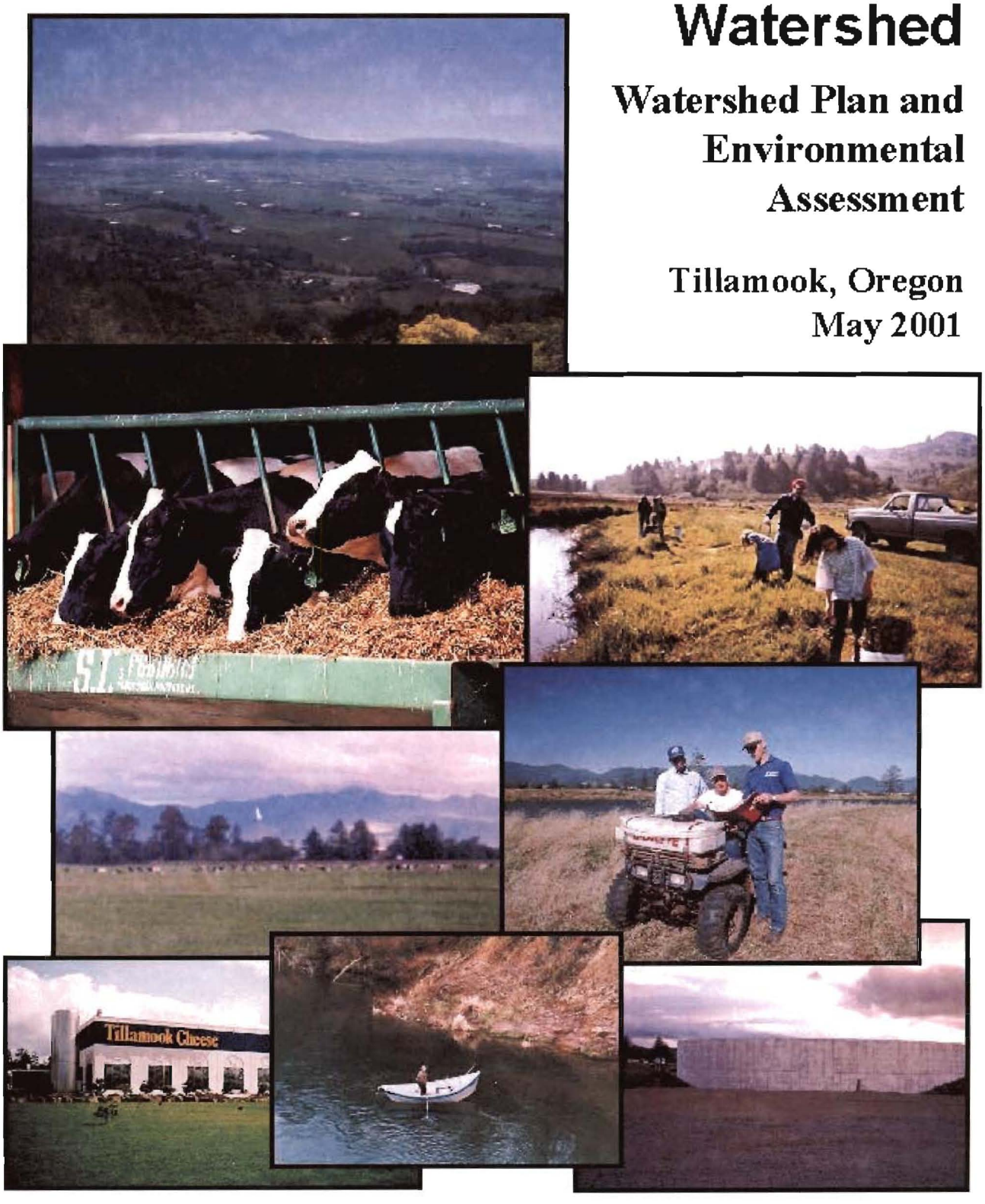
USDA NRCS Natural Resources Conservation Service

Lower Tillamook Bay Watershed

Watershed Plan and Environmental Assessment

Tillamook, Oregon
May 2001



Watershed Plan
And
Environmental Assessment

Lower Tillamook Bay Watershed

Tillamook, Oregon

Sponsored by:

Tillamook County Soil and Water Conservation District

Prepared by:

U.S. Department of Agriculture
Natural Resources Conservation Service

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June 2001

WATERSHED PLAN AND ENVIRONMENTAL ASSESSMENT
LOWER TILLAMOOK BAY WATERSHED
TILLAMOOK, OREGON

ABSTRACT:

This document describes a plan to improve water quality and fishery habitat within the Lower Tillamook Bay Watershed while improving the economic sustainability of the dairy and livestock industry. This plan will help the agricultural community meet the requirements under the Clean Water Act and the Endangered Species Act. The financial and technical assistance provided will offer the agricultural community the opportunity to accelerate efforts already underway through the Tillamook Bay National Estuary Study and other state and local programs (Oregon Plan, SB1010 plans, etc.). Proposed is the development and implementation of conservation plans on approximately 60 dairies, 22 heifer replacement operations and 34 other livestock operations. Plans will address resource concerns on farm headquarters, pasture and haylands, riparian areas and wetlands.

FOR ADDITIONAL INFORMATION CONTACT:

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Watershed Agreement

Between the

Tillamook County Soil and Water Conservation District
(Referred to herein as TCSWCD)

And the
USDA Natural Resources Conservation Service
(Referred to herein as NRCS)

Whereas, application has heretofore been made to the Secretary of Agriculture by the sponsors for assistance in preparing a plan for works of improvement for the Tillamook Bay Watershed Plan, State of Oregon under the authority of the Watershed Protection and Flood Prevention Act (16 U.S.C. 1001-1008); and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to NRCS; and

Whereas, there has been developed through the cooperative efforts of the sponsors and NRCS a plan for works of improvement for the Tillamook Bay Watershed, State of Oregon, hereinafter referred to as the watershed plan-Environmental Assessment, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Secretary of Agriculture, through NRCS, and the sponsors hereby agree on this plan and that the works of improvement for this project will be installed, operated, and maintained in accordance with the terms, conditions, and stipulations provided for in this watershed plan and including the following:

1. Long-term contracts with individual landowners and operators will be used to fund enduring conservation practices. Long-term contracts will be developed to implement resource management systems that may include non-cost-shareable practices as well as cost-shareable enduring practices. Cost-sharing rate for the establishment of enduring practices is 65 percent of the average cost of installing the enduring practices in the selected alternative for each evaluation unit. The estimated total financial assistance cost for enduring practices is $6,420,901. The following table lists estimated total financial costs for each practice.

Enduring Practices[1]	Code	Estimated Financial Cost	Management Practices	Code	Estimated Financial Cost
Access Road	560	$50,400	Wetland Wildlife Habitat Management	644	Non-Cost Shared
Animal Trails & Walkways	575	$70,000	Use Exclusion	472	Non-Cost Shared
Critical Area Planting	342	$39,000	Prescribed Grazing	528A	Non-Cost Shared
Diversion	362	$2,000	Nutrient Management	590	Non-Cost Shared
Fence	382	$907,266	Pesticide Management	595	Non-Cost Shared
Fish Stream Improvement	395	$35,080	Waste Utilization	633	Non-Cost Shared
Floodwater Diversion	400	$270,000			
Heavy Use Protection Area	561	$4,656			
Manure Transfer	634	$21,808			
Pasture & Hayland Planting	512	$8,992			
Pipeline	516	$55,800			
Pumping Plant for Water Control	533	$28,500			
Roof Runoff Management	558	$831,365			
Stream Channel Stabilization	584	$25,000			
Streambank Protection	580	$144,000			
Tree/Shrub Establishment	612	$47,833			
Trough or Tank	614	$24,592			
Underground Outlet	620	$45,716			
Waste Storage Facility	313	$3,465,633			
Wetland Restoration	657	$343,260			

[1] Other possible enduring practices include: Structure for Water Control (587), Surface Drainage (607), Filter Strip (393A), Composting Facility (317), Riparian Forested Buffer (391), and Wetland Enhancement (659).

2. NRCS, with help from the sponsors, will provide technical assistance to landowners or operators to plan and install resource management systems shown in the plan. Percentages of technical and administrative assistance costs to be borne by the sponsors and NRCS are as follows:

Cost Item	Estimated Cost	Sponsors (%)	NRCS (%)
Technical Assistance	$1,284,180		100%
Project Administration	$321,045	10%	90%

3. The sponsors will obtain applications from at least 50 percent of the potential participants indicating their intent to utilize the program. These applications will be obtained before the first long-term contract is executed.
4. The sponsors will obtain agreements with landowners or operators to operate and maintain the resource management systems for the protection and improvement of the watershed.
5. The sponsors will acquire, or will ensure that land users or operators have acquired, with other than Public Law 83-566 funds, such real property or easements as will be needed in connection with works of improvement. (Estimated Cost $0).
6. The sponsors and NRCS will each bear the cost of project administration that each incurs, estimated to be $32,105 and $288,941, respectively.
7. The sponsors will acquire, or ensure that the landowners or water users have acquired, such water rights pursuant to State law as may be needed for the installation and operation of the works of improvement.

8. The costs shown in this plan are preliminary estimates. Final cost to be borne by the parties hereto will be actual costs not to exceed average costs incurred in the installation of works of improvement or an approved variation.
9. This agreement is not a fund-obligating document. Financial and other assistance to be furnished by NRCS in carrying out this plan is contingent upon the fulfillment of applicable laws and regulations and the availability of appropriations for this purpose.
10. A separate agreement (long-term contract) will be entered into between NRCS, TCSWCD and the landowner before either party initiate's work involving funds of the other party. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.
11. This plan may be amended or revised only by mutual agreement of the parties hereto, except that NRCS may deauthorize or terminate funding at any time it determines that the sponsor has failed to comply with conditions of this agreement. In this case, NRCS shall promptly notify the sponsors in writing of the determination and the reasons for the deauthorization of project funding, together with the effective date. Payments made to the sponsors or recoveries by NRCS shall be in accord with the legal rights and liabilities of the parties when project funding has been deauthorized. An amendment to incorporate changes affecting a specific measure may be made by mutual agreement between NRCS and the sponsor(s) having specific responsibilities for the measure involved.
12. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this plan, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.
13. The program conducted will be in compliance with the nondiscrimination provision as contained in Titles VI and VII of the Civil Rights Act of 1964, as amended, the Civil Rights Restoration Act of 1987 (Public Law 100-259) and other nondiscrimination statutes, namely, Section 504 of the Rehabilitation Act of 1973, Title IX of the Education Amendments of 1972, the Age Discrimination Act of 1975, and in accordance with regulations of the Secretary of Agriculture (7 C.F.R. 15, Subparts A & B), which provide that no person in the United States shall, on the grounds of race, color, national origin, age, sex, religion, marital status, or handicap be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity receiving Federal financial assistance from the Department of Agriculture or any agency thereof.
14. Certification Regarding Drug-Free Workplace Requirements (7C.F.R. Subpart F).

Certification:

A. The sponsors certify that they will continue to provide a drug-free workplace by:
   (1) Publishing a statement notifying employees that unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;
   (2) Establishing an ongoing drug-free awareness program to inform employees about:
      (a) The danger of drug abuse in the workplace;

(b) The grantee's policy of maintaining a drug-free workplace;
(c) Any available drug counseling, rehabilitation, and employee assistance programs; and
(d) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace.

(3) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (1);

(4) Notifying the employee in the statement required by paragraph (1) that, as a condition of employment under the grant, the employee will:
(a) Abide by the terms of the statement; and
(b) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;

(5) Notifying the NRCS in writing, within 10 calendar days after receiving notice under paragraph (4)(b) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer or other designee on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice shall include the identification numbers of each affected grant;

(6) Taking one of the following actions, within 30 calendar days of receiving notice under paragraph (4)(b), with respect to any employee who is so convicted:
(a) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or
(b) Requiring such employee to participate satisfactorily in drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.

(7) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (1), (2), (3), (4), (5), and (6).

B. The sponsors may provide a list of the sites of the performance of work done in connection with a specific project or other agreement.

C. Agencies shall keep the original of all disclosure reports in the official files of the agency.

15. Certification Regarding Lobbying (7 CFR 3018)

(1) The sponsors certify to the best of their knowledge and belief, that:
(a) No Federal appropriated funds have been paid or will be paid, by or on behalf of the sponsors, to any person for influencing or attempting to influence an officer or employee of an agency, member of Congress, an officer or employee of Congress, or an employee of a member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.
(b) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or

employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(c) The sponsors shall require that the language of this certification be included in the award documents for all sub-awards at all tiers (including subcontracts, sub-grants, and contracts under grants, loans, and cooperative agreements) and that all sub-recipients shall certify and disclose accordingly.

(2) This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

20. Certification Regarding Debarment, Suspension, and Other Responsibility Matters - Primary Covered Transactions (7 CFR 3017).

(1) The sponsors certify, to the best of their knowledge and belief, that they and their principals:

(a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency.

(b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

(c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and

(d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or local) terminated for cause of default.

(2) Where the primary sponsors are unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this agreement.

Tillamook County Soil and Water Conservation District

By _____
Rudy Fenk
Chair

Date: 6-25-01

Address: 6415 Signal Street, Tillamook, Oregon 97141-2417

USDA Natural Resources Conservation Service

By _____
Bob Graham
State Conservationist

Date: 6-25-2001

Address: 101 SW Main, Suite 1300, Portland, Oregon 97204

Summary of Plan/Environmental Assessment

Project Name
Lower Tillamook Bay Watershed Plan

Location
Tillamook County, Oregon

Sponsors
Tillamook County Soil and Water Conservation District

Other Local Supporters
Tillamook County Performance Partnership
Tillamook Bay Watershed Council
Tillamook County Creamery Association

Watershed Plan Objectives
The Lower Tillamook Bay Watershed Plan is designed to improve water quality and fishery habitat within the watershed while improving the economic sustainability of the local dairy and livestock industry. The plan will help the agricultural community meet the requirements of the Clean Water Act and the Endangered Species Act. The financial and technical assistance provided will offer the agricultural community the opportunity to accelerate efforts already underway through the Tillamook Bay National Estuary Study and other state and local programs (Oregon Plan, SB1010 plans, etc.). Proposed is the development and implementation of conservation plans on approximately 60 dairies, 22 heifer replacement operations and 34 other livestock operations. Plans will address resource concerns on farm headquarters, pasture and haylands, riparian areas and wetlands.

Resource Information
Size of the Watershed: 82,798 acres or 25% of the entire Tillamook Basin
Land Use:

Hay & Pasture Land		
• Commercial Dairies	14,273	17%
• Other Livestock	1,936	2%
Subtotal Hay & Pasture	16,209	20%
Rural Residential	1,312	2%
Urban	1,956	2%
Industrial	707	1%
Forestry	57,026	69%
Streams/Riparian	2,365	3%
Misc.	3,223	4%
GRAND TOTAL	82,798	100%

Number of Farms: 274 Farms

- 93 Commercial Dairies
- 62 Dairy Heifer Replacement Operations
- 119 Other Livestock operations (beef, horse, sheep, etc.)

Cultural Resources:

State Historical Preservation Office has identified two cultural and 5 archeological sites within the project area. Other unverified sites potentially exist.

Threatened and Endangered Species:

Listed Species	Status	Occurrence in Project Installation Areas
Stellar sea lion	Threatened	No
Marbled murrelet	Threatened	Possibly
Aleutian Canada goose	Threatened	Yes
Western snowy plover	Threatened	Unlikely
Bald Eagle	Threatened	Yes
Brown pelican	Endangered	Unlikely
Northern spotted owl	Threatened	Possibly
Oregon silverspot butterfly	Threatened	Possibly
Nelson's checker-marrow	Threatened	Possibly
Coho salmon	Threatened	Yes
Columbia River cutthroat trout	Proposed	Yes
Steelhead	Candidate	Yes

Species of concern that may occur in the watershed include: white-footed vole, Pacific western bigieared bat, California wolverine, Pacific fisher, long-eared myotis, fringed myotis, long-legged myotis, Yuma myotis, olive-side flycatcher, little willow flycatcher, tailed frog, northwestern pond turtle, northern red-legged frog, southern torrent salamander, green sturgeon, river lamprey, Pacific lamprey, pind sandverbena, tall bugbane, north coast birds-beak, frigid shootingstar, coast range fawn-lily, queen-of-the-forest, saddle mountain saxifrage, and Cascade Head catchfly.

Problem Identification: The project focuses on three priority problems:

1. Pathogen contamination affecting commercial and recreational shellfish harvest.
2. Degradation of an anadromous fishery with several species listed as either threatened or are being considered for listing under the Endangered Species Act.
3. Economic sustainability of the shellfish industry and sport fishing as well as the dairy industry.

Project Purpose and Objectives: To improve water quality and fishery habitat.

The four objectives expressed by the project's sponsors to address these problems are:

- To restore fish and other aquatic species whose populations have declined due to habitat loss or degradation;
- To improve water quality by reducing bacterial loads and warming of stream temperatures;

- To reduce excessive sedimentation that degrades habitats and modifies river flows and flooding; and
- To maintain a healthy, sustainable farm economy.

Principal Project Measures

Dairies:

The resource management system for *Headquarters* would include waste collection and storage facilities (both liquid and solids), roof runoff management (gutters and downspouts), diversions, and heavy use area protection.

On *pasture/haylands* resource management systems include pasture management (prescribed grazing, cross fencing, and pasture and hayland planting), pest management, nutrient management, and water facilities (troughs and pipelines).

Wildlife-Riparian areas would be fenced, animal use excluded, streambanks stabilized and riparian vegetation would be re-established. Other actions might include in-stream practices to improve fish passage with properly sized and placed culverts and fish-friendly tidegates or their removal where feasible.

Wildlife-Wetlands would be re-established from pasture/haylands in important tidally influenced areas. Practices would include fencing, use exclusion, wetland plantings, and water control structures added or modified to re-establish hydrologic conditions.

Other Livestock Operations (≥5 animal units) and Small Farms (<5 animal units):

The resource management system for *Headquarters* would roof runoff management (gutters and downspouts), heavy use area protection, and solid manure/compost facilities. This resource management system will provides for periodic confinement of animals on heavy use areas or barns, if available during extremely wet periods (estimated 60 days per year).

On *pasture/haylands* resource management systems include pasture management (prescribed grazing, cross fencing, and pasture and hayland planting), pest management, nutrient management, and water facilities (troughs and pipelines).

Wildlife-Riparian areas would be fenced, animal use excluded, streambanks stabilized and riparian vegetation would be re-established. Other actions might include instream practices to improve fish passage with properly sized and placed culverts and fish-friendly tidegates.

Estimated Project Costs

PL-566	Other Funds	Total
$5,746,706	$2,279,420	$8,026,126

In average annual terms, costs total $404,268. Costs were amortized at a discount rate of 6.375 percent for 50 years. Annual O & M is $15,092.

Project Benefits

Estimated average annual watershed protection benefits equal $521,880. Thirty-three percent of the total benefits will be derived off-site by increasing the commercial harvest of oysters and recreational harvest of salmon.

Other Impacts

Many impacts beyond those evaluated may be important to the sponsors or to other affected parties. For example, positive impacts are expected but were not estimated for many resources such as the following:

- Commercial salmon fishing
- Recreational clamming
- Aesthetics & wildlife viewing from restored riparian areas and wetlands
- Reduced odors from manure
- Improved dairy herd health
- Increased milk production

Environmental Effects

The project measures proposed will improve water quality by reducing bacteria contamination and by moderating stream temperatures. Individual agricultural operations that implement resource management systems on all land uses (headquarters, pasture/hayland and riparian areas) will be in compliance with environmental requirements (Clean Water Act and Endangered Species Act).

Major Considerations

- Coordination with the Tillamook County Performance Partnership and the Comprehensive Conservation and Management Plan.
- Consultation with the US Fish and Wildlife Service or National Marine Fisheries Service during on-farm planning if proposed actions possibly affect either threatened or endangered species covered under the Endangered Species Act (ESA). In addition NRCS is currently working with several federal and state agencies on a programmatic consultation under section 7 of the ESA for the Tillamook Basin.
- Cooperation with the Oregon Department of Agriculture's implementation of the state's plan (Senate Bill 1010; Agriculture Water Quality Management Plan) to restore salmon and trout populations and improve water quality. The PL-566 plan will help farmers meet SB1010 prohibited and required conditions while sustaining economic viability.
- Coordination with the Corps of Engineers to insure that the Corp's feasibility study complements rather than conflicts with PL-566 activities to improve water quality and fish and wildlife habitat.

Areas of Controversy

None

Issues To Be Resolved

None

Introduction

The Lower Tillamook Bay Watershed is a portion of the larger Tillamook Basin drained by the Miami, Kilchis, Wilson, Trask and Tillamook rivers. The lower tributaries that drain the lower agricultural floodplains and terraces were used to define this subwatershed of the larger Tillamook Basin. *This plan focuses on resource issues within the agricultural region of the Lower Tillamook Bay Watershed.* The Tillamook Bay National Estuary Project's Comprehensive Conservation & Management Plan (CCMP) includes actions that address problems throughout the Basin. Other Federal, State and local efforts are underway which address problems associated with flooding, forestry, urban run-off and other non-agricultural resource concerns. The alternatives proposed in this plan are intended to achieve most of the goals and objectives expressed in the CCMP *for agriculture.*

The watershed plan and environmental assessment for this project have been combined into a single document. The document presents a plan for improving water quality and fishery habitat while also helping to sustain the local economy within the Lower Tillamook Bay Watershed. It has been prepared under the authority of the Watershed Protection and Flood Prevention Act (Public Law 83-566, as amended) and in accordance with the National Environmental Policy Act (Public Law 91-190, as amended).

The intent of Public Law 566 is to assist local communities in solving their water and related land resource problems. The purposes of this watershed plan and environmental assessment are to describe the resource problems and alternative solutions, to provide a record of the process and rationale used in choosing a solution, and to set forth the arrangements for carrying out the plan. The plan consists of following sections:

Watershed Agreement -- The watershed agreement stipulates the roles and responsibilities of the project's sponsors and the Natural Resources Conservation Service. Financial responsibilities shown in the agreement are only estimates. Signing the agreement does not obligate sponsors to these costs. Financial obligations are set through individual project, and operation and maintenance agreements on the works of improvement.

Chapter 1 Project Setting -- This gives a general description of the project area. The focus is on the physical setting and social and economic factors that may influence resource management decisions.

Chapter 2 Watershed Problems and Opportunities -- This describes the reasons for initiating a planning effort and examines the problems and opportunities uncovered during the planning process.

Chapter 3 Scope of the Environmental Assessment -- This identifies both the resource concerns examined and which of those were found to be relevant during the planning process.

Chapter 4 Formulation and Comparison of Alternatives -- This summarizes the process to identify alternatives, the impacts of those alternatives, and the selection of the recommended actions.

Chapter 5 Consultation and Public Participation -- This describes how the sponsors and USDA Natural Resources Conservation Service (NRCS) consulted with other agencies and the public and how they involved them in the decision-making process.

Chapter 6 Recommended Plan -- This describes the measures to be installed, the responsibilities of each participating agency, the arrangements for financing the project, and the provisions for operation and maintenance.

References -- The references cited in this document are listed.

Appendices -- The appendices contain detailed tables, charts, maps and procedures that support the evaluations conducted. The "Analysis and Investigation Report" found in Appendix A provides information on the procedures and assumptions used to inventory and evaluate resource concerns and alternative solutions.

More detailed information, too voluminous to be included here, is in the supporting documentation and project files. Access to these files may be arranged by contacting the NRCS. All information and data, except where other sources are cited, were developed by the NRCS.

Chapter 1. Project Setting

1.1 General Setting

The Tillamook Basin is located about 65 miles west of Portland and 60 miles south of Astoria on the Oregon Coast. Tucked between the Coast Range and the Pacific Range, the Tillamook Basin, encompassing over 338,000 acres, drains the watersheds of five rivers: the Miami, Kilchis, Wilson, Trask and Tillamook. The Lower Tillamook Bay Watershed has been defined as the tributaries to the Bay and mainsteam rivers that originate below the forest/agricultural boundary (see Project & Location Maps in Appendix E). The watershed area drains 82,800 acres or 25 percent of the Basin.

About 275 farms in the Lower Tillamook Bay Watershed create an agricultural community of about 14,300 acres of hay and pasturelands on commercial dairies and 1,900 acres on other livestock operations. Forestry occupies 69 percent of the watershed.

Land Use	Acres	Percent
Hay & Pasture Lands		
Dairies	14,273	17%
Other Livestock	1,936	2%
Rural Residential	1,312	2%
Urban	1,956	2%
Industrial	707	1%
Forestry	57,026	69%
Streams/Riparian	2,365	3%
Miscellaneous	3,223	4%
Grand Total	82,798	100%

In the Lower Tillamook Bay Watershed, ownership is 79 percent private and 21 percent public. Of the private lands 34,400 acres are devoted to farms, residences and businesses and 30,800 acres are industrial forestlands (see Ownership Map in Appendix E).

The five rivers which drain into the Lower Tillamook Bay Watershed flow from the south, east and north and produce some of the west coast's most productive fishing spots. Yet their bounty of chinook, chum, coho, and steelhead pales when compared to earlier harvests.

There are about 25,000 residents in the watershed. The Tillamook Bay area is largely a resource dependent community supporting timber and dairy industries. In the past decade, however, tourism and transfer payments have also become important sectors of the economy.

Over the years, development and change to the landscape created several natural resource problems that have resulted in conflicts among diverse groups in the watershed. For example, high bacterial inputs from agriculture and urban sources have caused the closure of shellfish beds for about 90 days per year. In other cases, important fish and wildlife habitat has been modified and simplified to provide for transportation, agriculture, urban development and forestry.

In 1992, to address environmental issues in the Tillamook Bay and the Watershed, the Bay was selected a National Estuary Project (NEP). Under the NEP, the local community recently completed a 10-year Comprehensive Conservation and Management Plan (CCMP) to coordinate resources, strengthen commitments, and rededicate efforts to restore and

protect the Bay's natural resources. Three primary environmental problems underscored in the CCMP are:

- Bacterial contamination that causes periodic closures of the Tillamook Bay shellfish harvest,
- Excessive sedimentation that has reduced the volume of the Bay, simplified and degraded habitats, modified river flows and flood patterns, and decreased the available area for recreational and commercial boating, and
- Declining salmon and trout runs due to degradation of spawning and rearing habitat.

1.2 Climate

The Tillamook area receives a lot of rain. A typical year brings almost 100 inches (254 cm) of precipitation, mostly in the form of rain, but also snow in the upper Watershed. In 1996, however, 126 inches (320 cm) of lowland rain, very heavy upland rain and snow led to severe flooding throughout the Basin and caused significant economic and environmental damages. From 1961 through 1990, the city of Tillamook averaged 90 inches (229 cm) of rain per year with 76 percent of total precipitation occurring from October through March. The highest precipitation and rainfall events occurred during November, December, and January. Tillamook County averaged more than 23 days per year in which precipitation exceeded 1 inch (2.54 cm).

The seasonal, episodic nature of precipitation defines the natural system. Fall chinook migrate upstream with the first heavy rains in late autumn. Big storms cause major landslides in the steeply sloping upland regions. Although heavy storms have characterized the natural system, for thousands of years, human activities have exacerbated the impacts and consequences of high rainfall. Westerly winds predominate and carry the temperature-moderating effects of the ocean over all of western Oregon. Summers are cool and dry; winters wet and moderate. Winds blow nearly continuously throughout the year and often reach gale force in the winter. Prevailing winds come from the northwest during the summer and from the south and southwest during the winter.

Temperatures in Tillamook County are moderate. The mean annual temperature is 50.4°F (10.2°C), with yearly mean maximum and mean minimum temperatures documented at 59.3°F (15.1°C) and 41.6°F (5.4°C), respectively. Less than one day per year has temperatures over 90°F (32°C). September has had the greatest number of extreme temperatures. July and August have recorded the highest temperature of 102°F (38.89°C).

1.3 Soils & Geology

Tillamook Bay and its watershed are situated in typical Pacific Northwest coastal terrain. A relatively straight coastline consists of miles of sandy beaches punctuated with cliffs of igneous rock and small inlets such as the Tillamook Bay. East of the Pacific Coast, the high steep ridges of the Coast Range climb up to 3,500 feet (1,064 m). These upland areas consist mostly of volcanic basalt base material with overlying soils formed from basalt, shale, and sandstone. Primarily an Astoria-Hembre association, moderately deep upland soils cover the

gently sloping to very steep terrain of the forested uplands (USDA, 1964).

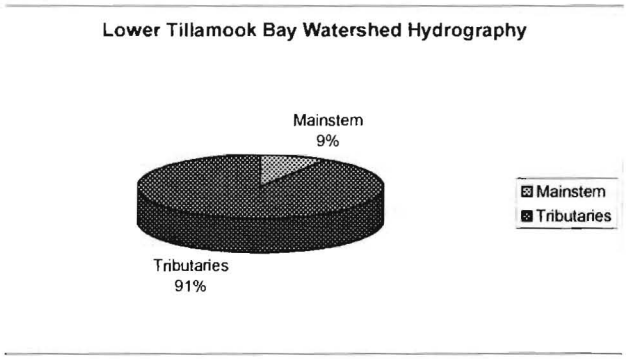
In the Tillamook Bay Basin, five river valleys dissect the steep slopes of the uplands and bring sediment and organic material to the rich alluvial plain and estuary below. In this setting, a discontinuous coastal plain separates the coast and the mountains. Derived from basalt and sandstone-shale bedrock, these deep, level soils of the coastal floodplain have been deposited over thousands of years by the streams and rivers. They range in width from a few hundred feet to more than a mile and can extend upstream up to seven miles along broad stream channels. Known as the Nehalem-Brenner-Coquille association, these are among the most fertile soils in the area, but require drainage for maximum productivity (USDA, 1964). Originally, these soils were almost all forested; but most have been cleared and are used for hay and pasture.

Between the bottomland floodplain and the forested regions, extensive alluvial terraces extend up to 80 feet (24 m). Referred to as the Quillayute-Knappa-Hebo association, these soils have high to medium organic content and are less fertile, but are better drained than soils on the bottomlands (USDA, 1964). Alluvial terrace soils make up about 50 percent of the Tillamook basin's tillable lands.

1.4 Hydrology

As noted above, the Tillamook Watershed receives abundant precipitation. The Tillamook basin drains the west slope of the Coast Range, where precipitation increases with elevation. Due to relatively warm winter temperatures, most precipitation falls as rain. Large rainfall events can produce flood events. However, the rare combination of snowmelt and an influx of warm, wet subtropical moisture cause most of the largest flood events.

The Watershed consists of a winding network of river channels, sloughs, and tributary streams that have been modified by dikes, levees, tidegates and surface drainageways. There are approximately 405 miles of streams of which 91 percent are tributary to the mainsteams of the five rivers or the Bay itself.



Stream Miles by Land Use Lower Tillamook Bay Watershed		
Length by Land use	**Miles**	**Percent**
Dairies	61.21	15.1%
Other Livestock Operations	9.91	2.4%
Urban	5.92	1.5%
Rural Residential	4.75	1.2%
Forestry	278.82	68.8%
Other	44.75	11.0%
Total	405.36	100.0%

Most (69 percent) of the stream miles in the Lower Tillamook Watershed lie with upland forested reaches. Agriculture uses account for most of non-forested stream miles.

The rivers in upper-forested Basin are generally incised in bedrock and contain large amounts of gravel and debris. As the rivers exit the Coast Range, slopes are reduced and

they enter large floodplains with deep alluvial deposits. As the rivers near the bay, they meander in a large complex of sloughs and tidal marshes. Floodwaters deposit large amounts of silt and gravel in the bay and the valley floodplains. Channels migrate rapidly as log jams and debris block floodwaters creating sloughs and tidal marshes. These morphologic changes are natural and have occurred throughout time. However, man-induced changes may have altered the natural balance of the system. It is speculated that actions in the upper watershed may have changed some of the ability of the forest to store rainfall. Roads and drainage facilities throughout the forested watershed may have modified runoff, which may have increase the energy of the rivers leading to Tillamook Bay. During this century, large forest fires and past salvage logging practices in the upper watershed resulted in large pulses of sediment and debris flows into the channel network system that degraded and simplified stream channels and deposited tons of sediment into Tillamook Bay (USACE, 2001). To this day, the streams are still adjusting morphologically to these events having reduced habitat complexity and capacity for salmon and other aquatic organisms. In the valleys, many banks have been protected with riprap, sloughs have been filled-in and bridges have created unnatural hard points in the channels (USACE, 2001).

Major flooding occurred in the Tillamook area in 21 of 80 years during the timespan 1916 through 1996. Flooding in the lowlands surrounding the city of Tillamook is caused by two main sources. Heavy rains combined with snowmelt in the Coast Range can result in high runoff in the local rivers (riverine flooding). Tidal surge produced by low-pressure systems in the Pacific Ocean can cause coastal flooding. When the two processes combine, the area can experience disastrous flooding as in the flood of February 1996. Flooding in the area can occur rapidly as strong orographic lifting occurs along the Coast Range to low pressure systems coming in from the Pacific Ocean. Streams flowing into Tillamook Bay are flashy. Concentration times are short and they quickly respond to rainfall events. For example, in October of 1997, the Wilson River experienced a flood event where it rose from 2,500 cfs to over 20,000 cfs in nearly 11 hours. Streams are normally above flood stage for less than two days; however, during large events, streams have remained above flood stage for three to four days as in February of 1996. Flood stages in the lowlands surrounding the city of Tillamook are controlled by tides in Tillamook Bay (USACE, 2001).

1.5 Socio-Economic Conditions

1.5.1 Historical

American Indian habitation of the northern Oregon Coast began by about 1000 BC with a period called the Early Marine, lasting until approximately 500 AD. American Indians inhabiting the Tillamook Basin at the time of European contact were known as the Nehalem band of the Killimuck (also known as Tillamook) tribe (Seaburg and Miller 1990). The only recorded alteration to the landscape caused by the Killimuck was periodic burning of the lowlands to encourage growth of grains and produce pasturage for horses (Coulton *et al.* 1996). This burning kept some lowlands open and clear of stands of large trees.

Henry W. Wilson brought the first cattle into the area in 1852 and the population grew to 80 by 1854. Most settlers came to the Watershed to farm, and immediately began clearing, diking, and draining the lowland forest to make more farmland available. They also

converted a significant portion of the intertidal and freshwater wetlands to pasture by the early 1900s (Coulton *et al.* 1996). Cheese was the best way to market milk from this remote area, and many small cheese factories opened. Ten smaller cheese producing cooperatives joined forces in 1909 as the Tillamook County Creamery Association.

Early settlers shipped their products by boat, and port activities (from Tillamook and Garibaldi) such as importing and exporting, shipping, and navigational improvements have long been part of the local economy. Boats needed deepwater channels to transport logs and lumber to West Coast markets (Levesque 1985). Before 1913, the Port of Tillamook maintained a shallow draft channel as far as the City of Tillamook for ocean-going ships. The main navigation channel was dredged regularly, beginning in the late 1880s. Dredging near the City of Tillamook ended in the 1920s. The Corps of Engineers last dredged the mouths of the Wilson and Trask Rivers in 1972 in an attempt to alleviate flooding, but ended dredging due to cost considerations.

Although natural resource extraction industries have historically supported the Tillamook Bay region, the Watershed became a tourist destination around the turn of the century (Coulton *et al.* 1996). Hiking, beach combing, wildlife viewing, sport fishing, off-road vehicle use, crabbing, and clamming draw numerous tourists. Many people, especially retirees, are also finding the Tillamook Bay Watershed an attractive place to live. Thus recreational users are competing for natural resources traditionally devoted to farming, fishing, and forestry.

1.5.2 Demographics

This section provides selected demographics of the Tillamook County population. Data are provided on population trends, age structure, employment characteristics, and income characteristics. Because very few statistics are available at the watershed level, most demographics included in this report are given for Tillamook County.

Since 1950, the population of Oregon has doubled and Tillamook County's population has increased by approximately 20 percent (U.S. Bureau of Census 1990). The Tillamook County population declined in the 1960s and rose sharply between 1970 and 1980, largely as a result of fluctuations in the timber industry (Coulton *et al.* 1996). The County population stabilized during the 1980s and has risen steadily in the 1990s. Population growth in Oregon, especially Tillamook County, historically depended on fluctuations in the natural resource industries. In recent years, population growth has been less a reaction to natural resource industries and more a function of living conditions and quality of life concerns. Population growth can be attributed primarily to in-migration, which is expected to continue to increase at a rate of 1.5–2 percent per year.

Population Change – 1950 to 1995 – Oregon and Tillamook County				
Year	Oregon	Avg. Annual % Change	Tillamook County	Avg. Annual % Change
1950	1,521,341	N/A	18,606	N/A
1960	1,768,687	1.63	18,955	0.19
1970	2,091,385	1.82	18,034	-0.49
1980	2,633,156	2.59	21,164	1.74
1990	2,842,321	0.79	21,570	0.19
1995	3,132,000	1.94	23,300	01.53

Since 1960, the older population of the United States (65 years and older) has been expanding at almost twice the rate of the total American population (Davis and Radtke 1994). In addition, much of this older population is migrating to new areas (Davis and Radtke 1994). Tillamook County has become a popular destination for older migrants, who are attracted to its rural, uncrowded conditions and proximity to nature-based recreation. Tillamook County's median age increased from 34.2 years in 1980 to 40.9 in 1990. Comparatively, the median age in Oregon in 1990 was 34.5 years. Additionally, nearly 21 percent of Tillamook County's population was 65 or older in 1990, compared with 14 percent statewide (U.S. Bureau of Census 1990). The continued influx of retirees and the aging of the baby boom generation virtually guaranteed an older population profile for both Oregon and Tillamook County.

Tillamook County's unemployment rate has historically fluctuated with trends in natural resource industries. During the 1970s and 1980s, declining jobs in the timber and fishing industries in Tillamook County caused higher unemployment rates than state and national figures. As of 1995, however, Tillamook County's unemployment rate (4.8%) was comparable to state (4.4%) and national (5.4%) figures (Oregon Employment Department 1996).

Tillamook County lags behind the state and the nation in average annual covered wage rates (Radtke 1995). This may be due to the fact that many jobs are in low paying industries, such as service/tourism industries, or are seasonal or part-time. Growth in these employment sectors, and continued decreases in the availability of family wage jobs, may combine to keep covered wage rates lower than state or federal rates.

1.6 Agriculture

Agriculture in Tillamook County has contributed significantly to the coastal economy since Euro-American settlement. The production of dairy products began in 1852, just one year after the first white settler arrived. During periods of low productivity for timber products and fishing industries, agriculture has provided a valuable, steady income source (Coulton et al. 1997). The number of farms and the land area used for farming have decreased since the 1950s due to conversion and combination of small farms to larger commercial farms (Coulton et al. 1997). In 1995, agricultural commodity sales from Tillamook County totaled $75.8 million (OSU Economic Information Office 1996). Dairy products generated 82

percent of the County's agricultural income in 1995. The only other major agricultural commodities in the County were small woodlots, and cattle and calves, which generated 11 percent and five percent of the total income, respectively (OSU Economic Information Office 1996).

Presently, in the Lower Tillamook Watershed there are approximately 155 dairy related farms (93 milking operations and 62 heifer / replacement operations); and 119 small farms (54 with five or more animal units; and 65 with less than five animal units)

Livestock Operations Lower Tillamook Bay Watered				
Type of Operation	**No. of Farms**	**Forage Acres**	**No. of Animals**	**No. of Animal Units (AU)**
Dairy & Replacement Heifer Operations	155	12,942	25,357	32,964
Other Livestock Operations				
Beef (< 5 Animal Units)	32	169	87	90
Beef (>=5 Animal Units)	40	1,164	775	787
Horse (<5 Animal Units)	21	140	42	53
Horse (>=5 Animal Units)	14	322	129	152
Other (< 5 Animal Units)	12	111	29	6
Subtotal Other Livestock	119	1,906	N/A	1,118
Grand Total	274	14,848	N/A	34,082

1.6.1 Dairy Milking and Heifer Replacement Operations

The dairy milking and heifer replacement operations have been the primary focus of efforts by NRCS and the Tillamook County Soil & Water Conservation District over the last several years. The Farm Location Map (see Appendix E) shows these farms distributed throughout the watershed but with greatest concentrations along the Wilson, Trask and Tillamook rivers.

Most of the operations have some facilities for livestock confinement and storage of animal wastes. Depending on individual site characteristics, dairies need adequate facilities to store livestock wastes for 100 or more days to avoid land application during environmentally unsafe periods (high rainfall). Based on NRCS Field Office records, the average storage currently on these farms is 50 days for liquids and 90 days for solid wastes. While many of these operations may have had adequate facilities in the past, herd consolidations and expansion over the last decade have them with inadequate storage facilities. Herd expansion in the future, however, will be limited by available acreage for disposing of wastes and permitting of dairy operations by the Oregon Department of Agriculture.

Dairies currently have enough acreage available to utilize available nitrogen at agronomic rates based on six ton yields of forage. There are 12,900 acres of land available and 11,900 acres would be needed for nitrogen based applications; however over 25,000 acres would be

needed for phosphorus. Based on soil tests by NRCS on heavily manured fields, soil phosphorus levels ranged from low (10 ppm) to moderate (50 ppm) with an average of 24 ppm (NRCS, 1999). At these levels, according to NRCS nutrient management policy, manure could continue to be applied at nitrogen based rates. Soil tests and the phosphorus index would have to be utilized to confirm whether phosphorus-based applications will be appropriate for individual farm plans. The Tillamook Bay National Estuary Study did not find phosphorus to be a problem. Estuaries, in general, are usually nitrogen not phosphorus limited; however data is specific to Tillamook Bay is still being evaluated.

Pastures on these operations produce between 4 and 6 tons (dry matter) of forage annually. There are approximately 62 miles of streams and ditches on these operations. Efforts locally to fence and re-establish riparian vegetation have been very successful; however, a significant portion (over 70%) of these miles still need treatment.

The NRCS field office estimates 26 of the milking operations and 14 of the heifer operations currently are implementing adequate conservation plans based on today's standards.

1.6.2 Other Livestock Operations

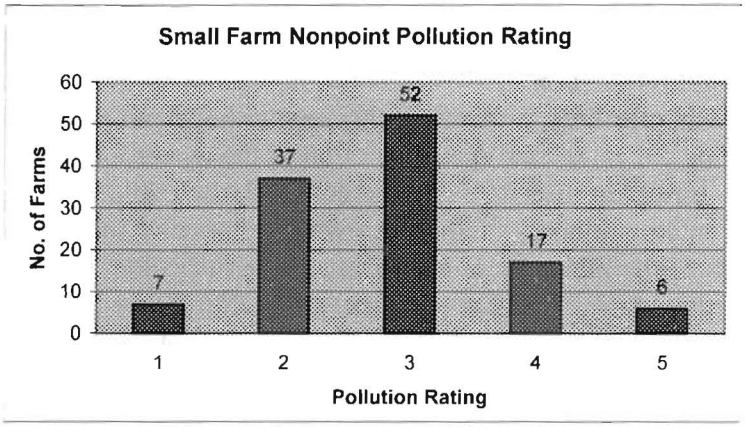
A visual survey of other livestock operations (non-dairy animals) was conducted in May 2000. The goal of the inventory was to locate all farm sites and evaluate the condition of each site in relationship to water quality and habitat. The inventory identified 119 farm sites, an estimated 43 percent of the total farms within the Lower Tillamook Bay Watershed. For this report, a farm is defined as a livestock keeping operation of any size. The Farm Location Map shows the general location of these operations in the watershed.

These livestock operations are primary small, noncommerical farms keeping animals for food or recreation. Over 60 percent of the small farm operations raise beef cattle. Horse ownership makes about 30 percent of the operations while another 10 percent raise sheep or other small livestock.

The farms range in size from four sheep and two beef cows confined to a one-acre paddock up to about 10 horses on 146 acres of pastureland. The most common type of farm has one to five head of beef cattle on an average of five to seven acres. The larger beef operations run from 25 to 60 head of beef on about 40 acres of pastureland. The second most predominant livestock are horses. Some of these farms do not have pastures and the horses are confined to dirt paddocks. Thirty percent of the operations are on parcels of five or fewer acres.

The farm sites were rated for their potential impact on water quality. The rating is subjective based on the presence or absence of observable practices which prevent pollution. The rating was determined using the following criteria: observed pasture condition; confinement area condition and location; slope of the pasture or paddock; animal density per acre; proximity to water and livestock access to rivers, streams, ditches, or wetland; and the presence or absence of manure storage and runoff systems. A rating of one meant the operation had a low potential for polluting waters and a rating of five indicated a high potential. The chart below shows most farms (75) have a moderate or higher potential of polluting area surface waters.

Poor pasture condition, livestock access to streams, continuous grazing and lack of confinement and waste storage facilities are common shortcomings.



Nonpoint Pollution Rating

1 – Low Potential to Pollute
2 – Low to Moderate
3 – Moderate Potential
4 – Moderate to High
5 – High Potential to Pollute

1.7 Commercial Fisheries

The Tillamook Bay ecosystem has historically supported extensive populations of anadromous fish. Coho, chinook, and chum salmon have supported river, estuary, and open ocean commercial fisheries (Coulton *et a*l. 1996). Although commercial fishing in local rivers and Tillamook Bay was regulated and restricted as early as 1892, catch totals and returning spawners decreased steadily. By 1961, the Bay and rivers were closed to commercial fishing entirely and the industry shifted to the sea.

In addition to ocean-based commercial fishing, small commercial shellfish industries have long been a part of Tillamook County's economy. Tillamook Bay has consistently produced Oregon's largest commercial harvest of clams and small local clamming operations have come and gone over the years. Since oysters were planted in the Bay in 1928, Tillamook Bay has been one of Oregon's top oyster-producing bays. Despite this, current oyster harvest levels are far below historic levels. Bacteria contamination and burrowing shrimp are two of leading reasons.

Although ports such as Newport and Astoria claim the majority of the Oregon coast's ocean-bound fishing boats, the fishing industry generated $4.9 million of personal income for Tillamook County in 1994 (Radtke 1995). Traditionally, large populations of chinook, coho, and chum made up most of the salmon catch. For the last several years, only fall chinook populations have been listed as stable or healthy. All other species are listed as depressed or declining (Klumph and Braun 1995b). Because of declines in the salmon fishery, commercial operations have turned to other fish species, primarily bottom fish such as rockfish, whiting, sole, and flounder.

Total personal income generated from commercial fishing is down from approximately $7 million in 1993 and $15 million in 1987 (Davis and Radtke 1994). This represents a 67 percent decrease in Tillamook County commercial fisheries income in less than 10 years (Radtke 1995). Commercial fisheries generated less than two percent of Tillamook County's total personal income in 1993, and this percentage is decreasing (Davis and Radtke 1994).

Tillamook Bay is the state's largest commercial producer of clams, accounting for 60 percent of the statewide harvest.

Oyster production in Tillamook Bay has fluctuated over time, ranging from a high of approximately 30,000 gallons in 1982 to a low of approximately 3,000 gallons in 1999. The personal income generated by oyster production in 1994 was estimated at $161,000 (Radtke 1995). Water quality, oyster growth, mortality, burrowing shrimp numbers, and meat quality play large roles in the overall biological and economic production of the oyster industry. Additionally, harvest of shellfish grown for interstate commerce is strictly regulated to protect human health. Bacterial contamination of shellfish-growing waters and subsequent shellfish harvesting closures have resulted in economic hardship for oyster culturists and contributed to the production trends. Many of the harvesting closures coincide with the highest demand periods, such as Christmas and New Year's (Hayes, J. 1996).

Future projections for ocean-based commercial fisheries are difficult due to changing regulations and ocean conditions, and shifts in species sought. Bottom fish harvesting and long-range fleets have provided an alternative all along the coast to depressed or restricted salmon. Based on existing information, with the exception of fall chinook, all species of salmon and trout in the watershed have shown sharp decreases in harvest levels. The chum, coho, and winter steelhead and introduced summer steelhead stocks are listed as declining in the Tillamook Basin (Klumph and Braun 1995b). It is nearly impossible to measure the impact of commercial fishing on the decline of any of these stocks, and to what extent other factors such as habitat degradation are responsible.

1.8 Recreation and Tourism

Tillamook Bay and its surrounding forests and rivers have long been a popular tourist destination. The region's natural resources support recreational fishing, clamming, crabbing, and hunting throughout the year. Recently, non-harvest recreational activities, such as wildlife viewing, hiking, beachcombing, birdwatching, boating, and simply "driving through" have increased in popularity. The Watershed's proximity to Portland, the largest metropolitan area in the State, creates potential for further development of the tourism industry. Tillamook County showed the highest tourism growth rate of all Oregon's counties between 1987 and 1991 (Davis and Radtke 1994).

Regardless of definition, visitors to Tillamook County contribute to the local economy by purchasing goods and services. Tourism generated $21.6 million dollars, or six percent, of total personal income in Tillamook County in 1993 (Radtke 1995). Tourism-related retail, sleeping, eating and drinking establishments collected most of the tourist dollars (Radtke 1995). The Tillamook Creamery attracts approximately one million visitors each year.

Obviously, many of the tourists who come to the Watershed focus on Tillamook Bay. Radtke (1995) estimated the income generated by "Bay-dependent" commercial and recreation pursuits. Ocean recreational salmon and bottom fishing generated a combined $1.1 million while Bay and Estuary recreational salmon and steelhead fishing generated $3.3 million in personal income in 1994. Most of this money is generated in the fall during the chinook salmon run, when as many as 1,000 boats a day can be seen on the Bay and local rivers.

Many of these boats belong to guides who charge up to $175 per person per day of fishing. About 60 guides belong to the Tillamook Guides Association and many others come from the Portland metropolitan area to lead trips.

For recreational boaters, Tillamook Bay is the most widely used bay in the state, and the sixth most-used water body statewide (Oregon State Marine Board 1994). Virtually all of the boating visitor-days are spent fishing.

Recreational clamming and crabbing in the Bay has been estimated to generate over $700,000 dollars of income annually for the local economy (Radke, 1995). Wildlife viewing, bird watching, waterfowl hunting and sightseeing represent additional outdoor recreational pursuits enjoyed in the watershed.

1.9 Water Quality

Bacteria and other pathogens from both point and non-point sources present a principal water quality problem. Bacterial pollution threatens public health through the ingestion of contaminated shellfish and water, or direct water contact. It also results in frequent closure of commercial shellfish harvesting areas. Many stream reaches do not meet water quality criteria for bacteria or temperature, and exceed recommended concentrations of suspended solids. Dissolved oxygen concentrations meet water quality standards in most areas of the Watershed except in lowland sloughs, where significant oxygen depression has been observed. Nutrient concentrations do not appear to adversely impact water quality except in lowland sloughs. No acute or chronic effects from toxic substances have been observed or monitored. The Oregon Department of Environmental Quality (ODEQ) has listed all five streams as being water quality limited for bacteria and stream temperatures. ODEQ has also completed a Total Daily Maximum Load (TMDL) study that establishes maximum load allocations by land use for both bacteria and temperature (ODEQ, 2001).

1.9.1 Bacteria

Bacterial loading has historically been highest during rainy seasons of the year: fall, winter, and early spring. Seasonal rains wash pollutants off farm fields and from urban areas and can cause sewage treatment plant overflows or bypasses. These pollutants create public health risks associated with water contact and eating raw shellfish. To protect consumers from contaminated oyster meats, ODA regulates shellfish harvesting and closes the Bay after heavy rains or unexpected discharges from sewage treatment plants. Oregon's shellfish growers must comply with FDA's standards for shellfish growing waters to participate in interstate commerce. These closures represent an important problem for local oyster growers. Although not native to Tillamook Bay, oysters grow well under aquaculture methods and historically provided significant income to the region.

1.9.2 Nutrients and Dissolved Oxygen

Plant nutrients, such as nitrogen and phosphorus, can stimulate alga growth and photosynthesis, leading to low levels of dissolved oxygen (DO), in the water.

According the Tillamook Bay Characterization (TBNEP, 1998), the available data for Tillamook Bay does not indicate a serious problems from nutrient loading. Reports of alga blooms in lower stream reaches and sloughs indicate high productivity may occasionally occur. Nitrate levels (between 0.1 and 1.0 mg/liter) in the Bay are within a moderate trophic level. Measured phosphorus levels (0.025 and 0.35 mg/l) also fall within a moderate trophic level. Highest concentration tends to occur during the winter months, which corresponds to periods when the system rapidly flushes and overall productivity is less.

Low DO can be harmful to aquatic or estuarine systems. Streams with low DO no longer provide suitable habitat for rearing, spawning, and migrating salmon. Large inputs of organic wastes, slow water movement, and high temperature can cause low DO. Characterized by slow water movement and nearby agricultural and urban activities, lowland sloughs sometimes have low levels of dissolved oxygen (DO) which may be an indication of high nutrient loading.

According to surveys by citizen volunteers, TBNEP, and state agencies, the main Bay and rivers generally show healthy nutrient and oxygen levels. However, initial surveys of lowland sloughs indicate several places where DO drops below the 8.0 mg/L standard.

1.9.3 Temperature Status and Trends

Temperatures in the lower reaches of the Miami, Kilcis, Trask, Tillamook, and Wilson rivers exceed water quality standards and may adversely affect salmon and salmonid habitat during part of the year. Warm water impairs rearing for juvenile salmonids, inhibits adult migration, and decreases dissolved oxygen levels. Temperatures increase with distance from headwaters of each river. Oregon Department of Environmental Quality has determined that the source of stream heating is derived from the combined effects of past removal of riparian vegetation and the subsequent widening of streams (ODEQ, 2001.)

1.10 Habitat

1.10.1 Lowland/Floodplain Habitat

Agricultural and urban development in the lowland floodplains altered riparian and instream habitats vital to salmon and other aquatic species. In earlier times, bottom land forest and open grassland covered a rich alluvial plain that regularly flooded in winter. This lowland floodplain's off-channel sloughs, oxbows, and wetlands provided ample habitat for rearing fish. A forest of mixed hardwoods and conifers supplied organic matter and insects to feed fish and support aquatic food webs. Large log jams in the main rivers led to frequent seasonal flooding in the floodplains, regularly depositing sediments to lowland areas and providing large areas of salmonid habitat. Log jams and other large wood also created scour pools in the mainstream channels. Adequate levels of large wood are an important component of healthy salmonid habitat. It is widely acknowledged, however, that the total amount and distribution of large wood has been greatly reduced over the last century to levels significantly below what existed historically across the landscape (TBNEP, 1998).

The basin has lost most of its natural floodplain and lowland wetlands. Much of the landscape has been diked, ditched, filled, drained, and cleared, with non-fish friendly tide gates and culverts cutting off fish access to remaining wetland habitat. Instream habitats have been channelized, straightened, armored, and mined. Most lowland riparian areas have been cleared of vegetation, except brush and grass. Livestock have direct access to streambanks and streams in some locations, resulting in crumbling streambanks, trampled vegetation, and disturbed streambeds, all negatively impacting salmon and salmonid habitat. Livestock in streams also pose a public health problem by polluting the water with bacteria. Healthy riparian areas still exist in some floodplain and lowland areas, notably along Hoquarten and Squeedunk Sloughs (TBNEP, 1998).

1.10.2 Estuarine Habitat

Fish and shellfish were historically plentiful in Tillamook Bay and residents quickly began a commercial fishing industry. Shellfish harvests before the 1960s were rarely documented, but Tillamook Bay has long been a major clam and oyster producer. Oysters are not native to Tillamook Bay, but were first planted in the Bay in 1928. Conditions in the Bay are very good for oysters and Tillamook Bay dominated Oregon oyster production for many years. Likewise, the Bay has long been a major clam producer, currently producing about 60 percent of Oregon's clam harvest (TBNEP, 1998).

Dredging and channel control, large wood removal, sedimentation, and the breach of Bayocean Spit have changed the Bay's bathymetry and reduced its complexity. However, diverse species continue to use the Bay. Its tidal channels and sloughs, intertidal sand and mud flats, eelgrass beds, and tidal marsh areas provide structural complexity and a rich source of insects, zooplankton, epibenthic organisms, and other species upon which salmon and other aquatic species depend for food. Juvenile and adult salmonids undergo physiological transition in the sloughs and channels before entering the next phase of their journey. Tidal sloughs were adversely impacted by adding tide gates, filling channels, and disrupting hydrologic connectivity in the floodplain and wetlands. Water in today's sloughs shows evidence of low dissolved oxygen (DO) and increased turbidity. Water quality behind tide gates can suffer due to long residence times and restricted access to tidal and other water exchange. Poorly functioning tide gates and culverts often block fish passage. The loss of off-channel rearing habitat in tidal and freshwater sloughs and oxbows may be an important factor in the decline of coho salmon (TBNEP, 1998).

1.11 Erosion and Sedimentation

Current levels of erosion and sedimentation may adversely impact the human and natural environment. Historic increases in sediment may have caused the loss of spawning and rearing habitat, degradation of estuarine habitats, and changes in the Bay depth, circulation patterns, and response to floods. Sedimentation has been considered an issue in Tillamook Bay and its surrounding watershed due to changes in Bay bathymetry, along with the filling-in of river mouths, sloughs and ditches. In addition heavy sediment loads can damage Bay ecosystems and salmon habitat and contribute to flooding problems. These problems result from changes in sediment quantity and quality, and in how sediments have moved through the Watershed, as well as into the Bay from the ocean.

Recent studies (McManus and Komar et al. 1998) completed by the TBNEP indicate that "about 50 percent of Bay surface sediments are contributed by marine beach sand carried into the Bay by waves, tidal currents and winds, while the remaining 50 percent is sand, silt, and clay from river sources." River sediments result from erosion on the steep slopes of the upper Watershed, along with degraded, eroding streambanks in the lowland floodplains. Sedimentation in the rivers and Bay is a natural process that can be modified by human actions. The influx of sediments to the Bay from ocean sources have stabilized in recent years (TBNEP, 1998). Concern about upland and lowland sources remain, since most sediment is now routed and deposited directly to the estuary, rather than deposited evenly on the lowland floodplain. Loss of instream complexity and floodplain connectivity may speed up the movement of sediment through the system and impact instream habitat value. Levees, roads, and dikes keep the sediment in the channels and move it directly to the lower river channels and Bay. Historic logging practices and forest fires likely contributed enhanced loads of fine-grained sediments carried by the rivers and subsequent rapid growth of shoreline and tidal flats in the southern (upper) end of the Bay. Furthermore, increased concentrations of fine-grained sediment in the rivers are known to be detrimental to fish (TBNEP, 1998). Thus, if there are to be changes in the management of Tillamook Bay and its surroundings, the focus should be on human activities in the watersheds of the five major rivers, and practices that can lead to decreased yields of fine-grained sediments.

Lowland sediments result mainly from bank erosion on agricultural lands. An estimated 9,010 tons of erosion are derived from agricultural lands (USDA, 1978). The absence of riparian vegetation in the lowlands destabilizes riverbanks and increases bank erosion. Without fences or other controls, livestock trample streambanks, destroy riparian vegetation, and increase erosion and water quality problems. In addition, stream channel modifications and the use of riprap to stabilize streambanks may increase erosion through changes in river fluvial response (TBNEP, 1998).

1.12 Biological Resources

Tillamook Bay supports a variety of biological resources, valued for their economic, recreational, aesthetic, and ecological importance. This section provides an overview of what is known about the status and trends of anadromous salmonids, non-anadromous fish resources, bay clams, Dungeness crab, and oysters – arguably the most valued biological resources of the Bay.

Anadromous Salmonids

Pacific salmon are recognized as an icon of the way of life in the Pacific Northwest and are one of the region's most valued natural resources. Tillamook Bay and its five major tributaries historically supported large runs of salmon and steelhead trout (Coulton *et al.* 1996). During the past several decades, the number of adult salmonids returning to Tillamook Bay tributaries has declined. Several resource agencies and many local residents are concerned that degraded habitat conditions may have contributed significantly to the decline of anadromous salmonid populations.

Anadromous salmonid species known to occur in the Tillamook Bay Watershed include chinook salmon *(Oncorhynchus tshawytscha*), coho salmon *(O. kisutch*), chum salmon *(O. keta*), steelhead trout *(O. mykiss*), and sea-run cutthroat trout *(O. clarkii*). Although details of their life history and habitat requirements differ substantially, all spawn in fresh water, migrate through the estuary, and rear for varying lengths of time in the ocean before returning to their natal streams to complete their life cycle.

Chinook Salmon. Both fall and spring races of chinook salmon are present in the Tillamook Bay Watershed. Mature *fall chinook* (two to six years of age) return to all five of the major subbasins from early September through mid-February. Of the five species present in the Watershed, only fall chinook salmon populations appear to be healthy and relatively abundant. *Spring chinook* salmon occur primarily in the Trask and Wilson Rivers, with a small population in the Kilchis River. Essential fish habitat for chinook salmon has been designated by the National Marine Fisheries Service (NMFS) under the Magnuson-Stevens Act (MSA) for the Tillamook area.

Coho Salmon. Coho salmon populations along the entire Oregon coast are now considered depressed and have been listed by the NMFS as threatened status under the Endangered Species Act (ESA). Coho habitat is also listed under the MSA. According to Hasselman (1995), Tillamook Bay coho abundance and adult spawning escapement have shown significant rates of decline not generally observed for other Oregon coastal river basins in the central and north coast.

Chum Salmon. Tillamook Bay historically supported the Oregon Coast's largest chum salmon fishery. During the 1930s and 1940s, catches of over 50,000 fish were common. Oregon is near the southern edge of chum salmon distribution which may, in part, account for the large interannual variability in run sizes that have been observed in Tillamook Bay streams over the years.

Since 1954, the peak counts appear to have declined somewhat and have shown high interannual variability. Due to very low counts on the spawning grounds since about 1992, concern has been growing that the chum population is experiencing serious problems. The Oregon Department of Fish and Wildlife (ODFW) is watching the situation closely. If numbers do not increase in the near future, ODFW may find it necessary to recommend closure of the catch and release fishery on the Miami and Kilchis Rivers.

Steelhead Trout. The NMFS is considering listing steelhead trout along the Oregon Coast as threatened under the ESA, based on concerns that hatchery fish heavily supplement many of the runs and that survival of both wild and hatchery fish has declined recently (Busby *et al.* 1996). The listing petition (ONRC *et al.* 1994) requested ESA protection for the winter runs of steelhead in the Miami, Kilchis, Wilson, and Trask Rivers. Two races of steelhead — "summer" and "winter" — reside in the Tillamook Watershed. Winter steelhead are native to Tillamook Bay streams and are widely distributed throughout the Basin. Summer steelhead were introduced to the Basin in the early 1960s and are supported entirely by hatchery production. No reliable information on the historic abundance of steelhead in Tillamook Bay streams is available. The only information available for assessing trends in the abundance of steelhead runs to Tillamook Bay streams is angler salmon/steelhead report tags and holding pool counts for summer steelhead. The combined recreational catch of winter steelhead for all five subbasins and Tillamook Bay shows a declining trend since the early 1970s. The recreational catch has declined from a high of more than 20,000 in 1970 to fewer than 2,000 in 1993. The trend in the combined catch reflects the trends seen in each of the individual subbasins. The combined recreational catch of summer steelhead for the five subbasins and Tillamook Bay indicates a decline in the catch, particularly since about 1980.

Sea-run Cutthroat Trout. Less is known about the present status of sea-run cutthroat trout than about any of the other anadromous salmonid species in the Tillamook Watershed. Sea-run cutthroat trout, the smallest of the anadromous salmonids present in the Watershed, have not been fished commercially. Although sea-run cutthroat trout are harvested in the recreational fishery, their numbers are not recorded on salmon/steelhead report tags. Therefore, determination of trends in abundance cannot be made on the basis of catch data.

Anadromous Salmonid Habitat

Anadromous salmonids utilize rivers and streams for migration, spawning and rearing; estuaries for adaptation to salt water conditions, refuge from predators, and for rearing; and the marine environment for rearing and maturation. Each of these environments plays a key role in the life cycle of the salmonid species that occur in the Tillamook Bay Watershed.

Substantial habitat can be classified as fair to good, according to an ODFW Aquatic Inventory done the early 1990's (Moore, 1995). Habitat has made substantial recovery from the heavy sediment loading that preceded reforestation, particularly since the early 1970s. However for some species such as coho salmon, which require specific overwinter rearing and refuge habitat, habitat conditions may be near a low point (Moore, 1995). For other species such as the fall chinook salmon, which spawn and rear in main stem and larger tributary habitat and do not spend long periods of time in the freshwater environment, habitat conditions appear to be satisfactory. One of the biggest problems in the Watershed is the general lack of large woody debris (LWD) in the small to medium-size tributary streams. The generally poor ratings for LWD recruitment from riparian areas indicate that recovery of habitat complexity in many areas will be a long process due to the lag time required to reestablish conifer communities in the riparian zone. Better management practices will help eliminate human-caused disturbances that have contributed to the present condition of the freshwater habitat.

Non-Salmonid Fish Species

In addition to its importance in the life cycles of anadromous salmonids, the Tillamook Bay Estuary provides food, shelter and nursery habitat for a wide variety of marine and estuarine fishes. However, fish fauna has not been surveyed recently. The most abundant non-salmonid species in the estuary were euryhaline marine species. Temporal cycles in the composition, abundance and distribution of these species are largely influenced by seasonal spawning migrations, reproductive cycles and the recruitment of large numbers of juvenile fishes that use the estuary as a nursery ground. Information on beach seine catch per effort and on length frequency distribution of Pacific staghorn sculpin, surf smelt, shiner perch, English sole, Pacific herring and starry flounder indicates that juvenile rearing is the primary use of the estuary. However, some species such as shiner perch, starry flounder, and Pacific staghorn sculpin also use the estuary for spawning

Dungeness Crabs

Dungeness crabs are an important biological resource of Tillamook Bay, harvested both for commercial and recreational uses. Most commercial harvesting of Dungeness crabs occurs along the open coast in shallow near-shore waters. The recreational harvest of Dungeness crabs in Oregon takes place in the estuaries. Cycles in crab abundance have been observed in the northern California, Oregon, and Washington crab catch statistics, with a nine to ten-year frequency of relatively high catches alternating with low catches (Berryman 1991). It is assumed that the catch reflects the general abundance of harvestable size crabs. However, because fishing effort varies from year to year due to weather conditions, crab price, and regulatory constraints, population trend analysis based on catch could be misleading.

Oysters

Oysters have been grown commercially in Tillamook Bay since the 1930s. Most of the production has been from culture of the Pacific oyster (*Crassostrea gigas*) that was introduced to the United States from Japan in the early 1900s (Quayle 1988). A smaller variety of *Crassostrea*, the Kumamoto oyster (*C. sikamea*) was introduced in the late 1940s and early 1950s. Between 1970 and 1989, total oyster production in Tillamook Bay remained relatively constant with an average annual production of about 21,200 shucked gallons. This level of production made Tillamook Bay the leader among the oyster producing estuaries on the Oregon coast. However, beginning in 1990, production dropped off sharply and has remained very low since that time. The growth of the oyster industry in Tillamook Bay is limited by a number of factors — some natural and some directly related to human activities.

Water quality affects oyster marketing, as well as growth and survival. One of Tillamook Bay oyster growers' biggest problems is fecal coliform bacteria in the water column, which periodically exceed state and federal health standards. Oysters need an adequate supply of phytoplankton for food, which must be composed of *usable species.* Since oysters remove bacteria from the water column, they may represent a health hazard if consumed raw. High bacteria levels result in temporary shutdowns of the Bay's oyster harvesting.

Clams

Twelve species of bay clams are found in Tillamook Bay. Gaper, cockle, butter and native littleneck clams are the most important commercially and recreationally. The long-term health of the bay clam population depends on maintaining good water quality and retaining appropriate substrate. Increased sediment deposition in the Bay could threaten some clam beds. Bacteria is less of a health concern with the harvest of clams compared to oysters since they are more thoroughly cooked before consuming.

1.13 Threatened and Endangered Species

The table below displays the species listed as endangered, threatened or candidate under the Endangered Species Act that may occur in the Tillamook County. The last column indicates which species possibly occur within agricultural regions of the watershed.

Listed Species	Status	Occurrence in Project Installation Areas
Stellar sea lion	Threatened	No
Marbled murrelet	Threatened	Possibly
Aleutian Canada goose	Threatened	Yes
Western snowy plover	Threatened	Unlikely
Bald eagle	Threatened	Yes
Brown pelican	Endangered	Unlikely
Northern spotted owl	Threatened	Possibly
Oregon silverspot butterfly	Threatened	Possibly
Nelson's checker-marrow	Threatened	Possibly
Coho salmon	Threatened	Yes
Columbia River cutthroat trout	Proposed	Yes
Steelhead	Candidate	Yes

Species of concern that may occur in the watershed include: white-footed vole, Pacific western bigieared bat, California wolverine, Pacific fisher, long-eared myotis, fringed myotis, long-legged myotis, Yuma myotis, olive-side flycatcher, little willow flycatcher, tailed frog, northwestern pond turtle, northern red-legged frog, southern torrent salamander, green sturgeon, river lamprey, Pacific lamprey, pind sandverbena, tall bugbane, north coast birds-beak, frigid shootingstar, coast range fawn-lily, queen-of-the-forest, saddle mountain saxifrage, and Cascade Head catchfly.

In 1996, the Magnuson-Stevens Act was re-authorized and changed by amendments to emphasize the sustainability of the nation's fisheries and establish a new standard by requiring that fisheries be managed at maximum sustainable levels and that new approaches be taken in the conservation of "Essential Fish Habitat" (EFH).

Under the Magnuson-Stevens Fishery Conservation and Management Act, both chinook and coho are listed for protecting Essential Fish Habitat (EFH).

1.14 Cultural Resources

A search of cultural resource files maintained at the State Historic Preservation Office (SHPO) in Salem, Oregon revealed that two buildings within the Lower Tillamook watershed, the US Post Office in Tillamook, and the US Naval Air Station Dirigible Hangar B, are listed on the National Register of Historic Places. SHPO maps also show two documented archaeological sites 35TI-7 and 35TI-9 and three reported but unverified archaeological sites within a mile of potential undertakings. The unverified sites include a burial and two historically attested Tillamook villages, Chishucks and Towerquotton. The scarcity of recorded sites within the Lower Tillamook watershed should in no way imply that the proposed projects pose no threat to significant archaeological resources. Ethnographic and archaeological evidence (Hajda 1984:67-90, 98-102; Newman 1959; Moss & Erlandson 1995) indicates that habitation of the resource rich area around Tillamook Bay and its tributaries dates back over nine-hundred years. The dearth of recorded sites encompassed by the watershed is more likely a reflection of the lack of a systematic archaeological survey on private land.