APPENDIX G

Summary Materials from Tillamook Bay NEP and Lower Columbia River NEP Comprehensive Conservation and Management Plans

Tillamook Bay NEP Comprehensive Conservation and Management Plan

(Introduction, pps. 1-1 to 1-23)

CHAPTER

1 INTRODUCTION

Tillamook Bay National Estuary Project

In April 1992, Oregon Governor Barbara Roberts nominated Tillamook Bay to the National Estuary Program (NEP). In her nomination, the Governor characterized Tillamook Bay as representative of the bays along the Pacific Northwest coast because it provided a vital resource to the local and regional economies, and supported diverse aquatic resources including anadromous fish, shellfish, and waterfowl.

In supporting the nomination, Oregon Department of Environmental Quality (DEQ) Administrator Fred Hanson underscored three environmental problems facing Tillamook Bay:

- *Bacterial contamination that causes periodic closure of Tillamook Bay shellfish harvest;*
- *Excessive sedimentation that has reduced the volume of the Bay, adversely affected fish and wildlife habitat, and decreased the available area for recreational and commercial boating; and*
- *Declining salmon and trout runs due to degradation of spawning and rearing habitat.*

Like Governor Roberts, Mr. Hanson also noted the very concerned and active community of Tillamook Bay, and recognized a "history of working together to take action to address its problems."

As the various management plans for Tillamook Bay Watershed are implemented, their results monitored, and additional scientific information gathered, this CCMP will evolve. Like the Bay, the CCMP is living and changing

Governor Roberts and Mr. Hanson promised that if selected for the National Estuary Program, a "…Management Conference will develop a plan for the Bay that will maintain and improve water quality and living resources, while ensuring compatibility with Tillamook County's economically important industries."

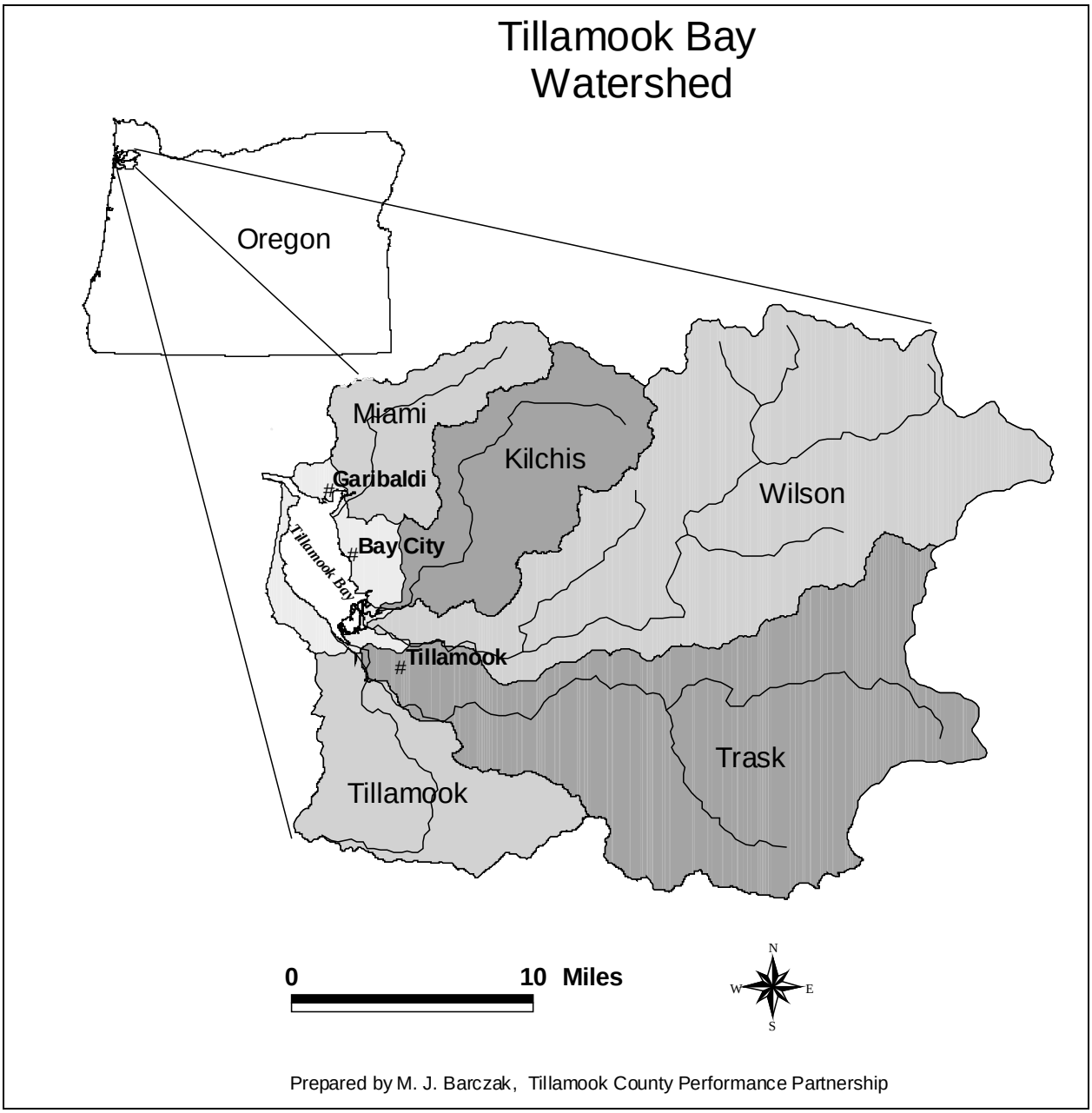


Figure 1-1. Map of the Tillamook Bay Watershed in Tillamook County, Oregon. It includes the watersheds of five rivers: the Miami, Kilchis, Wilson, Trask and Tillamook.

Tillamook Bay's nomination was approved, and seven years later, this Comprehensive Conservation and Management Plan (CCMP) fulfills the commitments made in 1992. It represents the collaborative work of the many citizens, managers, scientists, educators, and political leaders who supported the project over these years. The CCMP sets forth a 10-year action plan to coordinate resources, strengthen commitments, and rededicate our resolve to protect and enhance Tillamook Bay's natural resources.

About the TBNEP

In 1987, Congress established the National Estuary Program (NEP) as part of the Clean Water Act. The NEP's mission is to protect and restore the health of estuaries while supporting economic and recreational activities. The U.S. EPA administers the program. In 1994, TBNEP joined 27 other National Estuary Projects around the United States in developing and implementing science-based, community-supported management plans. To achieve program objectives and to complete a credible management plan, the TBNEP organized a Management Conference made up of policy makers, agency managers, citizens, and leading scientists from local, state, and regional institutions. The Management Conference established four committees to provide vital links in a cooperative effort to solve the environmental problems confronting the Tillamook Bay Watershed and its people.

Policy Committee

Composed of local, state, and federal leaders, the Policy Committee provided overall direction and set priorities for the program, defined Management Committee membership, and selected the Project Director.

Management Committee

Citizen leaders and agency managers, the majority of whom live and work in the Tillamook Bay Watershed, comprised the Management Committee. This group refined the definitions of Watershed problems and developed strategies to solve them. They also oversaw scientific characterization of the resources, completed action plans for the CCMP, and developed institutions and programs to implement the plan.

The Scientific and Technical Advisory Committee (STAC)

Represented by scientists, engineers, and planners from local and regional agencies and universities, the TBNEP STAC guided the environmental characterization of the Watershed and oversaw relevant activities. It provided research recommendations, reviewed findings and results, and worked to clarify sources of problems and identify practical solutions. The STAC steered Geographic Information Systems (GIS) and modeling efforts, and helped outline the monitoring strategy to track management effectiveness.

The Citizen Action Committee (CAC)

Drawn from citizen leaders and educators, the CAC worked to inform the public and develop strategies to involve all citizens in the decision-making process. The Committee oversaw the production of newsletters, videos, posters, and signs. It helped develop relevant educational programs and conducted many public meetings and forums to solicit public input and support the consensus process. The CAC worked to educate citizens, to listen to their problems and ideas, and to provide them with the tools and information to make good decisions.

Management, Science, and Citizen Wisdom

The committees in the Management Conference worked together to integrate good management, sound science, and solid community support into the final CCMP. The entire CCMP development process took about five years and countless hours of meetings and discussions.

The TBNEP began in 1994 with three priority problems. After considering new scientific information and intervening events, including the Flood of 1996, the Management Committee rewrote the priority problems and added a fourth: flooding.

- *The interaction of human activities with dynamic natural systems has increased the magnitude, frequency, and impacts of flood events. These events affect water quality, cause erosion, imperil fish and aquatic wildlife, destroy property, and threaten life.*

The Management Committee developed the CCMP, which contains action plans for all four problems, against the backdrop of other planning efforts. As a comprehensive management plan, the CCMP incorporates many Clean Water Act-related components of these other plans, and establishes a process to continue to coordinate all agency workplans. Other concerns (*e.g.*, social and economic) are only addressed here in the context of the Clean Water Act. Specific resource management plans relevant to Tillamook Bay and Northwestern Oregon include:

- ***The Oregon Plan for Salmon and Watersheds (OPSW)*** mission is to restore our native fish populations X and the aquatic systems that support them X to productive and sustainable levels that will provide substantial environmental, cultural, and economic benefits. This sweeping plan relies on the cooperation of private citizens, industry, and all of Oregon's resource agencies. Watershed councils and the development of watershed assessments are critical to the success of the OPSW. Several watershed assessments have been completed in the County with the assistance of the TBNEP.
- ***The Tillamook County Flood Hazard Mitigation Plan*** was developed after severe flooding in 1996. It recommends strategies to reduce the occurrence of X and damage caused by X major flood events.
- ***The Tillamook County Comprehensive Plan*** and the implementing Land Use and Land Division Ordinances were prepared and adopted by Tillamook County in compliance with *Oregon's Statewide Planning Goals and Guidelines*, statutes, and administrative rules. The Comprehensive Plan and implementing ordinances provide findings, policies and regulations that protect resource lands and manage growth in Tillamook County.
- ***The Oregon Northwest State Forest Management Plan*** provides a long-range vision of the state forests and proposes an approach called "structure based management" which diversifies forest stands and habitat types. *The Western Oregon State Forests Habitat Conservation Plan* is being developed in conjunction with the State's Northwest Forest Management Plan to provide long range strategies for the management of endangered and threatened animal species in state forests.
- ***Total Maximum Daily Loads (TMDLs)*** are water quality plans/regulations that DEQ writes for water bodies which do not meet the Clean Water Act water quality standards. Currently, DEQ is writing several TMDLs for Tillamook County.

- ***Oregon Senate Bill 1010 (SB 1010)*** mandates area water quality management plans for agricultural regions. Because the Tillamook Bay Watershed is viewed as a high priority area, the local advisory committee is already designing the North Coast Basin SB 1010 Plan.
- ***The President's Northwest Forest Plan*** provides a long-range vision of federal forest lands in the Pacific Northwest. It includes standards and guidelines emphasizing sustainable forest practices which provide for the long term health of Northwest forest ecosystems.

Chapter 3, Management Framework, provides more information on these plans, policies and programs. Citizens, stakeholders, and agency representatives on the Management Committee X and corresponding committees of other groups and agencies X worked to integrate these efforts into a coordinated CCMP that spans all agencies working in the Watershed. However, genuine cooperation requires more than a document; it also requires a well-managed implementation process.

The Tillamook County Performance Partnership succeeds the existing structure of the TBNEP, and assumes responsibility for CCMP implementation. Led by the NEP and a consortium of stakeholders, this new County department will continue to bring together all relevant federal, state, and local agencies, and watershed councils into a committee structure that makes collaborative decisions over resource management strategies and priorities. See Chapter 8, Implementation and Finance.

CCMP Development Process

Over the past four years, the Management Conference worked to integrate recent scientific findings, refine citizen input, and coordinate agency mandates into a comprehensive management plan. The formal CCMP development process boiled down citizen input to 63 Management Committee actions to solve the four priority problems in the Watershed and strengthen citizen involvement in the effort.

In year three of the program, the TBNEP invited citizens to recommend actions and strategies to address the priority problems. Under leadership of the CAC, TBNEP received over 200 recommended citizen actions to solve local problems. By July 1997, CAC refined the list to 25 high priority citizen actions, listed on Page 1-14, and submitted the list to the Management Committee for consideration and review.

By soliciting public input early, CCMP development followed a "bottom-up" approach to environmental management. Although the process endured some bumps and frustrations along the way, the TBNEP emphasis on citizen involvement led the way for watershed councils and supported the voluntary approach of the Oregon Plan for Salmon and Watersheds (OPSW). Both the CCMP and the OPSW share a vision of responsible and knowledgeable citizens solving their own environmental problems.

The Management Committee organized subcommittees to address each of the four priority problems: key habitat, water quality, sedimentation, and flooding. These subcommittees responded to original citizen recommendations and organized actions to correspond to agency programs and mandates.

At the same time, the TBNEP conducted more than four years of scientific and technical studies. Under STAC leadership, staff gathered existing technical information while academic and agency scientists worked to fill gaps in the knowledge base. The initial characterization identified about 250 miles of salmon core areas and identified key habitats and living resources in the estuary. Other studies mapped roads, landslides, and vegetation in the upper Watershed. Later scientific findings provided additional informa-tion about the sources and loading rates of bacteria and sediments to the estuary. The resulting information, summarized in the *TBNEP Environmental Characterization Report* (TBNEP 1998), provides a solid framework for scientific analysis and policy decisions, and simplifies public access to land use information. To ensure public access, these data are available via the World Wide Web and on Geographic Information Systems (GIS) layers at the Tillamook Coastal Watershed Resource Center. The CCMP commits to further developing information resources and other tools that support more informed decision-making by citizens and agencies alike.
After evaluating the scientific-technical information, incorporating citizen input, and reviewing agency authorities, the TBNEP developed a draft CCMP by September 1998. Following a citizen "Listening Post" meeting in October of 1998 and more Management Committee discussion, the CCMP was refined further. TBNEP staff received comments from state and federal agencies through March 10, 1999, and again from the public through April 23, 1999. The final CCMP includes technical revisions, specifications and criteria, and policy recommendations as a result of input from about 40 reviewers. See Appendix P. To focus activities on high-priority actions, the Management Committee ranked individual actions based on environmental benefit and benefit/cost ratios. See Appendix C.

As a result of the environmental characterization phase, TBNEP developed a rich Geographical Information Systems (GIS) database. In spring 1998, TBNEP collaborated with Economic Development Council of Tillamook County (EDCTC), Tillamook County Soil and Water Conservation District (SWCD), and Tillamook Bay Community College (TBCC) to establish the Tillamook Coastal Watershed Resource Center (TCWRC). The TBNEP transferred the GIS database to the TCWRC.

The TCWRC and watershed councils are new institutions that will facilitate citizen involvement with CCMP implementation. With support from the Performance Partnership, they will provide public access to habitat maps and geographic information, train citizens in watershed assessment, and support community-based decision-making based on good

science and public consensus. In 1998, citizens enrolled in a watershed assessment class at the center and conducted an assessment of the Trask River, one of the first citizen assessments to use the Governor's Watershed Enhancement Board Watershed Assessment Manual. The recently-formed Tillamook Bay Watershed Council is implementing the action plan developed as part of that effort.

The CCMP encourages all agencies with regulatory responsibilities to more effectively enforce current laws and mandates. For example, the County and cities will protect habitat through stronger enforcement of existing land use laws. They will adopt local ordinances to protect riparian areas and better manage stormwater runoff. At the state level, Oregon Department of Agriculture promises stronger enforcement of pollution prevention and control measures (PCMs) for agriculture and increased inspections of livestock operations. Oregon Department of Environmental Quality will enforce the Clean Water Act through the Total Maximum Daily Loads and other processes. Oregon Department of Forestry will oversee tough enforcement of the Forest Practices Act. These and other mandates put a heavy burden on state, county and city governments, which often lack resources to fulfill all their responsibilities.

This Document and the TBNEP Action Plan

Chapter 2, State of the Bay, describes the Bay and Watershed, and the four priority problems:

- key habitat,
- water quality,
- erosion and sedimentation, and
- flooding.

Goals and measurable objectives to chart our progress as we implement this Comprehensive Conservation and Management Plan are included for each problem.

Chapter 3, Management Framework, details the policies and programs relevant to this plan.

The TBNEP Action Plan X described in Chapters 4 through 7 X addresses the four priority problems with coordinated goals, objectives, and 63 specific actions. Citizen Involvement gets special attention in Chapter 9, with eight additional actions to ensure and strengthen public involvement. Each action details the steps required to complete the action; identifies coordinating entities, other partners, and completion dates; estimates costs; acknowledges regulatory issues; and plans for monitoring progress toward the CCMP goals and objectives. The actions are cross-referenced with one another, as well as the Oregon Plan for Salmon and Watersheds and other applicable programs and plans. Possible funding sources for each action are listed in Table 8-1 (Chapter 8, Implementation and Finance).

As a comprehensive management plan, the CCMP incorporates many good ideas from at least a dozen relevant resource management plans that focus on some part of the Tillamook Bay environment. Although not all are specifically referenced, the CCMP includes goals and objectives from all these plans and integrates them in a comprehensive, basin-wide vision for performance-based management.

The CCMP includes several types of actions to achieve immediate and long-term goals. It calls for on-the-ground projects to upgrade roads, enhance habitat, reconnect rivers and sloughs, and improve farm practices. The plan also recommends more effective enforcement of environmental laws and ordinances, and outlines actions to build local capacity for better enforcement and education. Other actions define additional needs for continued research and monitoring to track progress in achieving stated objectives. By integrating on-the-ground projects, stronger enforcement, institutional development, and monitoring efforts, the CCMP presents a comprehensive framework that combines local, state, and federal initiatives into a coordinated management plan for the Tillamook Bay Watershed.

The Priority Problems

The TBNEP began in 1994 with three priority problems: water quality, sedimentation, and habitat. After considering new scientific information and intervening events, including the Flood of 1996, the Management Committee rewrote the priority problems to more accurately reflect the current state of the Bay and Watershed, and added a fourth: flooding.

Key Habitat (Chapter 4)

To restore fish and other aquatic species whose populations have declined due to habitat loss or degradation, the CCMP presents an action plan to assess, protect, and enhance key habitats throughout the Watershed. It targets instream and riparian areas, along with tidal marshes and lowland sloughs, as high priority habitats for protection and enhancement. In the forested uplands, the plan commits to remove barriers to fish passage and improve riparian and instream conditions in salmon core areas. It commits to upgrade road culverts and enhance 100 miles of instream habitat by 2010.

In the lowland agricultural areas, the CCMP calls for major riparian enhancement projects designed to control livestock access to streams and improve water quality. It promotes bio-engineered river stabilization projects pioneered by TBNEP and the Soil and Water Conservation District (SWCD) and calls on the agricultural community to enhance river banks to healthy riparian condition (HRC). Based on the success of TBNEP prototype fish-friendly tide gates, the plan outlines a strategy to upgrade 25 tide gates in lowland sloughs. It also calls for the enhancement of 750 acres of tidal marsh through purchase, donation, or easements on marginal agricultural lands.

To improve rearing habitat for juvenile fish and to reduce flood impacts, the CCMP supports hydromodification to reconnect rivers and sloughs. With about 85% of lowland wetlands lost to diking and draining, scientists and citizens stress the importance of hydrologic connectivity and recommend projects to open up blocked sloughs and to reconnect floodplain wetlands to river channels. Projects of this magnitude will require additional analysis and planning.

To address the need for additional analysis and planning, the CCMP calls on the U.S. Army Corps of Engineers (COE) and the local sponsor to develop a hydrodynamic computer model to describe and predict changes in river flow. A completed analysis will guide multiple agencies in a coordinated effort to increase habitat and mitigate environmental and economic flood damages.

While this CCMP focuses on the threatened Oregon Coast coho salmon and other salmonids, the general emphasis on ecosystem health should benefit other species, including those listed as threatened or endangered under the Endangered Species Act.

Water Quality (Chapter 5)

Today, the Bay receives high bacterial loads and other pollutants from diverse sources including livestock operations, wastewater treatment plants, on-site sewage disposal systems (OSDS) and urban runoff. Many stream reaches also fail to meet water quality criteria for temperature, and exceed recommended concentrations of suspended solids. Significant oxygen depression and excessive nutrient concentrations have been observed in some lowland sloughs.

To improve water quality and reduce agricultural contributions to bacterial contamination, Oregon Senate Bill 1010 requires the development of agricultural water quality management plans (SB 1010 plans). The North Coast Basin SB 1010 Plan will encompass Tillamook Bay. To meet the landowner-supported pollution prevention and control measures (PCMs) required in the SB 1010 plan, livestock operation managers should implement voluntary farm management plans. The CCMP water quality action plan describes the improved farm practices necessary, and commits to helping local farmers implement voluntary farm management plans. Moreover, it calls for annual Confined Animal Feeding Operation (CAFO) inspections by 2004, with all agricultural operations (not just CAFOs) in compliance with the SB 1010 plan by 2010. To strengthen these efforts, the CCMP identifies agency partners, educational programs, and likely funding sources to improve agricultural practices in Tillamook County.

Recently-completed storm sampling of Tillamook Bay and the Trask and Tillamook Rivers found that 16B73% of the bacteria was of human origin, with the human-origin bacteria proportion tending to rise as the storm wore on. See Table 5-2, reporting findings of Bower and Moore, 1999. Based on these findings, the CCMP targets human activities and outlines action plans to upgrade wastewater treatment plants, expand sewer networks, and ensure that on-site disposal systems work properly. Wastewater treatment plants will eliminate all discharge failures by 2002, and the city of Tillamook will expand its sewer network by 2005. In the estuary, ODA will update shellfish management plans based on new information about bacterial sources, levels, and distribution.

Reducing bacteria inputs, enhancing key habitat, and addressing erosion and sedimentation problems will also reduce other water quality problems, such as excessive nutrients and low dissolved oxygen. However, specific water quality actions address temperature and suspended sediments.

Erosion and Sedimentation (Chapter 6)

Excessive sedimentation can simplify or degrade habitats and modify river flows and flood patterns. Sediment loading, movement, and deposition all affect instream and estuarine habitat and Bay bathymetry. The CCMP targets forest roads, an important source of human-caused sediment loading, and outlines a strategy to identify, prioritize, and upgrade forest roads. Under the leadership of Department of Forestry (ODF), the CCMP commits to upgrade 1,400 miles of forest roads with better culverts and drainage ditches. The plan also calls on state and private foresters to decommission at least 50 miles of unneeded forest management roads by 2010.

To improve sediment and habitat conditions associated with timber harvesting, the CCMP encourages state and private forest owners to
go beyond the Forest Practices Rules in protecting riparian and high-risk areas. The plan recognizes the voluntary efforts of the Oregon Forest Industries Council (OFIC) and private foresters to improve riparian and instream habitats.

In the lower Watershed, the CCMP targets urban runoff and calls on Tillamook County and the cities of Tillamook, Bay City, and Garibaldi to adopt new ordinances to control erosion due to construction. Other lower Watershed sources of sediment, including streambank erosion and runoff from agricultural lands, are addressed through actions in the Key Habitat and Water Quality chapters. These actions will reduce sediment loading to help meet habitat requirements for salmonids and other aquatic species and achieve state water quality standards by 2010.

Flooding (Chapter 7)

Large floods continue to damage human property, modify hydrology, and impact aquatic habitats. The CCMP endorses the Tillamook County Flood Hazard Mitigation Plan (FHMP) and its approach to comprehensive floodplain management. It supports better land use planning, structural and non-structural floodwater control, and innovative ways to enhance floodplain function and restore habitats. Based on a careful hydrological and hydraulic analysis, Tillamook County will implement future projects to improve drainage and increase floodplain water storage capacity.

> Under the Performance Partnership, Tillamook County will coordinate flood management programs of the COE, the Federal Emergency Management Agency (FEMA), and other agencies working to integrate flood control and habitat restoration. Although we support the human safety and economic actions outlined in the FHMP, the NEP's Clean Water Act basis limits this CCMP's Action Plan to environmental issues.

CCMP Implementation

Implementation and Finance (Chapter 8)

To address the need for better, faster, more efficient government services, the CCMP describes a Performance Partnership to coordinate and leverage agency resources. The NEP will continue through this new County department, which will coordinate a consortium of agencies, non-profits, and business and citizen members for greater cooperation among agencies and more innovative solutions for the citizens they serve. The CCMP also supports economic incentives to engage landowners in long-term environmental restoration and stewardship. Chapter 8 describes the Tillamook County Performance Partnership as the implementation vehicle and identifies likely sources of funding to accomplish program goals and objectives.

Citizen Involvement (Chapter 9)

To develop and reinforce strong stewardship among all citizens, the Plan supports new institutions in Chapter 9 to empower local citizens and provide them with information they need to make informed decisions about their watershed. The CCMP vision identifies the Tillamook Bay Watershed Council (TBWC) as the primary mechanism to ensure continued citizen support for implementation. The plan outlines a strategy to maintain a Tillamook Coastal Watershed Resource Center (TCWRC) that serves as a clearinghouse for geographic information and provides expertise to watershed councils.

To help citizens become effective partners in implementing the CCMP, the Citizen Involvement Action Plan sets forth new education and outreach programs for farmers, riparian owners/users, watershed council members, local judiciary, and others responsible for good land management. The Plan calls for better institutional linkages among regional universities, the local community college, and public schools. Other actions recommend better training for teachers and greater opportunities for outdoor learning.

Monitoring and Research Needs (Chapter 10)

The CCMP includes a plan to monitor the implementation and effectiveness of the Action Plan in meeting goals and objectives. The monitoring strategy in Chapter 10 describes quantitative methods to assess changes in key environmental parameters, and a format for monitoring CCMP implementation and effectiveness.

Although earlier studies provided a wealth of environmental information, scientists and stakeholders still have much to learn about how the ecosystem works and how to prioritize management actions. For these reasons, the Plan recommends additional assessment and monitoring programs and applied research in selected areas. Some important examples include:

- map and prioritize critical habitats for protection and enhancement;
- characterize interactions between oysters/eelgrass/burrowing shrimp;
- track fish population trends;
- characterize fish use of the estuary;
- identify road problems and prioritize upgrades;
- monitor water quality (bacteria, temperature, total suspended solids, etc.) hot spots and track trends;
- provide better information for farm management plans; and
- develop hydrodynamic computer models for river management.

These and other technical studies will optimize limited implementation dollars, ensure public accountability, and allow managers to evaluate progress in meeting goals and objectives. In most cases, state and federal agencies have already developed solid field methods to conduct surveys and implement monitoring programs. The Performance Partnership will develop a Web-based accountability system, housing all monitoring data at the Tillamook Coastal Watershed Resource Center, tracking progress and costs for easy Internet access. Quality-assured monitoring data will be available in GIS. Intent is for all studies and data to be Web-accessible. The Performance Partnership plans to better coordinate agency activities and to maintain robust monitoring programs that track core monitoring objectives, detailed in Chapter 10, Monitoring and Research Needs.

Federal Consistency (Chapter 11)

Coordinating still-evolving programs has been X and will continue to be X a major concern of the Tillamook Bay National Estuary Project and the Tillamook County Performance Partnership, which will implement this CCMP. In keeping with our Clean Water Act mandate and good management principles, Chapter 11 reviews federal mandates, laws, and programs which may affect or be effected by this plan, and sets forth a mechanism for avoiding and correcting inconsistencies.

Citizens' Priority Actions

The actions in the CCMP were developed based on citizen input. Beginning with the Visioning Process in 1995 and culminating with the Roundup in July of 1997 (see Chapter 9, Citizen Involvement), a list of 24 widely-supported citizen suggested actions emerged:

Water Quality

- Devise additional strategies for the control of fecal coliform bacteria.
- Ensure adequate wastewater treatment plant capacity.
- Prevent livestock access to streams with fences and/or vegetative buffers.*
- Achieve significant dairy participation in the MEAD project.

Key Habitat

- Define critical and protected fish habitat on small watershed scale.
- Support the Oregon Plan for Salmon and Watersheds (formerly the Oregon Plan and the CSRI).
- Control burrowing shrimp.
- Identify, assess, and map sloughs.
- Expand, identify, and facilitate economic incentives and cost-sharing programs for restoration/enhancement.
- Identify, assess, and map wetland areas.
- Increase the amount and quality of salmonid habitat (7 strategies).
- Protect and expand aquatic (salmonid) habitat.
- Tide gate and lowland culvert management and modification.
- Curtail land use in critical sub-basins.
- Designate Bayocean Spit as a Recreation/Natural zone.
- Protect riparian and aquatic habitats.
- Establish a land trust or adopt the Central Coast Land Conservancy as recipient and manager of purchased lands and easements.
- Encourage wetland restoration on private lands, through economic incentives and other methods.

Erosion and Sedimentation

- Resurvey the Bay bottom (bathymetry) to document changes.
- Upgrade forest roads by improving drainage structures and culverts.
- Develop and maintain better roads.
- Prevent livestock access to streams with fences and/or vegetative buffers.*

Flooding

- Set up association/control district to coordinate flood mitigation.

General

- Integrated GIS education, support, and planning.
- Establish a watershed council for Tillamook Bay.

* Repeated action

High Priority Goals and Actions

Directed to fully develop an action plan for each of the priority problems, subcommittees composed of management conference members and interested stakeholders used the citizen recommendations as a starting point. Although the action titles have changed, the intent of those 25 recommendations is woven throughout the current action plan. Some good ideas are not included in this plan due to the requirements and constraints of the legislation that funds the NEP, but are found elsewhere (*e.g.*, econ-omic development and the socio-economic effects of flooding are addressed in the Performance Partnership Goals and the Tillamook County Flood Hazard Mitigation Plan).

This list of priority goals and actions was developed using a three-pronged approach:

1. Management Committee Members completed a survey ranking each action (as published in the September 1997 Draft CCMP) as to its environmental benefit and its cost-benefit ratio (*i.e.*, "bang-for-the buck"). The top priority actions from the Management Committee Prioritization Exercise are on Page 1-16. Management Committee members' agency plans and comments on each action detailed in Appendices B and C. The highest scoring actions were then grouped according to six major strategies or goals which closely reflect the goals identified by the Tillamook County Performance Partnership.
2. To confirm public support for the priority actions, we revisited the priority goals and actions identified in the Visioning Process, the Roundup (Page 1-14), and the results of the 1995 TBNEP Public Questionnaire and the Tillamook County Futures Council Household Survey of March 1998.
3. We went out for final public comment in spring 1999, soliciting comments on the final draft. After placing newspaper news releases and radio announcements, and mailing 1,000 postcards to the TBNEP mailing list, the CCMP was made available on the TBNEP and Tillamook Coastal Watershed Resource Center web pages, and hard copies were placed in key locations. Comments have been accounted for in this document.

The ideas of the actions in the CCMP Priority Goals and Actions List appear repeatedly as priorities in each review process, indicating solid community support.

Just because a goal or action doesn't appear on the priority list doesn't mean that it isn't important, or that it won't get implemented — *it will! We intend to eventually implement each and every action and meet every goal.*

Table 1-1: Management Committee Priority Actions*

Actions		**Environmental Benefit Average Score**	**Cost Benefit Average Score**
WAQ-01	Implement agricultural pollution prevention and control measures	2.75	2.63
HAB-09	Limit livestock access to streams	2.75	2.38
SED-08	Restrict harvest practices & activities in areas at high risk of landslide	2.75	2.38
HAB-06	Protect & enhance floodplain/lowland riparian vegetation	2.75	2.22
HAB-21	Protect and enhance tidal wetlands	2.71	2.38
HAB-15	Adopt local ordinance to protect riparian areas	2.63	2.50
SED-02	Develop forest road maintenance and improvement plans	2.63	2.38

Table 1-1: Management Committee Priority Actions*			
Actions		**Environmental Benefit Average Score**	**Cost Benefit Average Score**
SED-06	Ensure sufficient resources to enforce Forest Practices Act	2.63	2.38
SED-01	Identify road problems & prioritize upgrades	2.63	2.25
HAB-16	Adopt local ordinance(s) to protect instream habitat	2.57	2.50
HAB-27	Prevent introduction & control exotic species	2.57	2.38
HAB-08	Protect & enhance freshwater wetland habitat	2.57	2.25
HAB-25	Reconnect sloughs & rivers to improve water flow	2.57	2.00
HAB-31	Support the Oregon Plan for Salmon & Watersheds	2.56	2.20
HAB-05	Protect & enhance upland riparian areas	2.56	2.10

* Management Committee members rated the September 1998 Draft CCMP actions for this exercise, providing environmental and cost-benefit scores as well as information about their agencies' activities and plans. Since some action numbers and titles have changed since then, they may not correspond exactly with those in this draft. They rated each action's environmental benefit/importance and cost-effectiveness "High", "Medium," or "Low" and these ratings were assigned values of 3, 2, or 1 and averaged. Other information from the exercise is summarized in Appendices B and C.

High-Priority CCMP Goals and Related Actions

Goal: Implement Pollution Control Measures

WAQ-01: Define, Implement, and Enforce Pollution Prevention and Control Measures on Agricultural Lands
WAQ-02: Implement Voluntary Farm Management Plans
WAQ-03: Implement Revised CAFO Inspection Procedure
WAQ-04: Use Farm-Specific Agronomic Rates for Nutrient Management
WAQ-05: Provide Farm Management Training Programs
WAQ-09: Ensure Properly Functioning On-Site Sewage Disposal Systems
WAQ-10: Implement Temperature Management Strategies

Goal: Improve Roads

SED-01: Implement Road Erosion and Risk Reduction Projects
SED-04: Ensure Sufficient Resources to Enforce Forest Practices Act

Goal: Enhance Riparian Areas

HAB-05: Protect and Enhance Upland Riparian Areas
HAB-06: Protect and Enhance Lowland/Floodplain Riparian Areas
HAB-09: Control Livestock Access to Streams
HAB-10: Stabilize Streambanks Using Alternatives to Riprap
HAB-11: Encourage Protection and Enhancement on Private Lands
HAB-13: Increase Incentive Program Payments

Goal: Enhance Instream Conditions

HAB-07: Protect and Enhance Instream Habitat
HAB-09: Control Livestock Access to Streams
HAB-14: Ensure Minimum Streamflows
HAB-15: Revise Local Ordinances to Increase Protection of Riparian Areas, Wetlands, and Instream Habitat
WAQ-10: Implement Temperature Management Strategies
WAQ-11: Implement Suspended Sediments Management Strategies
SED-02: Implement Practices That Will Improve Sediment Storage and Routing

Goal: Enhance Estuary and Tidal Habitat

HAB-11: Encourage Protection and Enhancement on Private Lands
HAB-13: Increase Incentive Program Payments
HAB-15: Revise Local Ordinances to Increase Protection of Riparian Areas, Wetlands, and Instream Habitat
HAB-17: Characterize Estuarine and Tidal Habitats
HAB-18: Prioritize Tidal Sites for Protection and Enhancement
HAB-20: Protect and Enhance Eelgrass Habitats

Goal: Improve Floodplain Condition

FLD-01: Develop a GIS-Based, Unsteady State Hydrodynamic Model
FLD-02: Implement Watershed Drainage Modification Projects
FLD-04: Update Existing Floodplain Map
FLD-05: Restrict New Construction and Development in the Floodplain
HAB-19: Protect and Enhance Tidal Marsh
HAB-21: Remove or Modify Ineffective Tide Gates and Floodplain/Lowland Culverts

CCMP Goals and Objectives: Key Habitat

Goal	**Assess, Protect, and Enhance Riparian Habitat**
Objectives	Enhance 200 miles of forested riparian habitat to healthy riparian condition by 2010.
	Enhance 500 miles of riparian habitat in the 0–500' elevation band to healthy riparian condition by 2010.
Goal	**Assess, Protect, and Enhance Instream Habitat**
Objectives	Enhance 100 miles of upland instream habitat by 2010.
	Upgrade 50% of all tide gates by 2010.
Goal	**Assess, Protect, and Enhance Wetland Habitat**
Objectives	Enhance 100 acres of freshwater wetland by 2010.
	Enhance 750 acres of tidal wetland by 2010.
Goal	**Assess, Protect, and Enhance Estuary and Tidal Habitats**
Objectives	Enhance 750 acres of tidal wetland by 2010.
	No net decline in eelgrass beds.
Goal	**Enhance Health of Salmonids, Shellfish, and Other Aquatic Species**
Objective	Achieve Oregon Department of Fish and Wildlife (ODFW) wild fish production and escapement goals (See chart on Page 4-2) by 2010.

Goals, Objectives, and Monitoring

The CCMP lays out a 10-year action plan to achieve specific targets. It builds on the NEP, and calls agencies, watershed councils, and industry groups to action under a Performance Partnership. This new partnership will implement the CCMP and commits to meeting CCMP goals by 2010.

To firm our commitments and measure our progress, the CCMP defines goals and objectives, and lays out a monitoring plan to measure our progress and adjust the plans as needed. Indicators such as bacteria loads, riparian condition, and eelgrass beds will be monitored. The TBNEP Management Committee agreed on these objectives, which define accountability for all stakeholders, based on best available science and best professional judgment. We believe these goals to be ambitious, but realistic.

The TBNEP offers these goals and objectives as challenges to the agencies, citizens, industries, and other stakeholders who commit to meeting them under the Tillamook County Performance Partnership.

CCMP Goals and Objectives: Water Quality

Goal	**Promote Beneficial Uses of the Bay and Rivers**
Objectives	Achieve water quality standards for bacteria in the rivers and Bay by 2010.

	Document at least a 25% reduction in bacteria loads to rivers, with apparent trends by 2005 and statistically significant results by 2010.
	Achieve at least a 25% reduction every four years in the number of days that the rivers are not in compliance with water quality standards for bacteria.
Goal	**Reduce Instream Temperatures to Meet Salmonid Requirements**
Objectives	Achieve in-stream temperatures that meet salmonid requirements by 2010.
Goal	**Reduce Instream Suspended Sediments to Meet Salmonid Requirements**
Objectives	Achieve in-stream suspended sediment concentrations that meet salmonid requirements by 2010.
	Document at least a 25% reduction in sediment loads to rivers, with apparent trends by 2005 and statistically significant results by 2010.
Goal	**Improve Farm Management Practices**
Objectives	Achieve Senate Bill 1010 compliance among 100% of livestock operations by 2010.
	Inspect every CAFO annually by 2004.
Goal	**Assess and Upgrade Wastewater Treatment Infrastructure**
Objective	End wastewater treatment plant failures by 2002.
Goal	**Assess and Upgrade Urban Runoff Treatment Infrastructure**
Objective	Control runoff from all construction and development in urban areas by 2003 (Erosion and Sedimentation objective).

CCMP Goals and Objectives: Erosion and Sedimentation

Goal	**Reduce Sediment Risks from Forest Management Roads**
Objectives	Upgrade 1,400 miles of forest roads on state and private lands by 2010.
	Decommission 50 miles of forest management road by 2010.
	Conduct regular road maintenance on all 2,000 miles of forest management roads.
Goal	**Reduce the Adverse Impacts of Rapidly Moving Landslides**
Objectives	Upgrade 1,400 miles of forest roads on state and private lands by 2010.
	Decommission 50 miles of forest management road by 2010.
	Conduct regular road maintenance on all 2,000 miles of forest management roads.
Goal	**Improve Channel Features to Improve Sediment Storage and Routing**
Objectives	Habitat Riparian and Water Quality suspended sediments objectives below
Goal	**Reduce Adverse Impacts of Erosion and Sedimentation from Developed and Developing Areas**
Objective	Control runoff from all construction and development in urban areas by 2003.
Goal	**Reduce Adverse Impacts of Erosion and Sedimentation from Agricultural Areas**
Objectives	Lowland, freshwater wetland, and tidal marsh habitat objectives below
Related CCMP objectives	Enhance 200 miles of forested riparian habitat to healthy riparian condition by 2010. (Habitat Objective)
	Enhance 500 miles of riparian habitat in the 0–500' elevation band to healthy riparian condition by 2010. (Habitat Objective)
	Enhance 100 miles of upland instream habitat by 2010. (Habitat Objective)
	Enhance 750 acres of tidal wetland by 2010. (Habitat Objective)
	Achieve instream suspended sediment concentrations that meet salmonid requirements by 2010. (Water Quality Objective)
	Document at least a 25% reduction in total suspended solids loads to rivers, with apparent trends by 2005 and statistically significant results by 2010. (Water Quality Objective)

CCMP Goals and Objectives: Flooding

Goal **Improve Floodplain Condition**

Objective Complete 20 projects within the two years following adoption of hydrodynamic model which:

- measurably reduce runoff rate in the Watershed's uplands (increasing interflow and ground water recharge, thereby reducing stream temperatures and increasing summer flows);
- improve drainage characteristics in the Watershed's lowlands (*e.g.*, connect sloughs and rivers to fresh water exchange in sloughs);
- increase floodplain storage capacity in the Watershed's lowlands (*e.g.*, set back levees to increase floodwater capacity, increase riparian area, and create opportunity for sediment deposition); and
- improve the natural environment's capacity to withstand and benefit from flood events.

Goal **Develop and Maintain a Comprehensive Floodplain Management Plan**

Objective Implement a GIS-based, unsteady state hydrodynamic model by year 2001.

Raise at least 60 houses at least 3 feet above the 100-year flood elevation by year 2001, and other houses as resources permit.

Construct 10 livestock and equipment pads in flood-prone areas by 2001 to reduce pollution from petrochemicals and animal wastes during major floods.

Secure and/or remove known hazardous chemicals from areas where they pose a real threat to water quality during flood events by 2005.

Citizen Involvement goals:

Goal **Improve Community Education**

Goal **Strengthen KB12 Science and Outdoor Programs**

Goal **Promote Community Development**

Key Habitat Action Plan

Riparian, Instream, and Wetland Habitat

HAB - 01 Characterize Riparian and Instream Habitat
HAB - 02 Assess and Map Riparian and Wetland Habitat
HAB - 03 Prioritize Upland Protection and Enhancement Sites
HAB - 04 Prioritize Floodplain/Lowland Protection and Enhancement Sites
HAB - 05 Protect and Enhance Upland Riparian Areas
HAB - 06 Protect and Enhance Lowland Riparian Areas
HAB - 07 Protect and Enhance Instream Habitat
HAB - 08 Protect and Enhance Freshwater Wetland Habitat
HAB - 09 Control Livestock Access to Streams
HAB - 10 Stabilize Streambanks Using Alternatives to Riprap
HAB - 11 Encourage Protection and Enhancement on Private Lands
HAB - 12 Sponsor a Native Vegetation Planting Day
HAB - 13 Increase Incentive Program Payments
HAB - 14 Ensure Minimum Streamflows
HAB - 15 Revise Local Ordinances to Increase Protection of Riparian Areas, Wetlands, and Instream Habitat
HAB - 16 Effectively Enforce Laws and Regulations

Estuary, Sloughs, and Tidal Marsh

HAB - 17 Characterize Estuarine and Tidal Habitats
HAB - 18 Prioritize Tidal Sites for Protection and Enhancement
HAB - 19 Protect and Enhance Tidal Marsh
HAB - 20 Protect and Enhance Eelgrass Habitats
HAB - 21 Remove or Modify Ineffective Tide Gates and Floodplain/Lowland Culverts
HAB - 22 Enhance Large Wood in Estuary
HAB - 23 Update the Estuary Plan and Zoning
HAB - 24 Reconnect Sloughs and Rivers to Improve Water Flow
HAB - 25 Control Burrowing Shrimp Populations
HAB - 26 Prevent Introduction and Control Exotic Species

Fishery Practices

HAB - 27 Effectively Enforce Fishing Regulations
HAB - 28 Evaluate Commercial and Sport-Fishing Practices
HAB - 29 Implement Essential Fish Habitat Mandates
HAB - 30 Support the Oregon Plan for Salmon and Watersheds

Water Quality Action Plan

WAQ-01 Define, Implement, and Enforce Pollution Prevention and Control Measures on Agricultural Lands
WAQ-02 Implement Voluntary Farm Management Plans
WAQ-03 Implement Revised Confined Animal Feeding Operation (CAFO) Inspection Procedure
WAQ-04 Use Farm-Specific Agronomic Rates for Nutrient Management
WAQ-05 Provide Farm Management Training Programs
WAQ-06 Ensure Adequate Wastewater Treatment Capacity
WAQ-07 Expand Sewer Network
WAQ-08 Ensure Adequate Urban Runoff Treatment and Retention
WAQ-09 Ensure Properly Functioning On-Site Sewage Disposal Systems
WAQ-10 Implement Temperature Management Strategies
WAQ-11 Implement Suspended Sediments Management Strategies
WAQ-12 Evaluate Shellfish Growing Area Classifications
WAQ-13 Update Shellfish Management Plan Closure Criteria

Erosion and Sedimentation Action Plan

Roads, Landslides, and Forest Practices

SED-01 Implement Road Erosion and Risk Reduction Projects
SED-02 Implement Practices That Will Improve Sediment Storage and Routing
SED-03 Reduce Risks in Landslide-Prone Areas
SED-04 Ensure Sufficient Resources to Enforce Forest Practices Act
SED-05 Reduce Sedimentation from Non-Forest Management Roads
SED-06 Develop, Implement, and Enforce a Stormwater Management Ordinance

Flooding Action Plan

FLD-01 Develop a GIS-Based, Unsteady State Hydrodynamic Model
FLD-02 Implement Watershed Drainage Modification Projects
FLD-03 Elevate and/or Relocate Structures, Livestock and Equipment
FLD-04 Update Existing Floodplain Map
FLD-05 Regulate New Construction and Development in the Floodplain
FLD-06 Effectively Clear Mapped Lowland Floodways or Floodplains of Hazardous Materials

Citizen Involvement Action Plan

CIT - 01	Implement an Oregon State University Extension Watershed Masters Series
CIT - 02	Implement an Associate of Arts Oregon Transfer Degree in Environmental Studies
CIT - 03	Improve Professional Development for K–12 Teachers
CIT - 04	Strengthen Organizational and Institutional Linkages
CIT - 05	Expand Authentic Learning Experience Opportunities
CIT - 06	Establish a Land Trust or Conservation Organization
CIT - 07	Sustain the Tillamook Bay Watershed Council
CIT - 08	Sustain the Tillamook Coastal Watershed Resource Center

Lower Columbia River NEP Comprehensive Conservation and Management Plan

(Chapters 4 and 5 without graphics)

Chapter 4: PRIORITY ISSUES

All things are connected. Whatever befalls the earth befalls the children of the earth.
Chief Seattle

The problems the Columbia River faces today are complex--the cumulative effects of many activities over many years. Current conditions in the Lower Columbia River Estuary must be well understood in order to determine appropriate and effective corrective actions. A key task for the Management Committee was to characterize the estuary and define the most significant concerns to be addressed.

The Bi-State Water Quality Program

In 1989, the States of Washington and Oregon recognized that more information was needed about the health of the lower Columbia River. While much activity was on-going in the Columbia Basin, the emphasis generally focused above Bonneville Dam. Not much attention had been paid to the lower 146 miles. A nomination to the National Estuary Program was being discussed, but data was lacking to confirm the degradation that would warrant participation in the program. To address that need, the Lower Columbia River Bi-State Water Quality Program (Bi-State Program) was created in 1990 and continued to 1996. Its study area was the lower part of the river from Bonneville Dam to the Pacific Ocean, a stretch of 146 river miles.

The Bi-State Program was a public/private partnership jointly administered by the Washington Department of Ecology and the Oregon Department of Environmental Quality and assisted by a Bi-State Steering Committee. Steering Committee members came from the many groups with an active interest in the health of the river: environmentalists, industry, private citizens, public ports, local governments, fishing interests, Native American tribes, the Northwest Power Planning Council, and state and federal agencies dealing with environmental and natural resource issues. The program was financially supported by the citizens of Oregon and Washington, the Northwest Pulp and Paper Association, and the region's public ports. Private contractors and state and federal agencies conducted the studies. During its 6-year existence, the Bi-State Program invested over $5 million in its work.

The Bi-State Program assessed the health of the river by looking at how well the "beneficial uses" of the river are being met. Beneficial uses are defined in state laws and regulations and include water supply, agriculture, fish and wildlife, recreation, and commercial uses. The program focused on those beneficial uses that relate to the health of humans, fish, and wildlife.
The 6-year studies were conducted in four steps:

1990-1991: Existing Data were gathered and studied so researchers could start with a coherent picture of what was already known about the river and its problems.

1991-1993: Reconnaissance Surveys were broad preliminary studies designed to provide information about existing environmental conditions and pollutants of concern by sampling and analyzing water, sediment, and fish. These were the first environmental studies to examine the entire lower Columbia River broadly, rather than focusing on a particular type of pollution, beneficial use, or interest group.

1993-1996: Baseline Studies were specific studies suggested by the results of the reconnaissance surveys. They were designed to fill gaps in the information gathered so far. Three types of studies were performed: regular water testing over the course of a year ("ambient monitoring"), a close look at the impact of pollution on fish and wildlife health, and a preliminary look at possible human health risks of eating fish from the river.

1995-1996: Advanced Studies were in-depth studies of priority problems, based on the findings of all previous phases. They included a more detailed human health risk assessment and a study to identify pollutant sources.

These studies generated over 50 technical reports, which are summarized in an integrated technical report called ***The Health of the River 1990-1996***. Based on this work, the Bi-State Program identified four major problems in the study area that warranted further study and action:

- Toxic contaminants in sediment and fish tissue that affect the health of humans, fish, and wildlife
- Habitat loss or modification that affects fish and wildlife resources
- Water quality problems that affect the beneficial uses in parts of the estuary
- Overall decline in fish and wildlife health, including a number of threatened and endangered species

The findings of the Bi-State Program supported nomination of the Lower Columbia River Estuary in the National Estuary Program.. The U.S. Environmental Protection Agency announced the Columbia River as one of the waterways accepted into the program in July 1995.

Estuary Program Priority Issues

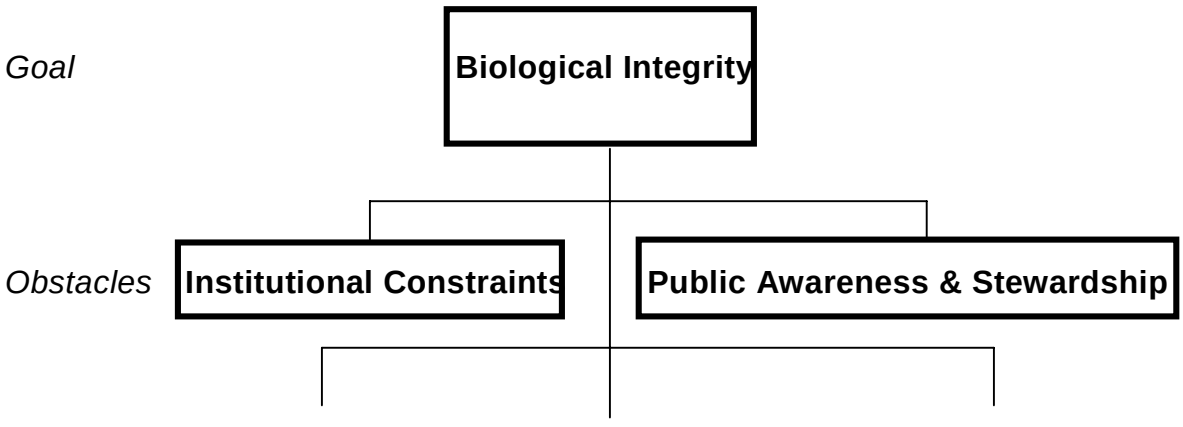
The Management Committee carefully reviewed the technical studies conducted under the Bi-State Program from 1990-96. Those studies provide the background for the technical elements of this plan. Using that technical data Based on this assessment and supplementary information, the Management Committee identified seven priority issues of concern to the Lower Columbia River Estuary:

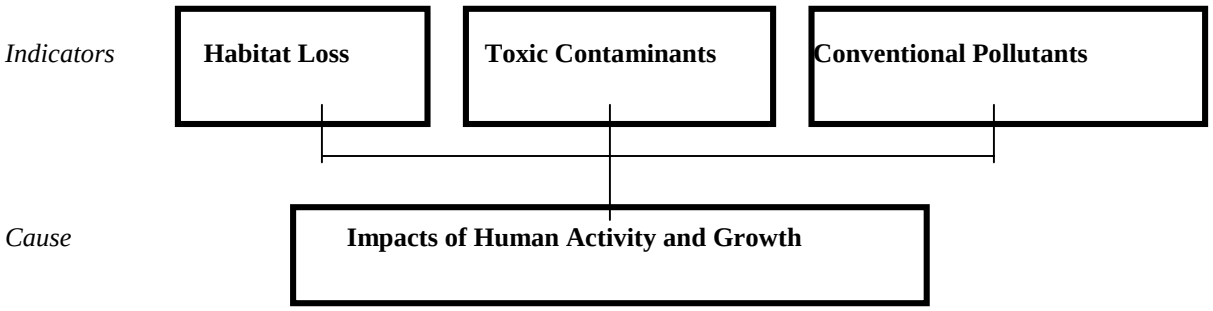
- Biological Integrity
- Impacts of Human Activity and Growth
- Habitat Loss and Modification
- Conventional Pollutants
- Toxic Contaminants
- Institutional Constraints
- Public Awareness and Stewardship

These issues are interrelated. The Estuary Program's fundamental goal is to achieve a high level of **biological integrity** for the lower Columbia River and estuary. That integrity has been degraded by **human activity and growth** over the last hundred years. The degradation is evidenced by **habitat loss and modification**, **conventional pollutants** (such as elevated temperature, increased dissolved gases, bacteria, and sediment), and **toxic contaminants** in fish tissue and sediments. **Institutional constraints** from multiple jurisdictions and **lack of public awareness and stewardship** make protection of the river challenging.

Stated in terms of future management of the lower Columbia River and estuary, actions taken to lessen the impacts of human activity, such as controlling urban stormwater runoff, will also help address water quality problems. Similarly, actions that protect and restore habitat will help provide the conditions critical to maintain biological diversity. Better public awareness of the river ecosystem and the cause/effect relationships that affect it will bring greater political will to bear on managing growth and development, which will in turn affect all the other issues.

INTERRELATIONSHIP OF PRIORITY ISSUES




Indicators
Habitat Loss
Toxic Contaminants
Conventional Pollutants
Cause
Impacts of Human Activity and Growth

The discussions that follow provide a synopsis of each of the priority issues and why they were selected for special attention. The information is this section is not meant to be an exhaustive discussion of all the problems associated with the river. In many cases the kinds of information needed to draw definitive conclusions is either inconclusive, incomplete or lacking altogether. To address these types of issues, the Estuary Program will implement a long term monitoring strategy which will attempt to fill in the gaps and provide the kind of information necessary to assess river health and track trends over time. Chapter 6 provides a more brief overview of the monitoring strategy, Volume 2 includes the entire strategy. For a more comprehensive discussion of the existing technical data, the reader should refer to the Bi-State Studies.

Biological Integrity

THE PROBLEM: The populations of certain native species in the lower Columbia River, its tributaries, and the lower Willamette River have declined, and certain ecosystem functions are impaired.

VISION: Integrated, resilient, and diverse biological communities are maintained and restored in the lower Columbia River and estuary.

The biological integrity of a river system is an indicator of "wellness." It is defined as the capacity of the river system to support and maintain an integrated, adaptive community of plant and animal life. That community needs to be composed and organized in a way that is comparable to systems supported by natural waters in the region.

Restoring and maintaining the biological integrity of the system is the ultimate goal of the Lower Columbia River Estuary Program. Because each of the other priority issues has significant impacts on biological integrity, actions taken to address them will contribute to this overall goal.

An underlying tenet of biological integrity is the maintenance of biological diversity at three levels: the individual level, the species level, and the ecosystem level. To sustain a biologically diverse community, the physical processes that support the system must be in balance. In the case of the Columbia River, good water quality and sufficient water quantity at the right times are keys to providing the aquatic environment necessary to support a diversity of native organisms. Diverse riverine habitat, including an abundance of functioning wetlands and riparian areas, are the other supports of this system.

Biological integrity is, in essence, the sum of all the parts of the natural system. When any of these parts is out of balance, biological integrity is threatened. Although a healthy system can adjust to significant disturbances, the overall integrity is compromised once the scales tip too far, and the system can no longer support the life cycles of some native species.

Tools to measure and define biological integrity are limited, and have not been extensively used in the Estuary Program study area. The river system is so large and observations regarding its condition are so varied that it is difficult to gain a full understanding of the status quo. Nevertheless, there is strong evidence to suggest that the biological integrity of the lower river and estuary is out of balance. The numerous causes for this imbalance are all the direct result of human activities. They include dam construction and operation, urban development, agricultural and forestry practices, industrial discharges, loss of habitat, and population growth.

Concerns regarding biological integrity include:

- The ability of the river system to sustain native wildlife and fish populations has decreased. Numerous species are listed as endangered or threatened under the federal Endangered Species Act(see page XX), including Columbia white-tailed deer, the Peregrine falcon bald eagles, two species of salmon and steelhead in the lower river. Of the additional 13 northwest populations of salmon and steelhead proposed for protection, nine use the

lower Columbia River for some part of their life cycle. Several species have become extinct in study area including the Grizzly Bear, Grey Wolf and California Condor.

- Toxic contaminants, including pesticides, metals, PCBs, and dioxins, have been found in the flesh of fish, river otters, and mink and in the eggs of bald eagles and other fish eating birds. These may be linked to decreased reproductive rates in eagles, otters and mink and also linked to the dramatic decline in mink populations. Contaminated fish flesh may also represent a health threat to humans.

- Radical population shifts of species are occurring along the river. Populations of some non-indigenous species have substantially increased, including shad, Asian clams, Scotch broom, and nutria. This expansion depletes habitat and food needed by native populations. Some native species of waterfowl and marine mammals have also shown large population growth. These dramatic changes are a key indication of a biological imbalance in the river.

ENVIRONMENTAL INDICATORS

For the three priority issues related to pollutants and habitat, the Estuary Program developed a set of environmental indicator informational sheets that are meant to be illustrative of kinds of problems the river faces. These are available upon request. Some portions of those sheets are included in the following discussions. Indicators that demonstrate the threats to biological integrity include bald eagles, river otters, mink, and large scale suckers as well as the loss of habitat. The Estuary Program will be developing additional information on the environmental indicators of biological integrity as knowledge of the lower river improves. This will include a more comprehensive analysis of other plant and animal species that are potential indicators, and analyses of the impacts of non-indigenous species on native species and the ecosystem.

Conspicuous in their absence from the environmental indicators discussion are salmonids. Clearly, the declining runs of salmon and steelhead are an indication of problems with the river system as well. Unlike the organisms described in this section, however, whose problems can be pinpointed fairly narrowly, salmonids are transients in the estuary and lower river and are affected by a wide range of factors most of which are outside the study area. Major efforts are underway in both Oregon and Washington to restore salmon and steelhead runs in the Columbia River basin. (See Chapter 6 page XX) The Estuary Program's role in this effort will be to focus on factors which may affect salmonids in the lower river rather than addressing fish management issues. This will include protecting, enhancing and restoring critical in river and riparian habitat, improving water quality, minimizing institutional constraints through improved coordination, and fostering a sense of river resource stewardship through education and outreach programs.

Bald Eagles

Why Are Bald Eagles Important to the Ecosystem? As a top predator, bald eagles play a key role in the food chain and are a good indicator of environmental health. Bald eagles are especially susceptible to habitat changes, human disturbance, and toxic contaminants, which can accumulate in their tissues throughout their long lives. Because eagles primarily consume fish that live in the river, their state of health is an excellent indication of water quality.
Where Are Bald Eagles Found? Bald eagles are mostly found in areas of open water, mudflats, and marsh habitats where they do most of their foraging. For perching and nesting, they require large trees with sufficiently high sturdy branches. These are usually coniferous stands bordering the estuary and on river islands.

Problem: Resident bald eagles in the lower Columbia River have unusually low reproductive rates.
What Are the Specific Concerns? Bald eagle populations in the lower Columbia River are fairly large and seem to be relatively stable at the present time. Their reproductive rate, however, is unusually low. This poorer success rate, compared to other eagle populations, is likely due to egg shell thinning caused by DDE (a metabolite of DDT). Other contaminants, including dioxins, furans, and PCBs, were found at concentrations exceeding levels known to impair reproductive success. Habitat loss and modification have also limited eagle populations and diminish the eagle's ability to deal with environmental stresses such as contaminants and human encroachment.

What Are the Sources of Toxic Contaminants in Lower Columbia River Bald Eagles? The ingestion of contaminated fish and waterfowl is the immediate source of toxic contaminants, which move through the food chain from multiple original sources. The sources of PCBs, pesticides, metals, and dioxins/furans are described under the "Toxic Contaminants" issue later in this chapter.

River Otters

Why Are River Otters Important to the Ecosystem? River otters are a top predator and play a key role in the food chain in many riverine environments. They are good indicators of environmental health because they are especially susceptible to habitat changes and human disturbance. Since river otters primarily consume resident fish, they provide an excellent indication of water quality, particularly accumulations of toxic contaminants in the lower levels of the food chain. They also consume amphibians, insects, birds, and small mammals. They are opportunistic feeders and will feed on whatever is most available.

Where Are River Otters Found? Otters generally inhabit the lower portions of streams, rivers, and estuaries, but are found throughout the Columbia River system. They are scarce in heavily populated areas and polluted areas. Critical habitat for river otters in the lower Columbia are sloughs and tidal creeks associated with willow-dogwood and Sitka spruce habitats. Otter dens are usually within 10 meters of the water. Otters tend to use existing formations such as logjams, man-made structures, or structures made by other animals such as beaver rather than making their own dens.

Problem: PCBs, pesticides, dioxins, furans, and some metals have accumulated in the tissues of river otters living in the lower Columbia River.

What Are the Specific Concerns? Data on population trends and general health are not extensive enough to accurately assess the current status of river otter populations in the lower Columbia River. The data do, however, indicate that populations have declined over the past 20 years. Monitoring has found levels of DDE (a metabolite of DDT) and PCBs in the livers of otters in the lower river that are elevated compared with other otter populations in the northwest. The impacts of these elevated levels are not well understood, but there is evidence that male sexual development is impaired. This may in turn affect the overall health of the population and may be causing a population decline. Levels of metals and dioxins/furans are also elevated, with unknown impacts. In addition, major losses of otter habitat have occurred on the lower river, which almost certainly has caused a decrease in the population.

What Are the Sources of Toxic Contaminants in Lower Columbia River Otters? The ingestion of contaminated fish and other river-associated organisms is the main source of toxic contaminants, which move through the food chain from multiple original sources. The sources of pesticides, PCBs, metals, and dioxins/furans are described under the "Toxic Contaminants" issue later in this chapter.

Mink

Why Are Mink Important to the Ecosystem? Mink are a top predator and play a key role in the food chain in many riverine environments. They are potentially good indicators of environmental health because they are especially susceptible to habitat changes and human disturbance. Unlike otters, mink are also grown commercially, and quite a bit of information is therefore available about their sensitivity to contaminants. Since they consume resident river fish and other potentially contaminated organisms, their health provides an indication of accumulations of toxic contaminants in the lower levels of the food chain. Common food items besides fish include small mammals, birds, amphibians, crustaceans, insects, and reptiles. Mink are opportunistic predators and will feed on whatever is most available. The importance of each prey item varies with the location.

Where Are Mink Found? Mink are found where there is abundant woody debris for cover and shallow pools for foraging, immediately adjacent to streams or rivers. The dens are usually within 10 meters of the water, preferably cavities in tree roots or rocks.

Problem: Mink in the lower Columbia River have elevated levels of PCBs and other contaminants in their livers.

What Are the Specific Concerns? Mink populations in the lower Columbia River are not well understood. Mink exist throughout the Columbia River system and in western Oregon and Washington, but recent data in the lower river are scarce because so few animals have been found. Information on population trends and general health is not available. The rate of mink harvest by commercial trappers has declined significantly over the past 20 years, but many variables besides the health of the populations could be the cause of this decline.

Limited monitoring data show elevated levels of PCBs in various mink tissues. Mink are known to be very susceptible to dioxins, but somewhat tolerant of DDT and DDE. The impacts of the elevated PCB levels and other contaminants found in the lower river are not understood well enough to make definitive conclusions. However, there is evidence that the mink population has declined significantly in recent years, and toxic contaminants may be part of the cause. A significant loss of habitat in the lower river is also a factor in the apparent population decline.

What Are the Sources of Toxic Contaminants in Lower Columbia River Mink? The ingestion of contaminated fish and other river-associated organisms is the main source of toxic contaminants, which move through the food chain from multiple original sources. The sources of PCBs, pesticides, metals, and dioxins/furans are described under the "Toxic Contaminants" issue later in this chapter.

Large Scale Suckers

Why Are Large Scale Suckers Important to the Ecosystem? Large scale suckers are an important part of the bottom-feeding community in the lower river, feeding almost entirely on organisms associated with bottom vegetation, including plankton, aquatic insect larvae, worms, and clams. Monitoring of the lower river backwater areas indicates that contaminated sediments settle in these areas. Because suckers sieve through the bottom sediment for food, they are likely to take up sediment-borne contaminants. Consequently, they can be an indicator of sediment contamination. Suckers are important prey for a number of carnivorous fish, birds, and mammals, including bald eagles and river otters.

Where Are Large Scale Suckers Found? Juvenile suckers are found in shallow pools and backwater areas associated with mud and cobble substrates. Adult suckers are found primarily in the main river drift, but probably feed in backwater areas where food is more abundant.

Problem: Large scale suckers in the lower Columbia River have elevated levels of PCBs, dioxins, and pesticides in their flesh.

What Are the Specific Concerns? Large scale sucker populations in the lower Columbia River are apparently thriving. They are generally abundant throughout the Columbia River system and in western Oregon and Washington. Concentrations of PCBs and dioxins above reference levels have been found in large scale sucker flesh at several locations. Some metals and pesticides have also been detected. Consumption of suckers that have bioaccumulated toxic contaminants results in even greater concentrations of the toxic contaminants in organisms that prey on them, such as eagles and otters.

What Are the Sources of Toxic Contaminants in Lower Columbia River Suckers? The ingestion of contaminated sediments and sediment-associated organisms (such as worms, clams, and plankton) is the immediate source of toxic contaminants. These contaminants have settled in the sediments and moved through the food chain from multiple original sources. The sources of PCBs, pesticides, metals, and dioxins/furans are described under the "Toxic Contaminants" issue later in this chapter.

Impacts of Human Activity and Growth

THE PROBLEM: The impacts of land use practices and population growth in the lower Columbia River and estuary, if unaddressed, will result in further loss of fish and wildlife habitat, degraded water quality, and diminished quality of life.

VISION: Land uses and land development practices, including results of past practices and population growth, are managed in a way that enhances the quality of life of the biological and human communities.

OBJECTIVES:

- Human activities, including land use practices, will not adversely affect natural systems.
- Cumulative impacts of development and human activity will be considered in planning efforts and programs.
- Development practices will conserve land.
- Enforcement of existing rules and laws will provide the basis to support voluntary efforts.
- Water quality and floodplain functions will be restored and maintained through habitat management.

Human activity over the past 100 years has significantly affected natural systems. Individuals today are less aware of the impacts their activities have on the natural environment than their forebears, and are often less physically connected to the river. The pressures of human activity and growth are evidenced in each of the other issues. Toxic pollutants are discharged into the river; land use practices cause runoff of contaminants and alter natural flood control processes; political boundaries do not recognize natural systems such as watersheds; habitat is modified and destroyed. The biological integrity of the river and estuary has been compromised as a result.

The impact of human activity over time and into the future is a core consideration that needs constant attention. Significant concerns include:

- Habitat, including wetlands, is lost. Wetlands provide critical habitat for a large variety of organisms.
- Pollutants accumulate in the ecosystem impacting the foodchain, water quality and sediment.
- The biological integrity of the river system is disturbed, as indicated by decreased biodiversity and the significant number of threatened and endangered species. Estuarine habitat, particularly wetlands, is critical to the juvenile stages of many salmon populations. Loss of key estuary habitat limits the ability of these populations to recover.
- Wastewater disposal and treatment systems tend to malfunction or perform poorly with increased loads, increasing the opportunities for discharging untreated wastes.
- The roofs, driveways, and streets of residential development reduce the land's ability to absorb and filter rainwater. The resulting erosion and contaminated runoff harm habitat and impair water quality.
- Land modification blocks animal migration routes, destroys nesting and rearing sites, and changes the habitat so much that it is unusable to some species. The continuous presence of humans and their pets may interfere with even those plant and animal communities normally able to adapt to some physical changes in the landscape.
- Commercial and industrial development contributes to air and water pollution. It also often uses large land areas and typically increases stormwater runoff problems. Traffic to and from commercial and industrial sites, and the increased human activity associated with the sites, can drive wildlife from neighboring habitat areas.
- Some agricultural and forest practices contribute to degradation of water quality and habitat: the spreading of fertilizers and pesticides, the presence of domestic and farm animals in or near streams, poor crop rotation, certain planting and harvesting methods, timber cutting near streams, and road building.

- Development in floodplains can cause pollution and excessive runoff and can result in property damage during high water.

Human population growth and activity will continue to occur. The effects of this growth, combined with past and present activities, could place significant additional stress on natural systems. If unaddressed, the adverse effects already documented will intensify, resulting in:

- Increased loss of fish and wildlife habitat. Each increment lost is more critical than the last.
- The release of more toxic and conventional pollutants to the system as a result of increased waste streams.
- Increased pollutant discharges and property damage during flooding.
- Diminished opportunity to enjoy and use the resource because of pollution from wastewater treatment, stormwater, and other non-point sources.
- Continued damage to the biological integrity of the ecosystem. Weakened integrity makes it even more difficult for the system to absorb future impacts.
- Impaired quality of life for humans, fish, and wildlife.

The issue is how to manage this human population growth and protect the integrity of the ecosystem. The effectiveness of land use planning will determine the extent to which sensitive areas and critical habitat can be sustained. Appropriate land use and development practices can reduce the stress placed on natural systems.

Habitat Loss and Modification

THE PROBLEM: The lower Columbia River and its tributaries have been modified by human activities that have negatively affected the habitat of certain fish and wildlife.

VISION: Habitat in the lower Columbia River and estuary supports self-sustaining populations of plants, fish, and wildlife.

OBJECTIVES:

- There will be no further loss or degradation of overall habitat values.
- Habitat management will focus on maintaining the biological integrity of the entire system.
- Native species will be protected and enhanced, when appropriate, and adverse effects of non-native species will be reduced.
- Habitats necessary for healthy populations of plants, fish, and wildlife will be protected.
- Future developments will protect or enhance habitat for native plants, fish, and wildlife.
- Important habitat already lost will be recovered, and impaired habitat will be enhanced and restored.
- Sensitive, threatened, and endangered species will be restored to healthy and self-sustaining populations

Habitat is critical to sustaining fish and wildlife populations. Changes in habitat directly affect a species' ability to forage and reproduce successfully. Some species may not survive habitat modifications.

Certain land and water management practices along the lower Columbia River during the last century have caused major losses and modifications of upland, wetland, and in-stream habitat. These practices include hydropower generation, dredging, agriculture, logging, channel alteration, and urban expansion. Development activity within the floodplain and loss of natural flood storage capacity have also affected habitat.

The depletion of fish and wildlife resources caused by habitat loss also directly affects the economic, recreational, and aesthetic uses of the river. For example, the decline of salmon and steelhead populations have resulted in lost revenues and recreational opportunities because of diminished commercial and sport fishing.
Regulations in place today, the Endangered Species listings, and voluntary efforts to protect and restore habitat in both Oregon and Washington, have begun to slow the losses, but losses still occur.

Concerns related to habitat loss and modification include:

- A comparison of habitat types along the lower river between the 1880s and 1991 shows large losses of wetlands, including marshes and forested wetlands, with accompanying increases in urban and developed land and open water.
- Habitat losses and modifications have had a major impact on the ability of salmon and steelhead populations to sustain themselves. Native salmon populations in the Columbia River have declined dramatically in the last century. Fish harvesting, hydropower, ocean conditions, and the presence of hatcheries are also factors in the decline.
- Several species that live in or depend on the lower Columbia River and estuary are listed as threatened or endangered, including the Columbia white-tailed deer, peregrine falcon, bald eagle, Lower Columbia River steelhead, Snake River chinook, and Snake River sockeye. (See Chapter 4 for more information about these listings.) The loss of habitat also results in important human losses of aesthetic, cultural, and scientific values.

- Development, diking, filling, damming, dredging, and many other activities that have provided economic growth to the area have resulted in loss of fish and wildlife habitat.

- In addition to affecting habitat, the loss of natural flood storage capacity due to development activity within the floodplain has contributed to increased flooding and subsequent property damage.

ENVIRONMENTAL INDICATORS

The Estuary Program studied certain "environmental indicators" that illustrate the degradation of the river system. Wetlands are an indicator that demonstrates habitat loss and modification. The lower river contains a wide variety of habitat types associated with marine, estuarine and freshwater influences. These range from open water, to bottom sediments, to tide flats, to the riparian zone. Because of the critical role wetlands play in the estuarine ecosystem, they were selected to illustrate the degradation of the river system.

Wetlands

What Are Wetlands? Wetlands are transitional areas between terrestrial and deep-water habitats where the water table is at or near the land surface, or the land is covered by shallow water. Wetlands can be vegetated or non-vegetated and are classified on the basis of their hydrology, vegetation, and soil type.

Why Are Wetlands Important to the Ecosystem? Wetlands provide important stopover, feeding, and breeding habitat for migratory waterfowl and shorebirds. They also provide critical breeding, rearing, and feeding habitat for native fish and wildlife, including a number of threatened and endangered species. About half of commercially harvested Pacific Ocean fish and shellfish species depend on wetlands for food, spawning, or nursery habitat during some stage of their lives. In addition, wetlands perform important hydrologic functions, including flood control, erosion and storm damage reduction, water quality maintenance, and water supply. Wetlands also support numerous recreational opportunities, including boating, birding and fishing.

Problem: Wetland habitat in the lower Columbia River has been substantially reduced. Historical evidence indicates that since 1870, more than half of estuarine wetlands have been lost as a result of diking, draining, filling, dredging, and flow regulation. Since 1948, certain types of wetland habitats in the lower 46 miles of the river have decreased as much as 75 percent, while barren land and open water areas have increased substantially.

What Is the Specific Concern? The loss of wetland habitat is believed to be one of the causes of declining salmon runs. It also may have a significant impact on other wetland-dependent organisms such as bald eagles, otters, minks, osprey, waterfowl, and a variety of estuarine fish and crustaceans.

What Are the Causes of Wetlands Losses in the Lower Columbia River?

- **Development:** Development is the largest single cause of the loss of wetlands. Relevant activities include diking and draining former wetlands to create farmland; filling wetlands so permanent structures can be built; and building in-stream structures such as tide gates, piers, jetties, and bridges that change river hydraulics and sedimentation. In addition, development activities in floodplains alter natural runoff and water movement patterns, causing significant wetland loss.

- **Dredging and Damming:** Dredging navigation channels and drainage channels to ensure that water drains more rapidly and spreads out less causes former wet areas to dry out and diminishes wetland habitat. Dredging also requires disposal of massive quantities of sediments, resulting in creation of new islands, filling of many former wetlands, and changing shoreline sediment types. Operation of the dams on the mainstem of the Columbia River and major tributaries has substantially reduced peak river flows and flooding, so that lands that were formerly wet part of the year are no longer wet. Dredging also may alter the important transfer of food and nutrients into and out of the system that are key to supporting wetland and other habitat types.

- **Flow Diversion:** Flow diversion for purposes such as irrigation and industrial use decreases minimum low flows. This in turn dries out areas that had formerly been wet year round.

Conventional Pollutants

THE PROBLEM: At times, certain water quality standards established to support aquatic life, protect human health, and for aesthetic purposes are not met in the lower Columbia River.

VISION: In the lower Columbia River and estuary, temperature, turbidity, bacteria, dissolved oxygen, total dissolved gas, and other conventional pollutants are controlled to levels that protect the health of fish, wildlife, and humans.

OBJECTIVES:

- Riparian and wetland vegetation will be maintained or reestablished as appropriate to protect the natural functions of estuarine areas, the mainstem of the river itself, and tributaries of the lower Columbia River to reduce conventional pollutants.
- Conventional pollutants from all sources will be prevented or reduced, and the Clean Water Act will be fully implemented with respect to conventional pollutants.
- Monitoring will be implemented and maintained to show long-term trends in conventional pollutants.
- Stream functions, including seasonal flows, fish and wildlife habitat, spawning beds, and groundwater recharge, will be maintained and enhanced.

Water quality standards have been established to protect the most sensitive beneficial uses of the river: recreation (water contact) and support of salmon and steelhead populations. Conventional pollutants for which standards exist include:

- Temperature
- Total dissolved gas
- Turbidity
- Fecal coliform bacteria
- Dissolved oxygen

Most conventional pollutants do meet established standards. The standards for temperature and total dissolved gas, however, are commonly exceeded in the lower Columbia. Bacteria, pH, and dissolved oxygen concentrations occasionally exceed standards. This means that full protection is not currently being provided, at a time when salmon and steelhead populations are under stress and human water contact activities are increasing.

Concerns regarding conventional pollutants include:

- The water temperature standard is often exceeded in late summer and fall when river flows are low. Water temperatures are frequently high enough to be harmful to native cold water species of fish and other organisms. This is of particular concern for salmonids.

- Total dissolved gas concentrations frequently exceed standards in the river during spring and summer months. Aquatic organisms may develop gas bubble disease, which can be fatal. This has caused extensive mortalities in downstream migrating juvenile salmonids.

- Turbidity and sedimentation adversely affect salmon and steelhead by smothering their redds (egg nests) and destroying existing and potential spawning and rearing habitat. In addition, toxic contaminants found in sediments of the lower river were probably transported there as part of the suspended solids load. These toxics are then ingested by bottom-feeding organisms and passed up the food chain, ultimately affecting the top predators.

- Fecal coliform bacteria concentrations at some locations occasionally exceed human health standards, resulting in possible increased risk of disease from water contact.

- Water withdrawals in some Columbia tributaries have interfered with the production of resident and migratory salmonid fishes. Lower flows reduce instream habitat and can cause increased water temperature and decreased oxygen levels.

- Violations of the dissolved oxygen and pH standards may be related to high temperature and high nutrient inputs from Willamette River sources or result from stagnation in backwater areas. These high nutrient levels can stimulate the growth of algae; however, excessive algal growth has not been a significant problem to date. Although dissolved oxygen levels are sometimes below standards, they also are not considered a serious problem at present.

ENVIRONMENTAL INDICATORS

The Estuary Program studied certain "environmental indicators" that illustrate the degradation of the river system. Indicators for conventional pollutants include temperature, total dissolved gas, turbidity and suspended solids, and fecal coliform bacteria. Other conventional pollutants of possible concern include dissolved oxygen, pH, and nutrients. Low dissolved oxygen concentrations associated with high pH levels have occasionally been measured in backwater areas in the lower river where warm waters coupled with sufficient nutrient availability, have stimulated algal growths. Low dissolved oxygen can be a problem for sensitive aquatic species such as salmonids. More data is needed to determine whether this is a significant issue.

Temperature

Why Is Water Temperature Important? Many northwest aquatic species are very sensitive to water temperature, particularly salmonids and some amphibians. Water temperatures that exceed a species' tolerance level can cause increased metabolic activity and abnormal growth, and can lead to stress and decreased resistance to disease and predation. Increased temperatures may also make juvenile fish more subject to predation by species that favor warmer waters.

Problem: Water temperatures in the lower river are frequently high enough during the summer and fall to be harmful to native cold water species of fish and other organisms.

What Is the Standard for Water Temperature? The standard, which was set to protect salmonid fish, establishes a range of temperatures that should not be exceeded. The existing standard for Oregon ranges from 50 to 68° Fahrenheit (10 to 20° Celsius), depending on the river basin and species being protected. The specific standard for the lower Columbia River is 68° F (20° C) for the average daily maximum temperature over a 7-day period. Washington's comparable standard for class A waters, which include the lower Columbia River, is that temperatures are not to exceed 68° F (20° C) in more than 15 percent of the samples taken over a 7-day period.

What Is the General Condition of the Lower Columbia River? The 68° temperature standard is exceeded in the late summer and fall when river flows are low. Temperatures rountinely reach 72° F (22° C) and above during late summer.

What Are the Specific Concerns? The lower Columbia provides critical habitat for juvenile salmonids, which are particularly sensitive to elevated temperatures.

What Are the Sources of High Temperatures in the Lower Columbia River?

- **Changes in Flow Patterns and Channel Morphology:** Actions or developments that have slowed river flow or exposed more open water to the sun (such as dams, siltation, and channel modifications) usually result in higher temperatures or changes in seasonal temperature patterns.

- **Water Impoundments:** Water impounded through such means as artificial ponds, diked impoundments for waterfowl, and other shallow bodies of water becomes warm and is discharged into the river.

- **Loss of Streamside Vegetation:** The riparian zones of many of the Columbia's tributaries have been altered by agricultural practices, forestry practices, urban development, industrial activities, and other factors that decrease protective vegetative cover and cause subsequent increased warming of the waters by solar radation.

- **Irrigation:** Water that is diverted or withdrawn for irrigation and other uses is usually warmer when it returns to the receiving stream because it has been exposed to increased solar radiation.

- **Groundwater Withdrawals:** The extensive use of groundwater for irrigation, drinking water, and other commercial purposes can decrease the amount of cold water recharge to stream systems.

- **Domestic and Industrial Discharges:** Treated domestic waste, industrial discharges, and other water uses may also contribute to the overall temperature increase.

Total Dissolved Gas

What is Total Dissolved Gas? It is a measurement of the amount of nitrogen and oxygen gas dissolved in water. Water is saturated when it can hold no more dissolved gas under normal atmospheric conditions. Concentrations exceeding 100 percent (known as supersaturation) can occur when gas is forced into the water under pressure; this can happen when water spills over a dam and plunges to depth.

Why Is Total Dissolved Gas Important to the Ecosystem? Like the air we breathe, water must have sufficient dissolved gas in the right proportions for aquatic life to survive and remain healthy. Concentrations in excess of the water quality standard of 110 percent saturation adversely affect aquatic life and can cause death.

Problem: Total dissolved gas concentrations frequently exceed standards in the river during spring and summer months.

What Is the Standard for Total Dissolved Gas? Oregon and Washington both have a standard of 110 percent saturation for the protection of aquatic life. Concentrations above this level are known to be harmful to fish and other forms of aquatic life.

***What Is the General Condition of the Lower Columbia River*?** During spring and summer months, total dissolved gas concentrations in the river frequently exceed 110 percent saturation, which can cause death. Supersaturation is highest below the dams and only gradually dissipates as the water moves downstream.

What Are the Specific Concerns? Aquatic organisms exposed to supersaturation can develop gas bubble disease. Symptoms of the disease include gas bubbles in the blood, lateral line, and intestinal tract; loss of swimming ability; reduced growth; and ruptured swim bladders. The disease can result in death.

What Are the Sources of Excess Total Dissolved Gas in the Lower Columbia River? Excess total dissolved gas concentrations in the lower river are almost exclusively the result of water spilling over Bonneville Dam and other dams upstream from it. Because of the configuration of some of the dams, the spills can drive atmospheric gases into solution, resulting in supersaturation of gases in the river.

Turbidity and Suspended Solids

What Are Turbidity and Suspended Solids? Turbidity is a measure of the amount of suspended material in the water, based on the material's refractory characteristics. Total suspended solids is a measure of the amount of organic and inorganic suspended material in the water. This is determined by filtering the water and measuring the dried residue. The two measurements are related, but there is not a direct correlation.

Why Are Suspended Materials in the Water Important? Suspended sediment in streams plays an important role in how some chemicals move throughout the environment. This also affects what ultimately happens to the chemicals. Some contaminants can attach to suspended particles, travel downstream with the suspended solids, and settle in distant locations. Suspended solids also decrease water clarity, inhibit photosynthesis, and decrease food production. In addition, excessive suspended solids eventually settle out and may fill or smother important spawning and rearing habitat.

Problem: Turbidity and suspended solids levels in the lower Columbia River are elevated and may be adversely affecting aquatic life.

What Are the Standards for Turbidity and Suspended Solids? Washington and Oregon have standards for turbidity. The Oregon turbidity standard states that concentrations cannot increase to a level that is 10 percent above the standard outside of a defined mixing zone or more than 10 percent relative to a control point immediately upstream of the source. In general terms, turbidity should not be raised more than 10 percent above the natural background level of the stream. Washington's standard is the same, except in rivers with low background turbidity. In these streams, turbidity concentrations should not increase more than five turbidity units. There are no standards for suspended solids.

What Is the General Condition of the Lower Columbia River? Turbidity and suspended solids concentrations in the lower river are somewhat elevated, but not excessive, compared to other rivers in the region. Turbidity has remained mostly unchanged throughout the historical sampling period. Concentrations increase downstream from Bonneville Dam.

What Are the Specific Concerns? Toxic contaminants at levels of concern have been found in the sediments of the lower river. These contaminants, which originated from upstream sources, were probably transported there as part of the suspended solids load.

What Are the Sources of Suspended Solids in the Lower Columbia River?

- **Stormwater Runoff:** Excessive precipitation during storm events leads to greatly increased runoff and subsequent increased levels of suspended particles from urban and rural lands. This runoff enters the lower Columbia River by way of its tributaries.

- **Land Alteration:** Construction of residential and commercial structures, road building, logging, and agricultural activities expose lands to possible erosion and landslides during rainy periods.

- **River and Stream Alterations:** Activities affecting stream beds or banks and activities affecting riparian areas along tributary streams may increase the possibility that high flows will trigger increased erosion. Turbidity and suspended solid concentrations increase as a result. Dams, on the other hand, trap suspended sediments and decrease or alter their downstream distribution.

- **Irrigation Returns:** Waters withdrawn for irrigation purposes may erode soils and return those materials to local waterways and, eventually, to the Columbia.

- **Photosynthetic Activity:** Algal blooms resulting from increased nutrients and/or sunlight can increase the suspended solids load.

Fecal Coliform Bacteria

What Are Fecal Coliform Bacteria? "Fecal coliform" refers to the group of bacteria associated with the feces of warm-blooded animals, including livestock and humans.

Why Are Fecal Coliform Bacteria Important? They constitute one of three bacteria commonly used to indicate possible contamination from human or animal waste. The others are *Escherichia coli* (*E. coli*) and *Enterococcus spp.*

Problem: Fecal coliform bacteria concentrations at some locations in the lower Columbia River occasionally exceed health standards.

What Is the Standard for Fecal Coliform Bacteria? A standard exists to protect the health of humans who come in contact with the water. It refers to the number of bacterial colonies found by filtering 100 millimeters (ml) of water through a membrane filter and incubating the filter for a specified period of time. The Washington standard, based on fecal coliform concentrations, is 100 colonies per 100 ml (based on a geometric mean of all samples with more than 10 percent exceeding 200 colonies per 100 ml). The new Oregon standard, which has replaced the old fecal coliform standard, is 126 E. coli per 100 ml (based on 30-day log mean with a single exceedance value of 406 E. coli per 100 ml). The two standards are not directly comparable because they measure different bacteria, but are thought to provide similar protection. For consistency, Washington's standard is used in this discussion since most

of the Estuary Program's data are for fecal coliform. The National Shellfish Sanitation Program has set standards for shellfish growing areas in which shellfish are harvested for direct marketing: fecal coliform median or geometric mean MPN does not exceed 14 per 100 ml, and not more than 10 percent of the samples exceed an MPN o 43 per 100 ml for a 5-tube decimal dilution test.

What Is the General Condition of the Lower Columbia River? The lower Columbia River shows minimal affects of fecal coliform. During high periods of runoff, however, fecal coliform levels occasionally rise above the standard, especially downstream from urban areas.

What Are the Specific Concerns? Since the lower Columbia River is used extensively for water contact recreation, any violations of standards may indicate a possible health hazard. Although, no disease outbreaks have been directly linked to the Columbia River, opportunities for human exposure do exist.

What Are the Sources of Fecal Coliform Bacteria in the Lower Columbia River?

- **Combined Sewer Overflows:** Many existing older sewage systems have combined storm and sanitary sewers. During high rainfall periods, the sewer can become overloaded and overflow, bypassing the treatment system. As it discharges to a nearby stream or river, untreated sewage enters the river system.

- **Treatment Plant Failure:** During intense rainfall periods, sewage treatment plants may fail, discharging untreated wastes into nearby streams. Unexpected mechanical breakdowns may also cause wastes to spill into nearby waters.

- **Livestock/Agriculture:** Agricultural practices that can contribute to fecal coliform contamination include allowing animal wastes to wash into nearby streams during the rainy season and allowing livestock to water in streams.

- **Urban Runoff:** Runoff from roads, parking lots, and yards can carry animal wastes, toxic chemicals, and other pollution to streams through storm sewers.

- **Wildlife:** Coliform bacteria can come from the feces of any warm-blooded animal. Large numbers of wildlife can therefore cause contamination of water bodies. This is especially likely during the wet season, when the wastes may wash into streams and rivers.

- **Failing Septic Tank Systems:** Individual home septic tanks, especially if not placed in appropriate areas, can become overloaded during the rainy season and allow untreated human wastes to flow into drainage ditches and nearby waters.

Toxic Contaminants

THE PROBLEM: Some toxic and/or bioaccumulative contaminants are at levels considered unsafe (or unhealthy) for certain wildlife species and may also cause human health effects.

VISION: Toxic contaminants are not present at levels that impair the health or threaten the future well-being of the lower Columbia River and estuary and the populations they support.

OBJECTIVES:

- The goals of the Clean Water Act and the requirements of the Endangered Species Act recovery measures that relate to toxic contaminants will be met.
- Toxic contaminants discharged to the river that are bioaccumulative or that persist in the environment will be eliminated or minimized to the greatest extent practicable through pollution prevention and technology.
- Toxic contaminants that do not bioaccumulate or persist in the environment will be controlled to safe levels.
- Naturally occurring chemicals that reach toxic levels as a result of human activity will be reduced to safe levels.
- Locations of elevated contamination will be identified, and contaminated hotspots will be removed, treated, or contained.
- Effects of toxic contaminants and long-term trends in toxic concentrations will be monitored.

The presence of toxic contaminants in the environment has implications for fish, wildlife, and humans. Many of these toxins work their way up the food chain by accumulating in the flesh of living organisms and can have both cancerous and non-cancerous human health effects. They can also affect the human immune system and lead to developmental abnormalities.

Toxic contaminants have been found in water, sediments, and biota (living plants and animals) of the lower Columbia River. They include PCBs (polychlorinated biphenyls), dioxins and furans, PAHs (polynuclear aromatic hydrocarbons), pesticides (particularly DDT and its metabolites), and arsenic. Some of these toxins come from current discharge sources. Others, such as PCBs and DDT and a number of pesticides, are no longer used or discharged into the river, but persist in the environment from past practices.

These toxic contaminants are impairing wildlife health in and near the river. Contaminants detected in fish tissue have also prompted human health advisories. People who consume large quantities of fish for subsistence, social, or cultural reasons are more likely to be affected by the contamination than average consumers. Health advisories may also affect the sport and commercial fishing industry if the public assumes that all fish in the river are contaminated at levels of concern, rather than only certain species and locations.

Concerns regarding toxic contaminants include:

Water

- Some pesticides have been detected at concentrations exceeding safe levels for both aquatic life and human health in the Willamette and Yakima Rivers. Both are tributaries to the Columbia River.

Sediment

- The majority of sediment samples from the lower Columbia show metals levels corresponding to background (average) levels in the Columbia River. Samples from a few locations, however, show concentrations of metals that may be harmful to humans and aquatic life.
- Dioxins and furans have been found in some sediment samples from the lower Columbia at levels that may be harmful to humans, fish, and wildlife.

Biota

- PCBs, dioxins, furans, pesticides, and some metals have accumulated in the tissue of river otters. One-year-old males are experiencing delayed development and abnormalities that may be associated with some of these contaminants.

- DDE (a metabolite of DDT), PCBs, and dioxins and furans have been found in the eggs of bald eagles at unsafe levels. The productivity of lower Columbia River eagles is well below levels of other eagle populations in the area.

- The mink population is at historically low levels. Contaminants found in the tissues of lower Columbia River mink have been measured at levels that may cause reproductive failures. Changes and losses in habitat have also contributed to the decline in mink population.

- Toxic contaminants have been detected in fish tissue. The Washington and Oregon health agencies recommend that women of reproductive age, pregnant or nursing women, and children limit their consumption of lower Columbia River fish because of the potential for human developmental effects. The Oregon Health Division issued a health advisory in 1993 concerning black crappie and carp in the Columbia Slough, based on detectable levels of PCBs. The Oregon Health Division is also evaluating a draft advisory for fish in the Willamette River, based on levels of methyl mercury. Other health advisories have been issued for other areas in the Columbia River Basin.

- PAHs are widely distributed in the environment and are common in runoff from urban areas. It is believed that PAHs may affect the health of fish and other organisms. Sampling and analysis of the impact on the Columbia River is ongoing.

- Several toxic chemicals exceed water quality standards for the protection of aquatic life in areas of the lower Columbia River. Arsenic, DDE, and PCB levels in some fish species exceed criteria at various sites from Bonneville Dam to the mouth of the river. DDE, DDT, dioxin, and lead standards are exceeded in the Columbia Slough. A total maximum daily pollutant loads for dioxin in the lower Columbia River because the compound exceeded water quality standards. Dioxin is still present due to its highly bioaccumulative nature.

- Although Chlorine was not identified in the Bi-State Study as a significant problem in the lower river, it is highly toxic to aquatic life in its residual form. Chlorine may also combine with constituents in the water to form toxic chlorinated hydrocarbons. Since most wastewater treatment facilities disinfect their effluent with chlorine, this highly toxic chemical is still impacting aquatic life in the study area. The Management Committee felt that the use of chlorine for disinfection purposes should be added to the list of concerns.

ENVIRONMENTAL INDICATORS

The Estuary Program studied certain “environmental indicators” that illustrate the degradation of the river system. Indicators for toxic contaminants include pesticides, metals, PCBs, and dioxins/furans. For many toxic contaminants there is insufficient data to make judgments on their effects on the lower Columbia River ecosystem. Much more work is needed in this area. A more comprehensive assessment of toxic contaminants in the water column, sediments and tissues is a key part of the monitoring strategy.

Pesticides

What Are Pesticides? Pesticides are chemicals that repel, kill, or prevent or regulate the growth of unwanted biological organisms. These chemicals which include herbicides and fungicides are used to control fungi, weeds, insects, plant diseases, and small animals, mainly mice and rats.

Why Are Pesticides Important to the Ecosystem? Pesticides not only target unwanted pests, they also may kill desirable organisms, either directly or by contaminating their food source. Pesticides can also accumulate in the food chain and cause adverse health effects in animals and humans. Because they are generally designed to be persistent, pesticides, their residues, and breakdown products can remain in the environment for long periods. Because they are

also designed to affect living organisms, they may accumulate in flesh, and their impacts may be magnified as they are transferred up the food chain. Generally speaking, newer pesticides are much less persistent and less likely to bioaccumulate than earlier organochlorine pesticides, such as DDT. However, much more research is needed on the newer generation of pesticides to understand their possible impacts on the environment.

Problem: Pesticides have been found in sediments and in fish tissue samples in the lower Columbia River.

What Are the Standards for Pesticides? State standards exist for some pesticides where sufficient data exist. For pesticides where data are limited, guidance values have been established. For the protection of aquatic life, the standards and guidance values are based on concentrations that cause no observable effect. For the protection of humans, the level is based on the risk of one additional cancer case in 1 million people. A wide variety of pesticides are in use, and new ones continue to be developed. Their toxic impacts on organisms are highly variable, and the standards and criteria for each are unique. The following table provides examples of some of the concentration standards.

PESTICIDE CONCENTRATION STANDARDS

Compound	**Fresh Water Aquatic Life**	**Human Fish Consumption**
Aldrin	3.0 ug/liter (acute)	0.079 ng/liter
Chlordane	2.4 ug/liter (acute)	0.46 ng/liter
Dieldrin	2.5 ug/liter (acute)	0.076 ng/liter
DDT	1.1 ug/liter (acute)	0.024 ng/liter
DDE*	1,050 ug/liter (acute)	--
Mirex	0.001 ug/liter (chronic)	--
* a guidance value	ug = microgram	ng = nanogram

What Is the General Condition of the Lower Columbia River? Monitoring on the lower Columbia has shown there are trace concentrations of some toxic organics in the water and in fish tissue. The most common pesticide found in the water column of the lower river is the herbicide atrazine, which is used extensively in the Willamette Valley. Atrazine concentrations found in the lower Columbia River are well below EPA criteria. The most common pesticides found in fish tissue are no longer in use. They include the organochlorine pesticides DDT and its metabolites DDE and DDD and, to a lesser extent, dieldrin and aldrin. The organochlorine pesticides chlordane and mirex were also found in otter and mink livers. Standards for many of the newer pesticides are still needed.

What Are the Specific Concerns? Fish tissue samples have shown sufficiently high concentrations of DDT and its metabolites DDE and DDD to be of concern for people who consume large amounts of fish. As a result, the Oregon and Washington Health Departments have issued fish consumption recommendations. There is also evidence that DDT and its derivatives may be responsible for thinning of bald eagle eggshells and reduced reproductive capabilities of mink and river otters. While concentrations of atrazine in the lower Columbia are well below levels of concern, levels found in the Willamette River are a possible concern.

What Are the Sources of Pesticides in the Lower Columbia River?

- **Stormwater Runoff:** Stormwater runoff accounts for much of the pesticides found in the water, animal flesh, and sediments in the lower river. Sources include agricultural runoff associated with crops and animal feedlots and pest and weed control applications associated with roadways, and residential, governmental, and commercial facilities. Specific sources include: direct disposal in storm drains and sewer systems; leaking landfills and hazardous waste sites; erosion of contaminated soils; contaminated groundwater; and fallout from rain, fog, and dust.
- **Application Processes:** Pesticides can enter the river directly through application to lakes, streams, and estuaries, and indirectly from drifting spray from aerial and land-based applications.
- **Spills:** Industrial, agricultural, and household spills, as well as improper storage, can introduce pesticides to the river.

- **Irrigation:** Irrigation runoff and return flows of pesticide-laced water into tributary streams and rivers are also likely sources.

Metals

What Are Metals? Metals are elements such as lead, copper, iron, and zinc that occur naturally in the environment in trace amounts. They are used extensively in manufacturing and industry. Depending on the characteristics of the metal, they can be dissolved in the water column, deposited in sediments, or both.

Why Are Metals Important to the Ecosystem? Trace amounts of these elements are normally a necessary part of existence and are not harmful to aquatic life or humans. When background levels of some metals are exceeded, however, they can become toxic and even lethal. Some metals can also be transferred up the food chain and bioaccummulate in predators.

Problem: Concentrations of metals that may be harmful to humans and aquatic life have been detected in sediments and fish tissue in the river.

What Are the Standards for Metals? There are state standards for each of the 16 metals normally monitored. There are values for fresh and marine waters and fish flesh. For aquatic life, the values are based on levels that produce no observable effects on aquatic life. For human consumption, the values are based on an increased cancer risk of one in 1 million. The metals of possible concern in the lower Columbia River are arsenic, cadmium, copper, chromium, lead, and mercury. The concentration standards for these metals are shown below.

METALS CONCENTRATION STANDARDS		
Metal	**Fresh Water Aquatic Life**	**Human Fish Consumption**
Arsenic	--	140 ng/liter (inorganic form)
Cadmium	1.1 ug/liter (chronic)*	10 ug/liter (fish & water)
Lead	3.2 ug/liter (chronic) *	50 ug/liter (fish & water)
Mercury	0.012 ug/liter (chronic)	146 ng/liter
Chromium**	11.0 ug/liter (chronic)*	
Copper	12.0 ug/liter (chronic)*	--
**trivalent & hexavalent forms	ug = microgram *dependent on water hardness	ng = nanogram

What Is the General Condition of the Lower Columbia River? The concentrations of most metals in the water column are generally well below the standards. Arsenic is persistently detected in the lower river at levels higher than the major tributaries, but not above standards. In the sediments, there are high metals concentrations in a few locations, and the levels in some fish species are elevated above background levels.

What Are the Specific Concerns? There are a number of concerns regarding metals in the lower Columbia:

- Elevated levels of cadmium and chromium in the kidneys and livers of river otters may be related to inhibited sexual development in males.
- Elevated levels of mercury, lead, and cadmium in bald eagle egg tissue occur.
- Levels of mercury and arsenic in some fish tissue are elevated and could affect humans who consume the fish.
- Elevated concentrations of arsenic, cadmium, and copper occur in some of the backwater sediments, although the significance of this is unclear without further study.

What Are the Sources of Metals in the Lower Columbia River?

- **Stormwater Runoff:** Runoff causes metals that are either dissolved in the water or attached to particulate matter to enter streams and rivers. The runoff may come from urban areas such as streets, parking lots, landfills, contaminated sites (from surface and subsurface drainage), abandoned mines, or contaminated groundwater.
- **Natural Sources:** Metals from rock and soil may be naturally introduced by dissolving in the water column.
- **Industry:** Metals may be discharged from mining or manufacturing processes, either directly to the river or through sewage treatment facilities.

PCBs

What Are PCBs? PCBs, or polychlorinated biphenyls, comprise a family of manmade colorless and odorless chemicals. Because of their insulating and nonflammable properties, PCBs were widely used as coolants and lubricants in transformers, capacitors, and other electrical equipment. Banned from production in the United States in 1976, PCBs found today are from historical use or spills.

Why Are PCBs Important to the Ecosystem? Because of their stable properties, PCBs persist in the environment for long periods. They have low water solubility, but accumulate in sediments and biological matter. Bottom-feeding fish ingest PCBs, which move up the food chain to accumulate in higher concentrations in the fatty tissues of predators. PCBs are carcinogenic and can cause reproductive problems in humans and other organisms.

Problem: PCBs have been found in fish flesh in the lower Columbia River at levels that may affect humans and other organisms that consume fish.

What Is the Standard for PCBs? The standard based on human health risk is designed to protect against the risk of one additional cancer in a population of 1 million individuals. Oregon's standard is 0.079 parts per trillion (ppt), and Washington's standard is 1.0 ppt. There are also chronic toxicity standards for the protection of organisms. The standard for fresh-water aquatic life in both Oregon and Washington is 14 ppt, and the standard for marine life is 30 ppt.

What Is the General Condition of the Lower Columbia River? Samples of fish tissue taken at various sites have elevated levels of PCBs. Bald eagles and mink appear to have had their reproductive capabilities affected by high levels of bioaccumulative contaminants such as PCBs.

What Are the Specific Concerns? Recent fish tissue samples have PCBs at high enough levels that they could adversely affect wildlife and humans who consume large amounts of contaminated fish. As a result, Oregon and Washington Health Departments have issued fish consumption recommendations.

What Are the Sources of PCBs in the Lower Columbia River?

- **Past Disposal Practices:** Past practices allowed used and worn out transformers, capacitors, hydraulic fluid, carbonless copy paper, plasticizers, and flame retardants to be taken to landfills. These materials then leaked into the groundwater and ultimately entered the river system.

- **Leaks and Spills:** Leaks from transformers and other electrical equipment may reach the water.

- **Dust Control:** In the past, the spraying of PCB-contaminated oil on roads for dust control was a common practice. This material ultimately leached into the streams and rivers.

Dioxins and Furans

What Are Dioxins/Furans? Polychlorinated dibenzodioxins (dioxins) and dibenzofurans (furans) comprise a group of chemical compounds that exhibit similar chemical, physical, and toxicological properties. They are created by the chemical interaction of chlorinated compounds with organic matter. The chlorine atoms attach themselves in various ways to produce 75 dioxin isomers and 135 furan isomers.

Why Are Dioxins/Furans Important to the Ecosystem? Dioxins/furans are widespread in the environment and persist over long periods of time. The compounds have been measured in air, soil, sediments, meat, milk, fish, vegetables, and human biological samples. Some of the dioxin/furan compounds have strong toxic effects because of their ability to attach to fatty tissues. Even in trace amounts, they have been linked to cancer and other health effects in laboratory animals. Of the numerous forms of these compounds, 17 are toxic. TCDD (2,3,7,8-tetrachlorodibenzo-p-dioxin), commonly called dioxin, is the most toxic and is considered by the Environmental Protection Agency to be a probable human carcinogen. A less toxic form, 2,3,7,8-tetrachlorodibenzofuran, has also been found in fish flesh.

Problem: Dioxins and furans have been detected in sediments and fish tissue samples in the lower Columbia River at levels that may be harmful to humans, fish, and wildlife.

What Are the Standards for Dioxins/Furans? Oregon and Washington have adopted a water quality standard of 0.013 parts per quadrillion for 2,3,7,8 TCDD. This standard is based on human health risk and is designed to protect against the risk of one additional cancer in a population of 1 million individuals. It applies to both fish consumption and drinking water. There are no standards for the other dioxin and furan compounds. There is also a guidance value for the protection of aquatic organisms that establishes a level at which there is no observable effect.

What Is the General Condition of the Lower Columbia River? Concentrations of TCDD exceeding the standard have been found in sediments and in the tissues of organisms in the lower river. Based on these findings, Oregon and Washington established waste discharge limits for TCDD for the known sources of dioxin at that time, the bleached pulp mills. The discharge limits were met in 1996. Because TCDD is long-lived and bioaccumulative in

the environment, however, elevated levels of TCDD in the sediments and tissues of organisms will continue to be found.

What Are the Specific Concerns? The concentrations of dioxins/furans found in sediments and fish tissue are believed to be one of the contributing factors in the poor reproductive performance of bald eagles and mink. In addition, humans who consume large amounts of fish may face increased risk of cancer. It is not known whether the concentrations are affecting other aquatic organisms.

What Are the Sources of Dioxins/Furans in the Lower Columbia River?

- **Industrial Processes:** A number of manufacturing processes use chlorine compounds or chlorine gas to bleach or disinfect. Chlorine is also used in electrolytic processes. Industrial sources include the pulp and paper industry, wood-treating facilities, and herbicide and pesticide manufacturers. The waste discharges from such sources could introduce dioxins/furans to the river.
- **Combustion:** The incomplete combustion of fuels from vehicles, wood stoves, fireplaces, and municipal incinerators results in the aerial deposition of dioxins.
- **Runoff:** Urban/industrial storm drains and combined storm overflows that discharge urban runoff can carry aerially deposited dioxins, pesticides, and herbicides to the river.
- **Past Management Practices:** Past waste management practices that allowed untreated or insufficiently treated wastes to enter directly into the river are in part responsible for present-day accumulations in the sediments. These sediments can be re-suspended when disturbed by dredging or floods and transported downstream.

Institutional Constraints

THE PROBLEM: The large number of agencies/governments in the study area with their different missions, responsibilities, policies, procedures, and priorities complicates the efforts to protect and improve the health of the lower Columbia River and estuary.

VISION: A coordinated, integrated network exists among all levels of government and other interested organizations that effectively and efficiently protects and manages the lower Columbia River and estuary.

OBJECTIVES:

- There will be improved coordination among governments and agencies of governments.
- Duplication of responsibility or overlapping jurisdictions will be identified, evaluated, and addressed to ensure the most effective and efficient protection of the resource.
- Areas of conflict, or potential conflict, will be identified and resolved between, among, or within governments or agencies of governments.

Effective natural resource management is extremely difficult in a system as large and diverse as the lower Columbia River and estuary. Over 160 agencies and organizations have jurisdiction or exert influence over management of the lower Columbia River. A variety of policies, laws, plans, and regulations are in place. The problems are complex, and decision-making processes are complicated and time-consuming. As a result, management efforts are often hindered by a lack of coordination and consistency, and natural resources may not receive the protection they need.

The issues affecting natural resource protection can be considered in three general groups:

- Organizational and institutional factors
- Decision-making factors
- Ecosystem management factors

ORGANIZATIONAL AND INSTITUTIONAL FACTORS

The agencies and organizations involved with management of the lower Columbia River include 19 federal, 22 state, 14 regional, and 37 local governments; 14 port districts; 7 tribes; and 44 non-governmental organizations. Each has a different jurisdiction, constituency, and purpose. Efforts at coordination are made more difficult because few, if any, are specifically charged with identifying overlaps in programs or gaps in provided services. The few that have an oversight role are often not empowered to prompt change when they identify such gaps or overlaps. This kind of fragmented approach is contrary to the need for comprehensive solutions to complex problems that do not recognize political or jurisdictional boundaries.

While some agencies and organizations are attempting to work together to develop a common vision and management strategy for the river, a number of constraints exist:

- Effective natural resource management depends on clear statutory authority and precise and implementable regulations. The Columbia River is governed by a host of different laws administered by different agencies, none of which focus on the river as a whole. Regulatory authority is often limited or inconsistent.
- The decision-making cycles of most government processes conflict with the longer timeframe needed to address many environmental issues. Problems requiring long-term solutions may be neglected in favor of those that appear easy to resolve or produce immediate results.
- Multiple issues compete for limited funding, and priorities are not always clearly set. Decisions are sometimes made in highly charged public or political arenas, which can compromise the objectivity of the decision-making process.

- The lower Columbia River and estuary encompasses diverse cultures, with multiple perspectives and needs. Disparate groups tend to work separately to accomplish individual interests, rather than focus on a common goal.

Concerns related to these organizational and institutional factors include:

- Several dozen different jurisdictions are responsible for the activities that affect water quality, fish, wildlife, and habitat in the lower Columbia River. Lack of coordination among jurisdictions adds to project costs (in terms of both dollars and time) and often results in competing plans for a given activity.

- Multiple resource management plans exist for anadromous fish, and there is continued court jurisdiction over some fish issues. As a result, decision-making and subsequent action are slowed or prevented.

- Washington and Oregon have different water quality standards, and regulatory review processes neither correspond nor dovetail. This can make the permitting process confusing and time-consuming. As a result, economic opportunities may be lost or diminished, and resources may not receive the protection they need.

- There is a lack of shared knowledge among agencies and across levels of government regarding other jurisdictions' structures, responsibilities, schedules, and contact points.

- Jurisdictions are often unable to pursue needed work because of insufficient funding. Pressures on budgets at all government levels make a long-term coordinated approach both more difficult to accomplish and more critically needed.

- Some interested parties may be underrepresented because of poor coordination and a lack of common understanding about the decision-making process. As a result, key issues are often raised in an untimely manner, adding to plan or project costs.

DECISION-MAKING FACTORS

Decision-making about natural resource management is complex, affected by numerous environmental, social, and economic conditions. Multiple and often competing questions must be considered:

- Are there conflicting environmental and biological needs or benefits?
- What are the immediate and long-term economic impacts?
- What are the social values, preferences, and needs at this time?
- What limitations does the decision place on future generations?
- What level of knowledge is needed?
- What level of scientific uncertainty is acceptable?
- Are sufficient financial resources available?

These factors would make the decision-making process difficult even in a constant world. The process is made even more challenging by continually changing values and perceptions over time. Public views and public policy are influenced by cultural and social values, the state of the economy, and political forces. Changes can be gradual and relatively easy to absorb, or more sudden and disruptive, making them difficult to manage.

The limits of science pose another problem in decision-making. Scientific knowledge is never sufficient to enable decisions to be made with absolute certainty. In addition, science alone does not determine policy, and must be considered in the context of other public values; while science may be able to solve problems, it cannot dictate which problems to solve. An informed citizenry is also crucial to scientifically based decisions. Science is useful in setting policy only to the extent that the public understands and accepts its findings as valid.

Another critical factor in the decision-making process is the need to monitor and measure the success of management actions. Measurable outcomes help determine if efforts are producing the desired results, if any

adjustments are needed, and where subsequent time and funding should be focused. The results of many actions are not easy to measure--for example, those intended to improve habitat or increase public knowledge. Without establishing clear connections between actions and effects, however, the results can be questionable and the public can lose faith in the management planning process.

Finally, current approaches to burden of proof and cumulative impacts affect the decision-making process. The burden of proof most often lies with regulatory agencies, which generally deny projects only if they can prove without doubt that the project would adversely affect the environment. Agencies are also not required to consider the cumulative impacts of activities and projects. These approaches tend to favor project approval. It may be more appropriate in some cases to place the burden of proof on the project proponent to demonstrate that the proposed action will not have unreasonable or irreversible adverse impacts on lower Columbia River and estuary resources.

ECOSYSTEM MANAGEMENT FACTORS

The complexity of the biological system is another major factor affecting resource management. The lower Columbia River and estuary is a diverse ecosystem, a transition zone between salt and fresh water that provides habitat for a wide variety of plants, fish, and wildlife. Complexity in biological systems is good because these systems are more likely to be stable and self-sustaining. The more complex a system is, however, the less evident the effects of our actions are. As a result, we do not always consider cumulative impacts. Nevertheless, each incremental change, whether visible or not, affects the biological system and almost always reduces its complexity. Each small encroachment makes it less likely that we will ever be able to restore the Columbia River ecosystem to a healthy state. The biological system must be viewed as an integrated whole, with each component dependent for its existence on all the other components.

The diversity of the lower Columbia River and estuary also means it offers many uses: environmental, economic, recreational, commercial, and aesthetic. Perhaps because it supplies so much, we have come to think of it as an inexhaustible source that can serve all of our purposes. Yet, the evidence indicates otherwise. We have to make choices about which uses are the most important to us and how much of each use the river can support. We must then manage the river to ensure that these uses will continue to exist. This will require coordination, cooperation, and a shared vision for the river and the broad community it serves.

Volume 3 of the *Management Plan* identifies the 160 agencies and entities references here. It provides their missions and enabling statutes as well as discusses the activity of each entity in the seven priority issues identified by the Estuary Program. That information is contained in the Base Program Inventory. Also in that Volume is a more extensive analysis of some of the factors that have traditionally inhibited cohesive and coordinated environmental protection. Finally, that volume provides an analysis of the major federal and state laws that govern the lower Columbia River and estuary.

Public Awareness and Stewardship

THE PROBLEM: Citizens are not now fully aware of their ability and responsibility to protect and improve the health of the lower Columbia River and estuary.

VISION: Everyone participates in maintaining and protecting the lower Columbia River and estuary.

OBJECTIVES:

- A network is maintained to provide information about activities that impact the water and habitat quality in the lower river and estuary.
- Every individual knows what lifestyle practices improve or impair water and habitat quality.
- Continuing education teaches us about the complexity of the Columbia River as a system and provide us with an evolving knowledge base to understand the system and to make environmentally sound decisions.
- Every individual is a trustee of the river.

Citizens are an integral part of a natural community; we need to develop and maintain a common concern for the well-being of that community. This concern is expressed as a commitment to environmental stewardship.

Human culture once centered upon and directly depended on water bodies. Although well over half of the nation's population still lives within 100 miles of a coast or significant river, our connection with these waters for sustenance and livelihood is less apparent than it was for our forebears. It is harder today to see how many of our daily lifestyle choices have direct impacts on our water resources. Our actions on land, even miles from the river, can have negative impacts on the health of the river. Fertilizer spread on lawns in urban areas drains to the Columbia River. The construction of miles of pavement for new shopping areas outside urban growth boundaries, and the roads to take us there, results in more heavy metals and toxic chemicals entering the river. The choice of bleached white paper adds dioxin to the water. We do not see the links, and we may not know the consequences or the alternatives. We feel less connected to the natural systems and, as a result, feel less direct responsibility for their care. Many people do not have a strong sense they belong to an "estuary community" or a "Columbia River community."

This lack of connection is compounded because it is very difficult to see the system as a whole. While some people are concerned about the health of the lower river and estuary, their focus is often more narrow. Interest groups tend to organize around a single issue, interest, or place; there is no group that promotes the health of the estuary system as a whole. People often look to institutions, not individuals, for the answers.

The problems we face today are multi-faceted, the result of multiple actions that accumulate to degrade habitat and pollute water. At one time, single point sources of pollution, such as major discharges from manufacturing plants, were considered the major contributor. Now we must address significant non-point sources, coming from numerous places and actions. This means that all of us need to assess our activities and choices, understand their impacts, and make adjustments.

Concerns related to public awareness and stewardship include:

- The processes that keep an estuary system healthy and balanced are not well understood in the lower Columbia River estuary, so citizens are unclear about the actions they should take to protect or restore it. This causes people to focus on single issues, often to the detriment of the estuary as a whole.
- People feel that individual actions will do little to affect such a large river.
- People do not believe their comments are really heard or acted upon. As a result, they are reluctant to spend the time and effort required to participate in a collaborative stewardship process.

If we are not successful in changing our attitudes, significant adverse effects will result:

- A continuing lack of knowledge about the estuary's biological and human systems will make it impossible for citizens to make decisions that will keep it healthy.

- People will be unlikely to develop a stewardship ethic unless they have a sense of place that makes them feel they own and belong to an estuary community.

- People will not participate and take action unless they believe their participation matters.

Most people want to protect the environment and leave it in a better condition for their children. With better factual information and a greater understanding of the connections, we can make more environmentally sound decisions and help shape responsible environmental policy.

From Vision to Action

The seven priority issues identify the Columbia River's priority problems based on current conditions, historical trends, and projected future conditions. They identify the visions--the statements that define what a healthy Columbia River should look like, and they identify the objectives, the steps needed to turn the vision into reality.

Identifying the priority issues was a complex and extremely important task, one the Management Committee wrestled with in its first year of existence. To identify the priority issues, the Committee relied on technical findings from the Bi-State studies, and the public, who in eight public meetings confirmed and helped refine the Committee's choices.

Early identification of the priority issues was key; the seven issues formed a framework for how the Management Committee should approach protecting and restoring the lower Columbia River. The issues kept the Management Committee focused on the overriding goals of the Estuary Program, goals such as preventing pollution not simply reducing it, and increasing wetland acreage rather than merely preventing further loss. They provided a foundation from which the Management Committee could examine issues, discuss ideas, resolve differences, and propose actions.

The priority issues also form the framework for the *Management Plan*. They are the guiding principles behind the both the plan and its actions. The priority issues directly link to the 43 **SMART** (**S**pecific **M**easurable **A**chievable, **R**esponsive **T**rackable) actions necessary to achieve the Estuary Program's fundamental goal--a high degree of biological integrity for the lower Columbia River and estuary.

The 43 actions are presented in Chapter 5. They represent the next step.

Chapter 5: ACTION PLAN

I am I plus my surroundings, and if I do not preserve the latter,
I do not preserve myself.
Jose Ortega y Gasset

The 43 actions presented in this chapter are the heart of the *Management Plan*. They are the result of extensive work involving many committed people and are based on scientific studies, the visions and objectives developed for each of the seven priority issues, and significant input from citizens of the lower Columbia River and estuary.

Developing the actions was a long-term process starting with the Bi-State studies in 1990. The Estuary Program picked up the ball and the pace in 1996 and now presents the actions. Along the way, after all the research, hundreds of hours of discussion, and heightened awareness among diverse viewpoints, one guiding theme for the Estuary Program emerged. **Protecting and restoring the biological integrity of the lower Columbia River demands that we avoid creating new problems**. **The health of the river will not significantly improve if new problems continually emerge even as old ones are addressed and solved.** This is a theme with a strong economic as well as ecological rational. Even as we struggle to fund attempts to fix existing problems, new ones emerge that are often more complicated and expensive to fix. As a society we can't afford, from an economic or ecological perspective to let the cycle continue.

The 43 actions address this underlying theme of the Estuary Program. They focus on preventing further habitat loss and restoring degraded habitats--securing a net gain in habitat. Wetland acreage won't increase if we simultaneously restore some wetlands and destroy others. The actions focus on preventing new pollution and deal with existing pollution problems. The actions encourage more environmentally sound land use in every sector from agriculture to forestry to urban development. They work toward government structures and agreements capable of anticipating problems rather than merely reacting to problems. Finally, the actions are market driven and volunteer based. To prevent future problems from occurring, everyone, individuals, corporations and governments, needs to proactively take responsibility for the future of the lower Columbia River.

The actions represent a vision for the lower Columbia River. **The actions address what the river needs**. In some cases other agencies and organizations have recognized similar needs. A number of agencies are currently expending considerable time and resources to address problems confronting the lower river and estuary. These organization's efforts are included as part of each action because they are part of what a comprehensive plan must include to address the ecosystem as a whole. For example, state agencies are developing total maximum daily pollution loads and establishing major initiatives in watershed management. Several local governments are actively pursuing stormwater management programs and reducing combined sewer overflows. The States of Oregon and Washington have completed comprehensive plans to recover recently listed threatened and endangered salmon and steelhead. In fact faltering stocks of Columbia and Snake River salmon and steelhead have prompted many different organizations and agencies to redirect their efforts on the river.

In addition to these considerable efforts of individual Federal, Tribal, State and local agencies and governments, a number of specific plans have been developed that are multi-jurisdictional and multi-issue in scope. The Estuary Program consulted a few of these in preparing this *Management Plan.*

- The plans of the states of Washington and Oregon to restore salmon runs in the Columbia River and elsewhere in the two states;
- The Northwest Power Planning Council Fish and Wildlife Plan;
- *Wy-kan-Ush-Mi Wa-Kish-Wit,* The Spirit of the Salmon Plan completed by the Columbia River Intertribal Fish Commission;

- The Biologic Opinions from the National Marine Fisheries Service.

All of these plans, prepared in response to different authorities and policy imperatives, have their own goals, geographic boundaries, and priorities. However, as much as there are observable differences among these plans, and between these plans and the Estuary Program *Management Plan*, there are substantial areas where these plans are complementary and in some cases overlap. (Chapter 6 of this Volume and Volume 3 of the *Management Plan* offer more discussion on these plans.)

The estuary plan is a plan oriented to water quality, the other plans focus on fish. Yet all of them highlight the importance of habitat that is needed for fish and recognize that adequate water quality is an important part of that needed habitat. Some of these plans, such as the Biologic Opinions, are oriented to a specific species; yet recognizes the importance of looking at habitat with a multi-species approach. The primary geographic focus of *Wy-kan-Ush-Mi Wa-Kish-Wit* is above Bonneville Dam, but it and the other plans mentioned recognize the critical nature of the lower river and estuary during some periods of the life cycle of fish**.** Similar to the overall goals, the actions identified in the plans are similar. As an example, when comparing the actions in this plan and those in *Wy-kan-Ush-Mi Wa-Kish-Wit*, about half of the 43 actions in *Management Plan* are similar in content to actions in *Wy-kan-Ush-Mi Wa-Kish-Wit*.

All of these plans, including this one, stress the importance of maximizing cooperative efforts among involved agencies to gain full return for money and effort expended, and propose scientifically sound monitoring to gauge the effectiveness of implemented elements of the plans.

The Management Committee recognized these efforts early on in its process. It chose not to limit the plan to new initiatives. The Committee developed actions first and foremost by focusing on what the river needs. In doing so, they made the plan comprehensive and opened the door to heightened coordination. After defining a set of comprehensive actions, the Management Committee worked to identify who is taking or should take the lead on a particular action. The Management Plan and the Estuary Program attempt to build on existing efforts and use existing strengths. There is much to be gained by capitalizing on those areas where the interests of different plans intersect and a good deal to be lost if we fail to grasp the opportunity to make common cause with these other efforts. Thus agencies and organizations already actively involved in a particular action were most often identified as the lead implementing entity. The Estuary Program will be involved in every action, although its role will vary. In cases where actions are currently being pursued, the Estuary Program will recognize and build on existing efforts, as well as identify new opportunities. In other cases the Estuary Program will be the lead group implementing the action with support from other groups. Both in their development, and their implementation, the actions are a partnership. The institutional complexity of the lower Columbia River demands that we as states, agencies, organizations and individuals work together and utilize our respective strengths.

Most of the 43 actions address multiple priority issues illustrating the interrelationship of the issues and the problems facing the river. The Columbia River is an extremely complex system. Its problems are multidimensional and interactive and involve not only the river itself but its tributaries and the watersheds where the region's residents go about their daily life. Effective restoration and protection requires addressing the problems with an approach and at a scale sufficient enough to incorporate all the significant components. The watershed approach does this. The Estuary Program focuses on maintaining the integrity of the whole lower Columbia River system--its chemical, physical, and biological properties, as well as its economic, recreational, and aesthetic values. Thus, each action contributes to this overall goal, and taken together, they form a comprehensive plan to restore and maintain the biological integrity of the Columbia River system.

The 43 actions are organized in three broad categories, Habitat and Land Use, Education and Management, and Conventional and Toxic Pollutants. For each action, the components that go into its implementation are identified--for example, how the action will be carried out, where, by whom, and with what funding. The template on pages XX-XX explains each component. The 43 actions then follow.

The Actions

Habitat and Land Use

1. Inventory and prioritize habitat types and attributes needing protection and conservation. Identify habitats and environmentally sensitive lands that should not be altered.
2. Protect, conserve and enhance identified habitats, particularly wetlands, on the mainstem of the lower Columbia River.
3. Adopt and implement consistent wetland, riparian, and instream habitat protection standards to increase in quality and quantity of habitat to protect aquatic species.
4. Preserve and/or restore buffer areas in appropriate locations along tributaries and the mainstem of the Columbia River to a condition that is adequate to maintain a healthy, functioning riparian zone for the lower river and estuary.
5. Restore 3000 acres of tidal wetlands along the lower 46 river miles to return tidal wetlands to 50% of the 1948 level.
6. Monitor the effectiveness of habitat protection, restoration and mitigation projects.
7. Develop floodplain management and shoreland zoning protection programs.
8. Reduce the volume and velocity and improve the water quality of stormwater runoff in developed areas.
9. Use tools and incentives in local planning ordinances and state laws to ensure that development is environmentally sensitive.
10. Establish, or modify, minimum flows (including mainstem Columbia River flows) to meet instream needs. Evaluate the cumulative impact of all proposed water withdrawals, diversions, or instream structures to ensure that established minimum flows are maintained.
11. Avoid the introduction of unwanted exotic species and manage the deliberate introduction of desirable exotic species in the lower Columbia River and estuary.
12. Require that human-caused changes in the river morphology and sediment distribution within the river channel and estuary are managed so that native and desired species are not harmed.

Education and Management

13. Create an entity that serves as an advocate for the lower Columbia River and estuary and carries out the goals of this *Management Plan*.
14. Establish a common vision for and unified commitment to the health of the river.
15. Maintain public information and education efforts about the lower river and estuary that focus on endangered species, habitat loss and restoration, biological diversity, and lifestyle practices and connections to the river.
16. Use best management practices to reduce non-point source pollution.
17. Help local governments implement federal, state and local environmental and land use laws.
18. Coordinate federal and state threatened and endangered species recovery activities in the lower Columbia River and estuary and help local communities meet species recovery requirements.
19. Enforce existing environmental and land use laws.
20. Improve coordination among government agencies.
21. Design, support and agree to use dispute resolution processes leading to resolution of institutional conflicts that affect the river.
22. Develop and implement consistent water quality related activities, laws, rules, and standards.
23. Establish an award program to promote successful stewardship and pollution prevention activities.
24. Administer grant programs to assist users with *Management Plan* implementation and to assist school children in educational efforts that focus on endangered species and habitat loss.
25. Coordinate volunteer monitoring programs and create or coordinate volunteer opportunities on the lower river.
26. Identify and improve points of public access to the river. Ensure that access does not cause further loss or degradation of habitat, increased erosion, loss of riparian vegetation, or degradation of water quality.

27. Implement the Estuary Program information management plan.
28. Implement the Estuary Program long-term monitoring plan.

Conventional and Toxic Pollutants

29. Monitor and evaluate potential effects of pollutants on human health and wildlife.
30. Develop a basin-wide strategy for identified toxic and conventional pollutants that defines their sources, fate and effects, and reduces their discharge.
31. Use pollution prevention to reduce or eliminate toxic and conventional pollution generated during manufacturing and industrial processes.
32. Reduce and maintain temperature and total dissolved gas, in the mainstem Columbia River and tributaries, to help sustain native species.
33. Reduce the bacterial contamination sometimes found in the Columbia River and its tributaries to limit human exposure to contaminated water.
34. Develop maximum pollutant loads for streams that do not meet water quality standards.
35. Eliminate new sources of persistent, bioaccumulative and toxic chemicals; eliminate existing point source discharges of persistent, bioaccumulative and toxic chemicals; and control persistent, bioaccumulative and toxic discharges from contaminated sites.
36. Require all permitted discharges to surface water to use alternatives to chlorine to protect aquatic life where such alternatives provide equivalent removal and treatment of bacteria.
37. Require that industrial wastewater that is discharged to municipal wastewater treatment facilities does not contain materials that exhibit chronic toxicity or that interact with other chemicals to cause toxic effects.
38. Reduce hydrocarbon (PAHs) and heavy metal discharges associated with petroleum powered vehicles and equipment that contaminate runoff with toxic chemicals.
39. Clean up hazardous waste sites.
40. Regulate and track the use of hazardous material to prevent re-uses that contaminate surface water or groundwater.
41. Provide subsidized hazardous material disposal opportunities for small volume users and generators.
42. Require all marine facilities to have safety and spill prevention and clean up plans in place and to have sewage and bilge pump out facilities and treatment procedures.
43. Pursue safe deposition and timely clean up of nuclear wastes stored at the Trojan and Hanford nuclear facilities.