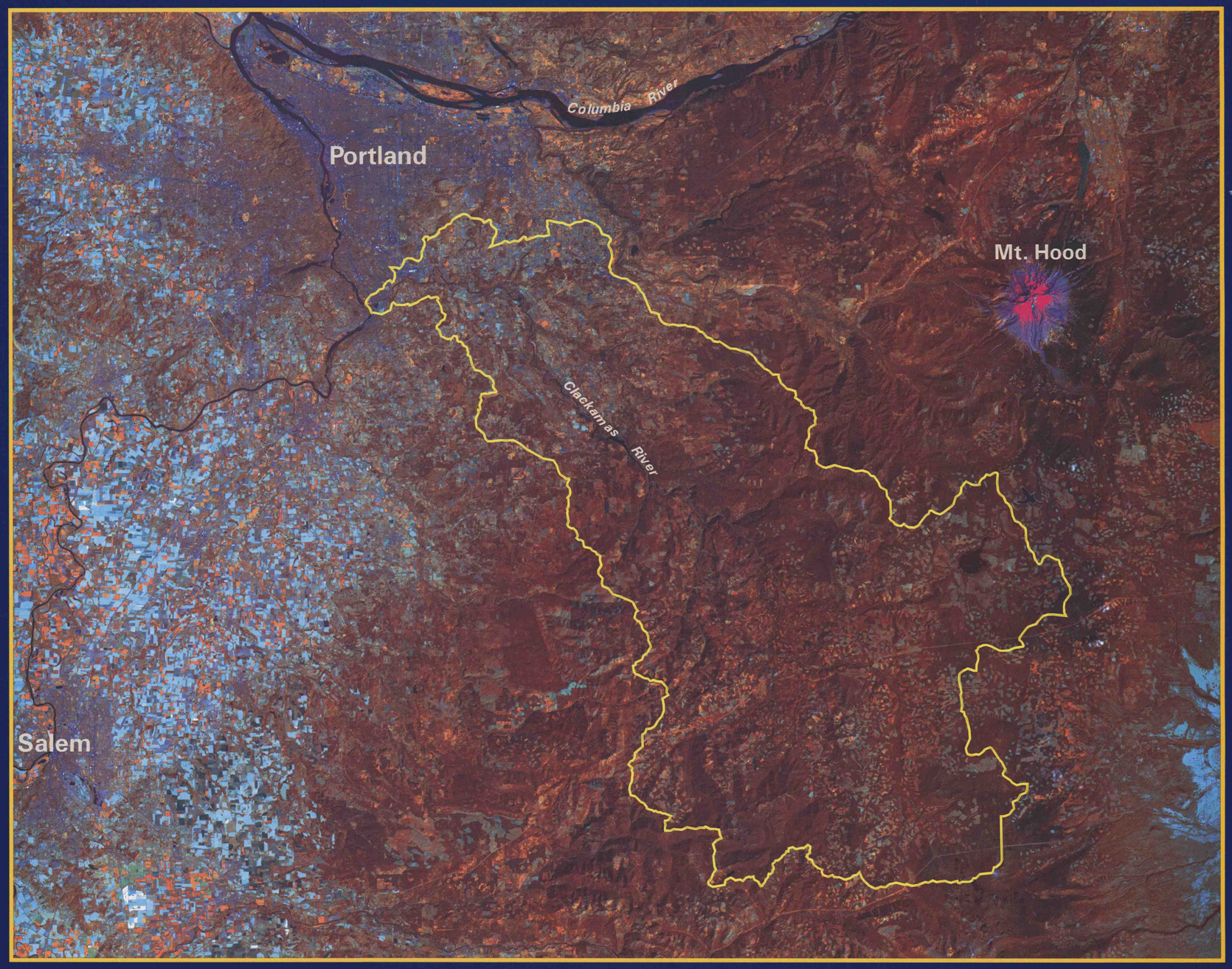
Clackamas River Watershed Atlas



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METRO
Regional Services

Acknowledgments

This atlas was made possible by the cooperation and support of all our partners. We greatly appreciate their willingness to look beyond traditional agency roles and boundaries to help us collect information covering the entire watershed.

We are especially grateful for the time, dedication and assistance provided by the members of the Technical Work Group (marked below with an asterisk*). This group spent many hours providing and analyzing information, answering questions, discussing issues and reviewing the text and maps to ensure that the atlas is both accurate and useful.

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Metro Project Team

Rosemary Furfey, team leader
Susan Payne, map design and GIS
Lynn Putnam, liaison and writer
Christine Finlayson, writer

On the front cover:

A Landsat Thematic Mapper satellite image, reprinted with permission from the Earth Observation Satellite Co., shows the Clackamas River watershed in relation to the Portland metropolitan region, Mt. Hood and the Columbia River. The image, taken in August 1993, displays three of the seven bands (light waves) recorded by a satellite. The combination of bands allows us to interpret the type and condition of vegetation based on hue. Visible Band 3, shown in dark blue hues, represents urbanized areas, open water or saturated soil conditions such as the snowcaps of Mt. Hood (the summit appears pink because of glare). Near-infrared Band 4, shown in orange and brown hues, represents the relative intensity of plant photosynthesis (young vegetation with vigorous growth is shown as brighter orange, while slower-growing, mature vegetation is shown by reddish brown hues). Mid-infrared Band 5, shown in green and light blue hues, represents non-vegetated or sparsely vegetated areas such as dry meadows, recently clearcut areas and harvested or dry farmland. The watershed boundary (yellow line) has been added to the image.

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Table of Contents

1 indicates the map page corresponding to the text description

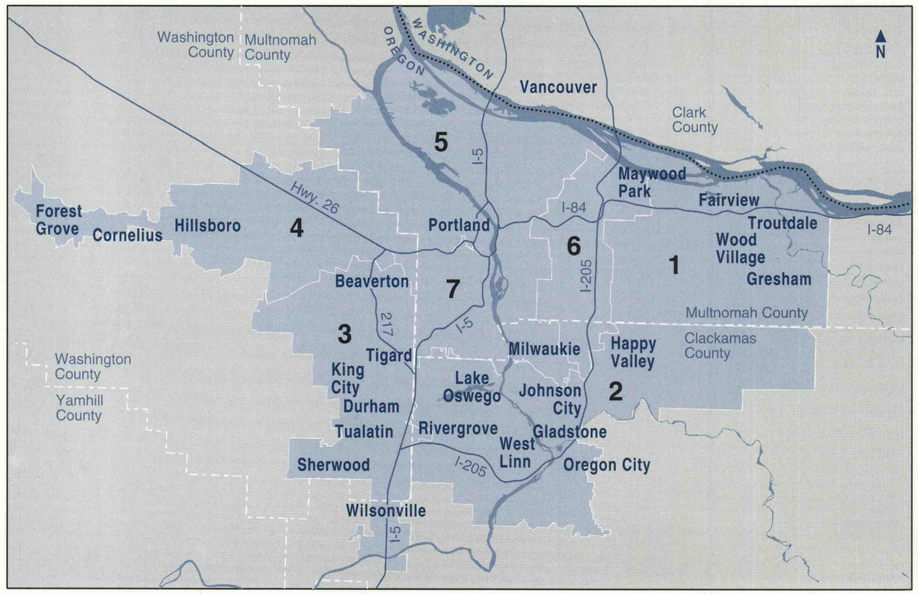
Figures

Tables

Appendices

Clackamas River Watershed Project

About Metro



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- *access to nature*
- *clean air and water*
- *the ability to get around the region*
- *safe and stable neighborhoods*
- *a strong regional economy*
- *resources for future generations*

Metro serves 1.3 million people who live in Clackamas, Multnomah and Washington counties and the 24 cities in the Portland metropolitan area. Metro provides transportation and land-use planning services and oversees regional garbage disposal and recycling and waste reduction programs.

Metro manages regional parks and greenspaces and the Metro Washington Park Zoo. It also oversees operation of the Oregon Convention Center, Civic Stadium, the Portland Center for the Performing Arts and the Expo Center, all managed by the Metropolitan Exposition-Recreation Commission.

For more information about Metro or to schedule a speaker for a community group, call 797-1510 (public affairs) or 797-1540 (council).

Metro's web site: www.metro-region.org

Metro is governed by an executive officer, elected regionwide, and a seven-member council elected by districts. Metro also has an auditor who is elected regionwide.

Preface

Metro received grant funding from the U.S. Environmental Protection Agency in 1995 to gather digital, or computerized, geographic data for the Clackamas River watershed. This atlas was produced as one way to share the information collected with resource managers, policy makers, and people living in and interested in the Clackamas River watershed.

During the first year of the Clackamas River Watershed Project, Metro staff met frequently with a Technical Work Group of local, state and federal partners (see Acknowledgements on the inside front cover) to define information needs and determine what digital data was already available. Although many agencies had gathered information about the Clackamas, each agency had focused on the lands it administered and its own issues of interest. The challenge was to gather watershed-based data about an area that crosses two counties and includes several cities and towns, as well as U.S. Forest Service and Bureau of Land Management lands.

We first focused on gathering data to characterize the entire watershed, especially data related to natural systems, such as geology, slope, land cover and fish distribution. We also gathered data related to human influences in the watershed, such as population density, land use and zoning. Then, with the information gathered, we used a geographic information system (GIS) to design the maps in this atlas.

After creating maps covering the entire watershed, we began looking in more detail at the smaller watersheds that make up the Clackamas. We graphed key variables such as road density (miles of roads per square mile of land) and places where roads and streams intersect (called road-stream crossings). We also estimated how much land in each area is currently covered with impervious (paved or hard) surfaces and how much could be covered with impervious surfaces in the future, as development continues. Graphs showing these key variables are included in the atlas.

Although the atlas does not analyze all conditions in the Clackamas River watershed, it provides a starting point to identify areas for more detailed data collection and assessment.

As we enter the next phase of the project, we will focus on two small watersheds, or subwatersheds, that feed into the Clackamas River: Rock Creek and Richardson Creek subwatersheds. Parts of both areas have been adopted as urban reserves, those areas designated by the Metro Council for future growth in the Portland metropolitan region. We plan to gather detailed information about these two subwatersheds so decision-makers will be able to consider natural resources as they analyze possible development patterns for future urban areas.

For people with access to a GIS, the digital data used in this atlas is available from Metro (send e-mail to drc@metro.dst.or.us or call (503) 797-1742 for more information or visit the Data Resource Center, 600 NE Grand Ave., Portland, Ore.). If you have questions or comments about the Clackamas River Watershed Project, send e-mail to 2040@metro.dst.or.us or call Metro's Growth Management Services Department at (503) 797-1562.

Introduction

This atlas was created through the Clackamas River Watershed Project, a project to gather information about the watershed's natural resources. This information was collected to help the Metro Council and other decision-makers when they evaluated areas in which to allow future urban growth. The project began in September 1995 as a partnership of several local, regional, state and federal agencies and groups, and has continued into 1997.

Study Area

The project study area is the entire land area draining into the Clackamas River in northwestern Oregon, referred to as the Clackamas River watershed. The watershed is part of the lower portion of the Willamette River basin. Figure 1 shows the watershed in relation to Oregon and Washington county boundaries. The map on the cover shows the watershed in relation to Mt. Hood, Portland and the Columbia River.

The Clackamas River watershed drains more than 940 square miles, including forested areas in the upper watershed and agricultural areas and densely developed areas in the lower watershed. The Clackamas River is nearly 83 miles long, beginning on the slopes of a High Cascade volcano and ending where the river flows into the Willamette River near Gladstone and Oregon City, southeast of Portland. Throughout the watershed, numerous small streams and tributary rivers feed the waters of the Clackamas.

Project Background

The Clackamas River watershed was selected for this project because of its potential for future development. In 1994, Metro's Growth Management Services Department began investigating and analyzing urban reserve study areas. These study areas were

What is a Watershed?

A watershed is any area of land from which water drains to a common point, be it a river, pond, stream or lake. Watersheds are bounded by topographic features such as ridgetops. Watersheds are hierarchical, with small watersheds nested within larger ones. A watershed can be as large as all the land draining into the Columbia River, or as a small as 20 acres draining to a pond.

Depending on its size, a watershed can be called different names. "Basin" is often used to describe the land area draining to a major river such as the Columbia, while a "subbasin" describes the land draining to a smaller river. Watersheds of any size can also simply be called "watersheds," with parts of these watersheds (such as the land draining to a stream) called "subwatersheds." For the purposes of this atlas, we call the land draining to the Clackamas River a "watershed" and the smaller, stream-based drainages that feed into the river "subwatersheds." Other agencies may use different terms to refer to these areas (see page 6 for more information).

Because all water in a watershed is connected, activities in one part of the watershed often affect other areas of the watershed. For example, human activities such as construction and timber harvesting, if not performed responsibly, and natural events such as floods or fire can cause erosion and degrade water quality downstream. Disturbances do not need to occur directly along a stream or in the riparian zone to have an adverse effect. Each piece of the landscape – streams, riparian zones and uplands – plays an important role in the watershed's overall health. For these reasons, many ecologists and resource managers advocate making watersheds, rather than jurisdictional boundaries, the geographic unit for natural resource study and management.

Figure 1

Locator map for the Clackamas River watershed

lands that could be selected as urban reserves through Metro Council decisions about the urban growth boundary. The council designates urban reserves to accommodate future urban growth in the Portland metropolitan region, in compliance with Oregon's land-use laws.

By 1994, several parts of the Clackamas River watershed had been proposed as urban reserve study areas. Metro staff felt that it was important to study the Clackamas River watershed further because:

- The Metro Council and Clackamas County Board of Commissioners needed more information about the watershed to make urban reserve decisions and to understand the impacts of growth on the watershed's natural resources.
- The watershed supports naturally spawning anadromous fish including steelhead, chinook and coho salmon, and cutthroat trout. Some of these species could be listed by the federal government as threatened or endangered. If a fish were listed, any proposed activities that might harm the species would be closely scrutinized.
- The Clackamas River provides a valuable source of drinking water for approximately 175,000 people and is targeted in the Regional Water Supply Plan as a source to meet future water demand. Metro is a member of the Regional Water Supply Planning Study along with 27 of the region's water providers.

The watershed is also important because it provides habitat for many wildlife species, both game and non-game animals, and supports numerous recreational activities such as fishing, boating and camping.

Metro worked with The Wetlands Conservancy, Clackamas County and the Oregon Graduate Institute's Student Watershed Research Project to

Key Concerns in the Clackamas River Watershed

Naturally Spawning Anadromous Salmonids

The Clackamas River supports several species of anadromous fish, including spring and fall chinook salmon, coho salmon, cutthroat trout, and summer and winter steelhead. However, fish populations have been declining due to several factors, including:

Overfishing: Harvest rates on late-run coho salmon have been as high as 80 percent in recent years. The resulting 20 percent escapement rate is far below the Oregon Department of Fish and Wildlife's estimate of a 31 percent escapement level needed to sustain the harvest of wild, late-run coho salmon.

Oceanic and downriver conditions: Conditions in the Pacific Ocean and Willamette River that affect fish include limited food, predation, poor water quality, loss or degradation of habitat, and disease.

Dams: Hydroelectric development can affect fish by causing mortality during downstream migration, blocking upstream migration and affecting the storage of sediment and organic matter in a river. Upstream fish passage on the Clackamas River was blocked at Faraday Dam (east of Estacada) from 1917 to 1939; during this time, no anadromous fish could reach spawning and rearing areas above the dam (U.S. Forest Service Environmental Assessment and Management Plan for the Clackamas Wild and Scenic River).

Land use (agricultural, timber harvesting and urban uses): Land-use practices such as removing large woody debris from stream channels, clearcutting, removing streamside vegetation, withdrawing water for irrigation, mining for gravel in-stream and road building can increase sediment loads and water temperatures.

When fish populations decline, they may be listed as "threatened" or "endangered" under the Endangered Species Act (ESA). The National Marine Fisheries Service (NMFS) is the federal agency responsible for managing marine species under this act.

As of this printing, the Lower Columbia River steelhead evolutionarily significant unit (ESU), which includes the Clackamas River stock, has been proposed as threatened; however, NMFS has delayed a final decision on the listing. Also as of this printing, chinook salmon, cutthroat trout and the Lower Columbia River/Southwest Washington Coast coho salmon ESUs are possible candidates for listing. Once a species is listed, activities that might affect the fish or their habitat are restricted, as outlined in the Endangered Species Act.

Urban Growth

When the Clackamas River Watershed Project began, the Metro Council was in the process of selecting urban reserves, areas that would form the long-range (30 to 50-year) land supply to accommodate growth in the Portland metropolitan region. Urban reserves are outside the urban growth boundary (UGB), which designates a 20-year land supply. The number of acres within the UGB and urban reserves provides some measure of the growth projected to occur in an area.

Three governing authorities in the Clackamas River watershed can establish UGBs and urban reserves: Metro and the incorporated cities of Sandy and Estacada. Metro works with 24 cities and three counties to establish the UGB and urban reserves for the Portland metropolitan area. As shown in Table 1, the Metro Council has adopted 4,468.2 acres of urban reserves in the watershed. Sandy also has 2,348.4 acres of urban reserve lands in the watershed. Estacada has a UGB, but no urban reserves.

Water Supply

In October 1996, water providers in the Portland metropolitan region issued the final report of the Regional Water Supply Plan. This plan resulted from a multi-year study to examine strategies and implement actions to meet the water supply needs of the Portland metropolitan area into the year 2050.

The Clackamas River currently provides municipal water to about 175,000 residents in the Portland metropolitan region. Water providers drawing from the Clackamas, including the city of Lake Oswego, Clackamas River Water and the South Fork Water Board, have developed intake and treatment capacity for 66 million gallons per day (mgd) on the lower five miles of the river. Estacada also has an intake. Several new or expanded water supply facilities, providing a total of 22.5 mgd, are currently planned on the Clackamas River within the next 10 years.

The water supply plan recognizes that additional future withdrawals raise concerns about the river's fisheries, but found that withdrawing another 50 mgd should not have severe adverse environmental impacts. The plan adds that the health of fisheries and ecosystems needs to be monitored and values preserved as more water is withdrawn. In addition, the plan recommends further study to better understand the possible impacts of future withdrawals.

Table 1

Acres of land inside urban growth boundaries and urban reserves, within the Clackamas River watershed

Urban growth boundaries	
Inside Metro UGB	
Gladstone	847
Happy Valley	42
Oregon City	777
Urban Clackamas County	3436
Total	**5102**
Estacada	697
Sandy	1178
Total	**1875**
Urban reserves	
Metro*	4468
Sandy	2348
Estacada	NA
Total	**6816**

** Acres will be allocated to individual jurisdictions as they are brought into the UGB.*

develop a comprehensive proposal to gather information about the Clackamas River watershed. The proposal was submitted to the Environmental Protection Agency's (EPA) Willamette Basin Initiative.

The Clackamas River Watershed Project received funding from the EPA in September 1995. The three project sponsors (Metro, The Wetlands Conservancy and the Student Watershed Research Project) submitted a joint proposal for the following tasks:

Metro/The Wetlands Conservancy/Clackamas County: form a Technical Work Group of project cooperators to assess data needs for the watershed and help Metro with its data collection efforts. The Technical Work Group was comprised of those individuals listed on the Acknowledgments page.

Metro: collect and map technical data for the Clackamas River watershed.

The Wetlands Conservancy: survey existing methods of rapid assessment and identify one to use in selected areas.

Student Watershed Research Project: monitor water quality in selected areas.

Goals

The project was designed to:

- develop a list of issues and goals related to natural resources in the watershed
- identify data sources and obtain the data
- produce maps of the watershed and determine a cost-effective way to make the maps and data accessible to the public
- identify data deficiencies and make recommendations for addressing them.

Process

A Technical Work Group of resource managers from federal, state and local agencies was formed as an ad hoc group to review the Clackamas River Watershed Project's work plan and provide guidance at key junctures. During the first year, the full work group met three times and smaller groups met several times.

Although the work group wanted to begin gathering data immediately, members also realized that they should wait until they had determined what information was needed and how it would be used. An overwhelming amount of data is available; without specific objectives, data collection could go on indefinitely. The EPA grant officer strongly advised that the group wait to acquire data until after pertinent questions about the watershed were formulated.

The challenge was to select a process to assist the Technical Work Group in identifying the data needed to answer key questions. The group decided to use conceptual models, which allow us to break an issue into its different components and organize information related to a particular topic. For this project, the group identified four issues of concern in the watershed, which they later wrote into goal statements and prioritized (see Table 2). Then, attributes that support each goal were identified. Stressors, or activities that can degrade the attributes, were also identified. Finally, characteristics describing each attribute and stressor, called indicators, were listed.

The group developed a conceptual model for Issue 1, native fish, listing the attributes, stressors and indicators for fish habitat. Next the group identified more than 30 measures, or data sets, on which to focus data-gathering efforts. Examples of supporting attributes for native fish include sufficient water quantity and quality, while examples of stressors that could degrade fish habitat are lack of riparian vegetation, barriers to fish passage and road-stream crossings.

Small work groups developed conceptual models for each of the four issues. Although we did not collect data for models showing water quality, water supply and natural areas, some of the data obtained for the native fish model (see Appendix A on page 39) does apply to one or more of the other models. The conceptual model can be used as a starting point for groups undertaking similar projects in other watersheds.

Products

Information about the Clackamas River watershed is available in several formats, including reports, maps and digital (computerized) data. Because Metro staff have considerable expertise with geographic information systems, the work group and Metro decided to focus on acquiring digital data. Data were analyzed and maps generated using Arc/Info, a GIS developed by the Environmental Systems Research Institute in California.

When acquiring data, we looked primarily for existing data sets rather than generating new ones. We tapped a variety of sources (see Appendix B on page 40), combining the data as necessary to give a complete picture of the Clackamas River watershed. With much of the watershed in national forest, the U.S. Forest Service was able to provide extensive digital geographic data for its managed lands. The Bureau of Land Management also provided data covering its smaller land holdings. State agencies, including the Oregon Department of Fish and Wildlife and the State Service Center for GIS, have also supplied data.

Table 2

Clackamas River watershed issues and goals*

Priority	Issue	Goal
1. Native fish	The Clackamas River watershed has several native runs of anadromous fish whose numbers are low and/or declining.	Maintain and improve native anadromous and resident fish habitat in the Clackamas River watershed.
2. Water quality	Significant portions of the Clackamas River and its tributaries currently do not meet state water-quality standards for temperature. Future land-use changes, growth and development threaten to further degrade water quality.	Maintain and enhance water quality of the Clackamas River watershed to meet and surpass state water-quality standards.
3. Water supply	Increased water withdrawals due to increasing regional water supply demands may conflict with other beneficial uses.	Maintain sufficient flows to support instream beneficial uses.
4. Natural areas	Future land-use changes and growth negatively impact natural areas associated with river and stream habitat.	Protect and enhance natural areas associated with river and stream habitat.

**as developed by the Technical Work Group*

Technical Considerations

Map Scale and Accuracy

All maps are printed with a specific scale. For example, a 1:24,000 map scale means that one inch on the map corresponds to 24,000 inches, or 2,000 feet, on the ground. Data shown on a map are also generated at a particular scale, called the source scale or resolution.

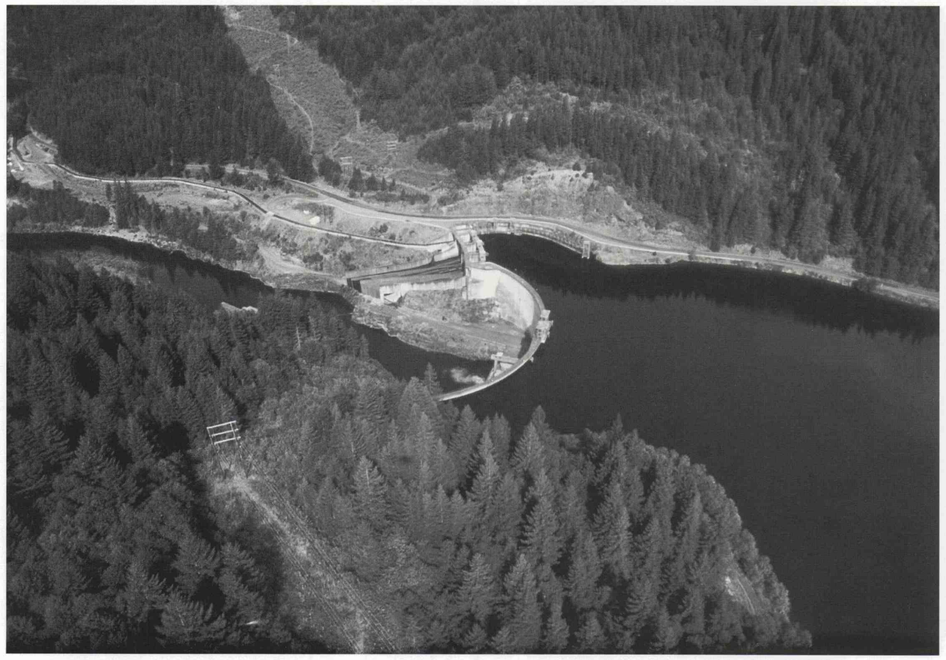
Throughout this atlas, a source scale is given for each data set. This scale determines the level of accuracy for each layer of information. The higher the number represented in the scale, the less accurate the resolution. For example, a scale of 1:500,000 has less detail and accuracy than a scale of 1:24,000. The former may have been derived from a satellite image and is referred to as "small scale" because features in the image appear very small. The latter may have been derived from an aerial photograph and is referred to as "large scale." Data gathered on the ground will have an even larger scale or resolution.

The concept of map resolution is similar to that of a microscope in a scientific laboratory. With the naked eye, it is difficult to see tiny organisms in any great detail. We may know the general shape and size of a cell, but cannot determine much about its internal composition. With a microscope, however, we are able to determine detailed information about each organism.

The same is true for maps of the earth. The closer our view, the greater the detail possible. For example, satellite images are valuable for mapping very large areas, but provide limited accuracy because of the great distance from the earth at which they are taken. A closer view provides more accurate information. For this reason, a road inventory delineated from an aerial photograph will not be as accurate as roads measured using surveying equipment on the ground.

Data collected for this atlas came from a variety of sources, were created for different purposes and have varying resolutions (see Appendix B for a complete list of data sources and scales). It is essential to consider resolution when using these maps and to avoid using the maps to compare information from one source with that from another less accurate source. For example, the maps should not be used to determine soil types on either side of a road because the soils data is only accurate to within +/- 40 feet, while the road itself may be less than 40 feet wide.

Note: *All maps in the atlas were reviewed for accuracy by the Technical Work Group. Although we took care in creating the maps, errors, omissions and positional inaccuracies may occur.*



Built in 1958, the North Fork Dam on the Clackamas River is operated by Portland General Electric. The dam's fish ladder allows adult fish to move upstream into the 331-acre North Fork Reservoir and beyond.

Data Limitations and Gaps

This atlas represents much, but not all, available information for the Clackamas River watershed. Before using the atlas to draw conclusions, it is important to understand how the data can best be used, given certain data limitations and gaps in information.

In some instances, the scale at which the data were generated (the source scale) is too inaccurate for answering specific questions. For example, land cover designations were coarsely assigned from satellite imagery over a very large area. This information was not thoroughly verified in the field. It is appropriate to display this data for a large area, such as the entire Clackamas River watershed, to give a general idea of vegetative cover. However, the map would not be accurate enough for classifying the riparian vegetation directly next to a stream.

Some data are so detailed that a watershed-wide application is too cumbersome. For example, data gathered by walking beside or in a stream – such as stream substrate texture, percent shade, large woody material, and stream width and depth – are important for understanding fish habitat, but would be too detailed to show on one watershed-wide map.

The watershed crosses two counties and includes federal land administered by two agencies, state land and private land. These different jurisdictions and fragmented ownership and land administration can lead to data inconsistencies and incomplete data. For example, the federal agencies were able to provide road networks with much more detail than available on non-federal lands. This does not necessarily indicate that there are more roads on federal land than on private land, but simply that the federal agencies have done a more complete inventory of existing roads.

Other important information has not yet been mapped in GIS format. For example, the Technical Work Group wanted to show the locations of restoration projects implemented by the U.S. Forest Service and Bureau of Land Management on their resource lands. Unfortunately, these restoration site locations have not yet been mapped and could not be included in the atlas.

Despite these limitations, the data collected for this project are extensive and form a foundation that can be expanded over time. The digital data used in the atlas supplement information about the Clackamas River watershed that is already available in written reports and maps, such as watershed analyses prepared by the U.S. Forest Service and various reports prepared by state and county agencies.

Note: *The maps are intended to be used with the accompanying text, which explains the data limitations specific to each map.*