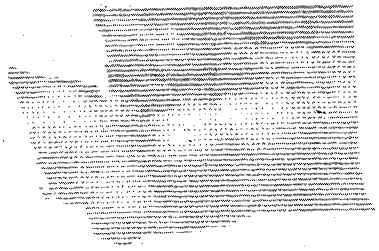
A-1161
1991
C.3

98190100

ENVIRONMENT 2010

The 1991 State of the Environment Report



Ecology Publication: 92-01-001

ENVIRONMENT 2010

A Product of Washington Environment 2010
July 1992

98190100

STATE OF WASHINGTON
OFFICE OF THE GOVERNOR

OLYMPIA
98504-0413

BOOTH GARDNER
GOVERNOR

June 1992

Dear Friend of the Environment:

I am pleased to share with you the 1991 State of the Environment Report. This biennial report provides an overview of Washington's environment and the progress we have made in improving it.

The report covers environmental issues crucial to all Washingtonians, including the air we breathe, the water we drink, and the land on which we live and grow our food. It is a product of Environment 2010, an ambitious public effort started in 1989. Environment 2010 provides both a vision and action agenda for protecting Washington's environment. Key to carrying out this vision has been new legislation on air quality, energy, water conservation, transportation, and growth management. State agencies have developed models and pilot projects in transportation alternatives, waste reduction and recycling, environmental dispute resolution, environmental education and economic incentives for natural resource protection.

Progress has been made possible through the support of the public, business, local government and the environmental community. All have made Washington an environmental leader. But we also have much to correct and much to protect. The 1991 State of the Environment Report points out the many critical challenges facing our environment. A key challenge is obtaining better information to accelerate the cleanup and protection of our environment.

I hope you will use this report to build an understanding and ongoing commitment to Washington's environment and quality of life.

Sincerely,

Booth Gardner
Governor

Table of Contents

Introduction

Overview

This document, the 1991 State of the Environment Report, is not the definitive word on the status of our state's natural resources and environment. It is, however, a reflection of the ways in which our state is evolving in its approach to the complex ecology of our air, water and land. Washington is a national, and, in fact, international leader in several areas of environmental management, but we want to do better, and that is the goal of every action we take under the broad umbrella of Washington Environment 2010.

Since its inception in 1989, Washington Environment 2010 has accomplished a great deal. *Toward 2010: An Environmental Action Agenda,* was adopted by Governor Gardner in July 1990. The action agenda spelled out more than 75 key actions to be taken by government, business and citizens to protect our environment well into the 21st century. Through the efforts of state and local government, businesses, environmental organizations, educators, news media and citizens throughout the state, most of those key recommendations have been set in motion.

Critical to carrying out the vision of Environment 2010 was major legislation passed in 1991. Bills dealing with air quality, energy and water conservation, transportation demand management, water quality and growth management all contained major elements directly supporting the 2010 Action Agenda. Under Executive Order 90-06, state agencies have developed models or begun pilot projects in transportation alternatives, waste reduction and recycling, environmental dispute resolution, environmental education and developing economic incentives for natural resource protection.

The state of Washington has made a good start, but we still have a long way to go. There are no snap solutions to any of the major problems facing us today, but we believe working toward a cleaner, healthier world is absolutely worth the effort. Balancing our dual needs to sustain environmental quality and economic vitality will likely pose some of the most difficult choices to be made by our policy makers and citizens. Still, we believe sound decisions can be made, especially when supported by good information, a spirit of cooperation and widespread public involvement.

In addition to providing a status report on the action agenda, this document represents Environment 2010's commitment to fuller and more precise *measurement* of the things, people and activities that affect our environment, for better or worse. The knowledge gained from measuring a single pollutant, for example, can lead directly to actions to diminish its impact. In other cases, simply deciding how to best develop an "environmental indicator" is a big first step.

Environmental Indicators

The concept of environmental indicators has been around for many years. Since the "environment" is a complex mixture of natural systems, scientific methods should be applied to a determination of the "state of the environment." Just like body temperature or blood pressure are used as indicators of a person's health, there are environmental variables which can signify improvement or degradation in our environment. In concept, it seems simple. However, defining indicators, determining how to measure a trend in variables, determining what a trend will mean and actually making environmental measurements, can be a complex and costly undertaking.

The most useful environmental indicators focus on either a stress placed upon the environment — usually from human activities — or the environmental response to such stress. Stress is often in the form of pollutants released to the environment or changes in land use and development patterns. Environmental responses include negative health effects, loss of habitat and degraded environmental conditions.

Since actual measurement of environmental stress and response can be expensive, there has been considerable use of "surrogate" indicators. Surrogate indicators do not reflect changes in the environment, but are intended to show activity or information which, in an intuitive way, should indicate a positive or negative change in the "state" of the environment. A reduction of emissions from cars for example, would generally be considered a good indicator of improved air quality and overall environmental health. However, this measurement falls short of measuring the actual outdoor concentrations of automobile pollutants. Emission levels from vehicles are a good surrogate indicator.

Other surrogates are less desirable because they are even more removed from actual environmental or pollutant measurement, and may lack a consensus as to the meaning of the data or trends. A good example of this more distant type of measurement might be the "number of regulatory actions" as a surrogate indicator. While the actions are consistent with law, they may or may not serve to improve the environment to any significant degree.

Statistics — the "mathematics" of organizing and using numbers — should be a major consideration in the development and use of environmental indicators. Anytime there is a measurement, there is a chance of error. Use of statistical analysis can help identify the extent of potential errors and predict the reliability of any conclusions drawn from the data. Ideally, data collection for an environmental indicator would be developed to foster short term (under 10 years) statistically justifiable predictions. This is most important because of the potential use of indicators.

Uses of environmental indicators include providing a guide in setting public policy and directing regulatory action. They can suggest adjustment of policies and actions over time to more effectively use environmental protection resources. They could be used to set priorities, develop budgets and defend budget decisions. To be valuable in these uses, however, trends and conclusions must be statistically supported.

In preparation of this report, various state agencies examined their existing information gathering efforts for the possibility of finding sufficient data to support the designation of environmental indicators. The results of this effort are summarized here. Because few current data systems meet the above requirements, or support finding any statistical trend, the information is not portrayed as environmental indicators. Instead, the information is referred to as "environmental data." Although not a true set of indicators, the extent of the data presented in this report provides an impressive "view" of the environment and its complexity of variables. It also sends an important message concerning the adequacy of existing data sources. It is clear that if a comprehensive set

of environmental indicators is to be developed, the effort will be costly. It is also clear that indicator development needs to be coordinated in and among the various state, federal, and local agencies to reduce costs. And, it is clear that data collection may be limited to specific geographic areas and priority issues in order to make environmental indicators statistically meaningful and affordable.

Working Toward a Sustainable Future

While the 2010 project has focused most of its initial efforts on the environmental impacts of growth, we recognize that Washington state's quality of life depends on a myriad of interrelated factors. Affordable housing, education, employment, health care, social justice and the status of our natural environment all define our quality of life. While we tend to grapple with these issues in isolation of each other, we believe that, ultimately, it is the integration of solutions that will yield the best informed and fair decisions about our present and future.

The concept of "sustainability" is receiving more attention as we understand the extent to which a healthy environment and a healthy economy cannot exist without each other. What do we mean when we refer to "sustainability"? The World Commission on Environment and Development defines sustainability as,

Meeting the needs of the present without compromising the ability of future generations to met their own needs. . . A process of change in which the use of resources, the direction of investments, the orientation of technological development, and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations.

More simply put, Robert Gilman of Context Institute has noted that sustainability addresses how we "keep going over the long haul."

In addition, many would agree with British economist David Pearce, who believes sustainability should meet three critical criteria:

1. Justice to nature. This assumes that the human and non-human are both valued, and while nature possesses remarkable regenerative qualities, humans must accept the responsibility as stewards, or guardians, of our resources.

2. Justice to future generations. Our present careful use and conservation of resources should ensure that all the needs of future generations can be met.

3. Justice to the present generation. This underscores the need to address current economic and social disparity, not only among developed and developing nations, but among members of our society, here in the state of Washington. Some of our natural resource decisions can affect the ability of a family to feed, clothe, shelter and educate itself.

Clearly, if our state and its communities seek a strategy for achieving a truly sustainable future, we must thoroughly re-examine our values and the process by which we make critical policy decisions. Moreover, we find ourselves at a unique juncture in American history, attempting to determine how to integrate the rights of society — today and tomorrow — with the rights of property owners.

As you read the 1991 State of the Environment Report, we invite you to think about how you can take action — in your home, at work and in your community—to protect Washington's rich natural resource legacy.

Setting in Motion the 2010 Agenda

The Washington Environment 2010 action agenda marked the end of planning and the beginning of action when it appeared nearly two years ago. Environment 2010's first State of the Environment Report in November 1989 represented a year of study and community involvement. Washington's environmental threats were ranked by panels of technical experts and by citizens who attended community meetings across the state. Toward 2010: An Environmental Action Agenda, published in July 1990, mapped a strategy for facing those environmental challenges.

Since that time, Washington has made remarkable progress in moving forward on the action agenda. This report summarizes the accomplishments in implementing the state's 20-year plan for environmental stewardship.

The action agenda contained recommendations to address a wide range of environmental threats. In this 1991 report, progress on the action agenda is summarized at the end of each related chapter or sub-chapter.

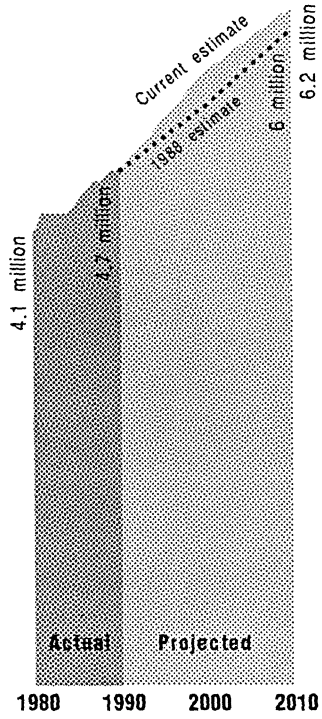
Overview

According to the Office of Financial Management, Washington state has experienced net growth in population during the past several decades. Growth has concentrated in the urban counties of the state, reflecting the national trend toward urbanization.

For the purposes of this section, two population characteristics will be examined. The first of these is the statewide trend in population growth, together with projected growth to the year 2010. The projected 2010 population will be compared to that projected in the 1989 State of the Environment Report.

The second issue to be examined will be the trend in population growth of the counties bordering Puget Sound. The Puget Sound Basin is the most rapidly urbanizing region of the state and the environmental consequences of urbanization will continue to be reflected most dramatically in that geographic subarea.

Figure 1
Statewide Population Trends, 1980 - 2010.



Rounded to the nearest 100,000

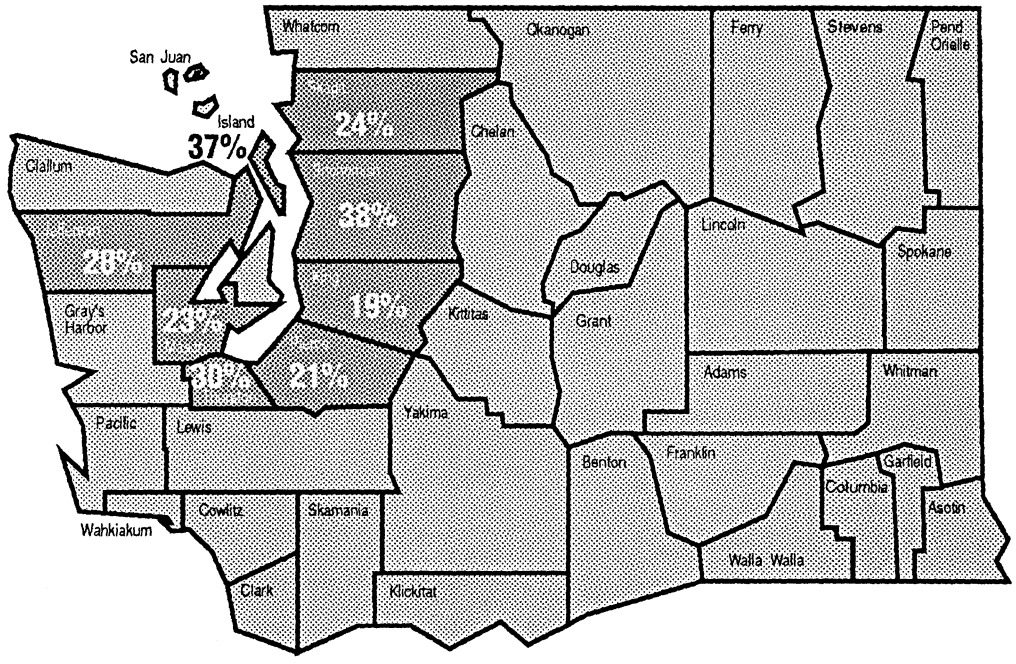
Source: "*Forecasts of Washington State Population By Age and Sex 1990 - 2010*," Office of Financial Management. (Undated.)

Environmental Data

Key population statistics which indicate the kind of growth this state is experiencing and will be likely to experience are summarized by the following. It shows population projections for the period 1990 - 2010 and represents a revision of the estimates provided in Table 2 as used in the 1989 State of the Environment Report.

Between 1980 and 1990, the overall population of Washington grew 17.8 percent, or to 4,866,000 people. Most of the growth occurred in western Washington counties, and particularly those bordering Puget Sound. The following table shows the extent of their growth compared with the state's growth rate.

Figure 2:
Puget Sound Growth Versus the Rest of the State, 1980-1990.



Source: *Washington State Population Change by County* - OFM/ Forecasting Division, June 1991.

Data Summary

◆ Statewide population growth continues at an increasing rate.

◆ Statewide population projections are being revised upward generally, and have specifically been revised upward since publication of the 1989 State of the Environment Report.

◆ Population growth in Washington is concentrated in existing metropolitan areas. This is particularly true of the eight counties bordering Puget Sound. This trend toward increased urbanization is consistent with national trends and has potentially significant consequences for environmental resources in urban areas.

Environment 2010 Progress

Three challenges in the 2010 action agenda relate directly to people and are reported in this chapter. These challenges are education, cooperation and knowledge building.

Toward 2010 - The Challenge of Environmental Education

1 Public-private partnerships should be established to develop materials and develop and implement environmental education strategies for targeted segments of the general public.

State agencies continue to create partnerships with business and local groups to educate specific groups.

◆ The Washington Conservation Corps (WCC) has served more than 2,300 young adults since 1983. The WCC provides employment training while conducting environmental restoration and preservation projects. The WCC has installed 10,000 feet of stream bank fencing, created 30 acres of new wetlands, and contributed more than 15,000 hours during response to five major oil spills in Washington.

◆ Governor's Council on Environmental Education was created under Executive Order 90-06.

◆ An informal Environmental Education Task Force of business, industry, environmental organizations, state natural resource agencies and the SPI assists with developing K-12 curricula.

◆ "Energy, Food and You" is a K-12 curriculum.

◆ Environmental Learning Centers represent a 25-year partnership with schools and marine and trade associations.

◆ Marine waste and litter pamphlets are distributed at state parks and other key locations.

◆ A variety of other partnership efforts are underway, including TV programs, videos, community cleanups, development of public service announcements, participation in environmental education conferences and teacher workshops.

2 State agencies should provide environmental education opportunities at convenient points of interaction with the public.

◆ There are numerous ongoing efforts in this area. Ecology enlists the cooperation of business to distribute brochures on topics from marine litter to wood stove smoke.

◆ All state parks have established recycling sites in cooperation with volunteer groups and park bulletin boards display recycling information.

◆ Rangers travel by bicycle at 26 state parks, providing education by example on air quality and energy conservation.

3 All school districts in the state should be required to develop and implement a plan for infusing environmental education into their K-12 curricula.

◆ The state legislature and Board of Education have adopted a requirement that "instruction about conservation, natural resources and the environment shall be provided at all grade levels in an interdisciplinary manner through science, the social studies and the humanities with an emphasis on solving the problems of human adaptation to the environment." The SPI Office of Environmental Education has been assisting educators to comply.

4 All teachers in the state should obtain a minimal level of environmental training as part of their certification requirements.

◆ The Governor's Council on Environmental Education formed a committee in December 1991, chaired by Superintendent of Public Instruction Judith Billings to help teacher training institutions include an environmental education component in certification requirements.

5 The Office of Environmental Education and other agencies that provide teacher training should expand in-service training and outreach programs for local teachers and school administrators.

◆ The Governor's Council on Environmental Education has continued to expand cooperative efforts among the state's resource agencies.

◆ The Office of Environmental Education has pursued a wide range of programs, including:

- ➤ Publishing "Environmental Education K-12" on how to utilize the SPI's office of Environmental Education.
- ➤ Conducting workshops for teachers and administrators. Assisting with increasing requests for assistance with in-service training.
- ➤ Helping script and narrate a video entitled "Earth Class," on environmental education, produced by Seattle Central Community College.
- ➤ Continuing a Puget Sound Water Quality Authority funded program that enables school districts to hire substitutes while teachers attend workshops relating to Puget Sound water quality. More than 700 teachers have participated.
- ➤ Participating in Coast Weeks — a marine debris education and cleanup program — conservation district conferences and the "Mountains to Sound" proposal.

◆ Ecology outreach to teachers and administrators includes:

- ➤ Publishing the "Away with Waste" curriculum and providing teacher training;
- ➤ Hosting "Discover Wetlands" and "Discover WILD" workshops;
- ➤ Conducting the Padilla Bay estuary teacher workshops;
- ➤ Coordinating with Nisqually Basin curriculum teacher workshops.

6 An environmental education coordinating group, consisting of the directors of t he state's resource agencies and representatives from the legislative, business, environmental and academic communities, and from tribes and local government, should be formed to establish broad environmental education goals for the state, and to foster communications, coordination and cooperation among the member groups.

◆ The Governor established a 12-agency Council on Environmental Education by executive order in 1990. Members include directors of Washington's natural resource agencies, the Superintendent of Public Instruction, Commissioner of Public Lands and a representative of Cooperative Extension. The Council promotes environmental education through interagency coordination with other government agencies, business and associations.

◆ The Environmental Education Task Force is a staff level ad hoc group representing Governor's resource cabinet agencies, SPI, DNR, business, environmentalists and educators.

7 Establish an Environmental Education Clearinghouse at the Office of Environmental Education to accumulate, maintain, and disseminate up-to-date environmental materials, to help coordinate environmental education initiatives and to provide technical assistance to groups starting new environmental education programs.
Ecology and SPI—under EPA grants—have begun a clearinghouse to link together the state's environmental education resources. Existing resources include:

◆ SPI's "Catalogue of Environmental Education Resources," a directory of publications, films, videos, catalogues, books and posters.

◆ SPI's resource library for educators.

Toward 2010 -
The Challenge of Cooperation

1 Establish participatory and consensus seeking approaches to addressing and resolving environmental issues and conflicts as the norm in Washington state.

◆ Washington has established itself as a national leader in collaborative resolution of environmental disputes through such accords as the Snoqualmie Basin Flood Plain Agreement; the Tribal Fisheries Management Accord; the Timber, Fish and Wildlife agreement; the Chelan Agreement on water resources and the Sustainable Forestry Roundtable.

◆ An inter-agency group has been working for a year to define additional state leadership roles in collaborative dispute resolution. The group recommended that a formal interagency council be created. The Governor's Office is moving to formalize, through executive order, an inter-agency dispute resolution council.

2 Establish a single telephone number that people can call for help in dealing with state government.

A consultant evaluated this proposal and concluded that it would not be technically nor economically feasible. Nevertheless, these toll free state agency numbers provide information and assistance on environmental topics.

◆ **Air Quality** 1-800-272-3780 (*Dept. of Ecology*)

◆ **Business licenses** 1-800-562-8203 (*Dept. of Licensing*)

◆ **Energy Assistance** 1-800-562-5677 (*Dept. of Community Development*)

◆ **Forest Fire Reporting** 1-800-562-6010 (*Dept. of Natural Resources*)

◆ **Hazardous Waste Spills** 1-800-262-5990 (*Ecology*)

◆ **Household Hazardous Waste Hotline** 1-800-633-7585 (*Ecology*)

◆ **Information** (*general state*) 1-800-321-2808

◆ **Litter Control** 1-800-548-8377 (*Ecology*)

◆ **Natural Resources, Dept. of** (general business) 1-800-527-3305

◆ **Parks** 1-800-562-0990 (*May 1 through Labor Day*)

◆ **Poaching Reports** 1-800-562-5626 (*Dept. of Wildlife*)

◆ **Puget Sound Water Quality Authority** 1-800-547-6863

◆ **Radon Information** 1-800-323-9727 (*Dept. of Health*)

◆ **Recycling Hotline** 1-800-RECYCLE (1-800-732-9253, *Ecology*)

◆ **Red Tide Hotline** 1-800-562-5632 (*Health*)

◆ **Underground Storage Tanks** 1-800-826-7716 (*Ecology*)

◆ **Wastewater Treatment Hotline** 1-800-633-6193 (*Ecology*)

◆ **Whale Sightings** 1-800-562-8832 (*Wildlife*)

◆ **Wood Stove Hotline** 1-800-523-INFO (1-800-523-4636) (*Ecology, heating season*)

◆ **Woodcutting Permit** 1-800-527-3305 (*Natural Resources*)

3 Organize diverse, broad-based community groups in locations throughout the state to maintain local forums for environmental dialogue, to foster cooperation on environmental issues, and to promote local implementation of action agenda recommendations.

Various projects have been started which reflect the distinct ecological, political and economic characteristics of Washington's communities. Local projects such as Project Rebound (Ellensburg), Sustainable Olympia, Sustainable Seattle, Visioning Yakima and the Timber Dependent Communities Project (Lewis and Clallam counties) share these common elements:

◆ Involvement by representatives of local government, business, environmental advocacy and education;

◆ A consensus approach to decision-making;

◆ The opportunity for meaningful and widespread public involvement;

◆ The encouragement of efforts that rely on public/private partnerships;

◆ Education components, both through our public schools and to the general population.

4 Establish a mechanism to improve coordination among environmental and resource management agencies.

◆ State agencies coordinate environmental efforts for major projects through the State Environmental Policy Act (SEPA) and the Environmental Coordination Procedures Act (ECPA) on an ongoing basis.

◆ Biennial publication of the State of the Environment Report establishes a mechanism for resource agencies to routinely update and evaluate environmental information.

5 Explore the benefits of a more comprehensive, coordinated approach to regulation.

◆ Ecology has been a multi-media regulator of major pulp and aluminum mills for more than two decades. Ecology integrates regulation of air and water emissions and on-site hazardous waste at 21 industrial plants.

◆ Ecology, Southwest Air Pollution Control Agency and EPA conducted a pilot multi-media compliance inspection at the Weyerhaeuser Company's pulp and paper mill at Longview in February 1991.

◆ Ecology's Eastern Regional Office is preparing a multi-media inspection pilot project to take place this spring. The project will include a position paper on the advantages and disadvantages of multi-media permitting.

Toward 2010 -
The Challenge of Knowledge Building

1 Develop a comprehensive, integrated environmental information management system.

◆ The departments of Information Services and Community Development, through a multi-agency technical advisory group, are designing a data management system to assist local governments with growth-management activities and environmental management. The project will make it possible to exchange information from among hundreds of categories. The state's Growth Management Act requires development of this system.

◆ Within the effort above, Ecology is developing a water resources data management program, mandated by legislation adopted in 1990. A task force of state agencies, tribes, user groups and environmentalists is targeting June 1992 to complete a five-year plan to guide the effort.

◆ The Department of Ecology is developing an information resources management strategic plan, as recommended by the Efficiency and Accountability Commission's study of Ecology's wastewater permit program. The completed plan is due in April 1992.

2 Produce a State of the Environment Report every two years.

This 1991 State of the Environment Report is the first biennial update.

Toward 2010 - Economic Incentives for Improved Environmental Management

◆ *Study economic incentives for improved environmental management*: A special task force submitted a proposal of potential economic incentives requiring additional research or development to the Governor's office in December 1991. The task force estimated the total funding required for further investigating all options is less than $400,000. Some options include:

- ➤ *Transportation Demand Management (TDM)*: Employers would charge their workers parking fees and subsidize transit, carpool or other options to drive-alone commuting. A study could be coordinated with a task force that is working to implement 1991 TDM legislation.
- ➤ *Marketable Permits for Air*: Companies facing high air pollution control costs could obtain "credit" for reducing air emissions at various facilities. The environmental goal would be to reduce overall emissions in a particular area. A study could be coordinated with an operating permit program being developed under the 1991 Clean Air Washington Act.
- ➤ *Biomass Conversion*: Water quality enforcement may create a need for new options for handling feedlot and dairy manure. Converting the waste into electricity, fertilizer and bedding material may provide a solution.
- ➤ *Deposit System for Waste Oil*: Do-it-yourself oil consumers would pay a deposit on motor oil purchases that would be refunded upon return of a specified quantity. This would reduce improper waste oil disposal and make more oil available for recycling.
- ➤ *Conservation Easements*: Property owners can benefit from reduced taxes by granting or selling conservation easements to government agencies or certain nonprofit corporations. This strategy shields land — such as timber stands, wetlands and agricultural land — from development, by providing an economic incentive to property owners.
- ➤ *Economic Incentives for On-site Sewage Systems*: Failure of septic systems often is tied to lack of maintenance. Inspection and maintenance programs by water, sewer or other districts or agencies can prevent water pollution from failed systems.

Air

Overview

Our air, that fragile layer of Earth's atmosphere, is all the air we've got, and we have done too little in our industrialized history to keep it healthy. Instead, we have filled the air with gases and particles, obstructing our vision as well as our breathing.

Washington holds onto a reputation for comparatively clean air, a natural complement to the state's spectacularly varied topography and rich water resources. By most measures, its reputation is deserved. This state is far from the worst air pollution offender, and in fact ranks solidly among the best in several air quality categories. But 10 counties in Washington are now perennial violators of one or more federal clean air standards, and another 19 counties are in serious danger of falling out of compliance.

Washington Environment 2010 ranked outdoor air pollution at the top of the state's list of environmental concerns. Our air is too often dirty, and much of the pollution is invisible. In the same way, its effects on our health and daily lives are not always plain to see, but might take years to show up.

How did it happen? Like most states, we pollute our air the modern way — by driving our cars and firing up our industries and woodstoves. We take single-occupant vehicles to work when we could car-pool or take the bus. We comply most of the time — but usually just barely — with standards for industrial emissions. We use wood-burning stoves and burn debris in our backyards, perhaps not realizing the impacts on air quality.

These are not grave sins. In fact, they are the things we do, as a matter of course, because we have always done them. These are some of the bad habits, although innocently carried out, that must be broken or modified on the way to cleaner air.

It is simplistic, however, to paint a totally gloomy picture. There is room for optimism. The state has sliced into air pollution in the past 20 years on the strength of some of the earliest and most progressive air-pollution legislation in the United States. There have been measurable improvements.

On the other hand, it is not possible, based on available information, to make sweeping statements about Washington's improvements in ambient air pollution. There is plenty of bad news. Still, there are indications that our state is moving in the direction of cleaner air in important, lasting ways. The new Clean Air Washington Act (which will be discussed in detail later in this section) is a decisive attempt to direct our thinking and clear our air.

Environmental Data

Ambient air quality is defined simply as the quality of the outside air in the environment around us. Ambient air pollutants are typically divided into two groups: criteria pollutants and toxic pollutants.

Criteria pollutants include particulate matter, carbon monoxide, sulfur dioxide, ozone, lead and nitrogen oxides. Toxic pollutants, for which data are so far extremely limited, include dioxins, benzene, chloroform, phenols, manganese, formaldehyde and many others.

This section will address several sets of environmental data and their attendant health threats. Visibility, which is not a pollutant but a monitoring parameter, is also examined.

Data Summary

Particulates

Tiny particles of air pollutants can come from many sources — woodstoves, dust, outdoor burning and industry. The small size of these particles allows them to travel deep into the lungs, causing potential breathing problems and aggravation of existing cardiovascular or pulmonary conditions. Particulates can cause lung damage, cancer (if particles are carcinogenic) and premature death.

Information collected to date shows a fairly stable particulate presence in the atmosphere, even a possible downward trend. But data collected during the last six years still reflect an average of 19 days a year in which particulate levels exceed state and federal standards.

Ecology found six areas of Washington violating federal particulate standards in 1988 — Spokane, Yakima and Thurston counties, the Kent-Duwamish and Wallula areas, and the Tacoma Tideflats. In 1991, an area covering parts of Benton, Franklin and Walla Walla counties was added, bringing to seven the number of non-attainment areas in the state. A non-attainment area is defined as an area in which concentrations of a federally regulated pollutant, such as particulate matter, exceed national health standards on an ongoing basis.

The long-term outlook shows particulate emissions are likely to increase because of a rise in woodstove use and forecasted population growth and urbanization. Potential new particulate problem areas are in Whatcom, Clallam and Kittitas counties.

Carbon monoxide

The more automobiles, the greater the concentration of carbon monoxide. This simple equation obviously means carbon monoxide is a big problem in our largest cities. Motor vehicles are the single largest source of carbon monoxide in the air, but there are other sources, too, such as indoor and outdoor woodburning and industry.

When inhaled, carbon monoxide replaces the oxygen in red blood cells, reducing the amount of oxygen delivered to the body. At low levels of exposure, health effects can include impaired perception, slowed reflexes, weakened judgment and drowsiness. More prolonged exposure at high levels can cause asphyxiation and heart failure from lack of oxygen.

Carbon monoxide levels in Washington appear to be declining, but there has been an average of 89 violations a year of state and federal carbon monoxide standards during the past decade. Furthermore, vehicle use and vehicle miles traveled are growing at a rate much faster than population growth, which threatens to reverse any downward trend in carbon monoxide levels. Urban areas in Kitsap, Thurston, Cowlitz and Whitman counties are the newest areas to show potential for violating federal carbon monoxide standards.

Sulfur dioxide

Sulfur dioxide is a colorless, irritating gas produced from the burning of sulfur-containing fuels (coal, oil and diesel), the smelting of metals and some industrial processes. Exposure at high levels can affect breathing and aggravate lung and cardiovascular illnesses and can alter the lung's ability to fight off infection. Sulfur dioxide is also one of the main ingredients in acid rain, which fortunately has not been a significant problem in Washington.

Some localized threats from sulfur dioxide remain, despite an overall decline in concentrations during the past 10 years (attributed to the closure of the Asarco smelter in Tacoma). Violations of state standards are still occasionally recorded. Emissions

from a coal-fired power plant near Centralia have placed that area at possible risk of violating standards.

Ozone

Ozone is a principal ingredient of smog. Ozone results from chemical reactions between volatile organic compounds and nitrogen oxides in the presence of sunlight, and thus is not emitted directly and in quantity by any one source. But again, motor vehicle use is a major culprit.

Ozone can break down human tissue and cells when it reacts with other chemicals. It can cause chest pain, coughing, sneezing, congestion and reduced lung function. Ozone is also responsible for reduced agricultural yields and noticeable damage to crops and some species of trees. Because ozone is a highly sun-specific pollutant, weather conditions can have a major effect on long-term patterns and consequent violations.

Ozone levels appear to be increasing gradually, though some fluctuation in levels would suggest further monitoring is needed to identify a true pattern. Again, weather conditions in the ozone season between May and September can be responsible for fluctuations. Washington exceeded federal ozone standards in 1990, which caused the Department of Ecology to designate the region of King, Pierce and Snohomish counties as a non-attainment area.

Visibility Impairment

Man-made impairment to visibility, mainly caused by particulate pollution, is a concern in our wilderness areas and parks such as the Mt. Rainier National Park. Though impaired visibility has no direct effect on our health, it does have an effect on our welfare and quality of life. As a response to this, regulations and control strategies were developed to protect visibility in our parks and wilderness areas. In addition, visibility protection in the urban environment should be favorably impacted by various air quality measures.

Visibility has improved at every monitoring site since protection strategies were begun — except at Mt. Rainier. Visibility impairments at Paradise on the mountain's south slope are virtually the same now as they were before controls were implemented. In addition, a new monitoring site at the Carbon River entrance to Mt. Rainier National Park definitely shows more visibility impairment than at other monitoring areas.

Results of an intensive visibility study by the National Park Service in the summer of 1990 will help identify the sources that continue to impair visibility. This information will be used to refine visibility-impairment controls. New restrictions on outdoor burning of agricultural debris and timber slash under Clean Air Washington should provide additional protection to visibility.

Toxic pollutants

Regulation of toxic air pollutants is a fairly new phenomenon. For many years, the only toxics regulated were those that contributed to the formation of ozone. Now, the Department of Ecology pays increasing attention to toxics like benzene, dioxins, chloroform, phenols, manganese and formaldehyde, a list that represents only a small portion of the hundreds of toxic pollutants emitted regularly.

It was not until 1988 that Ecology began to develop rules to control toxic air pollutants. Since then, the department has begun work with a consultant on evaluating control strategies, with an eye toward a plan for controlling existing sources of toxic pollutants. As noted previously, there is a serious lack of historical data on toxic pollutants, a situation being addressed by the new emission inventory system which will enable us to collect and store air toxics information in the future.

Clean Air Washington

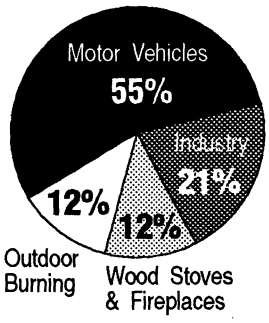
The 1991 Clean Air Washington Act is projected to help reduce the state's air pollution by 607,000 tons of pollutants a year. The economic benefit to the state from such reductions is projected to reach an impressive $1.1 billion. Clean Air Washington targets the state's top four sources of pollution — motor vehicles, industry, wood-burning stoves and outdoor burning. The law is designed to bring Washington into compliance before 1996 with strengthened air-quality standards of the federal Clean Air Act.

Clean Air Washington is projected to reduce statewide air pollution by 20.4 percent, which is a reduction in real numbers even arrayed against the state's growing population. This population growth, of course, means more cars on the road, more heavy industry and more people building fires. This new tier of polluters, in fact, has more than offset the air quality gains the state has made so far. Clean Air Washington is an important step in the right direction, but we remain in no position to say air pollution was a problem of the past generation. Instead, we should resolve it will be less of a problem for the next.

Clean Air Washington puts plans into place to attack outdoor air pollution, the state's top environmental problem as ranked by Environment 2010, by going after its root causes.

Motor Vehicle Pollution

Figure 3
Air Pollution Sources in Washington state



Motorized vehicles are Washington's largest air pollution producer, accounting for 55 percent of the state total of 2.475 million tons of pollutants a year. Cars, trucks, buses and motorcycles gulp fossil fuel at an unprecedented rate, emit alarming amounts of carbon monoxide and other pollutants and jam up our streets and highways.

Washington residents spend $2 billion a year to fuel motor vehicles, by far the state's largest single use of petroleum products. Advancements in technology have improved fuel economy and emission controls, but vehicle use in the state is growing two to three times faster than Washington's rate of population increase, negating past emission control achievements.

Consider the numbers. Motor vehicles annually give off 1 million tons of carbon monoxide, the single largest source of toxic gas in our state's atmosphere. Motor vehicles are also the largest producer of "greenhouse gases" that threaten to raise temperatures worldwide. They produce 106,000 tons of nitrogen oxides, 188,000 tons of volatile organic compounds (primarily hydrocarbons), 3,000 tons of combustion particulate and 59,000 tons of particulate from road dust. In addition, though localized statistics are difficult to pin down, leaky vehicle air conditioners are responsible nationwide for one-fourth of the chlorofluorocarbons (CFCs) that are boring a hole in the upper atmosphere's ozone layer.

Environmental effects of the petrochemical industry come not only from gasoline. Our discarded tires clog landfills and scar creek beds. Our used motor oil is dumped by the millions of gallons into our waterways.

While carbon monoxide levels in the state appear to be heading downward based on data collected between 1987 and 1990, Washington remains among the worst 10 states nationwide (along with Connecticut, Colorado, California, Arizona, Maryland, Massachusetts, Nevada, New Jersey and New York) in smog and carbon monoxide pollution. More study is clearly needed to confirm the continuing trend.

In the meantime, Clean Air Washington offers a positive plan for cutting pollution and conserving energy. If followed, it is projected to save millions of dollars that would otherwise be squandered on fuel, new pollution-control equipment, health care and lost work days. It is designed to take tens of thousands of vehicles off the road, which will reduce traffic congestion.

The plan concentrates on three separate motor vehicle issues: transportation demand management (TDM), alternative motor vehicle fuels and enlarging emission inspection areas.

Transportation Demand Management

People have cars. People will drive. Thus, attempts to reduce pollution must focus on reducing the number of cars and miles driven, especially by one-occupant vehicles.

Puget Sound's I-5 corridor has the nation's sixth-worst congestion, and the problem is growing elsewhere in the state. In Seattle alone, traffic jams cost residents and businesses an estimated $1 billion a year in accidents and health expenses.

"Transportation demand management" seeks to put more people in fewer vehicles. It promotes car and van-pooling, HOV (high-occupancy vehicle) lanes, bicycling, walking and public transit. To institute some of these changes will require a shift toward urban designs that emphasize multiple uses — residential and business — within neighborhoods. The most effective options for reducing air pollution, congestion, and energy consumption are those that eliminate a trip such as bicycling, walking, and telecommuting.

Any effort to change commuting behavior needs participation by employers, who are in a position to provide information to their employees about alternatives to solo commuting. Companies can offer flex time, ride-matching help, telecommuting options, alternative work schedules, bicycle parking and lockers and innovations such as a "guaranteed ride home" in times of serious need or emergency. Incentives such as preferential parking and lower parking charges for car-poolers or transit passes can work alongside a package of disincentives such as increased parking charges for single occupancy vehicles (SOV's) or restricted parking.

The state of Washington has recognized its lead role in encouraging alternatives to SOVs. The 1991 *Master Plan for the Capitol of the State of Washington*, for example, outlines a transportation plan that proposes incentives, including cash subsidies, for state employees who leave their cars at home. It calls for safe, convenient and weather-protected bicycle access and parking at state agencies. It suggests new state building clusters be made convenient for employees to walk to and among. It calls for transportation coordinators at each agency site to offer informal ride-matching help, transit schedules and access to a regional transportation database.

The state Department of Transportation, in conjunction with local governments and mass transit providers, is encouraging and working toward strengthening alternatives to solo commuting, including expanded use of high-occupancy vehicle lanes, high-speed passenger-only ferries and heavy or light rail systems.

Large public and private employers alike will be required under Clean Air Washington to adopt plans to reduce one-person/one-car commuting. Many private companies already are doing so. At US West in Bellevue, 26 percent of employees come to work in SOV's, compared to 80 percent for the rest of Bellevue's central business district. Swedish Hospital in Seattle reports only 44 percent of its employees drive solo to work, compared to 59 percent at similar locations. At CH2M Hill in Bellevue, 54 percent of its employees are in SOV's, compared to 82 percent at similar companies.

Clean Air Washington defines "major employers" — both public and private sector — as those that have 100 or more workers per site. These employers will be required to adopt plans for reducing solo commuting by April 1993 and put plans into effect by October 1993.

The act directs local governments in Clark, King, Kitsap, Pierce, Snohomish, Spokane, Thurston, and Yakima counties to adopt transportation demand management plans by October 1, 1992.

Clean Air Washington has set goals for reducing commute trips by 15 percent before 1995, 25 percent by 1997 and 35 percent by 1999.

Benefits of the plan can be dramatic — roughly 185,000 cars will be off the road during rush hours. That is projected to reduce annual fuel costs by $153 million and decrease dependence on imported oil. It could save more than $150 million by preventing air pollution and the subsequent need to upgrade emission control measures.

Alternative Vehicle Fuels:

Gasoline and diesel are not the only fuels our vehicles can use. Clean Air Washington calls for a renewed commitment to identifying and developing alternative fuels, such as compressed natural gas (CNG), propane, methanol, ethanol, reformulated gasoline or diesel, liquified petroleum gas, electricity and hydrogen.

Compressed natural gas has found favor with a number of the state's school districts to power their school buses, and a number of cities use CNG in their municipal buses. Propane or liquified petroleum gas (LPG) has been used by some private and public fleet operators for 20 years. The number of vehicles using CNG or LPG has grown from 973 in 1977 to almost 6,000 today.

Clean Air Washington requires the Department of Ecology to develop specifications for clean fuels and clean-fuel vehicles by July 1, 1992. Under the act, at least 30 percent of new vehicles purchased by the state must be clean-fuel vehicles, a requirement that will increase by 5 percent each year. These requirements are "fuel neutral" meaning that any vehicle that meets the standards would be acceptable.

The act also provides matching grants to offset costs for local governments that voluntarily choose clean-fuel vehicles for transit, including school buses.

Using cleaner fuels under plan specifications could reduce air pollution by up to 40 or 50 percent per vehicle and up to 3,700 tons a year. At this level it will remove the equivalent of 10,200 vehicles from the road and expose 8,800 fewer people to bad air.

As an added benefit, Clean Air Washington encourages fuel choices other than fossil fuel, which will in turn decrease dependence on foreign oil. North America has ample CNG reserves, the use of which could save the state government $1.1 million in fuel costs the first year and $1.8 million a year thereafter.

Motor Vehicle Emissions:

The U.S Environmental Protection Agency (EPA) requires inspection of emission control systems in areas where pollution from motor vehicles exceeds federal health standards, a description that can be applied to all of Washington's more populous counties. The testing program identifies the worst emission offenders and requires vehicle owners to take care of the problem.

Washington now requires testing only in the Seattle and Spokane areas. Under 1990 federal Clean Air Act amendments, the inspections will be expanded to Everett, south King County, Tacoma and Vancouver.

A program of vapor controls will be put in place, from refineries to service station pumps. This can mean encouraging development and use of low-volatility gasolines (gasoline that emits fewer vapors) or installing vapor-control devices at gas stations.

A tighter rein on vehicle emissions should cut statewide vehicle pollution by 15.5 percent, or 210,180 tons a year. This reduction would expose 373,000 fewer people to toxic air. It will remove the equivalent of 673,000 vehicles from the road. And it will promote better vehicle maintenance, meaning better gas mileage and longer engine life.

Industrial Pollution

Washington's commerce and industry account for 21 percent of the state's air pollution. The numbers break down like this: 274,000 tons of carbon monoxide, 112,000 tons of sulfur dioxide, 22,000 tons of particulate, 59,000 tons of nitrogen oxides and 42,000 tons of volatile organic compounds.

Washington ranks solidly in the cleaner half of U.S. states in measures of toxic chemicals released into the air by industry in terms of total pounds, pounds per capita and pounds per square mile. The state also ranks among the best in the output of ozone-depleting emissions by industry. But Washington, with 10 industry facilities emitting high risk cancer-causing chemicals, ranks a poor 47th in per capita emissions of toxic air pollutants.

Clean Air Washington will require the largest industrial polluters in the state to have five-year air quality permits, granted or renewable only if an industry can demonstrate it is using the best pollution-control technologies available. Smaller polluters that cause public health or environmental problems will also be required to get permits in areas where air quality is out of federal compliance.

Measures to control commercial pollution do not have to be punitive, and in fact the Department of Ecology will assist polluters, particularly small businesses, in reducing air emissions. A technical assistance team from Ecology will offer suggestions to reduce pollution, similar to hazardous waste reduction plans required by legislation passed in 1990.

Residential Wood Stoves

Wood stoves are homey, useful, seemingly cheap alternatives to oil, electric or gas heat. But any gain in personal economics has to be measured against health concerns, neighborhood impacts and the state's annual spending on air-pollution controls. Indoor wood stoves account for 12 percent of Washington's air pollution.

There has been a rapid rise in ownership of wood stoves, pellet stoves, fireplace inserts and fireplaces. Unfortunately, wood-burners are the most polluting form of home heating. They are the No. 1 source of combustion particulate emissions (soot and other tiny particles).

The problem with wood stoves is magnified because they are in use only about half the year. The winter heating season is commonly a time of stagnant air and inversion, which traps wood smoke close to the ground in residential areas. Studies have shown that residents of homes heated with wood can have increased respiratory problems and reduced lung function. Smoke from wood stoves also seeps into neighboring homes.

Clean Air Washington sets out a program for reducing emissions from wood stoves that includes wood-moisture requirements of 20 percent or less; restricts smoke density; calls for only those stoves that are certified to be sold in retail stores while tightening emission standards; and strengthens the ability to impose burn bans when wood-smoke pollution levels are high.

The benefits of greater care in the use of wood stoves will be significant. Pollution from wood smoke under the Clean Air Washington program is projected to drop by 11 percent, representing 34,700 tons of pollutants a year. Almost 100,000 fewer people a year will be exposed to smoky air. The public will save a projected $73.1 million in avoided health care expenses and lost work days.

Outdoor Burning

Fire is most often seen as a useful tool, a fast and simple way to dispose of backyard and land-clearing debris, agricultural stubble or timber slash. It is quick and easy, but more and more it is a choice made too quickly and too easily. In urban areas, outdoor burning has become an increasing nuisance to fire departments, neighboring residents and local air quality authorities. On timber sites, some fires can be so large that in a matter of hours they release more pollutants into the air than an industrial plant releases in a year.

Outdoor burning accounts for more than 12 percent of the state's annual air pollution. Debris gone up in smoke turns into 255,000 tons of carbon monoxide, 20,000 tons of volatile organic compounds, 26,000 tons of particulates.

Fire is now obsolete as a choice for disposing of residential debris. Fortunately, alternatives are emerging. For example, many municipal governments offer community composting and yard waste disposal programs. Some counties have launched pilot projects for disposal of construction debris.

Tighter enforcement of the burning that is permitted is called for under Clean Air Washington. State law already prohibits the burning of garbage, rubber, plastics, paints, petroleum products, asphalt and dead animals. No burning is allowed during air pollution episodes or where air quality is impaired.

Clean Air Washington is designed to encourage alternative ways to deal with yard leaves and clippings. It bans residential and land clearing outdoor burning in areas that don't meet federal air quality standards and phases out outdoor burning altogether in urban areas by 2001.

All these measures should reduce pollution from residential and land clearing by 3.2 percent, or 9,600 tons a year. Some 16,000 people will be freed from exposure to dirty air, a savings of $3.4 million a year in health costs and lost work days.

Clean Air Washington has set a goal of reducing slash burn emissions by 20 percent by 1995 and by 50 percent by 2001. The law directs the Department of Natural Resources (DNR) to encourage slash disposal alternatives and timber management practices that would produce less slash, make better use of slash and dispose of slash without burning, leaving slash burning as the choice of last resort. DNR is a leader in this effort — slash burning is not allowed on state forest lands.

A 16 percent reduction in emissions, or 48,000 tons a year, can be achieved under Clean Air Washington's plan for timber slash. Some 85,000 fewer people will be exposed to unhealthful air.

An estimated 3,000 to 5,000 agricultural fires are set each year to dispose of the stubble left over from harvest or to control weeds and plant diseases. Most of these fires are set in the drier months, which concentrates their fumes in one block of time and magnifies their pollution effects during that time well beyond its average spread throughout a year.

Clean Air Washington establishes a fee schedule for agricultural burning permits.

Toward 2010 -
The Challenge of Clean Air

1 Establish employer based incentive and disincentive programs that discourage, rather than encourage, employees from commuting to work alone.

"Transportation demand management" (TDM) legislation was adopted in 1991. It phases in a 35 percent reduction in solo commuting for major employers in Washington's largest counties by 1999. A state task force is drafting model local ordinances, due March 1992. Local TDM ordinances are required by October 1992; employer plans are due by April, 1993, with implementation set to begin the following October. State agencies must comply with TDM provisions, too.

2 Establish economic disincentives to solo commuting.

The TDM legislation encourages innovation in each local plan, including various incentive options. A state economic incentives task force has recommended further research into employee parking fees and employer subsidies of transit, carpools or other non-solo commute options. Meanwhile, a state transportation policy panel is developing recommendations for dealing with congestion in the Puget Sound, Spokane and Vancouver areas.

3 The state's Department of Transportation, in conjunction with local governments and regional transportation authorities, must continue and expand their efforts to develop mass transit opportunities that provide competitive alternatives to solo driving.

The Department of Transportation's (DOT) high capacity transit advisory council has approved $7.3 million in planning support to local agencies in 1991-92.

4 Control gasoline vapors.

Ecology adopted a statewide gasoline vapor recovery regulation in 1991. Stage I controls, to capture vapors vented off in the process of delivering gasoline to gas stations, will be required statewide by 1994. In Western Washington, a requirement for Stage II controls, which recover fumes as gasoline is pumped into each vehicle, will be phased between 1992 and 1998. Smaller facilities will be exempt.

5 Encourage transition to cleaner fuels and more fuel efficient vehicles.

The Clean Air Washington Act requires that an increasing share of state government vehicles be powered by clean fuels, starting with procurements in 1993. Meanwhile, DOT continues a demonstration project with natural-gas powered vehicles at its signal shop.

6 Expand the vehicle emission inspection and maintenance program to major urban areas and other regions with known air quality problems.

Federal law expands the program to include carbon monoxide non-attainment areas and environs, essentially the I-5 corridor from Marysville to Dupont, the Vancouver area and more of Spokane County. The testing procedure will be enhanced. The program changes will take effect January 1993 under the Clean Air Washington Act.

7 Explore and develop approaches to controlling emissions from diesel powered vehicles.

The Clean Air Washington Act requires that diesel vehicles be included in the inspection program. A testing procedure to measure visual exhaust density is being developed.

8 New development in areas where air quality is poor or threatened should be controlled to avoid further degradation of the air.

While this issue was not not specifically addressed in the Clean Air Washington Act, the measure does require all substantially remodeled buildings and new construction to have adequate non-wood heat sources beginning in July 1992. Also, major new or modified industrial sources must meet pollution reduction requirements in non-attainment areas. New developments may also be required to provide air quality mitigation under the SEPA process.

9 Phase out outdoor burning of land clearing debris, agricultural and yard debris and forest slash.

The Clean Air Washington Act sets these strategies in motion:

◆ Commercial/residential outdoor burning must be phased out by 2001 in urban growth areas and will be banned in areas not meeting federal carbon-monoxide or fine particulate standards. Permits will be required where burning is allowed. Rules are expected to take effect August 1992.

◆ Agricultural burning permits and a fee structure are required. A task force will set fees and advise Ecology on the best agricultural practices to reduce field burning. Rules will be adopted in July 1993.

◆ Slash burning must be reducted 50 percent by 2001. DNR has the lead on implementation and has already reduced slash burning on state lands by 80% percent.

10 Phase out residential wood-burning stoves and inserts.

The Clean Air Washington Act sets tighter emission standards for fireplaces and certified stoves. It bans installation of used uncertified stoves in new construction or major remodeling. It sets a higher fee on wood stove and fireplace sales. State law allows local air quality agencies to ban all use of uncertified wood stoves in 1995.

11 Require the recycling or reuse of chlorofluorocarbons (CFCs) from refrigerators and air conditioners.

The 1991 federal Clean Air Act amendments require registration of automotive air conditioning technicians and requires capture of all CFC cooling fluids for recycling and re-use. The Clean Air Washington Act also prohibits release of CFCs and requires capture. The state legislation bans the sale of non-essential consumer products that contain CFCs.

12 Establish and enforce a fee-based, renewable permit program to further limit air pollution, including air toxics, from major industrial and commercial sources.

Under the 1990 federal Clean Air Act amendments and 1991 Clean Air Washington, Ecology is developing a five-year renewable operating permit program. Permits will be required for major industrial sources or sources shown to cause or contribute to air pollution problems. Ecology will submit the proposed fees to the 1993 legislature. EPA must then review the state program. Draft state rules and fee structures should be available by May 1992.

Water

Water resources in Washington are astonishing in their variety, beauty and usefulness. It could be argued that no other state in the nation offers the wealth of water that Washington residents take for granted. From Puget Sound to Lake Chelan, from the Columbia River to the Strait of Juan de Fuca, from wetland to pond to mountain creek, Washington's waters are wondrous in their diversity and apparent abundance. Unfortunately, there are probably as many ways to pollute in Washington as there are bodies of water, and we can no longer say with certainty that there will always be enough water for every person and every use.

We use water for drinking and cooking, cooling and warming, irrigation, recreation and navigation. In short, it is the essential ingredient of life, unmatched in its importance and effects on our lives. We cannot afford to dirty the waters.

But we have. Washington ranks among the poorest of U.S. states in several key water quality indicators (1991-1992 Green Index; Island Press, 1991), including the number of water systems violating the Safe Drinking Water Act (48th). A major reason for this is the extremely large number (13,000) of small public water systems in the state. To be fair, Washington ranks among the best in other water quality measurements, among them per capita public spending on water quality related programs (16th). But there remains work to be done.

Washington Environment 2010 has ranked point and non-point source discharges to water as a major environmental threat, followed closely by drinking water contamination. Controlling point and non-point source pollution of water are among the critical recommendations in the Environment 2010 action agenda. The state's work toward implementing 2010 recommendations leads off this chapter of the State of the Environment Report.

This chapter then contains sub-sections on surface water, ground water, water as a resource and some of the various ways we pollute our water.

Surface Water Quality

Overview

Can you swim in it safely? Can you fish in it and eat or sell your catch? Can you drink it? In simple terms, these are some of the questions researchers have been asking about a cross section of the more than 1,400 individual waterbodies in Washington.

Environmental Data

The Department of Ecology's ambient monitoring section monitors approximately 80 freshwater and 35 marine stations each month. These sites are selected based on their representative nature of various water bodies, and based on the need for information related to a regional issue. This group has identified indicators that tell us how and where the state's water quality is impaired. The first of these indicators is the water quality index (WQI), which summarizes eight water quality variables (temperature, fecal coliform bacteria, turbidity, suspended sediment, oxygen, pH, nutrients and ammonia toxicity) and assigns a number value to a tested water body.

A second ambient monitoring indicator identifies where state standards are exceeded for temperature, fecal coliform, bacteria and oxygen. A third indicator identifies trends in conductivity — how readily water carries an electric current — and suspended sediments, described as "total suspended solids," or TSS.

There are other sets of data which may be valuable to determining trends in water quality. These are specific to lakes, and will be addressed later in this chapter. They measure total phosphorus levels and the "Secchi depth" from tests of 70 lakes.

Water Quality Index

Water quality index (WQI) numbers range from 0 to 100. Scores under 20 indicate that water quality in tested waterbodies is acceptable. Scores between 20 and 60 indicate marginal water quality, and scores greater than 60 indicate unacceptable water quality. Some of the information resulting in poor or marginal WQI scores are, as in other measures, the result of natural causes.

Three tested waterbodies had WQI scores in the unacceptable range — Crab Creek near Beverly, the Palouse River at Hooper and the South Fork of the Palouse River in Pullman.

Exceedences of Water Quality Standards

Fecal coliform standards are designed to protect human health, while standards for temperature and oxygen protect in-stream life. It is difficult to graphically show the results of fecal coliform data on a statewide basis. It is equally difficult to summarize this data. Consequently, this information is not included here, but should be examined in determining overall water quality at a local or regional level.

Trends In Conductivity and Total Suspended Solids

Conductivity: The higher the conductivity, the more dissolved ions are present in the water. Conductivity has increased in the last 10 years at 17 sites — possibly because of increased development in Western Washington —and decreased at three test sites. Of these 20 sites for which a change was noted, only two — the Sumas River and Crab Creek — had unusually high conductivity levels.

Total suspended solids (TSS): This refers to the amount of solid material in the water. Typical sources of TSS are land clearing, road runoff and agriculture. Two test sites carry notably high sediment loads — the Palouse River, due to agricultural sources, and the Toutle River because of the Mount St. Helens eruption a decade ago. In the past 10 years, TSS has increased at six sites, mostly in central Washington, and decreased at seven sites, all but one in Western Washington.

As part of a 1989 nonpoint pollution management program, selected waterbodies were also evaluated for two additional primary indicators — "support of designated uses" and "water quality limited" status.

Four types of surface waters — rivers, lakes, estuaries and coastal waters — were examined to see how well they supported such typical uses as fishing, swimming, drinking water, agricultural irrigation, industrial, wildlife habitat, fish and shellfish habitat, commerce and navigation.

A water body is considered to be "water quality limited" when the best available technology is not expected to eliminate pollution problems that prevent water from supporting its designated uses.

How well a water body, or a tested portion, supports its designated uses, also referred to as "beneficial" or "characteristic" uses, is rated on four levels:

1 Fully supported: This water body fully supports all its designated uses.

2 Partially supported: Contamination of this waterbody occassionally exceeds levels necessary to support designated uses.

3 Not supported: This waterbody frequently exceeds contamination criteria for supporting uses.

4 Threatened: This waterbody fully supports its uses, but anticipated impacts on the waterbody might soon preclude full support.

Of the 42 percent of Washington waterbodies assessed, 34 percent were found to be water quality limited.

The Clean Water Act requires the state to test its surface water, and the testing has come from a variety of sources during the past 10 years — Ecology, citizen lake monitoring, Department of Health shellfish monitoring, water quality monitoring by Seattle METRO, Indian tribes, Clean Lakes projects and other agencies and consultants. Collected information is entered into the waterbody system database, maintained by Ecology.

It is important to note that testing so far has not been comprehensive. Only 38 percent of estuaries, 12 percent of rivers and streams and 30 percent of lakes have been evaluated. Of coastal waters, 100 percent have been assessed and 100 percent fully support their uses. (See map.)

While data collected can serve as indicators of the state's water quality, it is also fair to say "the squeaky wheel gets the grease," which is to point out that information was typically collected from impaired waterbodies. This results in a set of data skewed to highlight problem areas.

Data Summary

Rivers and Streams

Washington has almost 41,000 miles of rivers and streams, winding and bending through mountains and valleys, marking the boundaries of cities and counties and bordering states. Our fresh flowing waters serve our industries and a host of human uses, and in many cases they are ill-served in return.

Using the previously identified environmental data, disturbing results are revealed. Twelve percent of the state's rivers and streams were assessed. Of those, only 31 percent fully support their designated uses, while 30 percent do not support their designated uses. Another 12 percent are threatened, and 27 percent partially support uses.

Pollutants which have the greatest impact on rivers and streams not fully supporting their uses were:

◆ Pathogen indicators (23 percent), which generally refer to high levels of fecal coliform, *e coli* or enterococci bacteria from point and nonpoint sources.

◆ Thermal modification (11 percent), which refers to the temperature of a river or stream becoming too warm, caused by lack of shading, a point source or other reasons.

◆ Siltation (10 percent), a condition of a river or stream that exceeds suspended solids standards in the water quality index and can impact spawning of salmon and other anadromous fish.

Several non-point sources (diffuse as opposed to originating in one place) contribute most heavily to degradation, or pollution, of rivers and streams:

◆ Pasture lands (10 percent) and their attendant agricultural practices (irrigation, pesticide and fertilizer application, grazing and animal holding pens and feedlots).

◆ Vegetation removal (10 percent) from stream and riversides.

◆ Runoff and storm sewers (9 percent).

Lakes

Washington is a land of 8,000 lakes, covering some 614,000 acres.

Thirty percent of the state's lakes were evaluated. Of those, almost half — 47 percent — do not support their designated uses. Only 11 percent fully support their uses, 20 percent are threatened and 22 percent are partially supporting uses.

The two water quality parameters, in roughly equal measure, most responsible for lake waters not fully supporting uses were nutrients (nitrogen or phosphorus that stimulate plant growth, from sewage or non-point sources) and low dissolved oxygen (from the loading of organic wastes).

The Department of Ecology's ambient monitoring section, with assistance from local volunteers, monitored 70 lakes in 1990. Researchers tested water clarity bi-weekly throughout the summer by measuring the distance a black and white disk can be lowered into the water before it disappears from view (Secchi depth). Ecology staff visited the lakes in the spring and fall to measure nutrient concentrations and other physical and chemical characteristics.

Lakes with deep Secchi depths, good water clarity, low nutrient levels and little plant growth are classified as "oligotrophic." Lakes with higher nutrient concentrations and shallower Secchi depths (from greater algae growth) are termed "eutrophic."

Nutrients: Phosphorus is the plant nutrient that best fosters algae growth. Lakes with phosphorus concentrations of less than about 13 parts per billion (ppb) are commonly found among the oligotrophic group. Phosphorus concentrations greater than 26 ppb commonly indicate eutrophic lakes. Of those lakes where both nutrients and secchi depth were measured, 18 had less that 13ppb total phosphorus, while 17 had greater than 26 ppb total phosphorus.

Secchi depth: Commonly, Secchi depths greater than 3.7 meters indicate oligotrophic lakes. Depths less than 1.9 meters indicate eutrophic lakes. Of those lakes where both nutrients and Secchi depth were measured, 28 had Secchi depths greater than 3.7 meters and five had Secchi depths less than 1.9 meters. Secchi depth measurements identified fewer lakes as eutrophic than nutrient tests, one reason being that some lakes are chemically treated for algae growth.

Estuaries

Washington's 2,900 square miles of estuaries (those bodies of water in which saltwater and fresh water merge or mix) are also endangered by pollution. More than half (54 percent) of the tested estuaries are not supported for designated uses or are only partially supported. Another 12 percent are threatened. Only 34 percent are considered clean enough to fully support designated uses.

Pathogens, an indicator of fecal coliform contamination, represent the greatest (38 percent) pollution impact on estuary waters, followed by low dissolved oxygen (28 percent).

On-site waste treatment systems (18 percent) represent the largest source of degradation. The next largest source (15 percent) is naturally occurring conditions. Close behind are animal management areas (14 percent) and pasture lands (13 percent).

Dioxin and Related Compounds in Water

Overview

The chemical commonly called "dioxin" (2,3,7,8-tetrachlorodibenzo-*p*-dioxin; TCDD) is a member of a family of compounds that includes the polychlorinated dibenzodioxins (PCDDs) and the polychlorinated dibenzofurans (PCDFs). The effects of these compounds on the environment and human health is presently a matter of intense debate and research. It is widely agreed, however that the release of PCDDs and PCDFs to the environment should be minimized or eliminated.

These compounds have varying toxicity based on the number and position of chlorine atoms in their structure. The relative toxicity of various members of the PCDD/PCDF "family" can be estimated by "toxicity equivalence factors" (see definitions). PCDDs and PCDFs are almost exclusively created as the unintended byproducts of industrial and combustion processes. The primary source — at least in Washington — is the bleaching of wood pulp in the production of paper. Historic sources in Washington include wood treating and preservation facilities which produced contaminants associated with pentachlorophenol.

PCDDs and PCDFs are relatively insoluble in water and have a strong affinity for animal tissue and sediments. They can be very toxic to fish, adversely affecting survival, growth and behavior.

Several definitions help when discussing dioxins and furans.

Toxicity Equivalence Factor (TEF): Number assigned to a PCDD/PCDF compound based on its toxicity relative to TCDD, the most toxic of these compounds. For instance, TCDD has a TEF of 1.0 and 2,3,7,8-tetrachlorodibenzofuran (TCDF), which has 1/10 the toxicity of TCDD, has a TEF of 0.1/ng/Kg.

Toxicity Equivalent (TEQ): Toxicity of an individual or mixture of PCDD/PCDF compounds converted to an equivalent concentration of TCDD. An example is a sample which has a TCDD concentration of 5.0 ng/Kg (parts per trillion) and a TCDF concentration of 20 ng/Kg. TEQ for this sample is [5.0 + (0.1)20] = 7.0.

Environmental Data

Most of the existing PCDD and PCDF data have been collected near pulp mill discharges in the Columbia River, Grays Harbor and Puget Sound. The Columbia River, which receives effluent from nine mills in Washington, Oregon, Idaho and British Columbia, is the most intensively studied. PCDD/PCDF levels in Columbia River fish have been surveyed by Environment Canada, the British Columbia Ministry of the Environment, EPA, the Northwest Pulp and Paper Association, Ecology, and the Oregon Department of Environmental Quality.

Aside from an Ecology study of Lake Roosevelt (upper Columbia River), investigations so far have focused primarily on contamination in fish. Evaluation of other media are needed to assess the transport, persistence and fate of PCDDs and PCDFs — and their ecological implications.

Trends in Columbia River concentrations are also unknown since all data have been acquired within the last four years. Continued monitoring will be necessary if we hope to track this problem over time.

Data Summary

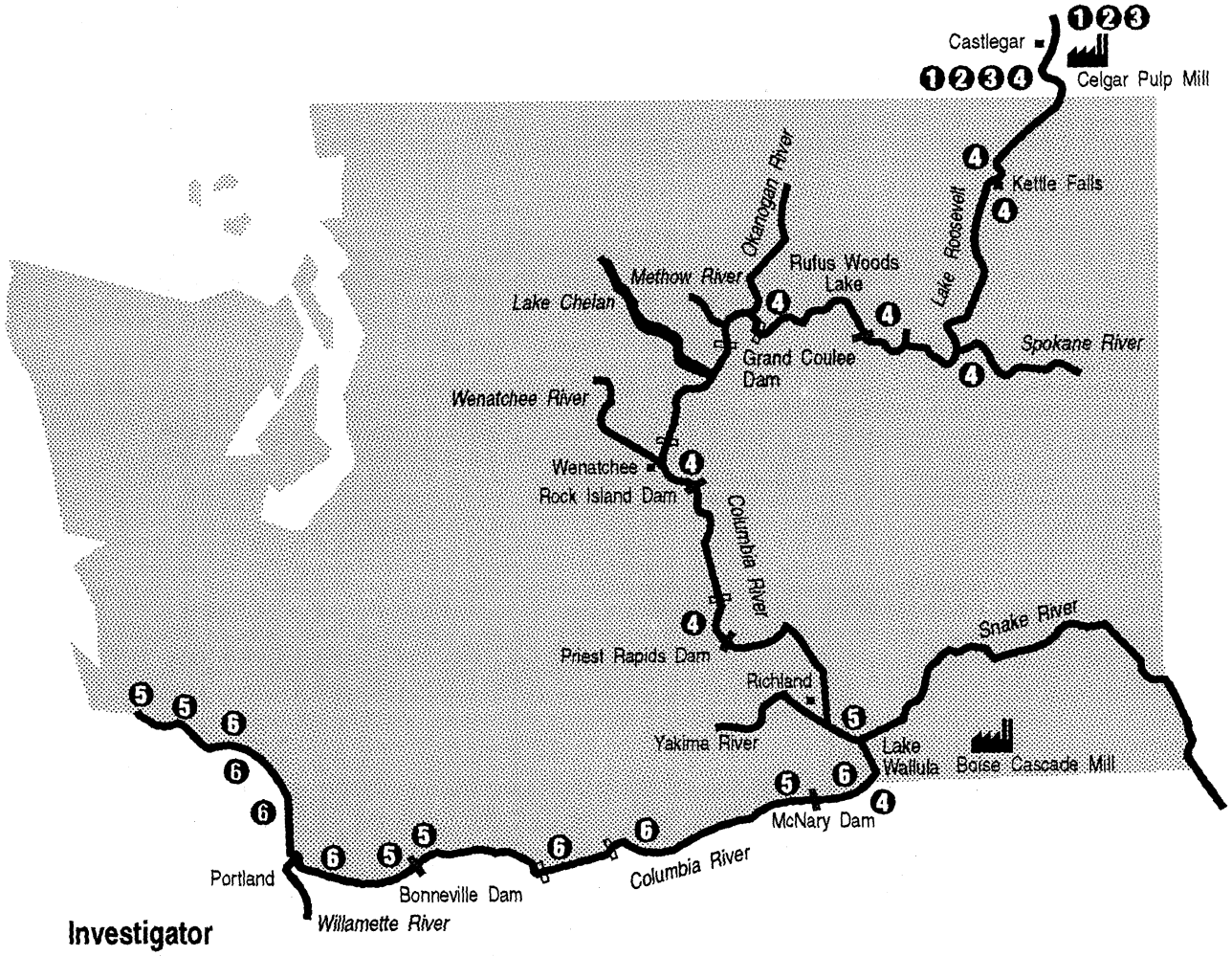
◆ The highest concentrations of PCDDs and PCDFs in the Columbia River are found below the Celgar pulp mill in British Columbia. Elevated TCDF concentrations have been found in fish more than 200 miles downstream; Celgar is the only significant source of this compound known in this region. Fish in the reach below the Boise Cascade pulp mill in Wallula, Washington, have the second highest concentrations of PCDD/PCDFs in the Columbia River.

➤ In reaches affected by the Celgar mill, TCDF is the major contributor to the total TEQ (see figure), while a greater portion of the TEQ can be attributed to TCDD below the Boise Cascade mill.

◆ Fish species with high fat content, such as whitefish and sturgeon, accumulate higher concentrations of PCDDs and PCDFs than those with low fat content, such as bass and walleye.

◆ Several studies have shown that salmonids returning upstream to spawn do not appear to accumulate significant concentrations of TCDD or TCDF.

Figure 4
Columbia River Mainstem Sites



Ground Water

Overview

Ground water is a vital source of water for natural ecosystems and growing human population. It supplies 60 to 70 percent of the drinking water for the state and is a major source of water for irrigation. Springs and seeps supplied by ground water provide base flows for lakes, streams, rivers and wetlands.

Despite its importance throughout Washington, ground water is often afforded less attention and protection than surface water. One reason for this is that it is less visible. Ground water moves through porous rocks, sand and gravel — water-bearing formations are called aquifers. The location, size and character of individual aquifers are still being discovered, while equivalent information about rivers, lakes and marine waters is much more complete.

Because ground water is generally hidden from view, its degradation often goes unnoticed. Contamination from septic systems, animal-keeping practices, crop and lawn fertilizers, and numerous other sources can and do pollute ground water. Since water in aquifers moves slowly, recovering and decontaminating polluted ground water is generally an expensive, time-consuming process.

Environmental Data

Washington has not yet set up a statewide ground water monitoring network. Long-term water quality monitoring data are generally unavailable. Information, therefore, is inadequate to depict the status of the state's ground water.

The analysis presented here uses data which are biased toward large public-supply wells in populated areas. These wells are often relatively deep and integrated over a range of depths. By the time contamination shows up in this type of well, a large volume of water may already be degraded.

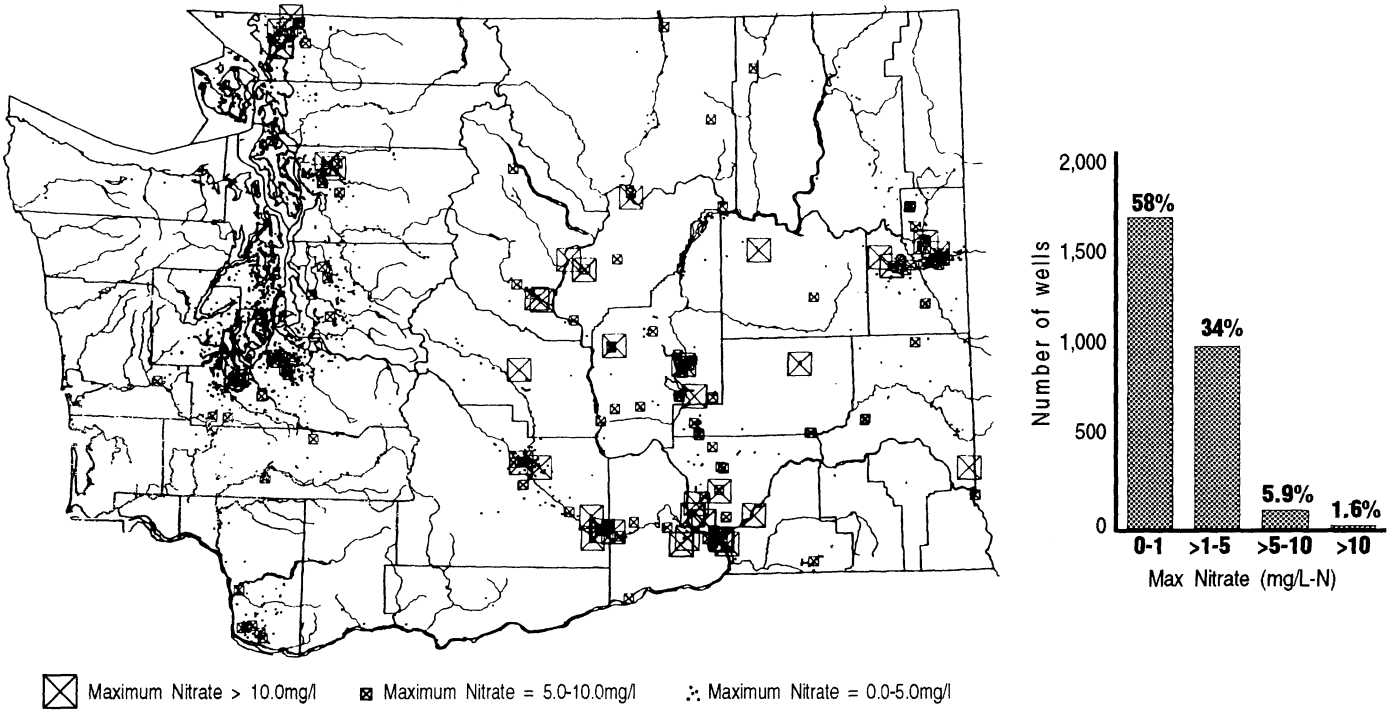
A key chemical used to assess ground water quality is nitrate. It is expressed as mg nitrate-N/l (or parts per million as nitrate nitrogen) in ground water. The federal drinking water standards set a maximum level of 10 ppm of nitrate-N. Nitrate is used as an indicator of contamination because it is associated with a wide range of contaminant sources, is highly mobile in ground water and can be a health concern, especially for infants, at concentrations over 10 ppm. Despite the fact that nitrate is probably the best single indicator available for ground water quality, many cases of contamination are not revealed by nitrate.

Data Summary

The state Department of Health monitored 2,894 Class 1 (minimum of 100 services) and Class 2 (minimum of 10 services) public water supplies for nitrate levels. These wells were monitored once every three years between 1975 and 1990. Results are compared against the maximum contaminant level (MCL) of 10 mg-N/l, which is defined as the maximum allowable concentration of a contaminant in water delivered to a public water system. Background concentrations for nitrate are typically less than 1 mg-N/l.

Figure 5

Public water supply well nitrate concentrations



Findings

◆ More than 40 percent of monitored wells have recorded nitrate concentrations greater than 1 mg-N/L (10 percent of the MCL). Thus, nearly half of the wells have recorded concentrations above background, indicating contamination from human activity.

◆ Almost 7.5 percent of these wells have recorded nitrate concentrations greater than 5 mg-N/L (50 percent of the MCL). Another 1.6 percent of wells have exceeded the drinking water standard of 10 mg-N/L.

◆ Clusters of high nitrate appear in the western portions of Whatcom, Snohomish, King, and Pierce counties; Thurston, Grant, Yakima and Spokane counties; and Wenatchee.

Again, these findings do not represent a comprehensive evaluation of ground water quality. As dependable water supplies become scarce — even in Western Washington — the need for a long-term ground water quality monitoring network is increasingly urgent. In addition, the state needs an interrelated program to assemble, validate and publish data available from other sources and for such purposes as toxic cleanup, solid and hazardous waste regulation, and for studies funded by the Centennial Clean Water Act.

Together, these efforts would allow reliable assessment of the state's ground waters and protect this precious resource.

1 Develop and implement comprehensive local plans to protect whole watersheds from the effects of agricultural and forest practices, failed septic systems, stormwater run-off, improper disposal of household wastes, construction related erosion, and other nonpoint sources.

◆ About $1.5 million in Centennial Clean Water Fund grants have been awarded to implement 12 watershed protection plans, with protection plans underway for 14 additional watersheds. The Washington Departments of Transportation, Agriculture, Health, Wildlife, Natural Resources and Fisheries and the Parks and Recreation Commission have provided technical assistance to watershed planning through involvement on an interagency team. Department of Fisheries has placed a fisheries biologist on the Puget Sound Cooperative River Basin Team.

◆ Background monitoring for the Yakima River Basin began in April 1991; a full time dairy inspector in Ecology's Northwest Regional Office was hired in late 1990; a full time U.S. Soil Conservation Service position was contracted in June 1991 to provide follow-up with individual dairy farmers; a full time staff position has been placed in Ecology's Southwest Regional Office to support Timber/Fish and Wildlife efforts.

◆ The U.S. Department of Agriculture (USDA) and U.S. Soil Conservation Service (SCS) provide funding for watershed studies and protection. The Puget Sound Cooperative River Basin Team, a state and federal effort supported by funding from SCS and other sources, provides direct technical assistance. Twelve watershed studies have been completed since March 1987. In 1991 four additional watersheds were completed: Lower Hood Canal, Dungeness River Area, Drayton Harbor and Lower Cedar River. Discovery Bay Watershed is the current project. The Tucannon River watershed project has been approved. Omak Creek is under consideration for federal watershed assistance.

◆ A pilot study to evaluate the effectiveness of using the state's computerized mapping system to identify non-point pollution sources has been completed.

2 Monitor on-site sewage systems and upgrade systems that provide inadequate treatment.

The Department of Health is developing regulations with cooperation by local health districts. Proposed regulations are scheduled to be considered by the State Board of Health later this year.

3 Explore the use of economic incentives and disincentives that promote the adoption of better land management practices.

◆ An economic incentives task force has proposed analysis of biomass conversion, a waste oil deposit system, conservation easements and incentives for septic system maintenance and upgrades.

◆ The Puget Sound Water Quality Authority drafted a shellfish protection bill for the 1992 legislature. The measure includes provisions to establish local programs that target non-point sources that threaten shellfish beds.

4 Establish local stormwater management programs.

◆ Ecology is developing the final version of a technical manual, supplemental guidelines and model ordinances. Materials will be distributed in March 1992. Worshops will be held later throughout the year.

5 Strengthen, expand, and enforce the wastewater discharge permits system, increase permit fees, and make the fees correspond to the volume and toxicity of discharges.

◆ Due to increased interest in the program by the legislature, permit holders and other parties, and in response to a request by Ecology, the Governor's Commission on Efficiency and Accountability in Government conducted an audit of Ecology's water quality program. In response to the audit, Ecology designed a plan for actions to improve the program. Additional changes make take place as a result of a recent set of recommendations by the EPA.

6 Promote the manufacture and use of unbleached paper.

◆ Several agencies and programs now use unbleached paper and envelopes.

◆ Ecology's policy on using environmentally sound paper encourages suppliers to bid on paper not bleached with elemental chlorine (which yields dioxin as a byproduct), but allows oxygen, ozone or chlorine dioxide bleached paper.

7 Develop and implement a comprehensive ground water protection program, including monitoring of ground water quality, research on soil quality and other important hydrogeologic features, and education.

◆ Ecology is exploring actions to improve the ground water program and how resources might be pooled within Ecology and among other agencies to better coordinate ground water protection efforts.

8 Reduce the number of small drinking water systems by consolidating them or merging them with larger systems.

◆ Legislation has been introduced that will absorb small, problem water systems into larger systems managed primarily by certified water system managers.

◆ Implementation of the Public Water System Coordination Act has begun in some areas of the state, in which private system owners and state and local health agencies set up a regional water system plan. Together, they will identify service areas and encourage developers to tie in to existing systems. The long-term effect is that the rate of new, small water systems being created will continue to decrease.

Water as a Resource

Overview

Aside from the cleanliness and quality of our water is the separate question of supply. Is water there when we need it? Today in the state of Washington the assumption is usually "yes," and we generally act as if our water could never run out. But surface water and ground water are finite resources, a reality too easily obscured by the apparent abundance of water in most of our homes, farms and industries. The truth is that demand for water and demands on water systems are rapidly increasing in Washington, especially in fast-growing metropolitan areas. Existing resources are being taxed to the limit.

Washington Environment 2010 ranked physical disruption of the water cycle, an important water resource issue, as a Priority Level 3 environmental threat.

Environmental Data

Analysis of water availability in this section is based on four main sets of data:

- Areas in which new surface water appropriations are prohibited or restricted;
- Areas covered by state and federal management programs;
- Reliance on ground water for drinking water;
- Trends in water right application processing.

Appropriations are Prohibited or Restricted

The map on the next page (Figure 6) shows the major geographical areas of the state where additional appropriations of surface water are prohibited or restricted by rule because of the need to protect existing water rights and maintain instream flows. Basin management plans and instream protection programs have been adopted for 18 water resource inventory areas. Many other lakes, rivers and streams, not shown, have been closed to additional appropriations. Administrative closures and minimum flows are established under terms of individual water right permits and are typically based on recommendations of the Departments of Fisheries or Wildlife and tribal governments. Ecology's water resources program has begun adding these streams to Geographical Information System (GIS) and will be completing this task within the next few years.

The maistems of the Columbia and Snake Rivers were withdrawn from further appropriation, with an effective date of December 20, 1991. This is the date that the listing of the Snake River sockeye salmon as an endangered species by the National Marine Fisheries Service took effect. Existing water rights and applications received before this date are not affected by the withdrawl. Ecology anticipates this withdrawal will be in effect long enough to determine: whether water is available for futher approproiation; whether there is sufficient water for fish and wildlife habitat; and whether it is in the public interest to allocate more water for out-of-stream use.

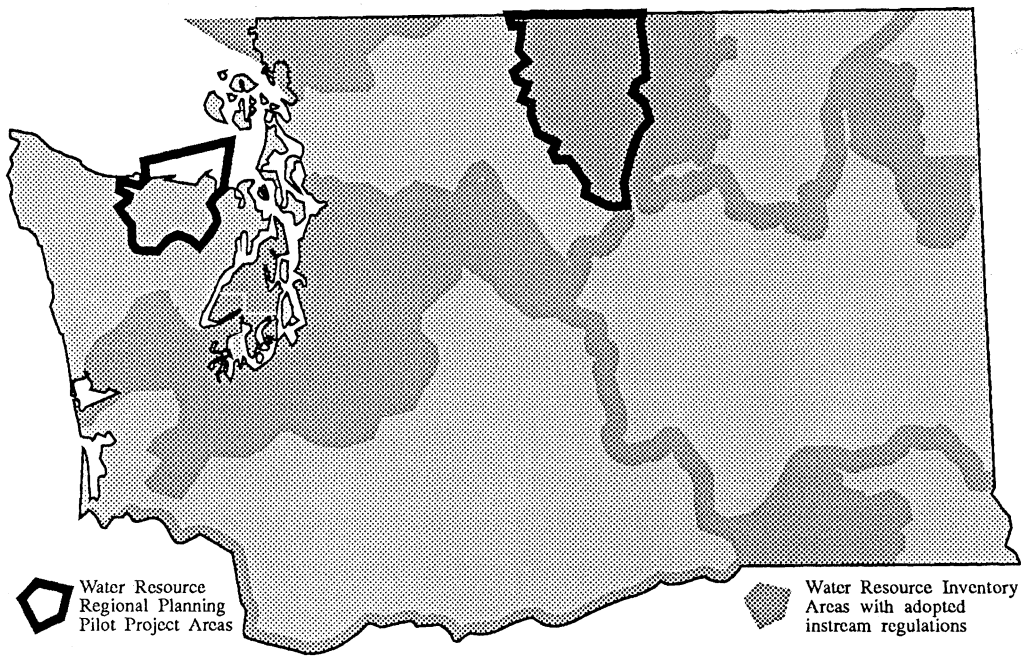
The Northwest Power Planning Council is preparing a recovery plan for all weak salmon stocks in the Columbia and Snake River Basins and has called upon the North-

Northwest states to develop a regional approach to future water appropriations in the basins. Ecology is meeting regularly with its sister-agencies in Oregon and Idaho to reach such an agreement. Oregon and Idaho have also withdrawn mainstem waters from further appropriation for the present. Through this pro-active, cooperative approach, the states hope to avoid federal intervention under the Endangered Species Act and successfully address both the environmental and economic implications of the endangered species issue.

To better plan for demands on our state's water, leaders in Washington came together in November 1990 to create a framework for cooperative water resources management. As a result, the "Chelan Agreement" was forged by representatives of state, tribal and local governments, agriculture, business, commercial and sport fishing, recreational groups, and environmentalists. The Chelan Agreement establishes several principles:

- Water resource management decisions should be based on a hydrologic unit or a regional planning area as defined by the planning participants.
- Future water needs should be met from resources within the same hydrologic unit.
- The state's unique environment must be protected and fish and wildlife habitat enhanced while accommodating growth.

Figure 6:
Major Areas Where Additional Appropriations of Surface Water are Prohibited or Restricted



In the spirit of the Chelan Agreement, Ecology is supporting development of regional water resources management plans for the Methow and Dungeness/Quilcene drainage basins.

All of the above efforts rely heavily on information produced by the U.S. Geological Survey (USGS), which has compiled a solid historical record of stream flows. As part of Ecology's cooperative effort with the USGS, a study is being conducted to improve drought forecasting capabilities. Part of this study includes a demonstration project of long-term trend analysis of stream flow and precipitation records. If successful,

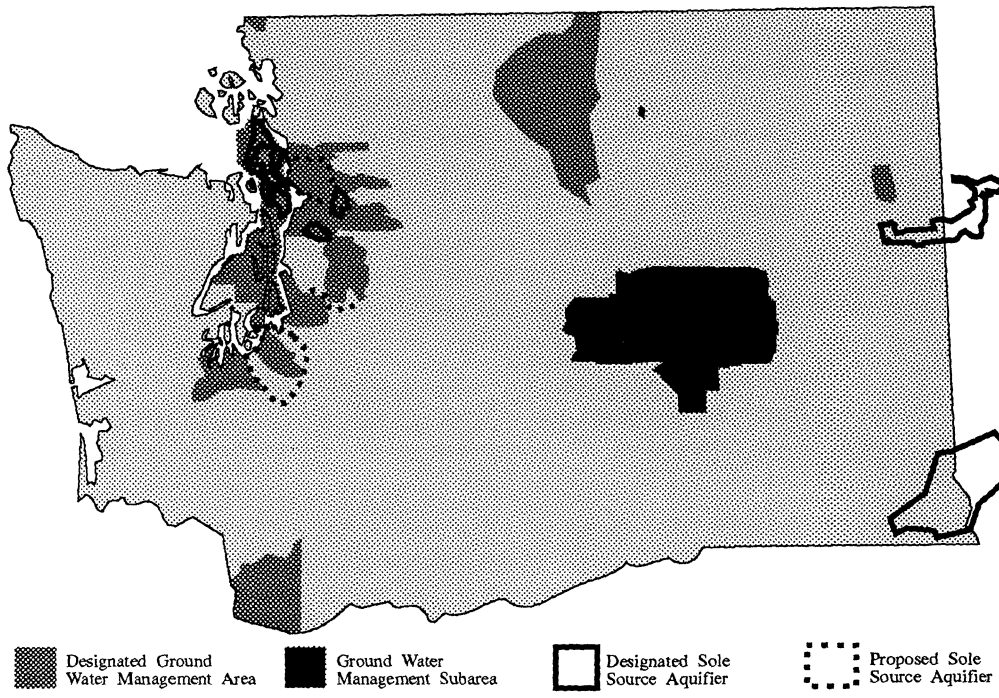
this demonstration project should provide the state with a valuable new tool to assess short-term variations in surface water supplies.

The National Weather Service and U.S. Soil Conservation Service maintain precipitation records for sites throughout the state as part of their flood and water supply forecasting efforts. Their records indicate precipitation totals during the most recent five-year period have been less than 1961-85 averages. So, while a great deal of information exists, long-term trend analysis of surface water supplies remains difficult.

Ground Water Management Programs

Reliance on ground water is increasing as surface water supplies become fully appropriated. This map (Figure 7) shows areas of the state where either the state or federal government has recognized the existence or possibility of ground water problems and undertaken special management activities to address them. Ground water problems are also likely to increase in areas which are experiencing rapid growth. In ground water management areas, comprehensive programs are developed with local governments to characterize the quantity and quality of ground water to better protect and manage the resource. There are 13 ground water management areas in Western Washington and two in Eastern Washington. As part of the cooperative effort, local agencies are collecting data on ground water in their areas and providing that information to Ecology.

Figure 7:
Recognized Ground Water Problems



Ground water levels tend to fluctuate and such fluctuations do not normally indicate a depletion of the resource. However, in specific areas of the state — such as in Lincoln, Adams and Grant counties or the Odessa Subarea — declines in ground water are occurring. Three ground water management subareas have been established in Eastern Washington to determine whether further ground water appropriations should be permitted. Studies within these subareas have included installation of monitoring wells and extensive computer modeling.

EPA has designated seven areas as sole source aquifers, in which the ground water in each needs special protection because of dependence upon it for drinking water.

Decisions on future applications to withdraw ground water will be complicated by the question of hydraulic continuity — the connection between surface and ground water. Since many proposed withdrawals will be in areas where additional surface water appropriations are no longer permitted, the effect of the withdrawal on stream flow will have to be evaluated before a permit is issued. The problem is complex enough that it has been referred to the Water Resources Forum, established through the Chelan Agreement, for consideration.

Reliance Upon Ground Water

Rural counties tend to be more dependent on ground water because wells are the major source of individual water systems. Several urban areas, most notably the central Puget Sound region, now rely on surface water sources administered by large municipal suppliers.

Water Right Application Processing Trends

A large increase in water right applications in the mid-1980s is probably traceable to a series of dry water years, which prompted irrigators to seek additional water supplies. A large 1990 increase is likely due to public speculation about how new growth management legislation might affect the future availability of water.

The increasing complexity of technical issues surrounding water availability is contributing to a decline in the number of decisions rendered which grant or deny water rights. This, in part, limits development and indicates there is no certainty about water being available for new uses in certain parts of the state.

Approximately 70 applications for water right permits were denied within the last year because of unavailability of water. Many more applications were partially denied or were approved with restrictions on water use. This trend is occurring not only in rapidly growing areas but also in drier areas where water supplies historically have been limited. Information on denials is not now tracked in the water resources information system (WRIS) or individual regional databases. The number of times Ecology has denied a water right application is a good indication that water availability is decreasing, a measure the water resources program will likely incorporate into a redesigned data management system.

Data Summary

Water resources are limited. The supply of surface water depends heavily on precipitation, and recharging ground water levels through percolation of rainfall or snowmelt takes a long time. Meanwhile, demand for water is increasing among water users as evidenced by agricultural, municipal and instream resource enhancement and protection efforts. Rapid growth, especially in the Puget Sound region, has magnified the problem.

Surface water alone cannot meet future demands. Many areas experiencing a rapid increase in demand rely on surface water. At the same time, pressure is building to protect and enhance fishery and wildlife resources, which requires, in part, the protection of stream flows. Without additional storage, conservation or water-use efficiency measures, water sources now being tapped are almost completely spoken for and are not available to meet new demands.

Ground water will increasingly be relied upon to meet future demand. In many areas of the state, surface water sources should not be expected to meet future leaps in demand. In some cases, better efficiency and new storage and conservation measures will help stretch surface water supplies. In other cases, however, ground water development remains the main option for satisfying new demand. While development might be enough to meet new demand, the continuity between ground and surface water must be considered to ensure that stepped-up withdrawal of ground water does not affect existing surface water rights, instream flows or ground water quality.

Conservation will help, but it's a limited answer. Conservation of water offers a way to address increased demand in areas where new water supplies are expected to be hard to find. Studies have identified plenty of opportunities to conserve water in the agricultural, industrial and municipal sectors through increases in efficiency. But while better efficiency in water use offers an immediate way to meet increased demand, it is not the whole answer. Meeting the water demands of the future will require new and innovative solutions.

Planning for future use is complicated. New and important issues such as increased public involvement, hydraulic continuity (the connection between surface and ground water), increased awareness of the value of the resource, the Chelan Agreement and government-to-government cooperation have contributed to the complexity of decision-making. As the water resource is used more fully, we can expect decisions to become even tougher to make.

We need better information, and better management of it. Data management systems now used by the water resources program of the Department of Ecology were developed in 1962. The water resources data management task force, established by the legislature, is advising in the development of a new data management program to make statewide and regional water-resource planning clearer and easier. The water resources program has been assigned to carry out the first recommendations of the task force, including a five-year data management plan and improvements in current systems for collecting, managing and using water-resource information.

Toward 2010 -
The Conservation Challenge

1 Remove legal barriers to water conservation and improve efficiency of water use.

◆ New legislation authorizes state agencies to acquire "trust water rights" by purchase, gift or by funding water conservation projects that create net water savings. Washington's Water Resources Forum is developing guidelines. Also, Forum participants continue their collaborative efforts at conservation policy development.

2 Reform the pricing of water to encourage conservation.

◆ Conservation is a water pricing objective established under new legislation.

◆ New rules and guidelines require irrigation district rates to encourage conservation. Interim guidelines and a handbook encourage public water systems to include rate incentives in conservation plans.

◆ Ecology, Health and water use consortiums continue to conduct conservation workshops.

Land

In today's world we have modernized the ways in which we attack and degrade our land. It is no longer drought, wind, floods and fire we fear most. We should be wary, instead, of human-made devices and decisions, practices and policies. Much of this is not directly our fault. Simply by keeping Washington's doors open, we heap stress on our farmlands and squeeze our recreational open spaces.

This section of the State of the Environment Report looks at agricultural lands, forest lands, recreation lands, rangelands, urban lands and shorelands. In some cases, there have been tangible steps taken to improve the situation, often in direct response to recommendations in the Environment 2010 action agenda. In other cases, information about the condition of our land is old news and we've only just begun fresh ways of tracking the particular impacts and conditions that affect these various land forms. But we can say with certainty that the situation is serious. While we are the beneficiaries of this land, we are simultaneously its most formidable opponent.

Agricultural Lands

Overview

Population forecasters say Washington will have more than 6 million people by the year 2010, nearly a quarter again the population of 1990. Where will they live? Where will they shop, play and do business? For better or worse, numbers tell us many new residents will settle onto land now used for agriculture.

The loss of important farmlands to urban expansion is a serious problem, particularly in the Puget Sound region. Conversion of farmlands to nonagricultural uses disrupts the livelihood and atmosphere of rural regions, reduces the availability of regionally produced farm commodities and endangers local agricultural economies. Economically, farmers are dependent on each other's existence to support their service and marketing systems. As farms are displaced by other land uses, the support from the larger structure weakens to the point of collapse, which may force remaining farmers to move on.

Good agricultural land depends on the right combination of soil-forming processes, climate and biotic formation. Good farmland takes millions of years to develop. The potential loss of this precious resource seems especially tragic in light of both the international hunger crisis and the domestic economic situation of the early 1990s. New planning strategies should steer new development away from prime soils, which are the most naturally fertile and productive, the least erosive and the most capable of growing a wide variety of crops. The loss of these prime soils will have the biggest impact on the overall production and revenues of an agricultural region. We cannot afford to lose this richly productive and increasingly scarce natural resource.

Environmental Data

This report relies on two indicators of the agricultural lands resource in Washington state:

- The trend in rate of conversion to other uses.
- The trend in rate of soil loss or erosion. Much of the information in this report originates from the Soil Conservation Service's National Resources Inventory (NRI), conducted every five years. The 1982 and 1987 reports were compared to determine trends in the selected indicators.

Conversion of Agricultural Lands

The Washington State Office of Financial Management forecasts a state population of 6,013,253 for the year 2010. This forecast represents a 23.6 percent increase over the 1990 population of 4,866,692. Population growth will affect the state's agricultural lands by exerting pressure to convert agricultural land to urban uses to accommodate new residents.

Table 1 shows changes in non-federal land use on a county by county basis, estimated by the SCS for 1982 and 1987. Statewide, land devoted to cropland dropped from 7,793,400 acres in 1986 to 7,758,100 acres in 1987, representing a loss of less than 0.5 percent. However, urban and developed land acreage increased

statewide from 990,200 acres in 1982 to 1,071,400 acres in 1987, representing a gain of more than 8 percent.

Table 1:
Land Cover/Use of Non-Federal Land by County (in thousands of acres)

County	Cropland		Urban Land		Non-Federal Land
	1982	1987	1982	1987	
Adams	645.4	643.5	4.2	4.7	1216
Asotin	40.6	40.3	5.4	5.8	341
Benton	418.1	419.6	33.1	34.9	801
Chelan	37.1	37.9	10.1	11.2	400
Clallam	7.6	7.6	14.8	16.4	598
Clark	20.3	20.3	46.1	50.1	392
Columbia	220.2	225.4	1.4	1.5	388
Cowlitz	11.9	11.9	22.7	23.6	700
Douglas	927.5	927.5	4.7	5.1	1127
Ferry	69.7	69.7	1.3	1.4	907
Franklin	437.8	436.2	10.0	11.0	736
Garfield	202.9	202.9	1.2	1.3	351
Grant	689.1	687.0	24.9	26.4	1390
Grays Harbor	6.3	15.1	24.0	25.2	1066
Island	8.4	8.3	11.0	12.3	127
Jefferson	0.0	0.0	3.9	5.6	452
King	17.3	14.3	213.4	227.0	1016
Kitsap	0.0	0.0	36.7	41.5	242
Kittitas	100.0	93.5	7.3	7.8	978
Klickitat	232.4	258.5	2.7	2.9	1160
Lewis	27.8	27.8	22.6	24.2	1054
Lincoln	923.8	892.0	3.4	3.6	1456
Mason	0.5	0.5	19.5	21.9	450
Okanogan	73.7	53.5	6.7	7.8	1819
Pacific	5.7	3.1	6.7	7.2	571
Pend Oreille	4.6	4.6	2.8	3.0	366
Pierce	4.2	4.2	98.6	106.4	668
San Juan	0.0	0.0	1.8	2.2	112
Skagit	75.5	71.4	23.0	25.4	593
Skamania	3.0	3.0	3.7	4.1	236
Snohomish	42.5	42.5	89.3	98.9	705
Spokane	388.5	387.6	100.1	106.1	1107
Stevens	83.8	85.7	13.4	15.2	1249
Thurston	9.2	9.2	36.0	41.3	444
Wahkiakum	0.0	2.2	0.9	1.1	164
Walla Walla	570.1	577.4	11.1	11.9	784
Whatcom	108.8	103.5	33.5	36.3	511
Whitman	941.2	934.0	18.7	19.7	1365
Yakima	427.9	436.2	19.5	19.5	2050
TOTAL	7,793.4	7,758.1	990.2	1,071.4	30,095

Source: 1987 National Resources Inventory, SCS.

This information suggests a significant potential for future loss of agricultural lands to urbanization. This study provides data only at the multi-county level. Information on the quality of agricultural land and specific soil types converted to urban uses is not available.

Trend in Rate of Soil Erosion

Soil erosion remains a serious environmental problem in parts of Washington, even after 50 years of state and federal control efforts. Erosion is the wearing away of the land surface by running water, wind, ice or other geologic agents. NRI reports on wind and water erosion include both sheet and rill erosion. Sheet erosion is the removal of a thin, uniform layer of soil by runoff water, while rill erosion is a process in which numerous small channels several inches deep are formed, mostly on recently cultivated soils. In estimating soil erosion rates, the Soil Conservation Service uses the universal soil loss equation, developed by W. H. Wischmeier and his associates, for sheet and rill erosion, and the wind erosion equation, published in 1965 by N. P. Woodruff and F. H. Sidoway.

Soil erosion causes off-farm as well as on-farm damage. These impacts include accelerated siltation of reservoirs and lakes; impairment of spawning and breeding grounds for fish and other aquatic life; increased costs for dredging harbors; freshwater streams and rivers burdened by sediment, fertilizers, and pesticides; siltation in rivers leading to increased damage from flooding, and more.

Nationwide economic impacts are estimated at approximately $6 billion dollars a year in 1980 dollars. On-site erosion damage can reduce the productivity of land, labor and capital on the farm and increase the need for fertilizer and other applications.

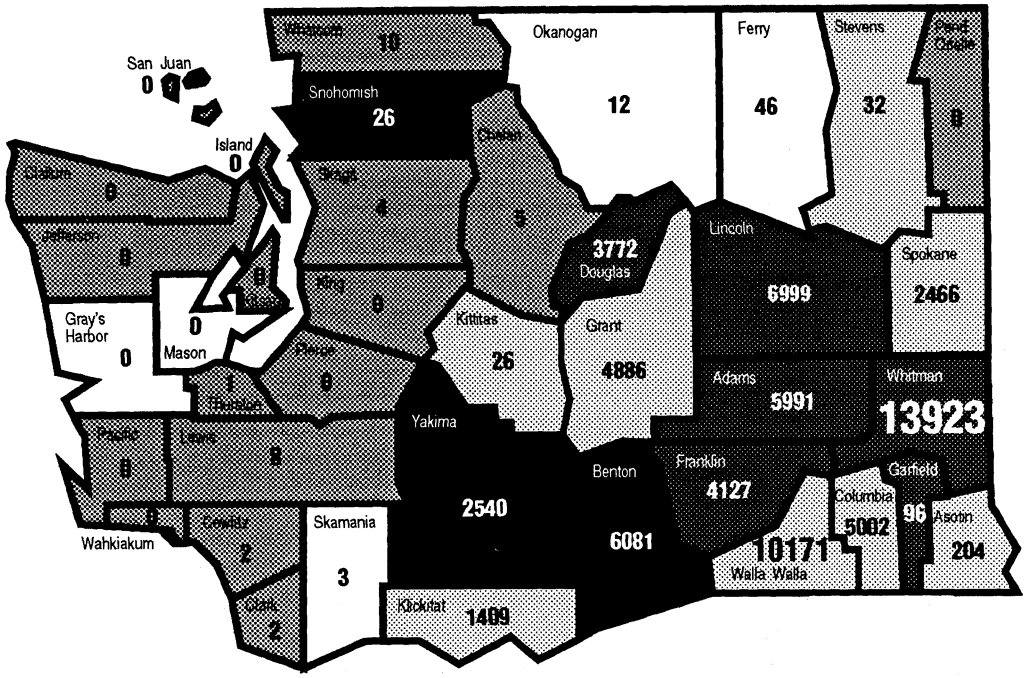
The generally accepted maximum rate of soil erosion is five tons per acre per year. One ton per acre is roughly equal to 1/150 of an inch of soil per acre. The five tons per acre per year tolerance is often used as a maximum rate of soil loss because this rate, in combination with technology changes and inputs and weathering, meets the goal of a sustainable soil resource for agricultural production. Thirteen of 39 Washington counties exceeded the five-tons-per-acre maximum rate of soil erosion in 1987.

Figure 8 indicates the estimated amount of soil erosion on all cropland per county in 1987. Wind erosion generally accounted for the majority of soil erosion in the southeastern counties, the region where the greatest amount of erosion occurs. However, the extent and causes of erosion are closely associated with land use. For example, erosion in Asotin County is limited because only 12 percent of the land is utilized as cropland. Neighboring Columbia County, where 58 percent of the land is tilled, has the highest estimated erosion rate in the state at 22.2 tons per acre. Whitman County had the highest total amount of soil erosion in 1987 and 68 percent of that county's land is classified as cropland.

Trends in estimated total soil erosion rates are shown in Figure 8. Counties with the largest increase in soil erosion rates from 1982 to 1987 are Benton, Skagit and Yakima counties. The erosion trend in Benton County seems the most troublesome — there, 6.1 million tons of soil were eroded in 1987. Although not as bad, Skagit and Yakima counties showed erosion of 27,800 tons and 2.54 million tons, respectively, in the same year. Although several counties showed significantly decreased rates of soil erosion from 1982 to 1987, these counties generally had low erosion rates to begin with and their overall impact on the statewide soil erosion rate is limited. Statewide, soil erosion rates increased from 8.5 tons per acre in 1982 to 9.0 tons per acre in 1987.

On-farm damages caused by soil erosion will likely include yield losses because of diminished water-holding capacity, infiltration rates, nutrient availability, organic matter and other beneficial topsoil characteristics. Erosion can reduce efficiency because it increases the variability of soils within a field, making management more difficult. The productivity of some soils can be lost forever with only moderate amounts of soil loss.

Figure 8:
Estimated Amount and Percentage of Soil Erosion on Cropland per County



Data Summary

Farmland conversion and soil erosion still happen, despite the best efforts of state and local governments to establish preservation and conservation goals and regulatory schemes. Still, it's worth the effort. Farmland is preserved to protect farming, to preserve open space, and to maintain the rural way of life. Soil conservation aims at maintaining farm productivity, reducing agricultural runoff and controlling soil erosion.

At times, the policies of governments in Washington conflict with each other. Many rural communities need farming and agribusinesses to help sustain their rural way of life. Federal production and conservation policies and state conservation and preservation policies all exert their particular influences on farming, farmland use and agribusiness. These policies may prohibit conversion on one hand but restrict uses, limit crop production and divert farmlands from crop production on the other.

Forceful, clear policies for owners of erodible lands are crucial to meeting individualized land use and resource conservation goals. This coordination of conservation and preservation programs should help address farmland conversion, soil erosion and water quality problems both locally and statewide.

Overview

The timing of this State of the Environment Report is such that little new information exists about the condition of Washington's rangelands. The next comprehensive five-year study is due in 1992. In the meantime, it is possible to identify in general terms the amount of rangeland degradation from overgrazing, noxious weed infestation, recreational activities and erosion.

For the present, we understand that most of our range has been damaged. The misuses of the late 19th and early 20th centuries are being corrected, but range condition is improving at a rate measurable in decades, not years. The entire range system is also adjusting to the introduction of Old World, primarily Mediterranean, plant species.

Environmental Data

This section documents available information relating to four key data sets which can indicate the condition of Washington's rangelands. They are:

1. Trend in number of acres of rangeland by seral stage as baseline.
2. Trend in number of acres affected by over-grazing.
3. Trend in number of acres affected by noxious weed infestation.
4. Trend in tons of erosion per acre.

This analysis is based completely on literature review. No original research was conducted. The definitions for terms are the same as those in the 1989 State of the Environment Report. They are as follows:

◆ **Rangeland:** As defined by Washington State University's Washington State Grazing Land Assessment (July 1984), rangeland is primarily covered with native vegetation and generally occurs on sites too isolated, too rough or with soil too shallow, sandy, alkaline or rocky for agricultural development. There are approximately 7 million acres of rangeland in Washington.

◆ **Grazeable woodland:** Open forest with understory vegetation suitable for forage. There are approximately 5.5 million acres of grazeable woodlands in Washington.

◆ **Four successional stages of rangeland** relate to amounts of vegetative cover:

- ➤ *Climax:* Vegetation dominated by native grasses, forbs and shrubs which are valuable as forage for wild and domestic animals. Between 75 and 100 percent of these kinds of vegetation produced would be found in this state. Lands in this category are generally in "excellent" condition.
- ➤ *Late seral:* These communities produce between 51 and 75 percent of the kinds and amounts of vegetation found in climax. ("Good.")
- ➤ *Middle seral:* These communities produce between 26 and 50 percent of the kinds and amounts of vegetation found in climax. ("Fair.")
- ➤ *Early seral:* These communities produce between zero and 25 percent of the kinds and amounts of vegetation found in climax. ("Poor.")

Data Summary

Most of the data in this section are based on the 1982 and 1987 Natural Resources Inventory (NRI). The latest information will not be available until after the 1992 NRI. According to the 1982 and 1987 NRI, the condition of Washington rangeland is summarized in Table 2:

Table 2

	'82	'87
Climax (excellent)	11%	8%
Late Seral (good)	21%	20%
Middle Seral (fair)	32%	35%
Early Seral (poor)	34%	36%

Other than the above numbers, we really do not have a basis for determining trends. The following narrative was provided by Dr. Ben Roche, WSU Extension range management specialist:

The trend in number of acres of rangeland by seral stage provides a baseline. Seral means successional. It also suggests progress toward biological stability following some type of disturbance.

The problem with today's efforts to evaluate trends is that previous interpretations of the plant community's biodiversity were based on an assumed potential plant population (climax). That assumption did not consider the influences of the many exotics being added, intentionally or accidentally, to our rangeland plant communities. For example, repeated range fires have fostered a community dominated by cheatgrass (Bromus tectorum). Range researchers recognized 40 years ago that a cheatgrass-dominated range was, in the absence of technological interference, an "arrested succession," meaning the abundance of cheatgrass stifled the establishment of other plant species.

If returned through technology to perennial grasses, the best adapted (most competitive) desirable species were likely to have been non-native. Thus, the range stabilized and was made productive but did not return to dominance by native species (climax). So, it was not classified as improved.

Range condition classification systems are currently being revised. A more realistic interpretation of stability and biodiversity helps us to see today's range for what it is: the product of the 20th century, not the 19th.

Regarding a trend in number of acres affected by overgrazing: overgrazing on the Washington range is being reduced. Overgrazing usually stems from misuse for short-term economic gain or mismanagement due to a lack of understanding of the health requirements of forage plants. The second reason is much more common. Educational programs aimed at biodiversity, watershed protection, soil stability, wildlife management, optimal animal production and weed prevention or control all support proper grazing management.

Trends are emerging in the number of acres impacted by noxious weed infestations. Weeds, by definition, are non-native. They are species that, by evolving with Mediterranean agriculture during the past 10,000 years, have taken on characteristics that make them highly competitive, especially following disturbances. Our rangeland did not develop under heavy grazing pressures, as did land east of the Rocky Mountains, which was heavily grazed by buffalo. Our rangelands have recently been disturbed by livestock and our international commerce has introduced Mediterranean weeds. That combination gives us an entirely new scenario we are still playing out.

Noxious weeds, as classified by the Washington State Noxious Weed Control Board, are those non-native species which are destructive, competitive or difficult to control.

A majority of the 92 species listed by the weed control board are either naturalized on our rangelands or are potential invaders of rangelands. Current survey efforts by counties and land management agencies are developing the baseline data needed for trend analysis. Only a few listed range weeds, most notably the knapweeds, have been adequately surveyed. The trend for knapweeds is toward continued expansion, except where county programs are eradicating early invasions of the weed.

Trends are evident in tons of erosion per acre on Washington rangeland. The Soil Conservation Service estimates that 27 percent of all rangeland and 40 percent of grazeable forest land need additional protection from erosion. Rangeland is estimated to be eroding at a rate of 1.1 average tons per acre per year. Grazeable forest land is estimated to be eroding at a rate of .8 average tons per acre per year.

Forest Land

Overview

There have been few issues in Washington state history as emotional and divisive as the current debate surrounding the state's forest land. The classification of the Northern spotted owl as a threatened species has been a flashpoint, but it is the forestry practices of a century, not one lone act of species protection, that have shrouded Washington's forests in uncertainty and left the timber industry in disarray.

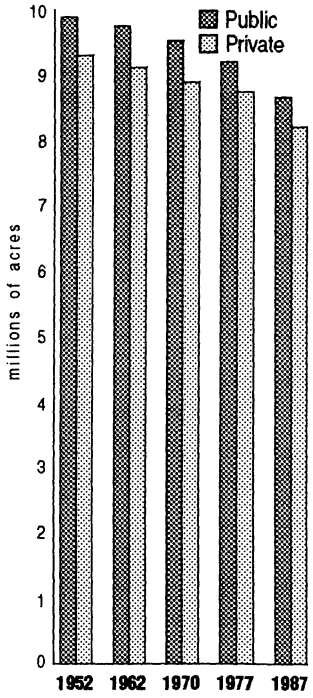
Timberland in Washington decreased by 2.3 million acres, or 12.2 percent, between 1952 and 1987. Much of this decline can be traced to the conversion of public timberland to national park or legislatively designated wilderness areas. The portion of the decline from privately owned forest land, however, is traceable to conversion of forests to intensive land uses.

Environmental Data

This section presents selected information on the trends in forest land conversion and the trends in rates of harvest.

Data Summary

Figure 9
Washington Timberland Area



Conversion of Forest Land

Forest land conversion can be tracked in three principal ways — by monitoring Class IV forest practice permit applications, remote sensing, or physical inventory. The most reliable information is gained when all three forms are used concurrently. At this time, the best source of data are the physical inventories conducted by the U.S. Forest Service every 10 years.

Although the Department of Natural Resources has required forest practice permits since 1974, review of permit applications to detect trends in conversion may be misleading as these applications were originally designed for other purposes. In addition, the applications are sometimes incomplete or inaccurate.

Remote sensing is another way of illustrating the rate of conversion of forest land to other uses. Landsat (satellite) observation platforms pass over any given spot every 16 days, allowing for repeat measurements of the amount of light reflected from surfaces. Differing amounts of light are reflected from mature forests, clearcuts and residential development. The satellite information is then beamed back to Earth as streams of computerized information and stored for later use. Landsat has been beaming information to Earth since the early 1970s, so a wealth of information on forest cover will be available once the Department of Natural Resources has perfected its analytical methods and the project is fully funded.

Although DNR is currently analyzing vegetation changes over time on the Olympic Peninsula, Landsat data on land use conversions for the whole state are not available at this time.

The U.S. Forest Service conducts comprehensive assessments of all forest and range land resources on both public and private land roughly every 10 years. The results of these assessments are reported in a publication called Forest Statistics of the United States, 1987 (Resource Bulletin PNW-RB-168). Table 1 illustrates public and private timberland acreage in selected years.

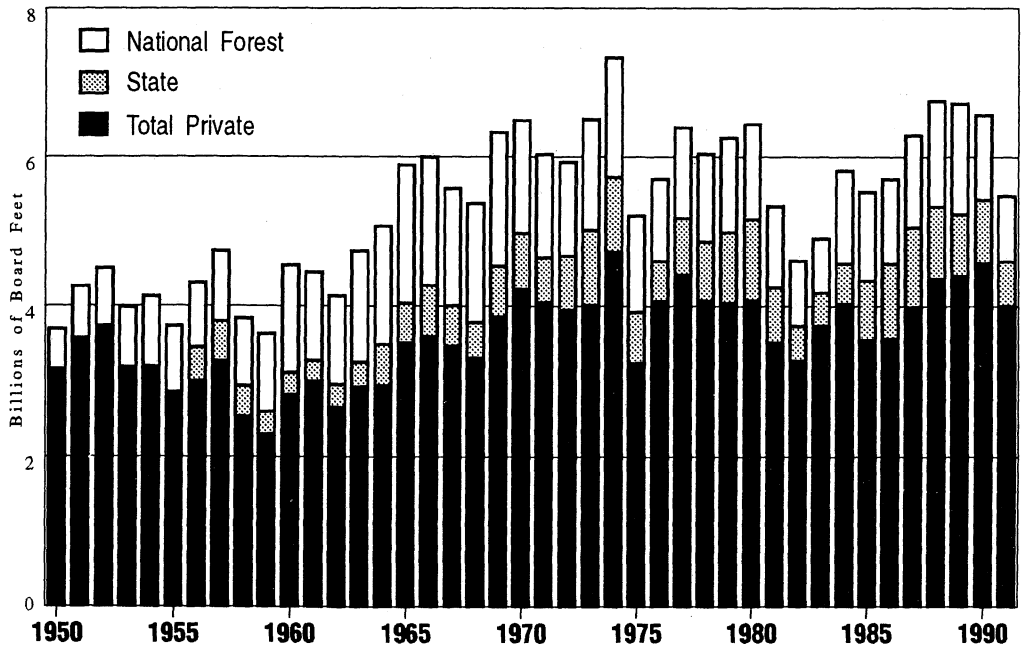
Timberland is defined in the Forest Service report as "forest land that is producing or is capable of producing crops of industrial wood (more than 20 cubic feet of wood per acre per year) and not withdrawn from timber utilization by statute or administrative regulation." The designations "public" and "private" refer to all public owners (federal, Indian, state, county and municipal, and others) and all private owners (forest industry, farmer and others).

The table shows that timberland in Washington has decreased by 2.3 million acres, or 12.2 percent, between 1952 and 1987. Timberland in public ownership fell by 1.2 million acres, or 12.5 percent, and in private ownership by 1.1 million acres, or 11.8 percent. The most likely explanation for this loss of public timber acreage is the change of use from commercial or industrial timberland to national park and wilderness areas. For example, the Olympic National Park has been enlarged and the North Cascades National Park created from national forest land during this time. Several wilderness bills have also been signed. Reduction in private timberland, however, is due almost exclusively to conversion to more intensive land uses.

Rate of Harvest

The rate of timber harvest in Washington in the past several years is seen by many people as unsustainable. It has been said that the rate of timber harvest or poorly managed harvest can damage fish, wildlife and soil stability, and can result in unsightly clearcuts. This may stem from a perception that more acres are being harvested than in the past. Interestingly, volume data show the total rate of timber harvest to be relatively stable after an initial rate of increase before 1965.

Figure 10
Statewide Timber Harvest by Owner



Rate of harvest is tracked by *volume*, rather than acreage, because volume controls take into account different tree sizes and thus yield "even-flow" harvest calculations. In addition, harvests on private lands are taxed on a volume basis, so the Department of Revenue collects and reports data on volume. Finally, using acreage controls rather than volume becomes too complex when partial cuts and thinnings are taken into account.

The DNR has been compiling annual reports on statewide timber harvest since 1949. Table 2 shows the rate of timber harvest in Washington by three ownership classes — private, state, and national forests — in the years between 1950 and 1990. The aggregate harvest, which includes these three ownership classes, in addition to harvests conducted by other federal, Indian, and non-federal owners, is also shown.

Because the timber market is price-dependent, changes in timber harvests by owner, whether positive or negative, are magnified in the total harvest. The slight overall decline in total timber volume harvested since the peak in the early 1970s may also reflect smaller volumes per acre, which may be offset by harvesting a larger number of acres. If so, this might explain the public perception that the rate of harvest is growing. As Table 2 shows, however, timber volumes harvested by ownership class appear relatively stable when compared over the past 40 years. Total harvests dipped between 1981 and 1982 because of a recession, dipped again in the recession of the early 1990s and were affected by the listing of the Northern spotted owl as a threatened species.

Urban Land

Overview

This examination of urban land begins with a simple fact — every major urban area in Washington has experienced impacts from population growth in the past decade. There is at least one major assumption implicit in this statement — increasing population will lead to increased pollution of the air, land and water. This may not be an absolute, but it does have a certain intuitive correctness and has usually been validated in the real world experience of most of us.

Using population growth as the indicator of the ecological health of urban lands also ignores the potential mitigating influence of improved pollution control technology and better urban planning and design. Finally, this indicator assumes the 1980 and 1990 Consolidated Metropolitan Statistical Area (CMSA) land masses are constant and that no additions or deletions have occurred to absorb new immigrants. It also does not account for increases or decreases in population totals that do not necessarily increase the population *density* in a given area.

Environmental Data

For the purposes of this section, "urban land" will be defined as Consolidated Metropolitan Statistical Areas (CMSA), the same as are defined in the 1990 10-year census. Each CMSA is comprised of one or more "Primary Metropolitan Statistical Areas" (PMSA), which are geographical sub-areas of the CMSA.

The Seattle-Tacoma CMSA, for example, consists of the Seattle consolidated area and the Tacoma primary area. For purposes of this statewide report, population growth or change will be reported at the CMSA level where that data is available. Where not, the level of reporting (PMSA or simply Metropolitan Statistical Area, or MSA) is noted.

Readers interested in subarea levels of information are referred to the 1990 census reported titled "United States Department of Commerce News, Economics and Statistics Administration, Bureau of the Census," February 21, 1991.

Population change in Washington's urban land is summarized in Table 3.

Data Summary

The obvious conclusion to be drawn from Table 3 is that every major urban area in the state of Washington has experienced population growth in the past decade with concurrent pressures upon urban land use and quality of life.

The Olympia MSA showed the largest growth (29.8 percent) when it grew from 124,264 people in 1980 to 161,238 in 1990. The Bremerton MSA also grew rapidly, from 147,152 in 1980 to 189,731 in 1990 — a 28.9 percent increase. The Seattle-Tacoma CMSA showed a 22.3 percent growth rate, compared to the moderate 5.7 percent rate of the Spokane MSA. The Richland-Pasco-Kennewick MSA grew at a comparatively slow rate of 3.9 percent between 1980 and 1990.

This across-the-board growth is consistent with the national trend toward growth in urban areas. Between 1980 and 1990 the national population in urban areas grew

11.6 percent. Between 1970 and 1980 the national urban population grew 10.6 percent. The metropolitan population of America now totals 77.5 percent, with 90 percent of the nation's growth in the 1980s occurring in metropolitan areas.

Table 3:
Population Change in Washington CSMA's: 1980 - 1990

Area by Class	1980 Population	1990 Population	% Change
Seattle - Tacoma CSMA	2,093,285	2,559,164	+ 22.3
Vancover PISA	192,227	238,053	+ 23.8
Spokane MSA	341,835	361,364	+ 5.7
Bremerton MSA	147,152	189,731	+ 28.9
Yakima MSA	172,508	188,823	+ 9.5
Olympia MSA	124,264	161,238	+ 29.8
Richland, Kennewick, Pasco MSA	144,469	150,033	+ 3.9
Bellingham MSA	106,701	127,780	+ 19.8

Shorelands

Overview

Shorelands, by definition, are the buffers between uplands and open waters. By common usage, shorelands are the beds and banks of rivers, lakes, wetlands, estuaries and near-shore coastal waters — in short, all the land we use when we go near the water. Protection of shoreland resources and their effective allocation are of supreme importance in their own right, of course, as well as in their role alongside all of these water forms.

Using the waters and shorelands of Puget Sound as the primary testing ground, researchers have found that development and land-use practices on shorelands and their upland links have contributed to deterioration of shellfish beds and general water quality.

Washington's shorelands come under a number of regulatory and management authorities — the Hydraulics Code (administered by the departments of Fisheries and Wildlife), the Aquatic Lands Act (administered by the Department of Natural Resources), and the Shoreline Management Act (administered by local governments and the Department of Ecology). For purposes of the Shoreline Management Act, shorelines are divided into those which come under the act (designated as SMA) and those which do not (non-SMA). Uplands adjacent to shorelands require consistent planning to complement and support shorelands management.

Statewide, SMA shorelands cover about 20,600 lineal miles of shoreline. This includes more than 3,000 square miles of inland sea and ocean waters, which translates into about 200 miles of ocean shoreline and about 2,200 miles of inland marine shoreline. SMA shorelands border 15,900 miles of river and stream shoreline and 2,300 miles of lake shoreline. State authority over shorelands is mainly through the Shoreline Management Act and the Floodplain Management Act.

The purpose of shorelands management is to:

◆ Protect natural resources, including wetlands, flood plains, estuaries, beaches, dunes, barrier land forms and fish and wildlife habitat.

◆ Manage shoreline development to make the best use of public monies and minimize loss of life and property in flood-prone, storm surge, erosion-prone and geologically hazardous areas.

◆ Protect areas vulnerable to sea level rise, land subsidence and saltwater intrusion or areas threatened by the destruction of natural protective features such as beaches, dunes, wetlands and barrier islands.

◆ Manage shoreline development to improve aesthetic conditions, maintain and improve the quality of adjacent waters and protect living marine and freshwater resources and existing uses of those waters.

◆ Provide public access to shorelands for physical, visual and recreational purposes.

Environmental Data

The ecological health of Washington's shorelands is primarily evaluated by the ratio of acres of approved, conditionally approved, restricted or prohibited commercial shellfish beds to the total acres of classified commercial shellfish beds.

Researchers have taken this information as a starting point in studies of the combined effect of water pollution, land use and development management practices on shellfish beds in test shorelands.

Data from this research were compiled by the Department of Health and have been published annually since 1988. Information from earlier years has been more difficult to acquire, and the quality of the data is uncertain.

There are some limitations on the data gathered so far. For example, there are no comprehensive laws governing the environmental quality of coastal zones, shorelands, flood plains or wetlands of the scope of laws for air quality or water quality. There are not even generally accepted quantitative standards. Thus, any analysis of Washington's shorelands must turn to additional information on the health of our shorelands.

It would be useful to have additional information on such factors as public access. This could be measured by the ratio of acres and length of publicly accessible shoreline frontage to population for each coastal county, computed along with the added acreage and frontage during the reporting period. No such comprehensive information is presently collected. In 1986, Ecology published the *Washington Public Shore Guide* (Scott, Reuling & Bales, 1986) which included information on marine public access acreage and shoreline frontage. Gathering this information would require coordination and cooperation among Ecology and other agencies and local governments as well as the identification and long-term commitment of monitoring funds.

Data Summary

In Puget Sound, data on shellfish bed status show an overall trend of shoreland and upland land use practices contributing to deterioration of shoreline water quality and shellfish habitat.

The four shellfish-growing area classifications used by the departments of Health and Ecology are taken from the national shellfish sanitation program "Manual of Operations," 1989 revision. They are as follows:

◆ **Approved:** A shellfish growing area may be classified as approved when sanitary survey and bacteriological water quality data indicate no dangerous concentrations of fecal material, pathogenic microorganisms, marine biotoxins and poisonous or harmful substances.

◆ **Conditionally approved:** An approved growing area subject to intermittent but predictable microbiological contamination may be classified as conditionally approved. Seasonal or weather related pollution events, such as overflows from sewage treatment plants (STPs), could necessitate a temporary closure of a growing area. The period of closure is based upon local conditions and varies with each conditionally approved area.

◆ **Restricted:** An area may be classified as restricted if the fecal coliform concentration does not exceed a geometric mean most probable number (MPN) of 88 per 100 ml, and if not more than 10 percent of the samples exceed an MPN of 260 per 100 ml. Shellfish harvested from restricted growing areas cannot be marketed directly but must be relayed to an approved growing area for controlled purification.

◆ **Prohibited:** A growing area may be classified as prohibited when it shows dangerous concentrations of fecal material, pathogenic microorganisms, marine biotoxins and poisonous or deleterious substances. Growing areas adjacent to STP outfalls and other persistent or unpredictable pollution sources are classified as prohibited. No shellfish can be harvested commercially from a prohibited area.

Growing areas not surveyed are considered to be classified as prohibited until a shoreline sanitary survey and an intensive water quality study have been completed.

The overall trend for Puget Sound is a decrease in the relative amount of approved shellfish beds and an increase in the relative acreage of conditionally approved, restricted and prohibited shellfish beds. There has been a steady increase in the total acreage of shellfish beds. The trends for the North Sound essentially mirror the overall pattern. In the South Sound, the information is clouded by relatively large additions to the base acreage, but it is clear there has been a steady increase in the acreage of conditionally approved, restricted, and prohibited shellfish beds. Conditions in Hood Canal have remained relatively stable, with slight declines in approved areas and slight increases in conditionally approved, restricted and prohibited shellfish beds.

The leading cause of shellfish contamination throughout Puget Sound is non-point pollution, from sources including urban runoff and general residential practices. In the North Sound, marinas, boating and sewage treatment plants are secondary causes, with animal waste being cited only once. In the South Sound, marinas, boating, animal waste and sewage treatment plants are all secondary causes. In Hood Canal, pollution is generally attributed to non-point sources and boating. (Office of Shellfish Programs, 1988, 1989, 1990.)

Recreation Land

Overview

It is a strange paradox: The recreational environments suffering most in our civilized state are those we think of as the most primitive and unspoiled. These most natural and least developed recreation lands are declining because competition for the use of them has caused fundamental modifications in their character, flora and fauna. The loss of these natural environments for recreation forces people to substitute other, usually more-developed settings for their leisure-time activities. We are seeing these changes at both the urbanized and primitive ends of the "recreational opportunity spectrum," which is defined below.

The squeeze is on, right next door and in our forests, parks and campgrounds. Some kinds of recreational opportunities are being eliminated because the land is either no longer available for parks or is developed to a degree that precludes recreational use. With the continuing press of population, the remaining recreational landscape is, in a sense, being loved to death.

Environmental Data

Recreational land acres encompass a range of developed recreation facilities or areas, from lands with little or no development to those with heavy development. Recreation lands are categorized based on degrees of change in environmental settings, recreational opportunities and management techniques used to create specific recreation environments. This range of land categories is called the "recreation opportunity spectrum" (ROS), a tool used by the U.S. Forest Service and other agencies in long-range planning and land-use management. Each category is described below.

Urban/rural lands are characterized by major developments with easy-access paved roads that are used by many people. Lands in this category reflect influences from civilization and show the most evidence of human changes.

Roaded lands include those on which the landscape looks natural, or has been only slightly altered, or for which obvious activities such as logging, mining, farming or grazing pattern the land. Developed recreation facilities, to some extent, are found on these lands. Identification of recreation lands for state agencies will include entire management units, such as a state park or wildlife management area, while federal agencies will report major management areas within a national park or forest.

Semi-primitive lands provide basically natural settings where interactions with other people will occasionally occur. Access is primarily by trail with motorized vehicles generally prohibited, although primitive roads may exist. Recreation facilities, if they do exist, are rustic in character.

Primitive lands show few human influences and recreation facilities generally are not provided. Access is by cross-country travel or by trails. No motorized recreational use is allowed. These lands are the most remote, upon which users will usually meet few, if any people. Wilderness acres are included in this lands category.

Shorelines, for purposes of this section, are defined as those publicly owned shores where land and water meet and the public has legal access. These land edges have always provided a high attraction to recreational users. Some water-dependent activities, like boating, depend on this legal public access.

The basic information for this section is the land acre, presented by ROS land categories. Two sources support this information — unpublished data from the Interagency Committee for Outdoor Recreation's (IAC) "Recreation Lands Inventory, 1988-89," and unpublished data derived from land-management plans for the seven national forests in Washington (U.S. Forest Service, Region 6, Recreation Staff, Portland, Oregon, 1990).

The second set of environmental information is that covering various types of linear shoreline. The primary source for this is the IAC "Recreation Lands Inventory, 1988-89."

Data Summary

◆ Increases in developed and roaded recreation lands will crowd those users seeking recreational opportunities on less-developed land onto a declining and more heavily-used land base.

◆ Acquisition of publicly accessible shorelines has not kept pace with growth in the state's population.

Outdoor recreation supply is commonly defined as lands and facilities available to the public for leisure activities. The first indicator — land acre — considers the publicly owned and managed portion of that supply. These acres represent a commitment by policy-makers to provide recreational opportunities in their communities. This definition considers potential opportunity. In other words, the acre has potential for use depending on certain social choices or behavior exhibited by the user.

Typical user choices will vary with ease of access, information about facilities and general interest in the recreational opportunity. A personal value judgment of "quality" also plays a part in the use of a recreational environment. In IAC's 1987 participation study, users marked settings as "last used" or "preferred" for various activity categories. Results showed that for several activity categories, many recreationists preferred to use settings which were more primitive than the settings they last used.

While numbers can tell how often a recreational setting is used, the effectiveness and accessibility of these lands must also be measured. For example, an acre can be too steep or covered with snow or water much of the year, preventing access to it. Moreover, knowledge and personal skills may mold the use of that acre for recreation — if no one knows about it or doesn't know how to use it, it won't be used. And in the case of some federal lands, that acre often must serve more than just recreational purposes. It might be used for timber harvesting, mining or wildlife habitat.

Recreational acres supplied by local agencies are represented in the Urban/Rural lands category. These acres provide the "close-to-home" opportunities that users desire. The roaded, semi-primitive and primitive lands categories represent state and federal agency managers, with varying intensities of management for recreation.

Although all boating-related facilities have increased since 1983, the rate of change for miles of publicly owned shorelines is the smallest — in fact, it grew at about half the population rate in the same period. Comparing the miles of shoreline to population in 1983 and 1989, the per capita availability of public shoreline has dropped. To partially offset this decline, facilities and access have been added, but the result has been crowding and displacement of users who simply cannot gain access to the shoreline.

As population increases, more congestion is inevitable at shoreline sites, and enhanced capacity at some sites may not be enough to meet the demand for access. Between 1983 and 1989, the number of sites with fresh or saltwater shoreline increased, but that was accompanied by a drop in shoreline availability per capita. This can be interpreted to mean that although more access points to water have been added, they have been limited in size.

In a 1987 IAC study of outdoor recreation participation, 72 percent of the state's households participated in such water activities as swimming, sailing, windsurfing, powerboating, non-motorized boating or beachcombing. Two of the top seven most popular outdoor recreation activities from this study are shoreline-related — visiting the beach or beachcombing and swimming or wading at the beach. Projected participation growth in water activities between 1987 and 2000 ranges from 20 percent for ocean powerboating to 41 percent for ocean non-motorized boating. The projected growth for all surveyed activities ranged from 8 to 44 percent. Meanwhile, population is estimated to increase 15 percent between 1989 and 2000. Much of the population that will come to live in Washington by the year 2000 will live in the Puget Sound region, where competition for shoreline access is particularly keen.

The state's commitment to recreational shoreline access is shown by the variety of funding programs that support the acquisition, development and enhancement of the public's access to shorelines. State and federal dollars represent a public policy interest in making shorelines available to recreational users. In a sense, what goes around comes around — in several instances, users generate the monies that support these programs.

Toward 2010 -
The Challenge Of Land Stewardship

1 Increase recreation resources, particularly near population centers, through public acquisition, encouraging private land owners to provide more public recreational opportunities, and other means.

◆ The Interagency Committee for Outdoor Recreation (IAC) provides grants and assists with land acquisition for many purposes: boating facilities, trails, off-road vehicle and non-highway road projects, shooting and archery facilities, critical and urban wildlife habitats, water access, natural areas, state and local parks, as well as education, enforcement and maintenance and operation activities. In 1991, IAC supported 67 such projects through grants of $5.6 million.

◆ The Washington Wildlife and Recreation Program is the newest and largest land set-aside program, with authorized funding for 1991-93 of $60.4 million, with another $90 million requested for 1993-95. The program has enabled the state to obtain natural areas, critical habitat, urban wildlife habitats, local and state park property, water access sites and trails across the state.

◆ The Washington Wildlife and Recreation Coalition (WWRC), representing over 88 conservation and business organizations, continues to work toward long range funding for acquisition of habitat and conservation and recreation lands.

◆ IAC, with its state resource agency partners, initiated a special land stewardship proposal to provide needed funding for operation and maintenance responsibilities. New legislation is planned for the 1992 session.

2 Preserve open spaces and green belts in urban areas by acquiring sites, regulating land use, developing tax incentive for preservation and acquisition, and through other means.

◆ IAC supported $19 million dollars in urban wild life habitat, local parks and trails projects under Washington's Outdoor Recreation Lands acquisition program in 1991. For 1991-93, $22.9 million is committed under the program.

◆ Under the Growth Management Act, the Department of Wildlife will provide assistance to city and county governments to establish priority habitat and species management criteria for developing or revising comprehensive plans. Other programs aimed at urban open space or green belt preservation include such programs as Backyard Wildlife Sanctuary, Washington Wild Acres, and cooperative grants for habitat enhancement.

3 Protect productive forest lands from conversion to non-forest use through land use control, economic incentives, and public acquisition of critical private forest lands.

◆ The Department of Natural Resources (DNR) has introduced legislation designed primarily to encourage small acreage forest landowners to not convert their forest land to other uses.

◆ The state Forest Practices Board is adopting rules to encourage people to leave their land forested. Since counties — not DNR — control land use, a new rule will require land owners to contact counties prior to obtaining a DNR logging permit.

4 Protect both the ecological and amenity value of public and private forest lands by promoting public land management decisions that preserve critical forest areas and by refining and enforcing new and existing forest management practices that protect ecological values, even in commercial forests.

◆ DNR protects the ecological value of forests through such land set-aside programs as natural area preserves, natural resources conservation areas, and state parks transfer. A new forest resource plan emphasizes analysis and protection.

◆ When reviewing logging permit applications, DNR considers a broad range of environmental effects including consequences to land, streams, wildlife and fish.

5 Promote the sustainability of forest resources through reasonable control on rates of timber harvest on both public and private lands.

◆ Washington's forest lands can yield timber forever if managed wisely. DNR is surveying all timber harvested on non-federal land between the summers of 1988 and 1990 to determine the rate of harvest and whether current forestry practices can indeed sustain this resource. New forest practice rules are being written to promote sustainable forestry.

6 Protect productive agricultural lands from conversion to non-agricultural uses through land use controls and economic incentives.

◆ Washington's Growth Management Act requires counties to include rural elements in their comprehensive plans. The Department of Community Development has developed guidelines for the classification of agricultural lands. There have been local efforts, as well, such as King County's farmland preservation program.

7 Protect riparian and native plant and wildlife species on range lands by:

1. *improving the grazing permit system,* by using taxes and subsidies to promote better management of range lands or by otherwise building incentives into the system; and
2. *educating range land owners and users* on how to apply existing knowledge about range species protection.

◆ DNR has set aside natural area preserves to protect threatened, rare and unique native range lands. DNR and the Nature Conservancy cooperatively administer a program in which landowners voluntarily agree to register and protect natural areas on their property.

8 Explore and pursue the creation of various mechanisms to promote land conservation.

◆ DNR has participated in land transfer programs through $171.5 million in special appropriations to set aside or exchange special lands. (See also items 1 and 2 in this section.)

◆ Natural Resources Conservation Areas: 24,000 acres, 13 locations.

◆ Natural Area Preserves: 11,500 acres in 33 preserves.

◆ State Parks Transfer Projects: 2,542 acres in 10 parcels.

Overview

Wetlands are vital features of the landscape, critical to the health of ecosystems as a whole. Their complex biology and rich nutrients provide valuable habitat and food sources for a wide variety of fish and wildlife. They also serve a number of direct community needs — the recharge and discharge of ground water, dissipation of flood waters, filtration of sediments and pollutants, stabilization of streambanks and shorelines, recreation, education and open space.

Washington offers a great diversity of wetlands — alpine meadows, riparian corridors, salt marshes, river mouth estuaries, freshwater marshes and more. Each type of wetland has its own unique chemical and biological characteristics. All are critical systems that support a rich variety of fish, wildlife, invertebrate and plant species.

But wetlands in Washington are endangered. Before the 1970s there were few regulations controlling the filling and draining of wetlands. In fact, federal policy often encouraged such activity. Major wetland losses were incurred thanks to drainage for agriculture, grazing, mining, forestry, and port and industrial development. In recent years, some new regulations have managed to slow the rate of wetlands loss, but it is estimated that each year, 2,000 additional acres of wetlands are destroyed in Washington. Although high quality wetlands are better protected, the aggregate loss of small (less than one acre) wetlands remains a problem.

In late 1991, though still unresolved, proposed new federal guidelines would narrow the definition of wetlands and make it easier for development to move in on formerly protected properties.

The federal Clean Water Act of 1972 prohibits filling in certain wetlands but it does not regulate dredging, draining or land clearing. It also exempts normal farming, ranching and forestry practices and allows filling in wetlands smaller than one acre. The state Shorelines Management Act (SMA) of 1971 restricts most activities in wetlands within 200 feet of coastal shorelines or large lakes and streams while exempting normal farming and forestry practices. Most significantly, however, the SMA authority excludes more than 75 percent of the remaining wetlands in the state because they fall outside the 200-foot margin. In recent years, a few local governments have passed ordinances to better protect wetlands within their communities, but successes in this area have been limited. Now, the proposed changes in the federal definition of wetlands might make it even more difficult to protect the shrinking wetlands resource.

Today there is increasing pressure to develop wetlands, particularly within the Puget Sound basin. The last remaining undeveloped lands, in the past considered "unusable" because of features like steep slopes or wetlands, are now prime areas to accommodate new growth. Market factors of scarcity and demand caused by increasing population pressure are a threat to remaining wetlands. Time is running out.

In the past two years, some positive steps have been taken to protect our wetlands. Most prominent is the state's Growth Management Act of 1990. Its provisions require local governments in high growth areas to plan for protection of sensitive features including wetlands. Land use ordinances are to be revised to include new protection measures. As of fall 1991, 85 percent of Washington communities had agreed on to participate in growth management planning.

Recent executive orders signed by Gov. Gardner authorize and direct the Department of Ecology and other state agencies to apply a goal of no-net-loss of wetlands to all agency actions relating to wetlands. This directive requires state government to examine programs and modify actions in accordance with wetlands protection needs. This is a first step toward minimizing wetlands impacts and loss. The Department of Ecology is working to achieve broad goals for wetlands protection, incorporating both regulatory and non-regulatory methods.

To identify progress toward no-net-loss of wetlands and gauge the general success of protection efforts requires monitoring. The key is knowing the current state of the wetlands resource base. This is and will continue to be a limiting factor. There currently is no "all inclusive" statewide wetlands inventory. One useful source is the National Wetlands Inventory (NWI), developed by the U.S. Fish and Wildlife Service, which consists of data on type and location of wetlands identified from high-altitude aerial photography. However, aerial interpretation, alone, without field checking and other mapped information misses many wetland systems. Thus, NWI information is not an entirely accurate base for determining the current extent of wetlands. For example, a recent pilot wetlands identification study conducted by the Thurston Regional Planning Council documented only 60 percent NWI accuracy in identifying wetlands in sample areas.

Complete evaluation of the wetlands base requires a step-by-step process of overlaying existing mapped data, such as NWI and Soil Conservation Service soils maps, followed by aerial and field interpretations and collection of new information. Establishing this information base will take time and money. Some local governments have conducted some field inventory work, but so far the number is small. With growth management planning, it is likely that more local governments will address wetlands inventory and more complete information about Washington's wetlands may soon be available.

Environmental Data

It is clear that monitoring the rate of wetlands loss is impossible with the current information base. Any follow-up study of wetlands loss would require inventories to identify change and tracking of activities that impact wetlands. Again, putting these monitoring systems in place is costly and time-consuming. The first step must be to accurately identify existing wetlands.

A comprehensive statewide identification process for wetlands will require development of a database. Computer software such as Geographic Information Systems (GIS) is an effective tool in tracking changes to the resource. Ecology's shorelands program recently obtained a computer system to use GIS for development of a statewide wetland database. This process, as funding and resources allow, will take several years to complete. In time, however, solid information about wetlands throughout Washington should be available.

Systems for monitoring wetlands might be installed in a more piecemeal fashion, as well. This might begin with local governments that have already inventoried their wetlands and can monitor future impacts or changes. But again, this information will take several years to establish and may not prove effective for a statewide evaluation.

In the meantime, some indicators of progress toward improved wetlands protection can be tracked. These include:

◆ The number of local government wetlands ordinances adopted or number of amendments to Shorelines Master Programs to include wetlands.

◆ The area (in square miles) covered by local governments for field inventory of wetlands.

Data Summary

It will be several years before comprehensive baseline measures of wetland numbers, locations and extent of loss using the GIS computer system is in place. In the meantime, work on its establishment will continue and indicators of progress for measuring improvements in wetlands protection will be employed.

Toward 2010 -
The Challenge of Wetlands Protection

1 Establish no net loss of Washington's remaining wetlands, based on acreage and function, as the state's immediate goal, with a longer term goal of increasing the wetlands base.

◆ The Governor directed state agencies to bolster the protection of wetlands under existing statutory authority. These Executive Orders, 90-4 and 89-10, are being implemented.

2 Develop and implement a comprehensive statewide wetlands protection and management plan.

◆ The programs listed under the following three agenda items are conducted under the state wetlands plan.

3 Complete a statewide inventory of wetlands, characterizing wetlands within discrete ecosystems, such as river basins, and maintain a database to contain the information.

◆ Initial work has begun on a data base and tracking system. Information from the U.S. Fish and Wildlife Service's National Wetlands Inventory is being converted for use with the state's Geographical Information System (GIS) mapping data base. As available, additional wetlands data from state and local agencies' inventories will be added.

◆ While development of the wetlands GIS data is a statewide project, it must also meet the directives of the "Puget Sound Water Quality Management Plan."

◆ Ecology is providing technical assistance for field inventories of wetlands being conducted under several grant programs, including the Coastal Zone Management Program, Centennial Clean Water Fund, and Flood Control Assistance.

4 Expand non-regulatory efforts in preservation, restoration, education, research, planning, and technical assistance.

◆ Ecology and Department of Wildlife provide preservation and restoration workshops, education materials, technical assistance and training to a variety of audiences, including local governments.

◆ Under an EPA grant, a pilot restoration program is being carried out in the Snohomish area. Ecology is also completing the first phase of a wetlands restoration guidebook for technical professionals.

◆ Non-regulatory protection of wetlands is a statewide effort involving several agencies, including the Puget Sound Water Quality Authority.

5 Establish and implement statewide regulation on land use activities on and near wetlands.

◆ Local governments must adopt critical areas ordinances including wetlands protection by March 1992, under the state's Growth Management Act.

◆ Ecology drafted water quality standards under an EPA Clean Water Act grant.

◆ Ecology produced a model wetlands ordinance as guidance for local governments.

◆ Ecology provides ongoing technical assistance to local governments on developing and implementing wetlands protection regulations.

6 Explore new and existing funding source to support implementation of these recommendations.

◆ Wetlands program grants were awarded under the Governor's executive order. Local governments received 31 grants in the 1991 fiscal year.

Fish and Wildlife

Fisheries of the State

Overview

It is not possible to paint a picture of Washington's fish and shellfish resources with a broad brush. Thus, the resource is depicted here through data chosen to represent the diverse species and different regions of our state. The challenge of maintaining and improving our fisheries resources while experiencing major human population increases is formidable.

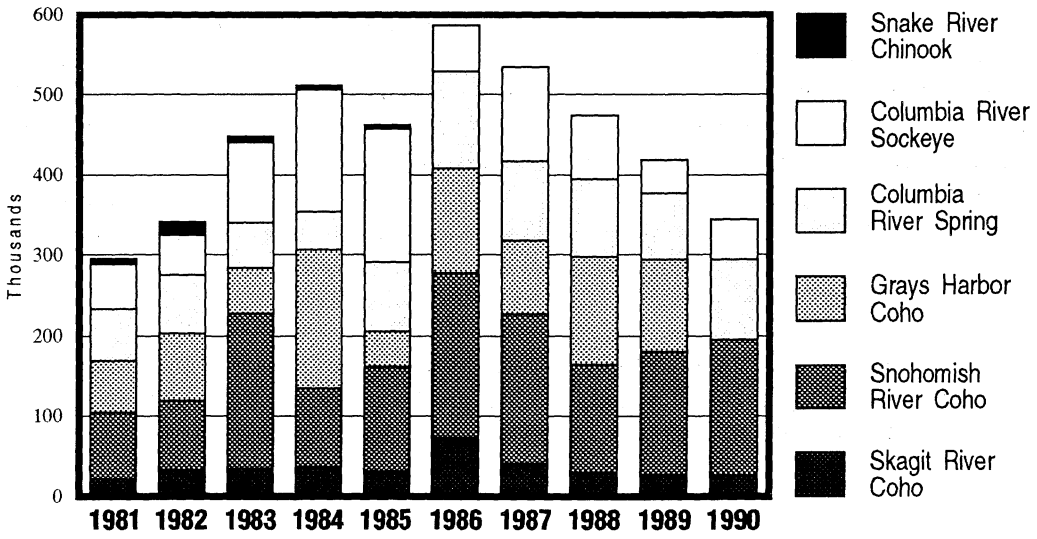
The Department of Fisheries, which is responsible for managing the foodfish and shellfish species, has chosen species abundance as the best indicator of the health of the fisheries resource. Any other choice would be statistically insupportable because no information currently being collected directly evaluates habitat status. New data collected as part of a Puget Sound water quality monitoring program might be incorporated into later versions of the State of the Environment Report.

Environmental Data

Salmon

Historical run-size data demonstrate the condition of Washington's salmon resource. Selected natural runs from Puget Sound, the Washington coast, and the Columbia River show that salmon run sizes are variable, with some runs decreasing and others increasing. In general, coho salmon runs were selected because coho salmon spend the first twelve months of their life history residing in freshwater habitats.

Figure 11:
Salmon run sizes 1981-1990



The Skagit River coho has varied from a low of 21,400 fish in 1981 to a high of 73,400 fish in 1986, as measured by run size entering the Strait of Juan de Fuca. The Snohomish river coho run size has a slightly upward trend for the period between 1981 and 1990.

A recent study of coho runs in the Grays Harbor area shows significant mortality among downstream-migrating salmon, believed to be related to parasite loading, disease and poor water quality conditions in the inner harbor. Information from the study indicates there was a roughly 50 percent mortality as a result of downstream passage through the inner estuary during the study years. Recent changes in industrial processing may have improved the water quality problem.

In 1991 the National Marine Fisheries Service (NMFS) received petitions requesting several runs of salmon in the Columbia River receive protection under the Endangered Species Act. As the year ended, the NMFS had declared the Snake River sockeye run to be endangered and was reviewing the petitions for Snake River spring/summer chinook and fall chinook. A recovery plan for Snake River sockeye is being developed.

Water quality and quantity are critical to maintaining the health of Washington's salmon resource, and the cumulative effects of human population growth on salmon habitat is an issue deserving attention.

Shellfish

In recent years, new fisheries for such shellfish species as ghost shrimp, sea urchin and sea cucumbers have started or expanded. The species selected for discussion here represent only a small portion of the different shellfish species.

Dungeness Crab

For both the coastal crab and Puget Sound fisheries, the trend for catches is increasing. This is thought to be part of typical variability of crab populations. There remain several concerns about crab habitat — especially regarding the impacts of dredging and other marine development — but these do not seem to influence crab catches significantly.

Clams

The commercial landings of Manila and native littleneck clams in Puget Sound were selected to indicate the status of Washington's clam resource. Commercial landings of Manila clams are increasing, while landings have been relatively constant for native littleneck clams. It is important to add that water quality degradation in Puget Sound is a major concern to the clam resource. Increased bacterial levels from a variety of sources — including private septic systems, farm operations and marine mammals — have forced closure of sport and commercial harvest in some areas of Puget Sound.

Shrimp

Fishery managers do not see a habitat-related impact on spot shrimp populations at this time. The variability in commercial harvest results from a combination of fluctuating natural abundance and allocation of harvest to sport and tribal fisheries.

Sea Urchins and Sea Cucumbers

There has been a big jump in the harvesting of sea urchins and sea cucumbers in recent years. This is due to greater interest in harvesting these two animals rather than increased abundance.

Marine Fish

Two data sets were selected to measure the status of the marine fish resource of Washington — the catch-per-unit effort in a commercial trawl fishery for English sole, and the incidence of tumors in English sole from various locations in Puget Sound.

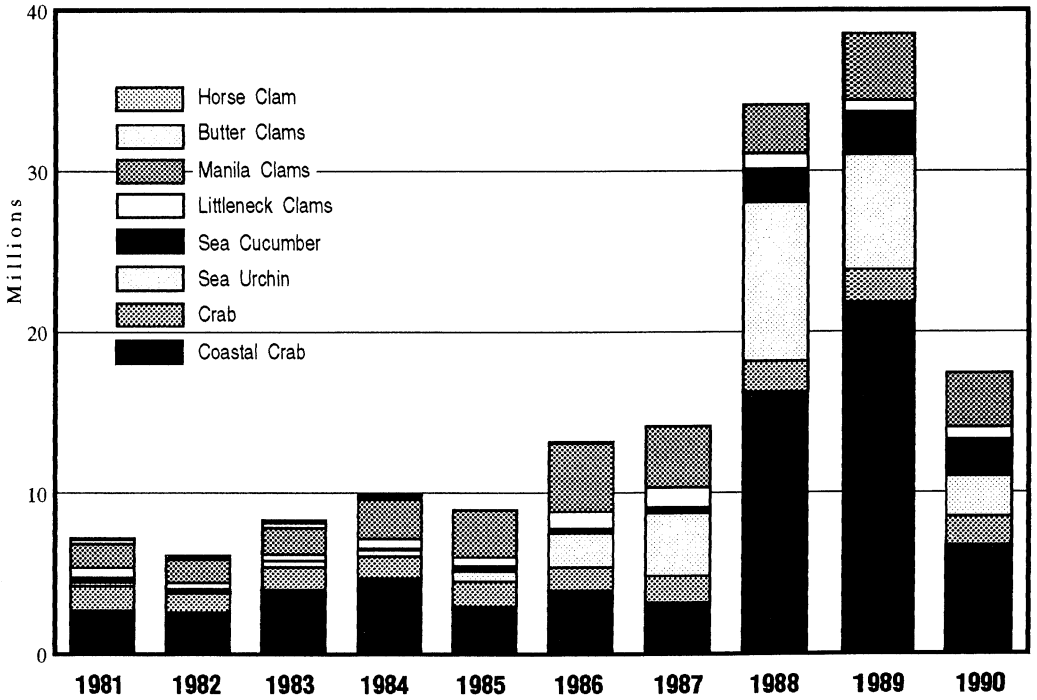
Although the impact of environmental changes on English sole in northern Puget Sound is not well documented, it does not appear to be significant, based on catch rates.

Liver lesions in English sole appear to be directly related to environmental contamination. Levels of contamination in urban bays, such as Elliott and Commencement Bays, might be harmful to bottomfish living there. There have been recommendations against eating the fish caught in these areas, but the actual risk to public health is unknown.

Sturgeon

The abundance of white sturgeon above Bonneville Dam, as measured by sport and commercial catch, was selected as significant information because this run is considered depressed and is being monitored closely. Catches, however, did increase between 1985 and 1987, primarily because of increased commercial harvest rather than greater abundance.

Figure 12:
Commercial landings 1981-1990



Data Summary

Overall:

◆ There is little information available directly measuring the status of foodfish and shellfish habitat.

◆ Habitat degradation is affecting salmon runs in the Columbia River and Grays Harbor.

◆ Shellfish populations appear to be healthy, although certain areas have been closed to shellfish harvesting because of public health concerns.

◆ Marine fish populations appear to be healthy, although the presence of tumors in English sole indicate pollutants are causing impacts in urban areas.

◆ There has been a big jump in the harvesting of sea urchins and sea cucumbers in recent years. This is due to greater interest in harvesting these two animals, not to increased abundance.

Wildlife of the State

Overview

Two little words — "spotted owl" — are all that most people know, or may care to know, about animal species in Washington that might be endangered. But the state Department of Wildlife is responsible for preserving, protecting and perpetuating more than 600 vertebrate species. To do so, Wildlife launched its priority habitats and species (PHS) program in late 1989 to identify and map the highest priority habitats and species in the state.

A "priority species" is a wildlife species of concern because of its population status and its sensitivity to changes in its habitat.

A "priority habitat" is an area with one or more of the following attributes: comparatively high wildlife density, high wildlife species richness, significant wildlife breeding habitat, significant wildlife seasonal ranges, significant movement corridors for wildlife, limited availability, and high vulnerability.

The first phase of the PHS program, completed in 1990, identified and mapped the highest priority habitats and species on commercial forestland. It found the highest priority species in forest environments are:

- In danger of falling or declining in numbers, or vulnerable due to such factors as disease, predation, exploitation or habitat loss or change.
- Rare or uncommon and potentially affected by habitat loss or change.
- Those for which maintaining a stable population and surplus for recreation might be affected by loss or change in habitat.

Environmental Data

During the next few years, Wildlife will complete the identification and mapping of priority habitats and species throughout Washington, including urban areas, agricultural lands, federal lands and tribal lands. Because the PHS program was not complete by late 1991, this report presents priority species in forest environments as "environmental indicators."

Data Summary

Priority Species in Forest Environments

Band-Tailed Pigeon *(Columba fasciata)*
Classification: Game species
This migratory bird is found primarily in mixed coniferous and hardwood forests of Western Washington. Populations have declined throughout the Pacific Flyway during the last decade.

Bighorn Sheep *(Ovis canadensis)*
Classification: Game species
While California and Rocky Mountain bighorn sheep are native to Washington, both subspecies were wiped out in the 1920s. In 1957, the California bighorn was reintroduced, followed in 1972 by the Rocky Mountain bighorn. Populations are limited in size and distribution in Washington.

Cavity-Nesting Ducks *(Wood Duck; Merganser; Bufflehead; Goldeneye)*
Classification: Game species
Although duck numbers in Washington have been increasing (mainly due to the buildup of mallards in the Columbia Basin), cavity-nesting ducks have suffered population declines because they depend upon the diminishing number of large timber snags, adjacent to wetlands.

Blue Grouse *(Dendragapus obscurus)*
Classification: Game species
Distributed statewide, this forest grouse requires large trees or patches of trees near ridgetops for wintering habitat.

Columbian Black-Tailed Deer *(Odocoileus hemionus columbianus)*
Classification: Game species
This species occurs in forested habitats throughout Western Washington, where it is generally non-migratory. Loss of habitats in the Puget Sound region is the biggest factor leading to population declines.

Elk
Classification: Game species

Rocky Mountain Elk *(Cervus elaphus nelsoni)*
Approximately half of Washington's estimated 52,000 elk are considered Rocky Mountain elk, a subspecies reintroduced in this state in 1912. There are currently four herds of Rocky Mountain elk — the Yakima herd, numbering 12,600; the Colockum herd, 6,000; the Pend Oreille herd, 600; and the Blue Mountains herd, 7,000.

Roosevelt Elk *(Cervus elaphus rooseveltii)*
Native to Western Washington, these elk occur on the Olympic Peninsula, Willapa Hills and western parts of the Cascades. There are six Roosevelt elk herds in Washington: Olympic Mountains, numbering 10,000; Willapa Hills, 4,000; St. Helens, 7,000); Nooksack, 1,500; northern Mt. Rainier, 3,500; and southern Mt. Rainier, 1,000.

Harleguin Duck *(Histrionicus histrionicus)*
Classification: Game species
Harlequin ducks occur in isolated pockets in Washington. They require forested mountain streams for nesting and are particularly vulnerable to human disturbance.

Canada Lynx *(Lynx canadensis)*
Classification: Game species and furbearer
This species originally occurred in high elevation forested areas of Cehlan, Okanogan, Ferry, Stevens, and Pend Oreille counties. Distribution has been reduced due to site specific exploitation — primarily trapping in the Kettle Range — and habitat changes.

Moose *(Alces alces)*
Status: Game species
Moose are found mainly in the forested areas of eastern Pend Oreille and Spokane counties but also occur in north Central Washington. They were first noted in this state in the mid-1950s and have increased to at least 265 animals. Loss of habitat may restrict future population increases.

Mountain Goat *(Oreamnos americanus)*
Classification: Game species
Mountain goats inhabit alpine areas of the Cascades, Olympics, and Selkirk mountains. They are native to the Cascades and Selkirks but were introduced in the Olympics in the 1920s. Populations are depressed from earlier levels.

Mule Deer *(Odocoileus hemionus hemionus)*
Classification: Game species
Mule deer are found throughout Eastern Washington from Okanogan County to the Columbia Basin. The largest populations are found in north Central Washington. In most areas, populations are limited by the amount of wintering habitat, which is increasingly altered by timber management, grazing and conversion to other uses.

White-Tailed Deer *(Odocoileus virginianus)*
Classification: Game species
This species is most numerous in northeastern Washington, although its range extends west to Okanogan County and south to the Blue Mountains. Loss of suitable habitat, particularly cover, is a limiting factor in white-tailed deer populations.

Wild Turkey *(Meleagris gallopavo)*
Classification: Game species
The Merriam's turkey has been introduced into several areas of Washington since 1960. The largest populations are currently found in Stevens and Klickitat counties. Wintering nesting and brooding habitat is limited, and is being diminished in Klickitat County, where the bird inhabits oak woodlands. The estimated population of all species in 1980 was between 2,000 and 3,000; in 1991, the population was estimated between 3,000 and 5,000.

Bull Trout/Dolly Varden *(Salvelinus confluentus/Salvelinus malma)*
Classification: Anadromous game fish
These species are found in Puget Sound, Hood Canal, the Straits of Juan de Fuca, the coast, the Columbia River and tributaries. Populations have declined in recent years due to habitat alteration. Spawning and rearing areas are being depleted by activities affecting instream habitat.

Olympic Mudminnow *(Novumbra hubbsi)*
Classification: State candidate species
The Olympic mudminnow has a limited distribution. It is found only on the Olympic Peninsula and part of the Chehalis and Deschutes river drainages. Many wetlands that once supported populations of this species are now gone, though there exists a perceived increase in the mudminnow's population trend.

Pygmy Whitefish *(Prosopium coulteri)*
Classification: State monitor species
The Pygmy whitefish is known to exist in just a few Washington lakes. It spawns in riffles of streams or lakeshores from late summer to early winter.

Rainbow Trout/Searun, Coastal and Westslope Cutthroat *(Oncorhynchus)*
Classification: Resident game fish
Approximately 12,000 miles of stream in Washington contain resident trout. Some trout populations are depleted due to streambed disturbance and alteration of stream and beaver pond habitat.

Steelhead Trout *(Oncorhynchus mykiss)*
Classification: Anadromous game fish
Steelhead populations can be divided into two major groups — winter runs, which return to streams from November through May to spawn; and summer runs, which return to streams from May through October, but spawn the following winter and spring. Steelhead streams are distributed throughout the Puget Sound region, the Columbia River drainage area and coastal areas draining directly to the Pacific Ocean. Spawning and rearing habitat for wild stocks is being depleted by degradation of instream habitat.

Marbled Murrelet *(Brachyramphua marmoratus)*
Classification: State candidate species
Washington's marbled murrelets nest in conifers that are at least 150 years old, located in mature or old-growth forests or residual old-growth trees. Nesting is assumed to have occurred in at least 14 sites in Washington. Old growth habitat is declining in supply.

Northern Goshawk *(Accipiter gentilis)*
Classification: State candidate species
The northern goshawk is a rare resident of Washington. It breeds in dense old growth and mature coniferous forests in this state. Currently, at least 80 known nests exist in Washington. Its habitat base is declining.

Oregon Silverspot Fritillary *(Speyeria zerene hippolyta)*
Classification: State threatened, federal threatened
This butterfly once inhabited scattered salt-spray meadows along the coast of Washington. All viable populations have been eliminated in this state. One silverspot fritillary — or group of butterflies — was observed in 1990, the first sighting in four years.

Osprey *(Pandion gakuaetus)*
Classification: State monitor species
There were 121 breeding pairs of osprey statewide in 1985, with productivity data of 1.3 young per occupied nest. New nests continue to be found. High nest site fidelity makes this species sensitive to nest site destruction.

Peregrine Falcon *(Falco peregrinus)*
Classification: State endangered, federal endangered
Surveys since 1975 show that the status of breeding populations of peregrine falcons is tenuous. These birds are particularly sensitive to disturbance during all phases of the nesting season.

Pocket Gopher *(Thomomys mazama)*
Classification: State candidate species
There are several subspecies of pocket gopher in Washington, each of which is extremely limited in distribution. Only one population of each subspecies is known.

Purple Martin *(Progne subis)*
Classification: State candidate species, federal sensitive.
Purple martins are insectivorous swallows that nest in cavities. The U.S. Fish and Wildlife Service has documented population declines of purple martin throughout its historic range in Washington. For example, about 12,500 birds existed in Seattle in 1945, but only 32 birds were counted in 1980. Reduction of breeding habitat has occurred through the elimination of snags and trees with cavities near water.

Sandhill Crane *(Grus canadensis)*
Classification: State endangered
Two of the six North American subspecies occur in Washington — the lesser and greater sandhill cranes. Breeding sandhill cranes were wiped out in Washington by 1941. Lesser sandhill cranes occur as migrants in the spring and fall on both sides of the Cascades. Greater sandhill cranes also migrate through the state, but in smaller numbers. Sandhill cranes are extremely wary, requiring isolated sites with good cover for nesting.

Spotted Frog *(Rana pretiosa)*
Classification: State candidate species
These frogs inhabit the marshy edge of ponds, streams and lakes. They were formerly widespread on the west side in forested regions; now they are known to exist in only one location in Thurston County. On the east side of the state, they are still widespread.

Spotted Owl *(Strix occidentalis)*
Classification: State endangered, federal threatened
Populations of spotted owl have declined with the elimination of old growth habitat. The owl occurs on both sides of the Cascades, east to Lake Wenatchee. There are currently 774 sites known in Washington. Of these, 557 have evidence of a nest, pair or young.

Townsend's Big-Eared Bat *(Plecotus townsendii)*
Classification: State candidate species
This bat has been recorded in Washington as breeding near Bellingham, Mount St. Helens and in the Columbia Gorge. A recent survey of known bat caves in Klickitat and Skamania counties indicated a decline in the number of bats using them. Some caves in Whatcom County formerly occupied by this species no longer contain these bats. They are extremely sensitive to disturbance.

Western Bluebird *(Sialia mexicana)*
Classification: State candidate species, federal sensitive
This species is widely distributed in the dry coniferous forests east of the Cascade crest. In Western Washington, it has become an uncommon, local breeder, although historically they were abundant and widespread. The western bluebird relies on cavities for nesting and the existence of natural cavities is declining.

Western Gray Squirrel *(Sciurus griseus)*
Classification: State candidate species
In Washington, this rare species occurs in the Puget Trough from Pierce County south, and in scattered localities east of the Cascades from the Columbia River Gorge to Lake Chelan and in the Methow and Okanogan valleys. The population of the squirrel has declined. It is very habitat specific, utilizing mature oak and conifer plant associations, which are being converted and lost.

Western Pond Turtle *(Clammys marmorata)*
Classification: State threatened
Approximately 40 western pond turtles remain in Washington. Pond turtles are no longer found in lakes that have undergone substantial shoreline development. The Puget lowlands populations have declined dramatically.

Woodland Caribou *(Rangifer tarandus caribou)*
Classification: State endangered, federal endangered
This species ranges into the northeast corner of Washington in the Selkirk Mountains. Numbers have declined dramatically in the last century. A reintroduction program was begun in 1987 in an effort to raise herd numbers to a self-sustaining level.

Bald Eagle *(Haliaeetus leucocephalus)*
Classification: State threatened, federal threatened
During the breeding season, bald eagles are widely distributed west of the Cascades, concentrating along marine shorelines. There has been a documented population decline from the mid-1800s until recently, when recovery has begun. There continues to be a loss of shoreline nesting habitat and winter night roost habitat in Washington.

Beller's Ground Beetle *(Agonum belleri)*
Classification: State candidate species
This species is currently known to exist at only three sites. Pesticides or changes in flow or level of water within sphagnum bogs is detrimental.

Columbian White-Tailed Deer *(Odocoileus virginianus leucurus)*
Classification: State endangered, federal endangered
Originally found in the Cowlitz River drainage, and the lower Columbia River to the upper Willamette Valley, the Columbian white-tailed deer is now confined in Washington to Wahkiakum County on islands in, and on the bank of, the Columbia River. Two viable subpopulations exist on secured habitat.

Common Loon *(Gavia immer)*
Classification: State candidate species
The common loon was historically a widespread breeder in Washington, but has declined. Undisturbed breeding habitats are becoming increasingly rare. There is currently successful nesting at five different lakes.

Golden Eagle *(Aquila chrysaetos)*
Classification: State candidate species
Golden eagles breed in scattered locations in Western Washington. They are found more commonly in Eastern Washington. In 1985, 164 known territories were surveyed, with 80 occupied. Human disturbance is a major factor in golden eagle nest failure.

Golden Hairstreak Butterfly *(Habrodais grunus)*
Classification: State candidate species
This butterfly is known from a single location in Skamania County. Golden chinquapin stands are necessary to the survival of this species.

Gray Wolf *(Canis lupus)*
Classification: State endangered, federal endangered
Wolves occurred historically throughout much of Washington. The last remnant populations were limited to the Olympic Peninsula; the Blue, Cascade and Selkirk mountains; and eliminated by the 1940s. In 1989, Wildlife biologists confirmed a set of wolf tracks from the North Cascades. In 1990, evidence was located of two dens in Washington.

Great Blue Heron *(Ardea herodias)*
Classification: State monitor species
Herons are colonial nesters, generally nesting in tall deciduous or coniferous trees near wetlands. Although the populations appear stable, the heron's colonial nesting habits make it susceptible and vulnerable to habitat loss.

Grizzly Bear *(Ursus arctos)*
Classification: State endangered, federal threatened
Grizzly populations declined as the West was settled. There are thought to be approximately 10 individuals in the North Cascades in Washington, and approximately 18 in the Selkirk Mountains.

Lewis's Woodpecker *(Melanerpes lewis)*
Classification: State candidate species, federal sensitive
This cavity nester is found east of the Cascade Mountains. Historically, it was more abundant on the west side, but declined as a breeder there. Its required habitat of soft snags is also in decline.

Other Species

Other priority species for which we currently have insufficient data include the: pine marten, kokanee, mountain sucker, mountain whitefish, pileated woodpecker, pygmy shrew, Van Dyke's salamander, yellow-billed cuckoo, white-headed woodpecker, black-backed woodpecker, Dunn's salamander, fisher, flammulated owl, Hatch's click beetle, and the long-horned leaf beetle.

Table 4:
Trends In Washington's Wildlife

Priority Species	Estimated Population		Population Trend
	1980	1991	
Band-tailed pigeon	Unknown	Unknown	>>
Bighorn Sheep	700 (1985)	850+	<<
Goldeneye	19,500	16,500	<<
Bufflehead	28,750	12,500	<<
Merganser	10,000	5,750	<<
Blue Grouse	400,000+(1984)	500,000+	>>
Columbian black-tailed deer	220,000	200,000	<
Elk	52,000(1985)	52,000	Unknown
Harlequin Duck	7	Unknown	Unknown
Canada lynx	150	150	—
Moose	100-150	265-310	>
Mountain goat	7,500(1985)	7,000	<
Mule deer	133,000	130,000	<
White-tailed deer	70,000	75,000	>
Wild turkey	2,000-3,000	3,000-5,000	>
Bull trout/Dolly Varden	Unknown	Unknown	<
Olympic mudminnow	Unknown	Unknown	>
Pygmy whitefish	Unknown	Unknown	<
Rainbow trout/Searun, Coastal, & Westslope, Cutthroat	Unknown	Unknown	<
Steelhead trout	Unknown	Unknown	>
Marbled murrelet	3,800-5,000(1979)	Unknown	>>
Northern goshawk	150 (terr.)		<
Oregon silverspot fritillary	Unknown	1	<
Osprey	183(1984)	345(1989)	>
Peregrine Falcon	3	18	>
Pocket gopher	Unknown	Unknown	
Purple martin	Unknown	Unknown	
Sandhill crane	3	1 or 2	<
Spotted frog	Unknown	Unknown westside	<
Spotted owl	Unknown	774 (1992)	<
Townsend's big-eared bat	Unknown	Unknown	Unknown
Western bluebird	Unknown	Unknown	>
Western gray squirrel	Unknown	Unknown	Unknown

1 Protect existing fish and wildlife habitat to ensure no net loss of function and values, and, through acquisition, restoration, and enhancement, achieve an overall net gain in the productive capacity of fish and wildlife habitat.

◆ This is an ongoing mission for the Department of Wildlife and is carried out in virtually all of its activities. In addition, public acquisition of sensitive and critical lands will ensure habitat protection for a vast array of Washington fish and wildlife.

◆ During the last two years, the Washington Department of Wildlife has acquired 22 million dollars worth of wildlife habitat on more than 3,500 acres in 60 locations. The two main programs responsible for these acquisitions are the Washington Wildlife Outdoor Recreation program and the Lower Snake River Wildlife Compensation Plan. Other habitat protection occurs with funds from personalized license plate sales and matching funds from such groups as the Rocky Mountain Elk Foundation and Ducks Unlimited.

➤ Fisheries is also working with Ecology and other agencies to develop guidelines to protect water quality from stormwater run-off.

2 Develop a statewide fish and wildlife habitat inventory.

◆ An inventory tracking the status of Washington's wild salmon populations is scheduled for completion by the Department of Fisheries in June 1993.

◆ The Department of Wildlife maps more than 11 million acres of state and private forest land with point or area locations of 62 species and 10 unique habitats; maps urban lands with locations for 28 species and four unique habitats; and is mapping coastal zone areas, federal lands and Eastern Washington agriculture and shrub steppe lands.

3 Identify and restore critical areas of fish and wildlife habitat that have been damaged and degraded.

◆ A new volunteer salmon enhancement program was initiated by the Department of Fisheries and restoration of several habitat areas is underway.

◆ A "wild stock" inventory will assist the Department of Fisheries in setting priorities among enhancement needs of wild salmon runs and habitat areas.

◆ Private land owners may obtain aid with habitat restoration projects from the Department of Wildlife. A Department biologist coordinates and approves the project design. Wildlife may provide funding for materials, supervision and mileage. The Washington Conservation Corps and Senior Volunteers may provide additional labor.

4 Develop a comprehensive program to clean up and protect coastal waters and estuaries that are critical to fish and wildlife species, such as Grays Harbor, Willapa Bay and the Columbia River.

◆ Under the 1991 Puget Sound Water Quality Management Plan:

- ➤ Ecology adopted sediment management standards in 1991 and approved 23 local environmental plans.
- ➤ Ecology has received plans from various local entities to protect watersheds, reduce and properly dispose of household hazardous waste, and reduce CSO.
- ➤ Ecology adopted a highway run-off rule.
- ➤ Ecology participated in developing the States/British Columbia Oil Spill Task Force recommendations, most of which were adopted in the 1991 Oil Spill Prevention Act. Subsequently, Ecology has also developed a guidance manual on oil spill prevention.
- ➤ To facilitate better analysis of water and sediment samples, Ecology accredited 83 labs under a new laboratory certification program.

◆ The governor's wetlands forum developed a priority list of wetlands for preservation. DNR acquired wetlands in four counties.

◆ Five agencies — Ecology, DNR, Health, Fisheries, and PSWQA — are implementing the Puget Sound Ambient Monitoring Program. The program is partly funded by the Fish and Wildlife Service.

◆ The Department of Health updated its inventory of shellfish bed status and adopted rules for recreational shellfish harvest and for on-site septic systems along marine shorelines.

◆ The PSWQA funded more than $1 million in local education projects; sponsored two Puget Sound research conferences; and helped create a nonprofit foundation to provide funds for Puget Sound research and education.

◆ EPA funded about $3 million in special Puget Sound projects.

◆ A study was launched to evaluate a possible North Puget Sound Marine Sanctuary Program.

◆ Willapa Bay — the source of nearly 20 percent of the nation's fresh oyster market — is receiving funding, technical assistance and other types of support from public and private sources to protect the area's precious resource.

◆ A four-year study under the Lower Columbia River Bi-State Water Quality Program will characterize water quality in the Lower Columbia River.

◆ A study of the Grays Harbor and Chehalis River areas will help determine the causes of low survival rates of juvenile Coho salmon.

5 Continue to promote sustainability of fish and wildlife resources thorough reasonable controls on rates of harvest.

◆ Department of Fisheries programs help manage salmon, marine fish and shellfish harvest rates in Puget Sound, coastal waters and the Columbia River.

◆ Bag limits and specific seasons for birds and big game are proposed by technical staff and sent to the Wildlife Commission for final approval.

◆ Fish management limits and seasons are proposed for specific areas by regional biologists with the Wildlife Commission granting final approval.

Cross Issues

Some issues affecting the environment of Washington are so big and broad that they cannot be neatly placed as sub-categories of sections on air, water or land. These are issues that affect all or part of these environmental media — all or part of the time.

Hazardous waste, for example, is a big enough problem that it threatens our air, water and lands in pervasive ways. Global warming will exert its influence on every aspect of our lives in the coming decades. A study of energy and its use and conservation forces us to look at our automobile-dominated society and its trail of trash and wastefulness: old tires in our landfills, used oil in our water and exhaust fumes in our air.

This section will look at toxic waste sites, radioactive and mixed wastes — with an emphasis on Hanford — hazardous waste and hazardous substances, recycling and litter, releases of hazardous substances, spills, contaminated sediments, underground storage tanks, global climate change and energy. The state of Washington has taken some positive steps toward addressing the cross-media issues of our environment. Some have been a direct result of legislation, some have come out of recommendations in the Environment 2010 Action Agenda, and some have been achieved through grass roots work by citizens of the state. But there remains work to be done.

Figure 13:
Energy use by fuel

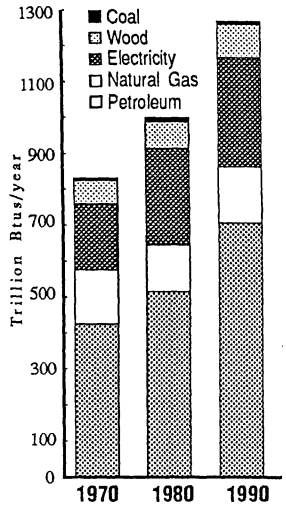


Figure 14:
Energy use per capita

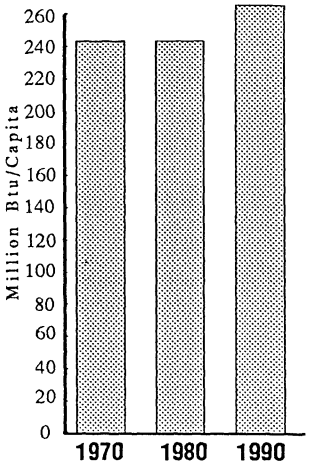
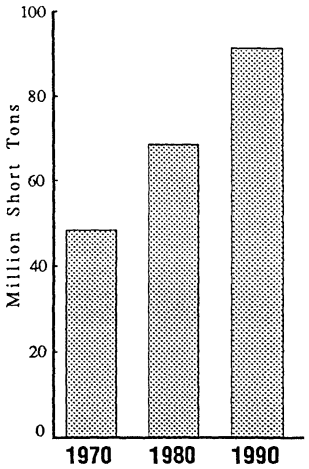


Figure 15:
Carbon Dioxide emissions from energy use



Overview

Energy use and the quality of the environment are intricately linked. As demand for energy can affect the environment, so can environmental policies and regulations influence the cost, availability and type of energy used.

The connections between energy and the environment can be complex, but increased energy use clearly has environmental consequences. Since 1970, Washington's energy use has risen by more than 50 percent and fully two-thirds of this growth can be traced to increased use of fossil fuels, especially petroleum. Increased petroleum demand means greater impact from drilling, increased risk of oil tanker spills, more emissions from vehicles and refineries and potential for greater leakage into aquifers from gasoline storage.

Increased demand for electricity can no longer be met with relatively clean hydroelectric facilities. Utilities in Washington own shares of coal-fired plants in Montana and Wyoming, and are likely to turn to natural gas for electrical generation to meet rising loads. Natural gas use is relatively clean, but nevertheless releases carbon dioxide as all fossil fuels do. Carbon dioxide is the major contributor to global warming.

Environmental Data

To provide an indication of trends in energy use and intensity, the following two tables present energy use and energy-use intensity indicators over the last 20 years.

Total energy use in Washington increased by 20 percent between 1970 and 1980 and again by 27 percent between 1980 and 1990.

Data Summary

Energy use per capita increased during the 1980s. This increase is traceable mostly to motor vehicles. Registered vehicles per capita increased 12 percent from .92 per person in 1980 to 1.03 in 1990 *(Source: Office of Financial Management)*.

Correspondingly, the average number of miles each vehicle was driven increased nearly 20 percent from 9,248 in 1980 to 11,016 in 1990 *(Source: Department of Transportation)*.

But there is good news. A 25 percent reduction in energy use per dollar of statewide personal income reflects changes in the industrial base over the last 20 years as well as improvements in efficiency. The decline in this index was more rapid during the 1970s than during the 1980s.

To provide an indication of the trend in the environmental impacts of energy use, the final table presents carbon dioxide emissions from energy use during the past 20 years. These figures include carbon dioxide emissions from in-state use, as well as those from electricity used in the state but generated in coal plants in Montana and Wyoming.

Toward 2010 -
The Conservation Challenge: Energy Conservation

1 Establish a "gas guzzler/gas sipper" program to encourage the use of fuel efficient vehicles.

The 1991 legislature rejected a proposal to assess environmental fees on vehicle manufacturers. Instead, a clean air excise tax on all registered motor vehicles except farm vehicles was adopted.

2 Improve vehicle fuel efficiency standards by lobbying the U.S. Congress to set higher Corporate Average Fuel Economy (CAFE) standards.

Higher CAFE standards are under consideration in Congress but have not been passed.

3 Improve the energy efficiency of manufactured homes.

◆ About 500 manufactured units have been certified as energy efficient through the Bonneville Power Administration's "*Super Good Cents*" program.

◆ Mason County Public Utility District #3 applies mandatory efficiency standards for all new hook ups. Puget Power is inquiring with the Utilities and Transportation Commission about a similar requirement.

◆ The Bonneville Power Administration and the state's public and private utilities have contracted with the manufactured housing industry to ensure that only high efficiency manufactured home units are marketed in Washington and the Northwest subsequent to April of 1992.

4 Adopt improved energy efficiency standards for new commercial buildings, such as office buildings, stores and public facilities.

◆ The State Building Code Council is revising the non-residential portion of the 1986 State Energy Code to become effective in July 1992.

5 Establish a financial mechanism to provide low-interest loans to encourage energy and water conservation measures and renewable resource development by state agencies, local governments, businesses and resource developers.

There's a long list of activities in this area. A sampler:

◆ Many utilities provide grants or low interest loans for energy conservation.

◆ State agencies finance conservation measures under the lease/purchase program.

◆ The State Energy Office has begun a $15 million dollar conservation loan program for school districts under legislation adopted in 1991. Meanwhile, the Washington State School Directors Association's "Flex Fund" finances public school conservation.

◆ Department of Community Development weatherization assistance grants enable 4,000 to 6,000 low income households each year to install energy conservation measures.

◆ Oil overcharge funds from a damage award in a pricing suit against oil companies are used for matching grants with utilities and landlords for energy conservation projects.

◆ Ecology administers Referendum 38 grants and loans to irrigation districts for comprehensive water conservation planning and system improvements. Approximately 70 projects have begun since voters approved the water supply bond issue in 1980.

◆ Water districts received authority from voters in 1989 to provide conservation incentives. Local programs have included rebates for ultra low flow toilets.

◆ Water and electric utilities use seasonal and inverted rate structures to encourage conservation.

◆ Water districts may apply for federal funds for system improvements.

◆ The Bonneville Power Administration has begun contracting with water districts to assist customers in obtaining low flow shower heads and high efficiency water heaters.

◆ Both public and private utilities are providing low flow shower heads and faucet aerators to customers to reduce both electricity use and water use. Puget Power distributed nearly 200,000 shower heads and aerators during 1991.

6 Incorporate environmental costs into energy planning.

◆ An executive agency task force has been convened to develop recommendations concerning the incorporation of environmental costs in energy planning decisions and energy resource development. Task force members include the Northwest Power Planning Council, the Departments of Ecology, Trade and Economic Development, Wildlife, Fisheries, the Utilities and Transportation Commission, and the Washington State Energy Office. The task force is being staffed by the Energy Office. Public Testimony is planned for this fall and a final set of recommendations is expected before the end of the year.

◆ BPA is developing methods to integrate environmental costs into major federal resource decisions under the Energy Independence Act.

◆ The UTC, working with Puget Sound Power and Light, is experimenting with new regulatory treatment that does not penalize the utility company for energy conservation.

7 Develop State Energy Strategy

◆ At the direction of the Legislature, a state energy strategy is being developed with the advice of an advisory committee including broad representation from the energy industry, regulators and public interest groups. The Energy Office is staffing this committee. The completed state energy strategy will be presented to the 1993 Legislature in January.

Global Climate Change

Overview

Global climate change, more commonly known as global warming, is a much-discussed subject when conversation and scientific scrutiny turn to the future of the planet. The effect of so-called "greenhouse gases" on our climate in the coming decades is fertile ground for truly frightening scenarios and should be cause for a serious examination of our ecological behavior.

There are indicators of global climate change appropriate in the context of Washington state. But the issue is, after all, one of *global* change, and indicators on a local scale are likely to be meaningless unless placed in a larger context. In addition, the issue is new and there are still relatively few generally accepted environmental measures of global climate change compared to more mature environmental fields such as water or air quality. This and future editions of Washington's State of the Environment Report can lead in the effort to define environmental quality as it relates to global climate change.

Global climate change has been judged by Environment 2010 to be a mid-range threat. This determination was reached by averaging the issue's high uncertainty (making it a low-range threat) with its potentially drastic effects (high-range threat).

Global climate change, for purposes of this report, is defined as a long-term alteration — measured in decades or centuries — of global climate due to an amplification of the greenhouse effect from a buildup of greenhouse gases. The most notable greenhouse gases are carbon dioxide, methane, chlorofluorocarbons and nitrous oxide.

In Washington, climate changes are expected to vary considerably throughout the state should there be significant increases in greenhouse gas levels. The Columbia River basin, now characterized by hot summers, cold winters and relatively low rainfall, could see an average annual temperature increase of 4 to 5 degrees celsius if carbon dioxide in the atmosphere were to double. In the Western Washington marine climate, the average annual temperature increase under the same scenario is projected at only 2 to 3 degrees.

Changes in precipitation patterns for the Northwest are not easy to forecast. Some general circulation models project up to a 30 percent increase in average annual precipitation under severe greenhouse conditions; others project little or no change. Global climate change also includes secondary and cumulative effects such as shifts in water cycle patterns and accelerated sea level rise.

Some scientists predict the direct effects of global warming could arrive as early as 2030 if the release of greenhouse gases is not severely curtailed.

Environmental Data

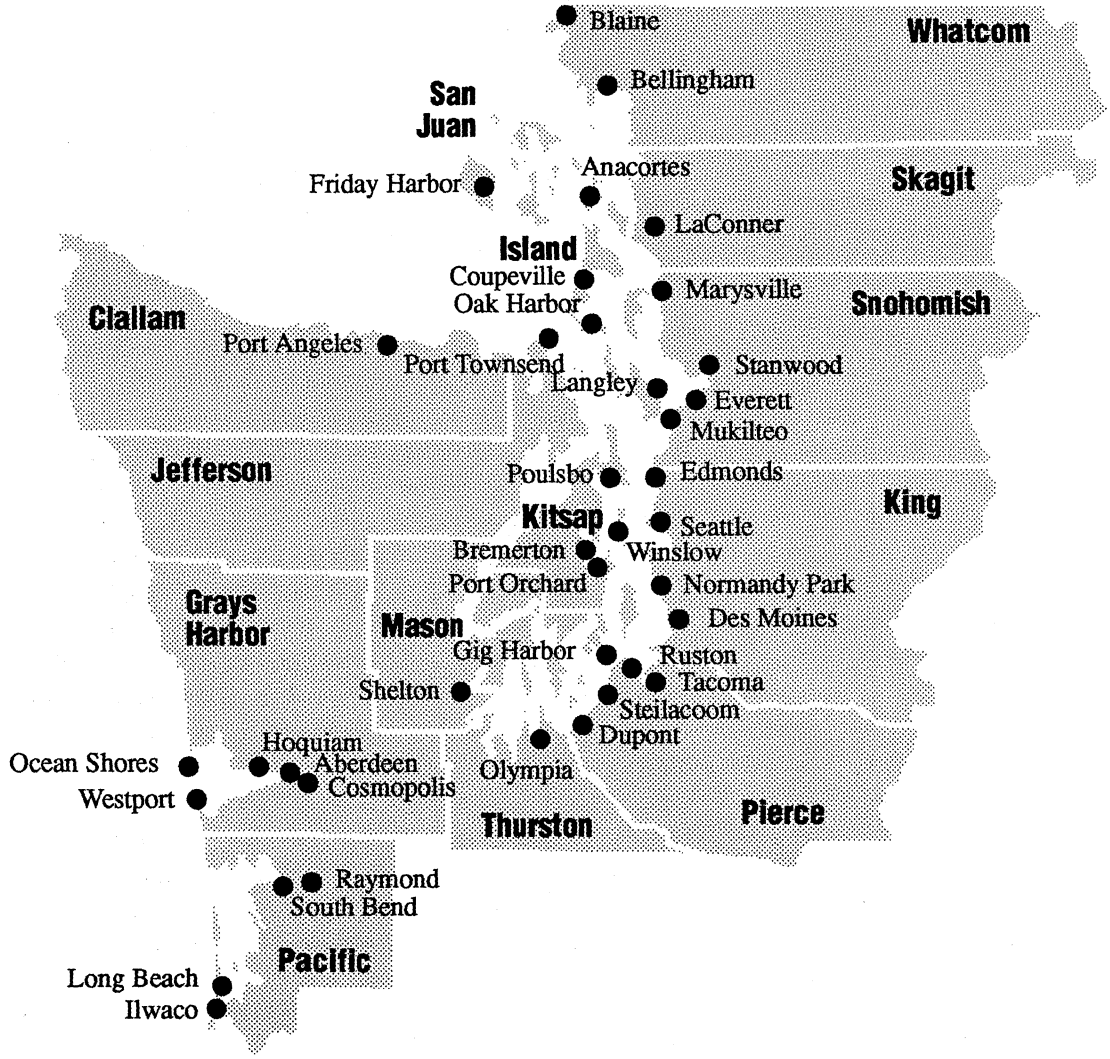
One measure of Washington's preparation for the effects of global climate change is the ratio of local governments with sea level rise provisions in their shoreline master programs to the total number of coastal local governments with master programs. This includes the number of program amendments for sea level rise response during the reporting period.

Sea level rise cannot be measured directly over the short term, nor is that type of measurement appropriate for a state-wide characterization. Measurement of sea level

change is more appropriately carried out at the national or international level. (Mean sea level is determined over an 18.6-year tidal epoch.) Sea level rise is now roughly two millimeters a year, caused by very long-term global warming as the planet emerges from the last Ice Age of about 15,000 years ago. Accelerated sea level rise from global warming may not be something we can affect — it will be a change to which we must respond. Thus, the chosen indicator evaluates the degree to which we are responding.

Fifteen counties and 38 cities in Washington — or 53 local governments — are subject to sea level change:

Figure 16:
Areas Affected by Sea Level change



The database used to analyze this information is the inventory of local shoreline master program amendments approved during the past year by the shorelands and coastal zone management program of the Department of Ecology.

Additional potential indicators of global climate change and secondary effects include:

◆ *The rate of shoreline erosion as a measure of the effect of accelerated sea level rise at selected locations on Puget Sound shorelines.* Implementing this indicator is technologically simple, but would require a dedicated funding source. Given the absence of any coastal erosion monitoring program in the past, a new program might not provide useful information for two or three decades.

◆ *Mountain glacier ice thickness and mass balance measurements as a measure of temperature and precipitation trends.* The National Park Service is proposing a study of North American glaciers as a part of a larger Park Service global climate change research program. A glacier research interest statement was approved by a Park Service global climate coordinating committee in May 1991, and a research proposal is being prepared. Final decisions were to be made in December 1991. If approved, funding would begin in mid-1992.

Nisqually Glacier in Mount Rainier National Park was monitored from the late 1800s through 1985 and national park researchers are now seeking funding sources to re-establish the program. Because there has been major study already, new monitoring information could be useful relatively quickly.

Data Summary

Local governments have begun addressing sea level rise — two of 53 local governments are studying sea level rise — though none has yet adopted response measures.

The number of local governments with sea level rise plans in their shoreline program indicates a similarly slow recognition of this environmental factor. No local governments have yet adopted shoreline master program amendments addressing sea level rise.

Two local governments are evaluating accelerated sea level rise:

◆ The city of Olympia has initiated studies of the local effects of sea level rise as a preliminary step to potential adoption of an amendment to the city's shoreline program. Olympia's study will be completed by June 1992; if proposed, a master program amendment could occur by June 1993.

◆ The Skagit County Department of Planning and Community Development is analyzing the effects of its winter floods in 1991, including the future risks associated with storm surge, sea level rise, geologic hazards and land subsidence. Skagit County is looking toward developing Shoreline Master Program amendments in 1992 or 1993.

Toward 2010 -
The Global Warming Challenge

1 Establish, by legislation or executive order, an interim goal of no net increases of greenhouse gas emission in the state by 2010, and by 1993 assess the feasibility of achieving more aggressive long-term goals.

◆ The Washington State Energy Office is developing an inventory of greenhouse gasses, including trace gasses and methane. WSEO's study includes tracking carbon dioxide emissions by fuel type and a preliminary analysis of carbon dioxide reduction options.

2 Continue to monitor the issue and to develop approaches for adapting to the potential impacts of global climate change.

◆ Coastal zone management grants have funded these projects:

- ➤ Skagit County flood control planning, including an evaluation of near term affects from a rise in the sea level.
- ➤ A study on the effects of a sea level rise on Olympia's central business district and port areas.

◆ An annual global climate change workshop for teachers (see item 4, below) includes discussion of adaptation to changing conditions expected to result from global warming.

◆ Ecology is studying the effects of widespread bulkheading to prevent coastal erosion at the request of Mason, Pierce and Thurston counties.

3 Develop public-private partnerships to promote reforestation, particularly in urban areas.

◆ DNR generally reforests the next planting season; the state's Forest Practices Act requires reforestation within three years. Funding has been provided to analyze how well reforestation is progressing. This will determine what is working well and what must be improved for continued reforestation.

◆ Some very successful local urban tree planting projects have been taking place. The Seattle EarthCorps organization of area high school students is responsible for planting thousands of trees. The City of Seattle will reimburse some costs to property owners who plant trees on city right-of- way planting strips.

4 Educate the public and policy makers about global warming.

◆ An annual global climate change workshop for teachers is sponsored by Ecology, the Washington Sea Grant Program, the Office of the Superintendent of Public Instruction, Washington State Energy Office and King County Cooperative Extension.

5 Support and participate in national and international efforts to understand and address the global warming issue.

Overview

The rate of recycling in Washington has not changed significantly in recent years despite an increase in population, growing amounts of generated waste and significant public education efforts. However, this is not a gloom and doom pronouncement. Washington continues to lead the nation in recycling with more than 28 percent of all solid waste statewide being recycled. Washington also rates among the best, if not *the* best, in convenient collection of recyclables for houses and apartments.

Washington has set a goal of 50 percent recycling by 1995. At the same time, the Hazardous Waste Reduction Act of 1990 has set a complementary goal of reducing hazardous waste generation by 50 percent by mid-decade.

Ecology's waste reduction, recycling and litter control program (WRRLC) has made several positive strides:

◆ A recycling and hazardous waste information line.

◆ Technical waste-reduction advice and assistance to business and industry.

◆ Statewide public education and information campaigns focusing on recycling and waste reduction.

◆ Support of major recycling and safe-disposal efforts for used motor oils, waste tires and vehicle batteries.

The Hazardous Waste Reduction Act of 1990 requires larger users and generators of hazardous wastes to prepare waste-reduction plans. Through a fee schedule established by the legislation, the Department of Ecology will provide direct technical assistance to industry and local government.

Other Ecology waste reduction and recycling highlights in 1990:

◆ A grant from the Environmental Protection Agency helped research innovative techniques for waste reduction in business and industry.

◆ A roundup of business waste-reduction success stories was published. For example, the Hytec company in Yelm began the recycling of acetone through distillation to remove residuals.

◆ A waste-reduction manual called "Waste Reduction in Your Business" was produced, outlining specific reduction and recycling strategies.

◆ Hazardous waste reduction and recycling workshops were presented across the state for metal platers, auto repair shops, dry cleaners, printers and photo processors.

◆ The latest recycling and waste-reduction techniques were demonstrated through a program of site visits and waste audits.

◆ A support group for local government recycling coordinators was maintained to continue the discussion of community recycling and hazardous waste collection projects, public information and education campaigns.

Environmental Data

Each year, a recycling survey of Washington is conducted by the Department of Ecology. Using mail and telephone surveys of the recycling industry, a statewide recycling rate is calculated by dividing the amount of waste recycled by the total amount of waste generated.

Data Summary

The major finding of the 1990 recycling study showed that the rate of recycling in Washington — 34 percent — did not significantly change, due to an increase in population and the subsequent total amount of waste generated.

The findings indicate continued efforts are called for to encourage and educate the public about waste reduction and recycling if we are to reach a 50 percent recycling rate by 1995.

1 Discourage excessive and wasteful packaging through economic incentives and disincentives.

◆ The General Administration Department is working with the Washington Retailers Association to develop voluntary packaging and production process standards. Retailers will seek to obtain products that meet these standards from manufacturers.

◆ Ecology provides ongoing technical assistance and research support for citizen action groups and business and industry efforts aimed at reducing packaging weight, volume and toxicity.

2 Develop economic incentives that encourage recycling.

◆ More solid waste utilities in Washington are adopting inverted rate structures. These provide monetary rewards for such waste reduction measures as recycling, composting and selecting products with less packaging.

3 Make recycling easier by providing more convenient collection opportunities.

◆ Local utilities continue to develop new curbside collection programs or drop-off sites.

◆ Many private firms offer recycling drop points for plastics and other materials as a public service and marketing device.

4 Develop markets for recycled products.

◆ The Clean Washington Center, established by the 1991 legislature, builds on a recycling market program operated by the Department of Trade and Economic Development (DTED) for more than two years. DTED operates the center, targeting five of the most difficult-to-market recycled materials as top priorities: mixed waste paper, plastics, compost, tires and glass. The Center will stimulate market development for these resources, emphasizing reprocessing and re-use within Washington and the Pacific Northwest, with five major strategies:

- ➤ Business assistance;
- ➤ Policy research;
- ➤ Information clearinghouse;
- ➤ Research and development; and
- ➤ Education and marketing.

First-year funding is $2 million dollars. The private sector is expected to gear up for marketing recycled materials and the Center will close in 1997.

◆ The King County Solid Waste Division publishes a catalogue aimed at reducing dangerous and hazardous wastes. It lists firms seeking to obtain or find buyers of specific by-products.

◆ The state motor pool utilizes re-refined motor oil and recycled anti-freeze.

◆ The Western States Contracting Alliance — comprised of 17 states — provides a powerful market force for purchasing goods containing recycled materials.

5 All levels of government should lead by example by procuring recycled goods.

◆ Under 1991 legislation, General Administration (GA), assisted by Ecology, provides technical assistance and model procurement policies for such items as paper, high mileage tires, recycled latex paint and compost.

◆ The "government options to landfill disposal" program, (GOLD), is helping state agencies achieve a 50 percent recycling rate by 1995, with paper products being targeted for 1993. Agencies must submit annual recycling reports to GA, starting in 1992.

◆ Under the Western States Contracting Alliance, 17 states are adopting master contracts for procurement of recycled products. Contracts for recycled copy paper, tissues and napkins have been completed so far. The alliance uses cooperative purchasing to enlarge the market scale for recycled products, utilizing existing distribution networks. Each state may subcontract for its political subdivisions.

◆ GA has established an administrative regulation that provides up to a 10 percent price preference for products manufactured with recycled content.

◆ GA's Central Stores — the equivalent of an office supply store for state agencies — now offer more than 40 recycled items in its catalogue, identifed by a special symbol. These products account for about 30 percent of overall sales. GA also converted to unbleached and recycled envelopes.

◆ Other accomplishments to date:

- ➤ About 90 percent of the paper stock procured at the State Printer's main plant contains recycled content.
- ➤ The Capitol campus recycles 60 percent of its total waste stream. Recycled materials include office paper, cardboard, aluminum and glass. Together, state agencies in Thurston County recycled 2,180 tons of waste in 1990, 2,576 tons in 1991.

Overview

Washington made big gains against litter between 1975 and 1983. Now, however, it can only be said that we're backsliding. Littering has increased every year since 1983 and the state has now lost much of the positive ground gained since the first Department of Ecology litter survey in 1975.

Environmental Data

The major indicator for litter is the trend in litter rates, based on results of an August 1990 litter study conducted by the Institute for Applied Research for the Department of Ecology. The report discusses trends in litter rates since 1975.

Data Summary

After analysis of litter rates, researchers made a number of determinations.

◆ After declining 73 percent between 1975 and 1983, the litter rate in Washington has since been increasing at a compounded rate of 6 percent a year. It is now at a rate that is only 48 percent lower than 1975.

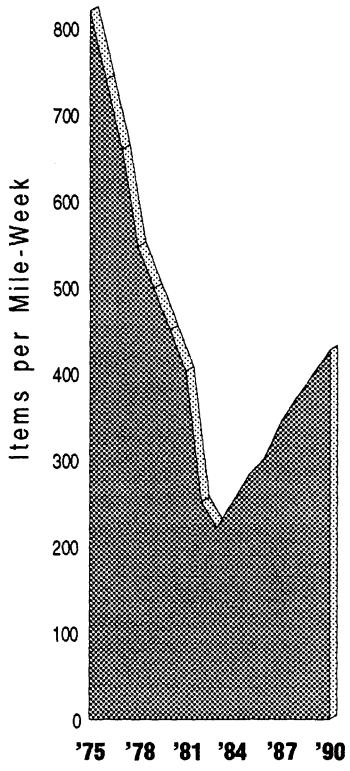
◆ In determining these findings, the "item count" litter rates were corrected to exclude changes due to traffic volume increases. These have seen a 47 percent growth since 1982 at the sites sampled.

◆ Although some of the increase in litter since 1982 can be attributed to this traffic growth, the rest has not.

◆ The Seattle-Tacoma area has had the greatest increase in litter since 1982, more than six times that of cities under 10,000 in population.

In calculating these results, the data were adjusted by the percentage of time spent by Washington motorists and pedestrians on freeways, rural roads, urban streets and parks. In some of the earlier surveys the litter was originally measured in cubic feet or pounds. Now, however, the results have been converted to item counts using estimates of items per pound or cubic foot, derived from concurrent measurements made in Washington and in other surveys conducted by the Institute for Applied Research.

Figure 17:
Litter Trends



Hazardous Waste Generation and Management

Overview

The news about hazardous waste is not new news at all — there are more producers of dangerous waste and there is more waste being produced. While overall waste generated in the last available test year jumped by more than 12 percent to more than 2.5 million tons, some individual types of waste such as mixed radioactive waste increased by as much as 278 percent.

Washington manages its hazardous waste by handling it on and off-site, most often by simply storing it in drums and tanks. And we exported more than 100,000 tons of hazardous waste to a permitted disposal site in Oregon.

There is yet another part to the hazardous waste story — while we struggle to find the best way to clean up past mistakes, we are also seeking an answer to the difficult problem of how to measure our successes and failures.

Environmental Data

The primary environmental information for this section is the number of hazardous waste generators.

In 1988, 3,467 reports were received from hazardous waste generators by Ecology. Each of these generators had, at some time, notified Ecology of their intent to conduct regulated dangerous waste generator activities. However, the number of *potential* generators statewide is a matter of intense speculation.

Most attempts to estimate the state's population of dangerous waste generators have relied on surveys taken by other states or by specific counties or planning regions. For example, in 1989 King County projected a population of 10,000 generating sites just within its own boundaries. Recent estimates have also been made by the Department of Ecology's waste reduction, recycling, and litter control (WRRLC) program. The WRRLC program attempted to arrive at a number by looking at recipients of a new waste minimization fee assessment — the best estimate ranged up to 50,000 potential generators statewide. This suggests that *known* generators may represent less than 7 percent of the total potential population of generators. However, it is expected, and hoped, that the vast majority of potential generators are not generating large quantities of waste.

While the number of generators provides a crude indicator, this report will discuss identification and distribution of the generator community and management methods and facilities employed by generators. However, the first order of business is to describe "waste status" and the types of waste most often generated.

Waste status differentiates first between *recurrent* wastes from a site's on-going production and all other waste generated. Unusual wastes that are generated infrequently — demolition debris, spill materials or cleanup wastes initiated privately or through government programs — are referred to as *non-recurrent* wastes. If recurrent and non-recurrent wastes were plotted on a graph, recurrent waste would be seen as relatively constant from day-to-day or year-to-year. Non-recurrent waste would be represented by spikes in the graph showing shorter-duration events of unpredictable and possibly great quantity.

Two additional categories are *radioactive mixed* wastes and *"permit-by-rule"* waste. The U.S. Department of Energy's Hanford Reservation occupies a unique niche in Washington's hazardous waste picture. While well-known for its role in the development of nuclear technology, Hanford's role as a generator of waste has become increasingly clear in recent years. High-level nuclear waste is regulated separately by Ecology's nuclear and mixed waste program. However, Hanford also generates significant amounts of federal and state-regulated hazardous wastes and mixed radioactive hazardous wastes. The majority of these waste streams are managed at the Hanford facility.

Permit-by-rule (PRB) waste streams are the last waste status of major concern. Essentially, PBR wastes are wastewaters discharged under National Pollution Discharge Elimination System (NPDES) permits, state water quality or local discharge permits. Tremendous volumes of PBR wastewater are generated statewide by relatively few permitted dischargers, dwarfing (by weight) all other sources of waste.

PBR wastewaters include liquids discharged by generators with totally enclosed treatment facilities, elementary neutralization units or hazardous wastewater treatment facilities. Acids and heavy metals in dilute concentrations are common in PBR wastewater.

Recurrent wastes include most solvents, paint-related wastes and aluminum potlining wastes. Non-recurrent waste generally includes similar wastes but with a large proportion of contaminated soil and debris.

In 1988, most commercial treatment-storage-disposal (TSD) facilities accepting shipments of off-site waste within the state were to be found in Western Washington: Chemical Processors in Seattle and Tacoma; Crosby and Overton in Kent; Northwest Enviroservice in Seattle; Safety-Kleen in Auburn and Lynnwood; Sol-Pro and Lilyblad Petroleum in Tacoma; and McClary Columbia in Washougal. The only exceptions are Cameron-Yakima in Yakima, Safety-Kleen in Pasco and Safety-Kleen and Washington Chemical in Spokane. (Source: Department of Ecology, *"Generator Annual Dangerous Waste Report," and "TSD Dangerous Waste Report.")*

Data Summary

Annual reports from 1988 revealed growth in both the number of generators and the amount of waste produced. Regulated generators increased in number by almost 400, more than 26 percent, to 3,467. Sectors of the economy prominently represented included business services, wholesale and retail trade and equipment manufacturing. Strong connections between population, prosperity and waste generated were supported by the geographical distribution of the regulated community and its predominant concentration west of the Cascades.

While overall amounts of waste generated during 1988 rose by 12.4 percent to 2,568,565 tons, growth of specific kinds of waste such as mixed radioactive (278.5 percent) was even more pronounced. Significant increases in the amount of recurrent waste generated from on-going operations (41,777 tons) nearly compensated for dramatic decline in non-recurrent waste from spills, cleanup or other remedial actions. All of the above mentioned changes were dwarfed, however, by an additional 423,293 tons of permit-by-rule wastewater reported in 1988.

Recurrent wastes are clearly associated with the more populous counties, but higher figures were also found in some rural areas. Individual large generators such as aluminum smelters and oil refineries boost totals for Chelan, Klickitat and Skagit counties. A booming economy in the Puget Sound metropolitan region — primarily from the aerospace industry — accounts for nearly half of all recurrent waste reported.

The big picture regarding Washington's management of dangerous waste has remained remarkably consistent over the years for which annual reporting has been required. Treatment and storage are still the favored management options for Washington generators, particularly since there are currently no permitted disposal facilities in the state. Almost 98 percent of the waste managed in-state was handled in one of these two methods. However, the vast majority of this share was wastewater treatment under permit-by-rule. To decide how to manage recurrent and non-recurrent wastes, generators must focus on the secondary question of *where* the treatment or storage should take place.

Locational options for waste management include on-site handling, off-site management in Washington and exportation. Aside from permit-by-rule waste, only 162,653 tons were managed on-site and nearly 60 percent of this figure was simply stored in drums and tanks. Off-site management by Washington facilities was chosen for an even smaller proportion of the state's waste. Nearly 57,000 tons were accepted by commercial or captive facilities and, again, the vast majority of these wastes — 41,852 tons — went into storage. Imports to these same facilities totaled 13,122 tons — an increase of more than 35 percent over 1987's level.

As expected, the predominant option for Washington's recurrent wastes was exportation. Figures from 1988 — 134,054 tons exported — show less than a one percent difference from 1987. Of this figure, more than 80 percent was exported to Oregon.

Toward 2010 -
The Waste Management Challenge

1 Educate the generators of solid and hazardous wastes —including individual citizens — about how to reduce the amount of waste they produce, and how to manage and dispose of wastes responsibly.

◆ The Department of Agriculture, with assistance from Ecology, has produced thousands of informational booklets and distributed them to registered pesticide applicators. Presentations have been given to thousands of growers during winter commodity group meetings and WSU pesticide applicator training courses. Materials are now being translated into Spanish, as well. Agriculture and WSU are producing a video on agricultural pesticide waste reduction and disposal.

◆ Ecology coordinated a statewide media campaign, "Shop Smart, Reduce Waste," which encouraged shoppers to make environmentally sound decisions each time they select products. The campaign worked closely with a steering committee comprised of representatives from county and local government, citizen activists and business leaders. The campaign produced several TV public service announcements, printed information, an instructional video, and provided $1 million in matching funds to counties and local governments to reproduce and distribute these materials.

2 Educate hazardous waste generators—including the general public— about proper waste management practices.

◆ Agriculture's waste pesticide program's education component has included slide show talks and mailouts. One staff person in each Ecology regional office has been assigned to visit new hazardous waste generators and give them information on how to comply with regulations. Ecology's "Shoptalk" quarterly newsletter — sent to all firms generating wastes — offers tips on how to reduce or recycle hazardous wastes and updates on regulation development. Single industry campaigns have been launched for such firms as automobteile service and repair.

3 Provide more convenient opportunities for collection of household hazardous wastes.

◆ About 50 household hazardous waste collection days were held around the state in 1991. In addition, eight permanent household hazardous waste collection facilities have been established and three mobile facilities are in operation. A battery collection facility has been established in Bellingham.

4 Strengthen enforcement of existing hazardous waste regulations, by increasing inspection and permit review.

◆ Ecology has revised enforcement guidelines to make them more understandable and clear.

Pesticides

Overview

Pesticides are substances which are used to control plants, animals or viruses. While appropriate use of pesticides benefits human activities by preventing or mitigating detrimental effects from pests, inappropriate use or unwanted residual effects can be harmful to non-target plants and animals as well as humans. These substances can also affect ground and surface water quality.

Pesticides can be categorized by their intended "target." For example, herbicides are produced to control certain plants, rodenticides — mice and rats, insecticides — ants, beetle larvae, and other insects, or nematocides — roundworms. There are many different pesticides that have been or are currently used. Between 200 and 300 compounds — active ingredients — are currently used in the 6,000 to 7,000 pesticides registered in Washington state.

The fate and effects of specific pesticides vary from compound to compound, depending on their physical and biological characteristics. Some are relatively benign and short-lived, while others are potent and persistent. Some are fat-soluble and therefore may concentrate in fish and animal tissue. Others, because they either degrade rapidly or are water-soluble, may be found only in ground water or are rarely detected in any environmental media.

Environmental Data

In lieu of more comprehensive data, three sets of data were examined for the State of the Environment Report.

◆ **Pesticides were detected in several environmental media — marine and freshwater sediments, surface water and fish tissue — as reported in studies conducted by Ecology and EPA since 1989.** The following information was reviewed: number of pesticides tested, pesticides detected, frequency of detection, locations where pesticide residues were reported and range of concentrations.

◆ **DDT residue concentrations in water and fish from the Yakima River drainage were reported by the U.S. Geological Survey, U.S. Fish and Wildlife Service and Ecology.** Reported concentrations of total DDT (DDT and degradation products) in water and whole fish were reviewed. Information collected from 1970 through 1991 make this one of the few good quality time-series data sets available for a pesticide in Washington state.

◆ **Pesticide concentrations were reported in potentially vulnerable ground water in Ecology's "Washington State Agricultural Chemicals Pilot Study," published in 1990.** This study tested for more than 40 pesticides in three different areas within Whatcom, Yakima and Franklin counties. Each test area ranged in size from five to 10 square miles.

Although the quality of data used here is high, none of the studies cited is comprehensive. Each has restricted areal coverage, addressed a limited range of environmental media, or targeted pesticides that represent a small fraction of pesticides used in the state. The studies did not directly evaluate the biological effects of pesticides, but rather on pesticide concentrations from which one may, in some cases, infer biological or human health effects. Broader studies are needed but will be expensive.

Data Summary

General

◆ Although data are spotty, it appears that pesticides are detected most frequently near application areas. Thus, concentrations in waters and sediment near agricultural and suburban centers are higher than those in more remote locations like central Puget Sound or high-elevation lakes.

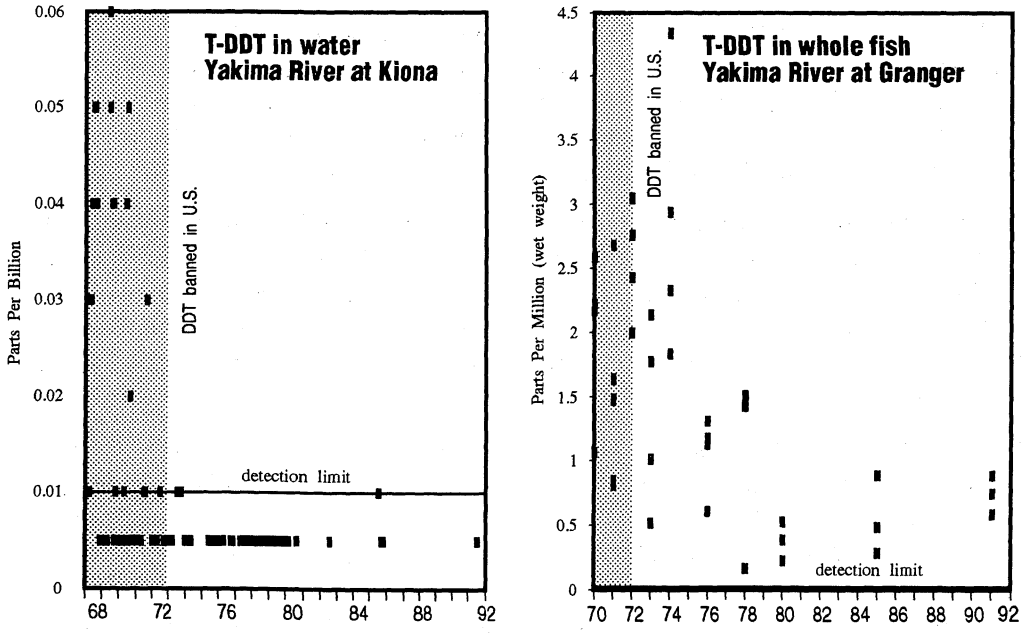
◆ When recent limited pesticide sampling results were compared against existing criteria such as FDA food standards, Ecology water and sediment quality standards, and Department of Health drinking water standards, exceedances were generally limited to ground water and drinking water.

DDT and Related Compounds

◆ Despite decreases in pesticide concentrations over time in the mainstem of the Yakima River, DDT and dieldrin still exceed EPA water quality criteria in several tributaries.

◆ Nearly 20 years after it was banned in the United States, DDT (and its breakdown products) remains one of the most frequently detected pesticides in Washington fish tissue and sediment. Based on information in Figure 18, concentrations have decreased substantially since use was suspended in 1972. Newer pesticide compounds currently in use have less potential for bioaccumulation.

Figure 18:
DDT Trends in Yakima River Water and Fish

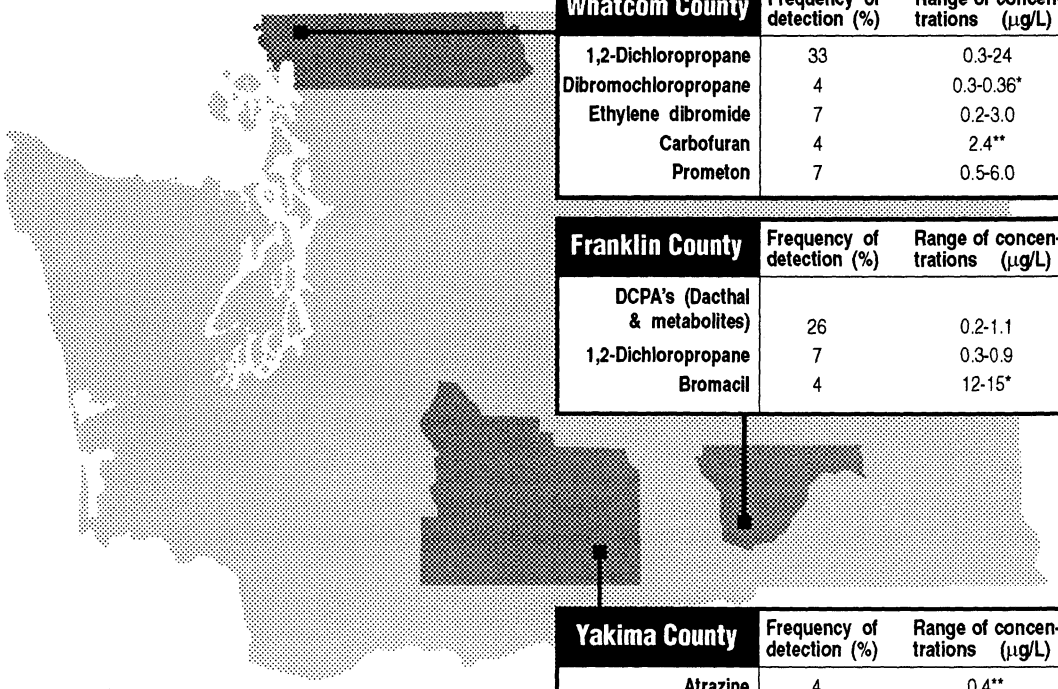


Pesticides in Ground Water

◆ At least one pesticide was detected in 28 percent of the wells tested in a preliminary survey of three rural areas with high potential for pesticide contamination. Test areas ranged in size from five to 10 square miles. (Figure 19).

◆ Eight pesticides were detected during this preliminary survey of ground water quality in selected rural areas. Three of the eight pesticides exceeded proposed MCL's in one or more wells (Figure 19).

Figure 19:
Pesticides in Groundwater



Whatcom County	Frequency of detection (%)	Range of concentrations (µg/L)	Proposed MCL (µg/L)/ (# of exceedences)
1,2-Dichloropropane	33	0.3-24	5 (5)
Dibromochloropropane	4	0.3-0.36*	0.2 (1)
Ethylene dibromide	7	0.2-3.0	0.05 (1)
Carbofuran	4	2.4**	40 (0)
Prometon	7	0.5-6.0	—

Franklin County	Frequency of detection (%)	Range of concentrations (µg/L)	Proposed MCL (µg/L)/ (# of exceedences)
DCPA's (Dacthal & metabolites)	26	0.2-1.1	—
1,2-Dichloropropane	7	0.3-0.9	5 (0)
Bromacil	4	12-15*	—

Yakima County	Frequency of detection (%)	Range of concentrations (µg/L)	Proposed MCL (µg/L)/ (# of exceedences)
Atrazine	4	0.4**	3 (0)

* Detected in one well on two occasions
** Detected in one well on one occasion
Source: *D. Erickson and D. Norton, 1990. Washington State Department of Ecology Report #90-46.*

In general, information on pesticide residues in Washington's surface and ground waters is sparse. Information on pesticides in ground water is so limited, in terms of statewide coverage, that no general conclusions can be drawn about the overall extent of contamination in ground water. Although a careful, well-conducted study focusing on a few small rural areas has been conducted, no such information is available for the vast majority of the state. The lack of information on specific pesticides used in different locations makes it difficult to design studies that address the most important chemicals used.

Since ground water is the source of 60 percent to 70 percent of the state's drinking water, a serious effort is needed to determine the distribution of pesticides in ground water.

Pesticide data for other media are also limited and uneven. Data for pesticides in Puget Sound sediments are more adequate than for other locations and media, since they are routinely analyzed as part of the sediment monitoring program (see section on "Contaminated Sediments"). On the other hand, few of the sediment monitoring locations are near pesticide application sites. Most studies reviewed for this report were one-time sampling events with limited coverage.

Toward 2010 -
The Pesticides Challenge

Prior to 1992, there was no comprehensive effort to monitor pesticides in Washington. Several studies had included analysis of pesticides. However, these studies were very limited in geographical scope, tested for only a small subset of registered pesticides, and lacked information about types, amounts and locations of pesticides used near the study area. Each study addressed only one or two of such environmental media as surface water, ground water, fresh water sediments, marine sediments or fish tissue.

Based on priorities identified in 2010, the 1991 legislature provided seed money to begin scoping a statewide pesticide monitoring program for surface and ground water. Two scientists have been hired and are locating data from previous studies, designing a computerized data base to store and help interpret these data, and working with experts throughout the state to design an ongoing monitoring program. This effort is modest considering the pervasive and complex nature of the issue, but it represents a clear step toward obtaining better environmental information about pesticides.

1 Encourage and support federal efforts to promote sustainable agriculture by developing and disseminating information for local crop production.

◆ A Washington State University Center for Sustainable Agriculture was authorized by the 1991 Legislature, but not fully funded.

➤ Part of the proposal, a food and environmental quality lab, was funded. It will be part of a federal, state and private sector project to evaluate pesticide re-registration for all Washington crops, except wheat. The lab will examine each pesticide's effect on crops and the environment.

➤ As envisioned, the Center would integrate ongoing and new research into how crops can be produced with less reliance on pesticides as part of an overall focus on total crop management. The Center also would explore economic thresholds of the effect of each insect or disease on each crop.

2 Develop and promote such alternatives to conventional pesticide use as encouraging research in biological and mechanical pest control methods, or development of pest resistant plant species.

◆ With additional funding, WSU could engage in these activities through the Center for Sustainable Agriculture. (See item 1 in this section.)

◆ Various ongoing WSU research has examined how such practices as soil conservation, tillage and rotation can be manipulated to take advantage of recent findings on genetic yield potential.

◆ Current research appropriations are inadequate to fund efforts to decrease the reliance on pesticides.

3 Increase compliance monitoring and enforcement of pesticide regulations.

◆ The State Department of Agriculture implements the state's pesticide compliance program. The department has developed a data base on pesticide application for use with the state's geographic information system.

4 Significantly expand opportunities for the general public and commercial users to dispose of pesticide wastes in an economical, legal, and environmentally sound way.

◆ The Department of Agriculture has conducted 12 regional collection days since December 1988, at which 114 tons of agricultural pesticide waste have been collected for disposal. Three to five collection days are held each year across the state. Of note, the program has collected 25,000 pounds of DDT and quantities of Endorin, examples of banned pesticides that had remained in storage on farms. Education and outreach are key elements of the program.

◆ Many local solid waste utilities, through funding assistance from Ecology, have provided disposal options for household hazardous waste, including home and garden pesticide waste and containers. Common strategies include collection days and special drop sites.

5 Enhance and coordinate the monitoring of pesticide residues in the environment.

◆ Approximately $180,000 each biennium has been appropriated by the legislature for pesticide monitoring and laboratory analysis.

◆ Ecology's environmental investigations and laboratory services program is working to characterize pesticide residues throughout the state in ground and surface water, fish and sediments. Objectives include:

- ➤ Identifying and prioritizing aquifers, lakes and rivers with known or potential pesticide contamination.
- ➤ Determining pesticide concentrations in high priority areas.
- ➤ Providing information to the Department of Health for human health risk assessment.
- ➤ Establishing and maintaining a state pesticide database for ground water and surface water.

◆ Ecology conducted a pilot survey of pesticide applicators and their facilities to:

- ➤ Determine their level of compliance with the state dangerous waste regulation.
- ➤ Provide information on how to safely manage wastes.
- ➤ Assist applicators in understanding which wastes may be regulated.
- ➤ Help applicators develop reuse and waste reduction techniques that can help them with voluntary compliance.

6 Educate homeowners and gardeners about the proper and appropriate use and disposal of pesticides and fertilizers.

◆ The state Department of Agriculture requested sales records of pesticides for home and garden use from all home and garden registrants. While the two dominant producers did not reply, a report based on responses from other producers is being prepared.

◆ The Agriculture Department prepared placards, safety signs and measuring cups on home and garden pesticide use. The Cooperative Extension Service distributed the materials through the Master Gardener program.

◆ An urban pesticide use committee has been formed, involving the EPA and the state departments of Agriculture, Ecology and Health. The panel is sponsoring integrated pest management (IPM) demonstration projects and held an IPM "summit" of experts in the field.

Hazardous Substances Releases

Overview

More than 45 million pounds of toxic chemicals were reported released into Washington's environment in 1989, most of which went into our air and water.
Tracking these toxic releases is a tough proposition, given the wide array of differing reporting requirements and methods used to estimate concentrations of chemicals.
It is clearly a complicated task but it *is* being addressed, thanks to Section 313 of the federal Superfund Amendments and Reauthorization Act (SARA) Title III, otherwise known as the Emergency Planning and Community Right-to-Know Act (EPCRA).

Environmental Data

Information on the "how much" and "how many" of chemical releases has been gathered from Toxics Release Inventory (TRI) reports filed under EPCRA Industries that meet specific size, business- classification and chemical use criteria are required to report their total annual releases to air, water, or land of more than 300 toxic chemical, along with information about chemicals transferred off-site. For this report, we will use the 1989 TRI data from the Washington SARA database summarized by industry type using the Standard Industrial Classification (SIC) codes.

The TRI reporting system has several limitations. For example, TRI regulations do not require companies to monitor the actual chemical concentrations in their releases, so much of the information reported is based on estimates. The quality of the estimates and the accuracy of the information vary widely.

Some kinds of businesses, such as hazardous waste management facilities and chemical warehouses, are exempt from reporting. Companies with fewer than 10 employees are exempt but still may release large quantities of hazardous chemicals that do not show up in TRI accounting.

Data Summary

◆ In 1989, more than 45 million pounds of toxic chemicals were reported released into the environment by 277 reporting facilities. More than 4.5 million pounds were transferred to off-site facilities during this same period.

◆ Of all substance releases or transfers reported under the Toxics Release Inventory, 90 percent were to air and water, one percent to land and less than 10 percent transferred to off-site locations.

◆ The paper-products industry had the highest percentage of all releases, accounting for 46.4 percent of all hazardous chemical releases or transfers reported on TRI.

◆ The second highest percentage was reported by the transportation equipment industry, with 19 percent of all releases or transfers. This class reported more than four million pounds of non-point air releases and more than three million pounds of point or stack air releases. This class also reported almost two million pounds transferred to off-site locations.

◆ The third highest percentage was reported by the chemical-products industry, 7 percent.

Underground Storage Tanks

Overview

Ground water in Washington is an increasingly fragile resource, threatened, as we've seen in previous chapters, by an array of potential contaminants. One of those threats is underground storage tanks, used most often for various types of fuel storage by facilities that provide fuel to all kinds of motor vehicles. The state has embarked on a program to regulate the installation and closure of tanks and protect existing underground tanks from deterioration.

Washington's underground storage tank (UST) program imposes new tank standards and upgrades standards for existing tanks. These standards include requirements for corrosion protection, leak detection and spill and overfill prevention.

The best way to prevent corrosion is to install tanks and piping made from such non-corrosive materials as fiberglass-reinforced plastic.

New and existing steel tanks are protected from corrosion by "cathodic protection." Cathodic protection directs an electrical current onto the tank system that is stronger than the natural flow of corrosive current away from the tank.

The Model Toxics Control Act

Significant cleanup actions at leaking underground tanks have been initiated in the last two years with the help of provisions in the Model Toxics Control Act. By assigning liability for contamination to current and past operators, the act has increased the number of voluntary and independent cleanups as businesses take positive steps to avoid future liability.

In fact, cleanup actions reached a record high during the 1990 fiscal year, while the number of enforcement actions to compel cleanups dropped. Of 750 initial investigations launched by the Department of Ecology, there were 20 enforcement actions. Of 654 cleanups started, 155 were completed by the end of the year.

The case of Unocal is an example of a private company taking the initiative. Eight of the company's eastern Washington service stations were found to have petroleum contamination from leaking underground tanks. Unocal inititated cleanup of the leaking tanks; five of those sites were cleaned up in 1990, and the rest were scheduled for cleanup in 1991.

The Washington Department of Transportation (DOT) has also been responding to the need for action on underground storage tanks. In the four years it has worked on tank replacement, DOT has completed three-fourths of its program, replaced 275 tanks, and expended more than $6 million on the program.

Environmental Data

Key data for underground tanks are the number of reported USTs in use and the number of tanks protected from corrosion.

The number of reported tanks represents the known universe of regulated USTs which may be a threat to the environment. There are several types of tanks not regulated under a state or federal UST program, including heating oil tanks, most tanks at farms and residences, tanks under 110 gallons, septic tanks and various others. Tanks "in use" means tanks which have not been permanently closed.

The number of tanks protected from corrosion will consist of those tanks to which one of the two methods described above has been applied. That is, these tanks will either be constructed of non-corrosive materials or protected by one of the two forms of cathodic protection. While many tank systems leak as a result of other factors (such as poor installation), tank corrosion is one major cause of releases from USTs.

Data presented here are based on reports to Ecology by tank owners and operators. Much of this information was first reported in 1986 in response to a federal requirement. The information was later used by the Environmental Protection Agency as a survey to characterize the UST universe; there was then no ongoing requirement that tank owners or operators update the information.

The state UST rule, which took effect in December 1990, does require that any changes to the originally reported information be provided to Ecology. Thus, the accuracy of the data can be expected to improve during the next year or so. The figures given below are for 1990.

Data Summary

- The number of reported USTs in use in Washington State is 28,862.
- The number of tanks reported as being protected from corrosion is 7,418, or 26 percent.

Reported Tanks

Many tanks are being closed in response to the new regulations. However, in the short term — July 1991 to July 1992 — the number of reported tanks might increase. A permit system took effect for the first time on July 1, 1991, and tanks cannot be used without an Ecology permit. An increase in reported tanks has been offset by the number of tanks permanently closed during the same period.

Protected Tanks

As new tanks are installed and existing tanks upgraded, the overall number of tanks protected from corrosion will increase. However, the *proportion* of protected tanks can be expected to decrease in the short term as the overall number of tanks reported increases. It is likely that most newly reported existing tanks will not be protected from corrosion. In the long term, this proportion can be expected to increase, although existing tanks are not required to have corrosion protection until 1998.

Overview

Spills of oil and hazardous substances totaled more than one million gallons in fiscal year 1991, the most in a single year since 1964 and 10 times more than in 1990. This only underscores the need for recent legislation designed to improve the chances for Washington — and the state's industries — to effectively respond to spills and other environmental emergencies.

The Department of Ecology has been cleaning up oil and hazardous substance spills since 1970, when the agency was created by the legislature. During the last two fiscal years, Ecology responded to more than 2,700 pollution complaints and conducted 421 emergency cleanups that required state funding. These cleanups included oil spills, abandoned or "derelict" drums, major illicit drug manufacturing laboratories (for drugs such as methamphetamine) and various hazardous wastes.

In these last two fiscal years, the Department of Ecology has responded to four large oil spills:

- **February 1990:** Diesel spill, Naval Manchester Supply Depot — 70,000 gallons;
- **August 1990:** Oil spill, Richmond Beach — 176,000 gallons;
- **January 1991:** Oil spill, Tacoma — 600,000 gallons;
- **February 1991:** Oil spill, Anacortes — 210,000 gallons.

Ecology also experienced a large increase in complaints about derelict drums (abandoned drums potentially containing hazardous wastes) in fiscal year 1991 with more than 100 cleanups conducted. The one bright spot of the last two fiscal years has been the decrease in the number of illegal drug lab cleanups.

Public concern over spills has prompted recent legislation to bolster oil pollution prevention and control. Contingency planning legislation passed in 1990 enhances the state's and industries' abilities to respond to spills and other emergencies. Legislation passed in 1991 focuses on oil spill prevention. We have learned by painful experience that only a small percentage of oil or hazardous substances can be recovered once spilled, meaning prevention and fast response are the keys to protecting the environment.

Much of the cleanup work at spill sites, whether it is emergency leaks or drug labs, is contracted to private companies. The number of emergency spill responses as well as the cost per cleanup saw major increases in fiscal year 1990. Ecology's emergency spill response program received $585,000 from a state account funded by a tax on hazardous substances. Another $30,000 was recovered from parties responsible for spills.

Environmental Data

- Environmental data identified for discussion of spill trends are as follows:
- Number of oil and hazardous substance spills.
- Number of emergency drug lab cleanups.
- Number of derelict drum and small hazardous waste emergency cleanups.
- Cleanup costs.

In order to be consistent for all four data sets, the information used has been limited to the last two fiscal years, 1990 and 1991. Information regarding emergency drug labs and cleanup costs have been limited to the cleanups that required state funding. In the future, researchers hope to include all cleanups, not just state-funded cleanups, and plan to report on the type and amount of substances spilled and cleaned up.

Data Summary

Number of oil and hazardous substance spills.

◆ In fiscal year 1991, there were 36 oil and hazardous substance spills totaling more than one million gallons. In fiscal year 1990, there were 25 spills which totaled more than 100,000 gallons. The 1991 amount represents the largest amount spilled in Washington in a single year since 1964.

Number of emergency drug lab cleanups.

◆ There were 22 percent fewer drug lab cleanups in fiscal year 1991 (71) than fiscal year 1990 (91).

◆ The number of drug lab cleanups in Washington during fiscal year 1990 represented the fourth highest number of such cleanups in the nation.

Number of derelict drum and small hazardous waste emergency cleanups.

◆ In fiscal year 1991 there were 117 derelict drum and small hazardous waste emergency cleanups compared to only 82 in fiscal year 1990. This represents a 30 percent increase.

◆ The number of facilities, including landfills, that can accept hazardous wastes has been reduced significantly in the last two years. The cost to legally dispose of waste has also increased during the last two years. These changes are causing more illegal dumping of hazardous wastes.

Cleanup costs.

◆ The cost of disposing wastes and the number of cleanups have been increasing. In fiscal year 1990, the Department of Ecology spent $585,000 for emergency spill contractors. In fiscal year 1991, Ecology spent $680,000.

Toxic Waste Sites

Overview

Hazardous wastes, the discarded materials of a highly technological society, were for years handled and discarded with little or no concern for their ultimate effects on human health or the environment.

By the mid-1980s, people in Washington were becoming aware of the magnitude of the problem and began seeking solutions. At the same time, a serious effort was begun to collect information.

In 1986 there were 550 confirmed or potential toxic waste sites. By late 1991 the total had grown to 929 sites. That number represents sites brought to the attention of the Department of Ecology through complaints, discovery by field investigators, referral from the U.S. Environmental Protection Agency or other governmental entities, or by contact from the property owner or operator of a business at a site.

The toxic waste site picture examined here does not include spills or cleanups at sites that are under permit through the hazardous waste regulatory program; sites at which cleanup is proceeding independent of Ecology's funding, oversight or enforcement; or current accidental spills from trucks, tankers, or drug laboratory operations that can be cleaned up through short-term emergency response action.

Model Toxics Control Act

In 1988, Washington voters passed Initiative 97, the Model Toxics Control Act, which provided Ecology with the basic framework for a toxic waste cleanup program. Since then, the state has met with mostly solid cooperation and support from industry and the public in implementing the new, streamlined cleanup processes mandated in the act. The result has been more cleanups administered more effectively, which in turn has resulted in increased support by citizens and businesses for cleaning up hazardous waste.

Regulation of cleanups under the act was developed in two phases. Phase I put in place the rules necessary to implement the law. The overriding principle of Phase I says that cleanup should be effective and expeditious. The best way to achieve this is for potentially liable persons to propose remedial — or cleanup — actions, with Ecology exercising authority for enforcement when necessary. Phase II includes provisions for establishing "how clean is clean" — or cleanup levels — and selecting appropriate cleanup actions.

A typical cleanup under the Model Toxics Control Act may consist of several interrelated steps, including discovery of a potentially hazardous site, overall assessment or characterization of the site and types of contaminants present, necessary short term or interim actions, a cleanup action plan, engineering and construction, and final monitoring to ensure the site has been cleaned up to specified standards.

The development of cleanup standards in Phase II considered six goals:

1 Cleanup must protect human health and the environment.

2 Cleanup standards must be scientifically and legally defensible.

3 Cleanup actions must be consistent with existing state and federal laws.

4 Standards must promote efficient cleanup of contaminated sites.

5 Cleanup standards must provide a consistent level of protection.

6 Cleanup standards must allow flexibility to address individual site characteristics.

Environmental Data

Progress in abating environmental threats from contaminated sites can be estimated by following, over time, the number of sites with:

- Contaminated groundwater
- Contaminated soils
- Contaminated sediments
- Contaminated air
- Contaminated surface water
- Contaminated drinking water
- Major waste categories at contaminated sites

Information for these categories is drawn from a Site Management Information System, a data base maintained by Ecology's toxics cleanup program. Information for the data base is provided by Ecology staff who are responsible for investigating or ensuring the cleanup of those sites.

In the future, when information is available and the database system is revised, a list of indicators will more closely reflect cleanup activity. The revised database will include the number of sites at which contamination has been decreased or contained, or contamination has been removed.

Together, these data will, over time, show whether Washington is making progress in addressing toxic waste problems. It is possible that future identification of sites now unknown and the confirmation of potential sites will skew the data to imply that the problem is increasing rather than decreasing, at least for a while.

Since the mid-1980s, the mission and scope of toxic waste programs have steadily evolved. Simply because of changes in definition, the number of confirmed and potential sites can be expected to change.

When fully funded and implemented, a site-discovery program called for under the Model Toxics Control Act could increase the base number of sites. However, the rate at which sites are discovered now through citizen complaints is causing the list of sites needing investigation to far outstrip Ecology's resources. In addition, some sites now in the database may have been included based on assumptions which are now invalid. For example, landfills which were expected to cause contamination sometime in the future may not pose immediate problems. These sites may eventually be deleted from the database unless they are shown to pose a sufficient risk.

As a last complication, the database system for tracking and managing site data is being revised. This may limit direct comparisons between current and future information.

Data Summary

Of the 929 toxic waste sites, 664 are confirmed sites and 265 are potential sites.

Soil is the most frequently contaminated medium — with 544 confirmed sites in this category — though multiple environmental media are contaminated at many sites. Groundwater contamination is confirmed at 282 sites. Of the remaining media, there are 159 sites with contaminated surface water, 93 sites with polluted sediments and 37 sites at which air is contaminated.

It is significant that while only 27 sites have contaminated drinking water, there are 242 sites at which this is a potential problem.

The most common contaminants are petroleum products, with 400 sites confirmed in this category, though several different contaminant types are often involved at a single site. Heavy metals such as lead, mercury, arsenic and chromium are found at 203 sites. Halogenated organics used in dry cleaning chemicals, plastic manufacturing and other chemical processes are confirmed at 140 sites.

Of suspected contaminants, heavy metals tops the list with potential contamination at 218 sites.

Toward 2010 -
The Waste Management Challenge

1 Promote the use of innovative treatment technologies at hazardous waste cleanups by conducting and sharing research on their effectiveness.

◆ Ecology has established an on-line data base with information on alternative treatment technologies; maintains resource materials in Ecology library files; and is maintaining a spreadsheet on vendors and site consultants.

◆ Each Ecology regional office has been provided with a data base that provides cleanup staff with information on soil and chemical properties.

◆ Ecology staff provided technical assistance in response to 24 requests between August 1990 and May 1991.

◆ In 1991, Ecology developed guidance documents for cleaning up leaking underground storage tanks."

2 Establish economic incentives that promote destruction rather than removal and disposal of hazardous wastes during cleanups.

◆ Ecology seeks to establish a staff position to research and develop recommendations for both economic and regulatory incentives. Despite the current unavailabity of funding during the 1991-93 biennium, this may become a higher priority as more sites move into cleanup action.

Contaminated Sediments

Overview

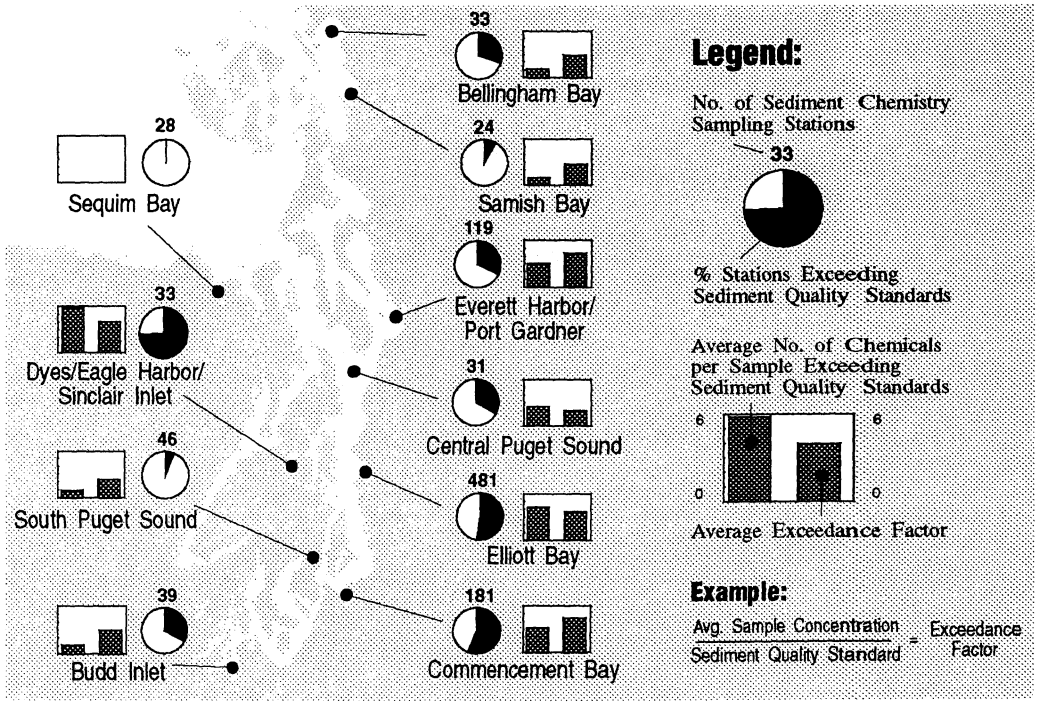
Washington is working to better understand the effects of contamination on the organic and inorganic material that has settled to the bottom of our marine, freshwater and estuarine waterbodies. These contaminated sediments are a result of toxic chemicals released from discharges, spills and point and nonpoint sources that bind to the sediments, which then accumulate and settle.

Research in Puget Sound has been the most successful in identifying the effects of contaminated sediments on biological resources. Not surprisingly, contaminated sediment levels are highest near cities and industrial areas. Contamination, in fact, has been found to be a direct result of human activities. In non-urban areas, by comparison, chemical concentrations in waterbody sediments is low.

The best way to measure the extent and effects of contaminated sediments is by checking levels against sediment quality standards. These standards have been established only for Puget Sound marine sediments; standards for freshwater and estuarine waterbodies are scheduled for adoption in 1994.

Spatial comparisons are used to assess those sediments or chemicals which do not have established standards.

Figure 20:
Affected Media



Environmental Data

Developing data bases for contaminated sediments will allow future researchers to see changes over time and to establish rates of sediment deposition from sediment trap information and lead^{210} dating. For now, data are limited to:

◆ Degree and frequency of exceedance of sediment quality standards for chemicals. (See figure 20.)

◆ Chemical and biological spatial comparisons of the Puget Sound Ambient Monitoring Program (PSAMP) data.

◆ Spatial comparisons of select chemicals on a statewide basis.

There are several goals behind efforts to characterize sediment contamination in Washington. These include the development of chemical and biological standards for sediments; characterizing the relationship between waste water and storm water discharges and sediment quality; and identifying contaminated sediment sites which need to be cleaned up.

Data Summary

◆ Sediment contamination has been associated with mortality to animals living in the sediment and development of tumors and other abnormalities in bottom-feeding fish. In addition, fish, crabs and clams have been seen to absorb and accumulate pollutants in areas with sediment contamination. The risks to human health, therefore, stem from eating contaminated fish and shellfish.

◆ Most of the PSAMP stations located away from point source discharge sites showed organic compound levels and metals to be well below sediment quality standards.

The most common organic compounds detected were the low and high polycyclic aromatic hydrocarbons, found in the highest concentrations at the mouth of City Waterway in Commencement Bay. The highest concentrations of metals, most commonly copper, were found in Sinclair and Dyes inlets.

◆ Relatively little information exists for levels of sediment contamination in fresh water but available data indicate definite regional differences.

The state's eastern ecoregions appear to have higher concentrations of DDT, an agricultural pesticide. The upper Columbia River has higher concentrations of copper, mainly due to smelting operations. It is important to note that sampling is not random — most testing was done in areas in which problems were already suspected.

We have a good understanding of sediments in Puget Sound (see figure 20). A fuller understanding of the condition of sediments statewide will require much more time and effort.

Hanford and Radioactive Waste

Overview

The 560-acre Hanford Nuclear Site in southeastern Washington was used for the production of nuclear weapons from 1943 until 1988. It left a dubious legacy — 1,400 hazardous and radioactive waste-disposal sites, widespread environmental contamination and the potential for long-term restrictions. The federal General Accounting Office has estimated the entire cleanup to cost from $37 billion to $50 billion.

The Hanford Federal Facility Agreement and Consent Order was signed in May 1989 by the U.S Environmental Protection Agency (EPA), the Washington State Department of Ecology and the U.S. Department of Energy (USDOE). The agreement establishes working relationships among the agencies and lays the framework for cleanup-permitting and deadlines. Cleanup is scheduled to be completed by the year 2018.

Environmental Data

◆ Currently, 78 operable units — a group of land-disposal sites organized for efficient investigations and cleanup — at Hanford are in the permitting phase. This process cannot measure the environmental quality at Hanford because it does not indicate improvement or deterioration of the environment. The focus instead is on the progress made toward the goal of site cleanup. The questions of "how clean is clean" addressed in Phase II of the Model Toxics Control Act and what the site will be used for in the future must be answered before this can be an environmental indicator. Until then, it should be understood only as an indication of site activity.

◆ Waste management practices are indicators of site activity. Current and future facilities will treat and process radioactive and hazardous waste on the site. Until facilities are built and environmental data is available, there can be no clear comparison between the effectiveness of waste management and improvements or deterioration of the Hanford environment. The focus is on the technology of waste stabilization and containment, so this too should be used only as an indication of site activity.

◆ Three expedited response actions (interim actions taken to alleviate an immediate threat to human health or the environment) are currently ongoing at Hanford. Other projects will be chosen on a case-by-case basis. This again is an "activity indicator" and does not show improvement or deterioration of the environment.

◆ A shallow-land burial facility for commercial low-level radioactive waste has been in operation since 1965. The 100-acre facility is operated by a private firm on a 1,000-acre tract within the Hanford Reservation. The land was leased to the state in 1964. Annual volumes deposited at the site have declined steadily since 1985 except for a slight increase in 1991. The Low-Level Radioactive Waste Policy Amendments Act of 1985 will enable Washington to stop accepting out-of-region commercial low-level radioactive waste commencing January 1, 1993. The Department of Health regulates the disposal facility and monitors air, water, ground water and soil. No off-site contamination has been detected.

Data Summary

Many of the environmental indicators related to Hanford are still in early stages of development.

◆ Cleanup of operable units: Operable unit cleanup actions are in their initial stages. No cleanups have been completed.

◆ Waste management: Waste facilities to stabilize and prepare the waste for relocation are still in the development stage.

◆ Expedited response actions: Three projects have been selected to undergo expedited response actions. Two have been completed.

◆ Commercial low level radioactive waste disposal: Low level radioactive waste (LLRW) continues to be disposed of at the commercial LLRW site at a declining rate. No off-site contamination has been detected.

Acknowledgements

Environment 2010 Steering Committee*

Duane Berentson, *Department of Transportation*
Judith Billings, *Superintendent of Public Instruction*
Joe Blum, *Department of Fisheries*
Brian Boyle, *Department of Natural Resources*
Lynn Brown, *USDA Soil Conservation Service*
Chuck Clarke, *Department of Community Development*
Dennis I. Okamoto, *Department of Revenue*
Kristine Gebbie, *Department of Health*
Christine Gregoire, *Department of Ecology, Committee Chair*
Wendy Holden, *Department of General Administration*
Paul Isaki, *Department of Trade & Economic Development*
Len McComb, *Office of Financial Management*
Nancy McKay, *Puget Sound Water Quality Authority*
AI Pettibone, *Department of Agriculture*
Cleve Pinnix, *Parks and Recreation Commission*
Dana Rasmussen, *U.S. Environmental Protection Agency, Region 10*
Curt Smitch, *Department of Wildlife*
Vernon Stoner, *Department of Employement Security*
Dick Thompson, *Department of Social and Health Services*
Dick Watson, *Energy Office*
Bob Wilder, *Interagency Committee for Outdoor Recreation*

Special thanks to the following individuals for their participation in the Steering Committee:

Tony Angell, *Office of Superintendent of Public Instruction*
Chris Drivdahl, *Department of Wildlife*
Julie Hagensen, *U.S. Environmental Protection Agency, Region 10*
Nixon Handy, *Department of Natural Resources*
Don Lund, *Department of Transportation*
Judy Merchant, *Department of Fisheries*
Bob Nichols, *Office of Financial Management*
Wayne Reid, *Conservation Commission*
Eric Slagle, *Department of Health*
Sandy Swarthout, *Department of Revenue*

*Agency Representatives During 1991

Environment 2010 Public Advisory Committee

Senator Neil Amondson, *Washington State Senate*
Sheldon Blue, *WSLA Development Corp.*
Don Bonker, *former U.S. Congressman*
Bill Brown, *Washington Environmental Council*
Representative Bill Brumsickle, *Washington State House of Representatives*
Chris Carlson, *Carlson Issues Management*
Dan Coyne, *Washington Dairy Federation*
Jerry Ficklin, *Ficklin Environmental Services*
Representative Greg Fisher, *Washington State House of Representatives*
Billy Frank, *Northwest Indian Fisheries Commission*
Bill Funk, *Water Research Center, Washington State University*
Carole Helm, *former Mayor of Pullman*
Mayor Nan Henriksen, *City of Camas*
Keith Herrell, *Pacific Salmon Sport Fishing Council*
Terry Hunt, *Wildlife representative*
Bill Jacobs, *Washington Forest Protection Association*
Senator Mike Kreidler, *Washington State Senate*
Moyes Lucas, *State Parks and Recreation Commission*
Petra MacGowan, *Student*
Jim Matsuyama, *Tri-County Health District*
John Miles, *Huxley College of Environmental Studies*
Alice Parker, *Women in Farm Economics*
Ron Sims, *King County Council*
John Smith, *Colville Confederated Tribes*
Fred Stouder, *City of Yakima*
Kirk Thomson, *Association of Washington Business*
Sheri Tonn, *Sierra Club*
Sally Van Niel, *Audubon Society*
Wini Voelckers, *Varia Associates*

Contributors to 1991 State of the Environment Report

Steve Butkus, *Department of Ecology*
Dick Byers, *State Energy Office*
Doug Canning, *Department of Ecology*
Barb Carey, *Department of Ecology*
Rachel Friedman-Thomas, *Department of Ecology*
Jane Ruby Frost, *Department of Ecology*
Dave Hallock, *Department of Ecology*
Candace Jacobs, *Department of Agriculture*
Art Johnson, *Department of Ecology*
Rob Kirkwood, *Department of Ecology*
Dan Kruger, *Department of Ecology*
Greg Lovelady, *Interagency Committee for Outdoor Recration*
Thom Lufkin, *Department of Ecology*
Peter Lyon, *Department of Ecology*
Doug McChesney, *Department of Ecology*
Steve Mishkin, *Department of Wildlife*
Emily Ray, *Department of Ecology*
Carole Richmond, *Department of Natural Resources*
Tom Schuettke, *Department of Ecology*
Rob Spath, *Department of Ecology*
Loren Stern, *Department of Fisheries*
John Tooley, *Department of Ecology*
Stu Trefry, *Department of Agriculture*
Bill Yake, *Department of Ecology*

Supporting Staff for 1991 State of the Environment Report

Larry Altose
Marc Horton
Mark Jackson
Tom Leonard
Philip Miller
Joan Pelley
Bart Potter

Your Views Help

For those who are interested in keeping up with changes to Washington's environment, we are planning the 1993 State of the Environment Report (SER). You can help us improve the SER by completing and mailing this survey to the address below before September 1, 1992.

1 The 1991 SER is:

	Very	*Somewhat*	*Not*	*No Opinion*
Informative	☐	☐	☐	☐
Easy to Read	☐	☐	☐	☐
Accurate	☐	☐	☐	☐
Balanced	☐	☐	☐	☐
Complete	☐	☐	☐	☐

2 The 1991 SER is (select one):

☐ About the right length ☐ Too long ☐ Too short

(suggestions on topics to add or cut):

3 My interest in SER information is mostly:

☐ General ☐ Business ☐ Public Policy
☐ Scientific ☐ Advocacy ☐ Academic
☐ Other (identify):

4 Other comments and suggestions (topics, format, quality, etc.):

5 Would you like to keep your name or add another name to the mailing list for a 1993 SER?

☐ Yes.

Name: _____ Name: _____

Address: _____ Address: _____

_____ _____

☐ No, please delete my name from the mailing list.

Please complete, cut out along dotted line, place in envelope and mail to:
Ben Bonkowski; **Washington State Department of Ecology,**
P.O. Box 47600, Olympia, WA 98504-7600