Lower Columbia River Estuary Partnership

2005 Report on the Estuary

Assessing Trends in the Lower Columbia River

The view from the river more and more includes osprey nests, on navigation markers, trees, pilings, and power poles. Osprey eat fish almost exclusively and prefer to feed near their nest sites, which they use year after year. Although toxic contaminants remain a concern, Osprey numbers in the lower Columbia and Willamette Rivers continue to climb. Photo by Judy Vander Maten.

From time to time, it is important to reflect on where one has been to determine where next to go. The Lower Columbia River Estuary Partnership completed our Comprehensive Conservation and Management Plan in 1999. Since then, we have been working with many partners to implement this regional set of actions aimed at improving conditions in the 146 miles of lower Columbia River and estuary, from Bonneville Dam to the Pacific Ocean.

Our Report on the Estuary is an attempt to provide a look at the river at this point in time. One of the most important things the Estuary Partnership can add to existing efforts is sustained science-based information that can tell us if conditions are improving or worsening. There have been many studies, but little long term monitoring of environmental conditions. A primary focus of the Estuary Partnership is water quality and ecosystem monitoring. With a wide array of partners, we developed a long term monitoring plan and strategy and have been successful in securing initial funds to institute aspects of the strategy.

This first report becomes our baseline for future assessment. As we expand our water quality and ecosystem monitoring programs, future reports will provide more detail with more data from which we can draw more refined conclusions about the conditions of the river.

We also include a bit of assessment about some of the progress the Estuary Partnership has made involving students and citizens. This is an important aspect of what we do. We believe that "experiential" learning by all ages helps us understand the river—in all of its ways—better. Full understanding gives us all better tools with which to make decisions about its uses and its protection.

It is a mighty river—it weaves through all of us here in the Northwest. We are incredibly fortunate that we have the means to give it to our children even better than we found it.

The Estuary Partnership Goals

The ecosystem and species are protected by increasing wetlands and habitat by 16,000 acres by 2010 and promoting improvements to storm-water management.

Toxic and conventional pollution is reduced by eliminating persistent bioaccumulative toxics, establishing maximum daily loads for streams that do not meet water quality standards, reducing hydrocarbon and heavy metal discharges, and reducing bacterial contamination.

Information about Columbia River ecosystems, economics, history, and culture is available to a range of audiences by compiling and evaluating data about the river, providing education programs for a range of audiences—focusing on children—and improving coordination among public and private partners.

Lower Columbia River Estuary Partnership

Are threatened and endangered species in the lower Columbia River recovering?

The answer is mixed depending on the species. Populations of some species, such as the bald eagle have improved, while others such as the Columbian white-tailed deer and salmon species continue to face an uncertain future.

When looking at the health of native species, the Estuary Partnership focused on three species: Lower Columbia River chinook salmon, bald eagles, and the Columbian white-tailed deer. Each is officially listed as threatened or endangered. Each is a characteristic species that serves as an indicator of the general health of the lower Columbia River.

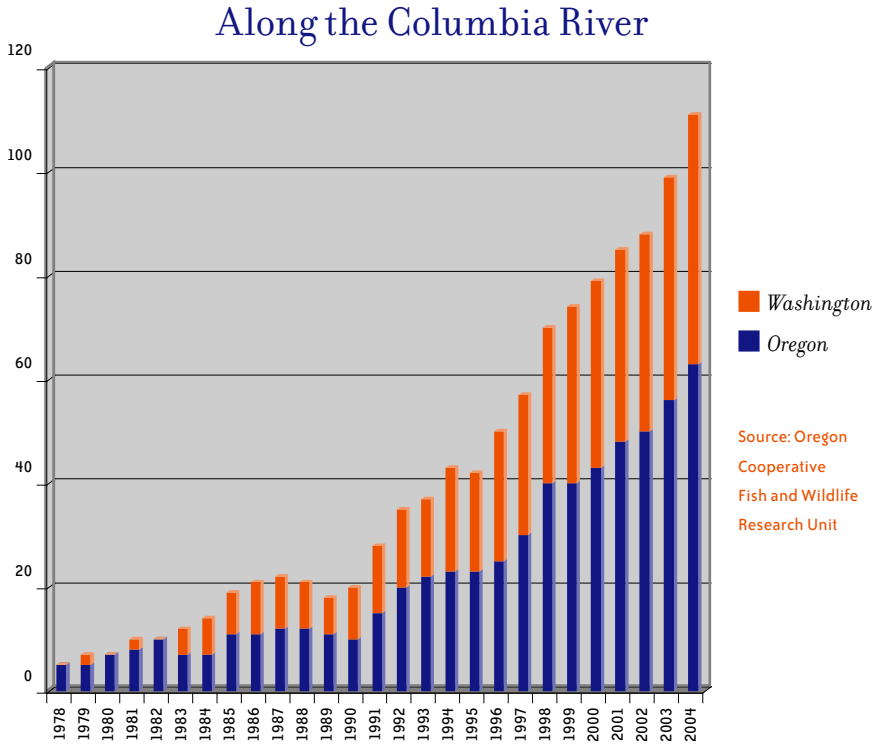
Lower Columbia River Chinook Salmon

Lower Columbia River chinook salmon is one of twelve species of salmon and steelhead listed as threatened or endangered under the Endangered Species Act that depends on the lower Columbia River and estuary. Also listed are Lower Columbia River chum, Lower Columbia River steelhead, and Lower Columbia River coho, as well as some Willamette River, upper Columbia, and Snake River salmon.

One hundred years ago, between 450,000 and 550,000 wild Lower Columbia River chinook returned to dozens of lower Columbia River tributaries. A variety of unique populations—spring, early fall, and late fall—returned to different tributaries at different times. For the fish and fishermen, times were good.

Times have changed. Since the 1980s annual Lower Columbia River chinook returns have averaged less than 100,000 fish—half of them hatchery fish. In 1999, just prior to a fish return of less than 25,000 fish, and with only a few naturally self sustaining populations of native chinook salmon left in the lower Columbia River, the National Marine Fisheries Service listed Lower Columbia River chinook salmon as threatened. The downturn can be attributed to many factors—hydropower operations, hatcheries, harvest, habitat loss, and ocean conditions among other reasons. However, scientists have singled out habitat loss and degradation due to hydropower projects, urbanization, logging, and agriculture as leading to a significant reduction in spawning and rearing habitat.

Occupied Bald Eagle Nest Sites Along the Columbia River



Source: Oregon Cooperative Fish and Wildlife Research Unit

In the past five years, salmon returns have improved some. Federal, state and tribal fisheries experts believe improved ocean conditions are the main reason for the recent up-swing. Colder ocean temperatures brought more nutrients to the surface for salmon to feed on and their ocean productivity and survival increased.

However, climatic signs are beginning to show that the Pacific's temperature may be warming again. Coupled with the sixth consecutive below-average water year in the northwest, the status of Columbia Basin salmon are still significantly at risk.

Bald Eagles

Bald eagles were listed under the Endangered Species Preservation Act in 1966. Their declining numbers, both around the country and in the lower Columbia River, were primarily attributed to pesticides. Particularly to blame was the pesticide DDT (Dichloro-diphenyl-trichloroethane), which was used for nearly three decades to control insect pests on crop and forest lands, around homes and gardens, and for industrial and commercial purposes. The chemical, which stays in the environment for years, was eventually banned in 1972 by the US Environmental Protection Agency because of increased insect resistance, development of more effective alternative pesticides, and growing public and user concern over adverse environmental side effects.

One of those side effects was bald eagle productivity. DDT and other chemicals like it accumulate up the food chain. As a top-of-the-food-chain animal, eagles absorbed a lot of DDT. As they nested each year and gave birth, the result of the pesticide accumulation was thin egg shells—and a very poor chick survival ratio.

In the years since DDT was banned, bald eagles have made a slow but steady recovery. Occupied bald eagle nest sites have been steadily growing along the Columbia River for over 25 years. While a few pairs nest above Bonneville Dam, most nest sites are in the lower Columbia River. These eagles are year-round residents who generally use the same breeding location year after year. A typical nest site is near water and an adequate fish supply, away from human activity, and surrounded by at least four large trees.

Unfortunately, problems remain. Extensive monitoring of bald eagle nests—all lower Columbia River nest sites have been monitored for productivity since the late 1970s—shows that the productivity of pairs nesting below river mile 60 remain low, especially for those nesting between river miles 13 and 31. The problem is blamed on significant concentrations of DDE, PCB, and dioxins in bald eagle egg shells. Various studies have been unable to establish why higher levels of these toxic bioaccumulative chemicals are congregating in this stretch of the river. Possibly, fine sediments and their associated toxins are being continually suspended in this mixing zone where the river's flow and the ocean's tides come together. More research is needed to truly understand the sources and causes for low bald eagle productivity in this reach.

Columbian white-tailed Deer

The Columbian white-tailed deer is one of the largest land mammals living within the lower Columbia River, and the only one with its own US Wildlife Refuge—the Julia Butler Hansen Refuge for the Columbian white-tailed Deer. The refuge, which contains over 5,600 acres of islands, pastures, forested tidal swamps, brush woodlots, marshes and sloughs along the lower Columbia River, was established in 1972 specifically to protect and manage the endangered Columbian white-tailed deer.

White-tailed deer were listed as endangered in 1968. They once ranged throughout river valleys from the Umpqua River in Southern Oregon to Puget Sound, but by the late sixties only the lower Columbia River population and a Roseburg, Oregon population remained. Habitat destruction and over hunting, primarily in the early 1900s, are most often cited for the decline.

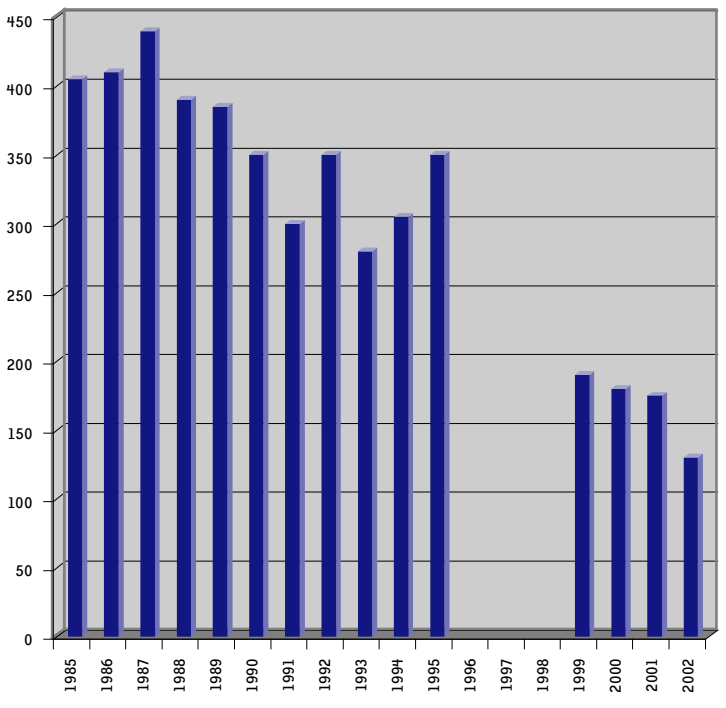
After the refuge was established, Columbian white-tailed deer numbers in the lower Columbia River began to rebound, to the point that in 1995, officials considered changing the deer's official status from endangered to threatened. But severe flooding in February 1996 killed more than half the population. Refuge lands on the mainland and Tenasillahe Island flooded and many deer perished in the high water.

Since then, wildlife refuge managers and state wildlife agencies attempting to re-invigorate the population have achieved only limited success. Deer numbers remain less than half of their 1995 population.

According to refuge managers, a variety of factors are hindering recovery, including:

- Degradation of riparian habitats through logging and brush removal.
- Historic riparian zone development for beef production, cottonwood plantations, alder harvests, and marinas.
- Deer and automobile collisions.
- Poaching.
- Entanglement in barbed wire fences.
- Competition with livestock for habitat and food.
- The introduction of wild pigs on Wallace Island in 1980.
- Habitat destruction resulting from the 1996 flood.
- Disease (foot rot) and parasites (stomach worms).
- Black tailed deer, which may compete with the Columbian white-tailed deer for food and resources and dilute the white-tailed population through in-breeding.

Columbia white-tailed Deer Counts in the Lower Columbia River



Source: Lower Columbia River Fish Recovery Board

A Columbian white tailed deer moves through a lower Columbia River meadow. A number of large protection and restoration projects have been implemented in the last few years to provide additional refuge for the deer, including a 400 acre project on Crims Island that will benefit both the deer and threatened and endangered Columbia River salmon. Photo courtesy of US Fish and Wildlife Service.

Trending Unknown

With few exceptions, threatened and endangered species in the lower Columbia River are not making significant recoveries. Approximately 24 species that live in or use the lower Columbia River for a portion of their life are listed as threatened or endangered, including plants, fish, animals, and birds. Some species, such as the bald eagle, and to a certain extent the Aleution canada goose, are slowly recovering. Many others, like the Columbian white-tailed deer, the spotted owl, the Oregon silverspot butterfly and most fish species are not.

The fact that significant energy and resources are still being expended to recover endangered species illustrates the depth of the lower Columbia River's problems. The health of an ecosystem can be gauged in large part on the health of its native species. Over thousands of years, these species have evolved and adapted to the specific peculiarities of an ecosystem, or even a watershed. When the ecosystem gets out of balance, degraded, or otherwise modified, native species no longer thrive. Additional habitat restoration and toxic and conventional pollutant reductions are key to achieving a more natural balance.

Are invasive species increasing or decreasing?

Since 1850 the number of invasive species discovered in the lower Columbia River has accelerated. Invasive species are one of the factors that have degraded the health of the lower Columbia River ecosystem.

Purple loosestrife near Wallace Island. Purple loosestrife is a non-native, invasive aquatic plant that is crowding out native wetland vegetation and impacting fish and wildlife. Photo by Ed Deery.

Invasive species can wreak significant economic and environmental damage. Studies estimate they cost the United States more than $100 billion each year and impact nearly half of the species listed on the federal Endangered Species Act. Once established, they are extremely difficult to eliminate. They thrive in altered habitats and permanently alter the natural ecosystem. Invasive species can dramatically alter food web dynamics, transmit diseases and parasites, and outcompete native species for habitat and food.

Invasive species are a problem all over the country and the lower Columbia River is not an exception. In our own backyards we see weedy species like Himalayan blackberry and scots broom. In and along the river, numerous non native fish, wildlife, and plant species thrive.

American Shad is a non-native game fish intentionally released into the lower Columbia River in the late 1800's. The population remained fairly stable until construction of the Columbia River dams, when its population began to rapidly increase. Today, nearly 4 million shad return to the Columbia River each year. Shad compete with juvenile salmon for habitat and food and also crowd fish ladders during salmon migration season. Although their full impact is not known, it's likely their growing presence has altered the estuarine food web.

What are invasive species?

Invasive species are defined as non-native to the ecosystem under consideration whose introduction causes or is likely to cause harm to the economy, environment or human health. Invasive species can be plants, animals, and other organisms. Human actions are the primary means of invasive species introduction.

Invasive plants are another problem. Purple loosestrife has invaded many wetland areas throughout the river. One plant can produce up to 2.7 million seeds each year. Eurasion water milfoil is an aquatic plant that shades out native vegetation, decreases oxygen levels, and increases phosphorous, nitrogen loadings, pH, and water temperature. Brazilian elodea is another invasive plant found in the lower Columbia River. Its dense stands restrict water movement, trap sediments, and impede boat navigation.

Latest Columbia River Invasive Species Data

Between 2002 and 2003, Portland State University's Center for Lakes and Reservoirs conducted an extensive survey of aquatic species in the lower Columbia River. Researchers sampled at 134 stations from Bonneville Dam to the Pacific Ocean, in brackish and freshwater marshes, urban sloughs, rocky shorelines and other habitats.

The field survey team identified 269 distinct aquatic species—54 invasive species (21%), 92 native species (34%), and 123 species of unknown origin (45%). When the field sampling was combined with a literature review, the team reported that 81 organisms, including fish, aquatic plants, crustaceans and worms have been introduced into the lower Columbia River since the mid 1880s.

Also of note was the discovery rate. Between 1880 and 1970, a new invasive species was discovered every five years. Over the last 10 however, a new invasive species was discovered about every five months, in part due to more frequent sampling.

The PSU study provides an important baseline, but too little is known about invasive species in the lower Columbia River. Improved monitoring and management strategies are needed to detect invasive species, limit their growth, and most importantly, prevent their introduction in the first place. While historically many invasive species were purposefully released into the river for sport or food, today's introductions are almost always unintentional, the result of ballast water discharges from international cargo ships. Hitchhikers on recreational boats and escaped or released pets can also add to invasive species problems.

Better management, monitoring, education, and vigilance are required to keep invasive species out of the lower Columbia River. Maintaining a healthy ecosystem will also help. Invasive species often thrive in degraded and disturbed ecosystems. An environment where native plants and animals are thriving will naturally prevent most invasive species from gaining a foothold.

Trending Negative

Invasive species appear to be on the rise in the lower Columbia River. New invasive species are discovered regularly, and many existing invasive species, both plant and animal appear to be thriving. While control and eradication efforts against certain species are increasing, education, monitoring, and management strategies to prevent, identify, and control new invasions are lacking.

In addition, officials are on the watch against a handful of potentially very destructive invasive species that threaten the lower Columbia River. The perennial marsh grass Spartina alterniflora is present in Willapa Bay and Puget Sound, and has established at a number of sites in Oregon. The Chinese Mitten Crab, European Green Crab, and Zebra Mussel are all significant threats. Mitten crabs can prey on salmon and sturgeon eggs, damage banks, levees, and pumps, and are a human health concern. Green crabs could negatively impact native Dungeness crab as well as clam and oyster fisheries. Zebra mussel can adhere to any hard surface, endangering native shellfish, as well as potentially damaging water pipes, boats, buoys, power plants, fish ladders, and navigation locks and dam operations. All significantly disrupt the native ecosystem.

Preventing unwanted invasive species introduction is possible. Each person, organization, and business must do their part. Never release pets, plants, or aquarium animals or plants into the wild, if traveling between water bodies clean recreational equipment of weeds or other accidental hitchhikers, and report any invasive species sighting to local fish and wildlife offices.

Are pollutant levels in the lower Columbia River increasing or decreasing?

We can't conclusively say because no sustained long term monitoring has taken place.

Throughout the summer, each day thousands of people take to the lower Columbia River to swim, fish, water ski, sail, or just picnic along its banks. Good water quality is imperative to their enjoyment of the river. It's even more important for fish and wildlife that live and eat from the river.

Good water quality is essential to a healthy river, one that can support all the biological communities that depend on it—fish, bugs, birds and people. In the lower Columbia River, pollutants from various sources have affected water quality. Common problems include high water temperatures and elevated levels of total dissolved gas. Bacteria, dissolved oxygen, and pH levels are also occasionally higher than standards permit. Toxic contaminants are also a problem. They've been found in sediment and fish tissue and levels of PCBs, DDE, and dioxin are high enough that they've been linked to reproductive failure in bald eagles, mink, and river otter.

In this report we are focusing on toxics, and two water quality indicators—temperature and dissolved oxygen.

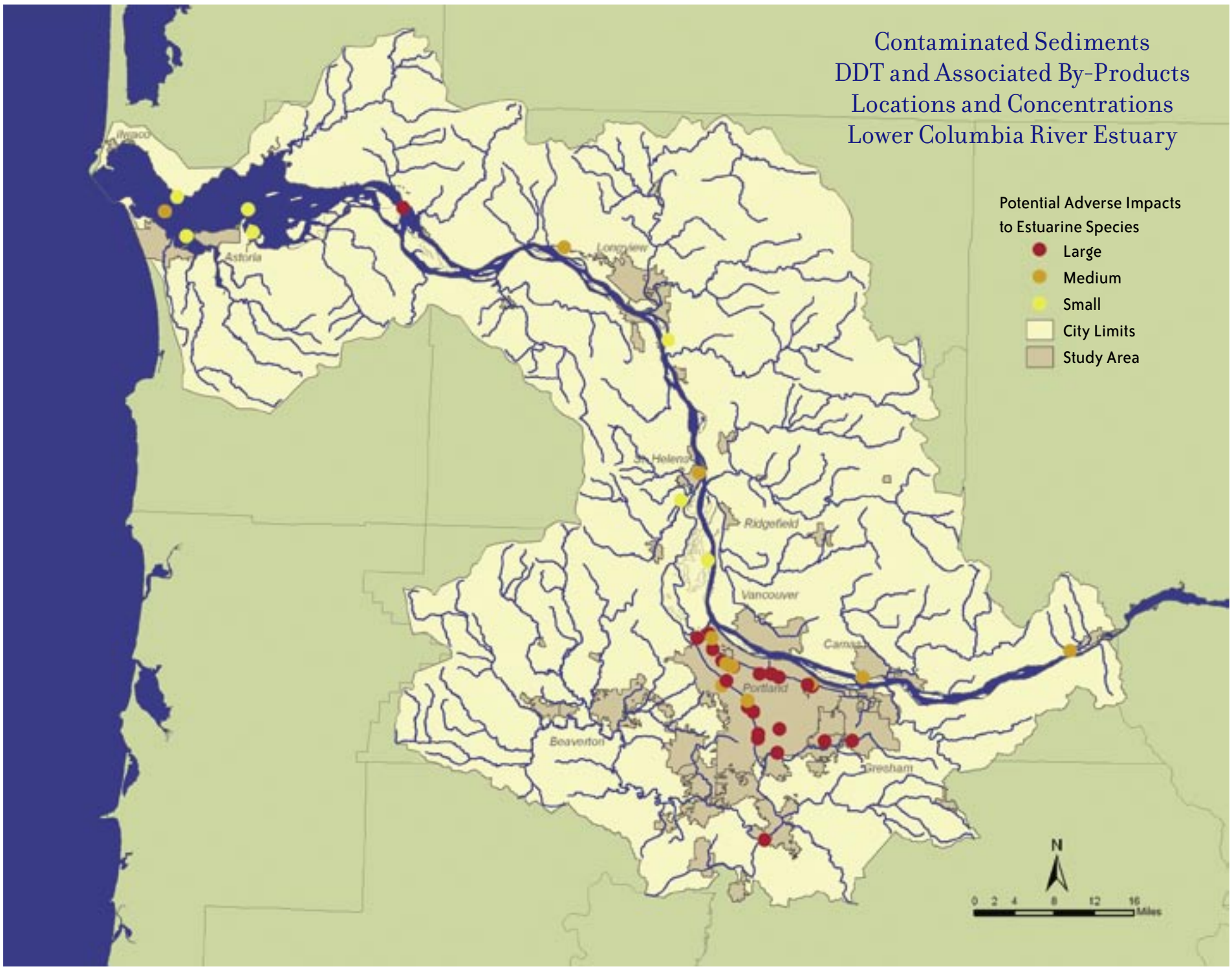
Are toxics in the lower Columbia River being reduced?

While the use and discharge of pollutants such as DDT, Dieldrin, and PCBs is now illegal, these pollutants remain in the lower Columbia River. Additionally, a number of emerging contaminants, such as the flame retardant PBDE, are being discovered in the lower Columbia River.

There are a variety of different toxic contaminants in the lower Columbia River ranging from pharmaceuticals, to insecticides, to trace metals. Some of the most prevalent and important are:

PCBs: PCBs, or polychlorinated biphenyls, were widely used as coolants and lubricants in transformers, capacitors and other electrical equipment until being banned in 1976. Thirty years later, they remain in the lower Columbia River. PCBs move up the food chain and accumulate in higher concentrations in the fatty tissue of predator animals.

Peamouth sucker spend their life in slow moving backwater areas of the lower Columbia River where toxic sediments tend to accumulate. As bigger fish eat small fish, and large birds eat big fish, toxics accumulate up the food chain.



Contaminants of potential environmental concern are present in the lower Columbia River at concentrations that may result in acute or chronic impacts to sensitive estuarine species. One of those contaminants, DDT and its associated byproducts, has been found in lower Columbia River sediments in studies ranging from the Bi-State Reports to the Sediment Quality Information System, data from which forms the source for this map. The Estuary Partnership has initiated a toxics monitoring program that will provide newer and more detailed contaminant information in the near future.

DDT/DDE: Pesticides such as DDT and its derivative DDE were designed to repel, kill, or prevent the growth of fungi, weeds, insects, plant diseases, and small animals such as rats and mice. These toxics continue to cause problems. Fish tissue samples have shown high enough concentrations for state health administrators to issue fish consumption recommendations.

PBDEs: Also known as brominated flame retardants, PBDEs are widely used as an additive to prevent or deter fires in electronic devices, furniture, and textiles. PBDEs have been found in the body fat of many wildlife species and evidence suggests that low-level exposure may produce detrimental health effects in humans and animals.

Toxic substances are of significant concern for several reasons:

- **They persist in the environment for decades**. Although banned in the United States in the early 1970's, DDT and its derivatives are still found at elevated levels in juvenile salmonids. PCBs and a variety of organochlorines and toxic metals such as mercury, cyanide, and arsenic also have been found above guidance levels in fish tissue and sediment.
- **They accumulate up the food chain**. Small fish eat contaminated sediment, bigger fish eat lots of small fish, and predator birds eat lots of big fish. Each step up the food chain, toxics accumulate at higher levels. The problem is serious enough that in 1996 the Oregon and Washington health departments each issued health advisories regarding the consumption of certain bottom dwelling fish species (carp, peamouth, and sucker). The advisories remain in effect.
- **They can cause cancer as well as impact the immune, reproductive, nervous and endocrine systems in animals**. Their impact on humans has not been adequately researched.

Are water temperatures in the lower Columbia River increasing or decreasing and do they support native aquatic species?

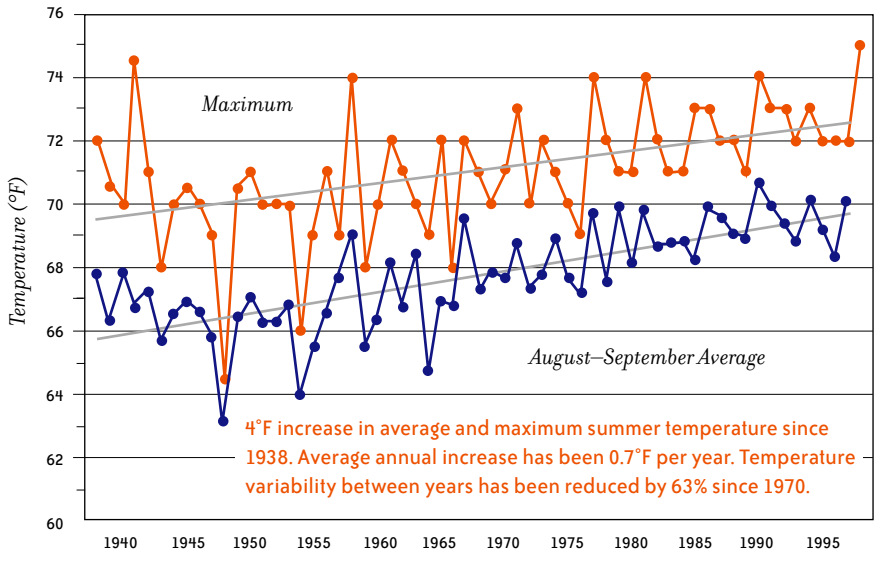
Water temperatures continue to increase putting native aquatic species at risk.

The temperature standard for the lower Columbia River is 68 degrees for the average daily maximum temperature over a seven-day period. During low flow months such as August and September, the water temperature in the lower Columbia River regularly rises above this limit. Lower Columbia River water temperatures have been slowing climbing over the last 65 years. Since 1938, both the August-September average and maximum summer temperature at Bonneville Dam have increased by around four degrees. The average increased from approximately 66 to 70 degrees and the maximum from near 69 to above 72.

The negative impacts of high water temperatures are numerous. High temperatures:

- Increase fish and other aquatic animals' susceptibility to disease by weakening their immune systems.

Historical Changes in Summer Water Temperatures at Bonneville Dam



Source: National Marine Fisheries Service (2000)

Mainstem Columbia River dams, like Bonneville Dam, have greatly changed the lower Columbia River's natural flow and temperature regime. Large reservoirs behind the Columbia's dams absorb the heat of the summer sun, raising water temperatures above the 68 degree standard set to protect aquatic species. When temperatures rise above 68 degrees, salmon and other native species become stressed and much more susceptible to disease.

- Lead to less dissolved oxygen in the water which can stress fish health.
- Slow or even stop fish migrations. Fish may seek cooler water off their migration route to avoid high temperatures.
- Make getting through fish ladders, where temperatures can be higher than the river, even more problematic.

Historically, the lower Columbia River was full of clean, cold water. Summer time temperatures may have increased, but as snow in the Cascades melted over the course of the summer, clean cold water would find its way down to the lower Columbia River. Salmon, steelhead, and most of the river's other fish and wildlife adapted over generations to that system.

Today, the Columbia River's flow is governed by dams rather than snowmelt. Large reservoirs behind the Columbia's dams absorb the sun's heat during the summer and water temperatures rise. Dam operations also play a part—depending on whether a dam is spilling water—and thereby flushing the top, warmer layer of water, or pulling cooler water from the bottom of the reservoirs and running it through turbines.

Other factors that may be impacting lower Columbia River temperatures include warmer tributary flows, due to tributary dams and the loss of shoreline vegetation that shades streams, the cumulative impacts of warm stormwater runoff from impervious surfaces, and the effects of global warming.

Do current dissolved oxygen levels in the lower Columbia River support native aquatic species?

Yes, according to state standards. In 2002, 95% of the lower Columbia River met Oregon's and Washington's dissolved oxygen standard.

Between 1995 and 2002, the lower Columbia River was classified by Oregon and Washington as an "impaired" water body with regard to dissolved oxygen. That meant at certain times of the year in certain reaches of the lower Columbia, dissolved oxygen levels fell below 8 milligrams per liter, each state's minimum standard for dissolved oxygen. When the 303d list (the name of each state's list of impaired water bodies) was updated in 2002, new monitoring data showed the lower Columbia meeting state standards and it was removed from the list.

Whether dissolved oxygen levels in the river actually changed is difficult to know. Sampling locations might have changed, water temperatures might have been lower—cold water tends to hold more oxygen—or any of a number of other factors might have led to improved dissolved oxygen levels.

Oxygen is a necessary element to all forms of life, whether on land or in water. Dissolved oxygen measures the amount of oxygen in water. Fish, aquatic invertebrates, and aquatic plants all require dissolved oxygen for respiration. When dissolved oxygen levels drop below 5 milligrams per liter, aquatic life feels stress—the lower the level, the greater the stress. Oxygen levels below 1–2 milligrams per liter for more than a few hours can result in large fish kills.

Water quality monitoring devices similar to this automatically record temperature, dissolved oxygen, turbidity, specific conductivity, and chlorophyll content. USGS technicians are using the devices at six lower Columbia River sites as part of the Estuary Partnership water quality monitoring program.

Trending Unknown

The lack of information and data collected over time on lower Columbia River water quality makes it difficult to accurately assess the river's water quality. A long-term monitoring strategy is a critical part of the Estuary Partnership's Management Plan. In 2003, with three-year funding from the Bonneville Power Administration, the Estuary Partnership initiated aspects of its water quality monitoring program. As additional funds are secured, we will expand this monitoring. The US Environmental Protection Agency is also targeting Columbia River toxics as a major work element. Over time, using a collaborative approach to monitoring that maximizes resources, we will have the data necessary to answer questions about the types of pollutants, where they are, and their impact on the health of humans, fish and wildlife.

The Columbia is a large and complex system. Even with good monitoring data, there are many factors at play that make finding answers to lower Columbia River water quality questions a challenging task. Yet, the importance of monitoring can not be over emphasized. It's critically important to our ability to assess the river's water quality, identify problem areas, and gauge the effectiveness of management actions. Without it, we're operating in the dark.

Tidally influenced floodplain wetlands provide important habitat for a wide range of species. Hogan Ranch in the Scappoose Bay Watershed is the site of a major ongoing restoration and protection project that the Estuary Partnership has helped fund. As part of the project, a grazing management plan has been developed for the area and approximately 300 acres of wetlands connected to the tidal influence of the Multnomah Channel have been permanently protected for the benefit of fish and wildlife.

Are We Gaining or Losing Habitat?

The pace and scale of habitat restoration projects continue to grow and regulations and greater environmental awareness have slowed the pace of habitat loss.

Why is habitat important?

Habitat loss and modification have been a major issue in the lower Columbia River for over 125 years. Certain habitat types have been drastically reduced. Tidal swamps have declined by an estimated 77 percent. Marsh habitat acreage is only 43 percent of historic levels. Meanwhile, developed acres and acres of open water have significantly increased.

Sustainable fish and wildlife populations depend on accessible, abundant, high quality habitat. Species such as salmon use a wide range of different habitats throughout their life, each critically important. Changes in habitat may directly affect a species' ability to find food or reproduce, increase stress, or change predator-prey relationships. A small drop in water level may dry out a formerly wet area. In the short term, amphibians, shorebirds, and other animals dependent on wet conditions will be affected. Over time, plants adapted to the formerly wet area will die and a new plant community, with its attendant bugs and wildlife will establish.

Increases in habitat restoration and protection since 2000 have been significant. The Estuary Partnership has funded 18 habitat protection projects that are restoring 3,289 acres of habitat and 24.1 miles of shoreline, removing seven culverts that are opening up 28.5 miles of stream habitat, and breaching dikes and removing tidegates at five sites. Funding for much of this work has come from public agencies. EPA, the Bonneville Power Administration, the Northwest Power and Conservation Council, NOAA's Community Based Restoration program and the Army Corps of Engineers have invested millions to support these projects.

Other organizations also are actively involved in habitat restoration. Since 1999, the Columbia Land Trust, Lower Columbia Fish Recovery Board, Ducks Unlimited, local watershed councils, and others have protected and restored more than 6,000 acres of additional habitat. Including those funded by the Estuary Partnership, 74 major projects are completed, underway, or ready to start.

Habitat loss is more difficult to quantify. We know that laws, regulations and extensive permitting processes instituted in the last few decades have slowed the loss of wetlands and other habitats. But develop-

Hundreds of old tidegates similar to this one were once installed throughout the lower Columbia River region. They served a dual purpose, draining fields for agriculture while keeping the tidally influenced river out. They also cut off thousands of acres of fish and wildlife habitat. Today, many tidegates are being removed or in some cases replaced with "fish friendly" ones that allow much better fish passage.

Nearly 80 major habitat restoration projects have been undertaken in the lower Columbia River floodplain over the past six years. Almost all projects are the result of the collaborative efforts of multiple partners, including the Estuary Partnership which has helped fund 18 projects.

One of those projects was at Devils Elbow on the Grays River, where the Columbia Land Trust, the Estuary Partnership, and other partners collaborated on a project that reconnected 80 acres of formerly dry land to the Columbia River's tidal influence through a series of dike breaches. The project will benefit threatened and endangered salmon as well as other Columbia River species.

ment continues. Urban areas continue to encroach on sensitive areas, and while much harder to get permitted, wetlands and shorelines continue to be dredged, filled, and rip-rapped.

Agencies that oversee wetland and shoreline permitting are in the process of improving data management and information sharing capabilities which will make tracking net habitat gains more feasible in the near future. Being able to measure habitat loss on a watershed basis is critical to fully understanding whether we are achieving a net habitat gain.

There are two factors that the Estuary Partnership looks at in assessing habitat: habitat restoration and habitat accessibility.

Are important fish and wildlife habitats being protected and restored in the lower Columbia River?

Yes. Substantial progress has been made protecting and restoring habitats critical to native species. The Estuary Partnerhip has identified 74 projects—completed, underway, or ready to start—that when finished, will protect and/or restore 10,674 acres of habitat within the historic Columbia River floodplain. Of the 74 projects, 32 completed projects have protected and/or restored 3,841 acres, another 23 projects are underway that will protect and restore 4,803 acres, and 19 projects are ready to start that will protect and restore 2,030 acres of habitat.

Habitat restoration may involve removing invasive species such as Himalayan blackberry and English ivy, planting native trees and shrubs, sculpting stream banks to reconnect a tributary stream to its floodplain, or breaching a dike to allow the river's tidal influence to re-establish a wetland.

Each habitat restoration or protection project has taken place within the historic lower Columbia River floodplain. While most projects target threatened or endangered salmon, they often benefit macroinvertebrates, other fish species, birds, wildlife, even humans by providing food, shelter, recreation, and other functions important to society. For example, in Stella, Washington, a regional partnership conserved forested streamside habitat along Germany Creek to benefit multiple salmon species, including an important population of Chum salmon. In addition, streamside vegetation was enhanced and 2.5 acres of salmonid rearing habitat and 250 feet of Chum salmon spawning habitat restored. At Hogan Ranch in Scappoose Bay, Oregon, the Scappoose Bay Watershed Council and others completed a multi-phase project that conserved 173 acres of land, involved volunteers in streamside planting, and implemented a cattle fencing and grazing management program that protects sensitive areas.

Are restoration efforts increasing opportunities for aquatic life to use previously inaccessible habitat?

Yes. Of the 74 projects identified, 28 projects (24 completed and 4 underway) have or will open up previously inaccessible habitat to aqutic life by re-establishing a tidal connection to the lower Columbia River. The 28 projects established 33 new tidal connections, primarily through dike breaches and tidegate removals, and culvert replacements.

Historically, lower Columbia River fish and wildlife could access a wide variety of habitat types that provided shelter, food, rearing areas, and other functions they needed at various life stages. However, in the last 100 years as many as 84,000 acres of lower Columbia River floodplain was

The Malarkey Ranch in the Scappoose Bay Watershed has been the site of a major restoration and protection project that includes a variety of different project elements, including replacing this undersized, non-performing culvert on a section of Malarkey Creek.

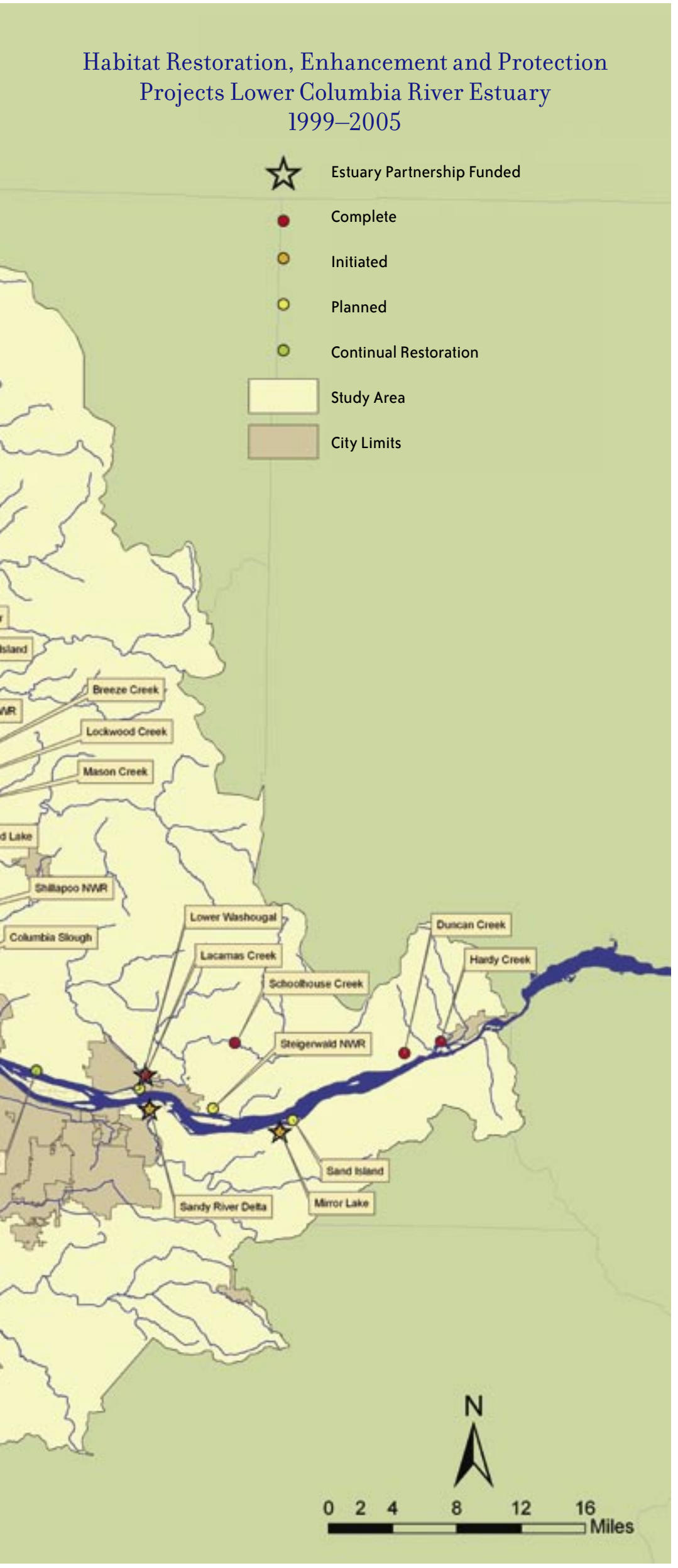
The culvert in the left photo was replaced with a bridge that allows for full fish passage and creates more natural stream conditions that will help maintain lower temperatures, and decrease sedimentation and erosion. Bridges such as this often provide the best long term solution to fish passage problems.

converted to agricultural, urban, or some other use. Evidence indicates that more than 50% of estuarine wetlands have been lost. Dikes, tidegates, and small dams kept the Columbia's daily tides out, radically changed the landscape, and restricted fish and wildlife access to once important habitats.

Reconnecting the river's tidal influence to an area improves water quality and allows a wide variety of species to access a broad range of habitat types formerly inaccessible. In particular, these areas often provide important resting and rearing areas for juvenile salmon.

Most of the 28 tidal reconnection projects undertaken since 2000 are located within the River's lower 32 miles where the ocean's tidal influence is more significant. When all 28 projects are completed, they will have reopened over 2,300 acres to fish and wildlife and the river's tides.

For example, in Grays River Washington, the Columbia Land Trust worked with several property owners across a number of sites to reconnect 555 acres of habitat to the river's daily tidal fluctuations, by removing four tidegates, two culverts, and breaching four dikes. In Brownsmead, Oregon, the Columbia River Estuary Study Task Force (CREST), in the first phase of a larger project, has restored fish access to 10 miles of previously inaccessible streams by replacing undersized culverts with larger fish friendly ones. Over time, these



reconnected streams and acres will once again provide a wide range of habitat types to fish and wildlife.

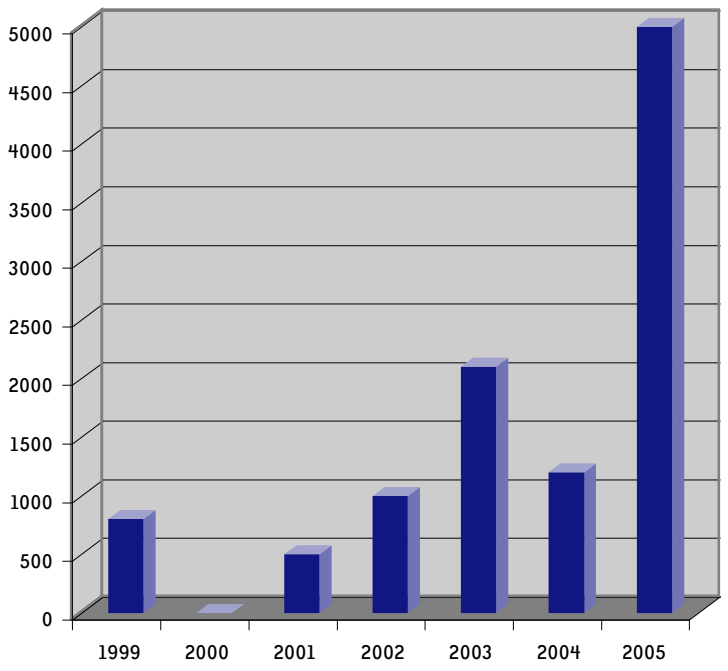
Outside of the Columbia's tidal influence, dozens of culvert removal or replacement projects have taken place that have opened up over a hundred miles of fish habitat. As tributary streams flow from their headwaters to the Columbia, they pass through thousands of road culverts. Hundreds of these culverts are barriers to either juvenile or adult fish passage—or both. Watershed groups from around the study area have been replacing or repairing the most problematic culverts in their watershed. Doing so has allowed fish access to over miles of high quality stream habitat previously inaccessible.

Prioritizing Restoration

In addition to funding projects, and tracking major projects within the floodplain, the Estuary Partnership is working hard to make sure that new projects are getting the most environmental bang for the buck.

Quality can mean more than quantity on habitat restoration projects. A 50 acre project that re-connects fish access to a pristine forested wetland in the lower 20 miles of the estuary may be more beneficial to certain species than a 200 acre project elsewhere that will require years of restoration. To address this issue, the Estuary Partnership has developed a strategy to prioritize conservation opportunities. The strategy will allow the Estuary Partnership to fund projects that deliver the greatest environmental benefits to the largest number of species, and thus be more efficient and targeted with restoration dollars.

Restoration Acres by Year



(Projects planned, initiated, or completed)

A multi-partner project in Germany Creek near Stella, Washington has acquired 150 acres of sensitive habitat, restored Chum salmon spawning and rearing habitat, and enhanced riparian habitat. Almost every project on the map at left represents the collaborative efforts of organizations and individuals committed to protecting and restoring the lower Columbia River.

Trending Positive

The pace and scale of habitat protection, restoration, and access projects has grown significantly. In the last five years more acres of lower Columbia River floodplain habitat have been protected or improved for native species than in the last few decades. And these efforts will continue. As a first step, the Estuary Partnership Management Plan calls for 16,000 acres to be protected and/or restored by 2010. With help from our partners, we expect to be 10,000 acres toward that goal in 2006. Working collaboratively with our public and private partners, we'll continue to protect and restore important lower Columbia River habitats.

The unknown part of the assessment is that we don't have a clear understanding of how much habitat is still being lost, much less the type of habitat and what species depend on it. We need to understand the rate and type of habitat still being lost in the lower Columbia River in order to fully and accurately assess restoration and protection efforts, and ultimately, the health of the lower Columbia River.

Aerial photos from 1976 and 1996 at right show a stretch of I-5 roughly between Burnt Bridge Creek and Salmon Creek in Clark County Washington. Though at a slightly different scale, the photos show the type of growth that has occurred throughout the Portland Vancouver metro area and in other lower Columbia River area communities such as Longview and Camas in the last 30 years. Farms and fields have been replaced with housing developments, strip malls, and roads.

A host of environmental impacts usually accompany development. Wetlands are lost or negatively impacted, impervious surfaces create stormwater that carries pollutants to local streams, habitat connectivity and species migration routes are disrupted and native trees and shrubs are often removed.

Cities in the lower Columbia River area have done a better job than many communities across the nation at minimizing some of development's environmental impacts.

1976 aerial photo – Interstate 5 between approximately 63rd Street and 117th Street in Vancouver, Washington. Photo courtesy of the US Army Corps of Engineers.

Do our land use decisions protect lower Columbia River water quality?

Some research into impervious surface and tree cover has been done that points to improvements in these areas. However, land use changes and their impact on the environment have not been consistently or comprehensively tracked. Hence, we lack the information needed to properly answer the question.

What are impervious surfaces?

Roads, roofs, parking areas, sidewalks and other hard or compacted surfaces that do not absorb rainwater.

Two hundred years ago, the confluence of the Willamette and Columbia River was a mish-mash of islands and wetlands. Large forests covered the hillside and surrounding upland. Lewis and Clark missed the Willamette River, the lower Columbia's largest tributary, twice.

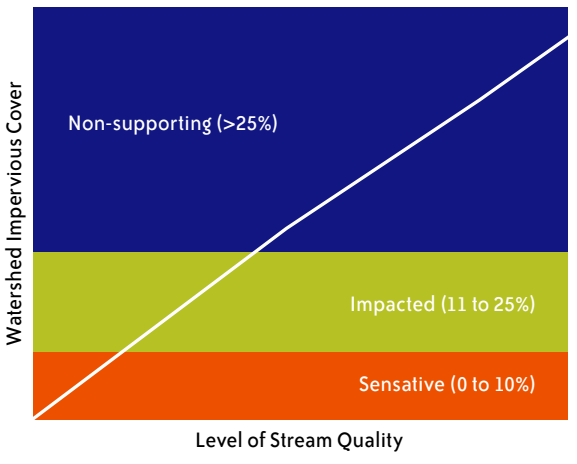
Today, the Willamette's mouth is unmistakable. North Portland is a bustling community; the Ports of Vancouver and Portland dot Columbia and Willamette riverbanks, and Kelly Point Park marks the confluence of the Willamette and Columbia. Development has radically changed the landscape. Yet development is not inherently bad. Development creates our businesses, homes, driveways, shops, schools, and streets.

The **where**, **type**, and **how** of development, however, plays a critical role in the long term health of the lower Columbia River's water quality and habitat. To determine whether land use decisions are protecting water quality the Estuary Partnership looked at impervious surface levels and tree cover in the lower Columbia River region.

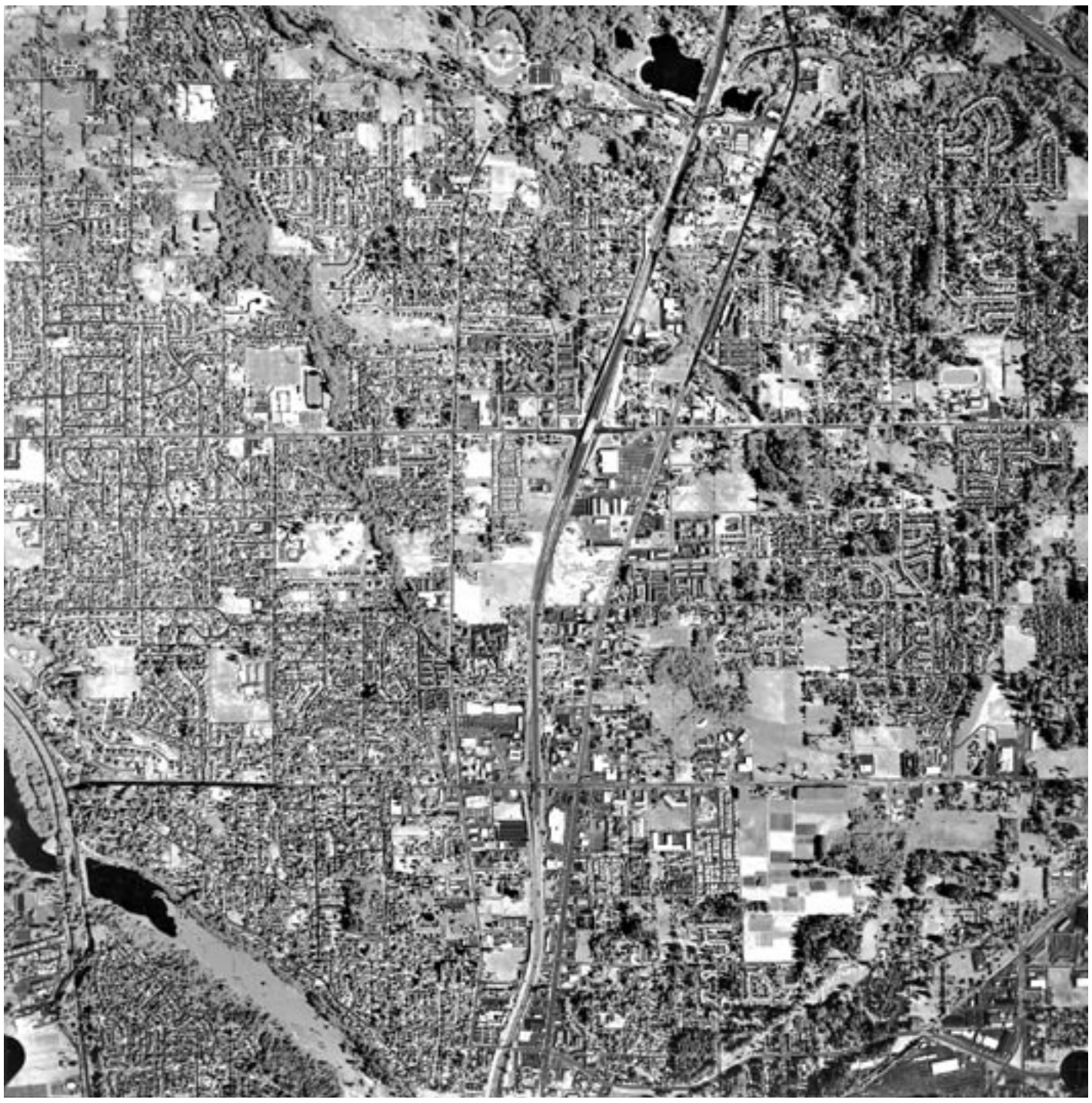
Is There More or Less Impervious Surface?

We can say with some certainty that there has been a significant increase in impervious surface within the lower Columbia River watershed between 2000 and 2005. However, Oregon and Washington land use laws, as well as a growing use of innovative stormwater practices that utilize on-site infiltration help lessen water

Relationship Between Impervious Cover and Stream Quality



Measuring the impervious cover in each subwatershed is an important part of watershed planning because of its direct link to water quality. Source: Center for Watershed Protection



1996 aerial photo – Interstate 5 between approximately 63rd Street and 117th Street in Vancouver, Washington. Photo courtesy of the US Army Corps of Engineers.

quality impacts and provide a small measure of positive news.

Impervious surfaces matter because they prevent rain from naturally infiltrating into the ground. Instead, rain "runs off" the surface and washes into creeks, streams and rivers, collecting solid objects, heavy metals like mercury, nutrients, litter, oils and greases, and other manmade chemical compounds that have accumulated on parking lots, streets, driveways, roofs and other impervious surfaces.

This polluted stormwater runoff (often referred to as nonpoint source pollution because it rarely come from a single source) decreases water quality and can endanger or kill the aquatic life that forms the building blocks of stream ecology. Stormwater runoff can also significantly increase stream flow, leading to erosion and channelized streams.

Impervious surfaces are a good indicator of stream health because research shows that as the amount of impervious surface in a watershed increases, stream health and stream species decline. The Center for Watershed Protection looked at 35 studies that dealt with impervious cover and aquatic quality relationships, and found that as impervious surface in a watershed increased, so did annual runoff, peak discharge, and bankfull frequency. Another survey of 68 studies found that impervious surface in a watershed above a threshold level decreases fish spawning, aquatic insect and salmonid numbers, and fish, wetland and amphibian diversity.

Impervious Surfaces in the Lower Columbia River

The lower Columbia River region encompasses two states, nine counties, 28 cities and lots of buildings in between. Tracking impervious surface changes between 2000 and 2005 across this diverse landscape has been infeasible. However we can draw some conclusions from a variety of sources.

One source is daily experience. Inherently, it makes sense that impervious surface coverage increased between 2000 and 2005. Everyone knows many examples of new subdivisions, businesses, and roads that have been constructed as more than 100,000 people have moved to the region in the last five years. On the other hand, very few people can pinpoint locations where a parking lot was destroyed to create a forest.

Another source is impervious surface mapping. In 2003, the Estuary Partnership worked with the cities of Longview and Oregon City on a project that included an impervious surface mapping component. Two maps were created in each community—one depicting current impervious surface levels, and another projecting future impervious surface levels based on current zoning and development patterns. The maps, which are available on the Estuary Partnership web site, project large increases in impervious surface in each community.

Aerial photo comparisons between years can also graphically illustrate new impervious surfaces. When viewed from the air, many sites in the lower Columbia River region show the subdivisions and roads associated with new development. The photos above illustrate development that's taken place in Clark County between 1976 and 1996 along a stretch of Interstate 5. While farmland still exists in many places, miles of new roads and hundreds of new houses were constructed during the 20 year period.

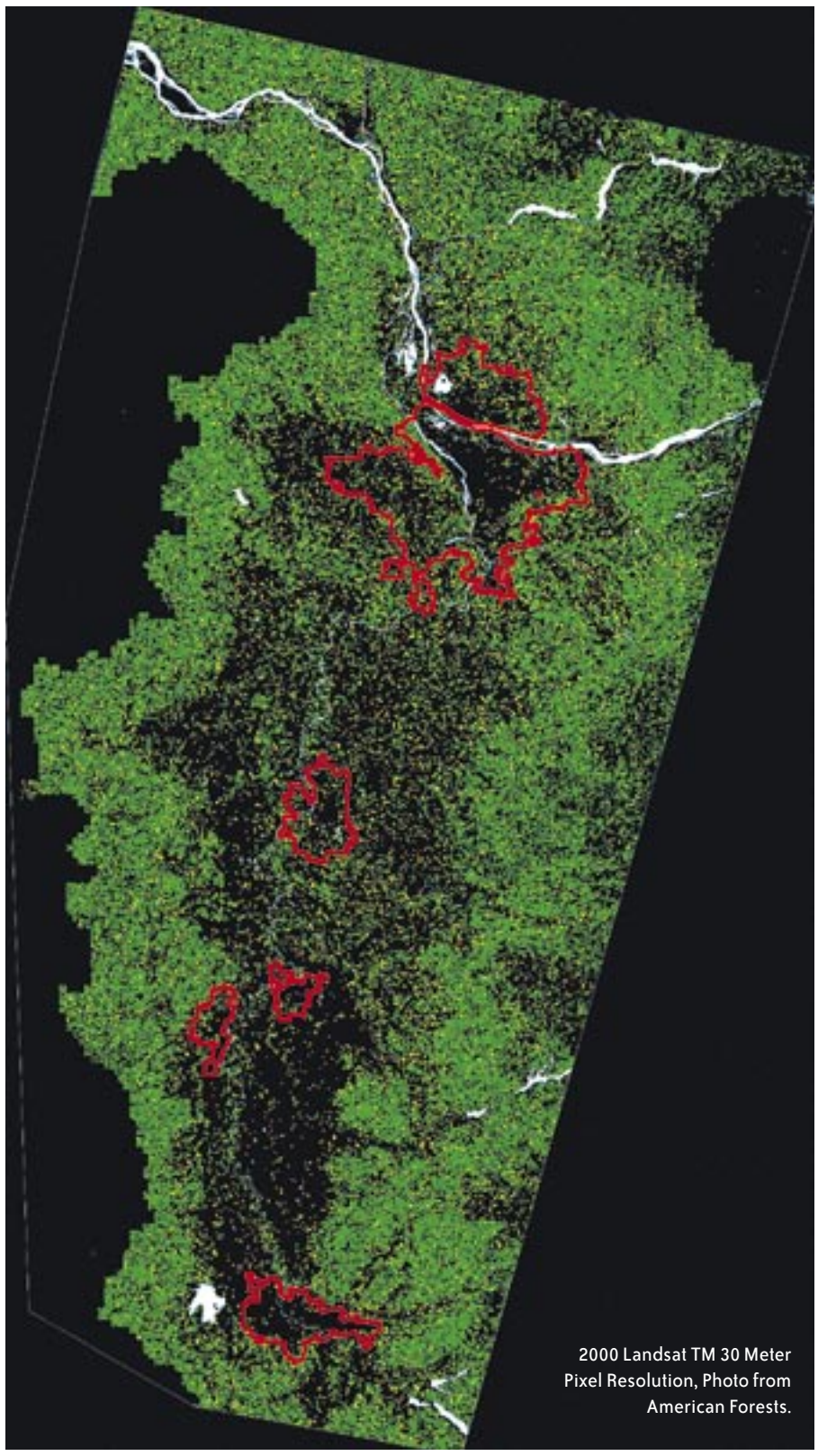
Innovative Stormwater Solutions

Certain areas, particularly Portland and Vancouver, are working hard to develop projects that help counteract new impervious surface. Portland's Bureau of Environmental Services instituted a number of stormwater code changes in 2002 that encouraged innovative stormwater projects. Many new parking lots are being built with techniques that capture and infiltrate stormwater runoff, dozens of ecoroofs dot the city, and thousands of residents and businesses have disconnected their downspouts. Portland is also scientifically testing the durability and permeability of different paving options on neighborhood streets. Meanwhile, Vancouver continues to test permeable pavement on some city sidewalks, and a number of Vancouver area sites feature grass pavers for parking and fire lanes.

Whether by limiting impervious surfaces or "disconnecting" them, stormwater management practices such as ecoroofs, permeable pavers, and infiltration swales can significantly decrease stormwater impacts. By infiltrating stormwater at the source, these practices recreate the natural hydrologic cycle, allow plants to uptake and filter pollutants, and keep stormwater out of local creeks. Slightly shifting parking lot designs so that the vegetative areas infiltrate stormwater can dramatically lessen

Planting strips like this one in SE Portland in front of the New Seasons Marketplace at 19th and Division may be the wave of the future. Instead of being built to keep road generated stormwater runoff out, they have been built to capture and infiltrate the runoff.

1972 Landsat MSS 80 Meter Pixel Resolution, Photo from American Forests.



2000 Landsat TM 30 Meter Pixel Resolution, Photo from American Forests.

Satellite images from American Forests show changes in land cover over a 28-year period from 1972 to 2000. Heavy tree cover (greater than or equal to 50%) is indicated in green. Black areas include several land use categories including areas with light tree canopy (less than 20%), urban areas, cleared forests, and agriculture. The images show a sharp decrease in heavy tree canopy. The downward trend actually started to reverse in 1986, but the increase has been gradual and the acres in heavy tree cover remains almost 2,000,000 acres below 1972 levels.

the parking area's stormwater impacts. In addition, stormwater projects that use infiltration and natural drainage ways often cost less than traditional pipe systems.

Land Conservation

Another way to limit impervious surface growth is by using less land through compact development. Person for person, low-density suburbs create more impervious surface than compact urban neighborhoods. An October 2004 report by Northwest Environmental Watch, an organization that tracks environmental trends, compared sprawl, smart growth, and rural land loss in 15 US cities between 1990 and 2000. The report, which lumped seven Oregon counties—Multnomah, Washington, Clackamas, Marion, Polk, Yamhill, and Columbia—as well as Clark County, Washington, found that new development in greater Portland consumed less than half as much land as the average city in the study. "If greater Portland had sprawled like Charlotte, North Carolina, over the decade, for example, it would have lost an additional 279 square miles of farmland and open space—an area more than twice as large as the city of Portland itself" (The Portland Exception, Northwest Environmental Watch, 2004).

Lower Columbia River water quality depends in part on reducing impervious surfaces and minimizing their impact through stormwater practices that maximize on-site infiltration. Whether this takes place depends in large extent on the cumulative actions of local governments, builders and developers, and citizens to require, build, encourage, and implement stormwater practices that protect lower Columbia River water quality.

Is There More or Less Tree and Forest Cover?

Since 1972, tree cover has declined significantly. The trend is reversing as we recognize the importance of tree cover to ecosystem health.

Ecoroofs such as this one at a NE Portland Fire Station are being used with greater frequency as a way to reduce the impervious surface associated with development. Most ecoroofs can absorb close to 100% of the rain that falls on them, significantly lessening the stormwater impacts associated with a traditional roof. Ecoroofs can also reduce heating and cooling costs.

In urban areas, trees prevent erosion, reduce and delay stormwater runoff, promote infiltration and groundwater recharge, absorb airborne pollutants like carbon dioxide and sulfur dioxide, decrease heating and cooling costs, reduce urban temperatures, buffer pedestrians and traffic, absorb noise pollution, increase residential property values, and stimulate downtown businesses.

In natural areas, trees shade streams and help keep water temperatures down, absorb carbon dioxide and other greenhouse

Urban trees, like these creating a canopy over this NE Portland street, play an important role in healthy watersheds, decreasing stormwater run-off, absorbing airborne pollutants, and promoting infiltration and groundwater recharge. More communities are recognizing the importance of urban trees and working hard to protect and restore the urban forest.

generating pollutants, contribute large wood to streams which increase channel complexity and fish habitat, provide critical habitat for birds and wildlife, often filter and protect drinking water supplies, decrease erosion, help prevent landslides, and provide recreation opportunities and aesthetic value. In short, trees are a good indicator of local ecological health. The more trees there are in the lower Columbia River region the better off we'll be—environmentally and economically.

In October 2001, the organization American Forests published the study "Regional Ecosystem Analysis for Willamette/Lower Columbia Region of Northwestern Oregon and Southwestern Washington State." The study looked specifically at tree cover changes in the Willamette/Lower Columbia Region* between 1972 and 2000 and released a number of major findings that can be used to help answer the question of whether land use patterns are protecting water quality.

Tree Cover

The American Forests study reports that tree cover declined significantly between 1972 and 2000 in the portion of the lower Columbia River watershed looked at in the study. While this trend may not be particularly surprising—the study notes a fundamental regional trend: As population and development expanded, tree cover declined sharply.

- Average tree cover in the region shrank from 46% to 24%.
- Areas with thick dense canopy decreased by 60% while areas with light and moderate canopies increased.
- Average tree cover in the region's urban areas dropped from nearly 21% in 1972 to 12% in 2000.

Economic and Ecological Implications

- Lost tree canopy would have removed about 138 million pounds of sulfur dioxide, carbon monoxide, ozone, nitrogen dioxide and particulate matter from the atmosphere annually, at a value of $322 million per year.
- Vegetation lost over this 28-year period would have stored 58 million tons of carbon and sequestered carbon at a rate of 157,000 tons per year.
- Tree loss between 1972 and 2000 resulted in an estimated increase of 963 million cubic feet of stormwater flow during peak storm events. Using cost estimates of $6/cubic foot to build stormwater systems in urban areas, and $2/cubic foot in rural areas, this vegetation loss approximates a $2.4 billion system.
- The value of the total stormwater retention capacity of the region's tree cover declined from $22.6 billion in 1972 to $20.2 billion in 2000.
- In 2000, the Willamette/Lower Columbia region's direct summer energy savings as a result of tree shade is estimated at $1.8 million annually.

* *The American Forests study did not look at the entire Estuary Partnership study area from Bonneville Dam to the Pacific Ocean. Forest cover west of Longview, Washington is not included in the study results.*

Tree Cover Growing

Fortunately, the trend of thick canopy losses and light canopy increases started to reverse in 1986 and continued through 2000. This may be the result of Urban Growth Boundaries working, improved forest management practices, increased awareness and attention to the importance of tree canopies, more municipal tree planting and preservation programs, and the work of Friends of Trees, watershed councils, and other groups that have made riparian and urban tree planting a priority. Friends of Trees for example, planted 17,000 native trees and shrubs in urban natural areas during their 2004–2005 planting season and 1,700 trees in urban neighborhoods in Portland and Vancouver.

If aggressive tree planting campaigns persist, cities continue to encourage and enforce tree planting and protection ordinances, and private and state forest management continues to evolve, tree cover in the lower Columbia River region may continue to increase, to the benefit of the region's residents, fish and wildlife.

Trending Positive

Positive trends are emerging with regard to stormwater management and tree cover in the lower Columbia River region. Tree cover is increasing and should continue to increase in the coming years as thousands of urban and natural area trees are being planted each year. In addition, the Portland/Vancouver area is one of the country's leaders with regard to implementing innovative stormwater management projects. And each new project leads to another as more developers, architects, and engineers realize the environmental, aesthetic, and economic benefits.

While we believe the trend is positive, we still lack the information to fully determine the impacts of land use on water quality. We need to find a better way to quantify development's impact on lower Columbia River water quality, as well as the efforts being made to minimize those impacts.

Has the Estuary Partnership provided children with more science-based programs about the lower Columbia River?

Estuary Partnership education programs have reached over 46,545 students in five years with classroom programs, field trips, and on-river trips. Another 3,100 students have participated in 79 service learning projects. The program has worked with more than 550 teachers in 32 school districts and developed more than 50 different field-based Columbia River curricula.

The Estuary Partnership has focused its education efforts on students to maximize its impact and respond to the greatest need. Our education programs provide experiential learning opportunities that augment existing class activities, help students develop their analytical thinking skills, and engage students in their communities.

Fourth graders from John Wetten Elementary in Gladstone, Oregon sample water quality as part of an Estuary Partnership field trip. Water quality monitoring projects are a great way to get students into the field to learn about the importance of temperature and dissolved oxygen to native species.

The Estuary Partnership developed an on-river program to help students experience and learn about the lower Columbia River. Canoe and kayak trips give students an intimate river experience.

We work with students from first grade through high school but focus on fourth, fifth, and sixth graders. At these grades, Oregon and Washington state standards related to ecosystems, animal adaptations, watersheds, and streams and rivers make Estuary Partnership education programs particularly compelling.

The Estuary Partnership works closely with teachers to make sure all elements of the education program integrate into each teacher's on-going lesson plans and classroom environment, as well as state science and education standards. In addition, the Estuary Partnership conducts teacher workshops each summer to provide teachers with the framework and tools that help them integrate the lower Columbia River into their lesson plans.

Response to the Estuary Partnership education program has been overwhelmingly positive among teachers, parents, and students and demand for the programs has greatly increased. Today requests exceed the Partnership's ability to provide programs. To narrow this gap as much as possible, and to continue to build on the program's success, the Estuary Partnership makes fundraising for education a top priority.

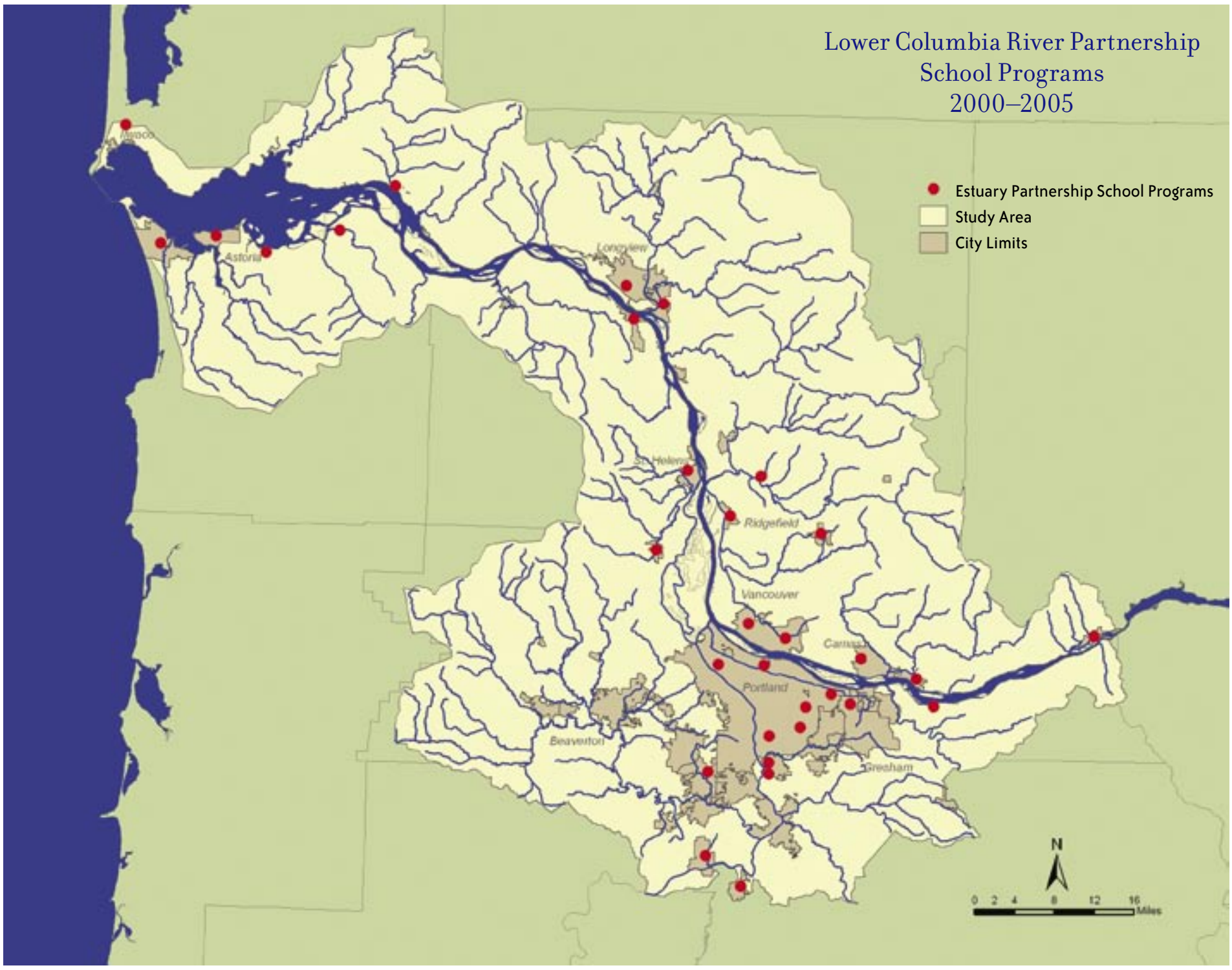
Highlights of the Estuary Partnership education program include:

- Reaching over 32,545 students through classroom programs that apply concepts to the lower Columbia River. This has been the Estuary Partnership's largest education program, accounting for approximately 75% of the students reached per year.
- Developing 50 distinct curricula programs that focus specifically on the lower Columbia River. Programs include projects on estuaries, mapping, soil science, human impact, and native plants among others.
- Increasing the number of students reached each year from 1,260 in 2000 to 10,834 in 2005. A slight drop occurred during the 2004–2005 school year as the Estuary Partnership focused more on service learning projects. These take more staff and preparation, but provide students with opportunities to engage in stewardship projects with real environment benefits, reinforce concepts learned in the classroom, and empower students to continue to engage in restoration projects.

Is the Estuary Partnership reaching students from throughout the study area?

Since 2000, the Estuary Partnership has worked with 32 study area school districts. In the last three years we have reached approximately 100 new teachers and 3,000 new students each year.

The Estuary Partnership works hard to maintain a geographic balance with its education program. Our study area stretches from Bonneville Dam to the Pacific Ocean in both Oregon and Washington. It is a large geography that encompasses highly urban areas with extremely large school districts, as well as rural areas with only one high school. In some places, students may rarely see the lower Columbia River, while in others, the school overlooks it. The program's flexibility and ability to address teachers' specific needs makes the program sought after from Corbett, Oregon to Cathlamet, Washington.



Since the Estuary Partnership's Education Program began in 2000, the Estuary Partnership has worked with 32 school districts within the Estuary Partnership's study area. The Education Program works hard to reach students from throughout the study area.

Are children gaining direct experiences as a result of Estuary Partnership programs?

More than 14,000 students have participated in Estuary Partnership field trips, service learning projects, on-river trips, or summer camps.

The Estuary Partnership has developed education programs that include both classroom learning and applied in-the-field learning. The Estuary Partnership uniquely provides programs in a regional context that take students from principles to actual physical involvement in the solution.

Creating an outdoor environmental experience for students adds an invaluable learning tool that cannot be matched in the classroom. Studies in the classroom, such as watershed models, river history, and salmon lifecycles, are enhanced by placing students in the field. Firsthand knowledge leads to a greater understanding of the lower Columbia River that students will eventually protect and manage for future generations. In almost all projects, the Estuary Partnership provides funds that cover transportation costs to and from the field site.

Field Trips: 7,200 students have participated in Estuary Partnership educational field trips. Field trips take place throughout the Estuary Partnership study area, generally using natural areas close to schools as to keep transportation costs low and engage students in their local area by building a sense of place and connection to nearby natural areas. Field trips have taken place at Whitaker Ponds in Portland, Sea Resources Watershed Learning Center in Chinook, Washington, Lacamas Creek Park in Camas, Washington and the Ridgefield Wildlife Refuge in Ridgefield Washington, among more than two dozen locations.

On-River Trips: Over the years, the Estuary Partnership has provided more than 3,700 students and adults with on-river trips designed to give participants the most direct connection with the lower Columbia River possible. The river's size, feel, and look always changes when you're on the water. Student on-river trips included an education component ranging from water quality monitoring, to native species identification, to water safety.

Service Learning Projects

The Estuary Partnership first offered service learning projects during the 2003-2004 school year. They have been a popular and growing component of the Estuary Partnership's in-the-field offerings. Students who participate in multi-class visit programs or year long programs undertake an on-the-ground service learning restoration project as part of the program. A growing number of schools require students to participate in service projects, and they are popular with teachers and students as well. Students remove invasive species, plant native species, or maintain plantings from previous projects. When possible, service learning project sites are close to schools, giving the students an opportunity to re-visit the site and establish a strong connection.

Trending Positive

The Estuary Partnership education program fills a gap in the educational process for schools in the lower Columbia River corridor. The Estuary Partnership provides science-based classroom visits, and applied learning through field projects, service learning projects, and on-river trips. The Partnership works closely with teachers to offer programs that meet their needs and state standards, and build their capacity to integrate lower Columbia River lessons and environmental field work into their classrooms. The Estuary Partnership provides programs that engage students in learning and environmental stewardship without telling them what to think. Through these activities, the Estuary Partnership's education program is making a difference in students' education and hopefully in the future health of the lower Columbia River.

Children are the future. Today's fourth graders are tomorrow's legislators. Today's middle school students are future commuters. Today's kindergarteners are developers of the decades to come. It is important that students are exposed to a broad cross section of lower Columbia River studies that integrate all aspects of the river—environmental, economic, historic, social and cultural. Giving over 46,000 students an experience in their community is a good start.

Has the Estuary Partnership provided citizens more hands-on opportunities to experience or protect the lower Columbia River?

More than 8,200 citizens have volunteered to help monitor or restore the lower Columbia River since 2000, planting over 11,000 native trees and shrubs at 18 restoration sites.

Each year the Estuary Partnership's Volunteer Monitoring Event engages hundreds of students and volunteers in water quality monitoring along the lower Columbia River and its tributaries. Participants typically measure temperature, dissolved oxygen, conductivity, and turbidity. Data from each event can be found on the Estuary Partnership web site: www.lcrep.org.

Water Trail Enhances Access

Another way the Estuary Partnership provides hands-on experiences is by facilitating access to the river through the Lower Columbia River Water Trail, a 146 mile trail designed to help non-motorized boaters access the water and connect with the ecology, people, businesses, and history of the river. Through the water trail effort, the Estuary Partnership is working to identify and improve new and existing launch and landing sites, campsites, and others sites of interest that will make it easier and more enjoyable for people to access and learn about the river.

The Estuary Partnership believes that with experience comes respect, and that respect fosters stewardship. People who experience the Columbia River first hand are inevitably impressed with its size, beauty, fragility and importance. We believe once that connection is established, people are more likely to factor the river's health into their daily decision-making.

When the Estuary Partnership started its volunteer program in 2000, volunteer opportunities in the lower Columbia River, especially outside of the Portland/Vancouver area were few. Today, the Estuary Partnership coordinates approximately 75 volunteer events a year in communities from Corbett to Cathlamet, from Washougal to Warrenton. The volunteer ans service learning programs have worked at 18 restoration sites within the study area. Each site gives citizens the opportunity to experience diverse habitats and geography along the lower Columbia River, whether close to home or off their beaten path.

The Estuary Partnership provides a variety of volunteer opportunities. Volunteers can participate in regular water quality training and monitoring or the Partnership's two-week water quality monitoring event that takes place each September. Volunteers can also participate in restoration projects, ranging from site preparation, to invasive plant removals, to native tree and shrub plantings. Volunteers also regularly participate in maintenance projects, helping weed or water new or existing plantings. Recognizing that different activities appeal to different people, the Estuary Partnership continues to develop new volunteer opportunities.

Highlights of the volunteer program include:

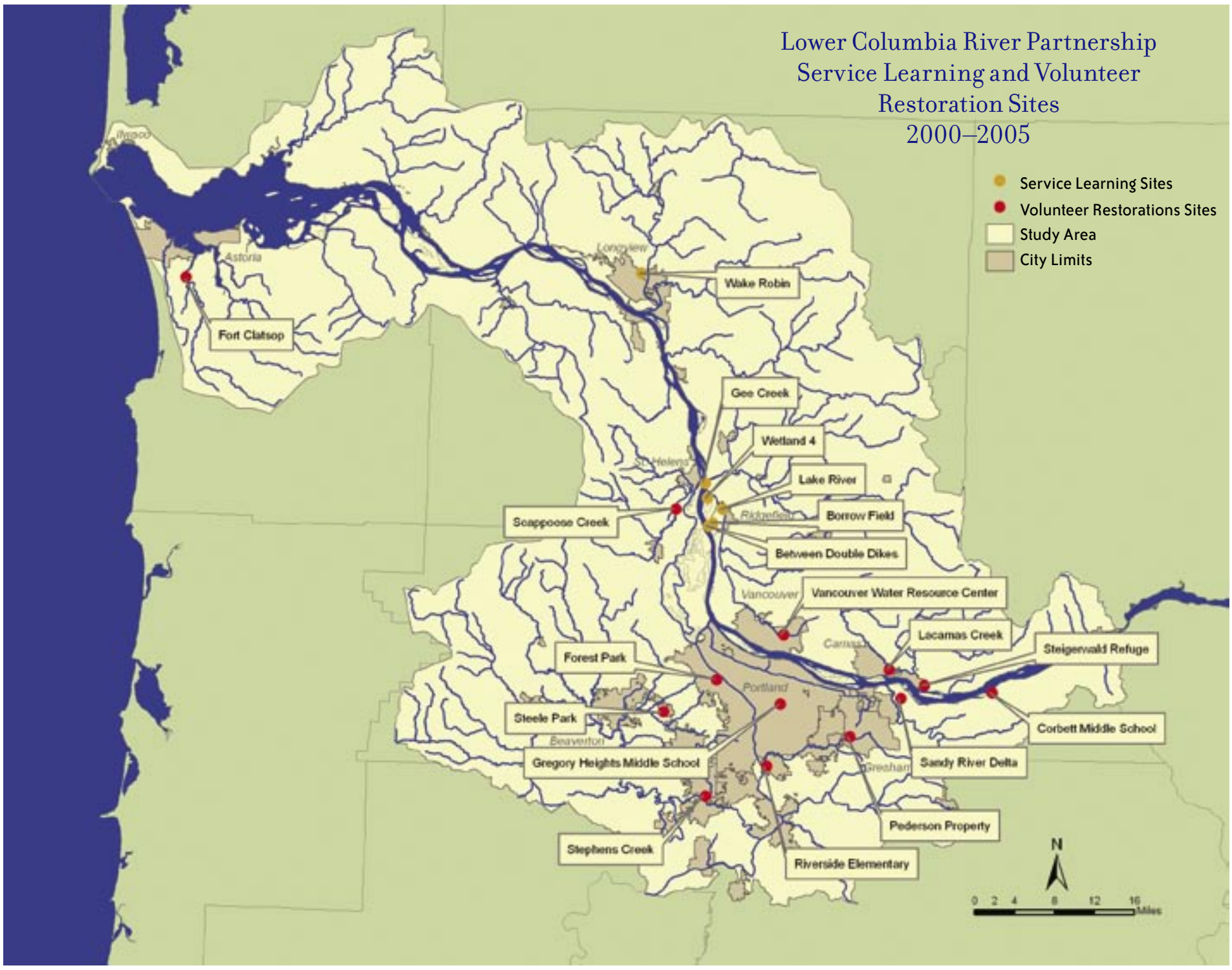
- More than 8,200 people have volunteered on Estuary Partnership projects.
- More than 3,200 of them have been involved in water quality monitoring.
- More than 3,800 volunteers have participated in restoration projects at 18 sites.
- Project participants have ranged in age from 5 to 70.
- Upwards of 3,100 students have participated in service learning projects at 79 sites.
- The number of volunteers has grown each year from 175 in 2000 to 3,484 in 2005.
- Two projects have combined Lower Columbia River Water Trail paddling and stewardship. In two projects with Washington State Parks, more than 25 people have paddled to Washington's Reed Island State Park to clean up the site at the start and close of the camping season.

Do hands-on experience and involvement compel citizens to build stewardship through volunteering?

Absolutely. Many volunteers participate in Estuary Partnership projects repeatedly.

Anyone who has ever planted a tree knows that a special connection forms during the planting. There's a heightened sense of stewardship. If you plant it you're more likely to care for the tree and enjoy the growth, habitat, and shade it provides. We believe that when volunteers spend time in the field monitoring water quality, planting trees and shrubs, or pulling invasive species, they are establishing a similar connection to the lower

The Estuary Partnership Volunteer Program engages hundreds of volunteers each year in projects that benefit the environment, often by removing invasive species and planting native trees and shrubs.



Locating sites appropriate for volunteer and service learning projects can be difficult. Sites need to be safe, reasonably close to the volunteer base or school, and in need of restoration work. Estuary Partnership volunteers and students in the service learning program have worked at 18 restoration sites throughout the lower Columbia River area, planting nearly 11,500 native trees.

Columbia River—one that fosters continued efforts to protect and restore the river. That connection, and the organization and legwork done by the Estuary Partnership, keep people and organizations coming back to work on stewardship projects.

- More than 900 citizens have been involved in more than one Estuary Partnership volunteer project.
- The Estuary Partnership works with dozens of schools and organizations on an ongoing basis, many over a period of years. While individual volunteers may change, the organizational partnerships have grown over time.

Organizations include: Friends of Ridgefield Wildlife Refuge, Ridgefield National Wildlife Refuge, Girl Scouts Columbia River Council, Retree International, Columbia Land Trust, the Columbia Slough Watershed Council, and others.

Schools include: Fisher's Landing Elementary, Elmonica Elementary, Columbia River High School, Corbett Middle School, York Elementary, Whitford Middle School, Ridgefield High School, and others.

Is citizen involvement in stewardship projects providing environmental benefits?

Estuary Partnership volunteers create long-lasting positive changes in the environment.

There are two purposes to the Estuary Partnership's Volunteer Program: To build stewardship and connections to the river through experience and to improve ecological conditions through native plantings and invasive species removals.

Since 2000, the Estuary Partnership and its volunteers have accomplished a great deal of on-the-ground work. Some highlights include:

- Planting 11,459 native trees and shrubs at sites throughout the Estuary Partnership study area including the Sandy River Delta, Scappoose Bay, and the Ridgefield National Wildlife Refuge.
- Removing more than 34 truckloads of invasive plants from various sites.
- Providing long term maintenance and monitoring at nearly a dozen sites where restoration efforts have taken place.
- Engaging more than 80 people in the Estuary Partnership's habitat mapping project. Volunteers ground truthed data at dozens of sites to improve the accuracy of high resolution habitat maps.
- Monitoring water quality at over 240 sites along the lower Columbia River and its tributaries during the Estuary Partnership's annual volunteer water quality monitoring event.

Trending Positive

For most of us, establishing a close connection with the river takes something above and beyond our normal routine. One hundred years ago, a person living in the lower Columbia River region most likely interacted with the river on a daily basis. Transportation was either by river or on trails bordering it. Food and commerce came from the lower Columbia River, as well as stories and myths about the seasons, geography, and community history.

Today, many people go weeks without seeing the river, much less interacting with it in some way. At times, even accessing the river can be difficult. Without that close connection, it's much harder to understand how daily lifestyle choices impact the river's health. Stormwater carries fertilizers spread on lawns and heavy metals from parking lots to the river, but to most of us, it's "out of sight-out of mind."

Yet the lower Columbia River remains the lifeblood of the region in many ways, economically, environmentally, aesthetically, and recreationally. We depend on its health—and to a large extent—its health depends on us. Experiencing the river directly affects how we think about it and care for it.

By providing a broad range of volunteer opportunities, the Estuary Partnership has helped over 8,000 people care for, connect with, and experience the lower Columbia River. We believe their stewardship makes a difference, both in the field, and in their daily decision making.

From the Executive Director

This first Report on the Estuary is a great starting point. We have made significant progress in key areas:

- Thousands of acres of habitat have been restored and protected not just by the Estuary Partnership but many other entities.
- We are wiser about land use and development and many communities now implement land use codes and ordinances that protect water quality by limiting the amount of polluted runoff that reaches streams.
- We have instituted water quality monitoring and stepped up our focus on toxics in the river.
- Volunteers are planting thousands of native trees and shrubs and removing acres of invasive species.
- Students are gaining outdoor applied learning about the Columbia River.

For the most part the trends are positive: we are achieving environmental gains from our actions. On-the-ground results are occurring and many parties are actively engaged. We can say with some certainty that investments made by the EPA and the States of Washington and Oregon in the National Estuary Program are improving the river and its environs. They have been substantially expanded with investments by Bonneville Power Administration and the Northwest Power and Conservation Council, US Army Corp of Engineers, and NOAA, as well as through corporate, foundation and individual contributions to the Estuary Partnership. But there are still unanswered questions.

The report identified some weaknesses in our efforts that will help direct our next steps. The work ahead is clearer:

- What is the net gain in habitat restored? We need to measure how much habitat are we losing.
- Can we reduce impervious surfaces and their impacts with more innovative techniques?
- How can we continue to focus efforts to make greater gains in species recovery?
- How do we re-tool our education programs so students can apply classroom concepts in their communities and the field?
- What opportunities can we provide for citizens to safely experience the river and help protect it?
- What toxics are where in our lower river and how do we reduce and eliminate them at the source? The data and research is essential for many reasons, certainly protecting human and species health is number one, helping us even more strategically invest our on-the-ground restoration activities is a close second.

All our activities need more sustained effort and many partners.

In 1995, the Estuary Partnership was just beginning its planning phase.

In 1998, the Oregon Watershed Enhancement Board's watershed protection programs gained significant momentum when voters authorized funding for Oregon salmon protection and watershed protection. Originally formed in 1987 as part of the Governor's office, OWEB became an independent agency in 1999.

In 1998, the Lower Columbia Fish Recovery Board was created. With significant investment by the State of Washington, the Fish Recovery Board has produced a strong species recovery plan that not only provides the framework for the Washington State portion of the lower river and estuary, but it stands as the model for other areas.

Together, the three of us now work to provide the binding that quilts together efforts by watershed councils, water resource inventory areas, local governments, federal agencies, conservation organizations, and land trusts, so we have a regional, agreed upon plan of action, that is giving us on-the-ground results and moving us forward.

Without the efforts of many individuals and corporations, organizations and agencies of government, the Report on the Estuary in 2005 would have far fewer successes to report.

The power of collaboration and supporting each other combined with a comprehensive regional approach is giving us environmental results. Most important, it is setting the stage for us to hand our children a more improved lower Columbia River.

Debrah Marriott

Lower Columbia River Estuary Partnership

In 1999, the Estuary Partnership began implementing its Comprehensive Conservation and Management Plan, developed over a three-year period through an inclusive process that involved many citizens from many sectors of Columbia River communities. Our overall mission is to preserve and enhance the water quality of the estuary to support its biological and human communities.

The Estuary Partnership is one of 28 estuaries in the nation designated an "Estuary of National Significance." The National Estuary Program was authorized in the 1987 Clean Water Act and is administered by the US Environmental Protection Agency. Its purpose is to protect nationally significant estuaries that have been degraded by human activity. The Estuary Partnership does this by bringing together diverse parties to identify problems, defining a course of actions to address problems, and working collaboratively to implement actions through a regional framework.

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