

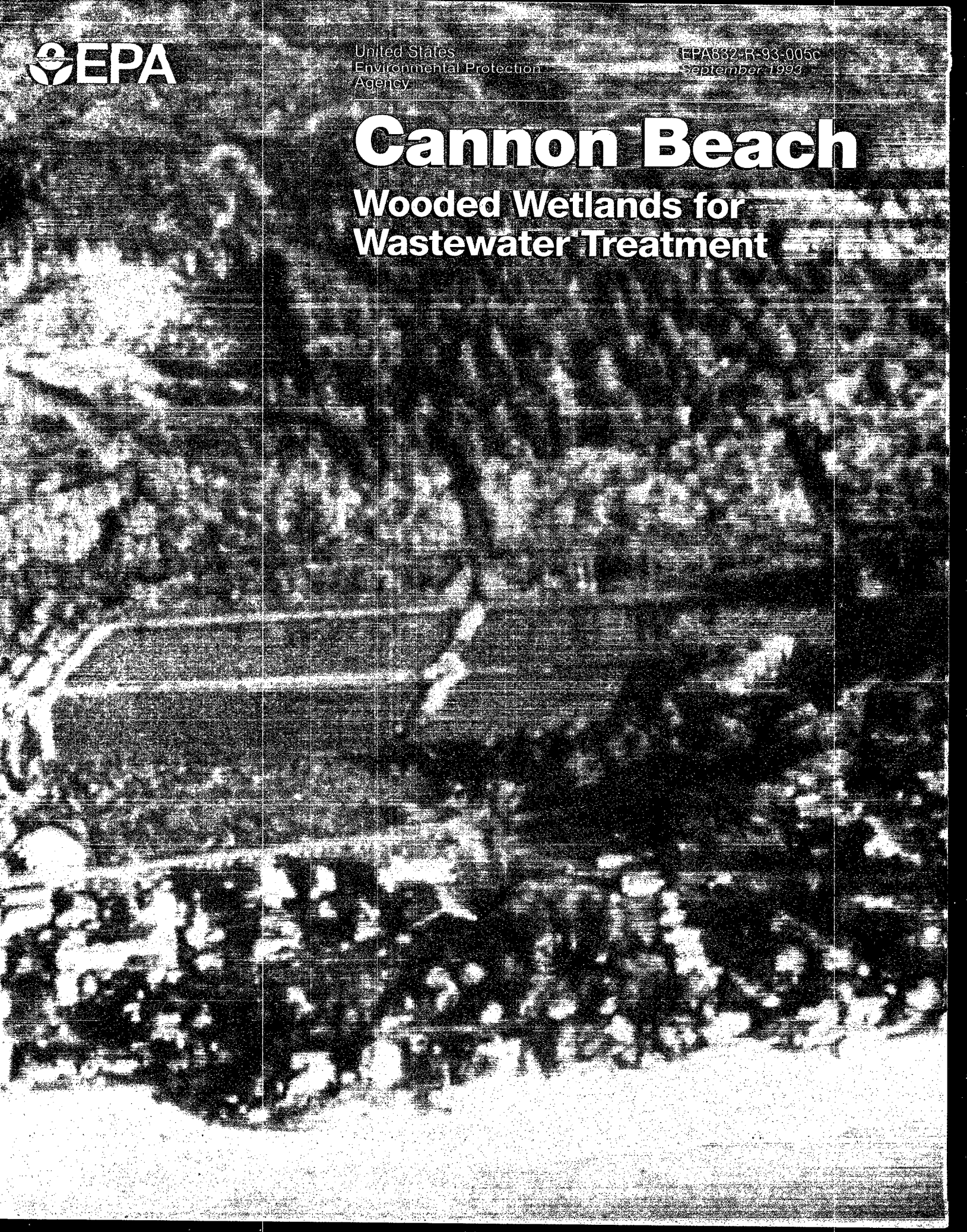


United States  
Environmental Protection  
Agency

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# Cannon Beach

## Wooded Wetlands for Wastewater Treatment



## THE HISTORY OF THE PROJECT

**D**ucks, geese, elk? These are not usual inhabitants of a wastewater treatment system. But in Cannon Beach, Oregon, particularly in the fifteen acres of the wooded wetlands cells of the system, they are a common sight. How did this come to pass?

Let's look a little closer. The City of Cannon Beach had a problem—how to treat and dispose of its wastewater. With much citizen involvement, a cost-effective ecologically-interactive wastewater treatment facility was created. This Environmental Protection Agency (EPA) funded "Innovative/Alternative" treatment system uses an existing wooded wetland to provide the final stage of the treatment process.

Here's the story. The three-celled sewer lagoon complex in existence at the time of the passage of the Clean Water Act of 1972 could not meet the more stringent effluent quality standards set by the Oregon Department of Environmental Quality (DEQ). In response to this situation, the City began a Facilities Plan. The completed plan recommended options for system upgrading which met with considerable community opposition.

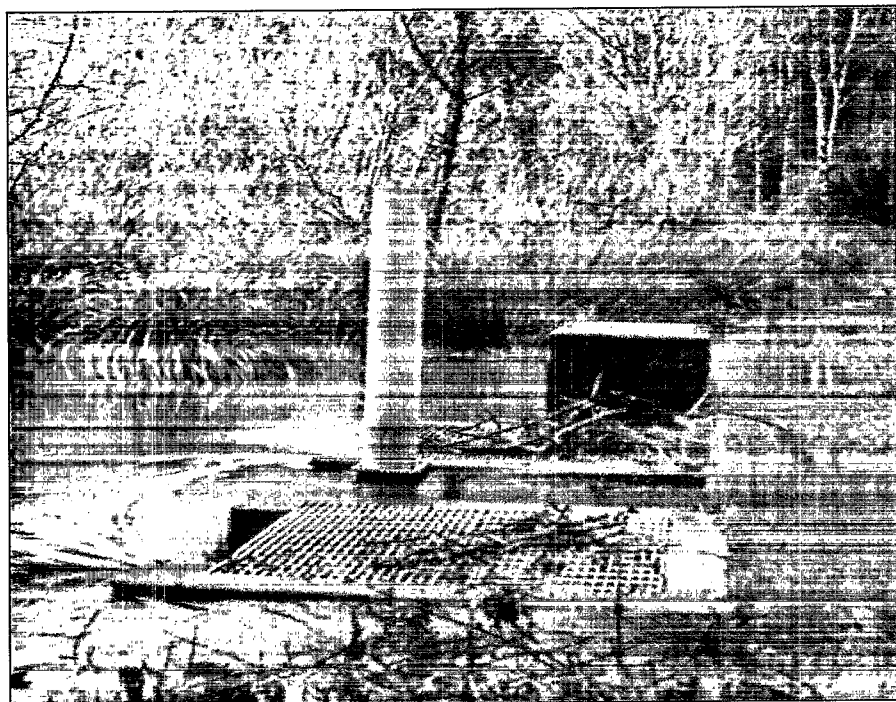
At this point in 1977, a Sewer Advisory Board was formed. The City of Cannon Beach is a resort community and during the tourist season the population swells from a permanent size of 1,200 to many times that number. Any design considered by the Sewer Advisory Board would have to be able to accommodate these large fluctuations in wastewater flows.



Confrontation led to a City commitment to pursue a biological solution instead of more high-tech treatment units to upgrade the treatment system. The bureaucratic struggle that ensued lasted eight years and the remarkable result of these meetings was the consolidation of a set of ideas which emerged as yet another facility plan addendum. The issues deliberated included: the use and integrity of the wetlands, elk habitat, chlorination, point of discharge, birdlife, the extent of ecological upset, berming and baffling, fencing costs, and the risks

*Confrontation led to a City commitment to pursue a biological solution instead of more high-tech treatment units to upgrade the treatment system.*

*Effluent structures during winter flooding (when wetlands are typically not operated).*





*Typical vegetation in the majority of the wetlands (brush, sedges, and ferns).*

of using new treatment techniques. It is a tribute to the professionals representing the various agencies involved in these meetings that, in spite of diverse and sometimes disparate responsibilities and divergent goals, negotiations took place in a spirit of cooperation and compromise sufficient to allow development of an approvable treatment scheme.

This scheme, the wetlands marsh wastewater treatment system, appeared

in draft Facilities Plan Addendum No. 2 in October, 1981 and became final in March, 1982. The Plan subsequently was adopted by the City Council and approved by all the appropriate agencies through the State Clearinghouse review process. Shortly thereafter, a grant application was completed and submitted to the DEQ and EPA and approval of funding for the project was granted in September, 1982.



## DESIGN

**H**ow does the treatment facility work? Contrary to popular belief, raw sewage, or wastewater as engineers prefer to call it, is over 99% pure water. About half of it comes from toilets and most of the rest is from kitchen sinks, showers, bathtubs, and washing machines. The Cannon Beach treatment system consists of a four-celled lagoon complex followed by two wooded wetland cells which serve as a natural effluent polishing system.

The objective of the wetland treatment is to meet water quality requirements with minimal disturbance to the existing wildlife habitat. Dikes, containing water control structures, formed the wetland cells, constituting the only physical alteration to the natural wetland. The fifteen acres of wetlands are primarily red alder, slough sedge and twinberry, including the remnants of an old growth spruce forest. These wetlands act as a natural filter to complete the treatment process, and the wildlife is not disturbed.

Design of the wooded wetland wastewater treatment system, along with improvements to the existing lagoon system, began in December, 1982. The design of treatment system improvements and the wetland system centered around meeting stringent effluent limitations imposed by the DEQ. Technically speaking, the wastewater treatment focuses primarily on the reduction of both biochemical oxygen demand (BOD) and suspended solids (TSS). The average monthly limitations were 10 mg/l of BOD and TSS during dry

weather and 30 mg/l of BOD and 50 mg/l of TSS above Ecola Creek background levels during wet weather.

The principal mechanisms in achieving BOD and TSS reductions in wetland systems are sedimentation and microbial metabolism. Absence of sunlight in the canopy covered wooded wetland contributes to significant algae die-off and subsequent decomposition. The two-celled wetland system was designed with multiple influent ports into the first cell, multiple gravity overflow into the second cell, and a single discharge from the second cell to Ecola Creek. Each cell was designed with approximately 8.0 acres surface area to be operated in series.

Improvements to the existing lagoon system were to provide capacity through the design year of 1998. They centered around three major improvements: upgrading the hydraulic capacity of the system; decreasing the loading to the facultative lagoon system with the addition of an aerated lagoon; and adding a chlorine contact chamber to provide adequate disinfection before discharging to the wetland marsh system.

The operational strategy developed around: 1) operating the upgraded facultative lagoon system during the wet weather period of the year, and 2) operating the aerated/facultative lagoon system along with the wooded wetland system during the dry weather season.

### 1998 Dry Weather Design Population, Flows and Loading

Population Equivalents 4085

#### Lagoons

Flow 0.68 mgd

Ave. Detention Time 7-15 days

BOD 817 lbs/day

TSS 817 lbs/day

#### Wooded Wetland

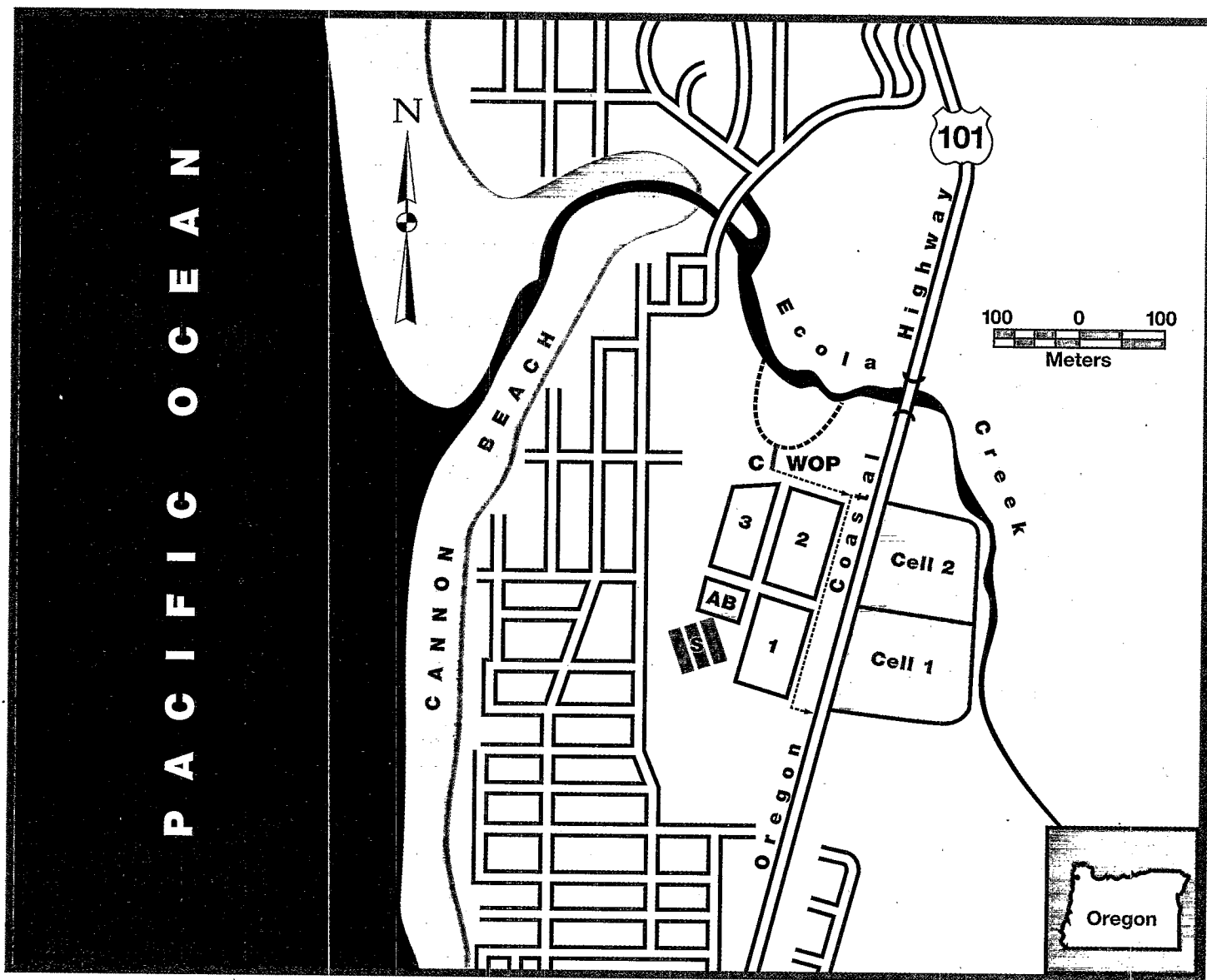
Flow 0.42 g/ac/day

BOD 14 lbs/ac/day

TSS 18 lbs/ac/day

*Effluent structures and vegetation located in north dike.*





**AB** ..... Aeration Basin  
**1, 2, 3** ..... Facultative lagoons  
**S** ..... Sludge disposal pits

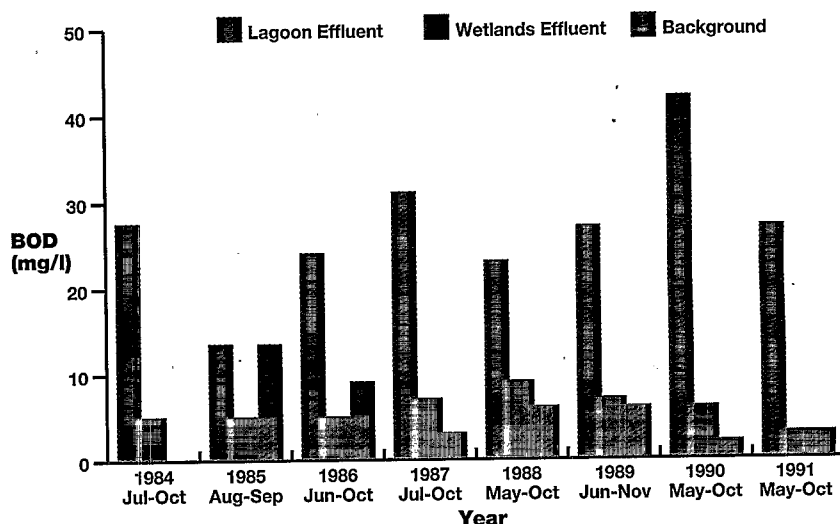
**C** ..... Chlorine contact chamber  
**WOP** ..... Winter outfall pipe  
**Cell 1, Cell 2** .... Wetland treatment cells

## CONSTRUCTION AND OPERATION

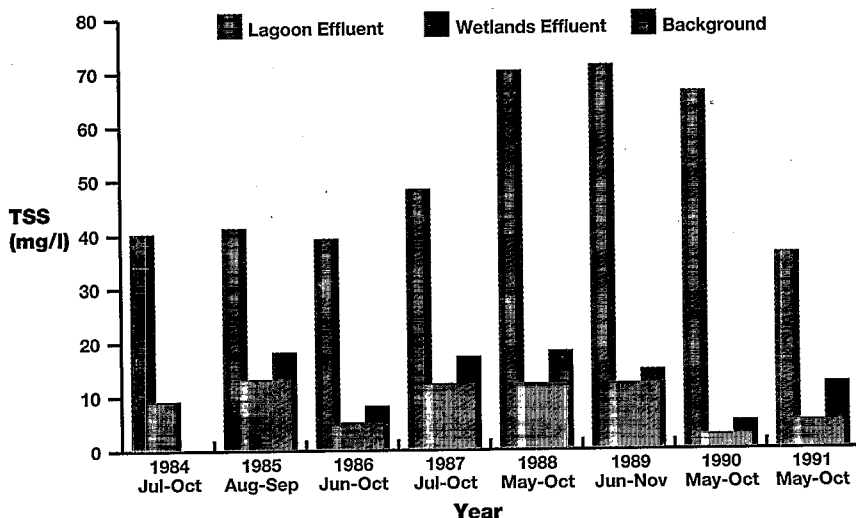
**C**onstruction of the wastewater facility improvements began in July 1983 and the facility officially began operation in June 1984 when flows from the facultative lagoons were initially pumped into the wetland. The system was initially operated with the aerated lagoon effluent flowing in series to the three facultative lagoons, with chlorinated effluent pumped to the wetland cells which were operated in series. The discharge from the system into Ecola Creek is approximately 25% to 50% of the influent flow with the remainder lost through evapotranspiration and seepage. The wetlands cells were initially operated at an approximate average depth of one foot and a detention time of 10-14 days.

Lagoon effluent BOD and TSS have averaged 27 mg/l and 51 mg/l respectively, while the wetlands effluent BOD and TSS averaged 6 mg/l and 11 mg/l respectively. Background water quality in Ecola Creek has averaged 6 mg/l BOD and 13 mg/l TSS. The wetland removes an average of 12% of the influent BOD while removing 26% of influent TSS. Operating efficiency has improved over time with respect to BOD and TSS. In 1991, an average of only 3 mg/l of BOD was discharged. For TSS, the past two years have shown average discharge concentrations of 2 and 5 mg/l respectively. These rates were significantly lower than those of five out of the first six years of operation.

**City of Cannon Beach  
Wastewater Treatment Facility: Effluent Quality**



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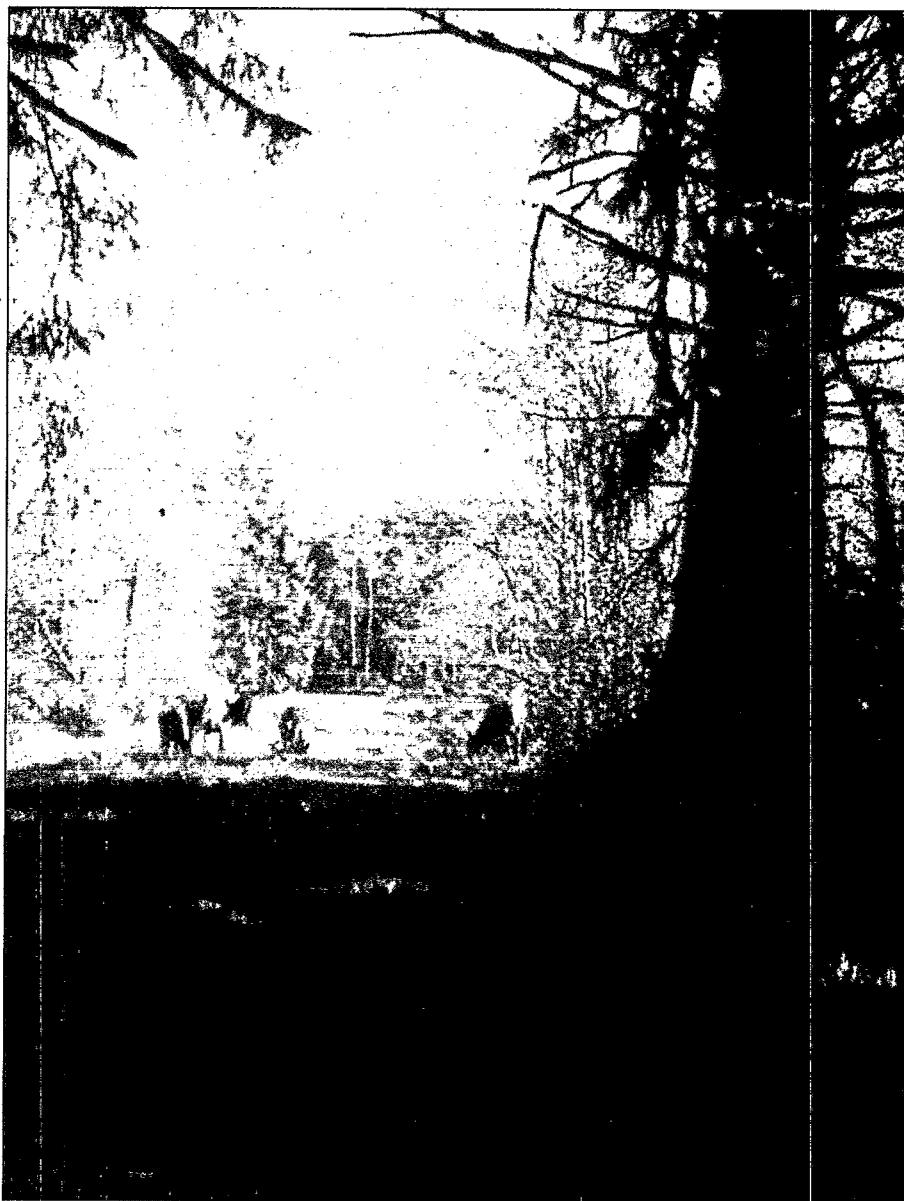
## COSTS AND BENEFITS

**T**he system has been a success. Performance of the system has exceeded expectations as the effluent has come close to meeting the 10/10 effluent limitations without considering the background water quality. The City has met its monthly permit requirements with only one exception with respect to concentrations in the first eight years of operation. The water quality impact on the creek has been significant, only 25% of the mass discharge loading directly reaches the creek.

The capital costs of the total system improvements were \$1.5 million in 1983. Of that, approximately 40% was classified innovative and alternative under the provisions of the Federal Clean Water Act, thus higher funding was provided by EPA. The City received an approximate 80% grant from the EPA. A significant portion of the City's share has been financed through a loan from Farmers Home Administration.

The total Sewer Department's 1992-1993 budget is approximately \$600,000. The total operational costs of the pond/wetland treatment facility represents approximately 12% of this figure. Staff includes one full-time operator who devotes approximately half of his time to plant operation and laboratory work, a weekend public works utility person, and a summer student intern.

Sewer billings are based on water usage, using a base rate of \$7.50 for the first 600 cubic feet and \$1.25 for each additional 100 cubic feet. This rate has remained unchanged since 1983. A 10% across-the-board increase is currently under consideration.



*Elk browse on their long-time path to Ecola Creek, along the edge of the wooded wastewater wetland, just 700 feet from downtown Cannon Beach.*

## A NATURE STUDY SITE

**T**reatment of facultative lagoon effluent through the use of a natural wooded wetland has been demonstrated as an effective method over the eight years of operation. The City's direct discharge to Ecola Creek has been reduced and its quality has been improved resulting in improved water quality for the creek. The capital, operation, and maintenance costs utilizing the wetland treatment system are significantly less than alternative systems. The treatment lagoons and wetland cells are a physical reality and an integral part of the City. Involvement in this sewerage project has resulted in a heightened awareness of the physical setting in which we live, the biological processes of which we are a part, and the society in which we function.

The City has cooperated with the school system in setting up a partnership. Educational materials that integrate social studies and science have been developed cooperatively using a City liaison person and resource teacher. As well as serving as a nature study site, the treatment marsh has been the focus of programs devised by Citizen Education. Waterfowl have been monitored by citizen effort. Tours are conducted for environmentally oriented classes; for groups of teachers, for sewer operators, for those seeking wastewater treatment solutions for their communities and for local citizens, as well as any interested individuals.

The organic nature of the sewerage facilities, the lack of offensive odor and the open layout of the facility contribute to a land use scheme that



has a minimal disruption to the environment. Very few visitors realize that the City's sewerage facilities are just 700 feet from the downtown shopping area! Within the site, the stream flows, trees and plants grow, and animals and birds come and go. Numerous species of wild ducks can be seen on the lagoons, elk can be seen in the wetlands area, fishing, walking, and bird watching take place here.

*Within the site, the stream flows, trees and plants grow, and animals and birds come and go.*

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*This brochure is dedicated to the memory of Don Thompson, "The Thinker and the Doer of the Cannon Beach Sewer."*

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