Lower Columbia River Estuary Plan

Lower Columbia River Estuary Program
Comprehensive Conservation and Management Plan

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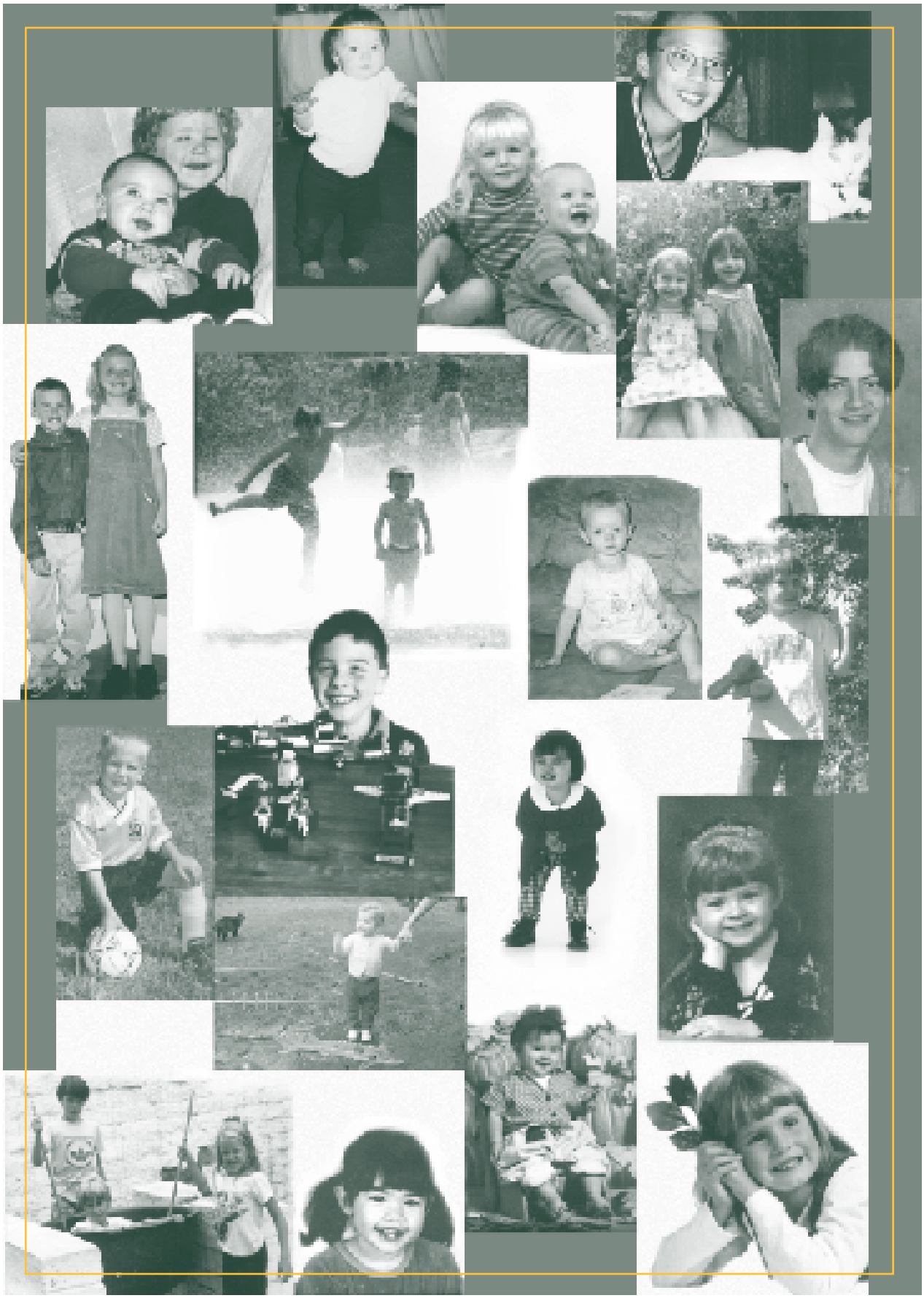
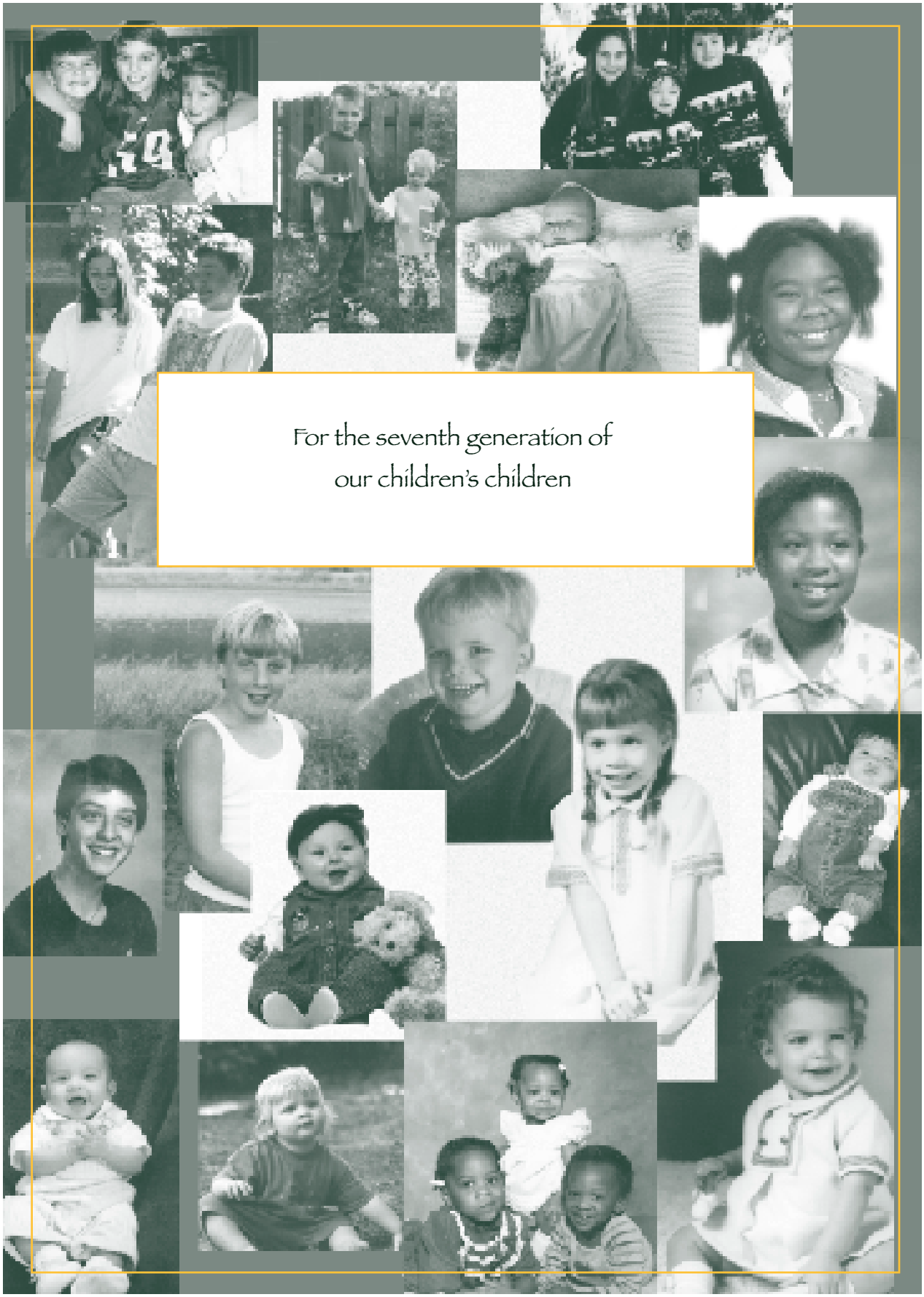
The Lower Columbia River Estuary Program is supported by the States of Oregon and Washington and the U.S. Environmental Protection Agency.

Eventually, all things merge into one,
and a river runs through it.

Norman Maclean





For the seventh generation of
our children's children

THE LOWER COLUMBIA RIVER ESTUARY PROGRAM

Comprehensive Conservation and Management Plan

VOLUME 1

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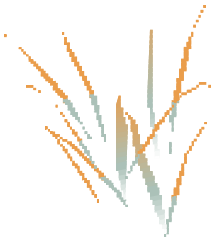

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Preface

This *Comprehensive Conservation and Management Plan* provides a broad framework for managing and protecting the lower Columbia River and estuary. It is a guide for preserving and enhancing water quality and habitat, to be implemented by federal, state, local, and tribal governments; river users; environmental interests; and citizens of the region.

As part of the National Estuary Program, the *Management Plan* focuses on the 146 miles of tidally influenced waters below Bonneville Dam. This river reach links ecosystems and economies north and south of the Oregon/Washington border, and east and west between the more heavily populated, wetter coastal valleys and mountains and the more sparsely populated, arid interior of the Columbia Basin. In addition to offering specific actions for the lower river and estuary, the plan provides a framework for coordinating the needs of the lower Columbia within broader, basin-wide considerations.

A diverse group of stakeholders participated on the Management Committee that prepared the *Management Plan*, with considerable input from the public. The plan is the product of a painstaking consensus process, which served not to dilute the decisions, but rather to create a better product. We tackled tough issues and make some bold decisions. The result is a plan that is ready for implementation, rather than requiring further debate.

The *Management Plan* defines specific actions for habitat, land use, and conventional and toxic pollutants. These actions will serve fish and wildlife habitat and water quality in three important ways: prevention of further loss, protection and enhancement of existing resources, and restoration where damage has already occurred. They focus both on solving existing problems and avoiding new ones. The goal is to achieve a net increase in water quality and habitat values.

The actions also address education and management. In our meetings with the public, we were told that education is key. Therefore, several actions call for the Estuary Program to provide hands-on education and technical and financial assistance to all parties as they work to implement this plan. Actions are also directed at both states and the federal agencies to increase consistency in setting standards, establishing regulations, and providing enforcement. Finally, the plan includes a long-term monitoring program so we can better identify problems and measure our progress.

This is an ambitious plan. Implementation of many actions can begin immediately. Success will not happen overnight, however. It will take years of diligence in many areas to see improvement. We will continually evaluate our efforts and adjust the plan to make sure it meets the river's needs. With the stewardship of all the citizens of the region, we can continue to enjoy the exemplary quality of life in the Pacific Northwest. We will be able to maintain the mutual regional goals of a vibrant economy and a healthy environment.

Glenn Vanselow, *Chair*
Lower Columbia River Estuary Program
Management Committee

Preface

The Lower Columbia River Estuary Program's *Comprehensive Conservation and Management Plan* is the work of the talented and highly dedicated members of the Management and Policy Committees. For 3 years, they have worked diligently, struggled tirelessly, and given much of themselves. The decisions did not always come easily, but after months and months of listening and learning, they make here a substantial contribution to the river and to future generations.

With completion of this *Management Plan*, we are well poised to solve problems in the lower Columbia River and estuary. Not only are the specific actions in place, they were developed in a collaborative process that will well serve their implementation. The goal has been to have the citizens guide this plan. We have often been frustrated by the size of the study area and the challenges posed by the range of cultural geography. The committee members worked very hard, using a number of innovative means, to make sure they were in fact listening to and representing all our citizenry. They took their role as representatives seriously, meeting with their constituents at critical milestones to seek guidance. While each wore a specific hat from 8:00 a.m. to 5:00 p.m., it was their 5:00 p.m. to 8:00 a.m. values that drove them. In all their public involvement efforts, the committee members never settled only for getting the public's review of their decisions; they asked for direction and guidance on issues still under debate. The plan they advance here reflects the struggles and the grace it takes to work collaboratively for a common good.

We were well served by every member, past and present. The Management Committee chair and vice-chair, Glenn Vanselow and Jim Bergeron, served as great role models in representing interests and working toward consensus. Like so many members, they gave generously of their time and energy. The faith and guidance of our facilitator, Carie Fox, made all the difference. We are indebted to Jessica Cogan and Jack Gakstatter from the U.S. Environmental Protection Agency, who were generous with their time, expertise, and resources. It is teamwork such as theirs that makes the National Estuary Program a model for dealing with any environmental issue. We appreciate the confidence and support of Marilyn Katz and Debora Martin of the U.S. EPA and Kate Kramer and the Western Center for Environmental Decision Making in helping us successfully integrate a risk ranking into our efforts. We are pleased to be on time with a quality *Management Plan* that was completed under budget, leaving program money available for additional grants and special projects. The program has benefited from a highly dedicated, talented, and fun staff.

We thank Governor John Kitzhaber of Oregon and Governor Gary Locke of Washington for their leadership in watershed management and effective government. That leadership will guide this plan and us through implementation.

To the many, many citizens beyond the committees—individual, municipal, and corporate—who joined us for workshops, participated in focus groups, gave us feedback, or planted trees: please know that this document reflects your work. We could not have done this without you.

And so, to the seventh generation of our children's children, we dedicate our work.

Debrah Richard Marriott, *Director*
Lower Columbia River Estuary Program

Mission

The mission of the Lower Columbia River Estuary Program is to preserve and enhance the water quality of the estuary to support its biological and human communities.

Values

We value the biological diversity and the economic, social and aesthetic benefits of the Lower Columbia River.

We acknowledge our differences and value our ability to come together to ensure the long term prosperity and sustainability of the river.

We are united into one community by the river. Its flow carries our history, our multiple cultures, our prosperity, and our future.

We value a common sense of stewardship toward the river by all people.

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1 Introduction

We call upon the waters that rim the earth, horizon to horizon, that flow in our rivers and streams, that fall upon our gardens and fields and we ask that they Teach us, and show us the Way.

Chinook invocation

The Columbia is a mighty river. From its origin in the Canadian Rockies, it travels 1,200 miles through forests, fields, and mountains until meeting the Pacific Ocean below Astoria, Oregon. The river's significance to this country is far-reaching. Native American peoples have fished its waters and lived near its shores for thousands of years. In 1805, the Lewis and Clark expedition journeyed down the river, seeking a route to the Pacific. Their exploration opened the vast, uncharted territory of the Columbia River Basin to a migration that continues even today. The river's powerful presence echoes in the legends and songs of those it has touched.

The grandeur and abundance of the Columbia River are revealed in many ways. Its natural beauty defines much of who we are in the Pacific Northwest, and we are drawn to it for recreation and renewal. Hundreds of species swim in its waters, dwell along its banks, and fly and nest in the surrounding heights. The Columbia generates electric power for residents and businesses, provides irrigation for crops, and harbors deep-water ships that come and go across the Pacific. Millions of people depend on the river for employment in water-related industries, for commerce, and for transportation.

Yet, the Columbia River is in trouble. As with many rivers and streams, human activities over the past 100 years have inflicted damage. Mighty as the river appears, it is not immune to pollution and the mounting pressure of sometimes competing uses. Stormwater runoff, industrial discharges, fishing, development, irrigation, power generation, forestry, mining, transportation, and water supply: all have left their marks.

Fortunately, we have the power to take action. A committed group of diverse citizens has participated in the Lower Columbia River Estuary Program (Estuary Program) to develop this *Comprehensive Conservation and Management Plan (Management Plan)*. The *Management Plan* focuses on a unique and critical part of the Columbia River system: the Lower Columbia River Estuary. It identifies how we can best preserve and enhance this magnificent resource.

As we confront the challenges of a new millennium, the *Management Plan* will help guide and support the wide community of people who care about the river's future. Working together, we can ensure that future generations will know the breathtaking beauty and wealth we have witnessed.

Where the River Meets the Sea

An estuary is the area where the fresh water of a river meets the salt water of an ocean. In the Columbia River system, this occurs in the lower 46 river miles. In an estuary, the river has a direct, natural connection with the open sea. This transition from fresh to salt water creates a special environment that supports unique communities of plants and animals, specially adapted for life at the margin of the sea. Estuarine environments are among the most productive on earth. They are fascinating and beautiful ecosystems distinct from all other places.

Estuaries are critical for the survival of many species that depend on estuarine habitats as places to live, feed, and reproduce. The wetlands that fringe them filter out sediments and pollutants, absorb flood waters to control flood damage, and prevent erosion. Tourism, fisheries, and other commercial activities thrive on the wealth of natural resources estuaries supply. The protected coastal waters of estuaries also serve as harbors and ports vital for shipping, transportation, and industry. Not least of all, estuaries provide the immeasurable values of recreation, scientific knowledge, education, and beauty.

The Clean Water Act, which authorizes the National Estuary Program (NEP), extends the definition of estuary to include tidally influenced waters of rivers. As part of the NEP, the Lower Columbia River Estuary Program uses this broader definition. The Lower Columbia River Estuary Program study area extends from the Pacific Ocean to Bonneville Dam at river mile 146 because of the far-reaching effects of the ocean's tides. It also includes near-coastal waters from the mouth of the Columbia to the 3-mile limit, to the extent those waters are influenced by the plume of fresh water flowing out of the Columbia River to the sea. The study area covers approximately 4,300 square miles. It contains a wide variety of habitats associated with marine, estuarine, and freshwater influences. These range from open water, to bottom sediments, to tide flats, to the riparian zone. The study area is also referred to as the lower Columbia River and estuary.

The Lower Columbia River Basin includes all tributaries and their watersheds that drain into the Columbia River from its mouth to river mile 146. It is larger than the study area because it includes the entire watersheds of the tributaries, beyond the waters that are tidally influenced. The Lower Columbia River Basin drains approximately 18,000 square miles, about 7 percent of the entire Columbia River Basin.

The Columbia River Basin includes all tributaries and their watersheds that drain into the Columbia River along its entire 1,200-mile length. It drains approximately 259,000 square miles.

The Lower Columbia River Estuary Program focuses on the study area, and the *Management Plan* identifies many actions that can be taken below Bonneville Dam to improve water quality and habitat in the lower Columbia River. The Estuary Program recognizes that many impacts in the study area are the result of problems or sources elsewhere in the Columbia River Basin. Efforts in the study area will be less effective if changes in the basin do not occur. For that reason, it is important not to separate the lower river and estuary from the larger watershed. While the *Management Plan* includes many actions that specifically address the study area, it also considers the impacts from the larger watershed and incorporates actions to address them where needed.

Astoria Bridge

I love any discourse of rivers, and fish and fishing.

—Izaak Walton

Lower Columbia River Estuary Program Study Area

Legend

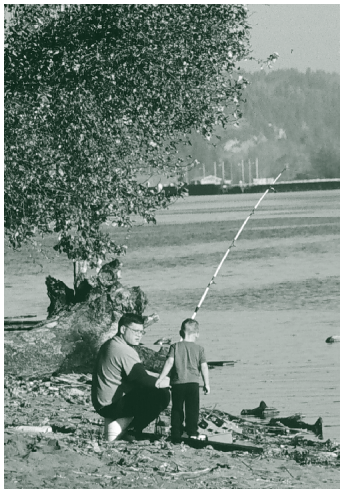
- Estuary Program Study Area
- Counties
- Water Bodies
- City Limits
- County Lines
- Rivers
- Study Area Boundary
- River Mile Marker

Scale 1:600,000

A Journey Down the River

The Lower Columbia River Estuary Program study area has a unique profile. The 146-mile journey down the river from Bonneville Dam to the Pacific Ocean reveals a rich variety of sights and uses:

- Approximately 2 million people live in the 4,300 square miles of the study area. Many more visit for rest, recreation, and business.
- Hundreds of species—175 species of birds alone—use the lower river and estuary as permanent or migratory habitat. More than a dozen rare and endangered species depend on it for survival.



- Six major pulp and paper mills contribute significant dollars and jobs to the regional economy.
- Aluminum plants along the Columbia River produce 43 percent of the nation's aluminum.
- Bonneville Dam generates power for the region and beyond—part of the Columbia River system that constitutes the world's largest hydropower system.
- A portion of the magnificent Columbia River Gorge—a National Scenic Area—lies within the Estuary Program study area. The waterfall-draped walls of this natural wonder rise 3,000 feet above the river, affording spectacular views for miles around.
- Extraordinary recreational opportunities abound, including fishing, boating, swimming, and hiking. The Columbia River Gorge is considered the windsurfing capital of the world.
- Salmon have historically been an important resource for both recreational and commercial fishing. While commercial fishing of salmon and steelhead has declined in recent years, it still plays a significant role in the regional economy. Recreational fishing also remains an important resource.
- Five deep-water ports support a shipping industry that moves 30 million tons of foreign trade worth $13 billion each year.[1]

This diverse and expansive character makes the lower Columbia River and estuary one of the most significant estuaries in the nation. Few rivers or estuaries command such beauty and supply the lifeblood for such a broad region, with widespread effects well beyond its own vast watershed.

[1] U.S. Department of Commerce, 1998

Caring for the River: A Work in Progress

By the 1980s, concern was growing that we may have irreparably harmed the Columbia River. The warning signs were becoming increasingly clear. Salmon runs were decimated, with serious effects on the fishing industry and Native Americans. Population was increasing rapidly, resulting in significant development impacts to the land, more pollution, and increased runoff. Habitats and wetlands were being destroyed. Species carried toxic chemicals in their tissue.

In response to these concerns, the States of Oregon and Washington, in cooperation with other public and private entities, initiated the Bi-State Water Quality Program (Bi-State Program) in 1990. Their purpose was to assess the state of the river, focusing on the Lower Columbia River Estuary. The 6-year Bi-State Program identified a number of significant problems related to water quality, habitat, toxics, and fish and wildlife health, and concluded that the river's future was uncertain.

Based on these findings, the Lower Columbia River Estuary was nominated and accepted into the National Estuary Program in 1995. The NEP is designed to encourage local communities to take responsibility for managing their own estuaries. The Lower Columbia River Estuary Program is one of 28 estuary programs currently working to safeguard the health of some of our nation's most important coastal and estuarine waters and upland habitats.

The Estuary Program has worked for 3 years to further refine the problems, identify specific actions to address the problems, and define how to implement those actions. This *Management Plan* is the primary product of that effort. The plan represents the extraordinary dedication of the many people who helped develop it. The collaborative process that was used has produced a viable, locally supported plan, and has also helped create a sense of community that connects and involves people with their river system. The work does not stop now. Implementation of the plan will require the continuing attention and dedication of all the region's citizens.

The Nature of the Problem

The *Management Plan* identifies seven priority issues, based on the detailed technical studies of the Bi-State Program and Estuary Program. As summarized below, these issues provide an overview of the breadth and complexity of the problems we face.

Biological Integrity

The populations of certain native species in the lower Columbia River and estuary have declined, and numerous species are now listed as threatened or endangered. Some ecosystem functions are impaired, decreasing the ability of the river system to support a healthy, adaptive community of plant and animal life. Restoring and maintaining the biological integrity of the system is the ultimate goal of the Estuary Program.

Impacts of Human Activity and Growth

Many past and current human activities have degraded the natural environment. As population continues to grow, land use and development practices could result in further pollution, habitat loss, and impacts to fish and wildlife.

Habitat Loss and Modification

Human activities over the last 100 years have significantly altered the lower river and estuary, resulting in much habitat loss and modification. Dams, dikes, maintenance dredging, urbanization, agriculture, forestry, and land use practices all contribute to this alteration. Loss of habitat harms fish and wildlife populations. Economic and recreational activities that depend on these resources are also threatened.

Conventional Pollutants

Pollutants from a variety of sources have negatively affected water quality. Common problems include high water temperatures and high levels of total dissolved gas. Standards for bacteria, dissolved oxygen, and pH are exceeded on occasion. Turbidity and sedimentation are also of concern.

Toxic Contaminants

Toxic contaminants have been found in sediment and fish tissue. Levels of PCBs, DDE, and dioxin are high enough that they may be linked to reproductive failure in bald eagles, mink, and river otter. They also pose a threat to human health.

Institutional Constraints

Many agencies and levels of government are currently involved in managing and protecting the lower river and estuary. This complex and sometimes conflicting network hampers efforts to protect and improve the health of the lower river and estuary.

Public Awareness and Stewardship

There is a continual need to connect ourselves as individual, corporate, and community citizens to the Columbia River. Greater awareness will lead to stronger protection of the river.

Future Prospects

What is the future outlook for this precious resource? The possibilities are as boundless as the river itself and our own determination. The *Management Plan* provides direction for the course we need to follow. The prospects are promising if we continue to undertake the needed work and fulfill our responsibilities as stewards of our estuary system.

A Call to Action

The *Management Plan* is both a guidebook and a call to action. The future of the lower Columbia River and estuary ultimately rests with those of us who live, work, and play here. Our activities, choices, and lifestyles directly affect the river's health and well-being. We can control and limit runoff, maintain and restore streamside vegetation, restore and protect habitat, choose less intrusive development practices, and use and discharge fewer toxic pollutants. The *Management Plan* gives us the background, tools, and vision we need. It is now up to us to carry out this vision through our continued attention and dedication. It will be well worth the effort.

We will know we are successful if:

- *Integrated, resilient, and diverse biological communities are restored and maintained in the lower Columbia River and estuary.*
- *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.*
- *Habitat in the lower Columbia River and estuary supports self-sustaining populations of plants, fish, and wildlife.*
- *In the lower Columbia River and estuary, temperature, turbidity, bacteria, dissolved oxygen, dissolved gas, and other conventional pollutants are controlled to levels that protect the health of fish, wildlife, and humans.*
- *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.*
- *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.*
- *Everyone participates in maintaining and protecting the lower Columbia River and estuary.*

Glossary

Algal growths: Growths of microscopic aquatic plants.

Alluvial: Relating to clay, silt, sand, gravel, or similar material deposited by running water.

Ambient: Refers to overall conditions surrounding a place or thing. For example, ambient monitoring refers to routine water quality monitoring.

Anadromous: Describes fish that are born in fresh water, migrate to the sea, and return to fresh water to spawn (reproduce). Examples include salmon, sturgeon, shad, smelt, and steelhead.

Aquatic: Living in or around water.

Arsenic: A naturally occurring chemical element, currently used primarily in the production of pesticides and wood preservatives. In some areas, levels of arsenic are increasing in groundwater because of seepage from hazardous waste sites. In sufficient quantities, arsenic is highly toxic to fish, wildlife, and humans.

Basin: An area of land drained by a river and its tributaries.

Bathymetry: The measurement of water depths in water bodies.

Beneficial uses: The specific uses of a river by people and wildlife, defined by state laws and regulations, and protected by state agencies. Oregon and Washington's defined beneficial uses for the lower Columbia River are: public and private drinking water supply, irrigation, stock watering, fish migration and spawning, other fish wildlife and aquatic plant uses, wildlife usage, preservation of significant and unique habitats, water contact sports, fishing and hunting, aesthetic quality, hydroelectric power, navigation and transportation, marinas and related commercial activity, and commercial fishing.

Benthic: Bottom-dwelling or substrate-oriented; at or in the bottom of a body of water.

Best Management Practice (BMP): A practice or combination of practices that are determined to be the most effective and practical means of controlling point and non-point source pollutants at levels compatible with environmental quality goals.

Bioaccumulative: Contaminants that accumulate in the tissues of individual organisms.

Bioassay: A laboratory test using live organisms to measure biological effects of a substance, factor, or condition.

Biodiversity: The number and abundance of species found within a common environment. This includes the variety of genus, species, ecosystems, and the ecological processes that connect everything in a common environment.

Biological integrity: The capacity of the river system to support and maintain an integrated, adaptive community of plant and animal life.

Biota: All living organisms that exist in a region.

Bis (2-ethyl hexyl) phthalate: A common plasticizer used in a wide variety of industrial processes.

Carcinogenic: Capable of causing or inciting cancer.

Chronic toxicity: Measured as the concentrations of toxics that cause long-term sublethal effects such as impaired growth or reproduction.

Clean Water Act: The 1973 Federal Water Pollution Control Act and Amendments are concerned with the pollution of surface water and groundwater and basically call for fishable and swimmable water everywhere. Permits are required for discharges into waters. The law provides for pretreatment standards, plans involving non-point source pollution, and effluent limitations to effectuate the statutory purpose.

Environmental Protection Agency Cluster Rule: An integrated, multi-media regulation to control the release of pollutants to air and water from the pulp and paper industry. The Cluster Rule sets new baseline limits for releases of toxics and non-conventional pollutants.

Columbia River Basin: All tributaries and their watersheds that drain into the Columbia River along its entire 1,200-mile length. The Columbia River Basin drains approximately 259,000 square miles.

Combined Sewer Overflow (CSO): Untreated overflow from commingled sanitary and storm sewers.

Confluence: The place where two or more streams or rivers meet.

Conventional Pollutants: Constituents or characteristics of the water that occur naturally but become problematic to aquatic organisms and humans due to human activity or, in some cases, natural events. Examples include high water temperatures and high levels of total dissolved gas.

Crustaceans: Invertebrates (animals without backbones) of the phylum Arthropoda, including amphipods, shrimps, crabs, barnacles, and other animals that have segmented bodies, jointed legs, and hard external shells.

Cumulative impacts: The combined environmental impacts that accrue over time and space from a series of similar or related individual actions, contaminants, or projects. Although each action may seem to have a negligible impact, the combined effect can be severe.

DDD: See DDT.

DDE: See DDT.

DDT (Dichloro-diphenyl-trichloroethane): The first chlorinated hydrocarbon insecticide (pesticide). DDT collects in the fatty tissue of some animals and was responsible for eggshell thinning and reproductive failure in eagles. The U.S Environmental Protection Agency banned registration and interstate sale of DDT in 1972 because of its persistence in the environment and accumulation in the food chain. In the environment, DDT breaks down to form DDD and DDE, which are also toxic.

Diking: A method of artificially changing the direction of a course of water or confining water.

Dioxin: A chlorinated organic compound that is widespread and persistent in the environment, some forms of which are highly toxic to fish, wildlife, and humans.

Dissolved oxygen (DO): Oxygen dissolved in water; necessary for the life of fish and most other aquatic organisms. The measurement of dissolved oxygen can be an important indicator of the condition of a water body.

Dredging: The removal of sediments from a river, estuary, or ocean, usually for navigation or docking purposes.

Ecology: The interrelationships of living things to one another and to their environment, or the study of these interrelationships.

Evolutionary Significant Unit (ESU): A population or group of populations that is considered distinct (and hence a "species") for purposes of conservation under the Endangered Species Act. To qualify as an ESU, a population must: 1) be reproductively isolated from other conspecific (of the same species) populations, and 2) represent an important component in the evolutionary legacy of the biological species.

Ecosystem: A community of organisms in a given area together with their physical environment and its characteristic climate.

Effluent: Wastewater discharged into a body of water from point sources.

Endangered Species: A plant or animal that is in danger of extinction throughout all or a significant portion of its range, as identified in accordance with the Endangered Species Act of 1973.

Endangered Species Act: A federal act to protect plant and animal species whose continued existence is in jeopardy. When species are listed under the Act as threatened or endangered, certain actions must be taken for their conservation.

Enhancement: Making changes or improvements to habitat to replace functions or values lost or damaged.

Environmental Indicators: Conditions or occurrences that indicate the health or degradation of the environment.

Erosion: Wearing away of rock or soil by the gradual detachment of soil or rock fragments by water, wind, ice, and other mechanical and chemical forces. Human activities can greatly speed this detachment.

Estuary: The area where the fresh water of a river meets the salt water of an ocean. In the National Estuary Program, this definition is extended to include the tidally influenced waters of the river.

Fecal Coliform: Bacteria associated with the feces of warm-blooded animals, including livestock and humans.

Fertilizers: Material added to the soil to supply chemical elements needed for plant nutrition.

Fill: Soil, sand, and debris deposited in aquatic areas, such as wetlands, to create dry land, usually for agricultural or commercial development purposes.

Flip lips: A structure added to the sloping surface of a spillway to change the downward direction of flow and "flip" it outward. This minimizes deep plunging of water, thereby reducing gas supersaturation and minimizing gas bubble disease in both juvenile and adult migrating fish. Also called spill flow detectors.

Floodplain: The area along a stream or river that is subject to flooding.

Food chain: An arrangement of the organisms of an ecological community according to the order of predation in which each uses the next (usually lower) member as a food source.

Furan: A chlorinated organic compound closely related to dioxin.

Gas bubble disease: A potentially fatal disease affecting fish, triggered by exposure to elevated levels of dissolved gas when water is spilled over dams.

Groundwater recharge: Replenishment of water that circulates in underground aquifers.

Habitat: Places where plants and animals live, feed, find shelter, and reproduce.

Infiltration: The downward movement of water from the atmosphere into soil or porous rock.

Instream water rights: Rights that establish flow levels to stay in a stream on a month-by-month basis, and are usually set for a certain stream reach and measurement at a specific point on the stream. Instream water rights have a priority date and are regulated in the same way as other water rights.

Lower Columbia River Basin: All tributaries and their watersheds that drain into the Columbia River from its mouth to river mile 146. It is larger than the Lower Columbia River Estuary Program study area because it includes the entire watersheds of the tributaries, beyond the waters that are tidally influenced. The Lower Columbia River Basin drains approximately 18,000 square miles, about 7 percent of the entire Columbia River Basin.

Lower Columbia River Estuary Program Study Area: Those portions of the Columbia River and its tributaries that are tidally influenced. The study area extends from the Pacific Ocean to Bonneville Dam at river mile 146. It also includes near-coastal waters from the mouth of the Columbia to the 3-mile limit, to the extent that those waters are influenced by the plume of fresh water flowing out of the Columbia River to the sea. The study area covers approximately 4,300 square miles. It is also referred to as the lower Columbia River and estuary.

Macro-invertebrates: Invertebrates large enough to be seen with the naked eye (i.e., most aquatic insects, snails, and amphipods).

Mainstem: The main course of a stream or river.

Marsh: A wetland where the dominant vegetation is non-woody plants such as grasses and sedges, as opposed to a swamp, where the dominant vegetation is woody plants and trees.

Metabolite: The product of the physical and chemical processes by which foodstuffs are synthesized into complex elements, complex substances are transformed into simple ones, and energy is made available for use by an organism.

Metadata: Information about data, such as their source, sampling protocol, and standards.

Metals: A group of elements found in rocks and minerals that are naturally released to the environment by erosion, as well as generated by human activities. Certain metals, such as mercury, lead, zinc, and cadmium, are of environmental concern because they are released into the environment in excessive amounts by human activity and can produce toxic effects.

Mitigation: Measures taken to reduce the severity of impacts resulting from an action or practice.

Morphology: The form and structure of a stream or river.

Mouth: The place where a stream or river enters a larger body of water (e.g., the ocean).

Native species: Species that are indigenous to the local region and have evolved to thrive in local conditions.

Natural flood storage capacity: The natural capacity of lands surrounding a river to absorb floodwaters and excess runoff.

National Estuary Program (NEP): A federal program established in 1987 by amendments to the Clean Water Act and administered by the U.S. Environmental Protection Agency. The NEP's primary goal is "to protect estuaries of national significance that are threatened by degradation caused by human activity." The NEP employs community-based environmental planning, designating primary responsibility for program development and implementation to the local community.

Non-indigenous species: Species not naturally growing or living in a particular area. Their introduction and expansion can destroy or deplete habitat and food needed by native populations. Also referred to as exotic or non-native species.

Non-point source pollution: Pollution entering waterways from broad land areas as a result of the way the land is used—for example, runoff from agricultural practices, construction and road-building, logging, and urban development.

National Pollutant Discharge Elimination System (NPDES) permit program: A provision of the Clean Water Act that prohibits discharge of pollutants into waters of the United States unless a special permit is issued by U.S. EPA, a state, or another delegated agency.

Nutrients: Essential chemicals needed by plants and animals for growth. Enriched nutrient loads from sewage, land runoff, and atmospheric deposition can result in excessive growth of algae and lead to degradation of water quality.

PAHs (Polycyclic or polynuclear aromatic hydrocarbons): A class of complex organic compounds, some of which are persistent and cause cancer. These compounds are formed from the combustion of organic material and are ubiquitous in the environment. PAHs are commonly formed by forest fires and by the combustion of gasoline and other petroleum products. They often reach the environment through atmospheric fallout and highway runoff.

Particulate matter: Material composed of minute separate particles.

PCBs (polychlorinated biphenyls): A group of manufactured colorless and odorless chemicals made up of carbon, hydrogen, and chlorine. 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. PCBs are suspected of causing cancer in humans and other animals.

Performance standards: Standards based on meeting certain desirable outcomes through flexible methods.

PBTs (persistent bioaccumulative chemicals): Toxic and long-lasting substances that can build up in the food chain to levels that can be harmful to human and ecological health. Many of these substances are man-made and have been in existence for a relatively short period. A few, such as mercury and cadmium, are naturally occurring.

Pesticides: Pesticides include herbicides, insecticides, fungicides, and rodenticides that are used to control unwanted plants, insects, fungi, or rodents, respectively. Most of these chemicals are manufactured and are not found naturally in the environment.

pH: Measure of the negative logarithm of the hydrogen ion concentration to determine the acidity or alkalinity of water. Water of pH 7 is neutral; lesser values are acidic; higher values (pH 14 maximum) are alkaline.

Plankton: Microscopic plants and animals that drift with currents.

Plume: An elongated column or cloud of water or suspended sediment.

Point source pollution: A source of pollutants from a single point of conveyance, such as a pipe. For example, the discharge from a sewage treatment plant or a factory is a point source.

Radionuclides: Decayed products of radioactive materials.

Redds: Nests made in gravel (particularly by salmonids), consisting of a depression that is

created and then covered.

Restoration: Returning a damaged habitat, as nearly as possible, to its condition prior to being damaged.

Riparian zone: The land bordering a stream or river, and the vegetation typical of those borders.

Riprap: Large rocks, broken concrete, or other structure used to stabilize streambanks and other slopes.

Riverine: On or near the banks of a river.

River mile: The mile marking a particular point along or in a river, measured from the mouth of a river to its source.

Rock barbs: Rock structures placed in a stream that alter flow to protect streambanks and create new aquatic and riparian habitats.

Runoff: Water from precipitation, snowmelt, and agricultural or landscape irrigation that runs off the land into water bodies.

Salmonid: Fish of the family Salmonidae, including salmon, trout, chars, whitefish, ciscoes, and grayling.

Sanitary Sewer Overflow (SSO): Overflow resulting from a municipal sanitary sewer system exceeding its capacity, due to unintended inflow and infiltration of storm water.

Sediment: Mud, sand, silt, clay and other particles that settle on the bottoms of waterways.

Self-sustaining: Species able to reproduce and rear successfully in their natural habitats and survive the remainder of their life stages.

Sensitive species: Those species that 1) have appeared in the Federal Register as proposed for classification and are under consideration for official listing as endangered or threatened species, or 2) are on an official state list, or 3) are recognized as needing special management to prevent their being placed on a federal or state list.

Slough: A channel through a marsh or mudflat.

Spawn: The act of reproduction of fish, which includes egg laying and fertilization, and sometimes nest building (e.g., salmon).

Stewardship: Taking care of the earth for ourselves and others; sharing knowledge and enthusiasm about that care with others.

Stormwater: Surface water resulting from all natural forms of precipitation.

Substrate: Material that forms a stream or lake bed (silt, sand, gravel, cobble, etc.).

Supersaturation: Water is supersaturated when concentrations of dissolved gas exceed 100 percent. This can occur when gas is forced into the water under pressure, such as when water spills over dams and forces gas into the water.

Suspended solids: Solid inorganic and organic materials that remain suspended in the water column.

Synergistically toxic: Chemicals that become toxic as they mix with other chemicals.

303(d) lists: State-compiled lists of stream segments that do not meet water quality standards.

They are called 303(d) lists after the section of the Clean Water Act that makes the requirement.

Tidal wetlands: Wetlands that have a direct connection to or are influenced by the ocean's tides. For the purposes of the *Management Plan*, tidal wetlands are defined as wetlands below river mile 46.

Tide flats: Flat areas of land exposed during low tides.

Tide gate: A structure designed to allow drainage of diked areas while preventing their inundation by the ocean's tides.

Threatened species: A plant or animal species likely to become endangered throughout all or a specific portion of its range within the foreseeable future, as identified in accordance with the Endangered Species Act of 1973.

Total dissolved gas: 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.

Total Maximum Daily Loads (TMDLs): Allocated measures that ensure compliance with water quality standards for 303(d)-listed water bodies.

Toxic chlorinated hydrocarbons: Toxic compounds resulting from the mixing of chlorine, carbon, and water.

Toxic: Poisonous, carcinogenic, or otherwise directly harmful to life.

Tributary: A stream or river feeding a larger body of water.

Tributylitin: An organic compound used as an additive in many marine anti-foulant plants to prevent algal and barnacle growth. Tributylitin is highly toxic to many marine organisms.

Turbidity: A measure of the amount of suspended material in the water, based on the material's refractory characteristics.

Urban growth boundaries: Generally state-wide, land use planning programs that mark the separation between rural and urban land. They are intended to encompass an adequate supply of buildable land that can be efficiently provided with urban services (such as roads, sewers, water lines, and street lights) to accommodate the expected growth during a specific time period.

Waste load allocations: The portion of a receiving water's loading capacity that is allocated to existing or future point source discharges.

Water column: The layer of water between surface and bottom sediments; the moving mass of water contained by a stream or river bed. The water column contains dissolved and particulate matter and provides habitat for plankton, fish, and marine mammals.

Watershed: A geographic area within which all surface water drains to a particular body of water.

Wetland: An area that is saturated by a surface of groundwater and subsequently is characterized by a prevalence of vegetation that is adapted for life in saturated soil conditions.

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Historical Photographs

Page 12 - Fish net seining. Earl Moore photo, Oregon Historical Society, #OrHi GI 7185 #390-D

Page 143 - The Rapids, Upper Cascades. Charles E. Watkins photo, Oregon Historical Society, #OrHi 21089 #1100B

In memory of Terry Husseman

whose vision and commitment inspires us still.
Terry served as Deputy Director of the Washington Department of Ecology
and was a founding member of the Estuary Program Policy Committee.
In large part, it was Terry's vision and guidance for a two-state comprehensive
environmental program that shaped the Estuary Program.
He is missed.