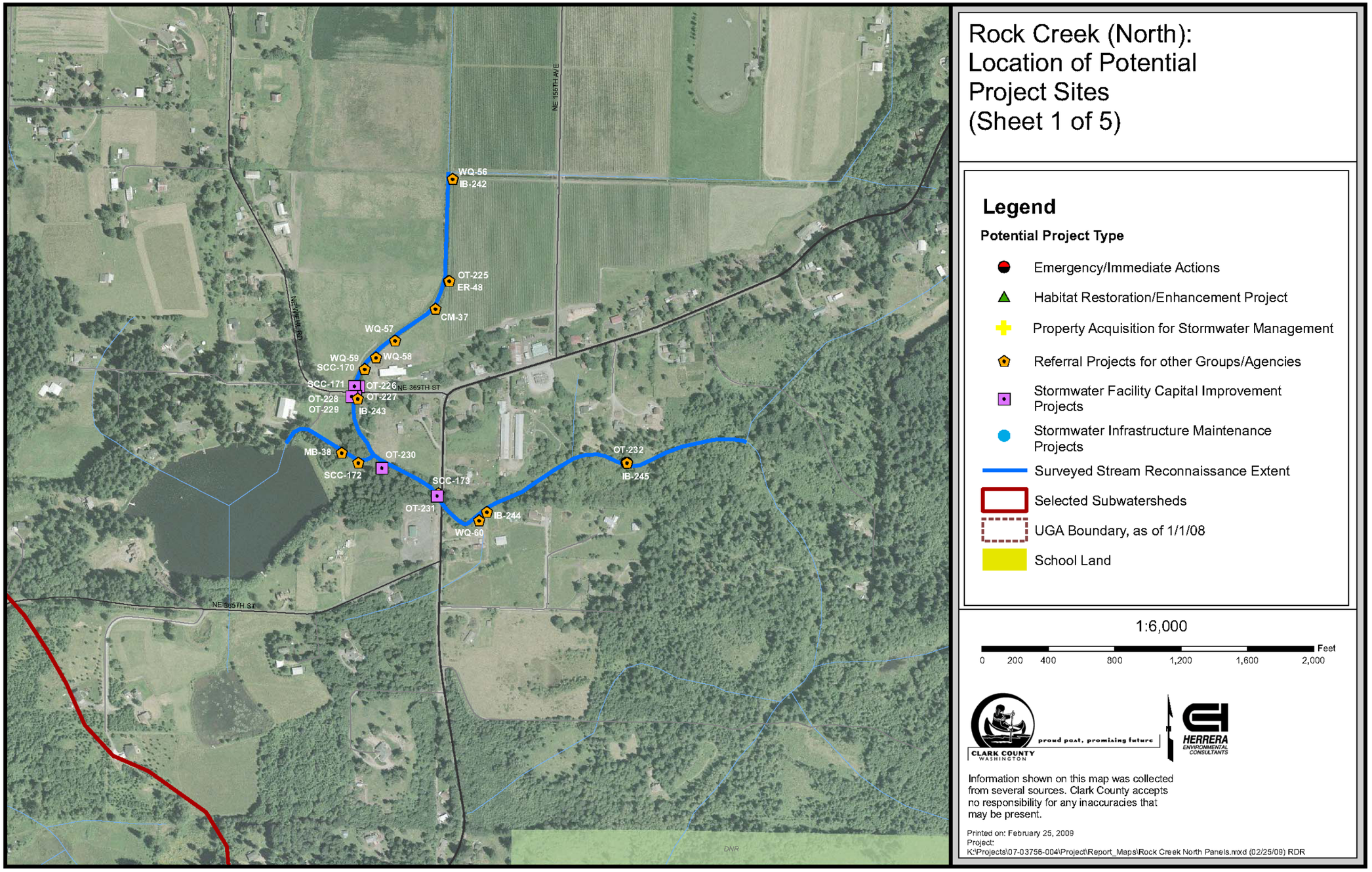
Potential Project Opportunities

Listed opportunities represent potential projects or project areas. They are not fully developed projects, and therefore require additional evaluation and development by Clark County or consultant staff prior to submittal to the SCIP process. Identifying them as potential projects in this document is the first step in the process of developing SCIP projects.

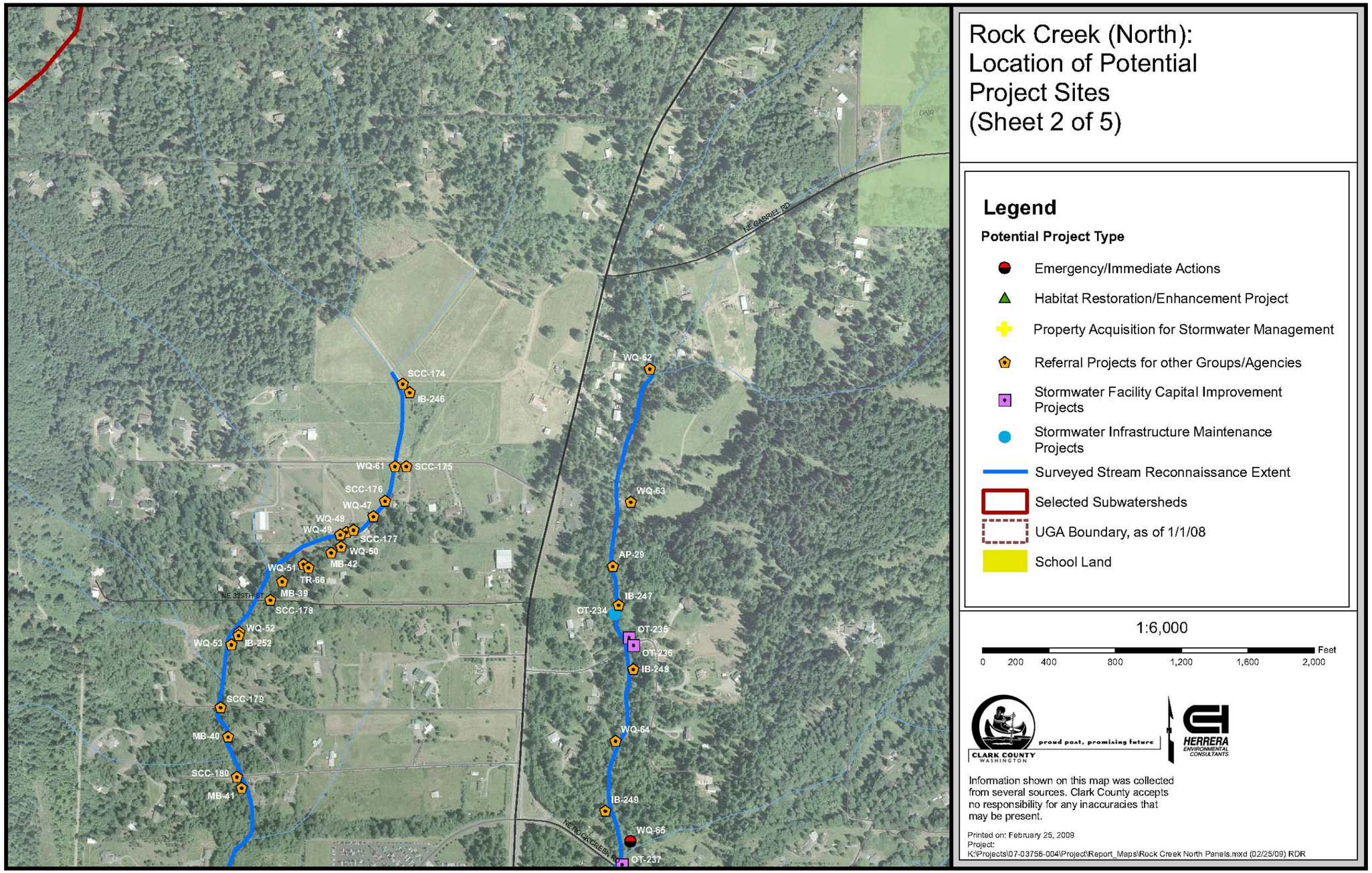
Potential project opportunities were identified based on the results of the Feature Inventory conducted in the Rock Creek (North) subwatershed. The CWP will evaluate the potential projects for further development or referral to the appropriate organization. Each potential project is listed in Tables 12 through 16, including the basis for the project and a description of the potential project. The location of each potential project is shown in Figures 8 through 12. Potential project opportunities were categorized into six groups based on the nature of the potential work. A total of 93 potential projects were identified. A summary of identified project opportunities by potential project category is shown in Table 11.

Table 11: Breakdown of Potential Project Opportunities by Category

Potential Project Category	Potential Projects Identified
Emergency/Immediate Actions	3
Stormwater Facility Capital Improvement Projects	15
Stormwater Infrastructure Maintenance Projects	1
Habitat Restoration/Enhancement Projects	5
Property Acquisition for Stormwater Mitigation	0
Referral Projects for other Agencies	69



Figures 8: Rock Creek (North) Location of Potential Project Sites



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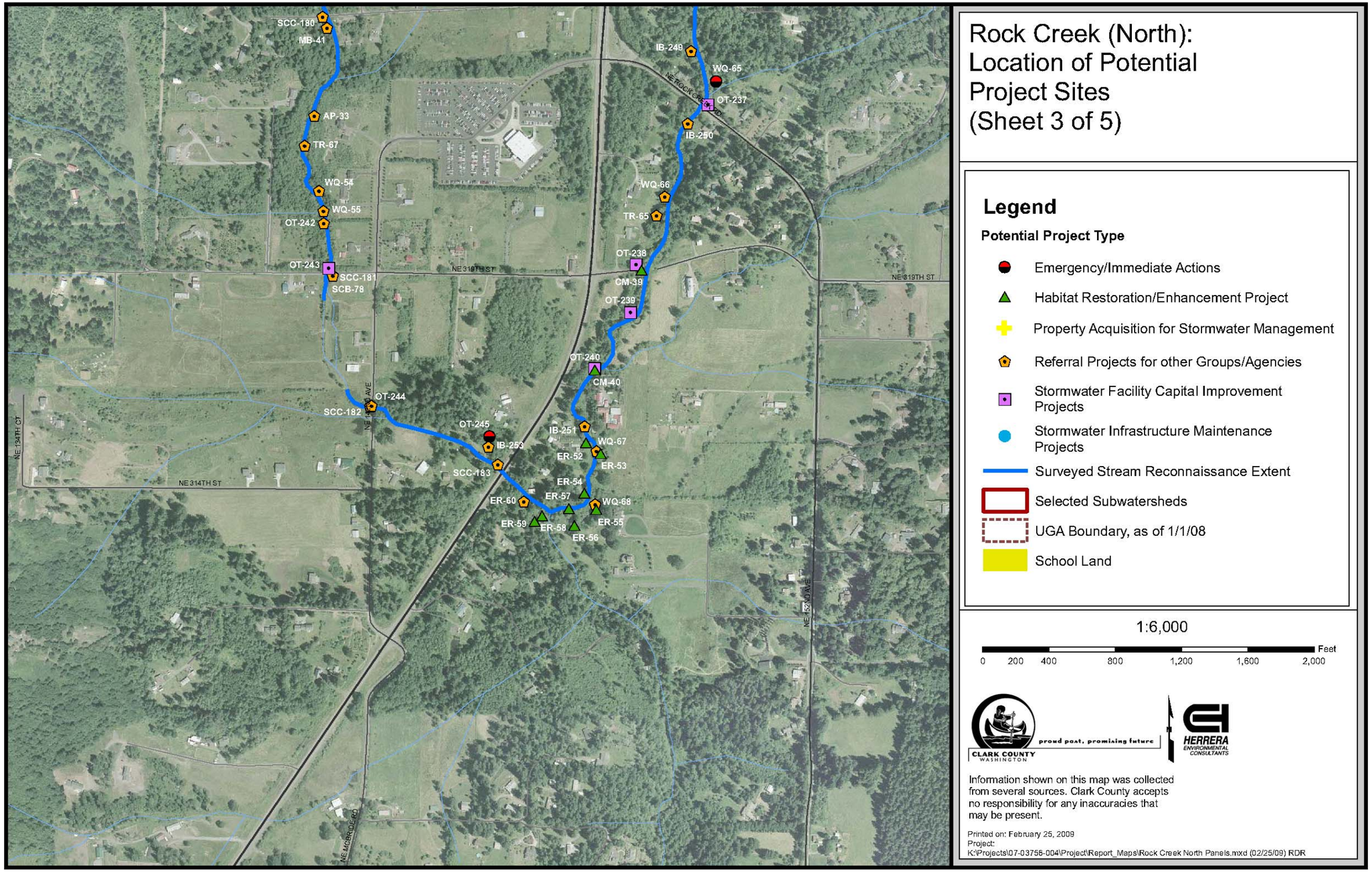

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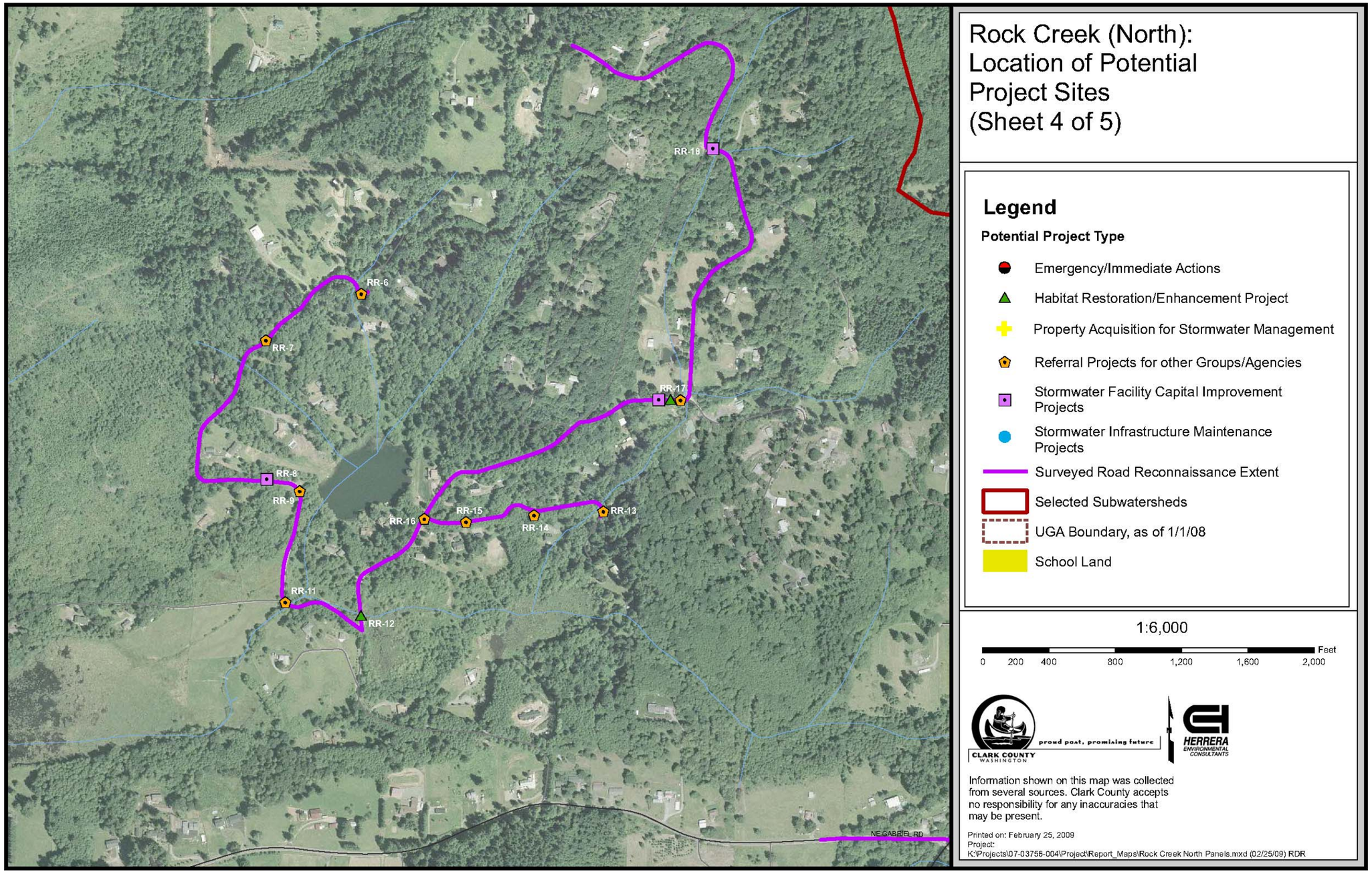
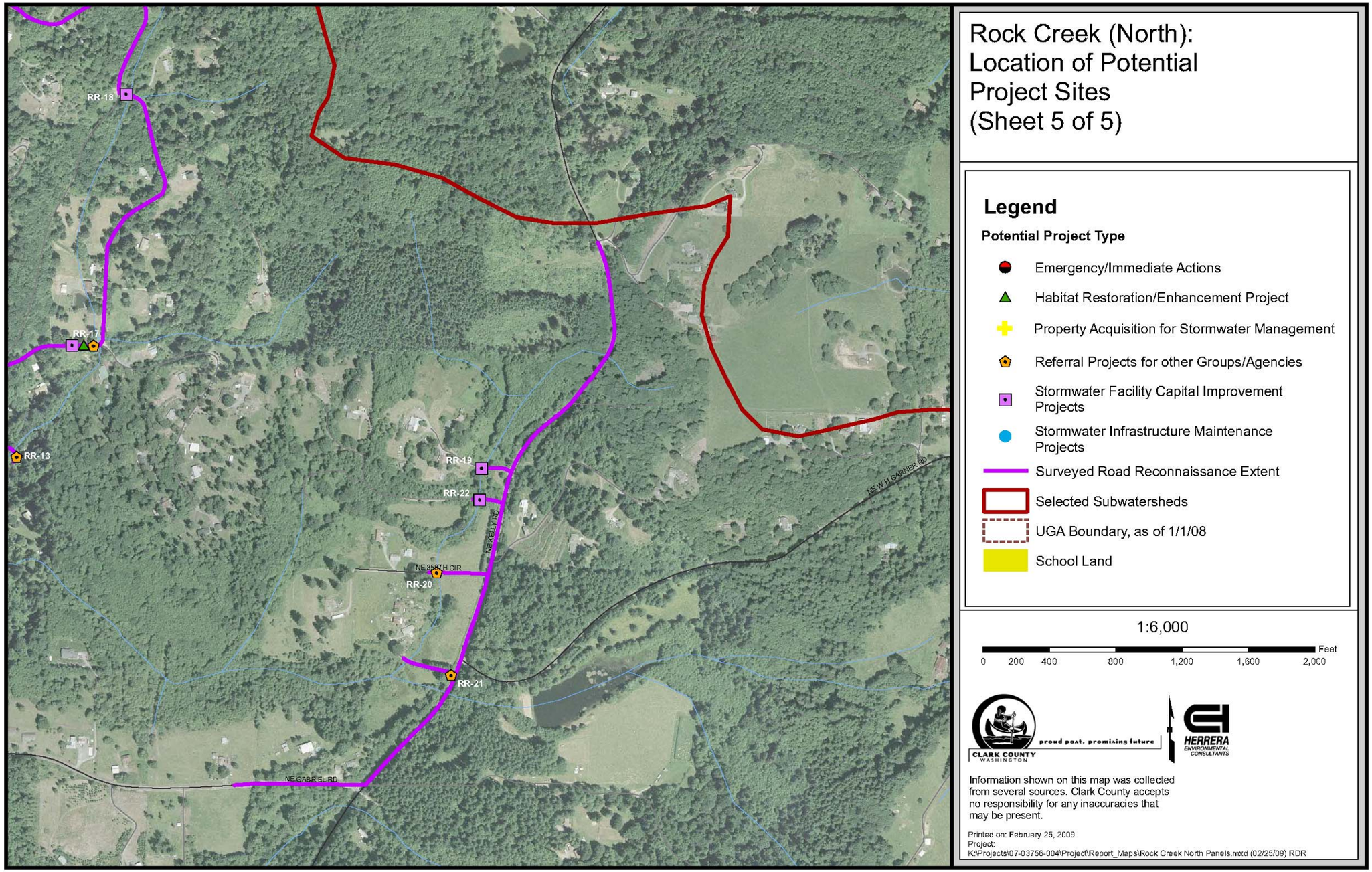


Figures 11: Rock Creek (North) Location of Potential Project Sites



Rock Creek (North): Location of Potential Project Sites (Sheet 5 of 5)

Legend

Potential Project Type

- Emergency/Immediate Actions
- Habitat Restoration/Enhancement Project
- Property Acquisition for Stormwater Management
- Referral Projects for other Groups/Agencies
- Stormwater Facility Capital Improvement Projects
- Stormwater Infrastructure Maintenance Projects
- Surveyed Road Reconnaissance Extent
- Selected Subwatersheds
- UGA Boundary, as of 1/1/08
- School Land

1:6,000

0 200 400 800 1,200 1,600 2,000 Feet

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Information shown on this map was collected from several sources. Clark County accepts no responsibility for any inaccuracies that may be present.

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Project:
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Figures 12: Rock Creek (North) Location of Potential Project Sites

Emergency/Immediate Actions
Emergency/Immediate Actions require an immediate site response project to address a potential or imminent threat to public heath, safety, or the environment. Emergency/Immediate Actions identified based on the results of the Feature Inventory are described in Table 12.

Table 12: Description of Potential Project Opportunities

ID	Basis for Project	Project Description
OT-232	4-inch-diameter HDPE pipe drains water to channel. Source may be a leach field.	Contact landowner immediately and conduct a site visit to determine source of runoff. Conduct IDDE investigation.
OT-245	3-inch-diameter PVC pipe drains water to channel from unknown source. Source may be a leach field.	Contact landowner immediately and conduct a site visit to determine source of runoff. Conduct IDDE investigation.
WQ-65	Horse manure on stream bank at tributary confluence.	Contact landowner immediately and remove manure. Educate landowner on proper manure disposal options.

Stormwater Facility Capital Improvement Projects
Stormwater Facility Capital Improvement Projects are projects that create new or retrofit existing stormwater flow control or treatment facilities. Facility retrofits include projects that will increase an existing facility's ability to control or treat stormwater in excess of the original facility's design goals. Stormwater Facility Capital Improvement Projects identified based on the results of the Feature Inventory are described in Table 13.

Table 13: Description of Potential Project Opportunities

ID	Basis for Project	Project Description
OT-226 OT-227 OT-228 OT-229	Roadside ditches drain stormwater from NE 269th Street to channel.	Confirm source of stormwater and construct facility retrofits on road ditches to detain and treat runoff appropriately.
OT-230	Small open channel drains water from an unknown source in the direction of the large earthen dam to the west.	Investigate source of stormwater. Develop project if necessary.
OT-231	Roadside ditch drains stormwater from NE Lewisville Highway. No apparent treatment. Some erosion present at outfall.	Confirm source of stormwater and construct facility retrofits on road ditches to detain and treat runoff appropriately. At a minimum, armor outfall to prevent additional erosion.
OT-243	Roadside ditch drains stormwater from NE Lewisville Highway. No apparent treatment. Some erosion present at outfall.	Confirm source of stormwater and construct facility retrofits on road ditches to detain and treat runoff appropriately. At a minimum, armor outfall to prevent additional erosion.

Table 13: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
OT-235	Small open channel drains water to the left bank from an unknown source in the direction of the houses to the east.	Investigate source of stormwater. Develop project if necessary.
OT-236	Eroding ditch along south side of driveway drains untreated stormwater and sediment to the creek.	Investigate source of stormwater and construct facility retrofits on ditch to detain and treat runoff appropriately. At a minimum, armor outfall to prevent additional erosion.
OT-237	Roadside ditch drains stormwater from NE Rock Creek Road. No apparent treatment. Some erosion present at outfall.	Confirm source of stormwater and construct facility retrofits on road ditches to detain and treat runoff appropriately. At a minimum, armor outfall to prevent additional erosion.
OT-238	Ditch drains stormwater to stream at historic NE 319th Street crossing. No apparent treatment.	Investigate source of stormwater and construct a new stormwater facility to detain and treat runoff appropriately.
OT-239	Small open channel drains water to the right bank from unknown source in the direction of NE Lewisville Highway.	Investigate source of stormwater. Develop project if necessary.
OT-240	Tributary stream or ditch drains stormwater from agricultural land and houses to the east of the creek. A roof drain from a house enters at the same point.	Investigate source of stormwater and look for additional impairments farther upstream on this inflow source. Develop stormwater treatment and water quality enhancement project(s) if appropriate.
RR-8	Road runoff drains directly to lake via roadside ditch. No apparent treatment.	Confirm source of stormwater and construct facility retrofits on road ditches to detain and treat runoff appropriately.
RR-17	Road runoff from ditch along NE Coda Drive drains to channel. No apparent treatment.	Confirm source of stormwater and construct facility retrofits on road ditches to detain and treat runoff appropriately.
RR-18	Water and sediment from several hundred linear feet of steep, rutted dirt/gravel road surface drains directly to stream without treatment. Significant water and sediment input to stream. Steep channel is small but degraded.	Confirm sources of stormwater. Implement road surface BMPs and construct facility retrofits on road ditches to detain and treat runoff appropriately. Consider using water bars to address erosion in conjunction with road resurfacing and regarding of ruts. Additional treatment for road runoff may be required.

Table 13: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
RR-19	Road runoff from NE 362nd Street and possibly NE Kelly Road delivered to creek. No apparent treatment.	Confirm volume and source of stormwater and construct facility retrofits on road ditches to detain and treat runoff appropriately.
RR-22	Road runoff from NE 360th Street and possibly NE Kelly Road delivered to creek. No apparent treatment.	Confirm volume and source of stormwater and construct facility retrofits on road ditches to detain and treat runoff appropriately.

Stormwater Infrastructure Maintenance Projects

Stormwater Infrastructure Maintenance Projects includes potential projects which address and repair maintenance defects affecting existing stormwater infrastructure. Infrastructure maintenance projects are required by the County NPDES municipal stormwater permit. Projects in this category with estimated costs exceeding $10,000 are considered under the SCIP process. Projects addressing simpler maintenance defects are referred directly to the County Public Works Operations and Maintenance staff. Stormwater Infrastructure Maintenance Projects identified based on the results of the Feature Inventory are described in Table 14.

Table 14: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
OT-234	Outfall from church parking lot drains through pond and vegetated swale into floodplain.	Conduct illicit discharge screening at outfall.

Habitat Restoration/Enhancement Projects

Habitat Restoration/Enhancement Projects include potential projects which result in the restoration or enhancement of wetlands, upland forest, or riparian habitat. In-stream channel habitat and bank protection projects do not fall within the scope of Clark County's CWP, and are placed under the category of Referral Projects for other Groups/Agencies. Habitat Restoration/Enhancement Projects identified based on the results of the Feature Inventory are described in Table 15.

Table 15: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
CM-39	Historic road grade and bridge approach (NE 319th Street) constricts floodplain and causes localized deposition of sediment and braiding in the channel upstream.	Improve floodplain connectivity and restore geomorphic processes by removing all or part of the historic bridge approaches. Consider potential positive and negative effects of such a project.
CM-40	Riprap bank.	Plant native riparian vegetation to compliment and enhance riprap bank armoring. Educate landowner about importance of native riparian vegetation and stream processes.
ER-52 ER-53 ER-54 ER-55 ER-56 ER-57 ER-58 ER-59	Significant bank erosion at outside of meander bends progressing downstream from ER-52 threatens outbuildings and property in addition to being a significant sediment source.	Develop a large scale channel restoration and habitat restoration project with landowners in this reach. The sudden onset of bank erosion and channel instability may be indicative of a larger issue either in this area, or farther upstream in the watershed. Consider a more in-depth geomorphic investigation as a first step.
RR-12	Culvert at NE Beaverbrook Road conveys flow from a large wetland complex upstream of the road. Culvert appears adequately sized due to significant flood storage capacity of upstream wetlands. Widespread invasive plant species, predominantly reed canary grass, in wetland complex and along channel downstream.	Consider large scale wetland habitat enhancement and invasive plant species management in this area.
RR-17	Creek is very steep and degraded by residential land use and historic logging.	Consider developing a large scale stream restoration project in conjunction with multiple landowners or the homeowners association to improve in-stream and riparian habitat as well as channel stability.

Property Acquisition for Stormwater Mitigation

Property Acquisition for Stormwater Mitigation Projects includes potential acquisitions of properties for any purpose that meets permit requirements to mitigate for stormwater impacts. This includes preservation or restoration of upland forest and riparian habitat zones. No projects of this type were identified in the surveyed reaches of the Rock Creek (North) subwatershed.

Referral Projects for Other Groups/Agencies

Referral Projects for other Groups/Agencies includes potential projects that do not fall within the defined scope of Clark County's CWP. This includes, but is not limited to, in-channel restoration, agricultural BMPs, fish-passage barrier removals, and invasive plant management. It also includes referrals for projects such as trash removal, stream culvert repairs/maintenance, and drainage projects. Referral Projects for other Groups/Agencies are identified based on the results of the Feature Inventory are described in Table 16.

Table 16: Description of Potential Project Opportunities

ID	Basis for Project	Project Description
IB-242	Widespread invasive plant species in riparian area and floodplain. No riparian shading. Left bank actively being cleared of vegetation on blueberry farm property	Eradicate reed canary grass. Work with landowner to reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat.
IB-243	Widespread invasive plant species in riparian area and floodplain. Predominantly blackberry.	Eradicate blackberry. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat.
IB-244	Widespread invasive plant species in riparian area and floodplain. Predominantly blackberry.	Eradicate blackberry. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat.
IB-245	Widespread invasive plant species in riparian area and floodplain. Predominantly reed canary grass. Area is mowed up to top-of bank.	Eradicate reed canary grass. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat. Educate landowner about importance of native riparian vegetation.
IB-246	Lack of woody riparian vegetation along channel. Some invasive plant species in riparian area and floodplain. Predominantly reed canary grass and blackberry. Headwaters recently clear-cut.	Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat.
IB-252	Widespread invasive plant species in riparian area and floodplain. Predominantly blackberry.	Eradicate blackberry. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat.
IB-253	Widespread invasive plant species in riparian area and floodplain. Predominantly blackberry and reed canary grass.	Eradicate blackberry and reed canary grass. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat.

Table 16: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
IB-247	Widespread invasive plant species in riparian area and floodplain. Predominantly blackberry and reed canary grass. Left bank is mowed to top-of-bank.	Eradicate blackberry and reed canary grass. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat. Educate landowner about importance of native riparian vegetation.
IB-248	Widespread invasive plant species in riparian area and floodplain. Predominantly reed canary grass and blackberry.	Eradicate reed canary grass and blackberry. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat.
IB-249	Widespread invasive plant species in riparian area and floodplain. Significant ivy and lawn/bare ground on right bank.	Eradicate ivy. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat. Educate landowner about importance of native riparian vegetation.
IB-250	Lack of vegetation. Mowed turf to edge of stream or within 5-feet of stream.	Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat. Educate landowner about importance of native riparian vegetation.
IB-251	Lack of vegetation. Mowed turf in floodplain. Significant reed canary grass.	Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat. Educate landowner about importance of native riparian vegetation.
WQ-66	Withdrawal point. Small submersible pump and garden hose.	Confirm landowners' water rights.
WQ-56 OT-225	Blueberry farm and hay fields dominate the floodplain, which is an old lake bed. Trapezoidal, constructed channel receives runoff from fields and water from tile drains and serves as a source of irrigation water. No riparian shading.	Discuss options for improving water quality and riparian cover with the owners of the blueberry farm. Look into opportunities to develop a large scale project that combines water quality enhancement and habitat restoration with multiple land owners in the old lake bed.
WQ-57 WQ-58	Ditches from a horse pasture drain agricultural runoff to the stream from the left bank.	Apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).

Table 16: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
WQ-59	Livestock crossing delivers sediment and nutrients to channel. Manure pile kept immediately adjacent to channel on floodplain.	Investigate alternative means for livestock to cross channel to minimize water quality impacts. Discuss options for improving management practices with landowners.
WQ-60	Livestock access point and inflow point for agricultural runoff.	Apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
WQ-61	Drainage ditch enters channel from NW. Ditch appears to start at clear-cut headlands and flows through horse pasture.	Segregate livestock from riparian area and restore riparian vegetation. Investigate quality of agricultural runoff, and apply source control, develop off channel watering, and/or construct appropriate facilities to enhance water quality.
WQ-47	Ditch enters channel from right bank. Potential source of agricultural runoff.	Investigate source of runoff. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
WQ-48	Swale drains to channel from right bank. Likely drains agricultural runoff from pasture during heavy rains.	Investigate source of runoff. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
WQ-49	Swale drains to channel from right bank.	Investigate source of runoff. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
WQ-50	Swale drains to channel from left bank.	Investigate source of runoff. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).

Table 16: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
WQ-51	Swale drains to channel from right bank.	Investigate source of runoff. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
WQ-52	Small channel enters stream from right bank carrying flow from an unknown source. Likely input for agricultural runoff.	Investigate source of flow. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
WQ-53	Small channel enters stream from right bank carrying flow from an unknown source. Likely input for agricultural runoff.	Investigate source of flow. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
WQ-54	Small channel enters stream from left bank carrying flow from an unknown source.	Investigate source of flow. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
WQ-55	Small channel enters stream from right bank carrying flow from an unknown source.	Investigate source of flow. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
OT-242	Small channel drains to stream from right bank carrying flow from an unknown source.	Investigate source of flow. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
OT-244	Small channel drains to stream from right bank carrying flow from an unknown source.	Investigate source of flow. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).

Table 16: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
WQ-62	Temporary livestock access and crossing with narrow riparian buffer.	Landowner is very interested in doing the right thing for the stream. Consider keeping in contact and offering suggestions for ways to improve water quality. This could potentially have a positive ripple effect with adjacent landowners in the subwatershed.
WQ-63	Small channel enters stream from left bank carrying flow from an agricultural field.	Investigate source of flow. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
AP-29	Lightly used livestock access.	Investigate alternative means for livestock to access the water. Discuss options for improving management practices with landowners.
WQ-64	Manmade pond drains to stream. Pond may be acting as a source of thermal loading and/or contributing to other water quality impairments.	Investigate the effects of the pond on water quality. Modify facility to achieve improved water quality.
WQ-68	Ditch drains several acres of agricultural land. Enters channel on the left bank. Potential source of agricultural runoff.	Investigate source of runoff. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality BMP).
RR-13 RR-14 RR-15 RR-16	Culvert crossing at NE Sunrise Road crossing (RR-13) is undersized and damaged, with evidence of recent road overtopping. The crossing diverts the flow out of the natural drainage pathway and into a ditch which parallels NE Sunrise Road and delivers flow to a large manmade lake. The ditch is perched on the hillside above houses south of NE Sunrise Road. Culverts under two driveways (RR-14 and RR-15) are undersized and could become clogged, resulting in flooding of houses.	Repair or replace culverts at RR-13, and consider reconfiguring the infrastructure to return flow to its natural drainage pattern. Diverting flows into the manmade lake likely results in reduced water quality due to thermal loading.

Table 16: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
RR-20	Potential agricultural runoff from fields upstream and downstream of the private crossing on NE 359th Circle.	Investigate source of flow. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality.
RR-21	Potential agricultural runoff from fields upstream and downstream of the private crossing on NE 366th Street.	Investigate source of flow. As needed, apply source control and/or construct appropriate facilities to enhance water quality (new stormwater facility to detain and treat runoff or agricultural water quality).
ER-48	Several bank erosion along left bank of agricultural channel. Bank is actively cleared of vegetation and fine lake bed soils are actively eroding.	Discuss options for improving management practices, bank stability, water quality, and riparian cover with the owners of the blueberry farm.
CM-37	Dredge spoils excavated from trapezoidal channel and piled into a levee on left bank.	Remove dredge spoils and revegetate area. Investigate the original purpose of the levee (it may have just been a convenient disposal site or an indication of a larger issue). Discuss options for improving management practices with landowners.
MB-38	Failing outlet structure on a small, in-line impoundment. Low risk of major damage if catastrophic failure occurs.	Site inspection by engineering staff to determine structural integrity of the dam and outlet works. May warrant removal of dam and restoration of tributary stream. At minimum, project should appropriately mitigate for thermal and fish passage impacts of the dam.
MB-42	Small asphalt dam with 2-foot drop height is a likely fish passage barrier. Upstream pond may be a water quality impairment, and banks are eroding immediately downstream of the dam.	Site inspection by engineering staff to determine structural integrity of the dam. May warrant removal of dam and restoration of stream. At minimum, project should appropriately mitigate for thermal and fish passage impacts of the dam.
MB-39	Debris jam founded on introduced materials creates a backwatered pond and significant fine sediment deposition.	Site inspection to determine if debris should be removed in a controlled manner to prevent unexpected failure and release of sediment.

Table 16: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
MB-40	Small (1-foot-high) concrete dam creates small pond extending approximately 100-feet upstream and is a likely fish passage barrier. Channel armored with concrete downstream of dam.	Site inspection by engineering staff to determine structural integrity of the dam. May warrant removal of dam and restoration of stream. At minimum, project should appropriately mitigate for thermal and fish passage impacts of the dam.
MB-41	Small (3-foot-high) concrete dam creates small pond and is a likely fish passage barrier.	Site inspection by engineering staff to determine structural integrity of the dam. May warrant removal of dam and restoration of stream. At minimum, project should mitigate for thermal and fish passage impacts of the dam.
RR-9	Dam and outlet structure to large manmade lake. Dam is approximately 10-12 feet high. Primary outlet is a pipe, but the overflow spillway was activated due to high flows at the time of the road reconnaissance survey. Structural integrity of the dam is unknown.	Site inspection by engineering staff to determine structural integrity of the dam. May warrant removal of dam and restoration of stream. At minimum, project should appropriately mitigate for thermal and fish passage impacts of the dam.
RR-6	Extremely undersized culvert crossing near the head of a steep drainage impounds significant amount of water during heavy rain and rain on snow events. Road grade creates a dam which could fail due to soil saturation or overtopping if wet conditions persist.	Site inspection by engineering staff to determine structural integrity of the road grade and sizing of the existing culvert. Findings may indicate that a more complex project is required to ensure that the crossing does not fail catastrophically. Analysis should include potential negative downstream impacts of larger culvert.
RR-7	Wet swale (obvious drainage pathway) crosses road. No culvert was observed. Evidence indicates that flow may overtop the road during large storm events.	Site inspection by engineering staff to determine if road crossing should be modified to restore natural drainage patterns.
SCC-170	Failing embankment due to undersized or clogged culvert at a private crossing.	Repair and armor embankments and replace culvert if necessary.
SCC-171	Failing embankment due to undersized or clogged culvert under NE 369th Street.	Investigate site issues and repair and armor embankments and replace culvert if necessary.
SCC-172	Undersized culvert on a private access path. Likely barrier to fish. Widespread invasive plant species in riparian area and floodplain. Predominantly blackberry.	Conduct additional barrier analysis to determine if culvert retrofit or replacement is required. Eradicate blackberry. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat.

Table 16: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
SCC-173	Box culvert under NE Lewisville Highway is likely a fish passage barrier at many flows due to steep gradient and concrete bottom. Significant bank/embankment erosion on downstream end.	Conduct additional barrier analysis to determine if culvert retrofit or replacement is required. Stabilize banks downstream of culvert.
SCC-174	Undersized culvert on a private access path.	Conduct additional barrier analysis to determine if culvert retrofit or replacement is required.
SCC-175	Culvert crossing under NE 333rd Street has a crushed outlet and a debris jam just upstream.	Repair or replace culvert with consideration for fish passage if appropriate.
SCC-176	Failed embankments and culverts at a foot path crossing.	Remove remainders of failed crossing. Restore channel and eliminate the crossing or replace culvert with consideration for fish passage if appropriate.
SCC-177	Culvert crossing on a private road.	Conduct additional barrier analysis to determine if culvert retrofit or replacement is required.
SCC-178	Undersized culvert under NE 329th Street. Expansion scour causing significant erosion downstream of the culvert.	Conduct additional barrier analysis to determine if culvert retrofit or replacement is required. Investigate site issues, repair banks and replace culvert if necessary.
SCC-179	Undersized culvert under NE 327th Street. Expansion scour causing some erosion downstream of the culvert.	Conduct additional barrier analysis to determine if culvert retrofit or replacement is required.
SCC-180	Culverts under NE 326th Street.	Conduct additional barrier analysis to determine if culvert retrofit or replacement is required.
SCC-181 SCB-78	Potentially undersized culverts under NE 319th Street. Private bridge immediately downstream. Some erosion downstream of the culvert.	Conduct additional barrier analysis to determine if culvert retrofit or replacement is required.
SCC-182	Box culvert under NE 142nd Avenue may be a fish passage barrier at low flows.	Conduct additional barrier analysis to determine if culvert retrofit or replacement is required.
SCC-183	Culvert under NE Lewisville Highway is likely a fish passage barrier at many flows due to steep gradient, lack of streambed material, and perched outlet.	Conduct additional barrier analysis to determine if culvert retrofit or replacement is required. Stabilize banks downstream of culvert.

Table 16: Description of Potential Project Opportunities		
ID	**Basis for Project**	**Project Description**
RR-11	Undersized culvert under NE Lakeview Drive. Culvert was observed at high flows near 100% of capacity.	Conduct additional barrier and hydraulic analysis to determine if culvert retrofit or replacement is required. Eradicate reed canary grass. Reestablish native undergrowth and canopy vegetation on floodplain to shade out invasive plants and enhance riparian habitat.
RR-17	Undersized culverts crossing under NE Beaverbrook Road and NE Dawn Lane. Evidence of recent high flows overtopping road. Residential subdivision was not designed to work with natural drainage patterns.	Conduct additional barrier and hydraulic analysis to determine if culvert retrofit or replacement is required.
TR-66	Old tree house platform and other construction debris on both banks. Could be swept downstream and plug culverts.	Contact landowner about removing the debris.
TR-67	Construction debris (pallet and plywood) on right bank. Could be swept downstream and plug culverts.	Contact landowner about removing the debris.
TR-65	Burn pile and trash pile on right bank.	Contact landowner about removing the debris.
WQ-67	Nursery owners disposing of potting soil on floodplain.	Contact landowner about removing the debris and educate them about water quality and floodplain fill regulations.
AP-33	Access point with shack/fort and significant accumulation of trash and debris.	Contact landowner about removing the debris.
ER-60	Tall, steep eroding banks in incised reach downstream of armored cascade with 8 to 10-foot vertical drop.	Monitor for signs of increased rate of erosion or additional headcutting. The mainstem of Rock Creek (North) is moderately to completely unstable at the confluence, immediately downstream of this feature.

Stormwater Management Recommendations

A number of general stormwater management measures should be implemented throughout the Rock Creek (North) subwatershed:

- Educate private landowners concerning importance of invasive plant removal, and suggest removal techniques.
- Educate private landowners on importance of native riparian vegetation for shading streams.
- Provide a list of suggested plants for stream revegetation and local nurseries that stock them for distribution to landowners.

- Encourage appropriate agricultural practices that emphasize soil and water conservation and reduction in nutrient load to streams.
- Post stream identification signs where roads cross streams. Repair or replace deteriorated signs if necessary.
- Do not overlook stormwater and agricultural runoff inputs to small tributary streams that were not surveyed as a part of this Feature Inventory. These inputs may be more numerous than originally anticipated and likely represent the most significant source of water quality impairment in the subwatershed.
- In the case of some water impoundments or withdrawals, the State should verify the owner has water rights.
- The county should consider producing an educational pamphlet in conjunction with the natural resources group for distribution to streamside property owners emphasizing the importance of native vegetation and canopy cover along streambanks.

Physical Habitat Assessment

Purpose

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

Methods

Physical habitat measurements were made for a reach of lower Rock Creek (North) RM 0.25 to RM 0.7 by S.P. Cramer (January 2005) for the Lower Columbia Fish Recovery Board. The project followed modified USFS Level II protocols. No comparable physical habitat survey information is available for the mainstem reaches of the East Fork Lewis River within the East Fork Lewis River (RM 15.75) subwatershed.

Results

The S.P. Cramer report includes a good narrative summary of the habitat survey results, including figures and tables, some of which are presented here. The full report may be found on the CWP website at: http://www.clark.wa.gov/water-resources/documents-monitoring.html#strmac

The lower Rock Creek (North) survey reach has a low to moderate gradient and is moderately confined by the valley hillslope. Its habitat type consists of more than half riffle (58 percent), one quarter pool (25 percent), and lesser amounts of glide and pool tailout. The lower part of the reach has a significant amount of side channel habitat.

Information in the S.P. Cramer report noted that the streambed riffle substrate is primarily cobble (47 percent) and gravel (34 percent). Pool substrate could not be evaluated due to high turbidity. Embeddedness was rated low with all estimates falling in the 0 to 25 percent embedded category. Table 17 summarizes habitat evaluations based on Washington Conservation Commission and NOAA Fisheries Properly Functioning Condition standards.

Table 17: Summary of Habitat Evaluations Based on Washington Conservation Commission and NOAA Fisheries Properly Functioning Condition Standards		
Parameter	**WCC[1]**	**PFC[2]**
% Pool by Surface Area	Poor	
Pool Frequency	Poor	Not Properly Functioning
Pool Quality		At Risk
LWD		Not Properly Functioning
Substrate		At Risk
Streambank Stability	Poor	Not Properly Functioning
Barriers	Good	Properly Functioning

[1] Available Rating: Good; Fair; Poor

[2] Available Ratings: Properly Functioning; At Risk; Not Properly Functioning

Geomorphology and Hydrology Assessment

A geomorphology and hydrology 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 increased future shading and woody debris recruitment, which can improve stream conditions to mitigate for stormwater impacts.

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.

Method

Where possible, the assessment is based on GIS data from existing reports, primarily the Habitat Assessment report prepared for the Lower Columbia Fish Recovery Board (S.P. Cramer and Associates, 2005). This report applies primarily to salmon-bearing stream reaches and therefore does not provide information for many smaller streams. Results are based on aerial photo interpretation using Washington Forest Practices Board methods for LWD delivery and channel shade estimates.

In streams where no data exists from the LCFRB assessment, 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 the respective sections, and most are included on a final list for referral to outside agencies.

The 2005 LCFRB Habitat Assessment report 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.

Results

Results are based primarily on the 2005 LCFRB Habitat Assessment for the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds. The full assessment report is available on the Clark County website at: http://www.clark.wa.gov/water-resources/documents.html#mon

For areas within the subwatersheds not included in the habitat assessment (tributaries to Rock Creek North and the East Fork of the Lewis River), LWD recruitment potential and shade rating analyses were based on a qualitative review of 2007 orthophotographs.

At the subwatershed scale, the LCFRB rated the riparian conditions within the East Fork Lewis River (RM 15.75) as moderately impaired, and Rock Creek (North) as impaired.

Riparian (Large Woody Debris (LWD) Delivery)

Figure 13 shows the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds' LWD delivery potential. Within the East Fork Lewis River (RM 15.75) subwatershed, the survey included the mainstem of the East Fork Lewis River. The mainstem of the East Fork Lewis River has primarily moderate to high LWD recruitment potential along the approximate four miles surveyed, and is dominated by conifers. The left and right bank tributaries to the East Fork of the Lewis River appear to have similar moderate to high LWD potentials based on orthophotography review, with the only scattered area of lower LWD recruitment found on the left bank tributary which crosses NE 279th Street.

The Rock Creek (North) subwatershed survey addressed only the mainstem of Rock Creek. The uppermost reaches and the two main tributaries to Rock Creek were reviewed using orthophotography to estimate LWD delivery potential. The overall surveyed reach of Rock Creek primarily consists of areas with moderate to high LWD recruitment levels, with smaller (under one-half mile) areas of lower recruitment potential. Upstream of the surveyed reach, LWD recruitment transitions from moderate to none, as Rock Creek passes through a system of ditches that drain agricultural land within the Farger Lake area. The two main tributaries to Rock Creek were estimated to have moderate LWD recruitment levels.

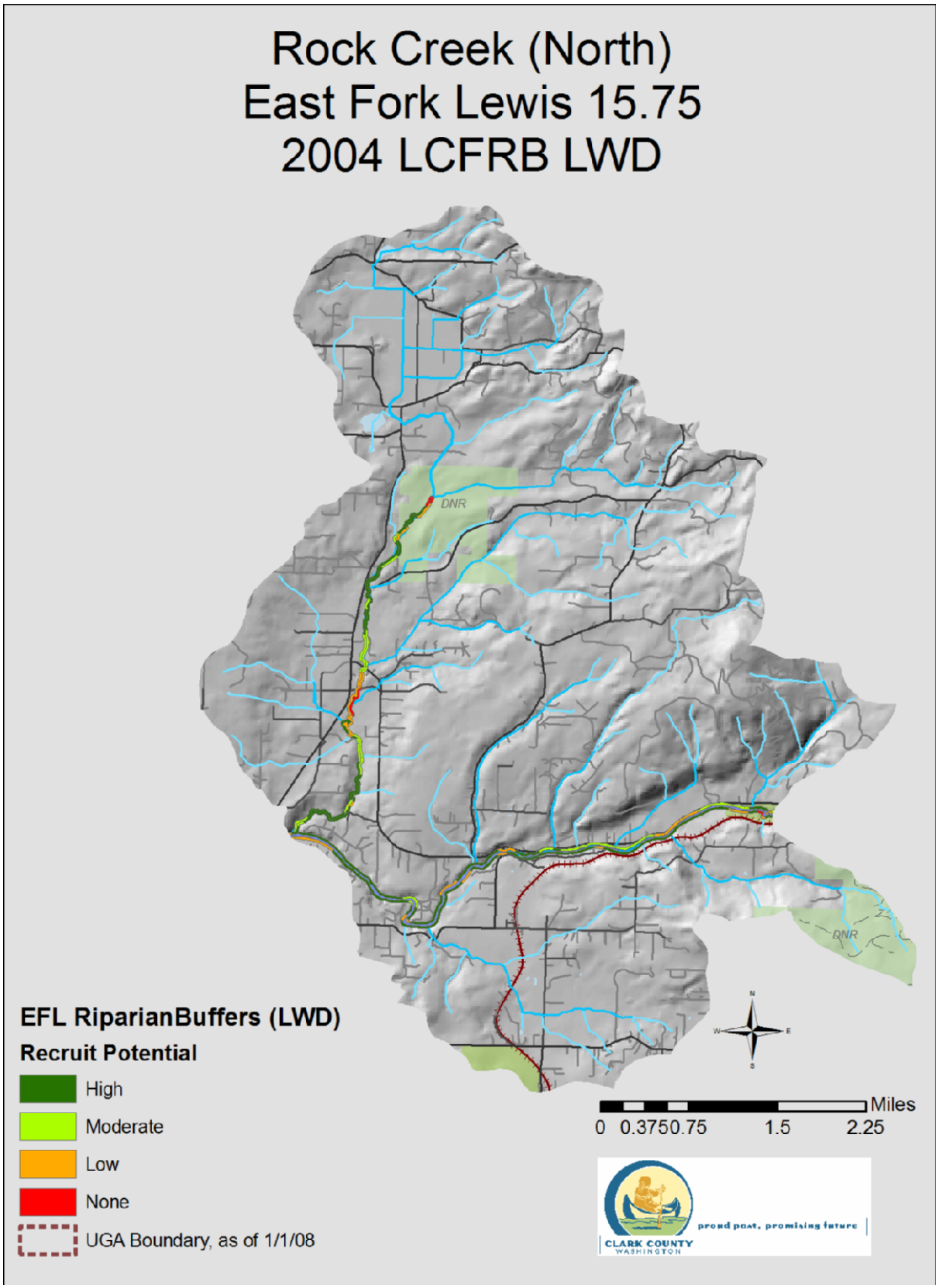

Figure 13: Rock Creek (North) and East Fork Lewis River (RM 15.75) LWD Recruitment Potential (adapted from S.P. Cramer and Associates, 2005)

Shade

Figure 14 includes the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds' shade ratings from the 2005 LCFRB Habitat Assessment. Overall, shade levels along the East Fork Lewis mainstem within the East Fork Lewis River (RM 15.75) subwatershed ranged between 20 and 70 percent. Areas with lower shade levels are due in large part to existing large woody debris and/or overhanging cover only providing limited amounts of cover across the entire width of the channel (S.P. Cramer and Associates, 2005). The left and right bank tributaries to the East Fork of the Lewis River appear to have higher shade levels overall (ranging from 40 to 90 percent) as compared to the mainstem, based on orthophotography review.

Higher shade ratings were found within the Rock Creek (North) subwatershed, with the surveyed reach of Rock Creek (North) indicating a range of 70 to 90 percent shade. The upper reaches of Lower Rock Creek not covered by the survey were estimated to have varied shade ratings of 0 to 90 percent with the lower shade ratings occurring north of Farger Lake Highway, where land use transitions from forest to agriculture. The two main tributaries to Rock Creek (which were not formally surveyed) were estimated to have shade ratings ranging from 40 to 70 percent.

Management Recommendations

Overall recommended management activities for the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds include riparian forest restoration in areas cleared for residential and agricultural land use, acquisition of existing forest land for future protection of streams and watersheds, and invasive species removal.

Potential Projects

Although there were several priority project areas within the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds listed for restoration within the S.P. Cramer and Associates (2005) report, this assessment did not discover any specific potential project opportunities likely to be suitable for consideration by the CWP SCIP for improvement of LWD recruitment or shade levels.

Recommended restoration projects in the East Fork Lewis River (RM 15.75) subwatershed include riparian forest restoration on private residential land along the south bank of the East Fork of the Lewis River, restoration for road impacts within riparian areas, and invasive species eradication. Reforestation of the left and right bank tributaries to the East Fork of the Lewis River is recommended in scattered areas that have been cleared for private agricultural and residential use.

Restoration projects in the Rock Creek (North) subwatershed include riparian forest restoration in areas that have been disturbed by small scale logging/tree removal, residential clearing and brush clearing.

Specific priority project areas listed in the S.P. Cramer and Associates (2005) report are the areas of private residences along the East Fork Lewis River's south bank. Review of orthophotography indicates that reforestation of a left bank tributary to the East Fork of the Lewis River is recommended in scattered areas that have been cleared for private agricultural and residential use. Specifically, the left bank tributary which crosses NE 279th Street/Boutelle Road could benefit from riparian reforestation within the area from NE 279th Street upstream to NE 182nd Avenue, and a small area immediately upstream of NE 194th Avenue.

Within the Rock Creek (North) subwatershed, riparian reforestation would be beneficial in the lower reaches of the mainstem of Rock Creek (North) (immediately downstream from the Rock Creek Road Bridge) and within cleared areas in the upper reaches of the mainstem both within Washington State Department of Natural Resources owned land and areas along agricultural ditches within Farger Lake. There are also scattered areas within the two main tributaries to Rock Creek cleared for private agricultural and residential use, which could benefit from riparian reforestation. Reforestation of these areas within the Rock Creek (North) subwatershed would provide improved LWD recruitment and stream channel shading.

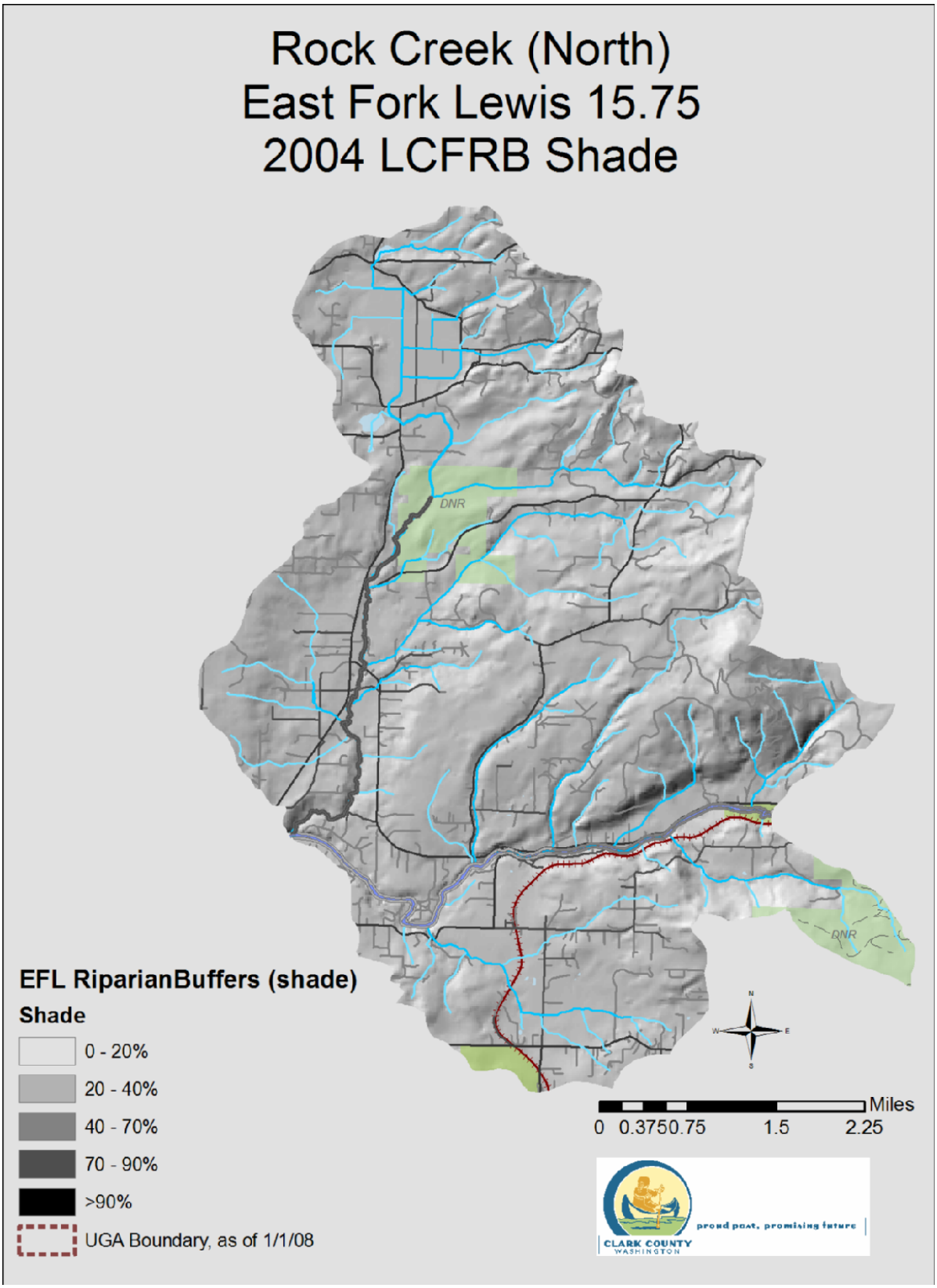

Figure 14: Rock Creek (North) and East Fork Lewis River (RM 15.75) Shade Values (adapted from S.P Cramer and Associates, 2005)

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; and
- 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 by 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 15 shows potential wetland areas within the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds based on data from the county wetlands atlas, including the Clark County wetland model, National Wetlands Inventory, and high-quality wetlands layer.

The East Fork Lewis River (RM 15.75) subwatershed has large expanses of potential wetland areas associated with the East Fork of the Lewis River riparian corridor and floodplain. Both left and right bank tributaries to the East Fork of the Lewis River have multiple potential wetlands within their floodplains, near their mouths and in their headwaters.

In the Rock Creek (North) subwatershed, pockets of potential wetlands are primarily associated with stream channel floodplains, with the exception of an

approximately 150-acre potential wetland area within Fargher Lake, north of Highway 503. This area was historically a large lake, which was drained for agricultural use approximately 50 years ago. Another larger wetland area is located along the tributary creek paralleling Gabriel Road.

Although there were many areas of potential wetlands within the subwatersheds reviewed, the review of the wetland inventories and studies did not identify any specific project opportunities within publicly held or tax-exempt lands within the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds.

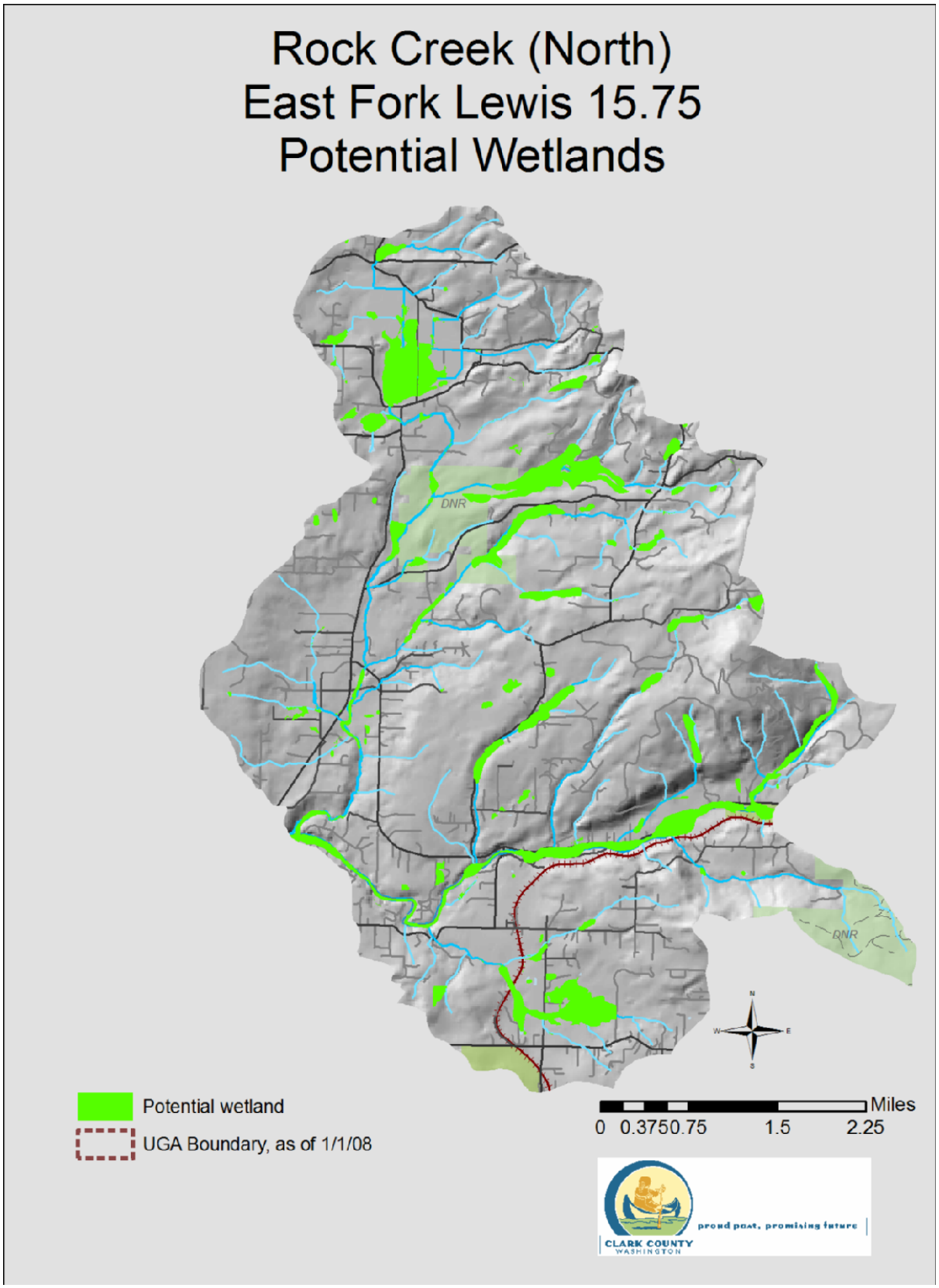

Figure 15: Rock Creek (North) and East Fork Lewis River (RM 15.75) Potential Wetlands

Draft 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 Draft Watershed Characterization (Washington Department of Ecology, 2007) may be found on the Clark County website at: http://www.clark.wa.gov/mitigation/watershed.html

Results pertaining to the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds are summarized below.

The Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds are part of the rain-dominated Mountainous hydrogeologic unit which is characterized by rain-dominated precipitation, shallow and deep groundwater flow patterns, glacial till over consolidated formations, as well as more permeable sedimentary formations (i.e., river alluvium and Troutdale formation), and moderate to steep topography (Ecology, 2007).

Figure 16 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.

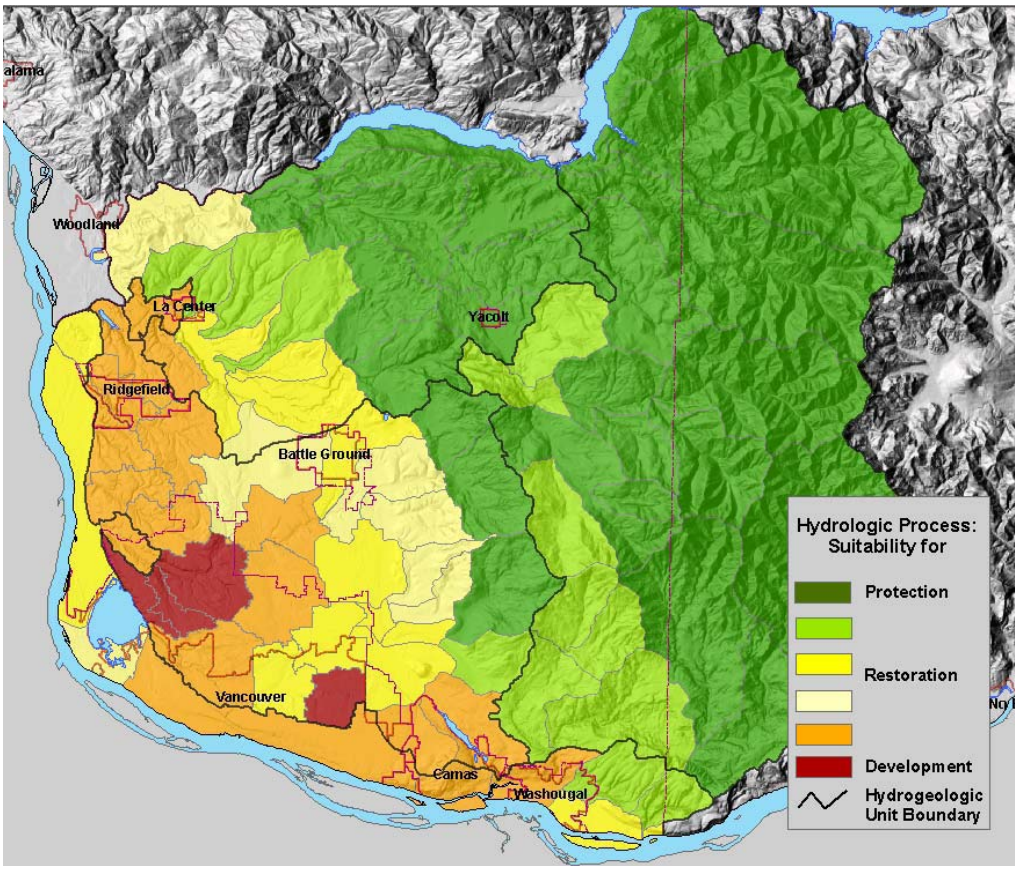

Figure 16: Priorities for suitability of areas for protection and restoration for the hydrologic process (from Draft Watershed Characterization of Clark County (Ecology, 2007)).

In general, green areas have higher levels of importance for watershed 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, 2007).

Protection ("dark green") is the focus for the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds. According to the Draft Watershed Characterization, protection within these subwatersheds suggests consideration of measures to protect watershed hydrological processes by maintaining forest cover. Additionally, restoration projects should be undertaken because they should have a higher level of success relative to other more highly altered units in the county (Ecology, 2007).

Potential Projects

This assessment did not identify any specific potential projects to improve wetland hydrology within the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds.

Macroinvertebrate Assessment

Purpose

The Benthic Macroinvertebrate Index of Biological Integrity or B-IBI (Karr, 1998) is a widely used measurement of stream biological integrity or health based on macroinvertebrate populations. Macroinvertebrates spend most of their lives in the stream substrate before emerging as adults. While in the stream, they are subject to impacts from continuous and intermittent pollutant sources, hydrology and habitat changes, and high summer water temperatures.

The B-IBI score is an index of ten metrics describing characteristics of stream biology, including: tolerance and intolerance to pollution, taxonomic richness, feeding ecology, reproductive strategy, and population structure. Each metric was selected because it has a predictable response to stream degradation. For example, stonefly species are often the most sensitive and the first to disappear as human-caused disturbances increase, resulting in lower values for the metric "Number of Stonefly taxa".

In addition to the overall B-IBI scores, examining individual metric scores gives insight into stream conditions and better explains differences in the overall score.

Methods

All field and laboratory work followed CWP protocols for macroinvertebrate sampling and analyses (Clark County, June 2003) or their equivalent. Samples are collected during late summer, preserved, and delivered to a contracted lab for organism identification, enumeration, and calculation of B-IBI metrics.

Raw data values for each metric are converted to a score of one, three, or five, and the ten individual metrics are added to produce an overall B-IBI score ranging from 10 to 50. Scores from 10 to 24 indicate low biological integrity, from 25 to 39 indicate moderate integrity, and greater than 39 indicate high biological integrity.

Results are influenced by both cumulative impacts of upstream land use and reach-specific conditions at or upstream of sampling sites. Thus, samples from a reach integrate local and upstream influences. Many of the B-IBI metrics are also influenced by naturally occurring factors in a watershed; for example, the absence of gravel substrate can lower scores.

Five Rock Creek (North) macroinvertebrate samples were collected intermittently from 2001 through 2007. Macroinvertebrates were sampled near Hammond Road at Station RCN010 by volunteers during 2004 and one mile upstream from Gabriel Road at Station RCN050 by CWP staff during 2001, 2004, 2006, and 2007. Two East Fork Lewis River (RM 15.75) subwatershed macroinvertebrate samples were collected by Clark Public Utilities in 2005 and 2007. Both samples were from the same location, approximately one-quarter mile downstream from the Basket Creek tributary.

Results

Station RCN010's single year B-IBI score of 32 and Station RCN050's four year average of 29 are in the category of moderate biological integrity. A 16-point decrease at RCN050 over a two-year period exceeds typical year-to-year variation of less than five points observed for Puget Sound streams (Karr 1998 and Law 1994).

Table 18 shows one low, seven moderate, and two high scores among the average results for individual metrics at RCN010. Station RCN050 has three low, five moderate, and two high. The low scoring metric for intolerant taxa at both stations suggests degraded water and habitat quality since these taxa are among the first organisms to disappear as human disturbances increase (Fore, 1999). Additionally, low scores for number of Mayfly taxa and percent predators at RCN050 could reflect the presence of pollutants such as heavy metals or pesticides, and decreasing diversity in prey items.

Table 18: Rock Creek (North) Station RCN010 and Station RCN050 Average Annual Macroinvertebrate Community Metrics and Total Scores from 2001 through 2007

	RCN010 1-Yr 2004			RCN050 4-Yr Averages		
BIBI Metrics	Value	Score	Category	Value	Score	Category
Total number of taxa	40.0	3	moderate	40.0	3	moderate
Number of Mayfly taxa	6.0	3	moderate	4.5	1	low
Number of Stonefly taxa	4.0	3	moderate	5.3	3	moderate
Number of Caddisfly taxa	11.0	5	high	5.5	3	moderate
Number of long-lived taxa	4.0	3	moderate	6.0	5	high
Number of intolerant taxa	0.0	1	low	0.5	1	low
Percent tolerant taxa	1.3	5	high	35.1	3	moderate
Percent predator taxa	10.9	3	moderate	8.3	1	low

Table 18: Rock Creek (North) Station RCN010 and Station RCN050 Average Annual Macroinvertebrate Community Metrics and Total Scores from 2001 through 2007.						
	RCN010 1-Yr 2004			RCN050 4-Yr Averages		
BIBI Metrics	Value	Score	Category	Value	Score	Category
Number of clinger taxa	19.0	3	moderate	20.0	3	moderate
Percent dominance (3 taxa)	64.5	3	moderate	43.0	5	high
Summary of avg. metric scores		32	moderate		28	moderate
Multi-year average B-IBI Score		**32**	**moderate**		**29**	**moderate**

The East Fork Lewis River (RM 15.75) station's average B-IBI score was 33, which is near the middle of the moderate biological integrity category. B-IBI results differed by two points from 2005 to 2007.

Table 19 shows two low, five moderate, and three high scores among the average results for individual metrics at East Fork Lewis River's (RM 15.75). As in Rock Creek North, the low scoring metrics for intolerant taxa and percent predator taxa suggest degraded water and habitat quality.

Table 19: East Fork Lewis River (RM 15.75) (CPUEFHE) Average Annual Macroinvertebrate Community Metrics and Total Score from Within the Period 2005 through 2007			
	CPUEFHE 2005, 2007 2-Yr Averages		
B-IBI Metrics	Value	Score	Category
Total number of taxa	47.5	5	high
Number of Mayfly taxa	8.5	3	moderate
Number of Stonefly taxa	6.0	3	moderate
Number of Caddisfly taxa	7.5	3	moderate
Number of long-lived taxa	3.0	3	moderate
Number of intolerant taxa	1.0	1	low
Percent tolerant taxa	37.4	3	moderate
Percent predator taxa	6.8	1	Low
Number of clinger taxa	28.5	5	high
Percent dominance (3 taxa)	41.8	5	high
Summary of avg. metric scores		32	moderate
Multi-year average B-IBI Score		**33**	**moderate**

Booth et al. (2004) found that there is a wide but well defined range of B-IBI scores for most levels of development, but observed overall that B-IBI scores decline consistently with increasing watershed total impervious area (TIA). Figure 17 shows that Station RCN010's 2004 and Station RCN050's four years of B-IBI scores fall in the middle and lower to middle portions, respectively, of the range of expected scores (estimated 2000 Total Impervious Area from Wierenga, 2005). By comparing Rock Creek (North) to the likely range of conditions for watersheds with similar amounts of development, measured as total impervious area, it is possible to make some general statements about the potential benefits from improving stream habitat.

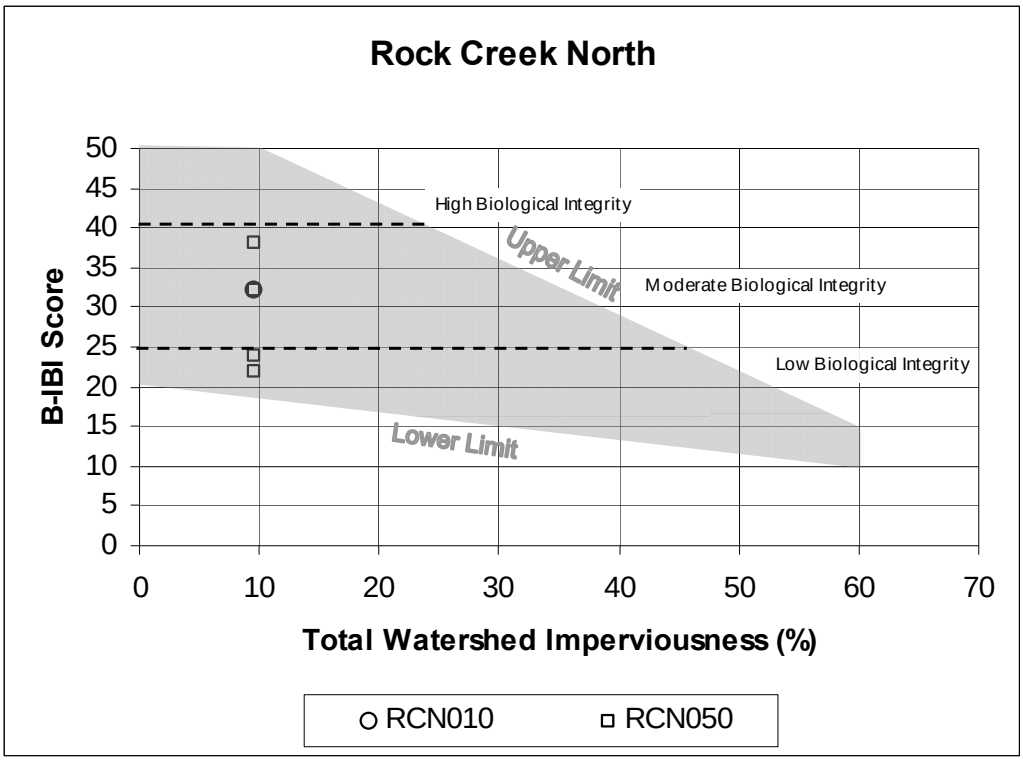

Figure 17: Approximate range of B-IBI in Puget Lowland watersheds, showing progressive decline with increasing imperviousness in the upstream watershed. Adapted from Booth et al., 2004. Markers indicate Total BIBI scores at Station RCN010 and Station RCN050 for particular years, versus estimated 2000 subwatershed TIA.

Rock Creek's (North) B-IBI scores range from low to moderate for its 10 percent subwatershed impervious area. This implies an opportunity to significantly increase the level of biological integrity by improving stream conditions and riparian forest habitat. Management strategies that limit further watershed degradation and promote protection of healthy riparian areas, combined with rehabilitation in impaired areas are important for improving biological integrity.

Figure 18 shows that the 2005 and 2007 B-IBI scores for the East Fork Lewis River (RM 15.75) fall in the middle of the range of expected scores for its nine

percent subwatershed impervious area (estimated 2000 Total Impervious Area from Wierenga, 2005).

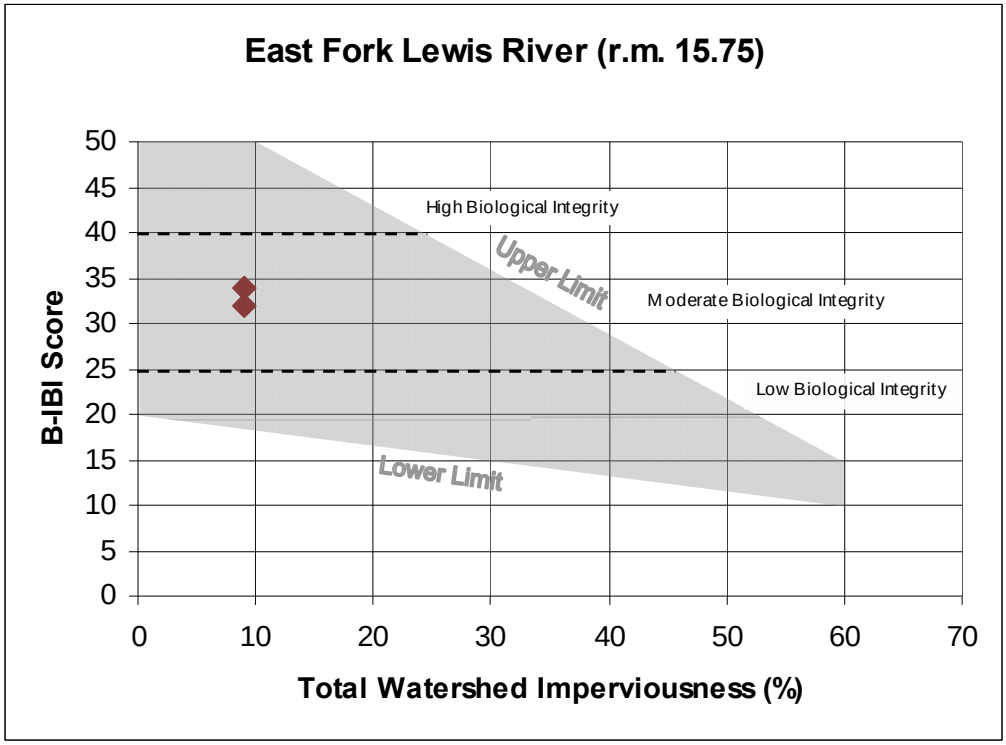

Figure 18: Approximate range of B-IBI in Puget Lowland watersheds, showing progressive decline with increasing imperviousness in the upstream watershed. Adapted from Booth et al., 2004. Markers indicate Total B-IBI scores at East Fork Lewis River (RM 15.75) for particular years, versus estimated 2000 subwatershed TIA.

This East Fork Lewis River site's midrange B-IBI scores suggest that biological integrity can be increased by improving habitat and stream conditions. Management strategies that protect existing beneficial conditions and promote rehabilitation of degraded areas are important for at least maintaining or improving its moderate biological integrity.

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 Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds is mapped from existing Clark County GIS information, which reflects data collected and analyzed by the Northwest Indian Fisheries Commission (NWIFC). Fish distribution data for Clark County is available on the County's website.

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

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

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

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

Results/Summary

Distribution

The fish distribution mapped from Clark County GIS information (Figures 19, 20, 21 22 and 23) varied slightly from fish distribution data originating from the SalmonScape database within the Rock Creek (North) subwatershed. These differences are identified within the individual subwatershed discussions below. For the purposes of this report, when the fish distribution mapping figures differ from SalmonScape fish distribution data, it is assumed that the SalmonScape distribution is a more accurate representation of the fish populations within the listed watershed.

The available evidence suggests that anadromous fish use within the East Fork Lewis River (RM 15.75) subwatershed includes fall Chinook, Coho, chum, and winter and summer steelhead (Figures 19, 20, 21, 22 and 23). Above Lucia Falls, fish use is limited to winter and summer steelhead only.

The Rock Creek (North) subwatershed is listed as having known anadromous fish use by Coho salmon and winter steelhead. The SalmonScape fish distribution data also identified the presumed presence of chum salmon and summer steelhead within the mainstem.

The LCFRB 2004 Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan identifies the middle reaches of East Fork of the Lewis River in the East Fork Lewis River (RM 15.75) subwatershed as Tier 1 reaches (highest priority). The Rock Creek (North) subwatershed surveyed reaches are rated Tier 2.

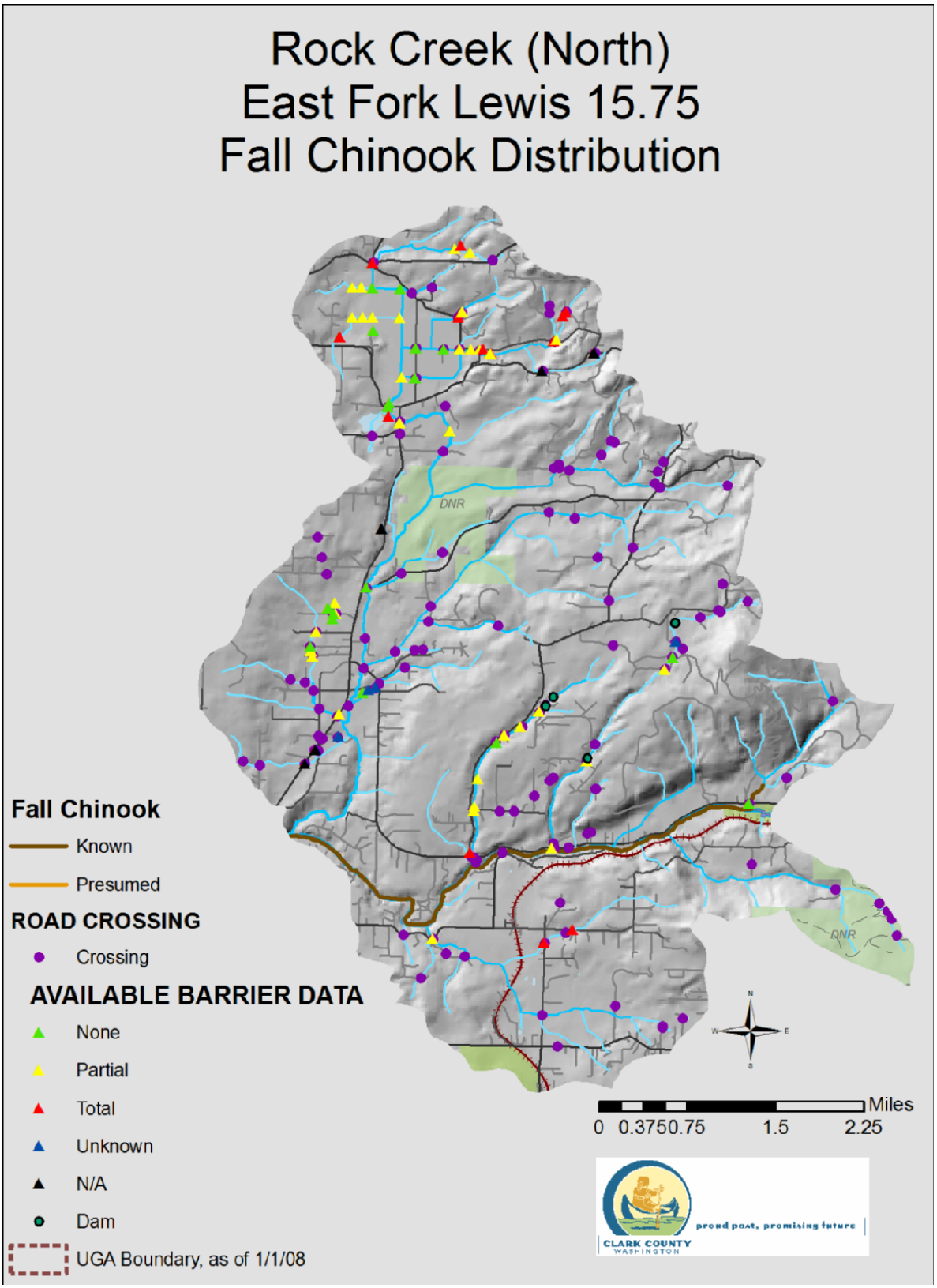

Figure 19: Rock Creek (North) and East Fork Lewis River (RM 15.75) Fish Distribution and Barriers

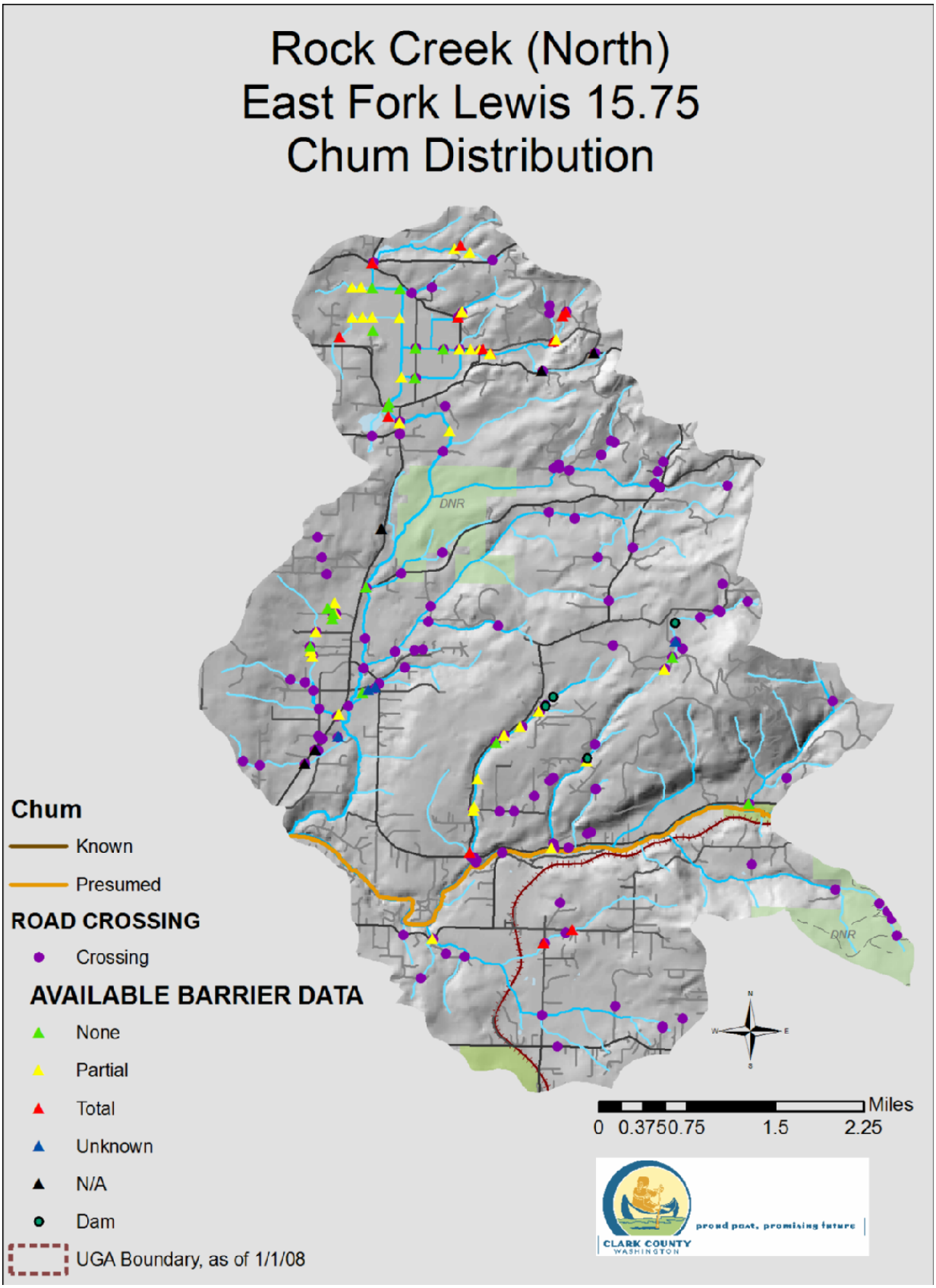

Figure 20: Rock Creek (North) and East Fork Lewis River (RM 15.75) Fish Distribution and Barriers

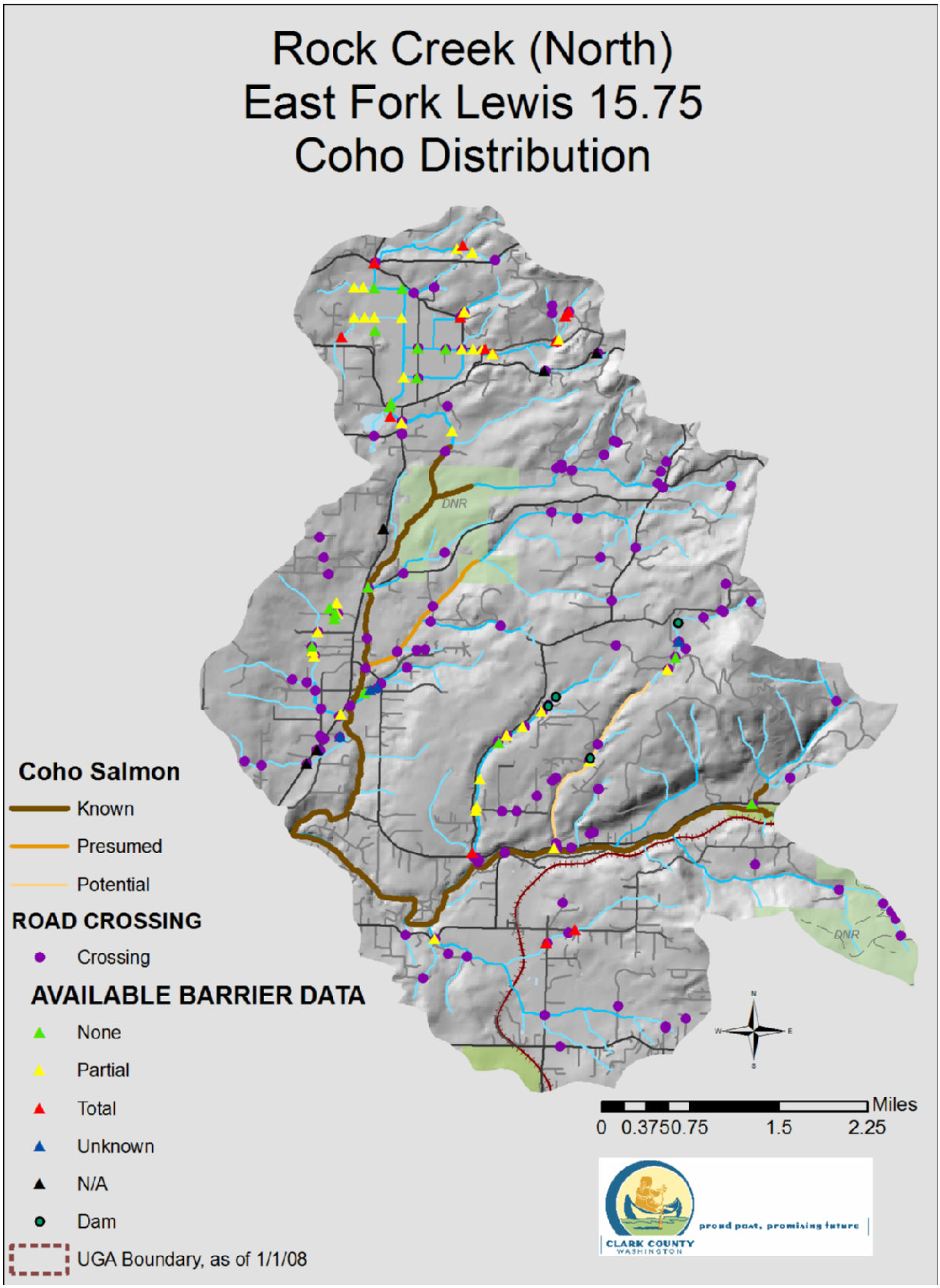

Figure 21: Rock Creek (North) and East Fork Lewis River (RM 15.75) Fish Distribution and Barriers

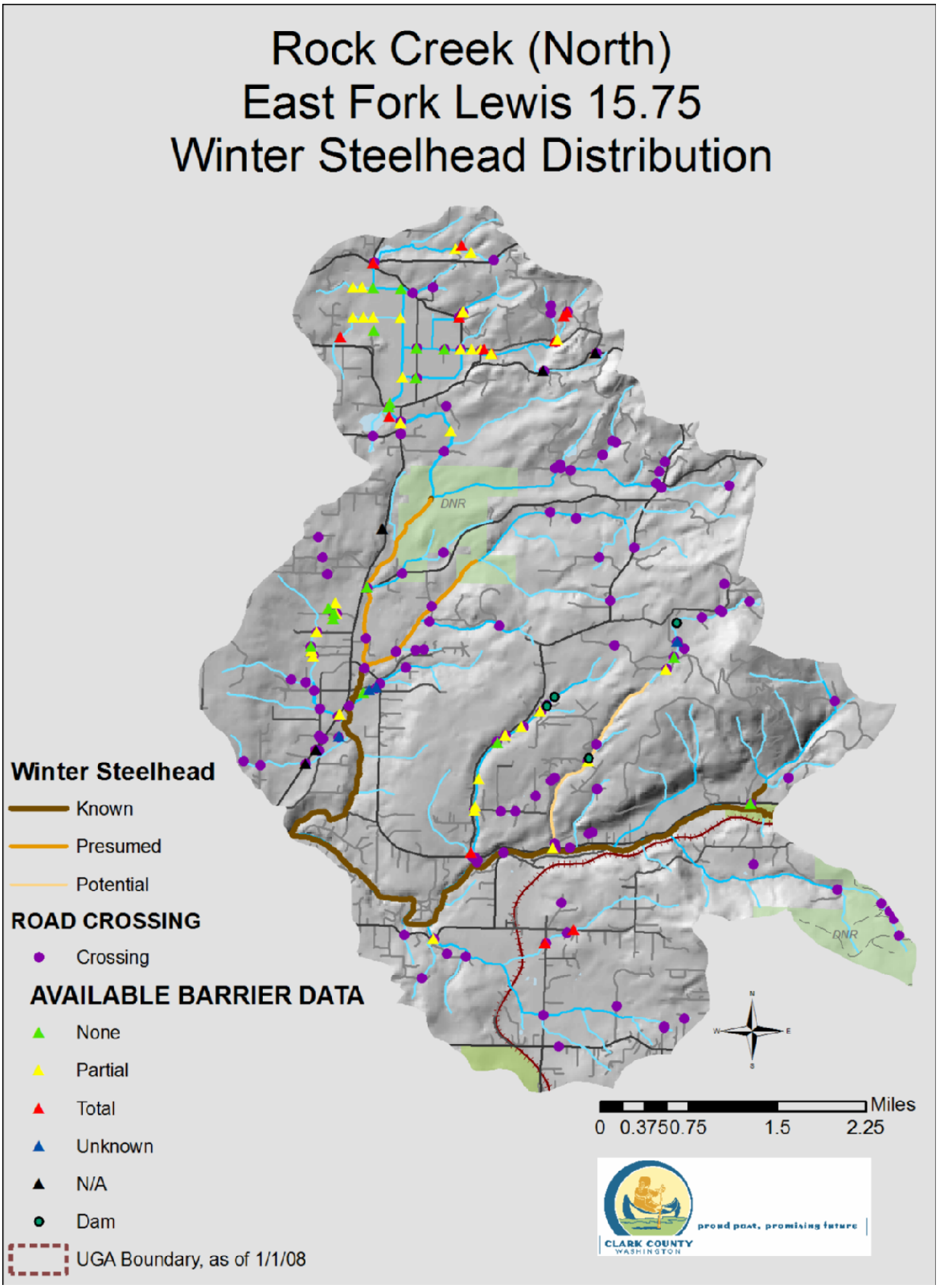

Figure 22: Rock Creek (North) and East Fork Lewis River (RM 15.75) Fish Distribution and Barriers

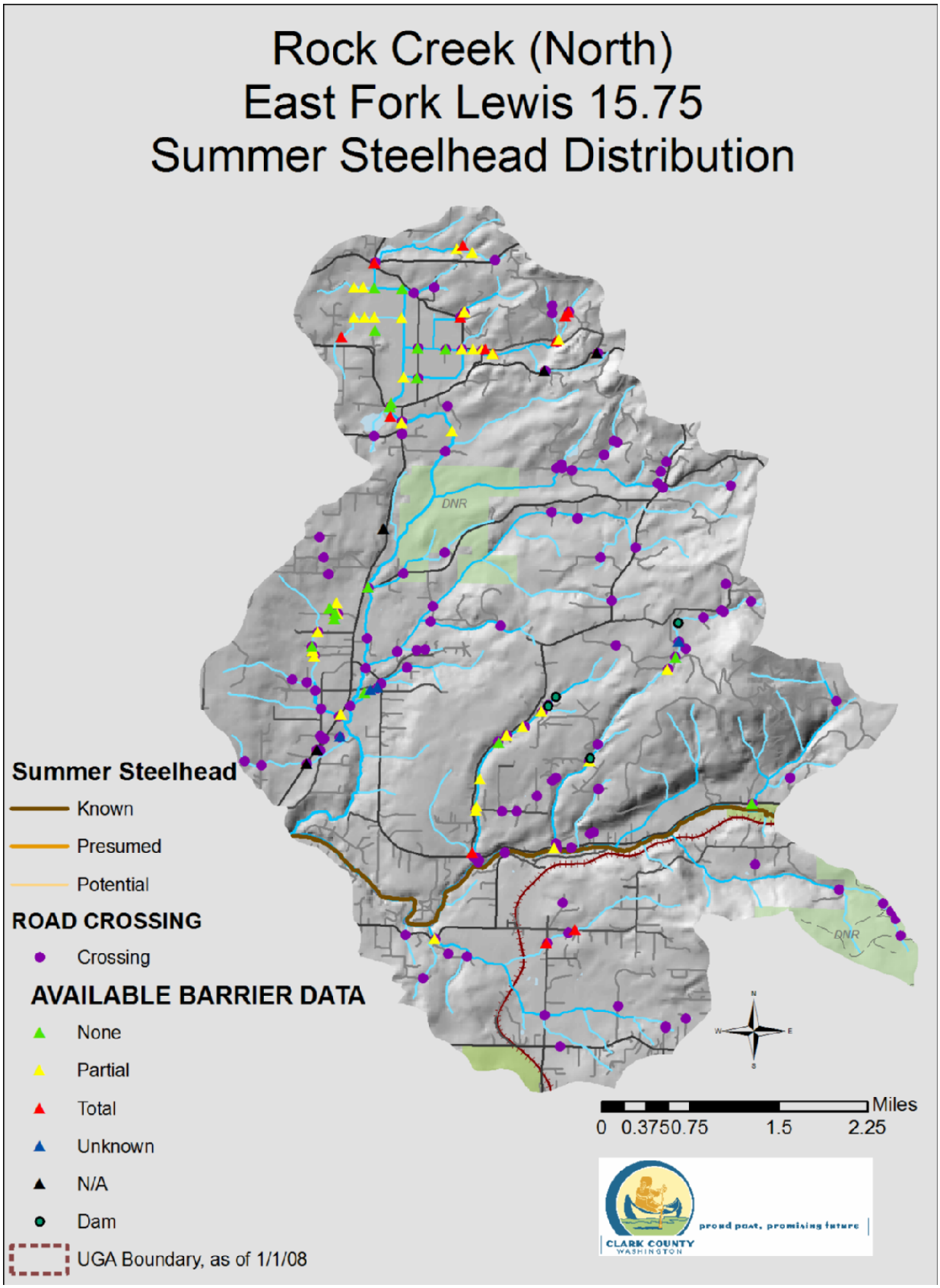

Figure 23: Rock Creek (North) and East Fork Lewis River (RM 15.75) Fish Distribution and Barriers

Barriers

The WDFW barrier database and the 2007 LCFRB Regional Culvert Inventory provide the most complete assessment of barriers in the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds (Figures 19, 20, 21, 22 and 23).

There is one mapped barrier within the mainstem of the East Fork of the Lewis River reaches within the East Fork Lewis River (RM 15.75) subwatershed. This barrier is approximately 0.4 miles upstream of the Heisson Bridge, adjacent to Cole Witter Road. However, information about this partial barrier is limited and the only description that could be obtained identified the barrier as a waterfall. Another natural barrier is Lucia Falls, which is located just downstream of the NE Hanwick Road and NE Lucia Falls Road crossing. Only steelhead species can routinely pass above Lucia Falls.

There are multiple barriers identified on several unnamed left and right bank tributaries to the East Fork of the Lewis River within the East Fork Lewis River (RM 15.75) subwatershed. On one of the left bank tributaries, there is a partial barrier at the Routelle Road/NE 279th Street road crossing. There are two right bank tributaries identified as having full or partial barriers. One of the right bank tributaries (located adjacent to NE Kelly Road) has a full barrier near its mouth at Lucia Falls Road and five partial barriers on private roads off of NE Kelly Road. There are also two dams mapped just upstream of NE 317th Street, near the headwaters of this tributary. The second right bank tributary with mapped barriers has a dam located near NE 308th Street, and an additional dam and partial barrier near its headwaters.

Within the Rock Creek (North) subwatershed, the majority of the mapped barriers are located in the uppermost reaches of Rock Creek. The first mainstem barrier is located just downstream of Fargher Lake Highway (State Route 503), with additional full and partial barriers located upstream within the Farger Lake agricultural area and on side channels of Rock Creek. A full barrier is located upstream of the Fargher Lake agricultural area at NE Grantham Road, just downstream of Fargher Pond. Two partial barriers (culverts) are also located near the headwaters of Rock Creek at private road crossings.

Barrier/reach information for many of the East Fork Lewis River and associated tributary subwatersheds has been obtained from the Draft East Fork Lewis River Community Habitat Restoration Plan and Project Design Technical Memoranda 1 and 2 (LCFRB, 2008), in order to assist in determining the most significant barriers for fish passage. However, these documents provided minimal information regarding the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds, so assessment of significant barriers was based on the mapped fish distribution and its relationship to barrier location.

Recommendations

The Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds contain a number of full and partial fish barriers within tributaries to the mainstem of the East Fork of the Lewis River, and the mainstem of Rock Creek. Improvement or removal of these barriers would provide potential upstream habitat for a variety of anadromous fish species.

Specific project recommendations include:

- Improve or remove the partial barrier at the road (culvert) crossing at Routelle Road/NE 279th Street (Left Bank Tributary, East Fork of the Lewis River). Field visit results are included in Table 20 below.
- Improve or remove the full barrier at Lucia Falls Road and partial barriers located on private road crossings off of NE Kelly Road (Right Bank Tributary, East Fork of the Lewis River).
- Improve or remove the partial barrier/dam at the NE 308th Street road crossing (Right Bank Tributary, East Fork of the Lewis River).

Table 20: Field Visit Results

ID	Basis for Project	Project Description
260 block on 279th Street/Boutelle Culvert-FB	Culvert is a partial blockage (66%) to fish passage. The existing 7 1/2 feet by 7 1/2 feet corrugated metal culvert is too small, creating velocity issues. The lower 1/3 of the culvert is heavily rusted. There is a plunge pool that is 40 feet long, 35 feet wide and 5 feet deep.	Replace culvert with a new fish passable bridge. Recommended bridge size is an 80-100 foot long bridge. Fill plunge pool with streambed material. Install LWD pieces in the plunge pool.

In addition to the project recommendations above, barriers should be removed over time as stream crossing infrastructure is replaced or upgraded.

Hydrologic and Hydraulic Models

No modeling was performed for this assessment area.

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.

Summary of Conditions, Problems, and Opportunities

Conditions and Problems

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

Coordination with Other Programs

The Washington Department of Ecology is developing TMDLs for bacteria and temperature in the East Fork Lewis River watershed including Rock Creek (North).

Broad-Scale Characterization

Both subwatersheds are located in rural unincorporated Clark County northeast of the City of Battle Ground and west of the City of Yacolt. The subwatersheds lie in a transition area from the predominantly rural residential and agricultural Willamette Valley to the mixed forest and other land uses of the Cascade Mountain foothills. The East Fork Lewis River cuts through a northwest-southeast trending ridge as it flows west through the study area. Prior to emptying into the East Fork Lewis River upstream from Lewisville Park, Rock Creek flows generally southwest from its ridge top headwaters and drains the peat bogs of the Fargher Lake area which are intensively managed for croplands. Soils are typically well drained.

Standard subwatershed scale metrics compared to NOAA fisheries standards indicate significant human alteration in the study area, but suggest Rock Creek (North) and East Fork Lewis River (RM 15.75) streams have largely properly functioning habitat. Based on the 2008 Clark County Comprehensive Plan, effective impervious area is projected to change little in the near term.

Based on current and predicted subwatershed EIA and forest cover, it is likely that stream channels in the East Fork Lewis River (RM 15.75) subwatershed should remain stable but those for Rock Creek (North) are categorized in the zone of uncertain channel stability.

Water Quality Assessment

In the study area, both Rock Creek (North) and the East Fork Lewis River are on the 2008 Washington State 303(d) list of impaired waters as polluted waters

requiring a TMDL for water temperature. Additionally, Rock Creek (North) is also listed for fecal coliform bacteria. Both subwatershed creeks are included in the state's East Fork Lewis River fecal coliform and temperature TMDL project.

State monitoring has shown that the mainstem East Fork Lewis River (RM 15.75) within the study area met state standards for fecal coliform bacteria. Rock Creek (North) failed to meet the bacteria standard. Summer stream temperatures consistently exceed state standards by six to 10 degrees F for Rock Creek (North), and to a lesser extent also for the mainstem of the East Fork Lewis River within the study area.

Clark County rates Rock Creek (North) as having fair general water quality when using the Oregon Water Quality Index. Although Rock Creek (North) has moderate levels of turbidity, a trend in turbidity indicates decreasing water quality.

Drainage System Inventory
Drainage mapping is now generally complete for these two subwatersheds due to the priority of identifying and mapping previously unmapped discharge points and stormwater conveyances during 2008.

Public Stormwater Facility Inspection
As of October 2008, there were no known public stormwater facilities in the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds.

In the East Fork Lewis River (RM 15.75) off-site assessments conducted for 24 accessible outfalls found that all were in compliance with maintenance standards.

Illicit Discharge Screening
Screening conducted at 193 known stormwater outfalls found three potential illicit discharges. Lab results for these three found no illicit discharges.

Stream Reconnaissance Feature Inventory
Significant stream impairments, potential environmental and safety hazards, and stormwater project opportunities were recorded for approximately three miles of the Rock Creek (North) stream corridor. The East Fork Lewis River (RM 15.75) was not included in the stream reconnaissance feature inventory. A total of 132 features were identified, primarily stream crossings, water quality impacts, stormwater outfalls, severe bank erosion, and impacted stream buffers. Ninety-three potential projects were identified in five categories, with the majority being projects outside the scope of CWP activities and subsequently recommended for referral to outside groups or agencies.

General observations from the feature inventory in Rock Creek (North) included:
- Predominant source of stormwater is runoff from agricultural land and rural residential developments via open channels.

- Impacted buffers are prevalent, with a wide range of riparian vegetation conditions.
- A significant portion of surveyed stream reaches have established riparian forest canopy composed of small to medium sized trees.
- Lack of woody riparian vegetation is common in residential development and agricultural areas.
- Features of interest were often discovered along small first-order tributaries, many of which were not included in the survey scope. Thus, it is likely that additional features of interest exist in areas not assessed.
- A road reconnaissance conducted in the northeast portion of the subwateshed noted that this private residential development area contained some of the most degraded stream conditions and poorly functioning infrastructure that may provide significant project opportunities.

Physical Habitat

Physical habitat measurements were made in 2004 (Cramer, 2005) on a portion of Rock Creek (North). Streambed embeddedness was rated low. Metrics for pool frequency, large woody debris (LWD), and streambank stability indicated conditions that are not properly functioning. Pool quality and substrate were in the "at risk" category.

Geomorphology and Hydrology

Detailed analyses of the geomorphology or hydrology of either Rock Creek (North) or East Fork Lewis River (RM 15.75) was not performed for this study. However, Rock Creek (North) has been observed to have little surface flow in the summer months and to periodically dry up during the late summer and early fall. Also portions of both study area streams are high gradient and have little to no floodplains.

Riparian Assessment

The most reliable riparian assessment data for the study area is from the 2005 LCFRB Habitat Assessment. Overall, the LCFRB assessment rated the riparian conditions on the East Fork Lewis River mainstem as moderately impaired and those for Rock Creek (North) as impaired. LWD recruitment potential was estimated as moderate to high along the East Fork Lewis River mainstem and tributaries, while Rock Creek (North) was rated as moderate to high except for very low in the Fargher Lake area. Overall shade levels along the East Fork Lewis River mainstem varied from low to moderate, while its tributaries rated higher. Rock Creek (North) was estimated at moderate to high along its lower mainstem reach and main tributaries, but much lower in the Fargher Lake area.

Wetland Assessment

Potential wetlands are primarily limited to riparian areas and stream channel floodplains, with the exception of large areas in the vicinity of Fargher Lake and Gabriel Road. Ecology's draft watershed characterization of Clark County places

the study area in a category where the primary priority should be protection of wetland hydrology by maintaining forest cover.

Macroinvertebrate Assessment
Macroinvertebrate data from six years on Rock Creek (North) and three years on the mainstem East Fork Lewis River (RM 15.75), indicate that their average scores are moderate in biological integrity. Scores are clustered in the mid-range for the East Fork Lewis River and spread across the lower half for Rock Creek (North) when compared to the predicted range of B-IBI scores for areas with similar levels of TIA. It is likely that biological integrity could be improved through enhancement of habitat.

Fish Use and Distribution
The available evidence suggests that anadromous fish use of the mainstem of the East Fork Lewis River within the study area includes Fall Chinook, Coho, and chum salmon, as well as winter and summer steelhead. Steelhead are the species capable of passing the partial barrier at Lucia Falls. Known anadromous fish use within Rock Creek (North) is limited to Coho salmon and winter steelhead. The LCFRB (2004) has identified the middle reaches of the mainstem in the East Fork Lewis River (RM 15.75) subwatershed as the highest priority (Tier 1) for anadromous fish use and Rock Creek (North) as the next lower priority (Tier 2).

There are two natural partial mainstem barriers and several man-made tributary barriers within the East Fork Lewis River (RM 15.75) subwatershed while the majority of barriers for Rock Creek (North) are located in its uppermost reaches. Three known barriers on tributaries to the East Fork Lewis River are recommended for improvement or removal.

Recently Completed or Current Projects
There are no recently completed or current stormwater capital projects under the Transportation Improvement Program (TIP) or the Stormwater Capital Improvement Program (SCIP).

Analysis Approach
Purpose
The Analysis of Potential Projects narrows the initial list of possible projects to a manageable subset of higher priority opportunities. 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.

In general, potential capital projects are evaluated 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

The assessment did not discover any situations requiring immediate action.

Potential Stormwater Capital Projects

Stormwater Facility Capital Improvement Projects

Identifier	Issue	Project	Action
OT-226 OT-227 OT-228 OT-229	Roadside ditches drain stormwater from NE 269th Street to channel.	Detain and/or treat ditch runoff	Evaluate for 2010 SCIP
OT-231 OT-243	Roadside ditch drains stormwater from NE Lewisville Highway. No apparent treatment. Some erosion present at outfall.	Detain and/or treat ditch runoff	Evaluate for 2010 SCIP
OT-237 OT-238 and CM-39	Roadside ditch drains stormwater from NE Rock Creek Road and historic NE 319th Street crossing. No apparent treatment. Some erosion present at outfall.	Detain and/or treat ditch runoff, reduce constriction of floodplain	Evaluate for 2010 SCIP
SCC-173	Box culvert under NE Lewisville Highway is likely a fish passage barrier at many flows due to steep gradient and concrete bottom. Significant bank/embankment erosion on downstream end.	Examine for size and condition of culvert	Initial Engineer Evaluation / Possible referral to WDOT
SCC-178	Undersized culvert under NE 329th Street. Expansion scour causing significant erosion downstream of the culvert.	Examine for size and condition of culvert	Evaluate for 2010 SCIP

Stormwater Infrastructure Maintenance CIPs

None

Stormwater Class V Underground Injection Control projects:

None

Habitat Rehabilitation/Enhancement Projects

None

Property Acquisition for Stormwater Mitigation

None

Public Works and Clean Water Program Referrals

Private Stormwater Facilities Maintenance

None

Public Works Stormwater Infrastructure Maintenance

The Public Facility Inspection section describes routine stormwater infrastructure maintenance needs referred to Public Works Operations during ongoing inspections. No additional stormwater infrastructure maintenance needs were discovered.

CWP Outreach/Technical Assistance

Identifier	Issue	Action
WQ-65	Horse manure on stream bank at tributary confluence.	Refer to CWP Outreach; contact landowner about BMPs and CCD assistance.
OT-236	Eroding ditch along south side of driveway drains untreated stormwater and sediment to the creek.	Refer to CWP Outreach
RR-8 RR-17	Road runoff into ditch along private road drains to channel. No apparent treatment	Refer to CWP Outreach
OT-240	Tributary stream or ditch drains stormwater from house roof drain east of creek	Refer to CWP Outreach
RR-18	Water and sediment from several hundred linear feet of steep, rutted dirt/gravel road surface drains directly to stream without treatment. Significant water and sediment input to stream. Steep channel is small but degraded.	Refer to CWP Outreach
WQ-56 OT-225	Blueberry farm and hay fields dominate the floodplain, which is an old lake bed. Trapezoidal, constructed channel receives runoff from fields and water from tile drains and serves as a source of irrigation water. No riparian shading.	Refer to CWP Outreach
WQ-57 WQ-58	Ditches from a horse pasture drain agricultural runoff to the stream from the left bank.	Refer to CWP Outreach

Identifier	Issue	Action
WQ-59	Livestock crossing delivers sediment and nutrients to channel. Manure pile kept immediately adjacent to channel on floodplain.	Refer to CWP Outreach
WQ-60	Livestock access point and inflow point for agricultural runoff.	Refer to CWP Outreach
WQ-61	Drainage ditch enters channel from NW. Ditch appears to start at clear-cut headlands and flows through horse pasture.	Refer to CWP Outreach
WQ-50	Swale drains to channel from left bank.	Refer to CWP Outreach
WQ-62	Temporary livestock access and crossing with narrow riparian buffer.	Refer to CWP Outreach
RR-20	Potential agricultural runoff from fields upstream and downstream of the private crossing on NE 359th Circle.	Refer to CWP Outreach
RR-21	Potential agricultural runoff from fields upstream and downstream of the private crossing on NE 366th Street.	Refer to CWP Outreach
ER-48	Several bank erosions along left bank of agricultural channel. Bank is actively cleared of vegetation and fine lake bed soils are actively eroding.	Refer to CWP Outreach
RR-7	Wet swale (obvious drainage pathway) crosses road. No culvert was observed. Evidence indicates that flow may overtop the road during large storm events.	Refer to CWP Outreach
SCC-170	Failing embankment due to undersized or clogged culvert at a private crossing.	Refer to CWP Outreach
SCC-176	Failed embankments and culverts at a foot path crossing.	Refer to CWP Outreach
WQ-67	Nursery owners disposing of potting soil on floodplain.	Refer to CWP Outreach
AP-33	Access point with shack/fort and significant accumulation of trash and debris.	Refer to CWP Outreach

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

Identifier	Issue	Action
OT-232 OT-245	Pipes drains to water channel from unknown source, possibly leach field.	Refer to Public Health
TR-65	Burn pile and trash pile on right bank.	Refer to Public Health
SCC-183	Culvert under NE Lewisville Highway is likely a fish passage barrier at many flows due to steep gradient, lack of streambed material, and perched outlet.	Refer to WDFW for potential barrier analysis.
RR-9	Dam and outlet structure to large manmade lake. Dam is approximately 10 to 12 feet high. Primary outlet is a pipe, but the overflow spillway was activated due to high flows at the time of the road reconnaissance survey. Structural integrity of the dam is unknown.	Refer to WDOE for water rights and dam safety investigation.
WQ-64	Manmade pond drains to stream. Pond may be acting as a source of thermal loading and/or contributing to other water quality impairments.	Refer to WDOE for water rights and dam safety investigation.
ER-52 ER-53 ER-54 ER-55 ER-56 ER-57 ER-58 ER-59	Significant bank erosion at outside of meander bends progressing downstream from ER-52 threatens outbuildings and property in addition to being a significant sediment source.	Refer multiple landowners in this impacted reach to CPU for riparian/streambank stabilization.
CM-40	Riprap bank.	Refer to CPU for education and planting native riparian vegetation to compliment armoring.
RR-17	Creek is very steep and degraded by residential land use and historic logging.	Refer to CPU for education and planting native riparian vegetation.

Identifier	Issue	Action
IB-242	Widespread invasive plant species in riparian area and floodplain. No riparian shading. Left bank actively being cleared of vegetation on blueberry farm property	Refer to CPU for education and planting native riparian vegetation.
IB-246	Lack of woody riparian vegetation along channel. Some invasive plant species in riparian area and floodplain. Predominantly reed canary grass and blackberry. Headwaters recently clear-cut.	Refer to CPU for education and planting native riparian vegetation.
IB-247	Widespread invasive plant species in riparian area and floodplain. Predominantly blackberry and reed canary grass. Left bank is mowed to top-of-bank.	Refer to CPU for education and planting native riparian vegetation.
IB-250 IB-251	Lack of vegetation. Mowed turf to edge of stream or within 5 feet of stream.	Refer to CPU for education and planting native riparian vegetation.
ER-60	Tall, steep eroding banks in incised reach downstream of armored cascade with 8 to 10 foot vertical drop.	Refer to CPU for education and planting native riparian vegetation.
RR-13 RR-14 RR-15 RR-16	Culvert crossing at NE Sunrise Road crossing (RR-13) is undersized and damaged, with evidence of recent road overtopping. The crossing diverts the flow out of the natural drainage pathway and into a ditch which parallels NE Sunrise Road and delivers flow to a large manmade lake. The ditch is perched on the hillside above houses south of NE Sunrise Road. Culverts under two driveways (RR-14 and RR-15) are undersized and could become clogged, resulting in flooding of houses.	Refer to PW Operations

Identifier	Issue	Action
RR-6	Extremely undersized culvert crossing near the head of a steep drainage impounds significant amount of water during heavy rain and rain on snow events. Road grade creates a dam which could fail due to soil saturation or overtopping if wet conditions persist.	Refer to PW Operations
SCC-175	Culvert crossing under NE 333rd Street has a crushed outlet and a debris jam just upstream.	Refer to PW Operations
SCC-179	Undersized culvert under NE 327th Street. Expansion scour causing some erosion downstream of the culvert.	Refer to PW Operations
RR-11	Undersized culvert under NE Lakeview Drive. Culvert was observed at high flows near 100% of capacity.	Refer to PW Operations
RR-17	Undersized culverts crossing under NE Beaverbrook Road and NE Dawn Lane. Evidence of recent high flows overtopping road. Residential subdivision was not designed to work with natural drainage patterns.	Refer to PW Operations

Conservation covenants:
There are at least five conservation covenants registered within this assessment area. These locations may provide opportunities for enhancement.

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 NPDES permit term.

Management and programmatic recommendations in the Rock Creek (North) and East Fork Lewis River (RM 15.75) subwatersheds, by permit component, include:

Storm Sewer Mapping and Inventory
None.

Coordination of Stormwater Activities
- Continue county support for Ecology's TMDL development process for bacteria and temperature

Mechanisms for public involvement
- Publish SNAP reports on CWP web page

Development Regulations for Stormwater and Erosion Control
- Emphasize stormwater management that reduces runoff by dispersing it into vegetated areas on-site
- Provide technical assistance to rural development projects required to implement stormwater controls

Stormwater Source Control Program for Existing Development
- Encourage landowners to adopt runoff reduction practices, such as disconnecting downspouts.

Operation and Maintenance Actions to Reduce Pollutants
- Confirm that county ditch maintenance practices minimize vegetation removal whenever possible.

Education and Outreach to Reduce Behaviors that Contribute Stormwater Pollution
- Perform targeted technical assistance responding to results of field assessments.
- Continue to encourage and support riparian planting efforts by private landowners.
- Replace missing or deteriorated stream name signs.
- Develop a process to provide education about appropriate ditch maintenance practices to rural landowners.

TMDL Compliance
- There are no approved TMDLs in the assessment area

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