Clackamas River Basin Action Plan

Clackamas River Basin Council

Clackamas, Oregon

2005

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Editors Note: Supporting maps and appendices are provided in electronic format on a CD Rom. Contact the Watershed Coordinator of the Clackamas River Basin Council for availability. *http://www.clackamasriver.org/*

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Executive Summary

The nine hundred square mile Clackamas River Basin is located in Clackamas and Marion Counties, Oregon. The Clackamas River is a part of the Willamette River, an important river system for anadromous fish and other natural resources within the Columbia River Basin. The Clackamas River supplies high-quality drinking water to over 200,000 people and supports significant wild runs of anadromous salmon while supporting thriving agriculture, recreation and other industries. The lower watersheds are experiencing significant population growth generated by the proximity to the city of Portland.

The Clackamas River Basin Council (Council) developed this Action Plan to provide a framework for the Council and its partners to work together cooperatively to protect and restore the Clackamas Basin's valuable natural resources. The Council is comprised of twenty one diverse member groups representing water providers, agriculture, forestry, environmental interests, streamside landowners, local governments and state and federal natural resource agencies and others.

An initial step in the Action Plan was to evaluate what is known about the natural resources of the Clackamas Basin by developing Basin Summaries that describe and evaluate the watershed resources, water quality, water quantity, and fish and wildlife populations and their habitats. The Basin Summary builds on natural resource studies, watershed assessments, and previous planning that has been completed in the basin. The Basin Summaries identified the key limiting factors and issues for fish, wildlife and water resources. These challenges to natural resources are organized by watersheds that are grouped within ten geographic areas.

The Lower Clackamas Basin contains a substantial agricultural and forest resource base under private ownership that is experiencing rapid population growth. The key challenges in the lower basin are to improve water quality impacted by nutrients, bacteria, pesticides, and high water temperatures, restore aquatic and riparian habitats, and restore/protect wildlife habitat and migratory corridors. Strategies to meet these challenges are described in the Action Plan at the basin and watershed scale. The Action Plan identifies sixteen key strategies to address these challenges including riparian, wetland and channel restoration, aquatic habitat improvement, fish passage, agricultural and urban management practices, and education and outreach initiatives. Where feasible, specific actions to implement these strategies are described at the subwatershed or stream reach scale.

The Upper Clackamas Basin is primarily managed by US Forest Service and Bureau of Land Management as forestland. Key challenges in the upper basin are associated primarily with legacy effects of past land management practices on stream channels, aquatic habitats, and riparian zones. Key strategies to restore these areas are reconnecting side channels of the river, addressing road network impacts on stream systems, and implementing management practices that minimize sediment runoff.

The Mainstem of the Clackamas River has been altered by past land management practices and the effect of major dams. The Action Plan identifies a number of opportunities to reconnect side

channels, restore instream aquatic habitats, and restore and protect floodplain forests and riparian areas.

The Action Plan and supporting documents provide a framework for addressing water quality, aquatic habitat and other natural resource challenges; however, it is not a static document. The Review and Revision schedule describes the suggested frequency for updating the plan. Many of the actions described in this document require further refinement prior to implementation. An Action Plan Database was developed to assist in updating the individual action descriptions, and provide a basis for project implementation and reporting.

Clackamas River Basin Action Plan

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Abbreviations and Acronyms

303(d)	Section 303(d) Clean Water Act; requires listing water quality limited waters.
BLM	Bureau of Land Management
BMP	Best management practice
CFR	Code of Federal Regulations
CRBC	Clackamas River Basin Council (refers to the Council and partner organizations)
E. coli	Escherichia coli, indicator bacteria of fecal contamination.
EPA	US Environmental Protection Agency
FERC	Federal Energy Regulatory Commission
GIS	Geographic Information System
Metro	Regional planning agency for the Portland metropolitan area.
mg/L	milligrams per liter, parts per million
NRCS	Natural Resource Conservation Service
NPDES	National Pollutant Discharge Elimination System
ODA	Oregon Department of Agriculture
ODEQ	Oregon Department of Environmental Quality
ODFW	Oregon Department of Fish and Wildlife
OWRD	Oregon Water Resources Department
PGE	Portland General Electric
PTI	Pesticide Toxicity Index
RM	River Mile
SWCD	Clackamas County Soil and Water Conservation District
TMDL	Total Maximum Daily Load
UGB	Urban Growth Boundary
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WAB	Water Availability Basin
WES	Watershed Environment Services, department of Clackamas County
µg/L	micrograms per liter, parts per billion

1.0 INTRODUCTION

The Clackamas River Basin supplies high-quality drinking water to over 200,000 people, supports significant wild runs of anadromous salmon, encompasses a thriving agricultural and forest industry, generates hydro-electric power and provides recreational opportunities. The Action Plan outlines a strategy for the Clackamas River Basin Council (CRBC) to identify ways to protect, enhance and restore these natural resource amenities over the next decade. The goals for the Action Plan are to provide a framework for community awareness and partnerships to provide clean water; to improve fish and wildlife habitat; and enhance the quality of life for those who live, work and recreate within the Clackamas River Basin.

Stream habitats and fish population conditions began to improve throughout much of the Clackamas River Basin in the 1970's as a result of improved forestry and land use practices and better management of fish populations and hatcheries. In addition, active habitat restoration by land managers, the Clackamas River Basin Council and others have helped to improve the basin's water quality condition and fish habitats. However, there remain important areas that require improvement to meet water quality and fisheries and wildlife objectives. Urbanization with the associated change in water quality, riparian zones, and habitat continues in the lower basin. Many of the river's side channels and other backwater areas have been lost and fish passage barriers occur at road crossings on most of the basin's streams. Trees and other vegetation have been lost from streamside areas and there is little large wood in stream channels to provide cover and pools for fish. It will take time and focused effort to address these impacts to the basin's stream quality and river habitats.

The CRBC, founded in 1997, is a local voluntary watershed group comprised of over twenty diverse member groups representing interests from water providers, local cities, small woodlot owners, commercial wood products, conservation districts, hydropower utilities, non-timber agriculture, environmental interests, educators, streamside landowners, community planning organizations, and state and federal natural resource agencies. When referring to the "CRBC" throughout this document, we are referring to the entire coalition of member organizations. The CRBC as a coalition of member organizations is essential to successful implementation of the Action Plan.

The Action Plan was developed by CRBC staff with input from the Council, Technical Advisory Groups, and the assistance of Watershed Professionals Network, LLC. The Action Plan identifies cooperative strategies, projects, and priorities to improve water quality, aquatic habitats, and fish and wildlife populations in the Clackamas River basin. The Basin Action Plan is intended to achieve the goals of the statewide Oregon Plan for Salmon and Watersheds, which focuses on incentive-based local volunteer efforts combined with local, state, and federal government actions to improve watershed conditions.

The Action Plan provides a framework for the CRBC and its partners to work cooperatively by providing a baseline for understanding existing conditions; formulating scientifically based goals and objectives; identifying challenges and developing strategies; identifying geographic priorities within the basin; and identifying protection, restoration, enhancement actions needed to make progress toward a common vision for the watershed.

The Action Plan was funded in part by a grant from the Oregon Watershed Enhancement Board (OWEB) and a consortium of public water supply providers that utilize water from the Clackamas River. The Action Plan provides specific actions where possible given our existing knowledge about resource conditions, funding sources and partners at the time the Action Plan was developed. The Action Plan provides a framework for CRBC actions over an expected 10-year horizon. The identification of general limiting factors and strategies to address these factors will not change substantially at the basin and watershed scale over this time period. The projects listed in Section 4.0 and in the database should be revisited on an annual basis to make refinements in project descriptions and address new opportunities and priorities.

The Action Plan addresses the expected Elements of Watershed Action Plans[1], which are described by OWEB. The list below is an abbreviated list of the OWEB required elements.

1. Baseline watershed assessment/characterization.
2. Vision of the desired future conditions.
3. Relation to past watershed restoration planning efforts.
4. Specific goals that address watershed functions.
5. Specific goals to address community involvement, understanding and accountability.
6. A specific method to identify protection and restoration priorities.
7. Specific tasks, sequence of tasks, priority, potential funding sources and partners.
8. Project plans that identify project locations and objectives, key partners and schedule.
9. Monitoring plan that tracks implementation and effectiveness.
10. Outreach and public involvement activities.

Organization of the Document

The document is organized into four major sections, plus supporting maps, appendices and action database.

Introduction (Section 1): Describes document organization, goals and objectives.

Background (Section 2): This section provides a summary of the basin assessment and characterization (Element 1), the Vision (Element 2), Relation to other planning efforts (Element 3), Specific goals (Element 4 and 5), and CRBC funding sources and partners (Element 7).

Basinwide Strategies and Actions (Section 3): This section describes the existing programs and gaps in programs that the Action Plan should address and the typical "Tools" available for restoration and protection. This section also describes methods to establish priorities (Element 6), an overall monitoring program (Element 9), and outreach and public involvement (Element 10).

[1] OWEB, 2002. Watershed Action Plan Guidance, Discussion Draft. OWEB, Salem, Oregon.

Geographic Area Strategies and Actions (Section 4): This section describes actions (Element 8) within nine major geographic areas in the basin. For each geographic area, the section characterizes the watershed by land use (acres) and fish use (stream miles); describes the limiting factors; provides a map of restoration and action zones or specific sites; and describes specific actions that have been identified within that area.

Action Plan Database: An online Action Database was used to develop actions. The Action Database allows the CRBC to sort needed actions by type of project, geographic area, cost, and partners. New projects can be added or existing projects edited to facilitate continual update of the Action Plan over time. The database can also be used for project tracking and reporting.

1.1 ACTION PLAN GOALS AND OBJECTIVES

The Clackamas River Basin Council has a history of working with diverse interests in the basin toward common goals. These common goals are reflected in the Vision Statement for the Clackamas River Basin and the goals and objectives listed below.

Vision Statement

The vision for the Clackamas River Basin is to achieve a mix of protected areas and working landscapes that enhances water quality and supports a productive and diverse community of fish and wildlife while sustaining the economic and social vitality of the current and future communities in the region.

The vision will be accomplished by protecting currently productive areas and undertaking an aggressive program of watershed restoration to enhance water quality and fish and wildlife habitat.

Water Quality and Water Quantity Goals and Objectives

1. Protect and enhance the quality and quantity of source water for domestic water supplies to meet an increasing human population into the future.

2. Reduce nutrients, bacteria and pesticide runoff from existing sources of contaminants associated with urban and agricultural sources to meet State water quality standards and the requirements of the Clackamas River Basin TMDL.

3. Improve water temperature regimes to meet State temperature criteria for cold water biota and the requirements of the Clackamas River Basin TMDL.

4. Reduce fine sediments and associated contaminants associated with urban, agricultural, forest land uses and road sources.

5. Investigate methods to meet future water supplies needs and maintain stream flows for fish and wildlife.

Aquatic / Riparian Habitat Goals and Objectives

6. Increase the abundance, diversity, and productivity of native resident and anadromous fish populations throughout the basin.

7. Improve fish habitat connectivity for anadromous and resident fish by modifying or replacing fish passage barriers throughout the basin.

8. Improve riparian habitat conditions and functions (for example shade, and large wood inputs) by planning native vegetation, installing fencing, conducting weed control, and ongoing maintenance.

9. Restore aquatic habitat complexity and water quality to conditions appropriate for all resident and anadromous fish life stages.

10. Assess and evaluate fish population abundance and trends throughout the basin.

11. Assess and evaluate aquatic and riparian habitat status and trends throughout the basin.

Wildlife Goals and Objectives

12. Restore key habitats: oak woodlands and savanna; upland prairie; wetland prairie, seasonal marsh, and wetlands; riparian habitats and floodplain forest; and mature and old-growth conifer forests.

13. Provide wildlife corridors across the landscape by connecting high quality habitat patches, particularly along riparian areas and between public and private lands.

14. Control non-native weeds, and restore native vegetation to improve both aquatic and terrestrial habitats and associated wildlife populations.

Overall Education and Outreach Goals and Objectives

15. Residents and users of the watershed will understand the benefits of the watershed for water quality and fish and wildlife resources.

16. The watershed community will help to protect water quality.

17. Residents, students, general public and volunteers will become engaged in conservation, riparian restoration and enhancement actives.

18. Streamside landowners will demonstrate partnerships for watershed improvement projects that protect and enhance these natural resources.

19. The watershed community will be engaged in implementing this Basin Action Plan.

2.0 BACKGROUND

2.1 PHYSICAL AND BIOLOGICAL SETTING[2]

The Clackamas River Basin is located in Clackamas and Marion Counties, Oregon, east and south of the Portland Metropolitan area (Figure 1). The Clackamas River is tributary to the Willamette River, entering the Willamette at approximately river mile (RM) 25. The Clackamas River is the last major tributary stream downstream of Willamette Falls. Portions of the cities of Sandy, Gladstone, Oregon City, Estacada, Happy Valley, and Damascus are located within the Basin. Important transportation routes passing through the Basin include State Highways 211, 212, 213, and 224; US Highway 26, Interstate Highway 205, and the north-south mainline of the Union Pacific Railroad. The Clackamas River Basin is approximately 941 square miles in area.

Elevations in the watershed range from approximately 10 feet at the confluence with the Willamette River, to over 7,200 feet at Olallie Butte located along the southeast boundary of the basin. Mean elevation and slopes generally increase from the mouth of the Clackamas River upstream to the headwater areas.

The Clackamas River Basin is ecologically diverse. Understanding this diversity is important in assessing water quality, aquatic habitats and wildlife habitats, and in developing solutions that are appropriate to the landscape. Ecoregions identify landscapes that are similar with respect to physiography, vegetation, climate, soils, land use, wildlife distributions, and hydrology. The Clackamas River Basin can be divided into four primary areas. The High Cascades roughly corresponds to the Cascade Crest Montane Forest Level IV ecoregion. This area is made up of recent volcanoes, some less than 1,500 years old such as Mount Hood, and surrounding lava and ash deposits. The Western Cascades includes all of the Cascades level III ecoregion, with the exception of the Cascade Crest Montane Forest Level IV ecoregion. This is an older volcanic chain that is no longer active, approximately 45 to 10 million years old. Underlying the Western Cascades area are the Columbia River Basalts. The Columbia River Basalts are exposed in areas where the Clackamas River and tributaries have incised through the overlying strata. The Willamette Valley area, which corresponds with the Willamette Valley level III ecoregion, occupies the remainder of the basin.

For the purposes of the Action Plan the Clackamas Basin has been divided into several spatial levels based on natural and management characteristics. Figure 1 shows subdivision of the basin into seventeen Geographic Areas, with an additional subdivision of selected geographic areas into watersheds. The characteristics of these geographic areas are described in the *Clackamas Basin Summary Watershed Overview*. The seventeen areas are grouped into ten larger geographic areas to organize the discussion of limiting factors, strategies and actions (See Section 4.0). The grouping of the ten areas is based on similar characteristics of land use and management, for example, small urban watersheds versus large forestland areas administered by the US Forest Service.

[2] Refer to the Clackamas Basin Summary, Watershed Overview for details on ecoregions, geology, climate, land use, land cover, and water resources.

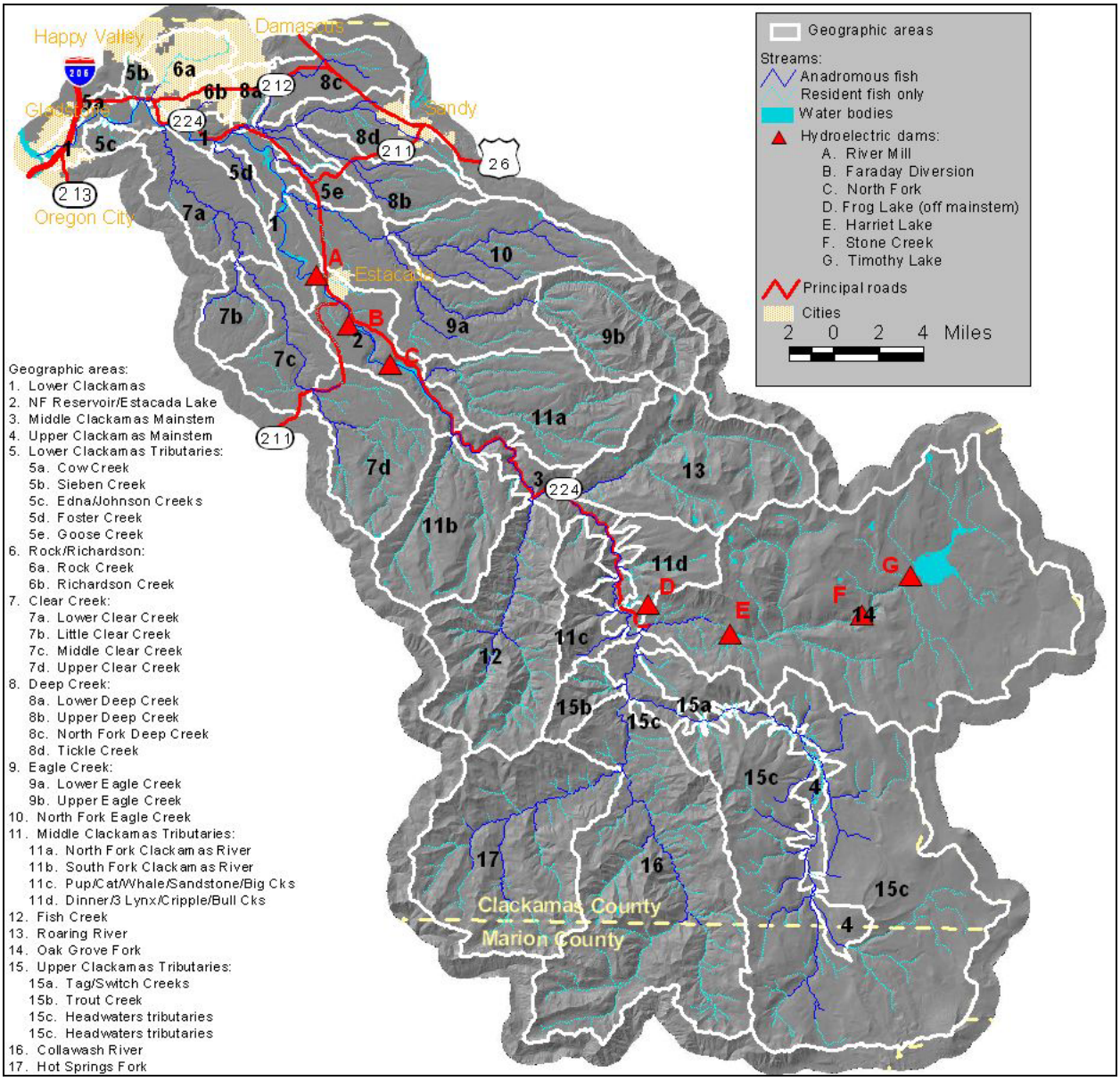

Figure 1. Geographic areas within the Clackamas Basin. Data sources: Clackamas County (2003), ODFW (2004), USGS (1999)

Land use is a major determinant of water quality and habitat conditions. At the scale of the entire Clackamas River basin, land cover is predominately (90%) forest and shrubland; agricultural activities cover approximately 8% of the basin, other developed areas make up approximately 2% of the total area (Figure 2). In general terms ecological integrity is generally higher on forestland, and decreases in agricultural and urban landscapes. Restoration and enhancement actions will therefore generally focus on the much smaller but more altered landscapes in the lower Clackamas River basin that is primarily in private ownership.

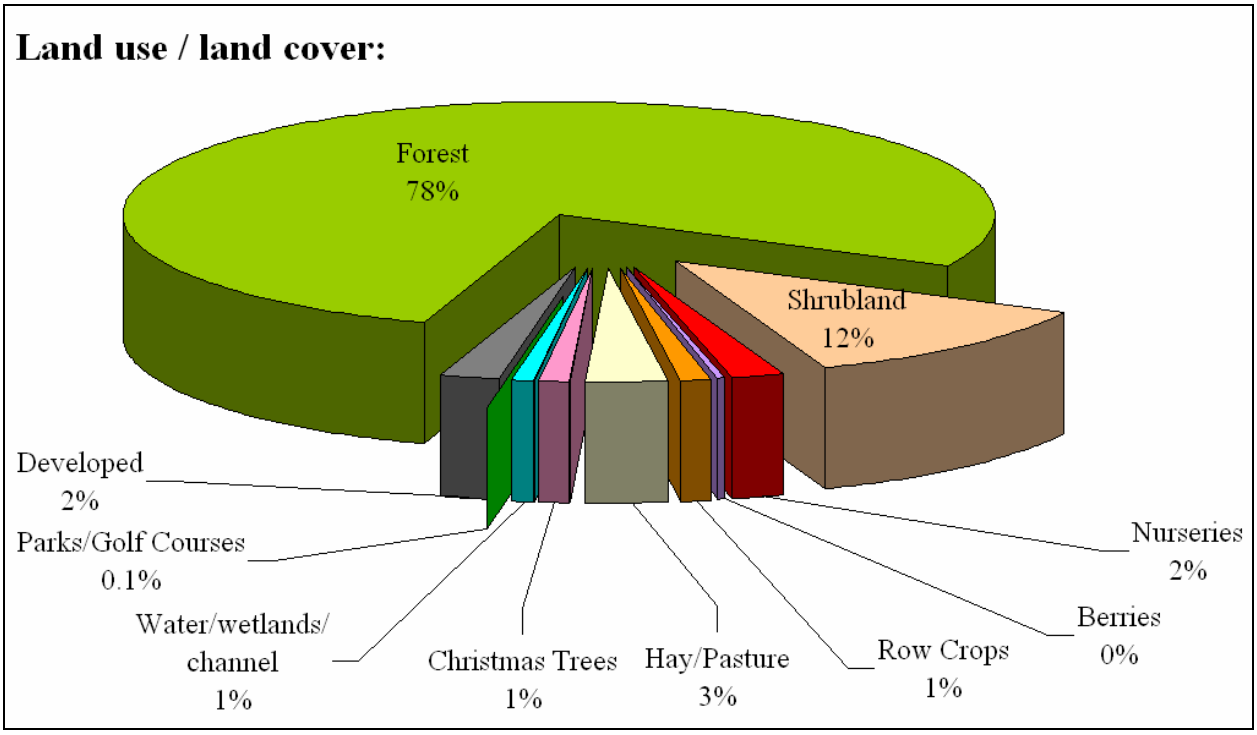

Figure 2. Proportion of total Clackamas Basin area by 10 Land use / land cover classes defined for this assessment.

2.2 BASINWIDE ASSESSMENT

The first step in the action planning process was to summarize what is known about the natural resources of the Clackamas Basin. For this purpose, the consultants developed four basin summaries, referred to as "White Papers".

1) Watershed Overview,

2) Water Quality And Water Quantity,

3) Fish Populations And Aquatic-Riparian Habitat, and

4) Wildlife.

The four white papers provide a technical and scientific foundation for the Action Plan. The white papers summarized existing reports, information and data available on the four topic areas. They provide background information, assess limiting factors by geographic area where feasible, and provide overall recommendations to consider in developing the Action Plan.

The information contained in these reports should be useful to cooperating agencies, CRBC partner organizations, stakeholders and the public interested in natural resources of the Clackamas River Basin[3].

2.3 RELATIONSHIP TO OTHER PLANNING EFFORTS

The impetus for developing the Action Plan at this time was the completion of watershed assessments throughout the majority of the basin, as well as completion of the Willamette River Subbasin Plan for Fish and Wildlife. At the same time, the Council recognized that a number of significant planning efforts were also coming to completion in the near future. These planning efforts are listed below.

1. **Willamette Subbasin Plan.** (Willamette Restoration Initiative 2004). This plan developed overall strategies for restoring fish and wildlife as part of the Northwest Power and Conservation Council Fish and Wildlife Program. The plan included the Clackamas River Basin and addressed significant issues for fish and wildlife in the basin. The Willamette Subbasin Plan was used as an important building block in assessing fish and wildlife limiting factors in the Clackamas Basin Action Plan.
2. **Watershed Assessments**. The CRBC sponsored six watershed assessments in the lower Clackamas River Basin following OWEB protocols: 1) Rock and Richardson Creek Watershed Assessment (Ecotrust 2000), Clear and Foster Creek Watershed Assessment (WPN 2002), and Deep and Foster Creek Watershed Assessments (WPN 2005). These watershed assessments cover the majority of the lower basin. In addition, the Mt. Hood National Forest completed eleven watershed assessments in the upper basin, which were assessed as part of the Basin Summary papers. See *Appendix A* for a summary of recommendations from the federal watershed assessments.
3. **Fish Passage Barrier Assessments**. The CRBC sponsored completion of fish passage barrier assessments in Clear and Foster Creeks (Robison and Walsh 2003), and Clear and Eagle Creeks (WPN 2005). In addition, fish passage barrier inventories have been completed by Clackamas County and Mt. Hood National Forest. Together, these assessments provide a comprehensive assessment in the basin.
4. **Clackamas Subbasin TMDL**. The Clackamas River was included in the Willamette River TMDL drafted by ODEQ in 2004. The TMDL addressed only temperature and bacteria. The Water Quality Summary for the Action Plan integrated issues and data from the TMDL, and actions are described that will assist in reducing heat and bacterial loading as required by the TMDL.
5. **Surface Water Management Program Master Plan.** Clackamas County WES is rewriting the surface water management program to build on sound scientific modeling, and incorporation of best management practices. The new program may include recommendations for incorporating 15,000 acres in the Damascus-Boring area to the existing 12,260 acres in the existing Clackamas County Service District No. 1 (CCSD #1). The plan will be completed by December 2005.

[3] Contact the CRBC council for copies of the Basin Summary papers, the "White Papers".

6. **Portland General Electric, Clackamas Hydroelectric Relicensing Project**. PGE has applied for a license for the hydroelectric projects on the Oak Grove Fork and mainstem Clackamas River. The Clackamas River Project Relicensing Settlement Working Group (SWG) is discussing a mitigation plan that is expected by July 2005.

7. **Clackamas County Damascus/Boring Concept Plan**. Clackamas County, in partnership with the cities of Damascus and Happy Valley, the community of Boring, Metro and the Oregon Department of Transportation is preparing a plan for future development in the approximate 15,000 acre expansion area of the METRO Urban Growth Boundary. The plan is a significant way of encouraging natural resource protection strategies as this area develops. The plan is expected to be completed by December 2005. To be implemented elements of the plan would need to be incorporated into the city of Damascus and Happy Valley comprehensive plans.

8. **ODFW Comprehensive Wildlife Conservation Strategy**. ODFW is preparing the comprehensive strategy to provide a non-regulatory, statewide approach to species and habitat conservation in Oregon. Congress created two non-regulatory grant programs to provide funding to states for proactive wildlife conservation efforts that will help states avoid expensive and potentially controversial measures for species conservation. The Conservation Strategy will be used to fulfill the requirements of these new federal grant programs administered by the U.S. Fish and Wildlife Service.

9. **Willamette Basin Habitat Restoration Priorities.** The Oregon Watershed Enhancement Board (OWEB) has established a framework for prioritizing watershed improvement projects that will be used by OWEB's Regional Review Teams when making funding recommendations to the Board. The document that delineates funding priorities for the Willamette Basin will be completed by the end of 2005.

2.4 CRBC PARTNERS AND FUNDING SOURCES

One primary goal of this Action Plan is for it to be a guide for the Council and its current and potential partners to clearly identify mutual interests and future projects. The Council presents this action plan as an invitation to those interested in working together to improve water quality, fish and wildlife habitat and promote thriving communities throughout the Clackamas Watershed. The Council intends to continue building partnerships with willing landowners, schools, businesses, community groups and local, state and federal agencies. It is hoped that this Action Plan will provide an opportunity for the Council to find new partners and to strengthen existing partnerships.

The main interest groups represented on the Council provide support and are involved with the Council in many ways: (1) Native American Tribes and interests, (2) Fish and Wildlife Interests, (3) Forest Service/BLM, (4) Cities and Counties, (5) Small Woodlot Owners, (6) Special Districts (7) Water Providers, (8) Local Hydropower Utilities, (9) Commerce, (10) Private Industry, (11) Agriculture (excluding timber), (12) Environmental Interests, (13) Recreational Interests, (14) Commercial Wood Products, (15) Citizens at Large, (16) Native American Interests, (17) Education/Youth, (18) Property Owners on the River, (19) Rural Community Planning Organizations, and (20)Urban Community Planning Organizations, (21)State Natural Resource Agencies, and (22) Property Owners on Tributaries.

The CRBC engages its partners in many ways to implement programs and projects. The CRBC mission starts with the phrase, "*Foster partnerships and projects for clean water, to improve fish and wildlife habitat…*". Since 2000, the CRBC has developed many project partnerships focused on five Action Areas adopted by the Council in the same year. The CRBC Action Areas include the following:

1. Council Operations and Development.
2. Stream Enhancement.
3. Assessments and Research.
4. Monitoring.
5. Education and Outreach.

The following is a sample of Council partners and how we have worked together over the past five years:

- Clackamas Water Providers Group provides board representation; operating funds and technical assistance for watershed assessments and in-kind contributions. Sunrise Water Authority provides office space. Its members also provide technical assistance to the Council on many activities.
- Clark-Skamania Flyfishers, Northwest Flyfishers, Northwest Steelheaders, and Trout Unlimited, Damascus Civic Club, NWSA AmeriCorps, Cedarhurst Improvement Club, Clackamas High School, and community volunteers participate in stream and riparian area restoration projects. Oregon Trout's Clackamas Chapter provides volunteers and at times funding for riparian restoration projects.
- Over three hundred volunteers work on riparian projects and volunteer for watershed projects, outreach activities and events.
- The Clackamas County Farm Forestry Association contributes technical advice on tree planting.
- The Friends of Barton Park, Friends of Tickle Creek, Friends of Clackamas River, and Citizen Participation Organizations of Clackamas, Fishers Mill, Rock Creek and Eagle Creek -Barton work with the Council on watershed monitoring and land use planning.
- Clackamas High School, Sunrise Water, Clackamas County Soil and Water Conservation District, Clackamas Community College, Eagle Creek School, Estacada High School, the Student Watershed Research Project, Portland State University, Concordia University and OSU Extension partner on Watershed Education , Restoration Projects and Monitoring.
- Water Environment Services of Clackamas County makes a financial contribution, provides meeting space, have board representation and its employees provide fieldwork, data, mapping, document review, technical advice and GIS services. In order to help raise awareness of the watershed they provided funding and coordination for the installation of watershed signs in their service district.

- Forest Service and BLM employees provide board representation, technical advice about fisheries, water, and forestry. USFS provides space in its chiller to store trees that are donated for restoration projects.

- Concordia University provides board representation, retreat facilities, storage and care for potted trees and staff assistance.

- ODFW provides technical advice and partners on fisheries and habitat restoration projects.

- Local Government has representation on the board. CRBC is working with the City of Estacada on riparian and water quality projects in their community. Clackamas County provides funding for riparian projects. Clackamas County Commissioners participate in Council events.

CRBC strives to engage board members and citizens in watershed issues in all of its work. Council members report back to their stakeholder groups and bring their concerns to the table.

The CRBC convenes Technical Advisory Teams and Action Planning Teams to guide and review our projects. These two teams include local residents and guidance from agency representatives. For a good list of these agencies and individuals see the acknowledgements page.

2.4.1 General Programs and Funding Sources

The CRBC has been fortunate in securing funding from many sources since 2000. The CRBC works closely with the funding organizations to work on projects that meet our mutual goals and objectives. CRBC will work with our traditional partners in funding this Action Plan, but will also strive to seek out new and innovative funding sources and partners[4]. Funding resources may include:

- **Oregon Watershed Enhancement Board (OWEB**): OWEB funds watershed councils and voluntary watershed improvement actions using a 15% set aside from the Oregon Lottery and other sources. The CRBC has used OWEB grants to fund watershed and fish passage assessments and on-the-ground projects.

- **Bonneville Power Administration (BPA):** BPA funds approximately 500 fish and wildlife projects a year identified by the Northwest Power Planning Council fish and wildlife program.

- **Stewardship Contracting:** Authority for stewardship contracting has recently been extended to allow BLM and USFS to enter into agreements for conservation on private lands.

[4] Potential funding sources are described in the *Catalog of Federal Funding Sources for Watershed Protection*. http://cfpub.epa.gov/fedfund/index.cfm.

Stewardship contracts may be used for forest or rangeland health, water quality, and fish and wildlife habitat.

- **National Fish and Wildlife Foundation:** Bring Back the Natives Grant Program, National Fish and Wildlife Foundation General Matching Grants, Natural Resources Conservation Service: Conservation on Private Lands, Pacific Grassroots Salmonid Initiative.

- **National Oceanic and Atmospheric Administration**: Community-based Restoration Program.

- **US Environmental Protection Agency**: Nonpoint Source Implementation Grants (319), Targeted Watershed Grants Program, Water Quality Cooperative Agreements, Pesticide Environmental Stewardship Grants.

- **US Fish and Wildlife Service**: Partners for Fish and Wildlife Program, Cooperative Endangered Species Conservation Fund, Landowner Incentive Program, Private Stewardship Grants Program.

- **Oregon Department of Fish and Wildlife programs**: Landowner Incentives Program, Western Oregon Stream Restoration Program, Access and Habitat Program, Salmon Trout Enhancement Program.

- **Oregon Department of Fish and Wildlife Tax Incentives:** Riparian Tax Incentive Program, Wildlife Habitat Conservation and Management Program.

- **Private Foundations:** Numerous private foundations fund habitat and conservation actions; for example, the Bullitt Foundation, FishAmerica Foundation, Ford Foundation, and David and Lucille Packard Foundation.

2.4.2 Agricultural Programs

In general, progress in improving water quality on agricultural land depends on the ability to provide technical assistance (assessment and design), cost sharing, and education and outreach to interested producers and rural landowners. The primary agencies that provide technical assistance to farm operators and rural residential land owners are the Clackamas County Soil and Water Conservation District (SWCD) and the USDA Natural Resources Conservation Service (NRCS). The Farm Service Agency (FSA) administers many of the financial programs that provide cost share.

Gaps in Implementation of BMPs

The Clackamas County SWCD identified the following gaps in program delivery. Filling these gaps will contribute to the increase application of conservation practices and improve water quality conditions.

- Technical assistance for design
- Implementation cost share
- Education outreach
- Large farms – Backlog of engineering design
- EQIP eligibility for small farm operations (See below for definition)
- Backlog of applications for ODFW Wildlife Habitat Conservation and Management Program (tax incentive)

Conservation Reserve Enhancement Program (CREP)[5]: CREP, administered by Farm Service Agency (FSA), provides cost share money for the implementation of riparian fencing and planting on a specified buffer. A rental payment on the riparian buffer, based on the USDA soil rental rate, is dispersed annually for 10 to 15 years.

Conservation Reserve Program (CRP): CRP, administered by the USDA and Farm Service Agency, provides rent and cost-share for landowners to remove environmentally sensitive lands from production. Rental payments are dispersed annually over a 10-15 year period.

Conservation Security Program (CSP): This program, administered by the NRCS is a voluntary program that provides financial and technical assistance to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on Tribal and private working lands. Working lands include cropland, grassland, prairie land, improved pasture, and range land, as well as forested land that is an incidental part of an agriculture operation.

Environmental Quality Incentives Program (EQIP): This program, administered by the NRCS, provides assistance to farmers and ranchers in complying with Federal, State, and tribal environmental laws, and encourages environmental enhancement. Through this program a conservation plan that includes structural, vegetative, and land management practices on eligible land is implemented. Cost-share payments may be made to implement eligible structural or vegetative practices. Five- to ten-year contracts are made with eligible producers.

Habitat Enhancement through Local Partnerships (HELP): This program, administered by the Clackamas County SWCD, provides product discounts at Wilco Farm Stores, the Home Depot in Oregon City and Coastal Farm & Home Supply to local landowners that are implementing soil and water related projects developed with an approved conservation plan.

Nonpoint Source Pollution 319 Grants: Oregon Department of Environmental Quality (ODEQ), provides grant funds available through Section 319 of the Water Quality Act of 1987. It is a critical element in turning Oregon's Nonpoint Source control program into water quality protection realities in watersheds throughout the state. Each year, DEQ identifies programmatic and geographic targets, solicits project proposals, assembles a proposal package for EPA's review, develops contracts and agreements for disbursement of grant funds, oversees program implementation, and evaluates program accomplishments.

[5] Program descriptions from: ODA, 2005. Clackamas Subbasin Agricultural Water Quality Management Area Plan.

Wildlife Habitat Incentives Program (WHIP): WHIP, administered by NRCS, provides financial incentives to develop habitat for fish and wildlife on private lands.

OWEB Small Grant Program: The SWCD and CRBC jointly administer this program that provides funds specific practices. Landowners may be responsible for a certain percentage of the total cost.

Oregon Riparian Tax Incentive Program: This program, administered by ODFW, offers a property tax incentive to property owners for improving or maintaining qualifying riparian lands. Under this program, property owners receive complete property tax exemption for their riparian property. This can include land up to 100 feet from a stream. For riparian land to qualify for this program, it must be outside adopted urban growth boundaries, and planned and zoned as forest or agricultural lands (including rangeland), or must have met these criteria as of July 1, 1997. If a riparian area is already in good shape it may also qualify for the program. (http://www.dfw.state.or.us/ODFWhtml/InfoCntrHbt.html).

Oregon Wildlife Habitat Conservation and Management Program: This program, administered by ODFW, is specifically for property zoned exclusive farm use or mixed farm and forest use that are managed for wildlife habitat. The landowner who qualifies and successfully completes the required steps will receive a tax benefit. (http://www.dfw.state.or.us/ODFWhtml/InfoCntrHbt.html).

Nonpoint Source Pollution Control Facilities Tax Credit: This program, administered by the ODEQ, is intended to cover expenditures for "on-the-ground" management practices and improvements. Possible eligible practices must be consistent with the implementation of any state approved plans including the local Agricultural Water Quality Management Area Plan and the total maximum daily load (TMDL) implementation plan. (http://www.deq.state.or.us).

2.4.3 Urban Landscape

2.4.3.1 Surface Water and Habitat Management

Surface Water Management Administrative Procedures and Rules and Regulations: Clackmas County Service District No. 1 (CCSD #1), and the Surface Water Management Agency of Clackamas County (SWMACC) are County Service Districts (Districts) authorized to provide surface water management under ORS 451 regulations. The Rules and Regulations for Surface Water Management require undisturbed buffers adjacent to sensitive areas. Buffer requirements are specified under the "Natural Resource Protection" sections of the Rules and Regulations for each District. Minimum buffer widths are calculated based on information in Section 3 of the Administrative Procedures. The performance goals of the undisturbed buffer are to: 1) filter pollutants from surface water, including providing shade for the sensitive area; 2) natural migration of the sensitive area; and 3) preservation of the ecological integrity of the sensitive area. The Rules and Regulations also provide for a variance from the minimum standard width in exchange for a mitigation of the buffer of 1.5:1. In order to qualify for a variance, the applicant must demonstrate that the performance goals of the buffer can be

achieved. The buffer width is set based on the horizontal distance measured perpendicular to the sensitive area boundary. The buffer width is determined based on slope of the land adjacent to the sensitive area in 25 or 50 increments. As a general rule, buffer variances are not encouraged. The Districts must uphold the buffer requirements to assist in ensuring compliance with the Endangered Species Act, Clean Water Act, and METRO requirements. Generally, buffer variances include completing a natural resource assessment and submittal of sensitive area certification and buffer variance application forms.

Goal 5 Fish & Wildlife Habitat Protection: Clackamas County and cities within the boundaries of Metro will assess the feasibility and best options for developing programs, ordinances or alternative approaches to comply with Metro's new Goal 5 program, which is being considered at this time. Metro's program is written to comply with Statewide Goal 5[6]. Metro conducted a public comment period on the Draft Model Ordinance and associated programs during May, 2005. The purposes of the Title 13: Nature in Neighborhoods program is to: 1) conserve, protect, and restore a continuous ecologically viable streamside corridor system, for the streams' headwaters to their confluence with other streams and rivers, and with their floodplains in a manner that is integrated with upland wildlife habitat and with the surrounding urban landscape; and 2) to maintain and improve water quality throughout the region.

Clackamas County Fish Passage Program: Clackamas County has assessed, developed a database of, and prioritized fish barriers throughout Clackamas County. Many of the barriers are impassible culverts on County roadways. Since 1999, Clackamas County has received more than $5 million in grants for fish passage enhancements and has completed more than 70 projects, potentially opening up 145 miles of stream to anadromous and native migratory fish species. The County has developed an Intergovernmental Agreement and is cooperating with the Oregon Department of Fisheries (ODFW) to fund an ODFW Biologist to assist County staff in permitting these projects.

Surface Water Management Program Master Plan: Clackamas County Service District No. 1 (CCSD1) is rewriting its surface water management (SWM) program. The goal is to emerge with a new program that is based on sound scientific modeling, and that incorporates best management practices. The new program will include recommendations for surface water management in the current 12,260 acres under the jurisdiction of CCSD1, as well as 15,000 acres in the Damascus-Boring area that may be added to Water Environment Services (WES's) jurisdictional responsibility. A draft of the new master plan is expected to be completed by the end of June, 2005 and the final plan is expected to be adopted by Clackamas County Commissioner's by December, 2005. When completed, the new Surface Water Management Program Master Plan will include the following seven elements: 1) Measurements and models of surface water runoff quality and quantity throughout North Clackamas County; 2) A prioritized list of detention facilities and other capital improvements necessary to protect against flooding;

[6] Goal 5 is required by Oregon Administrative Rule 660-015-0000(5). The objective of Goal 5 is to protect natural resources and conserve scenic and historic areas and open spaces. Goal Local governments shall adopt programs that will protect natural resources and conserve scenic, historic, and open space resources for present and future generations. These resources promote a healthy environment and natural landscape that contributes to Oregon's livability.

3) A set of maintenance programs designed to protect water quality; 4) A public education program to engage North Clackamas residents in water quality protection; 5)Design standards for new development and construction; 6) A long-term monitoring effort to continually evaluate the effectiveness of the SWM program; and 7) The financial and rate structure necessary to support the program.

Erosion Prevention & Sediment Control Program: WES staff review erosion prevention and sediment control plans in coordination with the Clackamas County Department of Transportation and Development permitting processes. The one-acre threshold of the Department of Environmental Quality's (DEQ) NPDES 1200-C permits has been incorporated into this process. WES is an agent of the DEQ for 1200-C permits. WES continues to require the use of a variety of best management practices to prevent erosion and control sediment. The most effective prevention and control measure continues to be the day-to-day work of the staff, who are primarily assigned to erosion inspection and enforcement. Frequent inspections throughout all stages of construction help prevent and minimize adverse impacts to the public storm system, adjacent properties and local waterways. Staff is assigned to individual projects until completion of construction, the continuity helps to build and maintain better relationships with the development community. Due to the growing volume of development, WES added a half-time inspection position to the two existing full-time Erosion Control Inspectors on staff. Over 2,900 inspections/site visits were conducted in the 2003-2004 permit period. WES is continuing its focus on erosion prevention by developing educational information for contractors and developers.

ESA Program Coordination/Facilitation: Clackamas County departments are working together and with local jurisdictions to restore salmon species within watersheds inside of Clackamas County's borders. The Board of County Commissioners appointed Water Environment Services Department to coordinate salmon recovery efforts within the County and with federal, state and local agencies, known as the Coordinating Council for Salmon and Steelhead Recovery Efforts in Clackamas County. The Coordinating Council for Salmon and Steelhead Recovery, which represents most departments of Clackamas County, was formed to address the potential policy changes that could result from responding to and complying with the Endangered Species Act in Clackamas County. Clackamas County is working together with local jurisdictions to restore salmon species within watersheds inside of Clackamas County's borders. Many of Clackamas County's 2,000 creeks and streams still contain important fish spawning and rearing habitat. Because - steelhead and cutthroat trout live in these waterways before migrating to the ocean, and the salmon return to these waters to spawn - access to high-quality rearing habitat is important throughout the watershed. WES has in the past and will continue to conduct fish, habitat, and biological surveys to develop a baseline and assess current conditions and overall effectiveness of salmon recovery efforts.

Clackamas County Stormwater Maintenance Programs: Clackamas County's Surface Water Management programs incorporate Best Management Practices (BMPs) to reduce the discharge of pollutants to local waterways and wetlands. WES performs and coordinates maintenance and repair of the components of the surface water conveyance system in conjunction with the Clackamas County Department of Transportation and Development. Cleaning and maintenance

occurs throughout the year in the road right of way and with Maintenance Agreements within Subdivisions.

WES is also responsible for the maintenance of the flood control detention facility on 87 acres located south of SE Harmony, west of 82nd and north of the Union Pacific Railroad main line. The facility is designed to help relieve flooding of low-lying homes and warehouses in this area. WES performs routine inspection, monitoring and minor maintenance of this facility.

Clackamas County Department of Transportation and Development (DTD) crews cooperatively work with WES and are responsible for cleaning and maintaining storm water systems within County-maintained rights-of-way within the Districts' boundaries and for street sweeping.

The Clackamas County Stormwater Injection Committee is responsible for maintaining and revising the County's UIC-Related Stormwater Management Plan. The Plan includes best management practices which have been implemented to maintain/improve stormwater quality, minimize/prevent spills, and address illicit discharges, thereby protecting groundwater quality. The Plan also includes the locations of all County-owned stormwater drywells, an evaluation of land use in areas that are served by those drywells, and the UIC program's record keeping policy. CCSD#1 also maintains private surface water facilities through On-Site Stormwater Facilities Maintenance Agreements with developers. During FY04-05, routine maintenance inspections were performed on 85 of the 145 Maintenance Agreement subdivisions, ponds, swales, structures and related structures. Trash pickup, vegetation maintenance and routine maintenance activities occurred in 45 detention ponds and other open space areas.

Clackamas County Stormwater Management Plan: Clackamas County is required to develop and implement a Stormwater Management Plan to comply with the National Pollutant Discharge Elimination System System (NPDES) Discharge Permit. Mandated by Congress under the Clean Water Act, the NPDES Stormwater Program is a comprehensive two-phased national program for addressing the non-agricultural sources of stormwater discharges which adversely affect the quality of our nation's waters. The program uses the NPDES permitting mechanism to require the implementation of best management practices and structural and non-structural controls designed to prevent harmful pollutants from being washed by stormwater runoff and discharged into local water bodies. The regulated entities must obtain coverage under an NPDES stormwater permit and implement stormwater pollution prevention plans (SWPPPs) or stormwater management programs (both using best management practices (BMPs)) that effectively reduce or prevent the discharge of pollutants into receiving waters.

The NPDES stormwater permit regulations, promulgated by EPA, cover the following classes of stormwater discharges on a nationwide basis: 1) Operators of Municipal Separate Stormwater Sewer Systems (MS4s) located in "urbanized areas" as delineated by the Bureau of the Census; 2) Industrial facilities in any of the 11 categories that discharge to an MS4 or to waters of the United States; 3) all categories of industrial activity (except construction) may certify to a condition of "no exposure" if their industrial materials and operations are not exposed to stormwater, thus eliminating the need to obtain stormwater permit coverage; and 4) Operators of construction activity that disturbs 1 or more acres of land; construction sites less than 1 acre are covered if part of a larger plan of development. All construction activities 1 acre or larger must

obtain permit coverage. Construction activities less than 1 acre must also obtain coverage if they are part of a larger common plan of development or sale that totals at least 1 acre. Small construction activities, i.e., less than 5 acres, may qualify for a waiver. The U.S. EPA has given the regulatory authority and oversight of the NPDES Stormwater Discharge Permit Program in Oregon to ODEQ. Clackamas County's NPDES Stormwater Management Program includes the following 12 general elements: 1) Source Identification; 2) Planning Procedures to develop, implement, and enforce controls from new areas and redevelopment; 3) Commerical and Residential Areas - Control measures to reduce pollutants in stormwater runoff; 4) Construction Sites - Implement and maintain structural and non-structural Best Management Practices (BMPs); 5) Capital Improvement Program; 6) Industrial Stormwater Program; 7) Illicit Connections - Determining and Removing from MS4; 8) Procedures to prevent, control, and respond to spills; 9) Monitoring program; 10) Public Involvement & Education; 11) Public Participation and Intergovernmental Coordination; and 12) SWM Staff, Training, and Equipment. Each of these elements are reported on annually as part of the NPDES permit requirements.

Potential Pilot Projects for Water Reuse and Biosolids Management: Clackamas County WES is exploring the feasibility of potential water reuse and biosolids management projects. Working in cooperation with various stakeholders and landowners, opportunities and options for wastewater treated effluent reuse and biosolids management options are being investigated. Permit conditions, appropriate sites, environmental constraints, energy, costs, operations and maintenance, monitoring requirements, feasibility and constructability as well as other factors are being assessed.

Clackamas County Cooperative Monitoring Program: Clackamas Water Environment Services (WES) monitors both water quality and flow in creeks, rivers, and storm sewers in Clackamas County Service District #1 (CCSD #1) and in the Surface Water Management Agency of Clackamas County (SWMACC). The Surface and Storm Water Monitoring Program has been routinely monitoring water quality since 1994 in CCSD#1 and since 1993 in SWMACC. Flow measuring was initiated at continuous monitoring locations in 2000 and was initiated at all monthly surface and storm water monitoring locations in 2001. The current monitoring program is comprised of two complementary types of monitoring systems: 1) Monthly surface and storm water monitoring. This consists of sample collection crews visiting the same locations on a monthly basis to collect water quality with hand-held meters, to collect water samples for delivery to WES' laboratory for further analysis, and to perform streamflow measurement activities. And, 2) Continuous surface water monitoring performed by small probes that are permanently mounted in the stream. Other surface water monitoring equipment is linked to the probes through cables and is stored in a nearby monitoring hut. Water quality and flow data is collected at each location. There are currently two of these sites in the Clackamas River Watershed. The monitoring huts are supplied with electricity and communications equipment to provide real-time, remote access to these valuable data. There are 10 sampling stations that WES monitors on a monthly basis in the Clackamas River watershed. Water quality constituents sampled and analyzed for generally include: nutrients, solids, bacteria, metals, pH, temperature, dissolved oxygen, and Oil and Grease. WES has also been involved in cooperative monitoring studies with other local agencies and has conducted fisheries, habitat, and macroinvertebrate studies. Additional studies will be undertaken as part of WES's Stormwater Management

Program Master Plan Update project (scheduled for completion during 2005) and the ongoing activities associated with the Clackamas County ESA Program. See the Monitoring Section of the Action Plan for specific details on locations, sampling types, parameters measured, and frequency of collection.

2.4.3.2 Public Drinking Water Providers

City of Estacada

Description: The City of Estacada's water comes from the Clackamas River. The Clackamas River has been used as a water source for the City since 1955. The City recently, (2002) completed an improvement project at the treatment plant adding monitoring and control equipment. Plant capacity was increased to 1.5 MGD (million gallons per day).

Facts:
Water Withdrawal: 0.6 MGD Average Daily Demand; 1.1 Peak Day Demand
Population Served: 2,400 people
Website: http://www.cityofestacada.org/

Clackamas River Water

Description: Clackamas River Water (CRW) is a domestic water supply district that serves customers in unincorporated Clackamas County, located in the southeastern part of the Portland metropolitan area. In addition to providing retail water service within its boundaries, CRW also serves Oak Lodge Water District and Sunrise Water Authority, as well as the cities of Gladstone (CRW will no longer service Gladstone after September- NCCWC will be the primary water provider) and Milwaukie as a wholesale water provider. CRW directly services a population of roughly 50,000 (through approximately 11,000 service connections), and approximately 100,000 wholesale and retail customers. The area served covers approximately 11 square miles, including the Sunnyside, Milwaukie, and Clackamas areas. The District's south service area covers the rural areas adjacent to Oregon City south of the Clackamas River, approximately 29.65 square miles) . The District's north service area is supplied with water from the CRW filtration plant, which is capable of producing 30 million gallons per day from its water source, the Clackamas River. The south service area is supplied with water purchased by CRW from South Fork Water Board, also from the Clackamas River.

Facts:
Water Withdrawal: 11.7 MGD Average Daily Demand; 17.8 Peak Day Demand
Population Served: 100,000 people
Website: www.crwwater.com

North Clackamas County Water Commission

Description:
North Clackamas County Water Commission is a water supply agency made up of Sunrise Water Authority and Oak Lodge Water District (these two entities jointly own the treatment plant). The NCCWC water treatment plant has slow sand filtration that was designed for 10 MGD. The plant is currently undergoing a membrane expansion that will add 10 MGD for a total of 20 MGD.

Facts:
Water Withdrawal: 5 MGD Average Daily Demand; 12.5 Peak Day Demand
Population Served: 67,500 people
Website: www.sunrisewater.com and/or http://www.oaklodgewater.org/

South Fork Water Board

Description:
Water withdrawal and treatment facility only; Oregon City and West Linn do the distribution

Facts:
Water Withdrawal: 8.7 MGD Average Daily Demand; 19.88 MGD Peak Day Demand
Population Served: 64,000 people
Website: http://www.sfwb.com/index.htm

Lake Oswego Municipal Water

Description: For more than 33 years the City of Lake Oswego Water Treatment Plant (WTP) has supplied all the water consumed in Lake Oswego.

The plant was constructed in 1967 in what was then unincorporated Clackamas County. It had an initial treatment capacity of 10 million gallons per day (MGD). The plant was expanded in 1980 to its present-day treatment capacity of 16 MGD. The source of all the City's water is the Clackamas River in Gladstone.

Facts:
Water Withdrawal: 7.2 MGD Average Daily Demand; 16 MGD Peak Day Demand
Population Served: 36,000 people
Website: http://www.ci.oswego.or.us/

3.0 BASINWIDE STRATEGIES AND ACTIONS

Introduction

The Clackamas Basin Action Plan was developed through a collaborative process that progressed from technical evaluation to project identification (Refer to flowchart in Figure 3). Existing conditions, challenges (issues of concern) and strategies (potential solutions) were identified during the technical assessment and were summarized in *Basin Summary Reports*. The Basin Summary Reports are a snapshot in time that will be improved through continued monitoring and analysis. This section provides a summary of the findings from the Basin Summary combined with input from the community, which provides the CRBC and its partners with tools to more easily understand and convey complex scientific concepts and findings.

Limiting factors and key issues are summarized at various spatial scales[7] depending on the degree of resolution of available data. These limiting factors and key issues together are referred to as "*Challenges*", which are summarized at the basin scale in Section 3.1. To address these challenges, existing programs and program gaps were reviewed (Section 2.4). The review helped identify the set of *Strategies* to address these challenges. The strategies are summarized in Section 3.2. *Monitoring* needs and *Action Plan Review and Revision* are discussed in Section 3.6 and Section 3.7.

[7] Spatial scale refers to different sizes of landscape: Three Large Areas , Mainstem, Lower Basin, Upper Basin, - Ten Geographic Groups – and Seventeen Geographic Areas.

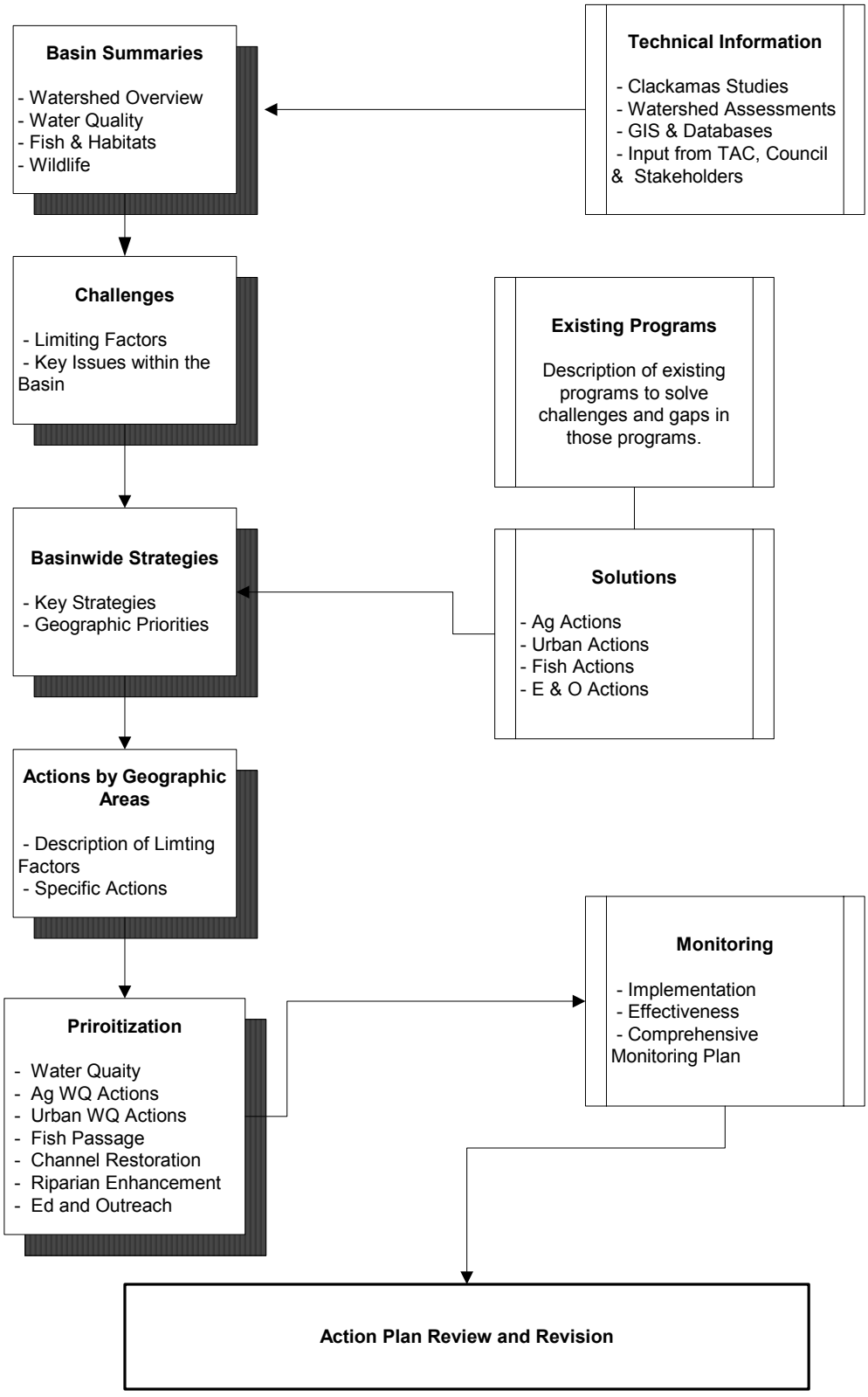

Figure 3. Flowchart illustrating the Action Plan process.

3.1 CHALLENGES AND STRATEGIES AT THE BASIN SCALE

Limiting factors to fish and wildlife populations and impacts to water quality are considered together as Challenges. The information is organized in the same manner as the Basin Summaries: Water Quality, Aquatic and Riparian Habitat, and Wildlife Habitat. The key challenges and general strategies to address them are summarized in Table 1, 2 and 3.

Table 1. Key Water Quality Challenges and Strategies.

CLACKAMAS WATER QUALITY	
KEY CHALLENGES	**KEY STRATEGIES**
Decrease Nutrients	• Increase width of shrub and forested riparian areas • Develop buffer strips to capture runoff • Reduce soil erosion • Promote responsible fertilizer use • Fence livestock away from streams and cover livestock waste • Reduce pet waste in parks and neighborhoods • Capture, slow, filter and release urban stormwater runoff • Identify areas of possible septic system malfunction
Decrease Bacteria	• Fence livestock away from streams and cover livestock waste • Identify areas of possible septic system malfunction • Increase width of shrub and forested riparian areas to reduce erosion
Decrease Pesticides	• Targeted pesticide education for urban and rural lower basin landowners. • Encourage nursery and agricultural industry to reduce pesticide application. • Recycle and reuse water from irrigation • Encourage alternatives to pesticides
Decrease Water Temperature	• Plant riparian vegetation over streams and riverbanks. • Plant trees to shade ponds or remove ponds especially in-stream ponds • Protect mature riparian forests • Augment summer stream flows • Promote irrigation conservation
Increase Summertime River and Stream Flow	• Promote landowner cooperation and education in highest need areas • Promote water conservation strategies Consider areas for water right leases and transfers
Reduce fine sediment	• Control erosion of soil at the source – dirt roads, agriculture fields, construction sites • Use green streets and filter road runoff • Replace undersized culverts

Table 2. Key Aquatic and Riparian Habitat Challenges and Strategies.

CLACKAMAS AQUATIC AND RIPARIAN HABITAT	
KEY CHALLENGES	**KEY STRATEGIES**
Loss of stream and river channel complexity	• Protect side channels and other backwater areas in the river's wide floodplain. • Restore and improve historic side channels and other backwater areas along the river and tributaries. • Add wood to existing side channels and other backwater areas in the river and tributaries where large wood is limited. • Add wood to stream channels were there are limited quantities of large wood. • Restore meanders to channelized stream sections • Remove dikes and rip-rap to allow natural river and stream meandering.
Fish Passage Barriers	• Address high priority fish passage barriers, with anadromous barriers first and then those impacting resident fish populations. • Start low and in mainstem of tributary watersheds and work upstream.
Riparian Areas	• Protect existing high quality floodplain forests and riparian areas. • Restore riparian areas focusing on areas with water quality issues, in-stream large wood deficits, and non-native vegetation. • Fence riparian areas that are subject to livestock grazing. • Control weeds and provide ongoing vegetation control for restored riparian areas. • Where old growth or mature forest has been eliminated along riparian areas, implement, silvicultural treatments to promote development of late seral forest characteristics.
Water Quality	• Where water temperatures are elevated, improve riparian conditions and reduce temperature to levels appropriate for the range of fish species and life stages. • Reduce and minimize inputs of toxic chemicals and pesticides that impact fish survival and behavior.
Future Habitat Studies	• Use snorkel surveys to identify juvenile coho and steelhead production areas in Clear and Deep Creeks • Continue to monitor smolt out-migration on key tributary streams. • Assess aquatic habitat conditions where there are no inventories.

Table 3. Key Wildlife Challenges and Strategies.

CLACKAMAS WILDLIFE HABITAT	
KEY CHALLENGES	**KEY STRATEGIES**
Loss of Key Habitats	• Improve and restore key wildlife habitats, emphasize the lower basin Ecoregions. • Improve terrestrial habitats by controlling weeds, vegetation control (for example, tree thinning), planting native vegetation, and other actions. • Improve and restore oak woodlands and savanna habitats • Improve, restore upland prairie habitats • Improve and restore wetland prairie, seasonal marsh, and wetland habitats • Improve and restore riparian habitats and floodplain forest; mature and old-growth conifer forests.
Habitat Connectivity	• Protect large intact areas comprised of key habitats to promote core areas for habitat connectivity. • Promote habitat connectivity between federal lands (BLM and Forest Service), public park areas, and private lands. • Restore habitats between intact patches of private and public lands to improve connectivity. • Improve habitat connectivity between core areas and the lower and the upper basin by restoring key habitats. • Restore degraded riparian areas to connect high quality riparian habitats.

3.2 RECOMMENDED BASINWIDE STRATEGIES

Of all the possible strategies to address the challenges that face the Clackamas Basin the following were identified by the Technical Advisory Committees and Council as the major set of protection, restoration, education and outreach, and monitoring activities needed in the Clackamas River Basin. The strategies are listed in the general order of the ecological principles that are discussed in Section 3.5. Although actions often address multiple ecological principles the general order follows the concept of protection, connecting habitats, and then restoration of habitats and reduction of land use impacts.

Riparian Protection & Restoration. Riparian areas mapped in satisfactory condition should be protected from further development. Riparian areas mapped as too narrow, sparse or absent require restoration to improve shade, future inputs of wood, and wildlife habitat conditions. Restoring riparian shade over channels will help address water temperature issues.

Upland Areas Protection. Currently intact blocks of upland vegetation need to be identified and protected through zoning or other means for wildlife and open space needs. There are many undeveloped parcels along the lower reaches of tributaries in the lower Clackamas that could be connected through natural areas, parks and greenbelts to provide wildlife corridors and open space.

Wetland Protection, Restoration, Creation. Existing wetlands need to be protected from further development. Wetlands can be developed in part to assist in retention, infiltration, and water filtration.

Fish Passage. Fish passage assessments have been completed to a large degree in the Clackamas Basin. Identified barriers need to be fixed.

Channel Restoration. Channels that have been altered via channelization, ditching, in-line ponds. Restore via altering streamside practices, re-meandering, reconstructing side channels, buffers, vegetative planting, fencing.

Water Flow Enhancement. Water flows have been impacted through withdrawals and diversions, particularly into ponds. Increased water use efficiency, transfer or lease of water and through better management of ponds and other diversions.

In-Stream Habitat. There has been a loss of aquatic habitat complexity due to limited wood in channels. Restore channels by adding pieces of wood, wood jams, or other structural elements.

Agricultural Practices. Additional technical assistance, outreach, and cost-sharing are needed to reduce sediment, nutrients, bacteria, and pesticides from (commercial and non-commercial) agriculture operations in the lower basin.

Storm Water Management. Storm water runoff from urban and developing areas contributes to increased stream flows during wet periods and can contribute toxins and other pollutants to the

aquatic system. Storm water runoff can be reduced and controlled through low impact development practices, proper drainage design, and other best management practices and state-of-the-art stormwater management techniques.

Erosion Prevention and Sediment Control Practices. Erosion prevention and sediment control reduces sediment and turbidity, but also pollutants associated with runoff. Address erosion through education, technical assistance, inspection and enforcement, cost share and as land use specific controls (e.g., Forest Practices Act, stormwater regulations, etc.)

Forest and Small Woodlot Management Practices. Management practices reduce sediment runoff and maintain forest canopies in riparian zones. Forest lands comprise a high percentage of land use in many watersheds in the basin.

Invasive Species and Weed Control. Some weed plant species (also referred to as exotic or invasive species) are plant species not native to the Clackamas River Basin. These plants, when introduced to watersheds, reproduce prolifically and can dominate riparian and terrestrial habitats. Left unchecked, many weed, non-native, and invasive species have the potential to impact fish and wildlife species by transforming the native vegetation that that native species depend on for food, shelter and habitat. Weed, non-native, and invasive species that have invaded habitats, particularly riparian areas, include such plant species as Japanese knotweed, Himalayan blackberry, reed canary grass, English ivy, and Scotch broom.

Comprehensive Monitoring Plan. Agencies and organizations are engaged in a variety of monitoring activities in the Clackamas Basin. Although these programs may meet specific agency objectives, taken together these monitoring activities do not constitute a goal oriented, rigorous program that is needed to evaluate effectiveness at larger spatial scales – subwatershed, watershed, basin. As described in the Basin Summary Papers (Water Quality/Quantity, Fish, and Wildlife) a number of monitoring needs have been identified. A comprehensive monitoring plan and implementation system are needed to assure that monitoring meets community goals and objectives. The monitoring plan should address implementation, effectiveness, and trend monitoring as well as agency coordination, monitoring resources, data base management, and annual review and revision.

Water Use Investigations. The effect of water use in the basin with respect to current and future water supply needs is unknown. Recommendations have been made in watershed assessments to develop a better understanding.

Septic Systems Evaluations. The contribution of pollutants from septic systems in the lower basin is unknown but inferred from observation of water quality data. The impacts from septic systems and the need for maintenance, retrofits, and treatment upgrades needs further investigation.

Education and Outreach. Education and Outreach needs cut across most land ownership and land use categories, but the gap appears to be the highest in urban, rural residential and small farm audiences.

3.3 CHALLENGES AND STRATEGIES IN MAJOR GEOGRAPHIC AREAS

The following Summary describes challenges and strategies within the context of three major geographic groupings in the Clackamas River Basin: 1) Mainstem Clackamas River; 2) Lower Basin; and 3) the Upper Basin. This summary is abstracted directly from the Basin Summaries for fish, wildlife, water quality and water quantity.

The Mainstem Clackamas River refers to the river channel, adjacent floodplain and lands that drain directly into the river that are not included in a named tributary. The Lower Basin includes all major tributary drainages downstream of River Mill Dam, and the Upper Basin, which includes all areas upstream of River Mill Dam Section. (For the purposes of this discussion the area referred to as the Middle Clackamas and tributaries are grouped with the upper basin.)

3.3.1 Mainstem Clackamas River

Challenges - Aquatic Habitat Complexity

Habitat complexity is created by a meandering river that creates side channels and captures gravel and large wood from its banks. These side channels are critical habitat for salmon and steelhead. Side channels provide refuge from high flows and in the most simple sense a meandering river with multiple side channels provides more available habitat. Along the entire mainstem of the Clackamas River side channels and habitat complexity have been reduced. In the upper watershed side channels in the Middle and Upper Clackamas River have been reduced through the placement of Highway 46. In the lower river the placement of dikes and rip rap have constrained the channel. Reconnecting side channel habitat and increasing habitat complexity by adding large wood or other structural elements is needed to improve habitat for fish and wildlife.

Strategies - Aquatic Habitat Complexity

- Protect and restore side channels in the river's wide floodplain below River Mill Dam. Actively reconnect side channels that have become disconnected from the river through active restoration.

- Restore and enhance side channels in the Middle and Upper Clackamas River

- Add wood to existing side channels and other backwater areas in the Lower, and Middle Clackamas River to improve habitat complexity. Where possible, create logjams with multiple pieces of wood.

- Protect and restore existing high quality floodplain forests and riparian areas through voluntary measures with landowners. Emphasize areas along the Lower Clackamas River.

Challenges - Water Quality :

Water quality issues in the mainstem result from land management practices in the tributaries and operation of hydroelectric facilities and reservoirs in the main stem. Water quality issues arising within the tributaries (bacteria, nutrients, pesticides) are discussed in the sections on Lower and Upper Basin below. Otherwise, the primary issues on the mainstem are those associated with the mainstem dams that have been identified as part of FERC relicensing process[8]:

1. Dissolved Oxygen: Discharges from Timothy Lake occasionally exceed the applicable DO standard. PGE has proposed changes to operations to improve dissolved oxygen.

2. Temperature: Diversion of flows from the Oak Grove Fork at Lake Harriet Dam creates temperature problems in the lower Oak Grove Fork. PGE has proposed changes in flow releases to improve temperature below the dam.

3. Taste and Odor: Blue-green algae in North Fork Reservoir may create taste and odor problems for domestic water supplies taken from the lower Clackamas River. (Blue-green algal blooms also occur in Timothy Lake.) Algal growth in the reservoir is in part stimulated by nutrients (especially phosphorus) in the basin above the reservoir. PGE, DEQ, US Forest Service, and the Water Providers are working cooperatively to monitor the blooms, toxins, and post necessary advisories.

   In the National Forest portion of the upper Clackamas River watershed there are no readily apparent or controllable nutrient sources[9]. Small background level of sedimentation from existing road systems may occur, but the amount of surface soil erosion from past timber harvest activities is minimal. Natural sources of sedimentation are associated with unstable earth flow terrain in the Collawash drainage or landslide activity in Fish Creek. Some fertilization after thinning activities is planned, but project mitigation measures are designed to minimize or prevent the entry of fertilizer into streams.

Challenges - Summertime streamflow restoration:

Within the mainstem the highest need for flow restoration is along the lower mainstem below River Mill Dam, with a moderate need in the middle mainstem area, and a low need in the upper mainstem. The following possible action are taken from Oregon Water Resources Department and Oregon Water Trust.

Strategies - Streamflow

1. Leases and transfers:

[8] From PGE Application for certification pursuant to section 401 of the Clean Water Act (PGE 2003) as cited in the Water Quality and Water Quantity Summary Paper.
[9] Ivars Steinblums, Mt. Hood National Forest, Personal Communication 2005.

a. Permanent Transfers to Instream Use: Instream transfers and leases carry the priority date of the original right. Junior water users may not divert the water while it is an instream right or lease. (Note: In-stream transfers may not necessarily benefit the water providers. There is an existing in-stream right that is senior to our right. The issue for water providers is that in low water years, the water users may be limited on available supply.)

b. Time-Limited Instream Transfers: Transfer to instream use for a specific period of time, at the end of which the right automatically reverts back to its original place and type of use. These transfers are generally used for periods of time exceeding five years; otherwise the instream leasing process is the preferred option.

c. Instream Leasing: Instream leasing allows water right holders a way to protect water rights that are currently unused while also providing instream benefits. Leases go through an expedited review process. The term of an instream use lease cannot exceed five years, but it may be renewed. Water rights for surface water use, storage, the use of stored water, and water saved through the conserved water program may be leased instream.

d. Split season leasing: Irrigators use water during the first half of the season, then water rights are leased instream during the second, drier half of the season.

e. Rotational pooling agreements: Irrigators coordinate with neighbors and take turns leasing water rights. In general, this method works best on a shared ditch system.

2. Conservation:

a. Modified land Management: Irrigators switch to crops that use less water, rotate crops or let pieces of less productive land go fallow, while leasing or selling the water rights for instream use.

b. Water conservation projects: Irrigators can install a more efficient irrigation system and transfer some or all of the conserved water to instream use, while increasing the productivity of their land.

c. Source switching: An irrigator's water source is switched from surface water to another source, usually groundwater or stored water and the surface water right is transferred or leased to instream use.

d. Point of diversion change: Irrigators withdraw water from a different location, which helps provide more water to the driest stretches of a stream. Generally this is done with a switch from flood to pressurized irrigation.

e. Education and outreach: Education and outreach can be targeted to reduce water use for both agricultural and urban water users.

3. Regulation: Oregon statutes declare that beneficial use without waste is the "basis, measure and extent of the right to appropriate water". Occasionally, watermasters take formal actions to obtain the compliance of unlawful water users or those who are engaged in practices which "waste" water. The waste of water means the continued diversion of more water than is needed to satisfy the specific beneficial use for which the right was granted.

4. Aquifer Storage and Recovery (ASR). Another option may be to promote ASR Systems. Where water is treated during the high flow periods and injected into the aquifer to supplement high demands and in-stream flows during the low flow periods.

3.3.2 Lower Basin

Strategies - Aquatic Habitat Complexity

- To improve aquatic habitat complexity, add wood to stream channels and existing and created side channels and other backwater areas. Emphasize areas used by juvenile Chinook, coho and steelhead.

- Restore meanders to channelized and stream sections.

- Use snorkel surveys to identify juvenile coho and steelhead production areas with in Clear and Deep Creeks. (These lower tributaries are singled out because of the threat from land uses and development. Specific actions can then be identified to protect these production areas.)

- Support continuation of smolt trap monitoring in Clear and Deep Creeks.

Challenges - Riparian and Floodplain Areas

Urbanization and rural development can reduce the availability, quantity and connectivity of floodplain areas which are vital to the health of the Clackamas Basin. A high priority should be placed on protecting high quality riparian areas, particularly intact floodplain forests along the Clackamas River and high quality riparian areas that could be subject to future land use changes in tributary streams. These forests provide vital services for water quality, flood control and for wildlife habitat. These valuable areas also provide social and recreational amenities near urban areas. Riparian restoration should focus on the following areas: stream segments with water quality issues, particularly water temperatures that can be addressed through improved shade; stream reaches dominated by weed vegetation; stream reaches dominated by non-conifers that are appropriate for conifer growth, particularly areas where there are limited quantities of large wood in the channel; and stream reaches between high

quality riparian habitats where restoration will provide habitat connectivity. See more in Streamside areas below in water quality challenges.

Strategies - Riparian Areas

- Protect high quality riparian and floodplain forests.

- Restore riparian areas focusing on areas with water quality issues and large wood deficits.

Strategies - Fish Passage Barriers

- Address high priority fish passage barriers. Address anadromous barriers first and then those impacting resident fish populations.

Challenges - Water Quality

The key water quality actions should address the major challenges that have been identified in the lower basin tributaries through water quality studies, regulations assessment (e.g., Total Maximum Daily Loads) and watershed analyses. (Watershed analyses: Rock and Richardson Creek (EcoTrust 2000), Clear and Foster Creek (WPN 2002), and Deep and Goose Creek (WPN 2004). The following "Key Pollutants or Parameters of Concern" are in not in priority order:

1. **Nutrients**. Reduction in nutrient loading from agricultural, urban, and forest lands. Nutrient inputs are derived from a variety of sources - application of fertilizers, soil erosion, livestock waste, pet wastes, urban stormwater runoff, and natural sources such as wildfire and wildlife. Although some management practices and source control programs are in place for these sources, the Action Plan can highlight where additional resources, activities or management actions are needed.

2. **Pathogens.** The potential hot spots for pathogens have been identified in the lower basin using *E. coli* bacteria as indicators. *E. coli* bacteria are associated with warm-blooded vertebrates so the specific source is not known – human, livestock, pets, wild birds, or other native wildlife species – however, the presence of the indicator is sufficient to cause concern for recreational use of water and use of water as domestic supplies.

3. Pesticides. A number of pesticides have been detected at concentrations of concern in the lower tributaries (Refer to the Water Quality Summary for detailed information.) Additional monitoring is currently underway (in 2005) to better identify and isolate specific source areas within tributaries of the lower basin. Given the current widespread availability and use of pesticides, it appears that there is a critical need to reduce pesticide loading and contamination of surface and groundwater.

4. **Sediment**. Sediment associated with accelerated surface erosion is an issue in all land use categories. Fine sediments can cause direct impacts associated with deposition in aquatic habitats; provide a growing medium for aquatic plants (especially in the mainstem), increase

turbidity; and clog water structures including domestic water supply intakes. Sediment associated with soil erosion provides a pathway for the input of nutrients, pesticides, and pathogens into water. High sediment loads can also stress fish and impact benthic macroinvertebrates.

5. **Streamside Areas.** In addition to controlling pollutants at the source, more stringent protection and incentives are needed to improve streamside riparian forest buffers. These areas provide important infiltration for groundwater and filter pollutants before reaching streams especially areas with dense riparian vegetation. Watershed assessments in the lower basin tributaries have identified specific areas along streams that are channelized or lack sufficient riparian buffers to accomplish water filtering benefits. In addition to restoring riparian areas, there is a need to protect intact riparian corridors within agricultural and urban areas. Protecting intact native vegetative buffers is always more cost effective and functionally effective than restoration of degraded systems.

6. **Water Temperature**. Water column temperatures exceed current state water quality criteria in many reaches of tributaries in the lower basin. Increased water temperature is primarily a riparian canopy and shade issue in the tributaries in the basin. Water withdrawals may also be a contributing factor, but it has not been verified to the same degree as with riparian alterations. Riparian improvement projects should be implemented to improve long-term water temperature conditions.

Challenges - Summertime streamflow restoration:

The Lower Basin geographical area has the greatest need for flow restoration in the Clackamas Basin. The highest needs are in the Lower Clackamas tributaries (Cow, Sieben, Foster, and Goose Creeks, Rock and Richardson Creeks, and Deep Creek and its tributaries. In addition, there is a high need for flow restoration in Middle and Upper Clear Creek, and Eagle Creek and its tributaries (Note: There is no consumptive water use in the National Forest portion of Eagle Creek.) Lower and Little Clear Creek has only a moderate need for flow restoration. Refer to Section 3.3.1 above for possible approaches to streamflow restoration.

3.3.3 Upper Basin

Strategies- Aquatic Habitat Complexity

- Reconnect side channels cutoff or impinged by road building in the past.
- Enhance side channel habitat where it may already exist and is functioning.
- Where road building and maintenance has reduced or eliminated instream wood in side channel habitats and stream margin areas, restore this important hiding and rearing habitat component.

- In the hydroelectric diverted reaches of the Oak Grove Fork, restore some level of instream flows, habitat complexity, and gravel/sediment recruitment conditions that will restore instream habitat and will benefit all anadromous fish species.

- In mainstem and tributaries where changes to stream channels such as historic riparian clear cutting and stream cleaning took place, restore high quality habitat features that were degraded. These actions should include instream wood placement

- Provide good stream access for salmonids through road system culverts.

Strategies - Riparian and Floodplain Forests

- Where old growth or mature forest has been eliminated along riparian areas, implement, where appropriate, silvicultural treatments to promote and hasten development of late seral forest characteristics beneficial to native fish species.

- Where past timber harvesting has taken place, implement actions that will speed growth and recovery of young tree stands bordering stream and wetland areas where appropriate.

- Where roads impinge on streamside riparian areas there are alternative roads to meet current and future transportation needs, obliterate and return the roads to productive forest.

- Where disbursed recreation activities are impacting riparian areas, attempt to mitigate or if conditions worsen or persist, discourage use and restore riparian conditions.

Challenges - Water Quality:

Land use in the Upper Basin is almost entirely forestland, and in contrast to the lower basin, water quality is very good. Forest management activities can have adverse effects on water temperature nutrient inputs, and sedimentation, but the extent and magnitude of potential effects is unknown. Effects may be minimal since land management in the Upper Basin on National Forests is primarily thinning with minimal road construction. Potential nitrogen sources are associated with harvest, prescribed burning, fertilization and natural processes. Phosphorus is associated with natural geologic sources in the upper basin, which can be increased by accelerated erosion. For these reasons, the following strategies should continue to be considered as part of land management activities.

Strategies: Water Quality

- Control nutrient inputs that are potentially associated with forest management activities using best management practices.

- Protect and restore riparian areas for water temperature and sediment trapping.

Challenges - Summertime streamflow restoration:

The Upper Basin geographical area has the lowest need for flow restoration in the Clackamas Basin. Only Oak Grove Fork is rated in the "Highest needs" category, while the Collawash River (including the Hot Springs Fork) and Pinhead Creek are rated as having a "Moderate" need for flow restoration. Since there is no water withdrawal in the Collawash and Pinhead Creeks, there may be no opportunity for streamflow enhancement in this area. Refer to Section 3.3.1 above for possible approaches to streamflow restoration.

3.3.4 Water Quality Focus - Agricultural and Rural Residential Lands

Although water quality is a theme throughout the Action Plan, the recommended focus is on restoration in the agricultural, rural residential and urban landscapes to make the most progress in improving water quality.

Agricultural activities within the Clackamas Basin are characterized by a high diversity of crops on small acreages. The agencies that provide technical assistance, the Soil and Water Conservation District (SWCD) and the NRCS, prefer to work with producers and rural residential landowners on a holistic basis. They develop Resource Management Systems or conservation farm plans that not only address erosion from fields, but also runoff from roads, streambank improvements, and green roof practices. Since 2001, these agencies have completed 73 conservation farm plans in the Clackamas Basin.

Conservation practices are described in the Field Office Technical Guide for Clackamas County. The Soil Conservationist works with landowners to meet their objectives, and selects conservation practices from the field guide that best meets both natural resource needs and landowner objectives.

In developing this Action Plan, the following critical gaps in current agricultural programs were identified:

- The small farm work load exceeds current staffing and funding levels. Technical assistance and funding are needed for design and implementation.
- The backlog of engineering design hampers implementation of projects on larger farms.
- Institutional issues such as the limitation on EQUIP eligibility.
- The Wildlife Habitat Tax Incentive Program (to protect small acreages) is not being implemented to the extent possible due to presumed institutional limitations.
- Watershed and micro-watershed targeting would improve the ability to bring various resources together to make a measurable difference in water quality.
- Monitoring to assess implementation and effectiveness is inadequate to detect improvements associated with conservation practices.

An overarching need to improve water quality and aquatic habitats is to work with the SWCD and NRCS to overcome these obstacles to delivering technical assistance and provide new and established programs to those landowners that want the help. The Action Plan will identify where the CRBC and its partners can work together to supplement these on-going programs to improve water quality and protect/restore aquatic habitats.

Agricultural land uses and typical conservation practices are briefly outlined in Table 4 below.

Table 4. Outline of agricultural land uses and conservation practices in the Clackamas River Basin.

Ag Land Use Categories	• Container nurseries • Ball & burlap nurseries • Berry crops • Christmas trees • Horses • Hay • Pastures • Row crops – vegetable crops • Small woodlot • Mixed rural residential
Resource management system	A combination of conservation practices identified by land or water uses that will prevent resource degradation and permit sustained use by meeting criteria established in the FOTG[10] for treatment of soil, water, air, plant, and animal resources.
Small acreage stewardship (protection and restoration actions)	**Typical Practices (Actions)** • Pasture and weed management • Managing mud and manure • Fertilizer management (and soil testing) • Pest management • Grazing management • Stockwater and fencing • Streamside buffers • Protecting streambanks • Erosion control practices (examples: cover crop, grass filter strips, grassed waterways, contour farming) • Water and sediment control basins • Irrigation management • Wildlife habitat enhancement • Woodlot management • Roof water management • Road and ditch erosion • Water Harvesting
Container Nurseries	• Large (over 2-3 acres) • Buffer strips • Grassed waterways • Tailwater containment and grey water reuse

[10] FOTG = NRCS Field Office Technical Guide

	• Road and ditch improvements • Irrigation efficiency • Fertilizer management
Ball and Burlap nurseries	• Large nurseries (over 20 acres approx.) • Primary issue – sediment during harvest in Dec & Jan • Cover crops & Buffer strips • Invasive species and noxious weed control
Berries	• Conservation cover • Perennial cover crops with banded herbicides
Horses	• Mud , manure and nutrient management • Pasture (paddock) rotation grazing system • Fencing • Winter turn-out / heavy use areas
Christmas Trees	• Commercial operations vs. U-pick operations • Filter strips • Compost & wood chips • Cover crops for U-pick operations
Conservation Incentives	• Habitat Program – tax incentive (ODFW) • Riparian Lands Tax Credit • Underproductive Forestland Tax Credit Program • Stewardship Agreements for forest land owners (ODF)

3.3.5 Water Quality Focus - Urban Landscape

In urban areas, current programs address land use planning, pollution control and education and outreach. The list in Table 5 provides a brief outline of the activities Clackamas County WES currently implements to comply with the National Pollutant Discharge Elimination System (NPDES) permit for municipal storm water[11]. As described in Section 2.4.3, the WES Surface Water Master Plan is under revision, so this provides an opportunity to make adjustments in the program.

Opportunities to build on these existing programs as part of the Action Plan include:

1. Homeowner pesticide use education and training.
2. Homeowner fertilizer and other nutrient management.
3. Household hazardous water collection.
4. Off-site stormwater retrofit.
5. Promotion of low impact development practices.
6. Enhance flows through created wetlands in the headwaters, upland management to promote infiltration, and water conservation projects.
7. Work closely with Goal 5 (riparian protection) implementation.

[11] Summary based on: Clackamas County WES, 2004. NPDES MS4 Permit Compliance Annual Report. Addresses Clackamas County Service District #1 and Surface Water Management Agency.

8. Enhance aquatic habitat in the urban environment by: creating off-channel habitat, reestablishing historical channels, removing drainage structures, and developing wetlands. (Nature in Neighborhoods Program)
9. Reduce pollution and conserve water through water reuse and biosolids management.
10. Protect/enhance riparian zones through acquisition/easement for greenbelts and parks.

The Action Plan will identify where the CRBC can supplement these on-going programs to improve water quality and protect/restore aquatic habitats.

Table 5. Management practices to control surface water pollution from urban areas.

Source Identification	• Identify and map storm drainage facilities and for subdivisions and commercial developments.
Plan Review	• Reviews plans for new developments for erosion prevention, water quality/quantity and mitigation of the impacts of new impervious area • Develops surface water master plans by project area • ESA Coordination • Riparian Restoration/Bank Stabilization:
Control Measures – Commercial and Residential Areas	• Stormline, culvert, ditch and catch basin cleaning • Public streets and highway maintenance, street sweeping • Underground injection control • Regional flood control facilities
Construction Sites	• Review of erosion and prevention sediment control plans. • Require BMPs for erosion and sediment control • Inspection and enforcement • Education for contractors and developers
Capital Improvements	• Major storm outfall water quality retrofits • Upgrade subregional detention and treatment facilities
Industrial Stormwater	• Inspections and recommendations for commercial, residential, and industrial facilities. • Investigations of industrial/commercial discharges • Illegal discharge investigations • Landfill runoff monitoring
Illicit Discharge Elimination Program	• Field screening at storm sewer outfalls to detect illicit discharges • Potential illicit connections/discharges investigations • Non-stormwater discharges
Spill Response Procedures	• Coordination with other agencies • Site investigation, impact assessment, and monitoring contractor cleanup. • Cross connection inspections
Water Quality Monitoring	• Water quality monitoring of storm sewer system
Public Awareness and Education	• Publications and newsletters • WES customer packets • WES website for stakeholder groups • News release and media coverage • Presentations and teacher course development

3.3.6 Fish and Wildlife Habitat

Active habitat restoration and protection by land managers, the Clackamas River Basin Council and others will improve the basin's habitats and fish and wildlife populations. Opportunities for protecting, restoring, and evaluating the status of stream, riparian, and terrestrial habitats include:

1. Addressing urbanization with the associated changes in water quality, streamside vegetation, and stream habitat continues in the lower basin through protection and restoration.

2. Improving aquatic habitat complexity by restoring side channels and other backwater areas that have been lost along the lower and middle Clackamas River and tributaries; adding wood to stream channels; restoring channelized stream sections; and allowing the river and tributaries to meander by removing rip-rap and dikes that constrain the channel. These actions should focus on areas used by adult and juvenile anadromous fish.

3. Addressing fish passage barriers at road crossings and other sites on many streams, particularly in the lower basin. Begin by addressing high priority anadromous fish sites and then progressing to areas where resident fish passage is impacted.

4. Protecting high quality riparian areas, particularly intact floodplain forests along the Clackamas River and high quality riparian areas that could be subject to future land use changes, such as urbanization.

5. Restore riparian trees and other vegetation that has been lost from streamside areas. Focus on planting native vegetation to restore lost riparian functions such as shade and large wood inputs. Riparian restoration should focus on the following areas: stream segments with water quality issues, particularly water temperatures that can be addressed through improved shade; stream reaches dominated by weed vegetation; stream reaches dominated by non-conifers that are appropriate for conifer growth, particularly areas where there are limited quantities of large wood in the channel; and stream reaches between high quality riparian habitats where restoration will provide habitat connectivity.

6. Restore water quality where it is affecting fish populations. Focus restoration efforts where water temperatures are elevated and toxic chemicals and other pollutants may be impacting fish distributions and productivity.

7. Restore key wildlife habitats. Focus terrestrial habitat restoration on areas that provide connecting corridors between existing high quality habitats; that extend habitat out from parks, and federal lands; and areas that connect riparian and upland habitats.

8. Provide habitat corridors across that landscape, including restoring riparian areas, connections between habitat patches, and corridors from the lower basin to the upper basin.

Protect high quality forest and other upland habitats to provide large core areas that promote landscape connectivity.

9. Monitor and evaluate the status and trends of fish populations and aquatic / terrestrial habitats. Focus monitoring efforts where there are key data gaps and where there is a need to maintain data continuity to evaluate long-term trends.

Table 6. Protection and restoration actions to improve aquatic, riparian and terrestrial habitats.

Aquatic habitat complexity	• Protect side channels and other backwater areas in the river's wide floodplain. • Restore and improve historic side channels and other backwater areas along the river and tributaries. • Add wood to existing side channels and other backwater areas in the river and tributaries where large wood is limited. • Add wood to stream channels were there are limited quantities of large wood. • Restore meanders to channelized stream sections • Remove dikes and rip-rap to allow natural river and stream meandering.
Fish passage barriers	• Address high priority fish passage barriers, with anadromous barriers first and then those impacting resident fish populations.
Riparian areas	• Protect existing high quality floodplain forests and riparian areas. • Restore riparian areas focusing on areas with water quality issues, in-stream large wood deficits, and non-native vegetation. • Fence riparian areas that are subject to livestock grazing. • Control weeds and provide ongoing vegetation control for restored riparian areas. • Where old growth or mature forest has been eliminated along riparian areas, implement silvicultural treatments to promote development of late seral forest characteristics.
Water quality	• Where water temperatures are elevated, improve riparian conditions and reduce water temperature to levels appropriate for the range of fish species and life stages. • Reduce and minimize inputs of toxic chemicals and pesticides that impact fish survival and behavior.
Restoring key habitats	• Improve and restore key wildlife habitats, with an emphasis on the lower basin Ecoregions. • Improve of terrestrial habitats by controlling weeds, vegetation control (for example, tree thinning), planting native vegetation, and other actions. • Improve and restore oak woodlands and savanna habitats • Improve and restore upland prairie habitats • Improve and restore wetland prairie, seasonal marsh, and wetland habitats • Improve and restore riparian habitats and floodplain forest; mature and old-growth conifer forests.

Habitat connectivity	• Protect large intact areas comprised of key habitats to promote core areas for habitat connectivity. • Promote habitat connectivity between federal lands (BLM and Forest Service), public park areas, and private lands. • Restore habitats between intact patches of private and public lands to improve connectivity. • Improve habitat connectivity between core areas and the lower and the upper basin by restoring key habitats. • Restore degraded riparian areas to connect high quality riparian habitats.
Monitor conditions	• Use snorkel surveys to identify juvenile coho and steelhead production areas in Clear and Deep Creeks • Continue to monitor smolt out-migration on key tributary streams. • Assess aquatic habitat conditions where there are no inventories. • Repeat habitat surveys of areas that have been inventoried to evaluate changes over time.

3.3.7 Public Education and Outreach

Outreach and Education will be integral to the Clackamas River Basin Council's effort to protect, enhance and restore the Clackamas Watershed. Many organizations work in the watershed in the arenas of monitoring, restoration and enhancement, education, land management and land use planning. The Council has worked with these groups in the past and will continue to coordinate and work in partnership with community agencies and organizations as well as individuals to support and/or implement the actions identified in this plan. The Clackamas County Water Education Team (CCWET) is a consortium of representatives from agencies and organizations involved with water related conservation education in the watershed. This group provided input and insight for this document, and is an excellent mechanism for collaboration and coordinating efforts and sharing resources. In addition, the Regional Water Providers Consortium develops and disseminates water conservation information and activities, the CRBC should evaluate how and where it can assist these efforts.

The CRBC will soon undertake a Strategic Planning process in order to assess needs as well the overall capacity of the organization and organizational development. This planning process will help guide the implementation of action plan items. This plan is meant to be an adaptive tool - actions may change as conditions, opportunities and priorities change. It will be important to increase the organization's outreach capacity and effectiveness in order to achieve objectives outlined in this plan.

Several targeted Public Education and Outreach projects designed to foster and implement stewardship of the watershed are identified in Section 4.0 under specific geographic areas. More generalized projects that can be applied watershed-wide are described in this section.

The Goal of the CRBC Education and Outreach Program is to:

Promote community awareness of the watershed by developing educational materials and programs that bridge the gap between public perception of the watershed and the technical information about the limiting factors affecting it.

This goal will be accomplished through multiple communication strategies:

- Cooperate with partners to educate individual residential property owners. Focus on alternatives and practices that reduce non-point pollution from fertilizers, pesticides and other potentially harmful household and garden products. Encourage and support water quality and habitat friendly landscaping, construction and land use practices.

- Support and publicize model agricultural practices, forest practices, and stormwater management plans that protect water quality and habitat. Share that information with involved partners, land managers and government agencies.

- Support hands-on conservation education opportunities: classroom activities and field trips for adults and school children, including working with high school student to work with elementary students as educators. Develop opportunities for hands-on field work and water quality and habitat monitoring.

- Provide information to the council and the public on natural resource values, challenges and trends in the watershed.

- Help disseminate and provide linkages for data and support collection of new data on watershed conditions.

- Disseminate information using various means, such as newsletters, maintain the CRBC Web site, and regularly provide information and reports to the watershed community.

- Educate the public about the significant natural heritage of Coho, winter steelhead, Pacific Lamprey and Chinook that is present in the watershed.

- Establish and use demonstration projects for successful farm, forestry, and "green-streets" roadway activities to provide hands-on examples of best practices.

- Use direct contact with local officials and the development community to provide assistance, including workshops, seminars and peer-to-peer exchanges on BMPs.

- Explore and support incentives that encourage agencies and individuals to adopt or implement BMPs.

- Support economy of riverside communities by encouraging the creation and distribution of a Clackamas River map showing public access and recreation sites. Include information on

cultural and natural history of "Mt. Hood Territory" in the Clackamas.

- Support the development of interpretive sites in the watershed that connect human history and the natural resource values that sustain the watershed economy. Clean and abundant water, fisheries, timber, recreation, etc.

Overall Education and Outreach Objectives:

1. Residents and users of the watershed will understand the benefits of the watershed for water quality and fisheries resources;

2. The watershed community will help to protect water quality;

3. Residents, students, general public and volunteers will become engaged in riparian restoration and enhancement actives;

4. Streamside landowners will demonstrate partnerships for watershed improvement projects that protect and enhance these resources;

5. The watershed community will be engaged in implementing this Basin Action Plan.

Specific issues (limiting factors) related to clean water and habitat were identified in the watershed assessment. The following particular issues will be addressed in communication venues, which include watershed studies with students, adult workshops, volunteer restoration activities, communication pieces and community outreach:

1. Livestock, manure, pond and nutrient management in rural areas.

2. Pesticide, fertilizer and herbicide application in urban areas.

3. The value of streamside vegetation for water quality and fisheries-temperature and stream buffers.

4. BMPs for nurseries and tree farms.

5. Crop, pasture and forest practices.

The strategic model the CRBC will use will be based on educating, encouraging and supporting residents and private and public landowners in undertaking voluntary actions to meet action plan goals to protect water quality and habitat. An objective is to spread the idea that watershed health provides values for residents, landowners and other citizens and will help sustain the economic viability and quality of life for the community.

The CRBC Education and Outreach Program will have three main areas of focus which will complement each other:

A. Public Awareness Strategy- Know Your Watershed

The CRBC will implement projects that facilitate awareness in residents that they live in a watershed, depend on it for water quality and fisheries values, and can take individual actions to make a difference. Key audiences will be elementary and high school students, streamside residents and landowners, and recreational users of the river. Strategies to achieve these outcomes include:

1. Provide a **Clackamas Children's Water Education Event** for local elementary children in cooperation with partners including Sunrise Water and Clackamas High School.

2. Install **Clackamas Watershed Signs** at significant river and tributary crossings and river access sites in the watershed, in particular on creeks bearing coho salmon, Chinook salmon, steelhead trout and above municipal water intakes.

3. Help coordinate an annual **Clackamas River Clean Up.** This clean up event will be held after the summer recreational boating season and engage volunteer recreational boaters, anglers and others to scour the river and remove refuse from at least 12 miles of the Clackamas mainstem between Estacada and Oregon City. This will be coordinated with an effort at access points and with outfitters and retailers to educate river users about keeping the river clean.

4. Produce a **biennial newsletter**. Articles in the newsletter will highlight partnerships, successful projects, key issues and opportunities and educational objectives.

5. Develop a professional quality **traveling exhibit** in order to gain attention and facilitate interaction at community events.

6. Print a **council brochure** and design eye-catching visual material such as **posters, postcards and flyers** to communicate council activities and events.

7. Prepare **educational materials** aimed at residents and landowners in the watershed. Work with partners to provide targeted billing inserts, web info, news articles etc.

8. Support **watershed-wide events** and forums that inspire community awareness and engagement with the watershed.

9. Support **interpretive programs and workshops** that inspire community awareness and engagement with the watershed.

10. Support a **Water Quality Snapshot Monitoring Day** and citizen water quality monitoring in cooperation with the Student Watershed Research Project and local schools.

B. Landowner Participation Strategy - Stream Stewards

The goal of the Stream Steward element will be to foster a sense of community and pride, promote land stewardship, and provide conservation materials and resources to property owners which they will then share with others. The objective of this program is for streamside landowners to demonstrate partnerships for watershed improvement projects that protect and enhance water quality and fish and wildlife habitat. The following actions will be part of this effort:

- Provide landowner workshops that focus on streamside and upland conservation practices in partnership with OSU Extension, the Clackamas Soil and Water Conservation District and Three Rivers Land Conservancy. Manure management will be a topic, as Clackamas County is number two in the nation in terms of residents with horses and watershed assessments have identified livestock, manure and nutrient management as a key issue. Another workshop will highlight streamside living best practices. A third will target small woodlot owners and offer streamside BMPs and conservation resources in partnership with Clackamas County Farm and Forestry Association.

- Stewardship demonstration projects will be used as "conservation star" models. These sites will demonstrate the following practices- riparian fencing and livestock management to enhance water quality and vegetative coverage, pond management, riparian planting for shade and to maintain riparian buffers, large woody debris, and culverts for fish passage. Tree School classes, tours and workshop visits will highlight these sites and best practices. Owners of the properties will provide peer communication and assist with workshops.

C. Clackamas Stream Team- Getting Involved

The Clackamas Stream Team will engage individuals, elementary and high school students and community groups in watershed enhancement and restoration projects. Project objectives are:

1. Streamside residents, students, general public and volunteers will become engaged in riparian restoration and enhancement activities that improve water quality and habitat;

2. Participants will understand the benefits of the watershed for water quality and fisheries resources and take future action to protect and enhance them.

Two main activities will engage students and volunteers in accomplishing these objectives:

- **Restoration-Native Planting:** Participants will remove invasive plants and use the native plant community as a guide. Native plant riparian buffers will be addressed in priority areas.

- **Monitoring and Study**: Volunteers, local elementary and high school students, residents and SWRP students will conduct water quality testing, photo-point and vegetation monitoring of council restoration project and "conservation star" sites.

Stream team projects and activities will be implemented in both urban and rural areas throughout the watershed.

The CRBC should continually assess which methods of public information and engagement yield effective results and modify activities as needed.

3.4 KEY CHALLENGES AND STRATEGIES

The following tables summarize the key challenges and key strategies developed during the planning process. The information was presented at public workshops and input from the public was incorporated into these tables. The tables are organized into three categories: Aquatic and Riparian Habitat, Wildlife Habitat, and Water Quality.

Table 7. Key Aquatic and Riparian Habitat Challenges and Strategies.

CLACKAMAS AQUATIC AND RIPARIAN HABITAT	
KEY CHALLENGES	**KEY STRATEGIES**
Loss of stream and river channel complexity	• Protect side channels and other backwater areas in the river's wide floodplain. • Restore and improve historic side channels and other backwater areas along the river and tributaries. • Add wood to existing side channels and other backwater areas in the river and tributaries where large wood is limited. • Add wood to stream channels were there are limited quantities of large wood. • Restore meanders to channelized stream sections • Remove dikes and rip-rap to allow natural river and stream meandering.
Fish Passage Barriers	• Address high priority fish passage barriers, with anadromous barriers first and then those impacting resident fish populations. • Start low and in mainstem of tributary watersheds and work upstream.
Riparian Areas	• Protect existing high quality floodplain forests and riparian areas. • Restore riparian areas focusing on areas with water quality issues, in-stream large wood deficits, and non-native vegetation. • Fence riparian areas that are subject to livestock grazing.

	• Control weeds and provide ongoing vegetation control for restored riparian areas. • Where old growth or mature forest has been eliminated along riparian areas, implement, silvicultural treatments to promote development of late seral forest characteristics.
Water Quality	• Where water temperatures are elevated, improve riparian conditions and reduce temperature to levels appropriate for the range of fish species and life stages. • Reduce and minimize inputs of toxic chemicals and pesticides that impact fish survival and behavior.
Future Habitat Studies	• Use snorkel surveys to identify juvenile coho and steelhead production areas in Clear and Deep Creeks • Continue to monitor smolt out-migration on key tributary streams. • Assess aquatic habitat conditions where there are no inventories.

Table 8. Key Wildlife Habitat Challenges and Strategies.

CLACKAMAS WILDLIFE HABITAT	
KEY CHALLENGES	**KEY STRATEGIES**
Loss of Key Habitats	• Improve and restore key wildlife habitats, emphasize the lower basin Ecoregions. • Improve terrestrial habitats by controlling weeds, vegetation control (for example, tree thinning), planting native vegetation, and other actions. • Improve and restore oak woodlands and savanna habitats • Improve, restore upland prairie habitats • Improve and restore wetland prairie, seasonal marsh, and wetland habitats • Improve and restore riparian habitats and floodplain forest; mature and old-growth conifer forests.
Habitat Connectivity	• Protect large intact areas comprised of key habitats to promote core areas for habitat connectivity. • Promote habitat connectivity between federal lands (BLM and Forest Service), public park areas, and private lands. • Restore habitats between intact patches of private and public lands to improve connectivity. • Improve habitat connectivity between core areas and the lower and the upper basin by restoring key habitats. • Restore degraded riparian areas to connect high quality riparian habitats.

Table 9. Key Water Quality Challenges and Strategies.

CLACKAMAS WATER QUALITY	
KEY CHALLENGES	**KEY STRATEGIES**
Decrease Nutrients	• Increase width of shrub and forested riparian areas • Develop buffer strips to capture runoff • Reduce soil erosion • Promote responsible fertilizer use • Fence livestock away from streams and cover livestock waste • Reduce pet waste in parks and neighborhoods • Capture, slow, filter and release urban stormwater runoff • Identify areas of possible septic system malfunction
Decrease Bacteria	• Fence livestock away from streams and cover livestock waste • Identify areas of possible septic system malfunction • Increase width of shrub and forested riparian areas to reduce erosion
Decrease Pesticides	• Targeted pesticide education for urban and rural lower basin landowners. • Encourage nursery and agricultural industry to reduce pesticide application. • Recycle and reuse water from irrigation • Encourage alternatives to pesticides
Decrease Water Temperature	• Plant riparian vegetation over streams and riverbanks. • Plant trees to shade ponds or remove ponds especially in-stream ponds • Protect mature riparian forests • Augment summer stream flows • Promote irrigation conservation
Increase Summertime River and Stream Flow	• Promote landowner cooperation and education in highest need areas • Promote water conservation strategies • Consider areas for water right leases and transfers
Reduce fine sediment	• Control erosion of soil at the source – dirt roads, agriculture fields, construction sites • Use green streets and filter road runoff • Replace undersized culverts

3.5 PRIORITIES

3.5.1 Geographic Priorities

The challenges and strategies vary by watershed depending on landscape characteristics, land use, and legacy impacts. The tables (Table 10 and Table 11) below summarize what strategies generally apply within a watershed or geographic area. Specific actions that implement these strategies are described in Section 4.0.

Table 10. Strategies By Geographic Area.

STRATEGIES	Clear Cr.	Foster Cr.	Deep Cr.	Goose Cr.	Rock Cr.	Richardson Cr.	Eagle Cr.
Improve Fish Passage Barriers	X	X	X	X	X	X	X
Restore And Enhance Riparian Areas	X	X	X	X	X	X	X
Restore Stream And River Channels	X	X	X	X		X	X
Decrease Stream Temperatures	X	X	X	X	X	X	X
Decrease Nutrient Levels			X		X		
Decrease Bacteria Levels	X		X		X		
Decrease Pesticide Levels			X		X		
Decrease Fine Sediment	X	X	X				
Increase Summertime Flows	X	X	X	X	X	X	X
Improve Key Wildlife Habitat	X		X		X	X	X
Improve Wildlife Habitat Connectivity	X	X	X	X	X	X	X
Manage Invasive Weeds	X	X	X	X	X	X	X

Table 11. Strategies By Geographic Area (part 2).

STRATEGIES	Wade Cr.	Oak Grove Fork	Collaw ash River	Cow Cr.	Sieben Cr.	Clacka mas River	Basin Tributa ries	Clack amas Flood Plain
Improve Fish Passage Barriers	X					X	X	
Restore And Enhance Riparian Areas	X					X	X	X
Restore Stream And River Channels	X	X	X			X	X	X
Decrease Stream Temperatures	X			X	X	X	X	
Decrease Nutrient Levels				X	X			
Decrease Bacteria Levels				X	X			
Decrease Pesticide Levels					X			
Decrease Fine Sediment								
Increase Summertime Flows		X				X	X	
Improve Key Wildlife Habitat		X				X		X
Improve Wildlife Habitat Connectivity								X
Manage Invasive Weeds	X			X	X	X	X	X

3.5.2 Prioritization

Prioritization incorporates ecological principles, community values, and practical considerations. *Ecological principles* (See Text Box) provided the basis for the evaluations used to complete the Clackamas Basin Summary papers. *Community Values* are addressed by the ongoing involvement of the watershed council throughout the process, and by using Technical Advisory Committees to generate appropriate actions. Technical Advisory Committee members represent agencies, council member organizations, and citizens that are actively involved in the basin.

These steps result in a set of strategies and actions that are scientifically based and are acceptable to the community and stakeholders. This set of actions necessarily includes both specific (ready to go) and non-specific action items that require further work. The final step then is to work through *practical considerations*, such as interested landowners and funding, to put the actions

on the ground. All the actions identified are rationally based and fulfill an identified need, therefore action ranking and reprioritization should be considered an on-going action, not a static process.

Community Values

The Clackamas River Basin Council is comprised of member organizations, agency representatives, private citizens, and land owners that come together to direct and guide the activities of the council and partner organizations. As described in the Introduction, the Council's goal for the Action Plan is to emphasize community partnerships in achieving clean water, restoring habitats, and enhancing the quality of life for people that live, work and recreate in the Clackamas River Basin. In the process of developing the Action Plan, the Council and Technical Advisory Committees focused on five primary emphasis areas.

1. The primary emphasis of the Action Plan is in assisting private landowners to achieve good land stewardship on watersheds in the lower Clackamas River Basin.

2. Protecting the current and future source of water in the basin for domestic water use.

3. Protecting and restoring the native fish populations of the Clackamas Basin.

4. Emphasizing outreach, education, and technical assistance to implement conservation practices on small acreage agricultural and rural land ownerships.

5. Emphasize the multiple benefits to water quality, fisheries, and wildlife that overlap in protecting and restoring riparian zones.

Practical Considerations in Prioritizing Projects

The direction from Technical Advisory Committees is that actions or projects should not be ranked in simple priority order. Rather they should be evaluated in general on their technical merits and then implemented based on the opportunity that arises. There are many areas of equal ecological value; therefore projects should be implemented when the window of opportunity opens such as with a willing landowner or program funding.

Practical considerations in evaluating project priority include:

1. Window of opportunity
2. Willing landowner or micro-watershed cooperative
3. Funding availability
4. Sequencing of projects
5. Addressing multiple objectives
6. Involve multiple partners
7. Feasibility/ constructability

8. Long-term commitment to stewardship and maintenance.
9. Education or demonstration value
10. Ease of access, availability of materials, etc.

Ecological Principles

A number of scientists have addressed basin-wide principles to restore water quality and aquatic habitats (Kauffman and others 1997, Roni and others 2002). OWEB incorporated these principles into a framework for prioritizing watershed improvement projects (OWEB 2004), which will be used by OWEB's Regional Review Teams when making funding recommendations to the Board.

These principles guided the basin-wide assessment, summarized in the four Basin Summary papers, which provide the technical foundation for the Action Plan. These principles also guided the identification of the Basin-wide Strategies and specific action recommendations.. In summary, these principles are:

1. **Protect existing high-quality or ecologically-functioning landscapes**. Many of the upper basin watersheds are in relatively good to excellent ecological health. Protecting these existing forested landscapes is an overall priority and can be accomplished through the land management agencies. In the lower basin, there are many areas of remnant forests adjacent to the riparian corridors in private ownership. Although not in pristine condition, these areas are in relatively good ecological health and provide many benefits to water quality, fish and wildlife, and open spaces for communities. Protecting these areas is a high priority.

2. **Focus on connecting habitats for fish and wildlife species**. For stream systems, the Basin Summary and Action Plan combined a number of fish passage assessments to develop an overall strategy to reconnect aquatic habitats and prioritize these projects. Connecting wildlife corridors can be accomplished by protecting remnant intact riparian and upland habitats in the lower basin to upper basin protected habitats.

3. **Focus on restoring watershed processes versus treating symptoms.** Safe capture and storage of water, natural surface erosion rates, connectivity between stream channels and floodplains, and filtering water through riparian zones and wetlands are examples of natural watershed processes. The Basin Summary was based on the foundation of watershed assessments completed in the Clackamas Basin that incorporate these concepts.

4. **Restore key habitats for sensitive, threatened, and endangered species**. Two Basin Summaries, the fisheries and wildlife summaries, specifically focused on identifying limiting factors for aquatic and terrestrial species. These summaries reevaluated and refined previous assessments completed for the Willamette Subbasin Plan for Fish and Wildlife, which included the Clackamas River basin.

5. **Reduce the impact of land uses on water quality and aquatic habitats**. The Basin Summary connected water quality impacts and limiting factors for fish and wildlife to management activities through land use mapping. Top Tier Actions, such as stormwater management and agricultural practices, identify pollution control procedures and conservation measures that reduce the effect of land uses on water quality and habitats.

3.6 MONITORING

A number of organizations in the Clackamas River Basin are involved in monitoring to meet a diversity of objectives. On going water quality monitoring is completed by ODEQ, USGS, Clackamas County WES, Water Providers, the Student Watershed Research Project (SWRP) and PGE. ODEQ monitors three river stations to measure trends in water quality over long term periods of time. USGS has three gaging stations in the basin. The Carter Bridge station measures stage, pH, turbidity, conductivity, DO and temperature. River Mill and the Oregon City monitors measure these as well as flow. The Oregon City station also measures chlorophyll a. USGS also completes intensive surveys in the basin to evaluate specific issues, and has recently studied nutrients, algal growth, and pesticide issues. WES measures water quality at several tributary stations, in part to comply with NPDES stormwater permits. Water Providers monitor selected parameters at the water intake and at tributaries in the basin to evaluate the quality of the water that influences their water sources. SWRP monitors water quality parameters in several tributaries for student training and cooperative data collection. PGE will continue to monitor selected stations as part of the FERC relicensing agreement.

Although on-going monitoring activities may be individually successful in meeting their objectives, collectively these monitoring activities are missing linkages to tie them together and assure that the questions that need to be addressed in the long-term in the Clackamas Basin can be answered. A comprehensive monitoring program would provide the framework needed to coordinate these diverse monitoring activities.

Coordination with the OWEB Oregon Plan

Coordinating monitoring and reporting activities under the umbrella of the *Oregon Plan for Salmon and Watersheds* is a good first start. OWEB needs to show that funds expended are effective at improving water quality and aquatic habitats. Clackamas Basin monitoring cooperators should align a monitoring plan with OWEB guidance to be successful in obtaining grants and in demonstrating that the public funds are used effectively. OWEB guidance describes four categories of monitoring:

1. **Natural Resources Monitoring**
   This category includes Watershed Condition Monitoring (Watershed Assessment); and Fish, Wildlife, Water Quality and Water Quantity Monitoring. (It should be noted that CRBC and cooperators have already completed watershed assessments throughout the basin.)

2. **Implementation Monitoring**
   This category includes monitoring individual projects, such as a culvert replacement or large woody debris placement. Methodologies that might be used for this type of monitoring include photo-points and GPS latitude/longitude readings.

3. **Effectiveness Monitoring**
   OWEB is working on a strategy to implement a monitoring program which will focus on gauging the effectiveness of projects OWEB funds. This effectiveness evaluation will consist of at least two major elements: effectiveness of the project achieving its

objectives and the contribution a project makes to a larger cause (e.g. Oregon Plan, species recovery, watershed health, etc.).

4. **Validation Monitoring**
   Validation monitoring is a research level of monitoring that addresses basic scientific questions about watershed processes. Paired watershed studies are an example of such a study; these studies require long-term commitment to funding resources.

OWEB (www.oregon.gov/OWEB) has described a number of tools that should be considered for inclusion in a comprehensive monitoring plan.

1. *Monitoring Strategy for the Oregon Plan for Salmon and Watersheds*. This document describes a series of strategies useful in building a comprehensive monitoring plan. The strategies describe typical goals and objectives and methods to measure these objectives.

2. *Oregon Watershed Restoration Inventory*. The Watershed Restoration Inventory is a tool for accomplishing Implementation Monitoring. It provides a systematic means to report actions to improve aquatic habitat and water quality conditions. Sections are organized to address:
   a. Instream Activity
   b. Riparian Activity
   c. Wetland or Estuary Enhancement
   d. Upland, Grazing and Irrigation Management
   e. Road Improvements
   f. Fish Passage Improvements
   g. Urban Impact Reduction
   h. Project monitoring

3. *Water Quality Monitoring Technical Guide Book*. The guide provides guidance on designing monitoring strategies and to provide standard water quality monitoring protocols. The Guide Book addresses components of a monitoring plan: Monitoring Strategy, Selecting Sites, Data Quality, Data Storage and Analysis. Protocols are described for Stream Temperature, Dissolved Oxygen, pH, Conductivity, Nitrogen and Phosphorus, Turbidity, Stream Macroinvertebrates, Pesticides and Toxins.

4. *Oregon Riparian Assessment Framework*. This document provides guidance for 1) assessing riparian conditions, functions, processes, and management or project actions; and 2) tracking changes in riparian characteristics over time.

5. *Oregon Watershed Assessment Manual*. Section 11 of the watershed assessment manual outlines the steps in developing a monitoring plan and references typical monitoring protocols.

Comprehensive Monitoring Program Plan

Agencies involved in water quality monitoring in the Clackamas River Basin have expressed a great interest in improving monitoring coordination. Agencies and organizations do not individually have the resources to develop a comprehensive basin-wide monitoring program. Collectively, the natural resource agencies and local organizations can pool their expertise to develop the program plan, but this requires a dedicated time commitment and a monitoring coordinator with a high level of scientific competence in the field to lead the effort. An occasional coordination meeting between interested parties will not suffice.

Developing a Comprehensive Monitoring Program Plan for the Clackamas Basin is a critical action that is needed if CRBC cooperators want to use their available monitoring resources effectively and make a case to agencies to fund monitoring activities in the basin. The monitoring plan needs to incorporate implementation, and effectiveness monitoring in addition to ambient and trend types of monitoring[12].

Implementation Monitoring

Implementation monitoring is simple, and it is a cost-efficient form of monitoring. This essential part of any monitoring effort is often taken for granted: assuming that activity was undertaken and completed as planned. Monitoring during the project can lead to mid-course corrections that save the project from failure. Implementation monitoring after the project is necessary to report the success of the restoration effort to the watershed council and the funding agency.

Implementation monitoring can be as simple as counting the number of structures installed and evaluating if the structures were installed as designed. The actual monitoring activity consists of visual inspections, field notes, and photographs. For example, if improved road maintenance was the restoration action, implementation monitoring would consist of checking to see if ditches and culverts were cleaned and functional, and if cut and fill slopes were seeded, or to determine if seasonal road closures were installed in time.

The on-line *Action Plan Data Base* developed as part of the Action Plan provides the CRBC an easy way to track and report implementation monitoring. Columns for reporting implementation monitoring can easily be added to the data base. Also, it is easy to add a project to the data based or edit the project description, cost, and sponsors for an existing project.

Effectiveness Monitoring

Effectiveness monitoring is more complex than implementation monitoring because of the need to connect the action with an outcome in the riparian area or stream channel. In the road maintenance example, we may want to determine if ditches and culverts plugged during a storm,

[12] Implementation monitoring: Documents whether or not management practices were applied as designed. Effectiveness monitoring: Evaluates whether the management practice was effective at accomplishing the objective. Ambient monitoring: Measures water chemistry and aquatic life to determine the water quality – not particularly related to cause and effect. Trend monitoring: Measures parameters repeatedly at the same location to determine if water quality (also aquatic life and habitat) are improving or declining over a long time period.

if the vegetation seeded on the slope was established in time to prevent erosion, and if the road closures prevented rills on the road surface. With stream restoration projects, some actual evidence of an improved condition may not be become evident until several cycles of high flows or after many years so indirect observations of effectiveness may be the only reasonable monitoring procedure.

3.7 ACTION PLAN REVIEW AND REVI SION

This Action Plan is designed to be a working and living document. The CRBC intends the plan to guide priorities, inspire partnerships and propose projects to improve the Clackamas Basin. This is a plan that should not and will not stay on the shelf. A very important issue for the Council is how the Action Plan gets implemented. The Action Plan provides ideas for protection, restoration, enhancement, education and outreach. For some actions, the responsible agency and funding sources may be well defined and projects can proceed, for other actions the Council may need to expand existing partnerships or seek out new cooperators. To begin this discussion, the Council will initiate a strategic planning session in August 2005.

The Basin Action Plan should be evaluated and updated on a regular basis. The Action Plan is based on current condition assessments as outlined in the Basin Summaries. As new data and knowledge about the Clackamas watershed and individual streams becomes available, one can expect that this information would necessitate changes in strategy at the stream reach scale, but would not necessarily change substantially at the Clackamas watershed scale. A schedule for revisions and updating this plan is outlined below.

Action Plan Component	Update Frequency	Description
Basin Summaries	5-10 Year Interval	Basin summaries are based on the best available information available at the time that they were written. The need for revision depends on the amount of new data that becomes available.
Basin-wide Challenges and Strategies	5-Year Interval	The Basin-wide Challenges and Strategies, although specific to the Clackamas River. are described at a conceptual level. These will not change over short time periods.
Geographic Area Strategies	2-Year Interval	Overall strategies could change for a specific Geographic Area (or watershed) depending on the outcome of a focused study or availability of a new program.
Action Tables	Annual	The Action Tables for each Geographic Area should be revised annually to reflect revisions to actions or new actions that have been identified.
Action Plan Data Base	On-going	Action descriptions completed for this document are a mix of specific

		actions and placeholders for more detailed action development. The database should be continually updated as details are added to the action description.

4.0 GEOGRAPHIC AREA STRATEGIES AND ACTIONS

Strategies and actions are organized by ten major geographic groupings. These groupings are based on land ownership and land use considerations as well as natural characteristics. Emphasis is placed on the private lands area in the Lower Basin, consistent with the Council's mission.

Each section is organized to address the following topics. In some cases, a topic is not addressed because there was little information available.

- **Watershed Characterization**. Summarizes land use within the geographic area. See the Watershed Overview for sources of land use information.

- **Fish Distribution**. Source is Stream Net. http://www.streamnet.org/

- **Future Land Use**. An estimate of the population pressure expected.

- **Limiting Factors**. Linkage between the limiting factor and the source for the assessment is made in the Fish/Aquatic Habitat and Water Quality Basin Summary Papers. The Water Quality rating is based on comparison of pollutant concentrations between watersheds; the rating categories are Lowest, Low, Moderate, High, and Highest. Refer to the subject summary report for details on limiting factors.

- **Protection and Restoration Strategies and Actions**. This section lists the general strategies and actions that apply within the geographic area.

- **Strategy and Actions Table**. The table lists only the project Top Tier Action Category and Title. The Data Base Id. Number links the table listing to the Action Plan Database.

The list of actions is not intended to be a final comprehensive list. Rather this document, these lists, and the Action Plan Database provide the foundation and tools for a basin wide plan. The CRBC will use this organizational structure to continually refine and revise the Action Plan in response to new information or changing priorities.

4.1 LOWER MAINSTEM CLACKAMAS RIVER

Watershed Characterization

The Lower Clackamas River watershed encompasses 15,428 acres, includes the river, floodplain, upland areas, and the lower portions of small tributary streams. Edna and Johnson Creek, a 1,530 acre watershed on the south side of the river is included in this geographic area. The majority of the Lower Clackamas River Subbasin is in private land ownership. A large proportion of the land use is urban, primarily concentrated in the lower portions of the river (Table 12). The Metro Urban Growth Boundary (UGB) covers the Lower River and associated floodplain and upland areas north of the river. A significant portion of the area is in forest and agricultural land uses. Edna/Johnson Creek watershed contains nurseries, row crops, and hay/pasture lands but has retained a large percentage of forestland (47%).

Table 12. Lower Clackamas River: Land use percent by major category.

Percent of Watershed	Urban	Forest	Ag	Water
Lower Clackamas River	22.7%	43.1%	29.7%	4.5%
Edna/Johnson Creek	9.0%	46.8%	44.2%	0.0%
Total	21.3%	43.5%	31.1%	4.1%

Table 13. Lower Clackamas River land use in acres.

Acres	Urban		Forest		Agriculture					Water
	Parks/Golf	Developed	Forest	Shrubland	Nurseries	Berries	Row Crops	Hay/Pasture	Christmas Trees	Water Features
Lower Clackamas	232	2,918	4,974	1,016	1,083	41	1,320	1,151	534	629
Edna/Johnson Cr.	20	119	536	180	223	6	160	194	93	0
Total	251	3,037	5,510	1,196	1,306	47	1,480	1,345	627	629
Total Area	**15,428 acres**									

Coho and Chinook salmon and steelhead all use the lower Clackamas River for migration to the upper basin (Table 14). Fall Chinook salmon also spawn in this portion of the river. Juvenile salmon and steelhead occupy the lower river for a period of time on their downstream journey to the ocean. Migratory cutthroat trout and lamprey also use this section of the river. Johnson and Edna Creek is indicated as resident fish use only, but may provide refugia for juvenile anadromous fish.

Table 14. Lower Clackamas anadromous and resident fish distribution

	Fish Use (Miles of Channel)				
Subwatershed	Spring Chinook	Coho	Steelhead	Resident only	No salmonid use or unknown use
Lower Clackamas River	22.9	22.9	22.9	0.5	0.8
				2.9	
TOTAL	22.9	22.9	22.9	3.4	0.8

Future Land Use

The Metro UGB is adjacent to the Clackamas River on the north side to approximately Carver then swings north of the river excluding lands further west within this geographic area. Land on the south side of the Clackamas River and Edna/Johnson Creek watersheds are not included in Metro UGB. These lands may be currently open for further low density development.

Given the location of these lands near or within the floodplain of the Clackamas River and near a growing population, this land would be highly valuable for open space protection as parks, recreation, or natural reserves.

Limiting Factors

Water Quality Limitations

Lower Clackamas River flow regime and temperature are influenced primarily by the PGE Clackamas River Hydroelectric Projects, but also by water withdrawals, lack of riparian canopy, and recreational activities. Effects of the hydroelectric project were evaluated for the Clackamas River TMDL and 401 certification for FERC relicensing. Predictive models used to evaluate project effects show maximum daily temperatures are cooler than natural thermal potential immediately below River Mill Dam, but significantly warmer further downstream. Mitigation related to the hydroelectric projects is being discussed by the Clackamas River Project Relicensing Settlement Working Group (SWG), which should complete a report by the end of 2005.

Nutrient and bacteria concentrations in the main stem river measured below River Mill Dam and at Carver ranked in the "Lowest" nutrient categories when compared to nutrients measured in adjacent tributaries. Pesticides rated as "Moderate" compared to other monitoring stations. Actions to reduce pollutants need to focus on tributary streams that deliver high concentrations of pollutants to this section of the river.

Fish Habitat Limitations

Because the lower river is used as a migration corridor and rearing habitat by salmon and steelhead, and because there is extensive loss of historic habitats, studies have underscored the importance of the lower Clackamas River for habitat protection and restoration. There has been

extensive loss of floodplain areas and habitat complexity. The major factors impacting fish populations in the lower river are channel stability, habitat diversity, sediment loads and water temperatures. Channel stability has been changed through the placement of dikes and channelization, which has restricted connections between the river and floodplain. Habitat diversity has been impacted through loss of large wood in the channel and loss of side channels and other off-channel areas. The narrowing of the channel has impacted key habitats for fish. Temperature is a major limiting facture during the late summer and early fall, particularly for the fall and spring Chinook salmon that spawn during this period. Changes in sediment patterns and storage are also impacting fish populations. The river channel in the first two miles below River Mill Dam is coarsening and downcutting, which affects the quality of spawning habitats. Sediments, nutrients and other pollutants also flow into the lower river from the urban tributaries, such as Rock, Richardson and Deep Creeks.

Protection and Restoration Strategies and Actions

1. There are opportunities to protect high quality floodplain and riparian habitats along the lower Clackamas River. Protection emphasis should be on existing river meander corridors and large patches of intact floodplain forest.
2. Because there has been extensive loss of historic backwater areas, restoration actions should focus on increasing the active channel width through side channel and alcove restoration. These actions can be combined with restoring other floodplain functions, particularly establishing native vegetation and creating wetlands.
3. There are opportunities for riparian restoration and invasive weed demonstration projects with land owners, particularly for residential areas that border the river. These restoration sites would be visible to river recreation participants, which will help build community support for riparian restoration.
4. Seek opportunities to restore river channel function by removing rip-rap, dikes, and other bank stabilization that is limiting river migration.

Table 15. Lower Clackamas River: Strategies and Actions Summary.

Map	Project Title / Description	Subwatershed or Reach	Data Base No.
Map 1	**Land Use:** Goal 5 Fish & Wildlife Habitat Protection	01. Lower Clackamas & Tributaries	88
Map 1	**Fish Passage:** Clackamas County Fish Passage Program	01. Lower Clackamas	93
Map 1	**Public Outreach:** Down the River Clean Up		89
Map 1	**Public Outreach:** WES Public Involvement & Education Programs		108
Map 1	**Public Outreach:** Clackamas/Willamette confluence comprehensive restoration		119
Map 1	**Water Quality:** Surface Water Management Programs (See Section 2.4.3)		--
Map 1	**Monitoring:** Clackamas County Cooperative Monitoring Program		97

Map 1	**Clackamas Side Channel Construction:** Calcagno/Rock Creek	Clackamas 01_C	98
Map 1	**Clackamas Side Channel Construction:** Beaver Dam	Clackamas 03	99
Map 1	**Clackamas Side Channel Construction:** Mouth of Foster Creek	Clackamas 04	100
Map 1	**Clackamas Side Channel Construction:** Pigeon Lake/Richardson Creek	Clackamas 04	101
Map 1	**Clackamas Side Channel Construction:** ODOT/Fisherman's Bend	Clackamas 05	102
Map 1	**Clackamas Side Channel Construction:** Barton Park	Clackamas 05?	103
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4.2 COW CREEK AND SIEBEN CREEK

Watershed Characterization

Cow Creek subbasin drains 871 acres, which is nearly all within WES Clackamas County Service District #1. The acreage is developed primarily as industrial with transportation corridors and a few pockets of residential and agricultural use. Many sections of the channel have been moved and or/altered over time to accommodate development. A portion of the Clackamas Industrial Area and Highway 212 are located in Cow Creek.

Sieben Creek drains 1,230 acres of primarily residential property (mix of high, moderate, and low density) with some industrial and commercial land use. Most of the lower watershed comprises the developed area (58%), with forest (28%) and agriculture (14%) in the middle and upper part of the watershed (Table 16). The lower reaches of the channel are highly altered, with less alteration in the middle and upper reaches. Carly Creek, the original outlet of Sieben Creek, begins at a Clackamas County owned storm sewer concrete pipe. A large portion of the watershed is within the Clackamas Industrial Area. Although Carly Creek begins at a storm sewer outlet, the riparian area is fairly intact due to a lack of access and the channel is considered potentially valuable as rearing habitat and refugia in this section of the lower basin.

Table 16. Cow and Sieben Creek: Land use percent by major category.

Percent of Watershed	Developed	Forest	Ag	Water
Cow Creek	83.7%	10.8%	5.4%	0.0%
Sieben Creek	58.3%	27.9%	13.8%	0.0%
Total	**68.2%**	**21.3%**	**10.6%**	**0.0%**

Table 17. Cow and Sieben Creek Land Use in acres.

Acres	Urban		Forest		Agriculture					Water
	Parks/Golf	Developed	Forest	Shrubland	Nurseries	Berries	Row Crops	Hay/Pasture	Christmas Trees	Water Features
Cow Creek	6	648	70	15	17	0	8	15	2	-
Sieben Creek	11	706	280	63	34	2	19	96	19	0
Total Area	**2,011 acres**									

Coho and steelhead use only the very lower portions of Cow and Sieben Creeks. Resident cutthroat trout are distributed throughout the streams (Table 18).

Table 18. Cow and Sieben Creek anadromous and resident fish distribution.

	Fish Use (Miles of Channel)				
Subwatershed	Spring Chinook	Coho	Steelhead	Resident only	No salmonid use or unknown use
Cow Creek	0	0.3	0.3	1.0	1.7
Sieben Creek	0	0.3	0.3	2.6	6.7
TOTAL	0	0.6	0.6	3.6	8.4

Future Land Use

The City of Happy Valley recently annexed approximately 150 acres of largely undeveloped land in upper Sieben Creek. In general we can expect continued conversion of existing open space to residential and commercial use over time.

Limiting Factors

Water Quality Limitations

Cow Creek and Sieben Creek are one of the most altered subwatersheds in the Clackamas Basin. High bacteria, nutrient and pesticide concentrations are due to the high degree of development in these watersheds. Improvement in stormwater quality from industrial development in Cow Creek and mixed residential areas in Sieben Creek will be a high priority to reduce pollutant concentrations.

	Pesticides	Nitrates	Phosphorus	Bacteria
Cow Creek		High	High	Very High
Sieben Creek	Highest	Very High	Very High	Very High

Fish Habitat Limitations

There is very little information on fish habitat limitations in this area. Based on discussions with biologists and others familiar with the area it appears that degraded riparian conditions (including weeds) and impaired water quality are the primary habitat factors affecting fish populations.

Protection and Restoration Strategies and Actions

The primary strategy in Cow and Sieben Creeks is restoration with an emphasis on reducing pollutant loading from existing sources. Protection of some specific riparian zones and open space areas will assist in filtering water, providing refugia for juvenile fish, and improving aquatic habitat.

Table 19. Cow and Sieben Creek: Strategies and Actions Summary.

Map #	Project Title / Description	Subwatershed/Reach	Data Base No.
Map 2	**Pollution Control**: Increase industrial stormwater education/enforcement	Entire watershed	--
Map 2	Investigate riparian and wetland enhancement opportunities	Cow Creek 01	133
Map 2	**Acquisition**: Investigate opportunity to acquire lands in lower Cow Creek for park development or other open space protection.	Cow Creek 01	--
Map 2	**Pesticide Use Education**: Homeowner pesticide use education and outreach	Sieben Creek	135
Map 2	**Fish Habitat:** Carly Creek protection/restoration	Carly Creek	118
Map 2	**Riparian Protection**: Implement riparian protection and enhancement on Clackamas County owned parcel.	Rose Creek (Sieben Creek 01)	136

4.3 ROCK CREEK AND RICHARDSON CREEK

Watershed Characterization

Rock Creek drains an area of 6,026 acres. The current land uses are primarily forest (45%) and agriculture (38%) with less land currently in residential use (17%) (Table 20). Agricultural land is used for container and in-ground nurseries, row crops, hay/pasture and Christmas trees farms (Table 21).

Richardson Creek drains an area of 2,674 acres. Richardson Creek is currently less developed (12%) than Rock Creek and more agricultural (45%). Agricultural land is currently in nurseries, row crops, hay/pasture and small acreage in berries. (Table 21).

These watersheds have been extensively evaluated in relation to urban growth boundary issues. A stormwater master plan[13] was developed in anticipation of future development in the area. The plan noted that although riparian vegetation and stream channel characteristics have been considerably altered by human activities, the overall drainage pattern is largely intact. Metro has evaluated the landscapes and riparian areas in the watershed in preparation of the Metro Damascus/Boring Concept Plan.

Table 20. Rock Creek and Richardson Creek: Land use percent by major category.

Percent of Watershed	Developed	Forest	Ag	Water
Rock Creek	17.1%	44.6%	38.3%	0.0%
Richardson Creek	11.5%	43.3%	45.1%	0.2%
Total	15.3%	44.2%	40.4%	0.1%

Table 21. Rock Creek and Richardson Creek land use in acres.

Acres	Urban		Forest		Agriculture					Water
	Parks/Golf	Developed	Forest	Shrubland	Nurseries	Berries	Row Crops	Hay/Pasture	Christmas Trees	Water Features
Rock Creek	228	800	1,581	1,109	599	47	561	969	131	2
Richardson Creek	5	302	588	569	310	79	228	545	42	6
Total	**233**	**1,102**	**2,169**	**1,677**	**910**	**126**	**789**	**1,514**	**173**	**7**
Total Area	**8,699 acres**									

[13] Rock and Richardson Creek Watersheds Master Plan, Clackamas County WES.

Resident cutthroat trout are the most prevalent and widely distributed salmonid in Rock and Richardson Creeks (Table 22). Waterfalls and other barriers limit the distribution of anadromous spring Chinook, coho and steelhead, which use the lower portions of both creeks.

Table 22. Rock and Richardson Creek anadromous and resident fish distribution.

	Fish Use (Miles of Channel)				
Subwatershed	Spring Chinook	Coho	Steelhead	Resident only	No salmonid use or unknown use
Rock Creek	0	1.2	1.2	6.4	38.7
Richardson Creek	0.5	1.9	1.9	0	11.3
TOTAL	0.5	3.1	3.1	6.4	50

Future Land Use

Ninety-one percent of the watershed is in the Portland UGB. Population is expected to increase as forest and agricultural lands are converted to urban landscapes. The City of Happy Valley annexed approximately 700 acres in Rock Creek. A decision on the Damascus/Boring Concept Plan[14] which addresses approximately 12,000 acres is expected by the end of 2005. The plan visualizes an increase in population between 80,000 and 95,000 people with 30,000 to 36,000 new dwelling units.

Limiting Factors

Water Quality Limitations

Water quality monitoring indicates that Rock Creek is highly impaired by pesticides, bacteria and nutrient inputs. Richardson Creek was rated as moderate for pesticides when compared to other subwatersheds in the lower basin. (Comparable data was not available for nutrients and bacteria in Richardson Creek.) However, a macroinvertebrate study completed for Metro attributed significant recovery in the lower reaches of Richardson Creek to the intact riparian zone. This study highlighted the importance of protecting riparian areas for both water quality and aquatic habitat values.

	Pesticides	Nitrates	Phosphorus	Bacteria
Rock Creek	Highest	High	High	Very High
Richardson Creek	Moderate	na	na	na

Fish Habitat Limitations

Fish habitat is impaired in both Rock and Richardson Creeks primarily from changes in riparian vegetation and function, limited large wood and complexity in stream channels, and increased sediment delivery to the aquatic system. Invasive weeds, including knott weed, are affecting

[14] http://www.co.clackamas.or.us/dtd/lngplan/damascus/.

riparian areas and upland habitats. There are some high quality riparian habitats present in the watershed, particularly in the canyons of lower Rock and Richardson Creeks.

Protection and Restoration Strategies and Actions

Due to the planned urbanization in these watersheds both protection and restoration strategies are important. Actions to protect riparian zones will be critical to prevent further degradation of water quality as the urban area expands. Open space areas associated with parks, wildlife corridors, and protected riparian zones will help provide a buffer to reduce the impact of additional urban runoff. Innovative approaches for stormwater and surface water management should incorporate preventive measures, such as planned communities, water conservation and green landscaping to prevent pollution associated with urbanization.

Several major initiatives are underway that address water quality and aquatic habitats in the urban zones. 1) Metro Goal 5 Implementation[15] is currently (2005) in the planning stage; 2) Clackamas County WES Surface Water Management Program Master Plan revision, which is scheduled for completion at the end of 2005; and the Damascus Boring Concept Plan. The Concept Plan will establish the blueprint for population growth, density, transportation, green corridors and protection of riparian areas, steep slopes, and uplands.

Stormwater management practices and agricultural conservation practices are needed to reduce pollutant loads from existing sources as well as addressing the planned development.

Fish habitat restoration and protection should focus on protecting existing high quality riparian habitats, particularly in the lower canyons of Rock and Richardson Creek, restoring riparian habitats and controlling sediment delivery to stream channels. There are opportunities to restore riparian vegetation and function by planting native vegetation and controlling invasive weeds. In selected stream channels, improve stream habitat complexity by adding large wood.

Table 23. Rock and Richardson Creeks: Strategies and Actions Summary.

Map	Project Title / Description	Subwatershed or Reach	Data Base No.
Map 2	**Stormwater Management**: Street of Sustainability		139
Map 2	**Riparian Protection & Restoration**: Protect forested riparian areas in upper Rock Creek through acquisition, easement, or tax incentive		140
Map 2	**Agricultural Practices**: Rock and Richardson Creek small acreages stewardship and conservation		142
Map 2	**Riparian Protection & Restoration**: Protect forested riparian areas in Richardson Cr. through acquisition, easement, or tax incentive		150
Map 2	**Riparian Protection & Restoration**: Rock Creek Riparian Restoration Demonstration Project		172
Map 2	**Riparian Protection & Restoration**: Richardson Creek Riparian Restoration Demonstration Project		173

[15] Goal 5 addresses protection of streamside corridors and floodplains and water quality improvements.

Map 2	**Monitoring**: Coordinate a long-term monitoring plan to evaluate water quality pre- and post-development in the UGB.		155
Map 2	**Water Conservation**: Encourage water conservation as with the Water Providers Purple Pipe plan to use sanitary water for irrigation.		157
Map 2	**Education and Outreach: Stormwater facility interpretation**		190
Map 2	**Open Space Planning**: Coordinate with Clackamas County and City of Damascus on parks, natural areas, riparian corridors, and green community development.		--
Map 2	**Land Use Planning**: Partner with development community in erosion control, green landscaping, and water efficiency as communities are built.		--

4.4 CLEAR CREEK

Watershed Characterization

Foster Creek is combined with Clear Creek for the purposes of this Action Plan. There are five subwatersheds in this geographic area.

1. Foster Creek
2. Lower Clear Creek
3. Little Clear Creek
4. Middle Clear Creek
5. Upper Clear Creek

The majority of this watershed is in private land ownership. Land use changes considerably from a forested landscape in Upper Clear Creek (95% forested) to an agricultural and rural landscape in Lower Clear Creek (53% agriculture) and Foster Creek (56% agriculture) (Table 24). Small woodlot and commercial timber operations are significant land uses in Little, Middle and Upper Clear Creek (Table 25). In Lower Clear, Foster, and Middle Clear Creek, there are many Christmas tree farms as well as rural residential and hay/pasture fields. Actions can be identified at the subwatershed and reach scale because a detailed watershed assessment was completed for Clear and Foster Creek watersheds in 2002 (WPN 2002), and the CRBC completed a Recommended Action Plan following the watershed assessment.

Table 24. Clear Creek: Land use percent by major category.

Percent of Watershed	Urban	Forest	Ag	Water
Foster Creek	3.4%	40.9%	55.6%	0.0%
Lower Clear Creek	7.2%	40.2%	52.6%	0.0%
Little Clear Creek	3.3%	74.1%	22.5%	0.0%
Middle Clear Creek	3.6%	64.0%	32.4%	0.0%
Upper Clear Creek	0.0%	95.3%	4.7%	0.0%
Total	**3.2%**	**69.1%**	**27.7%**	**0.0%**

Table 25. Clear Creek land use in acres.

Acres	Urban		Forest		Agriculture					Water
	Parks/Golf	Developed	Forest	Shrubland	Nurseries	Berries	Row Crops	Hay/Pasture	Christmas Trees	Water Features
Foster Creek	7	69	613	297	166	3	97	510	461	-
Lower Clear Creek	25	880	4,029	1,000	696	38	506	3,065	2,283	2
Little Clear Creek	0	194	4,044	257	126	1	38	749	393	1
Middle Clear Creek	57	338	6,639	441	389	8	230	1,803	1,152	2
Upper Clear Creek	-	6	8,583	7,890	-	-	143	556	111	2
Total	90	1,486	23,907	9,885	1,376	50	1,014	6,683	4,400	7
Total Area	**48, 899 acres**									

Clear Creek is an important production area for coho salmon and steelhead (Table 26). Spring Chinook salmon use the lower portions of Clear Creek and they may hold in pools in the upper portions of the creek and spawn nearby. Although the specific areas that contribute to smolt production have not been identified, is probable that stream reaches and subwatersheds with high quality riparian areas are the likely sources. The Clear Creek Watershed plays an important role in maintaining the genetic and population diversity of the lower Clackamas River native coho and steelhead populations. The watershed also has significant migratory cutthroat and Pacific lamprey populations. Resident trout are distributed throughout the watershed and there are isolated populations above many of the natural barriers.

Table 26. Clear Creek anadromous and resident fish distribution.

	Fish Use (Miles of Channel)				
Subwatershed	Spring Chinook	Coho	Steelhead	Resident only	No salmonid use or unknown use
Rock Creek	0	3.7	3.7	2.9	2.9
Richardson Creek	7.0	13.9	13.9	2.3	15.9
Little Clear Creek	0	5.0	5.0	3.5	11.2
Middle Clear Creek	0	8.9	8.9	7.7	8.0
Upper Clear Creek	0	5.1	5.1	31.7	23.3
TOTAL	7.0	36.6	36.6	48.1	61.3

Future Land Use

Clear Creek is outside the UGBs so residential development is not expected at the same pace as in other lower Clackamas subbasins. However, lower Clear Creek is highly prized for its scenic

pastoral quality, so continued conversion to rural residential use can be expected to occur along the transportation corridors.

Limiting Factors

Water Quality Limitations

Overall water quality is in better condition in Clear Creek than in other lower basin watersheds. In Lower Clear Creek pesticides, nitrates, and phosphorus were ranked from low to moderate in comparison to other watersheds. The primary exception is bacteria, ranked very high, which is associated with rural residential and agricultural land use. Two small tributaries, Bargfeld Creek and Hattan Fork Creek, exhibit high nutrient and bacteria concentrations[16]. Nutrients and bacteria are likely associated with cumulative effect of septic systems, livestock wastes, and chemical application of fertilizers. In general, the lowest concentrations of nutrients and bacteria occurred in forested landscapes.

	Pesticides	Nitrates	Phosphorus	Bacteria
Foster Creek	na	na	na	na
Lower Clear Creek	Moderate	Low	Moderate	Very High
Little Clear Creek		Low	Moderate	High
Middle Clear Creek		Low	Moderate	Very High
Upper Clear Creek		Low	Low	na

Fish Habitat Limitations

Key factors limiting fish populations in Clear and Foster Creeks are fish passage barriers, limited wood in stream channels, and loss of wetland functions. These issues are especially pronounced in Foster Creek and the lower portions of Clear Creek. Specific fish habitat limitations include:

- Fish Passage: There are fish passage barriers, primarily culverts that are a high priority to address.
- Channel Complexity: In Clear Creek, limited large wood is primarily an issue in the channel below Viola.
- Temperature / Riparian Cover: See map for priority areas with limited riparian cover
- Riparian: High – See map for areas with limited riparian vegetation. Invasive weeds, including knotweed are affecting riparian vegetation.
- Wetlands: There has been extensive loss of wetlands in Foster Creek and lower Clear Creek.

[16] Clear and Foster Creek Watershed Assessment, WPN 2002.

Protection and Restoration Strategies and Actions

1. Clear Creek is a significant native coho and steelhead production area near the growing metropolitan region and the watershed contains high-quality riparian and terrestrial habitats. The watershed is also important for spring Chinook. Land use and habitat protection and restoration strategies should emphasize maintaining and improving wild fish production and protecting terrestrial and riparian habitats.

2. Upper Clear, Little Clear, and parts of Middle Clear Creek are forested watersheds that are a source of clean water to the lower creek and Clackamas River. This area also has relatively high quality fish habitat. These sections of the watershed should be maintained or protected in the current condition to continue this level of quality into the future.

3. Lower Clear (and tributaries Bargfeld Creek and Hattan Fork), Middle Clear (in the vicinity of Fischer's Mill), and Foster Creek should be targeted for restoration activities.

4. Lower Clear Creek provides a good opportunity for targeting conservation practices on Christmas tree farms because of the high concentration of these operations in the watershed.

5. There are opportunities to extend riparian and terrestrial habitat restoration and protection by working out from current protection areas. The Metro property on lower Clear Creek and Bureau of Land Management Lands in the middle and upper portions of the watershed provide key core areas for extending riparian and terrestrial habitat corridors through restoration and protection. There are opportunities to provide corridors between the federal lands, parklands (e.g., the Metro property) and other core intact habitat areas in the Clear Creek watershed with protected and restored habitats on private lands.

6. The lower Clear Creek watershed and Foster Creek watershed offer opportunities for wetland habitat restoration. In some cases wetland restoration can be combined with stream and riparian habitat restoration.

7. Work with forest and other landowners to promote good land stewardship and to provide high quality habitat in connecting corridors across the landscape.

Table 27. Clear and Foster Creeks: Strategies and Actions Summary.

Map	Project Title / Description	Subwatershed or Reach	Data Base No.
Map 3	**Fish Passage:** Culvert Replacement at sit CL088 - Little Clear Creek, Redland	Little Clear 01 & Little Clear 02	82
Map 3	**Riparian Protection & Restoration**: Identify Streamside Restoration and Revegetation Sites	07a. Lower Clear Creek	113
Map 3	**Riparian Protection & Restoration**: Identify Streamside Restoration and Revegetation Sites	07c. Middle Clear Creek	162
Map 3	**Riparian Protection & Restoration:** Riparian Restoration Demonstration Project	Clear Creek	165
Map 3	**Riparian Protection & Restoration:** Riparian Corridor Restoration	07a. Lower Clear Creek	166
Map 3	**Riparian Protection & Restoration:** Protect forested riparian areas in Clear Creek through acquisition, easement, or tax incentive.	07a. Lower Clear Creek	177
Map 3	**Riparian Protection & Restoration:** Riparian Corridor Restoration	07c. Middle Clear Creek	167
Map 3	**Riparian Protection & Restoration:** Riparian Corridor Restoration	07b. Little Clear Creek	168
Map 3	**Wetland Protection & Restoration:** Restore Wetland Habitat and Functions	05d. Foster Creek	158
Map 3	**Wetland Protection & Restoration:** Restore Wetland Habitat and Functions	07a. Lower Clear Creek	164
Map 3	**Monitoring:** Continue to Monitor Smolt Production	Clear Creek	151
Map 3	**Monitoring:** Identify Fish Production Areas	Clear Creek	153
Map 3	**Monitoring:** Assess impact of In-Channel and Off-Channel Ponds on Flow and Water Quality	Clear Creek	170
Map 3	**Outreach and Education:** Outreach and Education to Address Off Road Vehicle Impacts in Upper Clear Creek	07d. Upper Clear Creek	169
Map 3	**Upland Habitat Protection:** Protect Upland Habitats to Provide Connecting Corridors	Clear Creek	171
Map 3	**Upland Protection:** Work with commercial forest and woodlot owners on sustainable forest operations.	Clear Creek	179
Map 3	**Agricultural Practices:** Implement conservation practices on Christmas tree farms in Lower Clear Creek watershed.	07a. Lower Clear Creek	176
Map 3	**Pollution Source Identification:** Investigate pollutant sources in Bargfeld and Hattan Fork Creeks and develop a control plan.	07a. Lower Clear Creek	180

4.5 DEEP AND GOOSE CREEKS

Watershed Characterization

Goose Creek is combined with Deep Creek for the purposes of the Action Plan. There are five subwatersheds.

- Goose Creek
- North Fork
- Upper Deep Creek
- Lower Deep Creek
- Tickle Creek

The majority of this watershed is in private land ownership. Land use for the Deep and Goose Creek watershed is 10 % urban, 47 % forest and 42 % agricultural uses (Table 28). Table 29 summarizes detailed land use / land cover for the subwatersheds. Actions can be identified at the subwatershed and reach scale because a detailed watershed assessment was completed for Deep and Goose Creek watersheds in 2005 (WPN 2005).

Table 28. Deep Creek: Land use percent by major category.

Percent of Watershed	Urban	Forest	Ag	Water
Goose Creek	10.3%	45.2%	44.4%	0.0%
Lower Deep Creek	9.7%	46.9%	43.4%	0.0%
Upper Deep Creek	2.6%	67.0%	30.4%	0.0%
N.F. Deep Creek	11.4%	31.6%	57.0%	0.1%
Tickle Creek	15.9%	44.7%	39.4%	0.1%
Total	**9.9%**	**47.3%**	**42.7%**	**0.1%**

Table 29. Deep Creek Land Use in acres.

Acres	Urban		Forest		Agriculture					Water
	Parks/Golf	Developed	Forest	Shrubland	Nurseries	Berries	Row Crops	Hay/Pasture	Christmas Trees	Water Features
Goose Creek	13	306	730	673	371	13	192	745	56	0
Lower Deep Creek	14	428	1,551	586	949	24	294	574	137	-
Upper Deep Creek	-	234	4,737	1,239	264	399	389	1,479	183	3
NF Deep Creek	116	918	1,274	1,599	3,497	154	518	763	254	10
Tickle Creek	0	1,391	3,082	835	1,269	384	348	1,223	231	7
Total	**144**	**3,278**	**11,374**	**4,933**	**6,351**	**975**	**1,742**	**4,785**	**860**	**20**
Total Area	**34, 461 acres**									

The North Fork Deep Creek watershed has been the most highly modified with 57 % of land cover classified as agriculture and 14% as urban land use. Many stream channels in NF Deep Creek have been ditched, and riparian areas have been altered. Locations are mapped (See maps in the Deep and Goose Watershed Assessment, WPN 2005). Container and in-ground nurseries (ball and burlap nurseries) comprise the largest percent of agriculture and therefore should be a target for conservation and education/outreach activities. Urban land use in Deep Creek is centered around the town of Boring and the city of Sandy, but also includes scattered rural residential parcels. Tickle Creek contains a large acreage in nurseries, hay/pasture and rural residential development.

Steeper canyon landscapes along the lower reaches of NF Deep, Tickle Creek, and Lower Deep Creek are forested and have less development. These areas are generally identified as a high priority for protection.

Although the watershed has been highly modified, fish use is still extensive (Table 30). The smolt trap at the mouth of Deep Creek has shown that Deep Creek is a high producer of salmon smolts compared to other lower basin tributaries. Although the specific areas that contribute to this smolt production have not been identified, we can speculate that stream reaches with protected riparian areas are likely sources. The Deep Creek Watershed plays an important role in maintaining the genetic and population diversity of the lower Clackamas River native coho and steelhead populations. The watershed also has a significant migratory cutthroat population. The existing forested riparian areas in the lower watershed and on tributaries (particularly Tickle Creek) should be protected not only for the likely anadromous fish production, but also to reduce temperature and assist in trapping and filtering out sediments and associated pollutants.

Table 30. Deep Creek anadromous and resident fish distribution.

	Fish Use (Miles of Channel)				
Subwatershed	Spring Chinook	Coho	Steelhead	Resident only	No salmonid use or unknown use
8a. Lower Deep Creek	1.5	3.7	6.0	4.6	3.8
8b. Upper Deep Creek	0	10.1	10.1	6.8	11.2
8c. North Fork Deep Creek	0	7.4	7.4	4.5	13.8
8d. Tickle Creek	0	8.5	8.5	7.0	13.8
TOTAL	1.5	29.7	32	22.9	42.6

Future Land Use

Population is expected to increase in the city of Portland's and city of Sandy's UGBs. A decision on the Metro Damascus/Boring Concept Plan (Portland UGB) is expected by the end of 2005, and will increase population in the N.F. Deep subwatershed centered around the new city of Damascus. Sandy is located in part in the Tickle Creek subwatershed. The 2000 Census shows Sandy's population at 5,385 with a 2.6% per year increase since the 1990's[17]. At the current growth rate of 30% per decade the population would reach 15,200 by 2040.

[17] City of Sandy website http://www.ci.sandy.or.us/

Limiting Factors

Water Quality Limitations

	Pesticides	Nitrates	Phosphorus	Bacteria
Goose Creek	na	na	na	na
Lower Deep Creek	High	High	Very High	Very High
Upper Deep Creek	na	High	Moderate	High
NF Deep Creek	na	High	Moderate	Very High
Tickle Creek	na	Very High	Very High	Very High

Mixed agricultural and urban land use is responsible for the poor water quality rating in Deep Creek, especially in Tickle Creek and N.F. Deep Creek subwatersheds. Water quality monitoring indicates that nutrients and bacteria are very high in Tickle Creek, with septic systems suspected of contributing to the high nitrate concentrations. Pollutants are also high in N.F. Deep Creek. Water quality degradation in these two subwatersheds is suspected to cause the high pollutant concentrations detected in Lower Deep Creek. Tickle Creek and N.F. Deep Creek are high priority areas for water quality improvement.

Water temperature data shows a general relationship with the mapped riparian shade condition completed in the Deep Creek watershed assessment. Stream reaches mapped in the 70 to 90% shade category had lower water temperatures and fewer exceedances of water quality criteria. The riparian shade map (with channel condition and LWD recruitment maps) can be used to identify specific stream reaches where planting programs and reestablishing buffers are needed.

Fish Habitat Limitations

Fish habitat is impaired in the Deep Creek Watershed primarily from fish passage barriers, changes in riparian vegetation and shade, limited large wood and complexity in stream channels, and increased sediment delivery to the aquatic system. The North Fork has the largest area with degraded stream channels and altered riparian areas. Specific fish habitat limitations include:

- Fish Passage: The three highest priority barriers are on the North Fork Deep Creek and there are other barriers in the watershed (see map).
- Channel Complexity: Limiting in channelized sections, particularly in the North Fork (see map); this is also a key factor in other reaches due to lack of wood and limited streamside vegetation
- Temperature / Riparian Cover: This is also a key factor – See map for priority areas with limited riparian cover
- Riparian: Limiting throughout the watershed – See map for areas with limited riparian vegetation. Invasive weeds, including knotweed are affecting riparian vegetation.

Protection and Restoration Strategies and Actions

Deep Creek is considered a high priority watershed due to a combination of factors:

1. Deep Creek supports a robust production of salmon smolts compared to other watersheds in the lower Clackamas Basin.

2. Deep Creek is one of the three larger tributaries that contribute flows to the lower river below River Mill dam.

3. Current water quality and habitat limitations have been identified in the Deep and Goose Creek Watershed Assessment. Specific streamside areas have been targeted for protection and restoration.

4. The planned urban growth could readily cause changes in habitat that would decrease the current level of salmon smolt production.

5. There are opportunities to protect high-quality riparian areas within the watershed.

6. There are a number of fish passage barriers that can be addressed to extend anadromous fish distribution.

Table 31. Deep Creek: Strategies and Actions Summary.

Map #	Project Title / Description	Subwatershed or Reach	Data Base
Map 4	**Riparian Protection:** Protect forested riparian areas in Deep Creek through acquisition, easement or tax incentive.	NF Deep Cr. DeepNF01, 02, 03 Upper Deep. Deep06, 07 and riparian forested tributaries. Tickle Creek. Tickle 01, 02, sections of Tickle 03 and lower reaches of tributaries.	121
Map 4	**Riparian Restoration:** Deep Creek Riparian Demonstration Project	Deep Cr.	181
Map 4	**Riparian Restoration:** N.F. Deep Creek Riparian Restoration	NF Deep Cr.	183
Map 4	**Riparian Protection & Restoration:** Protect forested riparian areas in lower NF Deep through acquisition or easement.	NF Deep Cr. NF01,NF02, NF03A	120
Map 4	**Riparian Protection & Restoration:** Identify, map and control invasive plants.	08d. Tickle Creek	159
Map 4	**Riparian Protection & Restoration:** Identify, map and control invasive plants.	08b. Upper Deep Creek	160
Map 4	**Riparian Protection & Restoration:** Identify, map and control invasive plants.	08a. Lower Deep Creek	161
Map 4	**Agricultural Practices:** Small acreage agricultural conservation demonstration project	NF Deep Cr. Doane Cr. 01, Dolan Cr. 01, Deep NF 10	122
Map 4	**Agricultural Practices:** Implement conservation practices on nursery operations in NF Deep Creek watershed.	NF Deep Cr.	125
Map 4	**Channel Restoration:** Highway 26 Channel restoration demonstration project in NF Deep Creek.	NF Deep Cr.	127
Map 4	**Stream Habitat:** N.F. Deep Creek Channel Restoration	NF Deep Cr.	182
Map 4	**Wetland Protection & Restoration:** Restore Wetland Habitat Functions in NF Deep Creek	NF Deep Cr.	184

Map 4	**Education and Outreach:** Green up your lawn not the creek workshops.	08c. North Fork Deep Creek	188
Map 4	**Education and Outreach:** Education and Incentives for Manure Management	Deep Creek watershed	189
Map 4	**Education and Outreach:** Workshop and technical assistance on water management.	08c. North Fork Deep Creek	191
Map 4	**Education and Outreach:** Golf Course Quality Lawns and Landscapes	08b. Upper Deep Creek	192
Map 4	**Education and Outreach:** Workshop on home wells and septic systems	08b. Upper Deep Creek	193
Map 4	**Monitoring:** Tickle Creek Pollutant Source Assessment	Tickle Cr.	131
Map 4	**Agricultural Practices:** Berry Orchards Conservation Practices	Lower Deep Cr.	132
Map 4	**Monitoring:** Continue to Monitor Smolt Production	Lower Deep Cr.	149
Map 4	**Monitoring:** Identify Fish Production Areas	Deep Cr.	154
Map 4	**Fish Passage:** Crossing DPD01 – This is a cement weir maintained by a Clackamas County wastewater treatment facility outside of Boring on the North Fork Deep Creek.		
Map 4	**Fish Passage:** Crossing DP026A – This crossing is an unused bridge/culvert on the North Fork Deep Creek, not far upstream from the wastewater facility's weir.		
Map 4	**Fish Passage:** Crossing DPD02 – This barrier is a dam on private property on the North Fork Deep Creek upstream of DPD01 and DP026A.		
Map 4	**Fish Passage:** Crossing DPD05 – This is a 30-foot high dam with a fish ladder running up its face and four weirs downstream that raise the channel on Deep Creek.		
Map 4	**Fish Passage:** Crossing DP037 – This crossing is a box culvert on the North Fork Deep Creek that runs underneath Highway 26.		
Map 4	**Fish Passage:** Crossing DP069 – This is a crossing on Tickle Creek near the Sandy wastewater treatment facility on private property		
Map 4	**Fish Passage:** Crossing DP074 – This crossing on Tickle Creek is a combination dam and pipe culvert on private property.		
Map 4	**Fish Passage:** Crossing DP083 – This crossing is a double culvert crossing immediately upstream of DPD05 on Deep Creek.		
Map 4	**Fish Passage:** Crossing DP079 – This crossing is a box culvert underneath SE Orient Road on a tributary of Tickle Creek.		
Map 4	**Fish Passage:** Crossing DP116 – This crossing is a cement box culvert on Tickle Creek that has been identified by the ODFW as a barrier.		

4.6 EAGLE CREEK

Watershed Characterization

There are three subwatersheds in this geographic area.

1. Lower Eagle Creek
2. Upper Eagle Creek
3. North Fork Eagle Creek

Eagle Creek transitions from primarily private ownership in Lower Eagle Creek and North Fork Eagle Creek to primarily national forest land in Upper Eagle Creek (Table 32). A significant block of private commercial forest occurs in the watershed. Lower Eagle Creek includes urban and rural residential uses centered on the city of Estacada, and mixed agricultural land used for hay/pastures, row crops, nurseries and Christmas trees (Table 33). Upper Eagle and North Fork Eagle are primarily forestlands. The Salmon-Huckleberry Wilderness is partially within the Upper Eagle Creek Watershed.

Table 32. Eagle Creek: Land use percent by major category.

Percent of Watershed	Urban	Forest	Ag	Water
Lower Eagle Creek	5.5%	72.9%	21.5%	0.0%
Upper Eagle Creek	0.3%	99.4%	0.0%	0.3%
North Fork Eagle Creek	0.4%	93.6%	6.0%	0.0%
Total	2.3%	87.3%	10.2%	0.1%

Table 33. Eagle Creek Land Use in acres.

Acres	Urban		Forest		Agriculture					Water
	Parks/Golf	Developed	Forest	Shrubland	Nurseries	Berries	Row Crops	Hay/Pasture	Christmas Trees	Water Features
Lower Eagle Creek	24	1,205	12, 629	3,714	528	17	1,410	2,514	358	11
Upper Eagle Creek	-	46	15,379	1,847	-	-	-	-	-	54
North Fork Eagle Creek	-	69	11,908	4,857	12	-	253	662	138	5
Total	24	1,321	39,916	10,418	541	17	1,663	3,177	496	69
Total Area	**57, 641 acres**									

Coho, spring and fall Chinook and steelhead spawn and rear in Eagle Creek (Table 34). Spring Chinook salmon spawn in the lower reaches while coho and steelhead spawn and rear in streams and low gradient tributaries. All of the streams provide habitat for migratory and resident cutthroat trout and anadromous and resident lamprey.

Table 34. Eagle Creek anadromous and resident fish distribution.

	Fish Use (Miles of Channel)				
Subwatershed	Spring Chinook	Coho	Steelhead	Resident only	No salmonid use or unknown use
Lower Eagle Creek	13.0	20.2	20.2	13.0	15.3
Upper Eagle Creek	0	0	0	23.6	137.0
North Fork Eagle Creek	5.9	20.6	20.6	15.6	12.8
TOTAL	18.9	40.8	40.8	52.2	165.1

Future Land Use

Increased development can be expected in the UGB for the city of Estacada, which includes 1,300 acres in the Lower Eagle Creek subwatershed. The population in Estacada was 2,460 in 2001. Continued growth in the rural residential population in Lower Eagle Creek and N.F. Eagle Creek will also likely occur.

Limiting Factors

Water Quality Limitations

In comparison to other watersheds in the lower Clackamas River basin, the nutrients, nitrates and phosphorus were ranked Low, and the bacteria was ranked Moderate.

Fish Habitat Limitations

Most of the fish habitat limitations are within the lower portions of the Eagle Creek geographic area. Reduced wood in stream channels, particularly on private lands, is limiting the formation of deep pools and minimizing habitat complexity. Fish passage barriers in are also an issue. The highest priority fish passage barrier in Eagle Creek is a dam that crosses the North Fork, which is a complete barrier. Mature riparian trees have been reduced, particularly in the lower watershed.

Protection and Restoration Strategies and Actions

Fish habitat and water quality is impaired in the Eagle Creek Watershed primarily from fish passage barriers, changes in riparian vegetation and shade, limited large wood and complexity in stream channels.

Specific restoration and protection actions include:

1. Addressing high priority fish passage barriers.
2. Identifying why water temperature is an issue in the lower portions of Eagle Creek.

3. Identifying riparian protection opportunities.

Table 35. Eagle Creek: Strategies and Actions Summary.

Map #	Project Title / Description	Subwatershed or Reach	Data Base Id
Map 5	**Monitoring:** Continue to Monitor Smolt Production	10. North Fork Eagle Creek	152
Map 5	**Monitoring:** Monitor Water Temperatures in Eagle Creek and Tributaries		185
Map 5	**Riparian Protection:** Protect Forested Riparian Areas in Eagle Creek Through acquisition, easements, or incentives		186
Map 5	**Riparian Restoration:** Eagle Creek Riparian Restoration Demonstration Project.	Eagle Creek	187

4.7 MIDDLE CLACKAMAS TRIBUTARIES

Watershed Characterization

This area includes the watersheds of North and South Fork Clackamas River, Fish Creek, Roaring River, and other tributaries that flow into the Middle Clackamas River. The tributaries include Pup, Cat, Whale, Sandstone, Big Dinner, Three Lynx, Cripple, Bull Creeks. This is a forested area managed primarily by the Mt. Hood National Forest, but with some lands managed by Portland General Electric (PGE). The combined area is 113,412 acres, with most of the area in forestlands with very little developed land uses.

Table 36. Middle Clackamas Tributaries land use in acres.

Acres	Urban		Forest		Agriculture					Water
	Parks/Golf	Developed	Forest	Shrubland	Nurseries	Berries	Row Crops	Hay/Pasture	Christmas Trees	Water Features
North Fork Clackamas River	-	34	16,734	4,369	-	-	-	-	-	11
South Fork Clackamas River	-	43	13,265	5,916	-	-	-	-	-	31
Pup/Cat/Whale/Sandstone/Big Cks	-	-	5,946	1,876	-	-	-	-	-	21
Dinner/Three Lynx/Cripple/Bull Cks	-	-	7,653	500	-	-	-	-	-	34
Fish Creek	-	42	23,148	6,353						254
Roaring River	-	2	24,776	2,230						174
Total Area	**113,412 acres**									

Coho, spring Chinook, steelhead and resident cutthroat and rainbow trout spawn and rear in watersheds of North and South Fork Clackamas River, Fish Creek, Roaring River, and other tributaries that flow into the Middle Clackamas River (Table 37).

Table 37. Middle Clackamas tributaries anadromous and resident fish distribution.

	Fish Use (Miles of Channel)				
Subwatershed	Spring Chinook	Coho	Steelhead	Resident only	No salmonid use or unknown use
NF Clackamas River	2.0	2.4	2.4	37.1	79.2
SF Clackamas River	0.8	0.8	0.8	24.4	76.5
Pup, Cat, Whale, Sandstone, Big Creeks	0	2.2	4.7	2.0	70.3
Dinner, Three Lynx, Cripple, Bull Creeks	0	0	0.7	8.3	43.0
Fish Creek	4.1	7.9	11.3	35.1	196
Roaring River	3.0	3.0	3.0	31.8	183.6
TOTAL	**9.9**	**15.9**			

Future Land Use

Land use will remain forested into the future.

Limiting Factors

Fish Habitat Limitations

Because much of this portion of the basin is characterized by old-growth and mature forests, a large proportion of these streams have high quality riparian and aquatic habitats. There are exceptions. Fish Creek Watershed, for example, is now recovering from extensive road building and harvest. There are localized impacts to riparian areas from streamside harvest; and roads have reduced riparian trees, isolated floodplain side channels, and created fish passage barriers.

Protection and Restoration Strategies and Actions

In the context of the entire Clackamas River Basin, this portion of the basin is important for the production of wild fish. Because of the Upper Basin's importance for wild fish, it is important to restore degraded areas and protect high quality habitats.

The Forest Service is pursuing a comprehensive habitat protection and restoration strategy for the North and South Fork Clackamas River, Fish Creek, Roaring River, and the other Middle Clackamas River tributaries. Current and past restoration actions were primarily focused on the Fish Creek Watershed. Restoration actions for Fish Creek and other tributaries include:

1. Restoring fish passage where there are identified barriers.

2. Adding large wood and other material. Logs and boulders will add habitat complexity, providing adult fish holding and juvenile rearing areas. Side channel restoration actions can be combined with additions of large logs and large boulders to restore and enhance instream and overhead cover. Large wood can also be added to other sites.

3. Enhancing riparian areas to promote mature and late successional forest stands.

Table 38. Middle Clackamas tributaries.

Map #	Project Title / Description	Subwatershed or Reach	Data Base Id
Map 6	**Monitoring:** Continue to Monitor Smolt Production	11a. North Fork Clackamas River	145
Map 6	**Monitoring:** Continue to Monitor Smolt Production	12. Fish Creek	148
Map 6	**Fish Habitat:** Fish Creek LWD Project	12. Fish Creek, Fish 01	138

4.8 UPPER CLACKAMAS TRIBUTARIES

Watershed Characterization

This area includes the watersheds of Collawash River, Hot Springs Fork, Tag Cr., Switch Cr., Trout Cr .and other tributaries that flow into the Upper Clackamas River. This portion of the basin is forested and managed primarily by the Mt. Hood National Forest. The combined area is 194,371 acres, with most of the area in forestlands (Table 39). There is 407 acres in wetland, water and channel habitats. The Bull of the Woods Wilderness is primarily within the upper portions of the Collawash River and Hot Springs Fork.

Table 39. Upper Clackamas Tributaries land use in acres.

Acres	Urban		Forest		Agriculture					Water
	Parks/Golf	Developed	Forest	Shrubland	Nurseries	Berries	Row Crops	Hay/Pasture	Christmas Trees	Water Features
Tag/Switch Creeks	-	-	4,215	944	-	-	-	-	-	2
Trout Creek	-	-	3,202	1,054	-	-	-	-	-	46
Headwaters tributaries	-	143	84,319	2,945	-	-	0	-	-	175
Collawash River	-	-	52,474	5,812	-	-	-	-	-	163
Hot Springs Fork	-	-	33,654	5,344	-	-	-	-	-	20
Total Area	**194,371 acres**									

In the context of the entire Clackamas River Basin, this portion of the upper basin, combined with the Middle and Upper River, is the key stronghold for the production of wild fish. Coho, spring Chinook, steelhead and resident cutthroat and rainbow trout spawn and rear in watersheds of watersheds of Collawash River, Hot Springs Fork, and other tributaries that flow into the Upper Clackamas River. (Table 40).

Table 40. Upper Clackamas River tributaries anadromous and resident fish distribution.

	Fish Use (Miles of Channel)				
Subwatershed	Spring Chinook	Coho	Steelhead	Resident only	No salmonid use or unknown use
Tag, Switch Creeks	0	0	0.9	6.3	34.0
Trout Creek	0	0.6	0.6	5.1	38.3
Headwaters Tributaries	26.7	35.1	36.7	79.5	293.2
Collawash River	5.0	8.5	16.7	80.7	328.7
Hot Springs Fork	12.3	12.3	17.8	32.8	184.5
TOTAL	44	56.5	72.7	204.4	878.7

Future Land Use

Land use will remain forested into the future.

Limiting Factors

Fish Habitat Limitations

Much of this portion of the basin is characterized by old-growth and mature forests, a large proportion of these streams have high quality riparian and aquatic habitats. There are areas where riparian vegetation has been modified through harvest and there has been some loss of channel habitat complexity, particularly where roads parallel the river or stream channels. Historic Side channels and other habitats have been modified where the channel has been impinged upon by roads, particularly along the Collawash River and Hot Springs Fork.

Protection and Restoration Strategies and Actions

In the context of the entire Clackamas River Basin, this portion of the basin is critical for the production of wild fish. Because of the upper basin's importance for wild fish, it is important to restore degraded areas and protect high quality habitats.

The Forest Service is pursuing a comprehensive habitat protection and restoration strategy for the Collawash River, Hot Springs Fork, and other tributaries that flow into the Upper Clackamas River. Current and past restoration actions were primarily focused on the Collawash River and Hot Springs Fork watersheds. Restoration actions for Fish Creek and other tributaries include:

1. Restoring side channel areas. Because there has been some loss of historic backwater areas, particularly in the Collawash River. Historic side channels can be restored were the natural river channel has been affected and impinged upon by roads and other actions.

2. Adding large wood and other material. Logs and boulders will add habitat complexity, providing adult fish holding and juvenile rearing areas. Side channel restoration actions can be combined with additions of large logs and large boulders to restore and enhance instream and overhead cover. Large wood can also be added to other sites.

3. Enhancing riparian areas to promote mature and late successional forest stands.

4. Addressing fish passage where there are identified problems.

Table 41. Upper Clackamas tributaries: Strategies and Actions Summary.

Map #	Project Title / Description	Subwatershed or Reach	Data Base Id
Map 6	**Clackamas Side Channel Construction:** Hot Springs Fork Off-Channel Habitat Enhancement	03. Middle Clackamas Mainstem, Clackamas 15	137

4.9 MIDDLE AND UPPER MAINSTEM CLACKAMAS RIVER

Watershed Characterization

The Upper and Middle Clackamas River includes North Fork Reservoir/Estacada Lake. This is a forested watershed managed primarily by the Mt. Hood National Forest, but with some lands managed by Portland General Electric (PGE). The PGE hydroelectric development facilities are an important feature of this watershed, and include a large area in the North Fork Reservoir/Estacada Lake complex. The combined area is 36,864 acres, with most of the area in forestlands with very little developed land uses. There is 1,214 acres that are in reservoir, wetland, water and channel habitats.

Table 42. Middle and Upper Mainstem Clackamas: Land use in acres.

Acres	Urban		Forest		Agriculture					Water
	Parks/Golf	Developed	Forest	Shrubland	Nurseries	Berries	Row Crops	Hay/Pasture	Christmas Trees	Water Features
NF Reservoir/Estacada Lake	3	1,019	6,338	1,519	178	1	317	1,132	772	519
Middle Clackamas Mainstem	-	24	9,380	1,740	0	-	8	-	13	584
Upper Clackamas Mainstem	-	8	11,316	1,882	-	-	-	-	-	112
Total Area	**36,864 acres**									

The Upper and Middle Clackamas River is very important for salmon and steelhead and encompasses the highest quality fish habitat in the basin. In the context of the entire Clackamas River Basin, this portion of the upper basin, combined with the Collawash River, Hot Springs Fork, is the key stronghold for the production of wild fish. Fish are distributed throughout the river channel and within the reservoirs (Table 43). Spring Chinook, coho and steelhead use this section of the river for migration, spawning, and juvenile rearing.

Table 43. Middle and upper Clackamas River anadromous and resident fish distribution.

	Fish Use (Miles of Channel)				
Subwatershed	Spring Chinook	Coho	Steelhead	Resident only	No salmonid use or unknown use
NF Reservoir/Estacada Lake	12.6	12.6	12.6	7.8	4.7
Middle Clackamas Mainstem	18.7	18.7	18.7	0.8	54.5
Upper Clackamas Mainstem	24.8	21.9	24.8	8.9	44.2
TOTAL	56.1	53.2	56.1	17.5	103.4

Future Land Use

Land use will remain forested into the future.

Limiting Factors

Fish Habitat Limitations

Fish must pass over the PGE dams and move through the reservoirs to access the middle and upper Clackamas River. The reservoirs have eliminated stream and river habitat. Salmon and steelhead migrating up the Clackamas River are delayed as they move through the mainstem PGE facilities, and the dams also have some impact on juvenile salmon and steelhead migrating downstream.

Above River Mill Dam the middle Clackamas River is more confined than the lower valley, but historically there were extensive side channels, other backwater areas and floodplain forest. Because the river in this section provides important spawning and rearing habitat for all of the anadromous species, this area has a high value for restoration. Most of the loss of habitat in this section is the result of reductions in large wood in the river, channel confinement from roads and other actions, and impacts to riparian areas. Road 46, which parallels a large portion of the river, prevents channel meandering and restricts the channel, all of which increases channel flow velocities and minimizes complex, slow water habitats. The river cannot meander through the historic floodplain and access side channels and other habitats.

The upper Clackamas River includes the mainstem from Oak Grove Fork to the headwaters. This portion of the river is a key spawning and rearing area for coho salmon and steelhead populations, and it provides important habitat for spring Chinook salmon as well. The area includes Big Bottom, which is generally considered to be the highest quality spring Chinook salmon habitat in the Clackamas River Basin.

Protection and Restoration Strategies and Actions

Alternatives for improving fish passage at the PGE facilities are being examined through the FERC process for re-licensing the Clackamas River hydroelectric projects.

In the context of the entire Clackamas River Basin, the Upper and Middle Clackamas River is critical for the production of wild fish. Because of this portion of the river's importance for wild fish, it is essential to restore degraded areas and protect high quality habitats.

The Forest Service is pursuing a comprehensive habitat protection and restoration strategy for the Middle and Upper Clackamas River. Current focus areas for restoration actions include:

1. Restoring side channel areas. Because there has been extensive loss of historic backwater areas, restoration actions should focus on increasing the active channel width through side channel and alcove restoration. Historic side channels can be restored where the natural river channel has been affected and impinged upon by Highway 224.

2. Adding large wood and other material to the river and off-channel areas. Logs and boulders will add habitat complexity, providing adult fish holding and juvenile rearing areas. Side channel restoration actions can be combined with additions of large logs and large boulders to restore and enhance instream and overhead cover. Large wood can also be added to other sites.

3. Enhancing riparian areas to promote mature and late successional forest stands.

Table 44. Middle and Upper Clackamas River: Strategies and Actions Summary.

Map #	Project Title / Description	Subwatershed or Reach	Data Base Id
Map 6	**Monitoring:** Continue to Monitor Smolt Production	04. Upper Clackamas Mainstem,	146
Map 6	**Fish Habitat:** Upper North Fork Reservoir Fish Cover Enhancement	02. NF Reservoir /Estacada Lake, Clackamas 13	123
Map 6	**Fish Habitat:** Upper Clackamas Large Wood Project RM 57 to RM 64	04. Upper Clackamas Mainstem, Clackamas 26	129
Map 6	**Clackamas Side Channel Construction:** Upper Clackamas River Side Channel RM 37	03. Middle Clackamas Mainstem, Clackamas 15	124
Map 6	**Clackamas Side Channel Construction:** Tar Creek Side Channel RM 55.5	04. Upper Clackamas Mainstem, Clackamas 24	126
Map 6	**Clackamas Side Channel Construction:** Two Rivers Side Channel Enhancement RM 57.0	04. Upper Clackamas Mainstem, Clackamas 25	128
Map 6	**Clackamas Side Channel Construction**: Road 4650 Side Channel RM 65.0	04. Upper Clackamas Mainstem, Clackamas 26	130

4.10 OAK GROVE FORK

Watershed Characterization

Oak Grove Fork is a forested watershed (Table 45) managed primarily by the Mt. Hood National Forest, but with some lands managed by Portland General Electric (PGE). The PGE hydroelectric development facilities are an important feature of this watershed. The PGE Oak Grove Fork Development begins at Timothy Lake Dam, a compacted earthfill structure, that creates the 1,430 acre Timothy Lake. Lake Harriet Dam is located about 10 miles downstream of the Timothy Lake Dam and has a surface area of 20 acres. At Lake Harriet Dam, all the water flows through an intake and control structure into a steel pipeline and is diverted to Frog Lake. From Frog Lake water flows to the Oak Grove Powerhouse, which discharges Oak Grove Fork water into the mainstem Clackamas River at RM 48.

Table 45. Oak Grove Fork Land Use in acres.

Acres	Urban		Forest		Agriculture					Water
	Parks/Golf	Developed	Forest	Shrubland	Nurseries	Berries	Row Crops	Hay/Pasture	Christmas Trees	Water Features
Oak Grove Fork	-	47	86,605	2,381	-	-	-	-	-	1,541
Total Area	**90,575 acres**									

A waterfall in the lower river at RM 4.1 limits anadromous fish distribution within the Oak Grove Fork. Resident fish are extensively distributed throughout the watershed (Table 46. Non-native brook trout are present in Timothy Lake and its tributaries.

Table 46. Oak Grove Fork anadromous and resident fish distribution.

	Fish Use (Miles of Channel)				
Subwatershed	Spring Chinook	Coho	Steelhead	Resident only	No salmonid use or unknown use
Oak Grove Fork	4.1	4.1	4.1	96.7	271.6
TOTAL	4.1	4.1	4.1	96.7	271.6

Future Land Use

Land use will remain forested into the future.

Limiting Factors

Water Quality Limitations

Water quality limitations on the Oak Grove Fork are related to the operation of the PGE hydroelectric facilities. The primary issues are dissolved oxygen in the discharge from Timothy Lake and the effect of diversion of flow from the Oak Grove Fork at Lake Harriet Dam on water temperature. These issues are being addressed as part of the mitigation and enhancement measures included in the FERC license agreements.

Oak Grove Fork has a relatively high concentration of phosphorus where it discharges into the mainstem Clackamas River. Phosphorus concentrations are highly variable in the water shed. Some tributaries to Oak Grove Fork, such as Crater Creek, have a naturally high concentration of phosphorus where it flows into Timothy Lake. The source of phosphorus is likely the result of naturally occurring phosphorus from young volcanic rocks in the area.

Fish Habitat Limitations

Major fish habitat limitations are related to PGE's and Eugene Water & Electric Board's hydropower facilities. Factors affecting fish populations and habitat are stream flow diversions, water temperatures, and limited large wood in the system.

Protection and Restoration Strategies and Actions

The Clackamas River Project Relicensing Settlement Working Group is addressing Oak Grove Fork operations for fish habitat, water quality and other mitigation measures. The group is meeting through September 2005. A report from this group in the future will describe the outcome and agreements.

It is important to continue to trap and monitor smolts moving out of the Oak Grove system. Information form the Oak Grove Fork, along with data generated through smolt traps in tributaries in the upper and lower basin, will provide a comprehensive picture of fish population trends over time.

Table 47. Oak Grove Fork: Strategies and Actions Summary.

Map #	Project Title / Description	Subwatershed or Reach	Data Base Id
Map 6	**Monitoring:** Continue to Monitor Smolt Production	Oak Grove Fork	147