Liberty Bay
Nearshore Habitat Evaluation & Enhancement Project

Prepared by

Environmental Research Scientist/Engineer: Christopher W. May, Ph.D.

and

Project Director: Kathleen Byrne-Barrantes

GIS Technician & Volunteer Coordinator: Luis E. Barrantes

for

THE LEMOLO CITIZENS CLUB & Liberty Bay Foundation

Funded through the Washington State Department of Ecology Water Quality & Environmental Assessment Program by the U.S. Environmental Protection Agency Non-Point Source Pollution Funds GRANT PROJECT #G0100125

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Final Report

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Christopher W. May, Ph.D.
Environmental Research Scientist/Engineer
Poulsbo, Washington 98370
Affiliate, University of Washington
Adjunct Professor, Western Washington University
Senior Research Scientist, Battelle Marine Sciences Laboratory

Kathleen Byrne-Barrantes
President, Liberty Bay Foundation
& Grant-Solutions, Inc.

and

Luis Barrantes, GIS Services
olympicgis@comcast.net
17212 Lemolo Shore Drive NE
Poulsbo, WA 98370

Department of Ecology Project Managers:
David Pater & Sarah Davenport-Smith, NWRO

In association with:

Liberty Bay Foundation

Suquamish Tribe

Kitsap County Health District

Marine Taxonomic Services, Corvallis, OR

Washington State Departments of:

Ecology, Fish & Wildlife

Salmon Recovery Funding Board

Puget Sound Action Team

for

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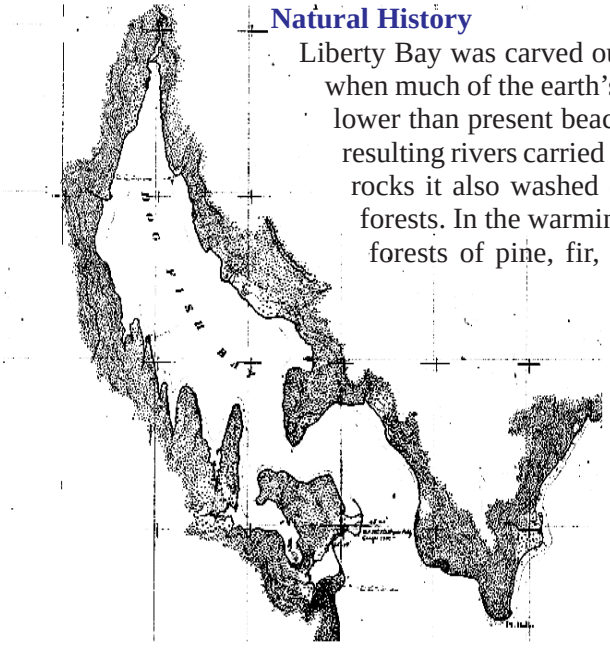
Executive Summary

Liberty Bay is one of many embayments that lie in the middle of the Puget Sound trough, bounded by the Cascade Mountains to the east and the Olympics to the west, in and around the town of Poulsbo and the *Naval Undersea Weapons Center* (NUWC) installation at Keyport, in Kitsap County. It is a unique and important part of the Puget Sound ecosystem, providing nearshore habitat for fish and wildlife, and recreational opportunities such as swimming, water sports, shellfish harvesting, fishing, and boating. However, due to the pressures of shoreline development and watershed land-use activities, the natural resources of Liberty Bay have been stressed. The loss of natural forest cover, native soil structure, wetlands, and riparian vegetation all contribute to the disruption of the natural landscape. Shoreline development has resulted in the loss of physical habitat. Nonpoint-source (NPS) pollution carried by stormwater runoff has degraded water quality in Liberty Bay and its tributaries.

Nearshore Ecology

Puget Sound is an estuary ecosystem with a diverse array of nearshore and freshwater habitats. To understand the importance of nearshore habitat, one must learn the processes that the ecosystem establishes, and the functions that are held in place by these. The nearshore ecosystem is the meeting place of air, land, deep marine water currents, and freshwater flows. It has been called the "bathtub ring" because it is the rim of elevation around the inland waters — from the upper beach riparian and erosional zones to the bottom of the photic (light penetrating) zones in the marine water and benthic substrates (*Marine Resources Summit 2003*). It is a transition zone, with many ecotones contributing to the mosaics that make up the ecosystem. In general, nearshore habitats are defined by a variety of complex interactions between physical, geological, chemical, and biological components. The effects of human-caused changes in physical conditions affect the structure of habitats, and ultimately their function. This may help us understand natural and human-caused effects on nearshore functions.



Natural History

Liberty Bay was carved out by the great glaciers that came down from the north when much of the earth's water was frozen and ancient shorelines were 100 feet lower than present beaches (Rangvald Kvelstad, 2004). The retreating ice and resulting rivers carried gravel, sand, and clay – soil. While the glacier deposited rocks it also washed down fertile quantities of decomposed earth from the forests. In the warming climate, nature covered the landscape with grass and forests of pine, fir, cedar, spruce, hemlock, willow, madrona, and maple dominating the upland landscape (Kruckeberg, 1991). Man introduced blackberry vines and the scotch broom into the environment about 150 years ago. Under natural historic conditions, a rich mixture of native forests and wetlands covered the Liberty Bay watershed (**Figure 2**). The natural nearshore areas were a complex medley of tidal wetlands, rocky beaches, sand spits, eel grass meadows, small-stream estuaries, brackish lagoons, and eroding bluffs (Kruckeberg, 1991). The largest drainage was Dogfish Creek, that forms an estuary at the head of the Dogfish Bay (former name of Liberty Bay).

HISTORY OF CIVILIZATION & SHORELINE DEVELOPMENT

Inhabitants of this area for over 15,000 years, the Suquamish Tribe harvested its abundance. Before white settlement, fishing was the most important source of food; Chinook, Chum, and Coho salmon caught with lines made of nettle stems and natural roots. Smaller fish, herring, and smelt were taken with "rakes" dragged through the water. It was the water, teeming with fish, soil full of rich organic humus, and verdant forests left behind by the glacier's retreat that brought the first Scandinavians to Poulsbo (1880) to harvest the timber, find fresh game, and carve out farmland. Next came the roads made by the growing timber industry and within 20 years nearby forests were cut and the logging came to an end (Prine, 2004). Abundant fish fueled the codfish industry and a "Mosquito Fleet" of steamers sailed from Seattle to Poulsbo for 60 years. World War II brought a housing boom to accommodate workers in Keyport. Homes popped up all along the shorelines and hills, many enjoying unobstructed views of the Olympic range as the intervening hills and ridges had been denuded of timber. Within a span of five generations, the Liberty Bay area grew from untouched shores to a thriving community.

PROJECT PURPOSE & SUMMARY OF KEY ELEMENTS

The goal of the Liberty Bay Nearshore (LBNS) project was to 1) characterize the watershed utilizing historical data and to evaluate current habitat and water-quality conditions, 2) provide public education, encourage community involvement, and increase citizen stewardship, and 3) reverse the degradation through shoreline revegetation and restoration program.

- The LBNS project evaluated physical habitat characteristics, monitored physio-chemical water-quality, completed inventory of priority species, developed a program for regular monitoring, and conducted biological sampling. This information will provide a baseline assessment of ecological conditions in Liberty Bay to support adaptive management, future conservation, enhancement, and restoration efforts.
- The LBNS project provided education for homeowners about erosion and the negative impacts of bulkheads, stormwater, and improper septic systems. Children and adults had opportunities and places to develop a sense of caring and ownership for marine resources, and to learn how impacts to the nearshore, intertidal and estuarine habitats are compensated by effective improvements.
- Working in cooperation with key stakeholders, the project mitigated adverse effects of shoreline development on habitat by planting abundant native vegetation in the nearshore zone. Volunteer opportunities were easy and fun, and for more complex projects, well supported by advisors.
- A technical advisory team helped manage activities, shared understanding of the issues, engaged new players, and helped build opportunities for volunteers to participate in monitoring and restoring marine habitats. Other elements, such as characterizing diversity and abundance of fish species, salt marsh vegetation, benthic and shellfish surveys, provide a gauge of ecosystem functions with which to predict environmental outcomes of future "salmon focused" restoration projects.

This project recognizes the importance of community-based involvement in watershed issues. If funding continues to be available for watershed restoration in Washington State, positive measurable outcomes will be achieved. The problem we will face, however, is how will we keep them that way? That answer lies within the watershed communities which are most impacted by laws and regulations brought down to them by governmental agencies, which often carry substantial burden. If they are not involved in a positive and productive way, watershed restoration, on a long term basis, will not be successful.

ENTITIES CONTRIBUTING TO THIS PROJECT

State Dept. of Ecology & project managers David Pater, Sarah Davenport-Smith, Aleceia Tilley, Dan Filip, Lemolo Citizens Club, Liberty Bay Foundation, Kitsap County Health District, Suquamish Tribe, Salmon Recovery Funding Board & IAC Project manager Mike Ramsey, Marine Taxonomic Services Corvallis OR owners Howard & Kathy Jones, the Kitsap Peninsula Business Journal, North Kitsap Herald & Editor Joe Irwin, Kitsap SUN reporters Chris Dunagan and Susie Oh, Bight of Poulsbo Inc. & Bill Austin, Poulsbo Noon Lions Club, North Kitsap High School Horticulture & Marine Science Classes, Northwest College of Arts Natural Resources Class & Brent White, West Sound Academy, Americorps, Central Market & Manager Tom Hall, Starbucks Corporation, Kitsap Master Gardeners, Kitsap Trees & Urban Forester Jim Trainer, Washington Scuba Alliance & Don Larson, Bud & Mary Jean Bushnell, Jocelyn Horder, Jim & Suzan Martin, State Dept. of Fish & Wildlife & Doris Small, Washington Sea Grant, U.S. Congressman Jay Inslee, State Senator Phil Rockefeller, State Representative Sherry Appleton, Kitsap County, City of Poulsbo, as well as many volunteer and professional organizations and individuals working in the Liberty Bay watershed.

ENVIRONMENTAL ASSESSMENT and GEOGRAPHICAL INFORMATION SYSTEMS (GIS) MAPPING

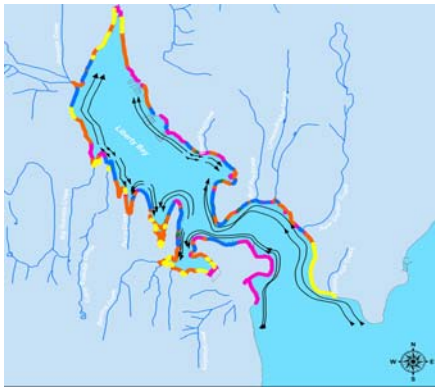
The intertidal zone is home to an incredible diversity of plants and animals that live at the edge of the sea. Juvenile and migrating adult salmonids depend on forage fish, benthic fauna and an intertidal zone that supports them. As our population grows in coastal areas, so may our impacts on marine habitats. Long-term *Intertidal Habitat Monitoring and Surveying* of species of intertidal plants and animals, habitat conditions, and other attributes collectively indicate the Bay's overall environmental health.

Therefore, the *key objectives* of this project are:

1) Mapping: The comprehensive nature of the Liberty Bay Nearshore Habitat Evaluation and Enhancement Project required the gathering of a vast amount of data. Critical to the overall success of the project was the development of a Geographic Information System (GIS) to handle the data and facilitate its analysis and ESRI's ArcGIS 8x was selected as the software. Luis Barrantes, volunteer coordinator, attended training for >year and was responsible for development and maintenance of the GIS.

Base layers were obtained from various sources including the Kitsap County GIS department. Our data collections were done by trained volunteers and input into the GIS. The County is cooperating on the project by sharing GIS data and may use the list of identified potential restoration and preservation projects to guide its own efforts in the Bay and may also use mapping data to augment the information provided in the Limiting Factors Analysis and other reports.

Mapping current conditions will enable us to target areas for revegetation and enhancement efforts and will also provide identification/location of possible stressors to salmonids or prey species including the loss of riparian vegetation, shade and its role in moderating temperatures and moisture of smelt spawning substrates, loss of organic matter and prey input to the nearshore.



2) Seining: The project team and 3 schools assisted the Suquamish Tribe in obtaining fish species information by 'beach seining' which employs a net dragged across the bottom of the bay. When the 'purse' is pulled, the fish are counted and tagged fish are collected for laboratory analysis. Beach seining projects conducted by the WDFW and Tribe are finding high counts of terrestrial insects in the stomachs of juvenile salmonids suggesting that salmon gorge on insects from vegetation thriving in the nearshore.

3) Inventory: To detect gradual changes to habitats and local biodiversity, we need long-term data sets. The key to getting reliable scientific data is to use standard survey methods so that everyone is collecting data in the same way over time at all sites.

We employed a rigorous intertidal surveying methodology, collecting detailed data annually at the same sites for >3 years then entering the field data into the Dept. of Ecology Environmental Information Management (EIM) database. This will serve as a baseline to help determine if future actions meet the standards of the Endangered Species Act. The study area has a documented surf smelt spawning area and vegetation would provide food for salmonids, forage fish and their prey as well as water quality abatement from the adjacent road.

4) Shoreline Modifications: Future restoration efforts may be guided by the inventory of existing shoreline modifications. In addition to identification of potential restoration sites, we identified those natural areas that should be protected, including an inventory and qualitative assessment of shoreline modifications. This will lead to identifying bulkheads and other structures that can be removed or improved to reduce the impact on nearshore habitat.

We found that approximately 50% of the shoreline of Liberty Bay is still in a natural condition. These natural areas are concentrated along shoreline areas with relatively steep slopes. Most of the low-bank areas of Liberty Bay are in a modified condition, with bulkheads, docks, and other structures. The area with greatest potential to benefit from revegetation efforts is the eastern shore of Liberty Bay, however, the recent construction of the Liberty Bay trail leaves no plantable shoulder and therefore this opportunity was lost.

The bay was subdivided into survey sections based on the *drift cell* defined by the net shore drift or "long-shore" drift which is the primary sediment transport mechanism in the Puget Sound nearshore environment. The easiest, most effective way to do this was with GPS and a digital camera to photograph individual properties. By using software to synchronize the GPS and digital camera clocks we were able to georeference each photo and plot then matching existing property lines using the parcel shapefiles with the photographs to create shoreline modification map. Structures or docks, floating platforms or moorings and stormwater outfalls were also mapped. View this from our website under GIS.

5) Submerged Vegetation Surveys Macro-algae were ubiquitous throughout Liberty Bay. However, no eelgrass was found anywhere in the study area. According to the DNR, 1/3 of all historic eelgrass beds in Puget Sound have been lost.

WATER QUALITY MONITORING PROGRAM

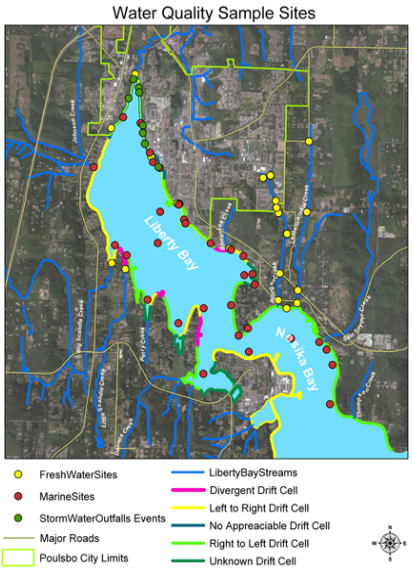
***Problem*:** Previous water quality studies of Liberty Bay indicate that significantly high fecal coliform counts are common in the Bay and its tributaries (*1994 Liberty Bay/ Miller Bay Watershed Water Quality Data Summary)*. The report describes the results of numerous studies over the previous 10 years in Liberty Bay using fecal coliform (FC) bacteria as an indicator of water quality and human impact. Marine samples collected in Liberty Bay and its tributaries (i.e. Dogfish Creek, Scandia Creek, and Johnson Creek) have routinely violated state standards. In addition, eroding shoreline bank failures, uncontrolled stormwater runoff, and upland development in and around the City of Poulsbo, has contributed to degradation of the bay.

***Objective*:** To affect non-point source (NPS) pollution problems through evaluation of existing conditions, implementing long-term, comprehensive improvements, while promoting citizen stewardship. To achieve these goals, we provided volunteer training, shoreline monitoring, and project-based learning opportunities through a highly visible program with strong community support.

***Methods*:** A major component of the project consisted of generating a comprehensive long term water quality monitoring program to evaluate baseline conditions for Liberty and Nesika Bays. The project team conducted marine monitoring, trained and engaged volunteers in shoreline stewardship. Liberty Bay shoreline property owners, area residents, students and others were recruited and trained in water quality issues while assisting project team with monitoring.

The project team sought to conduct physical-chemical water quality monitoring at 45-50 sites,

(**see MAP**) over a period of 24 months under a variety of storm conditions, as well as during periods of little or no precipitation. The scientific advisor reviewed aerial photographs and pinpointed



potential monitoring sites which included 50 sites consisting of a mixture of fresh water, stormwater outfall locations, and marine water sites. After a physical site visit to each of the potential locations was performed, final determinations were made, GPS readings of each location taken, and a sample site map created. Drift cell data (obtained from DOE) was mapped along with the sample locations to reference drift directions at each. Sites were selected based on the initial nearshore assessment,

location of stormwater outfalls, and considering existing WQ monitoring sites used by state, county, and local agencies.

Water Quality Analysis Results: Once the locations were determined, volunteers were recruited and underwent a detailed training in accordance with our approved WQ Assurance Project Plan (QAPP). The Kitsap County Health District (KCHD) assisted in training project staff in marine, freshwater, outfall sampling, and developing a volunteer network for water quality monitoring. KCHD also provided laboratory analysis of water samples for the presence of FC. KCHD's laboratory is accredited by the Dept. of Ecology.

The volunteer coordinator developed Geographic Information System (GIS) maps to supplement the monitoring and assessment.

Water quality parameters included pH, dissolved oxygen, temperature, conductivity, turbidity and bacterial (fecal coliform) counts. A LaMotte kit was used to determine dissolved oxygen levels while Hanna Instruments microcomputers were used to measure pH, temp, and conductivity. A secchi disk was

employed to evaluate turbidity for sites sampled by boat and a manual-fill turbidity tube was used for sites accessed by land in the nearshore. The findings indicate that during storm events levels spike. Stormwater outfall readings during those periods are something that will need to be addressed since, as a result of these findings, several areas and creeks in the Liberty Bay watershed are now listed on the latest 303(d) list. You can find this on Ecology's website at: **www.ecy.wa.gov/programs/wq/303d/2002/2002-index.html.**

Sediment Analysis: 18 sites were collected in 2003, 2004 and October, 2004 for a total of 108 samples delivered to Columbia Analytical Services in Kelso Washington. The bay in general is free of concerns regarding metals with the exception of some chromium at the head of the bay.

BENTHIC INVERTEBRATE BIOLOGICAL MONITORING & SEDIMENT ASSAYS

The Clean Water Act (CWA) requires federal and state governments to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." The CWA mandates the maintenance, enhancement, and restoration of biological integrity in receiving waters such as Liberty Bay to support beneficial use.

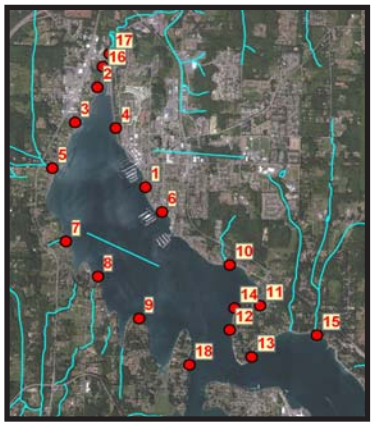
The combination of performing biological assessments and comparing the results with established biological criteria is an accepted approach for evaluating the *biological integrity* of aquatic ecosystems. Relatively undisturbed aquatic ecosystems tend to have high biological integrity, defined as the condition of an aquatic community inhabiting unimpaired water bodies of a specified habitat as measured by an evaluation of multiple attributes of the aquatic biota.

Physio-chemical water quality monitoring alone often does not adequately predict or reflect the condition of all aquatic resources. It can be used to detect the effects of nutrient enrichment or some other long-term pollution related impact, but is not designed to detect trace levels of toxicants or contaminants, pollutant spills, or combined impacts.

The so-called 'fishable-swimmable' concept requires us to look at the biological integrity and physical habitat conditions as well as the more traditional chemical water quality monitoring. Land use such as urban development, forestry, and agriculture impacts water quality and may lower biological integrity, which represents a decline in the overall biological condition of a water body. If the biological condition of the habitat is degraded, it will not support healthy fish and invertebrate populations.

Many natural resource agencies throughout the United States have begun the process of developing and implementing bioassessments and bio-criteria programs (US-EPA, 2000).

While this effort is being used in Washington, there is currently no approved bio-criteria established for intertidal biological communities here in the state. Scientists with the Nearshore Habitat Program at the Washington Department of Natural Resources (WA-DNR) have been studying intertidal biota in the Puget Sound region since 1997. This program is designed to collect baseline data on intertidal biological community patterns and to determine if intertidal biota are suitable as an indicator of ecosystem health (www.wadnr.gov/nearshore/).



Benthic Sampling Program

The LBNS Project volunteers collected samples of benthic infauna from intertidal areas of Liberty Bay in October, 2003, May, 2004 and October, 2004. The map above shows the locations of all benthic sample sites in Liberty Bay. Marine Taxonomic Services, Ltd. (MTS) provided fieldwork expertise and oversight of volunteer field crews involved with Intertidal benthic sampling in Liberty Bay, Poulsbo, Washington and provided laboratory analysis of the benthic community structure at their laboratory facilities in Corvallis, Oregon.

The quadrats were constructed from ¾" pvc pipe and kits were created for each site including a Mapquest direction map to the site, data collection form, GPS units, 10cm gauge stick, hand shovels, 3- 5 gallon buckets, pencils, and site ID tags. It was important not to use pens as the formalin would wash away ink on the ID tag during later transport to the lab. The most difficult item to find for this task was the 1mm sieves. We found two 8" sieves on Ebay for a good price but later found a firm in St. Louis that sold the nylon 1mm screen mesh and then constructed our own sieves at a very reasonable price. We advise any group doing benthics to have plenty of sieves… It will save countless hours and keep volunteers happy. We had great help from AmeriCorps volunteers on this task.

For sampling, a benthic sample with a surface area of 1/16 of a meter square was utilized at pre selected sites around Liberty Bay with three replicate samples of 1/16 of a meter square, 10 centimeters deep hand dug into a 5 gallon bucket per site.

All buckets were then returned to a central location and sieved through 1mm sieve. All material retained on the 1mm sieve was placed into containers then fixed with a solution of buffered formalin mixed with sea water to a concentration of 10%v/v

Three sediment cores were also taken at each site and frozen for later analysis. Benthic samples were transported to the MTS laboratory then rewashed on a 0.5mm screen to remove the formalin fixative, then retained material mixed with 70% alcohol and a protein stain. The samples were sorted under 10X magnification and separated into four groups; Annelids, Mollusca, Arthropods and others, then identified by taxonomic specialists to the lowest practical taxa (species level).

This data was used to characterize the current, "baseline" condition of the benthic-infaunal intertidal community of Liberty Bay. Cataloging this data will allow for application of this data to any standardized index of biological integrity developed by the WA-DNR or WA-DOE in the future.

Goals: For young students, older adults, scientists, government, teachers, property owners and service groups to work together to exchange knowledge, ideas and energy to protect our local water quality and learn to become good stewards of our Puget Sound shoreline. **Work items included:** Website Development, Tours of Shoreline, Fairs/Festivals, Community Outreach, Articles/Media, Local Schools Outreach: West Sound Academy, Northwest College of Arts, North Kitsap High School , and Home Schoolers Group. Workshops: eight/year (2 stormwater, 2 native vegetation, 2 on healthy habitat, 2 on water quality methods and results). Political & Policy Interaction: Advise and assist City of Poulsbo and Kitsap County on projects affecting shoreline, and coordinate restoration.

North Kitsap High School Marine Science Class

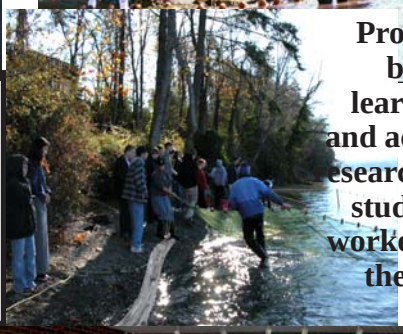
Over 40 NWCA students spent one semester here each year

Suquamish Tribe's Shellfish Biologist

PUBLIC INFORMATION and EDUCATION PROGRAM

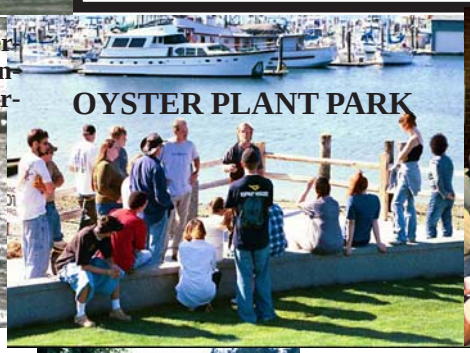
More than 1000 Individuals took part in this program over 4 years

Paul Dorn, Suquamish Salmon Recovery Coordinator & Mike Ramsey, State SRFB



Project-based learning and active research as students worked in the bay

Herb Armstrong, PE of ADA Engineering takes groups to demonstrate unstable slopes and shoreline disturbances

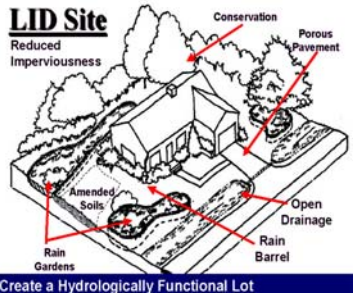


OYSTER PLANT PARK

Cosponsored Low Impact Development Conference with Home Builders Foundation attended by 50 builders, developers, local government, and business representatives.

Lectures by renowned environmental scientists and practitioners in their respective fields were conducted on Liberty Bay

Outdoor classrooms, festivals, project-based learning opportunities, and on-site venues scored highly with participants. Taking part in the project's activities and receiving instruction by experts in the field provided the most meaningful education.



Dr. Chris May & Paul Dorn

Congressman Jay Inslee sponsored an outdoor learning event with the Project. West Sound Academy, Colleges, NK High School, Residents, and Watershed organizations, local governments, over 150 attendees.

Site visits to see low impact solutions such as soft shore developments

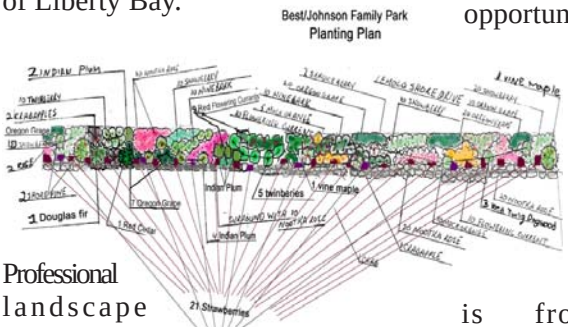
Conducted "Beach Walks" with adults and children

Marine Biologist Jim Bolger with WA Sea Grant Program

NATIVE PLANT REVEGETATION& RESTORATION PROGRAM

The cumulative effects of urbanization have threatened water availability and water quality while many streams and fisheries enhancement programs are in jeopardy of cumulative pollution. There is tremendous pressure from developers and local government to urbanize more of the formerly rural areas with major housing and commercial developments planned to accommodate the growth.

The Nearshore Habitat Evaluation & Enhancement project sought to mitigate the adverse effects of development along critical areas and protect these waters by planting abundant vegetation with native plants in 7500 linear feet of shoreline along the east side and upper reaches of Liberty Bay.



Professional landscape designers, master gardeners, botanists, and other project volunteers worked with property owners, businesses, and local government to plan and design on a site-by-site basis. Planned vegetation, stormwater controls, and types of plants to be installed were considerations. Shoreline property owners have concerns not usually faced by other landowners, such as erosion, water quality, algae blooms, protecting fish and marine habitat. Revegetation of disturbed sites serve several important functions here.

***Stabilizing shorelines*:** the roots of many native plants reinforce shorelines and minimize erosion from uncontrolled stormwater runoff, wind, wave action, boating wakes, currents and other forces of man and nature.

***Provide habitat*:** Cover, food, nesting sites, and resting areas for fish, amphibians, invertebrates, birds, and mammals. Diverse native plants will attract more diverse native wildlife.

Providing shade: Protects smelt egg production, restricts algal growth to open areas where light is available, reduces water temperature, allows more oxygen to dissolve in the water.

***Reduces nutrients*:** Slows water movement along shorelines, causing nutrient-laden sediment to settle to the bottom, where it is less available to algae, and low dissolved oxygen occurrences.

There are many resources available for information and help in using native plants. The local conservation districts hold annual plant sales and plant salvage opportunities. For information on the Kitsap County Conservation District sale call (360) 337-7171. Although some native plants can be purchased from nurseries, often the only way to obtain them is from plant materials centers that furnish plants for large-scale restoration projects. The county conservation districts and master gardeners association can offer help and a list of suppliers for your project. Remember that many climatic and site factors influence plant characteristics. Shoreline trees and shrubs have much slower rates of growth than upland sites and heights vary considerably.

For more information, a Guide is available on-line from WSU at http://gardening.wsu.edu/nwnative or www.wnps.org and go to native plant lists specific to this area. "*Gardening with Native Plants of the Pacific Northwest*" by Arthur Kruckeberg, is the classic reference on this subject.

The plants we used were not necessarily the most valuable species possible for erosion control, wildlife, or aesthetics. They were readily available, easy to propagate, and common in this area. Phyllis Meyers, former Fisheries Biologist with the Suquamish Tribe, performed considerable research on native plant establishment and provided the project team with a refined list from her successful trials.

The key to using vegetation to control erosion, and preventing polluted runoff, is to recognize the natural forces at work. Another important consideration is the frequency of care and watering it will receive in establishing. The largest, most continuous stretch of vegetated area in this project was along a narrow strip along a busy roadway with full sun and southern exposure.