Fisheries and Oceans Canada

Don't Disrupt!

Disruption of the shore is often the result of poor planning and project design. For example, you might build an unnecessarily large dock that shades out the aquatic plants, build too close to the shore, replace native vegetation with lawn, or construct a groyne that robs downdrift beaches of the sediment they need. These actions could alter both the shore processes and the nearshore biological communities that are a product of their physical environment.

Harriet Rueggeberg

Don't Harden!

By straightening and armouring our shores, we eliminate local foreshore habitat. On another scale, the straightening and hardening of shores alters the erosion, transport and deposition patterns along the coast, leading to bigger physical and biological changes over a much larger stretch of shore. Hardening the shore has led to the loss of much of our most productive coastal habitat.

Fisheries and Oceans Canada

Don't Pollute!

Everything we dump into our water ends up in the ocean. In a whole ocean of water, small amounts might seem trivial, but they tend to accumulate in bottom-dwelling organisms and sediments where they concentrate and become toxic. This is a problem especially in enclosed areas. Some of what is released into the water isn't normally considered a pollutant. For example, we use nitrates and fertilizers to boost plant growth, but when they are introduced to the sea, they can cause algal blooms, particularly in areas with limited circulation or tidal exchange. These algal blooms rob the water of oxygen, which can suffocate and kill local marine life.

Working With the Shore

With these ideas in mind, coastal activities can proceed in suitable locations and in a responsible manner, with a smaller and less harmful footprint on the shore environment. The following pages cover 4 categories of coastal activities:

Land Development: How to conserve shore resources in residential, commercial and road development, while promoting and managing sound shore use in appropriate locations.

Marine Facilities: How to incorporate design and construction practices that reduce or eliminate the impact of groynes, breakwaters, seawalls, piers, jetties, docks and dikes.

Marine Discharges: How to find out about reducing the impact from upland runoff, sewage outfalls, industrial discharges and ocean disposal

Coastal Industries and Commercial Activities: How to find information that can assist in reducing effects of dredging, log storage and aquaculture on shore systems

Land Development

Sound development in the coastal environment requires that environmental sensitivities and natural hazards are taken into consideration in the design stage. Get advice early on in the project from an expert in coastal processes.

The cost of not considering shore processes and structures can be high and too frequently becomes the taxpayers' burden. It is less costly to account for and protect these ecological values up front than to repair, restore or compensate for them after the damage is done.

How can the shore be used without damaging its biological integrity?

There are different ways to meet your objectives. Each has consequences to the shore, to the community and to your project. The best alternative is the one that enables the development to proceed with the least impact. Here are some questions to ask:

- How can the building be located on the lot to minimize interference with shore processes and the threat of shore forces?
- What are the natural attributes that drew you to the site in the first place? How do these enhance the value and appreciation of the property? How can the project be designed to enhance and retain these features?
- How can the natural features of the site be used to protect the property and to avoid costly and disruptive shore protection structures?
- How can the shore be reached without destabilizing the slope—or does it even have to be accessed from this site?

It just may turn out that the impacts will be significant and can't be adequately mitigated and so you have to reconsider or even cancel the project. These questions need to be asked, and answered, before you make any significant investment.

Four Common Planning and Design Mistakes

Impacts to the shore commonly result from four planning and design mistakes:

- Buildings and facilities are put too close to the shore and fall victim to dynamic shore processes. They then require expensive protective structures that further disrupt natural shore environments.
- Poor stormwater drainage initiates or accelerates natural erosive forces.
- Natural vegetation is destroyed, particularly in the all-important buffer along the shore. This destabilizes sediments, making them more prone to erosion and it eliminates wildlife habitat.
- Inadequate on-site sewage treatment and disposal results in pollution, and may lead to slumping and failure of coastal bluffs and the properties on them.

Too often, we build too close to the water. Waves will erode front yards. High tides and winter runoff will flood basements. Having built in the wrong place, we then try to protect property with rock revetments, timber piles, concrete blocks or other retaining structures that are expensive and usually not very effective.

Alternatively, to maximize the ocean view, we build too close to the top of a bluff, and cut down the trees that stabilize the slope but obstruct the view. We also direct drainage from rooftops and driveways away from the house. This runoff runs down the slope, forming erosion gullies or saturating the soils in the bluff, destabilizing them.

These buildings have been located too close the bluff. The ongoing processes of coastal erosion will lead to expensive damage. Adjust your site plan and building design to take coastal processes into account.

Regional District of Comox Strathcona

Coastal Stewardship and the Development Process

Protection of shore systems also requires that you conform to the environmental provisions and specifications of contract documents. You also need a contingency plan to deal with unforeseen circumstances.

Several tools are available to enable this. While these are usually part of large development projects such as marinas, industrial facilities and mixed or multi-residential developments, their use on smaller developments is also recommended.

Environmental supervision of construction *is undertaken on behalf of the developer or construction contractor by someone with special training in identifying environmental concerns The Environmental Supervisor will provide advice and direction on environmental protection measures, and orient crew members and workers to site sensitivities and procedures. The supervisor should have the mandate and experience to avoid environmental impacts and stop work on sites when required to mitigate apparent impacts.*

Environmental monitoring *is the collection of technical data to measure compliance with construction standards and practices specified for the project. The Environmental Supervisor typically does the monitoring.*

Security deposits *are a fairly standard form of assurance that construction practices comply with design specifications. Security deposits need to reflect the cost of performing restoration on the site to return habitat to pre-construction levels. Because of the risks associated with building on coastal shores, local governments should consider security deposits that address:*

- *Construction hazards posed by tides, winds and storms.*
- *Spills on site, which can have impacts far beyond the construction site through dispersal by runoff and waves.*
- *Impacts to adjacent properties where shore development disrupts longshore drift patterns, exacerbates vegetation blowdown, and disturbs marine flora and fauna.*

Substantial performance *is the formal point in the construction process when the site is accepted as ready for use. Substantial performance means that deficiencies in the contractor's work are identified, but the use of the site can begin. The process of achieving substantial performance can help ensure that environmental protection measures have been followed.*

Guarantee and maintenance *should be part of the contract; for example, include environmental protection clauses in the guarantee specification to be sure that pre- construction habitat conditions are restored.*

Residential

Residential development can have significant impacts on coastal systems. The scale of the impacts may not necessarily correspond to the size and density of the housing.

As Chapter 3 describes, some shores are more suitable for development than others. Sediment shores, estuaries and marshes change rapidly as their loose sediments respond to the natural variability in wave action and water level. Estuaries and marshes are particularly sensitive to pollution from runoff and septic tanks. Residential development should avoid these areas because of their high ecological value, sensitivity to development and risk associated with building in areas with unstable sediments.

Coastal bluffs that consist of unconsolidated sand, silt or clay sediments of recent geological origin are eroded easily by wave action at their base or destabilized by water saturation. This makes them extremely sensitive to uncontrolled upland drainage, compression from weight-bearing structures and loss of vegetation—all common occurrences with residential development.

Pocket beaches are sand and gravel beaches constrained by rocky headlands on a basically rocky coastline. In many cases, the land behind the beach is low relief and marshy. Due to the dynamic nature of sediment movement on these shores, the high water mark can change its position from year to year. Again, residential development in these areas is at risk if built too close to the shore.

Considerations – Things to Find Out

A legal survey: You need to know the accurate location of your property boundaries, including the high water mark (or legal "natural boundary"). The ocean frontage may have changed since the site was subdivided. If you have no legal survey, you will need to hire a registered B.C. Land Surveyor.

Professional assistance: Seek professional advice in assessing the coastal features and processes associated with your property. Consultants with expertise in coastal environments may be able to suggest options that deliver the project more effectively and at reduced costs.

You must conduct all necessary regulatory assessments and obtain all appropriate approvals: These may include cultural or archeological assessments if there has been First Nations activity on your land, or cumulative environmental impact assessments if the project triggers CEAA (the *Canadian Environmental Assessment Act*.) Qualified professional experts should be aware of all the applicable regulatory requirements and guidelines that would apply to your project and should understand how to meet them.

Physical character and processes: What shore type is it? (Refer to pages 22 to 33 for a discussion of shore types and their sensitivity to development.) How high are winter storms and storm surges? Is the shore eroding or accreting? What direction and intensity are the prevailing winds? What longshore drift cell is this property in? The age of the vegetation may indicate the relative stability of the shore.

Biological character and communities on the shore: Inventory vegetation types and identify environmentally sensitive areas (ESAs) or features that need protection. Then assess the environmental implications of your project and determine appropriate mitigation measures or compensatory works that will be required. Check with your local government for ESAs and assessment requirements before investing in site design and layouts. Remember: Under federal law you are required to ensure that your project will not result in the harmful alteration, disruption or destruction of fish habitat.

Building requirements: A building permit will be needed in almost all instances; a development permit may also be required for environmental protection or hazard management. There may also be special requirements in the form of ***covenants*** that have been placed on your property. Ask your realtor about covenants on title and contact your local government to find out about building or development permit requirements.

Setbacks: A vegetated buffer between your development and the shore is vital to protecting and stabilizing shore edges and reducing risks of erosion. This will minimize impacts of development on the shore and the impacts of marine processes on the development. A minimum vegetated buffer of 15-30 m back from HHW is generally recommended for private waterfront property in developed areas. Wider setbacks are generally required for developments on bluffs and cliffs. Check with your local planning office for setback requirements.

Fisheries and Oceans Canada

Slope stability: Check with your local government to see if your property has been identified as an area subject to slope instability. Additional slope protection measures, such as larger setbacks, may be required in these cases. An assessment by a geotechnical consultant is helpful, and may be required by your local government.

Potential for flooding: Low-lying coastal areas may experience flooding when high winter tides coincide with a severe storm surge. The Province has completed flood risk mapping for some of B.C.'s coastal areas. There may be floodproofing requirements for habitable rooms to be built at a certain height. For unmapped areas, consult local governments and long-term residents.

Storm drainage: Do not direct drainage or runoff from rooftops or other hard surfaces over the edge of a bluff or shore bank; this only creates or accelerates slope erosion. Try to direct drainage into permeable ground that slopes away from a bluff or steep bank. Consider the volume of storm drainage being put into the ground above a bluff; will it saturate the soil and weaken the slope? You may need to consult a hydrologist or geotechnical expert.

Septic systems: Septic systems and their drainage need to be large enough to handle the anticipated level of use and must be maintained regularly. There must be no direct drainage on to the foreshore. Weakening of bluffs and steep banks by over-saturation must be avoided. You may need to consult a hydrologist or geotechnical expert.

Views and sight lines: Placing dwellings back from the shore edge can increase sight lines over vegetation or through treetops. Vegetation should be retained on slopes where it is most needed. Letting trees and shrubs frame your view can be more attractive, and stable, than a view cleared of all vegetation.

Timing of construction: Restrictions on when construction can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (e.g., surf smelt or sandlance spawning, herring spawn, oyster spat, etc.) Construction may not be permitted during these critical times of the year. Contact your local government or *Fisheries and Oceans Canada* to confirm the timing restrictions that may apply to your site or activities.

Protection from construction activities: Before construction, mark the boundary of the construction area and temporarily fence off setbacks, sensitive features, and trees to be retained (including the root system) to avoid their disturbance during site preparation and construction. Install sediment control measures to avoid erosion and offsite silting. Be careful with toxic materials (such as fuel, paint, adhesives, etc.) and have a hazardous spill kit and spill response plan in place.

If you are building a dock - refer to the section on docks, page 65.

For More Information

- The planning or development services department of the applicable local government is usually the first stop. Staff there can provide information, or guide you to the appropriate agencies/sources for information on:
  - Legal surveys
  - Physical and biological shore features and environmentally sensitive areas
  - Development and building permits
  - Property covenants
  - Setback requirements
  - Flooding and other hazardous conditions
  - Construction timing restrictions
  - Best management practices and requirements for site design and preparation, storm drainage, septic systems and erosion control
- *"On the Living Edge: Your Handbook for Waterfront Living"* provides useful information on how to build on the coast and maintain shore properties in ways that are in harmony with the environment. Copies can be obtained from the *Living by Water Project by visiting their website.*
- *"Guides for Coastal Property Owners"* published by the Washington State Dept. of Ecology give a wealth of information on living on coastal bluffs. They can be downloaded from *their website.*
- *"Septic System Maintenance - Pure & Simple"* is an easy-to-read guide to septic system management. See "Stewardship Resources" (page 83) for details .

Dream home turns nightmare

The happy couple was so excited with their new sea-front property. They planned to build their dream home high on the bluff and cut down the trees that were blocking their magnificent view of the Coastal Mountains. And for easy access they built a 72-step stairway to the beach below, clearing away most of the small shrubs and plants in its way.

They planted a lovely garden, as a frame for their house. They put in a septic tank, dug a trench for the water pipes and put in weeping tiles to collect and redirect stormwater from their foundation.

But after a few years their dream became a nightmare. The remaining trees were no longer windfirm and the wind had knocked them down. The lawn was a desert in summer and a mudhole in winter - piping the stormwater had robbed the soil of natural drainage. Those carefully built steps were being undercut by winter storm wave erosion and had lost their foundations.

They consulted a geologist, who told them the bluff is in danger of falling into the sea. They must decide to either move back the house or relocate it to another site.

With better planning and knowledge of the coastal environment, experiences like this can be avoided.

Washington Department of Ecology

Another example of a bluff erosion nightmare.

Commercial

Many commercial and industrial operations along the waterfront are marine-related, but some are there only because of historic land use patterns or zoning. These operations use valuable waterfront space and can affect the coastal shore unnecessarily.

What Can Happen

Commercial and industrial development along the coast can harm the environment by:

- Straightening and hardening the shore zone
- Altering or eliminating backshore and inter-tidal habitat
- Depriving the community of shore resources and access to the sea
- Creating pollution
- Infilling intertidal/subtidal areas which displaces biological resources that occupy these areas.

Maintenance dredging or basin deepening for activities such as log sorts, log dumps, marinas or ferry terminals constantly modifies the bottom and disrupts or destroys benthic communities, increases suspended sediment concentrations in the water column and can liberate sediment associated pollutants

If the operation depends on water, then proper location and design is essential to avoid and/or mitigate the potential impacts. However, local governments should discourage any commercial and industrial development that does not have to be on the waterfront. This will prevent the impacts in the first place and permit sensitive shore zones to continue to support the natural and human systems for which they are best suited.

Considerations – Things to Find Out

Legal survey: You need to know the accurate location of your property boundaries, including the high water mark (or legal "natural boundary"). The ocean frontage may have changed since the site was subdivided. If you have no legal survey, you will need to hire a registered B.C. Land Surveyor.

Professional assistance: Seek professional advice in assessing the coastal features and processes associated with your property. Consultants with expertise in coastal environments may be able to suggest options that deliver the project more effectively and at reduced costs.

You must conduct all necessary regulatory assessments and obtain all appropriate approvals: These may include cultural or archeological assessments if there has been First Nations activity on your land, or cumulative environmental impact assessments if the project triggers CEAA (the *Canadian Environmental Assessment Act*.) Qualified professional experts should be aware of all the applicable regulatory requirements and guidelines that would apply to your project and should understand how to meet them.

Physical character and processes: What shore type is it? (Refer to pages 22 to 33 for a discussion of shore types and their sensitivity to development.) How high are winter storms and storm surges? Is the shore eroding or accreting? What direction and intensity are the prevailing winds? What longshore drift cell is this property in? The age of the vegetation may indicate the relative stability of the shore.

Biological character and communities on the shore: Inventory biota (including vegetation) and identify environmentally sensitive areas (ESAs) or features that need protection. Then assess the environmental implications of your project and determine appropriate mitigation measures or compensatory works that will be required. Check with your local government for identified ESAs and/or assessment requirements before investing in site design and layouts. Remember: Under federal law you are required to ensure that your project will not result in the harmful alteration, disruption or destruction of fish habitat.

Building requirements: A building permit will be needed in almost all instances; a development permit may also be required for environmental protection or hazard management. There may also be special requirements in the form of ***covenants*** that have been placed on your property. Ask your realtor about covenants on title and contact your local government to find out about building or development permit requirements.

Setbacks: A vegetated buffer between your development and the shore is vital to protecting and stabilizing shore edges and reducing risks of erosion. This will minimize impacts of development on the shore and the impacts of marine processes on the development. A minimum vegetated buffer of 15-30 m back from HHW is generally recommended for private waterfront property in developed areas. Wider setbacks will be required in more remote and undeveloped crown foreshore areas. Wider setbacks are generally required for developments on bluffs and cliffs. Check with your local planning office for setback requirements.

Slope stability: Check with your local government to see if your property has been identified as an area subject to slope instability. Additional slope protection measures, such as larger setbacks, may be required in these cases. An assessment by a geotechnical consultant is helpful, and may be required by your local government.

Potential for flooding: Low-lying coastal areas may experience flooding when high winter tides coincide with a severe storm surge. The province has completed flood risk mapping for some of B.C.'s coastal areas. There may be floodproofing requirements for habitable rooms to be built at a certain height. For unmapped areas, consult local governments and long-term residents.

Storm drainage: Do not direct drainage or runoff from rooftops or other hard surfaces over the edge of a bluff or shore bank; this only creates or accelerates slope erosion. Try to direct drainage into permeable ground that slopes away from a bluff or steep bank. Consider the volume of storm drainage being put into the ground above a bluff; will it saturate the soil and weaken the slope? You may need to consult a hydrologist or geotechnical expert.

Septic systems: Septic systems and their drainage need to be large enough to handle the anticipated level of use and must be maintained regularly. There must be no direct drainage on to the foreshore. Weakening of bluffs and steep banks by over-saturation must be avoided. You may need to consult a hydrologist or geotechnical expert.

Views and sight lines: Placing buildings back from the shore edge can increase sight lines over vegetation or through treetops. Vegetation should be retained on slopes where it is most needed. Letting trees and shrubs frame your view can be more attractive, and stable, than a view cleared of all vegetation.

Land use designation: Some municipalities and regional districts protect waterfront lands in their Official Community Plans or Zoning Bylaws for marine-dependent uses. The area may also be designated a "development permit area" with firm rules covering commercial or multi-family design, natural hazard management or environmental protection. Check with your local government.

Harbour, port or estuary management plan: Designated areas in many harbours and estuaries encourage or discourage development, based on their relative sensitivity to environmental impacts. Contact the Port Authority or local government.

Navigation issues: The protection of navigable waters influences many forms of coastal development, and applies to water bodies of all types. Contact *the Coast Guard of Fisheries and Oceans Canada.*

Timing of construction: Restrictions on when construction can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (ie: surf smelt or sandlance spawning, herring spawn, oyster spat etc.) Construction may not be permitted during these critical times of the year. Contact your local government or *Fisheries and Oceans Canada* to confirm the timing restrictions that may apply to your site or activities.

Protection from construction activities: Before construction, mark the boundary and temporarily fence off setbacks, sensitive features, and trees to be retained (including the root system). This protects vegetation during site preparation and construction. Install sediment control measures to avoid erosion and offsite silting. Train construction staff in the appropriate handling of toxic materials (fuel, paint, adhesives etc.) to ensure they are not accidentally spilled or intentionally disposed of on the shore or in the water, and have a hazardous spill response plan and equipment in place. The careful use of equipment near the shore is key to assuring low impact. Consult your local government about hiring a professional to develop appropriate avoidance and mitigation measures and monitor construction activities.

For More Information

- The **planning or development services department** of the applicable local government is usually the first stop. Staff there can provide information, or guide you to the appropriate agencies/sources for information on:
  - Legal surveys
  - Environmentally sensitive areas
  - Development and building permits
  - Property covenants
  - Setback requirements
  - Flooding and other hazardous conditions
  - Construction timing restrictions
  - Best management practices and requirements for site preparation, storm drainage, septic system installation and management and erosion control

Harriet Rueggeberg

Surface runoff is captured in a marshy depression and dissipates slowly into the ground.

Roads

The construction of roads along the coast can harm shore systems. Sloppy road building – inadequate bed preparation or inattention to drainage and high tide or storm surge water levels – can lead to severe washouts and impacts on adjacent shore areas, and destruction of the road itself. These problems are usually expensive to fix.

Coastal areas that are reached by road can be further impacted by road widening and upgrading activities. Road building cuts and fills on coastal shores usually remove riparian vegetation, eliminate backshore habitats (dunes, berms etc.), expose soils and alter runoff patterns. This can cause sedimentation of the foreshore, create a permanent impervious footprint across the backshore and become a source of chronic pollution, all of which can have a severe effect on the adjacent shore area.

Environmental damage from road use, a new road or an upgrade can include:

- Hardening of the shore zone
- Vegetation removal and bank destabilization
- Changes to drainage and coastal hydrology
- Filling in of small coastal drainages, marine wetlands, foreshores and estuaries
- Pollution from gas and oil, other hydrocarbons, salts and heavy metals in shore zone areas

In particular, building roads along the tops of eroding coastal bluffs can lead to expensive and, too often, unsuccessful coastal protection and erosion control works.

Considerations – Things to Find Out

Location: Are there alternative routes away from the shore that have fewer environmental impacts?.

Professional assistance: Seek professional advice in assessing the coastal features and processes associated with your project. Consultants with expertise in coastal environments may be able to suggest options that deliver the project more effectively and at reduced costs.

You must conduct all necessary regulatory assessments and obtain all appropriate approvals: These may include cultural or archeological assessments if there has been First Nations activity on your land, or cumulative environmental impacty assessments if the project triggers CEAA (the *Canadian Environmental Assessment Act*.) Qualified professional experts should be aware of all the applicable regulatory requirements and guidelines that would apply to your project and should understand how to meet them.

Physical character and processes: What shore type is it? (Refer to pages 22 to 33 for a discussion of shore types and their sensitivity to development.) How high are winter storms and storm surges? Is the shore eroding or accreting? What direction and intensity are the prevailing winds? What longshore drift cell is this property in? The age of the vegetation may indicate the relative stability of the shore.

Biological character and communities on the shore: Inventory biota (including vegetation) and identify environmentally sensitive areas (ESAs) or features that need protection. Then assess the environmental implications of your project and determine appropriate mitigation measures or compensatory works that will be required. Check with your local government for identified ESAs and/or assessment requirements before investing in site design and layouts. Remember: Under federal law you are required to ensure that your project will not result in the harmful alteration, disruption or destruction of fish habitat.

Setbacks: A vegetated buffer between the road and the shore is vital to protecting and stabilizing shore edges and reducing risks of erosion. This will minimize impacts on the shore and the impacts of marine processes on the road. Check with your local planning office for setback requirements.

Slope stability: Check with your local government to see if your property has been identified as an area subject to slope instability. Additional slope protection measures, such as larger setbacks, may be required in these cases. An assessment by a geotechnical consultant is helpful, and may be required by your local government.

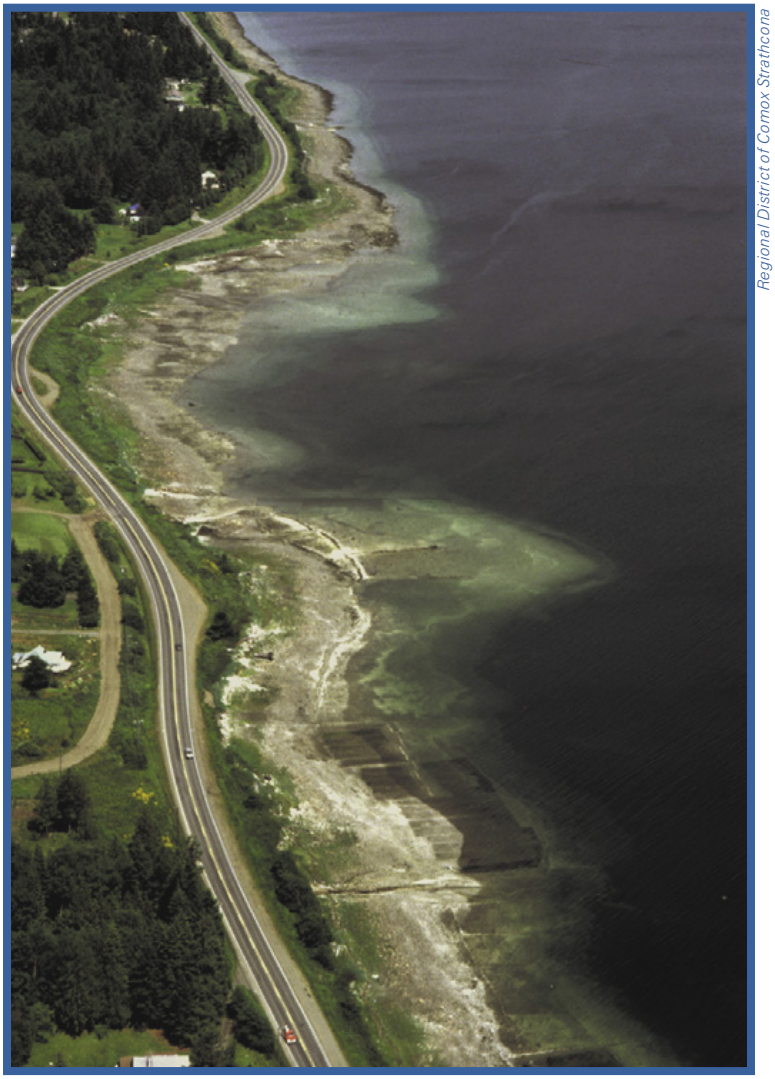
Potential for flooding: Low-lying coastal areas may experience flooding when high winter tides coincide with a severe storm surge. The province has completed flood risk mapping for some of B.C.'s coastal areas. There may be floodproofing requirements for habitable rooms to be built at a certain height. For unmapped areas, consult local governments and long-term residents.

Storm drainage: Road and parking designs must address runoff from road surfaces to prevent erosion and manage pollutants from reaching sensitive coastal ecosystems. Do not direct drainage or runoff from hard surfaces over the edge of a bluff or shore bank; this only creates or accelerates slope erosion. Try to direct drainage into permeable ground that slopes away from a bluff or steep bank. You may need to consult a hydrologist or geotechnical expert.

Timing of construction: Restrictions on when construction can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (e.g., surf smelt or sandlance spawning, herring spawn, oyster spat, etc.) Construction may not be permitted during these critical times of the year. Contact your local government or *Fisheries and Oceans Canada* to confirm the timing restrictions that may apply to your site or activities.

Protection from construction activities: Before construction, mark the boundary and temporarily fence off setbacks, sensitive features, and trees to be retained (including the root system) to avoid their disturbance during site preparation and construction. Install sediment control measures to avoid

erosion and offsite silting. Train construction staff in the appropriate handling of toxic materials (fuel, paint, adhesives etc.) to ensure they are not accidentally spilled or intentionally disposed of on the shore or in the water, and have a hazardous spill response plan and equipment in place. The careful use of equipment near the shore is key to assuring low impact. Consult your local government about hiring a professional to develop appropriate avoidance and mitigation measures and monitor construction activities.



Regional District of Comox Strathcona

Historic settlement patterns frequently include roads adjacent to eroding shore areas. Expensive shore protection measures are often required where roads have been widened to meet modern safety standards, or to accommodate more traffic.

A Helping Highway

The Gingolx Nation north of Prince Rupert badly needed a road to link their communities of Greenville and Kincolith, to get children to school and the sick to hospital. But the only route was right on the coast and threatened to disrupt important grizzly bear and salmon habitat. The coast was covered with sedge grass, which provides the grizzly's first food after hibernation and is a hiding place for salmon fry during high tide. The sedge would disappear during road construction

So the contractors harvested mats of sedge from other areas and transplanted 1,700 sq m of sedge to provide a buffer between the road and the ocean. It provided local employment and compensated for habitat losses associated with construction of the road.

Restoring Delkatla

While ideal coastal stewardship means no harm is done to the environment, the next best approach is to repair damage that was done in less thoughtful days.

That's the approach the people of Masset on Haida Gwaii (the Queen Charlotte Islands) took after they realized that a causeway that supported the only road into town was starving their Delkatla Wildlife Sanctuary of life-giving tidal waters.

They watched with alarm as bird numbers fell and freshwater vegetation crept deeper into vital migratory and wintering feeding areas.

The residents raised over $1 million and a few years ago re-engineered the causeway so the water in Delkatla now rises and falls twice a day. Delkatla is a tidal wetland again and once more a crucial link in the chain of life.

For more information, contact: Delkatla Wildlife Sanctuary (250)626-5015

Marine Facilities

Marine structures and facilities, such as wharves, docks, breakwaters, bridges and outfalls, are common human-made features of developed shores. In the past, these structures were designed and built primarily to withstand the physical and biological forces of the marine environment. Few builders considered their effect on the environment.

But now, anyone designing or building marine structures must respect environmental criteria. Designers must take into account bottom-dwelling ("benthic") communities, effects on nearshore vegetation, currents, wave patterns and shading effects.

General Considerations

Marine structures can be grouped into three types:

- Those that are based on ***fill*** of some type and are faced with slabs or revetments (e.g., groynes, breakwaters);
- Those that are supported or anchored by ***piles*** or posts (e.g., piers, wharves); and
- Those that are attached to shore and ***float*** over the water (e.g. floating dock).

As a general rule, a fill-based structure has a greater impact on the near- and foreshore environment because its footprint— the area of shore that is covered and destroyed — is considerably greater than a pile-based or floating structure. Its effect on shore currents, sedimentation patterns and wave actions also tends to be greater.

- Whenever possible, use pile-based or floating structures rather than fill-based structures.
- When planning any kind of marine structure, consider the following design parameters:
  - **Size/footprint** – the smaller the structure, the less damage to the bottom (for fill-based projects) and less shading (for pile-based floating structures) will occur.
  - **Materials** – reduce or eliminate the use of materials that leach toxics into seawater (such as copper, arsenate, zinc and chromate from treated wood).
  - **Location** – avoid or span areas of high biological productivity, such as marshes, eelgrass or kelp beds; avoid any changes to the currents or the way the sediment moves as these are either sensitive habitats or they are critical habitat forming processes.
  - **Roughness** – the greater the surface roughness of the structure, the greater chance that it will provide micro-habitats for attaching aquatic organisms. Where possible, try to replicate natural substrate type and quality with the design and fabrication of the structure.

Groynes and Breakwaters

Groynes are intended to reduce or eliminate site-specific erosion. They trap sediment moving along the shore. They are built perpendicular to the shore, creating a new beach on the updrift side (the side from which most of the sediment comes) and reducing deposition on the downdrift side. This creates a series of small beaches between groynes oriented roughly at right angles to the prevailing wave direction. Groynes are typically constructed of timber panels supported by piles, rock or concrete blocks. Multiple groynes (known as a groyne field) are built to protect a length of shore. Vancouver uses groynes successfully in English Bay to stabilize artificial beaches made of imported sand.


Mike Tarbotton

Breakwaters are designed to protect a shore area, harbour or anchorage from waves. Breakwaters can be floating or bottom-founded. Floating breakwaters, used in mild wave conditions, provide only partial wave protection because wave energy can pass below the float. Bottom founded breakwaters can be designed for any wave condition, but water depths over 15 to 20 m and waves bigger than 10 m make this type of structure too expensive.


Mike Tarbotton

Floating breakwaters such as this one in the Fraser river can be designed to reduce the erosive energy of wakes.

Breakwaters are usually connected to shore. However, offshore breakwaters sometimes form part of a harbour protection system.

The key factors to consider in breakwater design are wave height, length, direction and the effects of the structure on wave refraction and erosion.

What Can Happen

The major long-term impacts come from changes caused when we modify local wave and water circulation patterns and alienate marine habitat by using fill.

- Erosion transfer: These structures partially or completely cut off the supply of downdrift sediment. They can end up transferring an erosion problem to an adjacent, downdrift stretch of coast. Recent studies have shown that groyne fields are often ineffective and can cause serious coastal erosion elsewhere. Consequently, groynes have been out of favour in the coastal engineering community for the last 20 years. However, there are places where groynes can be effective as long as the designer has detailed studies of prevailing coastal processes.

- Burial of benthic habitat: The bottom area covered by groynes or breakwaters is alienated permanently. Groynes and breakwaters can also affect adjacent benthic habitats by changing sediment deposition patterns.
- Wave energy alteration: Breakwaters increase wave energy, causing localized shore erosion. They can also make a harbour or shore area unsuitable for boat use or moorage at certain times.
- Reduction in flushing: Breakwaters may reduce flushing of the marine waters they enclose, which may heat the water, concentrate the pollutants and add to the accumulation of sediment.
- Biophysical change: The reduced exposure to waves and surf behind a breakwater alters the physical environment and can encourage colonization by biota that could not otherwise occupy these areas. This may be good or bad, depending on your view. For example, eelgrass has colonized new areas of Roberts Bank in the Fraser River Delta in response to causeway construction. However, the mudflat and its associated biological community were displaced.
- Construction impacts: Construction of these structures can bury productive habitat, dislocate mobile species, cause turbidity and contaminate coastal waters.

Considerations – Things to Find Out

Need: Shore structures like these are often built without considering their consequences. Are there alternative ways of solving the problem? Consult a physical shorezone expert for options.

Impact assessment: Determine the type of shore being affected .(Refer to pages 22 to 33 for a discussion of shore types and their sensitivity to development.) Review long-term sedimentary processes in the area. Identify biological resources and habitats that need to be avoided or protected.

Regulatory requirements: See Chapter 3 of the DFO guide for Shoreline Structures Environmental Design (For More Information) for guidance on project review processes and requirements under the federal *Fisheries Act* and other regulations.

Provincial lease or licence: The province has jurisdiction over foreshore and inland waters (refer to Chapter 4, Coastal Planning and Approvals). You must get a lease, licence or permit to use these areas from Land and Water British Columbia Inc.

Local government requirements: Some local governments require a development permit to build within shore areas. Check with the municipal or regional district development services department.

Port, harbour or estuary management plan: Many ports, harbours and estuaries in developed areas have specific plans in place. These plans often identify areas where shore structures won't incur significant environmental impacts. Check with the applicable port authority or local government.

Impacts on navigation: Contact Navigable Waters Protection Division (Coast Guard) of Fisheries and Oceans Canada (DFO) for requirements under the *Navigable Waters Protection Act.*

Timing of construction: Restrictions on when construction can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (e.g., surf smelt or sandlance spawning, herring spawn, oyster spat, etc.) Construction may not be permitted during these critical times of the year. Contact your local government or *Fisheries and Oceans Canada* to confirm the timing restrictions that may apply to your site or activities.

Professional assistance: As can be seen from this list, many approvals can be required to build these structures, due in large part to the number of things these structures can affect. For this reason it is wise to hire a qualified professional to assist in assessing the coastal resources and processes, developing site plans that achieve your objectives while minimizing impacts to the shore, and finding options that deliver the project more effectively and at reduced cost. You must conduct all necessary regulatory assessments and obtain all appropriate approvals: These may include cultural or archeological assessments if there has been First Nations activity on your land or cumulative environmental impact assessments if the project triggers CEAA (the *Canadian Environmental Assessment Act*.) Qualified professional experts should be aware of all the applicable regulatory requirements and guidelines that would apply to your project and should understand how to meet them.

For More Information

- *"Shoreline Structures Environmental Design: A Guide for Structures along Estuaries and Large Rivers"* (M.A. Adams, 2002) This report by Fisheries and Oceans Canada covers project review procedures and design criteria for a variety of shore structures. It also provides detail on shore vegetation and its restoration.
- *DFO Fact Sheet: Marine Guide to Preventing Shoreline Erosion.* Outlines fish habitat issues associated with foreshore erosion control structures, impact assessment requirements, BMPs and local DFO contacts for additional information or advice. This fact sheet is available at *DFO's website*.

Seawalls and Revetments

Revetments are hard, smooth surfaces that are built to protect a bank or bluff from erosion by wave action and currents. Seawalls are free-standing structures made typically of concrete or rock. They usually create land by infilling behind the wall. They are commonly used to create public walkways along the shore.

Seawalls and revetments are built to facilitate various water-related activities and to protect upland property and structures from flooding, erosion and damage. Often the protected land originally was part of the shore process zone.

What Can Happen

Seawalls and revetments can alter shore processes significantly:

- Hardening and straightening of shores: Probably the most dramatic effects occurs when hardened, straight surfaces replace what were undulating, vegetated shores. This reduces the amount and diversity of substrates available for organisms to colonize, removes places of shade or protection from predators and removes shore vegetation that provides wildlife habitat and protection from erosion.
- Disruption of longshore drift: By changing the configuration of the shore, these structures alter how and where sediment is deposited.
- Wave energy alteration: Seawalls and revetments can increase wave energy, wave reflection and resonance, which can speed up shore erosion at the toe of the structure itself. This can also make the shore area inaccessible by small boats at certain times, particularly when high winds and high tides coincide.
- Burial or alienation of habitat: A seawall or revetment isolates the foreshore from the nearshore and eliminates intertidal habitats.
- Construction impacts: Construction of these structures can bury productive habitat, dislocate mobile species, cause turbidity and contaminate coastal waters.

Considerations – Things to Find Out

Need: Shore structures like these were historically designed or installed without considering the consequences of the activity or alternative ways to meet the objective. Consult a physical shorezone expert for options.

Impact assessment: Determine the type of shore being affected (Refer to pages 22 to 33 for a discussion of shore types and their sensitivity to development.). What are the impacts of the proposed project on the marine environment? On adjacent properties and along the coast? Generally, the more natural, the better; the less "hard", the better; and the less straight, the better. Review historical aerial photos, bathymetric charts or talk to long time residents to identify long-term sedimentary processes in the area. This may help you to anticipate changes to deposition and/or erosion as a result of the proposed seawall or revetment. Identify biological resources and habitats that need to be avoided or protected.

Regulatory requirements: See Chapter 3 of the DFO Guide for *Shoreline Structures Environmental Design* (For More Information) for guidance on project review processes and requirements under the federal *Fisheries Act* and other regulations.

Provincial lease or licence: The province has jurisdiction over foreshore and inland waters; you must apply for a lease, licence or permit to occupy or use this area from Land and Water British Columbia Inc.

Local government requirements: Some local governments require a development permit to build within shore areas. Check with the municipal or regional district development services department.

Port, harbour or estuary management plan: Many ports, harbours and estuaries have specific plans in place. These plans often identify areas where shore structures won't incur significant environmental impacts. Check with the applicable port authority or local government.

Impacts on navigation: The protection of navigable waters affects the design and construction of marine structures. Check with the Coast Guard of Fisheries and Oceans Canada (DFO) or your local government.

Timing of construction: Restrictions on when construction can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (e.g., surf smelt or sandlance spawning, herring spawn, oyster spat etc.) Construction may not be permitted during these critical times of the year. Contact your local government or *Fisheries and Oceans Canada* to confirm the timing restrictions that may apply to your site or activities.

Professional assistance: As can be seen from this list, many approvals can be required to build these structures, due in large part to the number of things these structures can affect. For this reason it is wise to hire a qualified professional to assist in assessing the coastal resources and processes, developing site plans that achieve your objectives while minimizing impacts to the shore, and finding options that deliver the project more effectively and at reduced cost. You must conduct all necessary regulatory assessments and obtain all appropriate approvals: These may include cultural or archeological assessments if there has been First Nations activity on your land or cumulative environmental impact assessments if the project triggers CEAA (the Canadian *Environmental Assessment Act*.) Qualified professional experts should be aware of all the applicable regulatory requirements and guidelines that would apply to your project and should understand how to meet them.

For More Information

"Shoreline Structures Environmental Design: A Guide for Structures along Estuaries and Large Rivers" (M.A. Adams, 2002) This report by Fisheries and Oceans Canada covers project review procedures and design criteria for a variety of shore structures. It also provides detail on shore vegetation and its restoration.

DFO Fact Sheet: Marine Guide to Preventing Shoreline Erosion. Outlines fish habitat issues associated with foreshore erosion control structures, impact assessment requirements, BMPs and local DFO contacts for additional information or advice. This fact sheet is available at *DFO's website*.

"Alternative Bank Protection Methods for Puget Sound shorelines (Parts 1-5)"- A series of five guidebooks and case studies on alternative approaches to coastal foreshore protection .These are available at the *Washington Department of Ecology- Shorelands Environmental Assistance web site.*

Regional District of Comox Strathcona

Revetments are shore protection measures designed to reduce shore erosion. When these shore protection measures are installed they frequently have unintended effects on adjacent properties such as localized scouring. The need for coastal revetments too frequently arises when buildings are located too close to the active shore.

David Reid

In urban areas, seawalls are often part of a public waterfront walkway.

Goodbye beach?

Tourists and surfers come from all over the world to enjoy Vancouver Island's west coast beaches. A few of them like it so much, they pay more than $1 million for beachfront property.

When a severe January storm carved away a chunk of their beach, the homeowners panicked. From their winter homes all over North America they telephoned instructions to a contractor to build a sea wall. Contrary to advice from experts on marine foreshore processes, they built a two metre high wall, 300 m long, at great expense.

"The seawall will change the character of the beach permanently", said one neighbour. "It will trap water behind it, undercut vegetation, change the dunes and become a collection spot for debris. We have to live with nature. We have a dynamic, exciting, high energy beach, and I want it to stay that way."

Fisheries and Oceans Canada

Human activities that interfere with natural shore processes can lead to irreparable damage.

Piers, Wharves and Jetties

Piers, wharves and jetties are pile-based structures designed to provide safe moorage for ships, tugs and commercial fishing boats. They may be located within a harbour protected by breakwaters. A pier normally extends at right angles to shore into deep water, providing moorage on both sides. Wharves generally run parallel to shore (often called a marginal wharf) with storage for industrial commodities such as wood products. Jetties technically are not used for mooring boats but are linear structures, similar to breakwaters, built out from shore and used to control sedimentation at the mouth of a river; e.g., Steveston Jetty on the Fraser River.

Mike Tarbotton

Whether for industrial, commercial, or recreational use, the construction of a pier or jetty must consider not only the impact of the structure itself, but also the impacts of its related activities.

What Can Happen

Piers, wharves, and jetties can have a significant impact on coastal processes and associated biological communities. Some specific impacts include:

- Shading: Shading can affect the vigour of such intertidal and subtidal plant communities as marsh plants, eelgrass and kelp beds. Shading impacts may be chronic (reduced productivity) or acute (elimination of plant communities, leaving affected areas barren.)
- Disruption of sediment drift: This results in updrift beach formation and downdrift shore erosion.
- Intensified wave reflection and resonance: This may cause localized shore erosion or could make a facility inaccessible to small boats at certain times. Wave reflection is most severe for structures with a vertical face.
- Short term disruption: Construction and dredging can bury productive habitat, and cause turbidity and discharge of contaminants.

Considerations – Things to Find Out

Need: Shore structures like these are often undertaken without considering the consequences of the activity or alternative ways to meet the intended objective. Consult a physical shorezone expert for advice on location or structural options.

Impact assessment: Determine the type of shore being affected .(Refer to pages 22 to 33 for a discussion of shore types and their sensitivity to development.) Review long-term sedimentary processes in the area. Identify biological resources and habitats that must be avoided or protected.

Regulatory requirements: See Chapter 3 of *Shoreline Structures Environmental Design* (For More Information) for guidance on project review processes and requirements under the federal *Fisheries Act* and other regulations.

Provincial lease or licence: The province has jurisdiction over foreshore and inland waters (refer to Chapter 4, Coastal Planning and Approvals). Get a lease, licence or permit from Land and Water British Columbia Inc.

Local government requirements: Some local governments require development permits to build on shore areas. Check with the municipal or regional district development services department.

Port, harbour or estuary management plan: Many ports, harbours and estuaries in developed areas have specific plans in place. These plans often identify areas where you can build a shore structure without incurring significant environmental impacts. Check with the applicable port authority or local government.

Impacts on navigation: Contact Navigable Waters Protection Division (Coast Guard) of Fisheries and Oceans Canada (DFO) for requirements under the *Navigable Waters Protection Act.*

Timing of construction: Restrictions on when construction can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (e.g., surf smelt or sandlance spawning, herring spawn, oyster spat, etc.) Construction may not be permitted during these critical times of the year. Contact your local government or *Fisheries and Oceans Canada* to confirm the timing restrictions of such activities.

Professional assistance: As can be seen from this list, many approvals can be required to build these structures, due in large part to the number of things these structures can affect. For this reason it is wise to hire a qualified professional to assist in assessing the coastal resources and processes, developing site plans that achieve your objectives while minimizing impacts to the shore, and finding options that deliver the project more effectively and at reduced cost. You must conduct all necessary regulatory assessments and obtain all appropriate approvals: These may include cultural or archeological assessments if there has been First Nations activity on your land or cumulative environmental assessments if the project triggers CEAA (the Canadian *Environmental Assessment Act*.) Qualified professional experts should be aware of all the applicable regulatory requirements and guidelines that would apply to your project and should understand how to meet them.

For More Information

"Shoreline Structures Environmental Design: a Guide for Structures along Estuaries and Large Rivers" (M.A. Adams, 2002) This report by Fisheries and Oceans Canada covers project review procedures and design criteria for a variety of shore structures. It also provides detail on shore vegetation and its restoration.

Docks

Docks are also an important part of small craft harbours or marinas and are used for mooring small vessels and pleasure boats. Property owners also install individual docks for mooring recreational craft.

Docks come in various sizes, shapes and designs:

- Fixed or permanent docks are secured to shore and sit above water supported by piles or pipes.
- Floating docks are tethered to shore or connected to a permanent dock by a ramp. They float on buoyant material built into the dock. They can often be removed for winter storage.
- Specialty docks include cantilever, suspension and lift docks. They too may be able to be lifted above the high water mark, or removed.

What Can Happen

The installation of docks can affect the coastal biophysical environment in a variety of ways:

- Shading: Shading caused by the dock can affect the vigour of intertidal and subtidal plant communities, such as marsh plants, eelgrass and kelp beds. These impacts may be chronic (reduced productivity) or acute (wiping out plant communities, leaving the area barren).
- Disruption of shore drift patterns: This can result in updrift beach formation and downdrift shoreline erosion.
- Shore damage: Removal of shore plants and disturbance of soils where docks are attached to land can increase erosion and sedimentation of the intertidal and adjacent subtidal areas.
- Bottom habitat: Installation of footings, pilings and other structures permanently alienates benthic habitat. Dredging to create sufficient depth next to the dock can also disrupt or destroy bottom habitat.
- Operational pollution: Poor refuelling and dock maintenance practices, bilge releases and accidental spills from boats and docks can release contaminants into the nearby waters.

Considerations – Things to Find Out

Need for a new dock: Are there alternative ways of meeting your docking or moorage needs? For example, could you use an existing public or community facility, share an existing dock with a neighbour, or use a mooring buoy?

Design: Select a size and design that fits your needs and minimizes disturbance to the shore and sea floor. If all your boating is in summer, consider a dock that can be removed during the winter. Post-supported, floating and cantilevered docks have progressively less impact on the shore and bottom habitat. Is there a less sensitive area in which to locate a dock?

Impact assessment: Determine the shore type and communities you may be affecting. Refer to pages 22 to 33 of this guide for help in identifying a shore type that may be less sensitive to construction of a dock. Your dock may harmfully alter or destroy fish habitat, so must be authorized by the Department of Fisheries and Oceans (DFO) under the *Fisheries Act*. Check with your local government first.

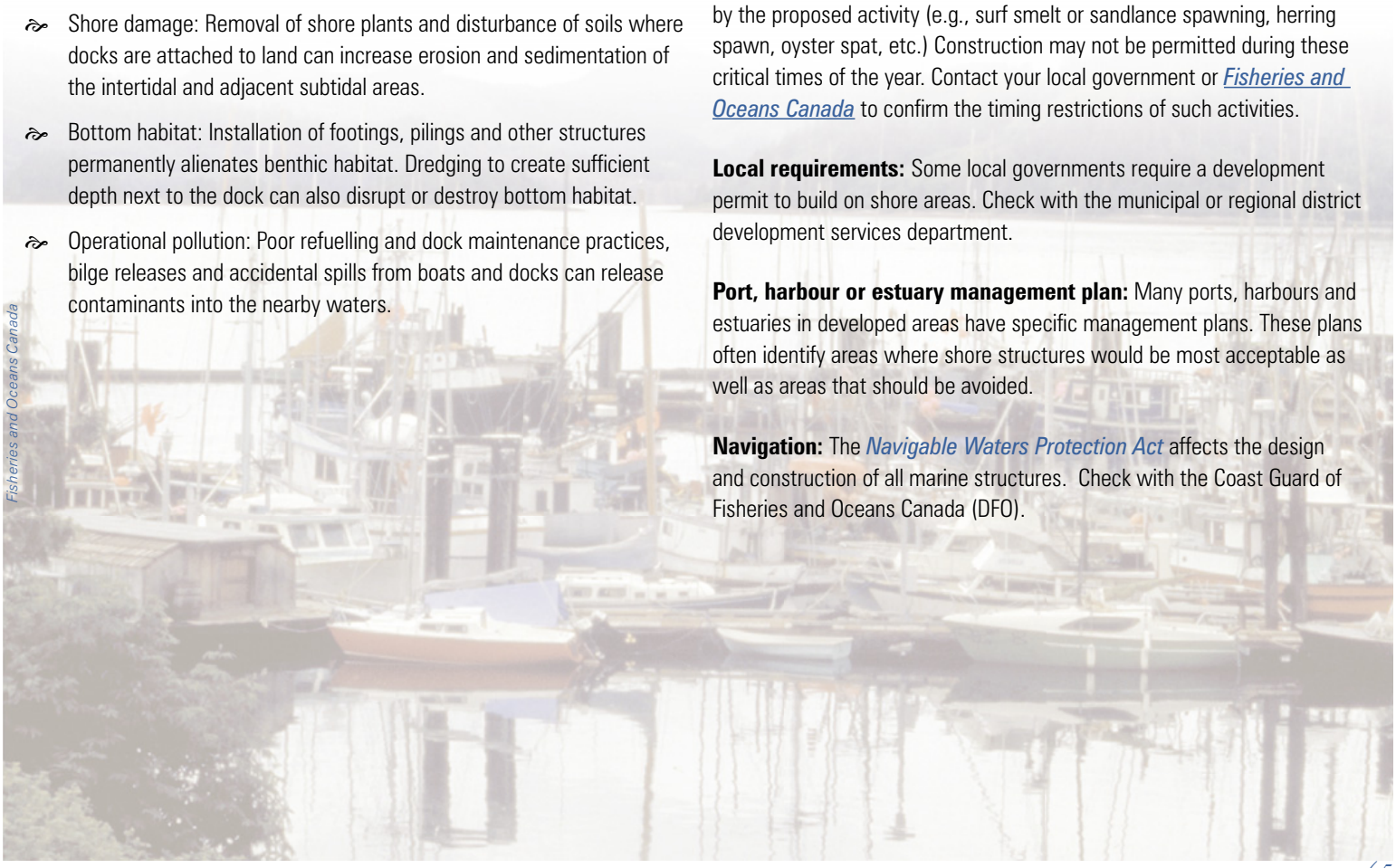
Provincial lease or licence: The province has jurisdiction over foreshore and inland waters (refer to Chapter 4, Coastal Planning and Approvals). Apply for a lease, licence or permit to use these areas from Land and Water British Columbia Inc.

Timing of construction: Restrictions on when construction can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (e.g., surf smelt or sandlance spawning, herring spawn, oyster spat, etc.) Construction may not be permitted during these critical times of the year. Contact your local government or *Fisheries and Oceans Canada* to confirm the timing restrictions of such activities.

Local requirements: Some local governments require a development permit to build on shore areas. Check with the municipal or regional district development services department.

Port, harbour or estuary management plan: Many ports, harbours and estuaries in developed areas have specific management plans. These plans often identify areas where shore structures would be most acceptable as well as areas that should be avoided.

Navigation: The *Navigable Waters Protection Act* affects the design and construction of all marine structures. Check with the Coast Guard of Fisheries and Oceans Canada (DFO).



Fisheries and Oceans Canada

Professional assistance: As can be seen from this list, many approvals can be required to build these structures, due in large part to the number of things these structures can affect. For this reason it is wise to hire a qualified professional to assist in assessing the coastal resources and processes, developing site plans that achieve your objectives while minimizing impacts to the shore, and finding options that deliver the project more effectively and at reduced cost. You must conduct all necessary regulatory assessments and obtain all appropriate approvals: These may include cultural or archeological assessments if there has been First Nations activity on your land or cumulative environmental assessments if the project triggers CEAA (the *Canadian Environmental Assessment Act*.) Qualified professional experts should be aware of all the applicable regulatory requirements and guidelines that would apply to your project and should understand how to meet them.

For More Information

- *"On The Living Edge: Your Handbook for Waterfront Living"* (Chapter 9), published by the *Living by Water Project*, provides many ideas on different types of dock designs, and building materials that are friendly to the marine environment.

- *DFO Marine Guide to Small Boat Moorage* – This fact sheet outlines the impacts from docks, provides environmentally friendly design and construction guidelines, outlines project assessment requirements and identifies local DFO contacts for information and advice. This fact sheet is available at *DFO's website*.

Canadian Wildlife Service

The impacts of residential docks may appear insignificant compared with the massive structures shown on page 64. But because of their numbers, these structures still require careful scrutiny to minimize their potentially destructive environmental impacts.

Dikes

Dikes are designed and constructed for one purpose - to prevent flooding of low lying lands. Dikes are extensive throughout the Fraser River estuary and, to a lesser extent, in other urbanized estuaries (e.g., Squamish and Nanaimo). While the era of large scale dike construction is over, habitat conservation remains a critical issue in the extension, modification and maintenance of existing dikes.

What Can Happen

A typical dike is built within the highly productive flood plain, which is the transition zone between aquatic and upland environments. Dikes can affect the biophysical shore system in three ways:

- They form a permanent barrier between the intertidal and backshore, thereby eliminating marshes, mudflats, and seasonally flooded areas that provide critical seasonal fish and bird habitat.
- They reduce the effect of tides, currents, storms and seasonal fluctuations on water levels. This changes elevations and salinities on both sides of the structure, thereby changing all habitat characteristics and biological community structure and reducing the shoreline's natural resiliency and diversity.
- They accelerate the erosive shear forces at the toe of the dike, which straightens, hardens and simplifies the shoreline and eliminates natural diversity and habitat niches for many organisms.

In addition, dikes must be maintained to ensure they continue to protect the developed areas behind them. Traditionally, this has led to sterile, minimally vegetated structures throughout the foreshore that contribute little to habitat productivity.

Where dikes accelerate adjacent accretion, regular dredging may be required to maintain open navigation channels. This dredging can increase turbidity, mobilize sediment-associated contaminants and trap or bury small aquatic organisms.

Considerations – Things to Find Out

These cautions apply to construction of new dikes as well as to expansion and maintenance of existing dikes.

The need: How significant is the flooding risk? Have you consulted flood risk maps for your area, where they exist? Are there alternative ways to address the local erosion or flooding problem you're trying to solve? Consult a physical shorezone expert for options.

Impact assessment: Define the type of shore being affected (Refer to pages 22 to 33 for a discussion of shore types and their sensitivity to development); determine sediment transport processes; identify biological resources and habitats; etc.

Regulatory requirements: See Chapter 3 of the *DFO Guide to Shoreline Structures Environmental Design* for guidance on project review processes and requirements. Section 3.2 addresses requirements under the federal *Fisheries Act*, and section 3.3 covers other authorities.

Maurice Jassak

image provided by seevancouverbc.com

While the era of large scale dike construction is over, habitat conservation remains a critical issue in the extension, modification and maintenance of existing dikes.

Provincial lease or licence: The province has jurisdiction over foreshore and inland waters (refer to Chapter 4 in this guide, Coastal Planning and Approvals). You must apply to Land and Water British Columbia Inc. for a lease, licence or permit to construct dykes in these areas.

Local government requirements: Some local governments require development permits for dikes; check with the municipal or regional district development services department.

Port, harbour or estuary management plan: Many ports, harbours and estuaries have specific plans that identify areas where you can build on shore without incurring significant environmental impact. Check with the applicable port authority or local government.

Impacts on navigation: Contact the Navigable Waters Protection Division of Fisheries and Oceans Canada (DFO) for requirements under the *Navigable Waters Protection Act*

Timing of construction: Restrictions on when construction can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (e.g., surf smelt or sandlance spawning, herring spawn, oyster spat, etc.) Construction may not be permitted during these critical times of the year. Contact your local government or Fisheries and Oceans Canada to confirm the timing restrictions of such activities.

Environmental design and maintenance: Several measures are discussed in Chapter 5 of he DFO Guide to Shoreline Structures Environmental Design. They include setback dikes, the use of vegetation, and ecologically sound maintenance and repair practices.

Professional assistance: As can be seen from this list, many approvals can be required to build these structures, due in large part to the number of things these structures can affect. For this reason it is wise to hire a qualified professional to assist in assessing the coastal resources and processes, developing site plans that achieve your objectives while minimizing impacts to the shore, and finding options that deliver the project more effectively and at reduced cost. You must conduct all necessary regulatory assessments and obtain all appropriate approvals: These may include cultural or archeological assessments if there has been First Nations activity on your land or cumulative environmental assessments if the project triggers CEAA (the *Canadian Environmental Assessment Act.*) Qualified professional experts should be aware of all the applicable regulatory requirements and guidelines that would apply to your project and should understand how to meet them.

For More Information

- *"Shoreline Structures Environmental Design: A Guide for Structures along Estuaries and Large Rivers"* (M.A. Adams, 2002). Chapter 5 is devoted to dikes. While focusing on flood protection, it also presents ways of locating and aligning dikes, establishing vegetation and maintaining dikes to be more habitat friendly.

Marine Discharges

Discharges to the marine environment can be characterized as originating from point or non-point sources. Point or "end-of-pipe" discharges are typically associated with industrial and municipal outfalls. Regulations and vigilance over the last decades have been generally successful in reducing the introduction of pollutants from these sources.

All point-source discharges are subject to one or more federal and/or provincial regulations. Be aware of the rules governing the type of outfall or discharge you are operating.

Non-point source discharges arise from many sources (see sidebar). Their effects are often subtle and gradual, but cumulatively they are recognized as a significant source of pollution in freshwater and marine environments. Highly toxic non-point source discharges from accidental spills or fugitive discharges can be immediately fatal to marine organisms in the vicinity of the spill.

General Considerations

- Non-point source pollution is very difficult to manage. It is hard to identify and control the many sources over a large area. The key is prevention through planning, education, and source control. Wide-scale prevention is necessary because the actions of many individuals contribute to the problem and many people must also be part of the solution.
- The quantity of pollutants originating from any one source, such as a home, business or farm, may be very small. The cumulative effect of hundreds or thousands of small sources within a watershed or discharging to the nearshore can create significant pollution.
- Both point and non-point discharges can kill fish and shellfish, damage human health, affect recreation and tourism and close areas to commercial fishing, aquaculture and/or food harvesting. It also affects aesthetics and lowers real estate values.

While pollutant source reduction or treatment can be expensive, the initial costs are amortized over the lifespan of the facility and often cost less than the ongoing cost of pollution clean-up, penalties and bad press.

Non-point pollution sources

Lanarc Consultants Ltd.

Land development - *sediment and toxics from clearing and construction*

Ministry of Forests

Agriculture - *fertilizers, manure, pathogens, pesticides and sediment*

Lanarc Consultants Ltd.

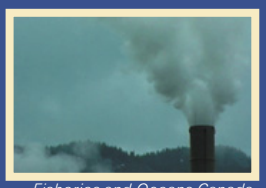
Stormwater runoff - *nutrients, sediments, pathogens and toxins*

Greater Vancouver Regional District

Sewage systems – nutrients, pathogens and pharmaceuticals

Lanarc Consultants Ltd.

Forestry - *sediment, fertilizers, pesticides, debris, ash from burning*



Fisheries and Oceans Canada

Atmospheric deposition – heavy metals, hydrocarbons and emissions from vehicles, heavy industries

Mike Tarbotton

Marine activities - *toxics from vessel operation, maintenance, sewage, spills*

Stormwater Runoff

Stormwater management, historically focused on reducing risks associated with rain and flooding. It did this by building bigger ditches, culverts and pipes to convey water away quickly and conveniently. Water arrived in the receiving stream, lake or coastal shore much faster and in much greater quantities than it would normally, without the benefit of being slowed and filtered through the natural system. This often resulted in erosion and pollution.

Today, managers are trying to balance flood concerns with environmental protection. "Integrated" stormwater management looks beyond pipes and ditches to consider a full range of measures to control surface runoff, thus protecting aquatic habitats.

What Can Happen

In typical urban conditions, stormwater discharge can cause:

- Shore erosion: Sudden and high discharges can erode shore beds and sediments around a stormwater outfall.
- Pollution: Storm water often contains such contaminants as hydrocarbons and heavy metals, washed off streets and parking lots; fecal coliform from cross-connections with sanitary sewers or from leaking septic systems; toxics spilled or dumped in upland areas; atmospheric emissions washed off vegetation, roofs and streets by rainfall.
- Sedimentation: Sediment washed down from construction sites or exposed soils can smother foreshore and intertidal organisms, interfere with suspension feeders and increase turbidity, thereby reducing light penetration and photosynthesis.
- Altered sediment transport: Drainage pipes or outfalls installed across the foreshore can alter longshore sediment drift and change habitat characteristics on both sides of the structure.

Considerations – Things to Find Out

Impact assessment: Define the type of shore being affected (Refer to pages 22 to 33 for a discussion of shore types and their sensitivity to development.); determine sediment transport processes; identify biological resources and habitats in the area; etc.

Regulatory requirements: Stormwater outfalls must not harmfully alter, disrupt or destroy fish habitat or cause the deposit of a deleterious substance under the federal *Fisheries Act*. If the stormwater system has connections with the sanitary sewer, requirements of the provincial *Waste Management Act* will also apply.

Provincial lease or license: The province has jurisdiction over foreshore and inland waters (refer to Chapter 4 in this guide, "Coastal Planning and Approvals"). You may need a lease, license or permit to cross foreshore areas; check with Land and Water British Columbia Inc.

Local government requirements: Some local governments require development permits for outfalls in shore areas. Check with the municipal or regional district development services department. Some municipalities may have bylaws or codes of practice regulating stormwater quality.

Port, harbour or estuary management plan: Many ports, harbours and estuaries have specific plans that identify areas where structures can be built without incurring significant environmental impact. Check with the applicable port authority or local government.

Impacts on navigation: Contact the Navigable Waters Protection Division of Fisheries and Oceans Canada (DFO) for requirements under the *Navigable Waters Protection Act*.

Timing of construction: Restrictions on when construction can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (e.g., surf smelt or sandlance spawning, herring spawn, oyster spat, etc.) Construction may not be permitted during these critical times of the year. Contact your local government or *Fisheries and Oceans Canada* to confirm the timing restrictions of such activities.

Environmental design considerations: There are many ways to reduce or slow down surface runoff "at source" so that it does less damage to the receiving environment. Minimizing the amount of impervious surfaces on a developed site and preserving trees and other greenspace will reduce the volume of stormwater generated. Use "soft" or pervious surfaces (grass, gravel, vegetated swales, paving stone with spaces, turf or "eco-roofing", etc,) wherever possible. You can improve water quality with such devices such as oil-grit interceptors, vegetated swales and settling ponds or constructed wetlands. Avoid using toxic substances that wash down the local storm drain. Check the guidelines listed below.

Professional assistance: Hire a qualified professional to assist in assessing coastal resources and processes, developing site plans that achieve objectives while minimizing impacts, finding options that deliver the project more effectively and meeting applicable regulations.

For More Information

- The provincial Ministry of Water, Land and Air Protection(MWLAP) publishes and updates *"Best Management Practices to Protect Water Quality"* to address non-point source pollution *on their website*.
- MWLAP and Environment Canada have recently published *"Stormwater Planning: A Guidebook for British Columbia"* (2002). Copies are available *from their website*.
- *"Natural Approaches to Stormwater Management"* by the Puget Sound Action Team provides excellent examples of low impact development measures. Copies are available *from their website*.
- The Stormwater Manager's Resource Center (SMRC) is a website managed and published by the *Center for Watershed Protection Inc.*, based in Maryland. It has compiled a comprehensive list of best management practices and education materials.
- The Greater Vancouver Regional District has developed several *Best Management Guides for Stormwater*. These are available on the *GVRD web site*.

Sewage Outfalls

Sewage outfalls carry liquid waste from onshore facilities out to sea. Discharges are usually made at some depth and distance from shore.

In B.C., the collection, treatment and disposal of sewage are typically the responsibility of local governments - municipalities, regional districts or local improvement districts - though there are also some private discharges. Communities experiencing development pressures or having significant liquid waste issues are encouraged, or may be directed by the Minister, to develop a Liquid Waste Management Plan to build and operate sewage facilities as well as addressing other liquid waste issues such as stormwater, on-site sewage systems and source control. Other communities and service providers must meet the requirements of the Municipal Sewage Regulation (MSR) under the *Waste Management Act,* or, if their discharge pre-dates the MSR, they must comply with conditions of a permit that authorizes the discharge.

What Can Happen

Sewage effluent contributes organic material and nutrients to the marine environment, and can also contain toxic contaminants. Siting outfalls in the best spot, relative to currents, tides and flushing rates is important. Otherwise, the sewage can wash up on the adjacent shores or contaminate nearshore waters.

- Increased nutrients can result in dramatic algae growth that depletes oxygen levels in the water, starving local fish and shellfish of oxygen.
- Bacteria from the sewage effluent, if swept shoreward, can make the nearshore waters unsuitable for swimming and other recreation and can seriously contaminate local bivalves, making them unfit to eat.
- Deposition of fine, organic sediments or other contaminants from sewage effluent can smother and destroy benthic (bottom-feeding) invertebrate communities.
- The alignment and construction of an outfall pipe across the foreshore can disrupt sediment drift patterns and deposition, contributing to habitat alteration and loss.

Considerations – Things to Find Out

Impact assessment: The location, design and construction of sewage outfalls are subject to specific impact study requirements under the MSR (see below: For More Information).

Regulatory requirements: The federal *Fisheries Act* prohibits the deposit of a deleterious substance to fishbearing waters and sewage discharges can be deleterious. The provincial Ministry of Water, Land and Air Protection also regulates sewage collection, treatment and disposal under the *Waste Management Act* and Municipal Sewage Regulation. Depending on the facility, a Liquid Waste Management Plan and an Operational Certificate under the Plan, registration under the MSR or a permit are required. Authorization under the federal *Fisheries Act* may also be required if physical habitat alteration or loss is an issue.

Provincial lease or license: The province has jurisdiction over foreshore and inland waters (refer to Chapter 4 in this guide, Coastal Planning and Approvals). You may need a lease, license or permit to build an outfall.

Local government requirements: Some local governments require development permits for outfalls; check with the municipal or regional district development services department

Port, harbour or estuary management plan: Many ports, harbours and estuaries have specific plans that identify areas where shore structures will not incur significant environmental impacts. Check with the applicable port authority or local government.

Impacts on navigation: Contact the Navigable Waters Protection Division of Fisheries and Oceans Canada (DFO) for requirements under the *Navigable Waters Protection Act*.

Timing of construction: Restrictions on when construction can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (e.g., surf smelt or sandlance spawning, herring spawn, oyster spat, etc.) Construction may not be permitted during these critical times of the year. Contact your local government or *Fisheries and Oceans Canada* to confirm the timing restrictions of such activities

Professional assistance: A qualified professional can assist in assessing coastal resources and processes, developing a design that deals with sewage while minimizing the impact and meeting applicable regulations.

For More Information

- *"Environmental Impact Study Guideline - A Companion Document to the Municipal Sewage Regulation"* (MWLAP, December 2000) details the impact assessment requirements for location, design and construction of sewage outfalls. The impact study must determine whether the proposed discharge meets the standards and requirements of the MSR. It is available on *MWLAP's website*.
- Contact the Pollution Prevention Manager in your regional MWLAP office, or the Pollution Prevention Section of MWLAP in Victoria, (250) 387-6663.

Greater Vancouver Regional District

Industrial Wastewater or Cooling Water Discharges

Some industries use outfalls to discharge wastewater or cooling water into the sea. Discharges can occur into both the intertidal zone and subtidal areas, sometimes at depths up to 200 m.

Various regulations cover industrial discharges. They are administered by the Ministry of Water, Land and Air Protection (MWLAP) under the *Waste Management Act*. Some specific industrial discharges are also subject to federal legislation (i.e., the *Fisheries Act* and associated regulations), as is the case for pulp mill and metal mining effluents. Most discharges require a permit, and are subject to environmental assessments prior to approval.

What Can Happen

- Discharges of cooling water or wastewater can heat or contaminate the shore environment. They can also cause thermal shock for species in the immediate vicinity of the discharge. It is important to choose the appropriate site for an outfall to minimize impacts on intertidal and subtidal biota and to ensure optimum treatment of effluents. Proper siting requires good knowledge of the currents, tides, flushing rates and dispersion patterns and often requires some oceanographic modelling.
- Industrial contaminants can impair biological communities around the outfall. For many years, areas near pulp mill effluent discharges were closed to crab harvesting because of dioxins and furans. Changes to pulp bleaching processes mean many of these toxics have been removed from the effluent and the areas are now safe for crabbing and have been reopened to commercial and recreational harvest.
- Some discharges also deposit suspended sediments and/or fine organic material that can smother benthic organisms, deplete oxygen levels and reduce sunlight penetration which inhibits algal photosynthesis.
- The alignment and construction of discharge pipes across the foreshore and nearshore benthic areas can disrupt sediment transport and contribute to habitat alteration or loss.

Considerations – Things to Find Out

Impact assessment: The location, design and construction of industrial outfalls and treatment of effluents are subject to rigorous impact assessment requirements; check with the local MWLAP and DFO office.

Regulatory requirements and approvals: Several specific industrial effluents such as metal mining effluents, pulp mill effluents and sewage effluents are the subject of specific regulations under the Federal *Fisheries Act*. All discharges that are deleterious are subject to the general pollution prevention provisions of the Federal *Fisheries Act*. MWLAP also regulates waste disposal and cooling water discharges.

Provincial lease or license: The province has jurisdiction over the foreshore and inland waters (refer to Chapter 4, Coastal Planning and Approvals). A lease, license or permit may be required; check with *MWLAP or Land and Water B.C. Inc. or visit their website*.

Local government requirements: Some local governments require development permits for any outfalls in shore areas. Check with the municipal or regional district development services department.

Port, harbour or estuary management plan: Many ports, harbours and estuaries have specific plans that identify areas where shore structures will not incur significant environmental impact. Check with the applicable port authority or local government.

Impacts on navigation: Contact the Navigable Waters Protection Division of Fisheries and Oceans Canada (DFO) for outfall siting requirements or restrictions under the *Navigable Waters Protection Act.*

Timing of construction: Restrictions on when construction can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (e.g., surf smelt or sandlance spawning, herring spawn, oyster spat, etc.) Construction may not be permitted during these critical times of the year. Contact your local government or *Fisheries and Oceans Canada* to confirm the timing restrictions of such activities.

Professional assistance: Hire a qualified professional to assist in assessing coastal resources and processes and to develop a site plan that will minimize the impact of your outfall, while meeting applicable regulations.

Pollution prevention plan: MWLAP's Pollution Prevention (P2) Planning program aims to avoid, eliminate, or reduce the release of polluting substances to the environment. See below for information sources.

For More Information

- Contact the Pollution Prevention Manager in your regional MWLAP office, or the Environmental Management Branch - Industry and Business Section in Victoria. PO Box 9342 Stn. Prov. Gov., Victoria, B.C. V8W 9M1
- For the Pollution Prevention (P2) Planning program: contact the Environmental Management Branch of MWLAP in Victoria, or visit the *Environmental Protection Division's website.*

Lanarc Consultants Ltd.

Discharges from pulp and paper operations are managed by federal regulations under the ***Fisheries Act*** *and by provincial guidelines that cover liquid effluent, sulphur, and other substances.*

Disposal at Sea

Disposal at sea is the act of deliberately dumping materials into the open ocean as a means of disposing of them. Environment Canada regulates disposal at sea under Part VII of the Canadian *Environmental Protection Act* (CEPA). Through a permitting system, CEPA controls disposal of nonhazardous waste where such disposal is the environmentally preferable and practical option.

Substances commonly dumped in the ocean include dredged and excavation materials; ships, and other manmade structures; scrap metal and other bulky, nontoxic materials. Material destined for ocean disposal must pass a rigorous chemical analysis before a permit is given. The criteria for ocean disposal are conservative, and ocean disposal sites are designated and monitored.

CEPA's requirements do not apply to discharges resulting from offshore mineral exploration and development, from the normal operation of ships and other craft, or from land based sources. Other legislation such as the *Canada Shipping Act, Fisheries Act, Navigable Waters Protection Act*, and provincial waste management legislation regulate these.

In British Columbia, coastal topography and the lack of suitable landfill sites are key constraints in disposing of these types of wastes on land. The annual volume of dredgeate and excavation wastes in the Lower Mainland alone, for which there are no alternative beneficial uses, cannot be accommodated by existing landfill sites. Consequently, ocean disposal has become a practical and economical alternative to landfilling.

In the past, most ocean disposed material originated from maintenance dredging of harbours and channels for navigation and industry. In recent years, the amount of excavated native soils from construction sites has increased and now contributes 25-50% of material that is approved for ocean disposal.

What Can Happen?

- The primary impact of ocean disposal is smothering of benthic communities at the dumpsite by the large amounts of sediment or other sinkables dumped on the sea floor.

Considerations – Things to Find Out

Need. There may be alternatives to ocean disposal. Check the "Users Guide"listed under "For More Information."

Impact assessment: The ocean disposal permit application defines assessment requirements. Each application must also undergo a CEAA screening; see "For More Information."

Regulatory requirements: Environment Canada requires an ocean disposal permit be issued to dispose of any substance in Canadian waters from ships (including foreign vessels in our waters), aircraft, platforms and other artificial structures. All materials must meet Environment Canada clean-up standards and/or regulated screening criteria prior to permit approval. In exceptional circumstances, an emergency permit may be issued. An emergency is defined as a situation where disposal is necessary to avert danger to human life, a ship,aircraft, platform or other structure. Permits are issued for a maximum of one year, and govern timing, handling, storing, loading and placement at a disposal site.

Professional assistance: A qualified professional can assist in assessing whether ocean disposal is the preferred method and meets applicable regulations.

For More Information

- Environment Canada has published a *Users' Guide to the Application Form for Ocean Disposal*, which addresses such things as allowable substances, alternatives, disposal site, management measures and monitoring. Copies of the Guide are available through the Environmental Protection Service of Environment Canada in Ottawa, or visit *their website.*

Environment Canada

Dredgeates and excavated soils from construction form the bulk of materials disposed at sea.

Coastal Industries and Commercial Activities

A wide range of industrial and commercial activities occur along B.C.'s coasts. This section is limited to those activities that are common or increasing: dredging (primarily in ports and harbours), log handling and storage, finfish and shellfish aquaculture.

Many marine industries require access to the ocean and therefore must be situated on the coast, but they are also under close public and government scrutiny. Sound industrial development in coastal environments means that environmental sensitivities and natural hazards must be assessed and addressed as part of the design and operation. Failure to consider shore processes and habitats results ultimately in high costs to the company, taxpayers and/or the environment. It is far less costly to account for and protect ecological values up front than to attempt to repair, restore, and compensate for them after the damage is done. In many cases compensation or remediation may not be feasible.

General Considerations

- Federal or provincial and/or municipal regulations cover siting and operation of virtually all industrial activities. Be aware of the rules governing your particular operation.
- An industrial activity may involve several of the activities covered in previous sections – i.e. land development, marine structures and marine discharges. Review these sections as they apply to your operation.
- Try to minimize interference with shore processes. Also be aware of the risks that shore forces can pose to your industrial activity.

Dredging

Dredged material is usually discarded away from its source. Provincial waste management regulations and provincial and/or local government land use regulations govern dredge spoil dumped on land. Ocean disposal is regulated under the federal *Canadian Environmental Protection Act* (see "Ocean Disposal").

What Can Happen

- Benthic impacts: Dredging changes the nature and bathymetry of benthic bottom-feeding habitat, causing short and/or long term changes to plant, fish and invertebrate communities.
- Sedimentation: Suspension of sediment causes short term changes to water quality. Toxic materials bound to sediments can be mobilized and ingested by filter feeding organisms while settled sediment can smother bottom-dwelling organisms and may alter water chemistry.
- Contaminant release: Sediment-associated contaminants can be re-suspended and carried some distance.
- Alterations to the intertidal zone: Intertidal habitat can be affected by shoreline excavation, infilling and shoreline stabilization works.

Considerations – Things to Find Out

Impact assessment: Determine the nature of the intertidal and benthic substrate, biological communities and whether the site provides fish habitat. Determine whether the bottom sediments may be contaminated.

Regulatory requirements and approvals: As the landlord of foreshore and nearshore areas, Land and Water British Columbia Inc. must approve any dredging, filling, or significant displacement of beach material. Dredging likely will affect fish habitat so an authorization under the federal *Fisheries Act* by Fisheries and Oceans Canada (DFO) may also be required.

Local government requirements: Some local governments may require a development permit for any dredging near shore.

Port, harbour plan or estuary management plan: Many ports, harbours and estuaries in developed areas have specific management plans that may identify areas where dredging is acceptable. Check with the local port authority.

Impacts on navigation: Approval under the *Navigable Waters Protection Act* may be required; contact the Navigable Waters Protection Division of DFO.

Timing: Restrictions on when dredging can occur may apply if sensitive life history stages of organisms will be affected by the proposed activity (e.g., surf smelt or sandlance spawning, herring spawn, oyster spat, etc.) Dredging may not be permitted during these critical times of the year. Contact your local government or *Fisheries and Oceans Canada* to confirm the timing restrictions of such activities.

Professional assistance: A qualified professional may be useful in assessing the coastal resources and processes associated with the project, and may be able to suggest options.

For More Information

- DFO's Central Region publishes a Fact Sheet entitled *"What you should know about Fish Habitat and Dredging".* While intended for Ontario, there are suggestions for "environmentally friendly practices" that are useful for any dredging situation.

Canadian Wildlife Service

Dredging in estuaries or from the sea floor is disruptive. The process requires that the bottom sediment be lifted, stored, and deposited away from its original location.

Marine Log Storage

In British Columbia, coastal forestry operations often move logs by water from logging areas to sorting areas or processing mills. Today, most logs are transported by barge rather than towed booms. However, logs continue to be stored in the water in designated booming areas adjacent to coastal logging operations or while waiting for entry to a mill. Some areas are used only for a short time, while other areas adjacent to dry land sorts or mills may be used for decades.

The state of Alaska is so concerned about environmental damage that it has banned all new log storage and transport sites on water.

What Can Happen

- Benthic impacts: Logs stored in intertidal areas will often ground at low tide, compacting the substrate and smothering benthic or bottom-feeding communities. The sea floor can become a desert, void of all life. Unbundled logs, particularly hemlock, can also sink to the bottom.
- Shading: Logs stored in deep water can shade the sea floor, inhibiting the growth of algae and sea grasses.
- Debris accumulation: Bark and wood debris accumulate on the bottom, particularly in sheltered areas. The decomposing organic material alters sediment chemistry and alienates benthic communities. Larger amounts of decomposing material can also create an oxygen debt, which starves the benthic species of the oxygen they require.
- Natural wood products also contain resin acids that leach into waters and over time can concentrate to toxic levels in sediments and organisms.

Considerations – Things to Find Out

Need: Are there alternative, feasible methods of storing or handling logs at the site?

Assess the impacts: Determine the type of shore and benthic substrate being affected; identify biological resources and habitats; determine sediment transport processes in and around the site; etc.

Provincial lease or licence: The province has jurisdiction over foreshore and inland waters; a lease, licence or permit to use these areas must be obtained from Land and Water British Columbia Inc. (LWBC). Depending on the size and extent of your log supply, you may have to provide a Log Handling and Storage Prospectus. You might also have to get the upland owner's consent if the log storage affects access to deep water. You may also need guarantees of performance and clean-up. Contact the local LWBC office *or visit their website* for details.

Federal approval: Log storage in water that harms fish habitat will also require authorization under the federal *Fisheries Act*. The storage site will also be reviewed for any hazard to navigation, under the *Navigable Waters Protection Act*. Contact the local Fisheries and Oceans Canada office.

Local government approval: You may need zoning or development permits. Check with the applicable municipality or regional district.

Port, harbour or estuary management: Many ports, harbours and estuaries in developed areas have specific plans in place. These plans often identify areas where log storage may not cause significant environmental impacts and therefore be most appropriate. Contact the local port authority or DFO.

Obtain professional assistance: A qualified professional can assist in assessing the coastal resources and processes associated with the site and its surrounding area. The professional can help in developing the site plan, and in determining how to meet all applicable regulations.

For More Information

- The Fraser River Estuary Management Program (FREMP) has developed Log Storage Guidelines. For details, contact FREMP at Suite 501, 5945 Kathleen Avenue, Burnaby B.C., V5H 4J7; Telephone: 604.775.5756, or *through their website*.
- *Guidebook: Best Environmentally Sustainable Management Practices for Log Handling Facilities in B.C.*: Available on the *BC Stewardship Centre website*.

Fisheries and Oceans Canada

Marine log storage is a significant issue in many large coastal estuaries. Storage areas shade benthic vegetation, cause abrasion of bottom-dwelling communities, deposit debris on the bottom and rob the sediment and water of oxygen as the debris decomposes.

Fisheries and Oceans Canada

A floating ramp rises and falls with the tide. This reduces bottom scour and the velocity at which the logs hit the water, which in turn lessens the amount of bark debris and loose limbs generated by the logs.

Fisheries and Oceans Canada

A "sea rake" skims the water and collects bark debris and loose branches before they can sink to the bottom.

Fisheries and Oceans Canada

By using heli-yarding as a method of log transport, logs are carried directly to barges without any water transport at all.

Logging, with care

The Lax Kw'alaams Nation has reactivated an old log dump in Stumaun Bay, north of Prince Rupert, but is operating it with care for the environment. There is an important herring spawn area less than 500 m from the dump, so all log handling activities cease during the spawning period. No wood storage is allowed in the bay, and the barges come in and out only on the high tide, to avoid any benthic damage to the sea floor. There has been no impact to the intertidal habitat, said a pleased Fisheries officer.

Another north coast lumber company has re-evaluated and modified its log handling practices to avoid the benthic impact caused when the logs thundered down a steep skid into the water. Its delivery ramp now floats and the logs are put into the water at high tide when the skid slope is less steep. The logs no longer hit the water at a high velocity, dislodging bark and breaking off branches. This has reduced the amount of debris generated. The company is also using a boom boat with a sea rake or trash screen welded on the front that collects all branches and bark before they can sink. These are deposited on shore for disposal. The company is also working to restore fish habitat, building reefs and providing other habitat for displaced nearshore benthic organisms.

Finfish Aquaculture

The provincial and federal governments regulate aquaculture. The province regulates the location of farms by providing tenure for finfish cultivation on Crown foreshore and inland waters. It also monitors aquaculture operations, making sure they comply with the *Waste Management Act*. DFO is responsible for ensuring that fish habitat and wild fish stocks are protected under the *Fisheries Act*. In 1984 there were 50 companies operating fish farms: now there are 12, owned primarily by multi-national firms.

Environmentally sound management of these facilities depends on finding an appropriate location and having responsible operating practices. Although this has not always been the case, the finfish aquaculture industry now is subject to regulations on location, as well as regulations aimed at reducing potential environmental impacts.

What Can Happen

- Pollution: A major concern is the pollution caused by leftover fish food and wastes from the fish in netpens. These wastes can accumulate on the bottom. They smother habitat and affect sediment and water quality. Other potential pollutants include blood or wastes from fish harvested and processed on site.
- Antibiotics: The use of medicated feed may introduce antibiotics into the environment. There is some concern that this may lead to antibiotic-resistant species.
- Escapes: The use of an introduced species (Atlantic salmon), with their potential for their escape, could lead to competition for food and habitat with native Pacific species. There is also a risk of genetic dilution from escaping pen-reared Chinook.
- Disease spread: Disease and parasites, including sea lice, may spread from farm fish to migrating or local native salmon.
- Predator control: Fish farms attract such potential predators as seals, sea lions, River otters, Great blue herons and some seabirds. Measures to control predator attacks may displace these creatures from key habitat areas, with accompanying declines in local or coastal populations.
- Nuisance factor: Neighbouring upland property owners may find fish farms reduce access to their waterfront, create too much noise and illumination, or are unsightly.

Clive Lance

Finfish aquaculture is a growing industry on the British Columbia coast. Atlantic salmon (a non-native species) accounts for about 65 percent of B.C. production, with the remainder being Pacific species, primarily Chinook and Coho salmon.

Considerations – Things to Find Out

Location: There are rules about where you can establish a finfish farm; contact Land and Water British Columbia Inc. (LWBC) for the latest information *visit their website*.

Provincial approval: The province has jurisdiction over foreshore and inland waters. You must get a licence to use these areas from Land and Water British Columbia Inc. (LWBC). A five-year licence of occupation is issued until the site is determined to be viable; then a longer- term lease can be obtained. Contact the local office of LWBC or *visit their website*.

Aquaculture operations must be licensed under the Aquaculture Regulation of the provincial *Fisheries Act*; contact the *Ministry of Agriculture, Food and Fisheries* for details.

Federal approval: A fish farm that harmfully alters, disrupts or destroys fish habitat will also require authorization under the federal *Fisheries Act*. It is also illegal to deposit a deleterious substance in fish-bearing waters under the federal *Fisheries Act.* All sites will also be reviewed for any hazard to navigation, under the *Navigable Waters Protection Act*. Where any federal legislation or regulation applies, the project will also require a CEAA screening. Contact the local Fisheries and Oceans Canada office.

Escape prevention: The provincial government amended its Aquaculture Regulation in April 2002 to require more stringent escape prevention controls. Contact the *Ministry of Agriculture, Food and Fisheries (MAFF)* or visit its website.

Pollution prevention: The Ministry of Water, Land and Air Protection (MWLAP) is responsible for protecting the marine environment and fish and wildlife species and administers the Aquaculture Waste Control Regulation under the *Waste Management Act* which is available *on their website*.

The regulation addresses fish feed usage, waste disposal (including sewage), application of therapeutics, fish kills, spills and any events of potential contamination. Contact MWLAP's Vancouver Island Region office for further details. The federal *Fisheries Act* also prohibits the deposit of deleterious substances to fish-bearing waters. Noncompliance can result in criminal charges and a hefty fine.

Professional assistance: A qualified professional can assist in assessing coastal resources and processes, developing site plans that achieve objectives while minimizing impacts, finding options that deliver the project more effectively, and meeting applicable regulations.

For More Information

- All three agencies – *DFO, MWLAP and MAFF* – have extensive information related to finfish farming. Visit their websites.

Shellfish Aquaculture

Like finfish farming, shellfish aquaculture is regulated jointly by the provincial and federal government, but the province does most of the administrative activity. Land and Water British Columbia Inc. (LWBC) regulates the location of aquaculture sites by providing tenure on Crown foreshore and inland waters. The Ministry of Agriculture, Food and Fisheries (MAFF) licenses aquaculture operations and is developing a Code of Practice (see below) for the industry. The Ministry of Water, Land and Air Protection (MWLAP) monitors and regulates environmental impacts and waste generation from these operations. The federal Department of Fisheries and Oceans (DFO) reviews projects to prevent infractions to the federal *Fisheries Act* associated with destruction of natural fish habitat. The federal *Navigable Waters Protection Act* also regulates any effects that fish farms have on navigation so you may also need a federal permit.

Environmentally sound management of these facilities depends on finding an appropriate location and having responsible operating practices.

What Can Happen

Concerns that have been raised about the shellfish culture industry include:

- Habitat displacement: Intensive shellfish cultivation may occur in sites that are vital habitats for other marine populations, displacing or destroying native plant communities and animal or fish populations.
- Predator control: Shellfish culture can attract potential predators, such as River otters, seastars and some seabirds (e.g. Scoter species). Measures to control predation may displace these creatures from key habitat areas or eliminate local populations.
- Nuisance factor: Neighbouring upland property owners may find shellfish farms reduce access to their waterfront, create noise or too much illumination, or are unsightly.

Considerations – Things to Find Out

Location: There are rules covering the location of shellfish farms; contact LWBC for the latest information.

Provincial approval: The province has jurisdiction over foreshore and inland waters; a lease, licence or permit to use these areas must be obtained from LWBC. A number of special requirements must be met in applying for a shellfish tenure. You must submit a detailed management plan and show proof of consultation with neighbouring upland owners and leaseholders. Contact the local office of LWBC or visit its website. Shellfish culture operations must be licensed under the Aquaculture Regulation of the provincial *Fisheries Act*; contact the *Ministry of Agriculture, Food and Fisheries* for details. Other regulations under this Act also apply to wild oyster harvest and oyster culture; again, check with the MAFF

Federal approval: A shellfish operation that can harm native fish or shellfish habitat will also require authorization under the federal *Fisheries Act*. The site will also be reviewed for any hazard to navigation, under the *Navigable Waters Protection Act*. Contact the local Fisheries and Oceans Canada office.

Professional assistance: A qualified professional can assist in assessing coastal resources and processes, developing site plans that achieve objectives while minimizing impacts, finding options that deliver the project more effectively, and meeting applicable regulations.

Best management practices: Codes of practice have been developed by MAFF; see below.

For More Information

- The provincial Ministry of Agriculture, Food and Fisheries (MAFF) is developing a Code of Practice for shellfish aquaculture. Compliance with the Code will set the standard for shellfish aquaculture operations in B.C. A copy of the draft Code of Practice and information on its review can be obtained from MAFF or *from its website.*

Shellfish aquaculture is defined as the commercial seeding, growing and harvesting of marine molluscs, bivalves and other invertebrates in a natural or manufactured environment. The primary types grown are oysters and clams.

David Suzuki Foundation

Coastal Living

Managing Use of the Shore

The previous section focused on "development" – when structures are being planned, designed and constructed. This section focuses on "maintenance" – good stewardship practices when living on, using or managing coastal property. It provides a synopsis of coastal use and management issues that may result in harmful impacts, and suggests what to do to avoid or to deal with problems.

Harriet Rueggeberg

The three basic messages from the discussion on development– "don't disrupt, don't harden, don't pollute" – apply equally to coastal management. The way we live on and manage our coastal property can shape the shore - positively and negatively. Through stewardship practices, education and monitoring, individuals and organizations can maintain the natural shore systems.

But stewardship involves more than education, enhancement and restoration. It demands a change of attitude, the understanding that we all can make a difference.

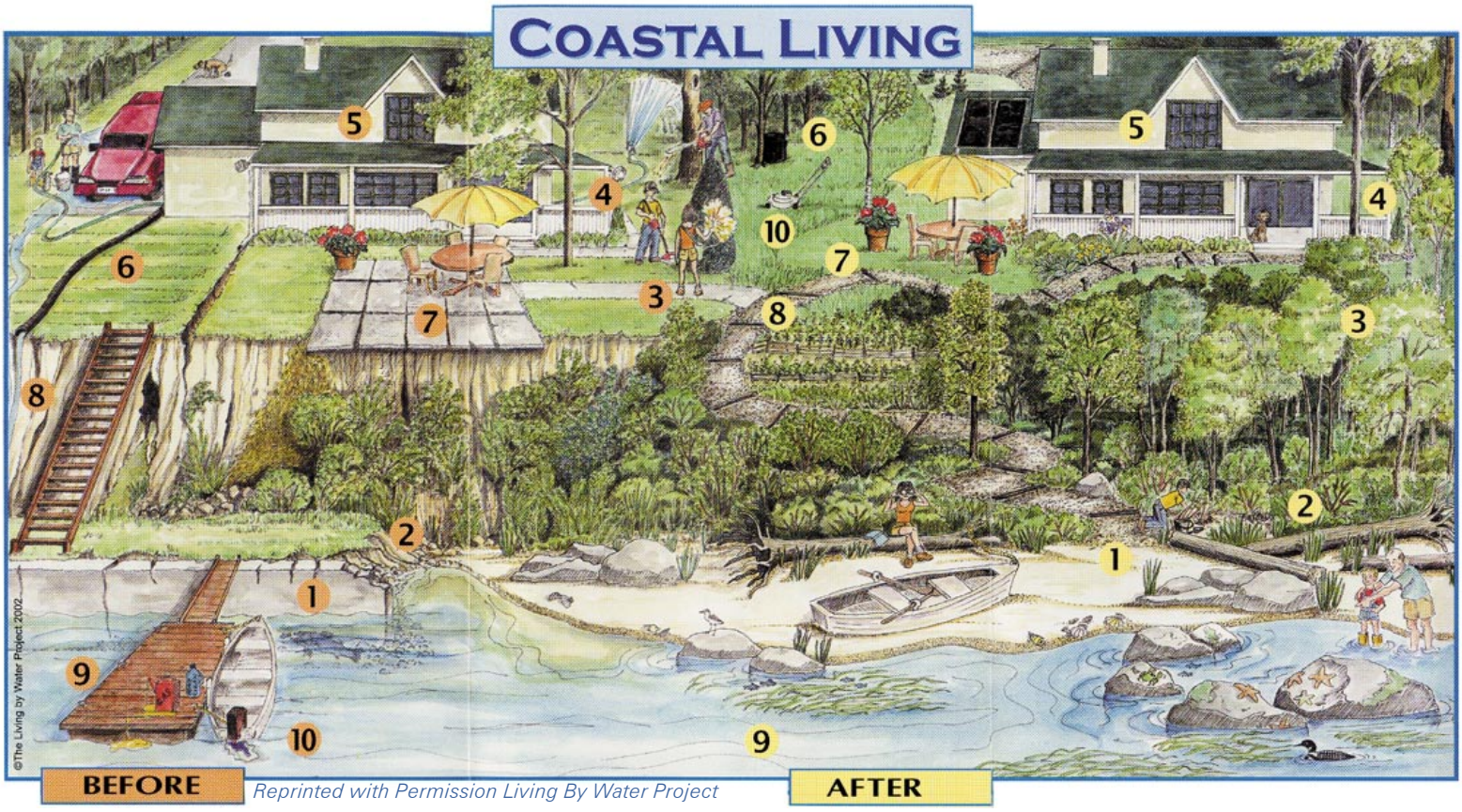
As the immediate neighbour to the shore, landowners may be the most clearly affected by coastal changes. They are also likely to be the first to notice them. Their connection to the shore suggests a special responsibility to act with care and caution, respecting not only their own property, but also their neighbour's. Because of their ability to notice and to take action quickly, local landowners may be in the best position to act as local stewards of our shores.

One of the greatest social values associated with the shore is recreation. Beaches are treasured for swimming, playing and socializing. On rockier coastlines, we enjoy tide pools. Scuba diving is a popular activity. In estuaries, bird and nature watching are primary activities.

But shores aren't just for fun. They are vital for sustaining life. A recent scientific study indicates that the economic value of wild ecosystems far outweighs the value of converting these areas to other uses (*Science,* Aug 9, 2002).

As well as providing recreation, coastal areas regulate our climate, treat our wastes, support transportation, feed us, provide storm and flood protection and attract tourists. Paying for these "free" services would cost us billions of dollars. But unfortunately, we often ignore these unaudited benefits while making short-term economic gains at the expense of long-term preservation of our environment. When we ignore the value of nature's services, we are "cooking the books."

Sustaining the shore and its intrinsic features is essential to our social, economic and environmental well being.



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1. Hardened shorelines accelerate erosion, eliminate the shoreline's "filtering" ability, degrade habitat.
2. Removal or rearrangement of natural debris leaves your shoreline vulnerable to erosion.
3. Chemical fertilizers and pesticides reduce water quality, are deadly for fish and other wildlife.
4. Cleared "manicured" lots lack shade and privacy. Loss of native plants leads to more erosion, runoff and work for you!
5. Harmful household chemicals and cleaners damage septic systems and degrade water quality.
6. Malfunctioning septic systems and improper waste disposal degrade water quality, can lead to beach closures for swimming and shellfish harvesting.
7. Runoff flows over solid surfaces, accelerating erosion; excess silt degrades habitat for fish and other aquatic critters.
8. Inappropriate beach access, such as steep stairs, destabilizes banks and leads to increased erosion.
9. Private docks, piers and boat ramps destroy eelgrass beds and habitat for fish and other wildlife.
10. Poorly maintained engines leak oils and other petroleum products and waste 25-40% of fuel.

1. Work with an expert to "soften" your shoreline; improve erosion protection with native trees, shrubs, grasses and beach logs.
2. Resist the urge to "tidy up"; let organic debris like beach logs and fallen trees act as a natural seawall.
3. Landscape with low maintenance native plants. Mow lawns high using a mulching mower.
4. Prune trees, rather than removing. Plant native trees and shrubs to reduce erosion and absorb runoff.
5. Use environmentally friendly products and cleaners, or alternatives like baking soda and vinegar.
6. Repair and maintain your septic system (consult an expert). Compost house and yard waste.
7. Reduce solid surfaces and porous materials. Redirect gutter runoff into porous or vegetated areas, away from shore.
8. Share beach access with neighbours, maintaining a narrow winding trail. Avoid accessing steep banks.
9. Use public docks and boat launches where possible; consider replacing your dock with a low impact private access option (e.g. a mooring buoy).
10. Use a well-maintained electric or push mower, and a 4 or 2-stroke boat motor that meets or betters EPA 2006 guidelines.

Give your Shoreline a Make-over!

Issues around Coastal Living

The following table provides a quick review of the main issues associated with living and enjoying the marine shore, and where to look for more detailed guidance on how to live with nature and ensure our activities do no harm.

Issues	Some Things To Do	Resources (See next section for details)
Foreshore care What happens on the beach can affect us all	• Clean up human garbage, but leave logs and natural debris alone unless they threaten your property. Logs washed up by high tides and storms play a vital role in stabilizing the backshore and providing a base for vegetation to establish. • Don't dump or burn garden waste on the beach for the ocean to "take care of." It's unsightly – and if everyone did the same, we'd soon exceed the coast's capacity to absorb it. • Keep fire pits off the intertidal zone – they kill the marine life under and immediately around the area. Use established ones, and share with a neighbour.	*On the Living Edge* *Caring for Our Shores*
Shore vegetation Shore vegetation plays a vital role in stabilizing shores, filtering out excess nutrients and contaminants and providing shade and habitat.	• Resist the urge to cut and mow right to the shore edge! Retain a healthy buffer of native vegetation - tall grasses, shrubs and trees. A width of 15-30 m is ideal, but every bit helps. • Prune trees and shrubs rather than remove them, to open up your frame of view. • Remove only "invasive" plants that choke out native species. • In the upland area, practice good lawn and yard care – leave grass clippings or compost them, don't use fertilizers, herbicides and pesticides. Use biological control agents or eco-friendly products instead. Water only as needed. Try xeriscaping, which minimizes the need for watering.	*On the Living Edge* *Caring for Our Shores* *Shoreline Structures Environmental Design* *Washington State Department of Ecology*
Shore erosion There are many ways to limit or avoid losing your shore.	• Help nature do its job in preventing erosion. Leave logs along the shoreline and retain natural vegetation. Plant additional native grasses, shrubs and trees that will help hold the soil and support the shore. • When planting alone is not enough, try "bio-engineering" approaches that use such natural materials as logs, live stakes and brush bundles called wattles. • Where erosion is severe, more radical measures may be needed. Consult a coastal professional before spending money on shore structures. If you have to reinforce with riprap, be sure that the slope is at least 1:2 (vertical: horizontal) and plant deep-rooted vegetation species above and behind the rock to fill the voids and increase its effectiveness and life span. • Stay away from gabions or vertical retaining walls, if possible. They often deflect wave energy rather than dissipate it, simply moving the erosion problem elsewhere.	*On the Living Edge* *Caring for Our Shores* *DFO Marine Guide to Preventing Shoreline Erosion* *Washington State Department of Ecology*

Steep bluffs and slopes

Rocky bluffs rarely pose a problem, but steep slopes of loose soils, clays or soft, sedimentary rock may be prone to erosion, sloughing or sliding.

- If you're concerned about the stability of your slope, seek the advice of a geotechnical specialist.
- Avoid adding weight-bearing structures (buildings, stairways, parking or storage areas) close to the edge of bluffs or banks.
- Don't dump rocks, leaves or garden debris over the edge of a bluff in hopes of stabilizing the surface. Often the added weight simply aggravates a problem.
- Prune rather than cut trees to improve the view or to build a trail or stairway. Tree removal on a susceptible slope should be done only with advice of a geotechnical expert who can gauge whether certain trees are stabilizing or destabilizing a slope.

On the Living Edge

Washington State Dept. of Ecology

Surface runoff

Roof and surface drainage can be a benefit or a hazard to a shore property.

- Evaluate natural drainage patterns and avoid obstructing the drainage route.
- Minimize paved and other hard, impervious surfaces – these can accelerate surface flows that contribute to erosion. Use gravel or paving stones that allow water to seep into the soil.
- Direct roof gutter, and other runoff to gravel or areas where soil won't become satuated and erode; never discharge at or over the top of a bluff or bank.

On the Living Edge

Caring for Our Shores

Washington State Dept. of Ecology

Septic Systems

Protect the water quality along the coast and save dollars.

- Locate septic fields as far from the shore as possible. Slope the field to direct drainage away from the shore.
- Minimize the amount of water flowing into the septic system. This allows it to work most efficiently without overloading the tank or drain field.
- Pump the tank regularly – every one to three years, depending on use.
- Avoid septic additives, and never pour caustic cleaners and chemicals into the system; they only kill the helpful bacteria in the tank and field.

On the Living Edge

Caring for Our Shores

Septic System Maintenance: Pure and Simple

Pollutants

Controlling what goes on the land and down the drain goes a long way to protecting healthy shores.

- Don't ever flush paints, thinners, and oil and petroleum products into a ditch, stream or storm drain. One way or another, they end up in coastal waters.
- Go easy on fertilizers and avoid using herbicides and pesticides on lawns and gardens; they end up in surface runoff and eventually in coastal waters.
- Avoid harsh chemicals such as solvents, bleach or caustic cleaners at home, on the dock or in the boat. Be especially careful in handling fuel, paints and other chemicals on docks and boats. Check out the guides described above for alternatives that are not toxic to aquatic life. There are many new environmentally sensitive and biodegradable cleaners and products, usually found in stores that sell natural or organic products. If you can't find them locally, ask your retailer to bring them in.

On the Living Edge

Caring for Our Shores

Guide to Green Boating

Protecting the Aquatic Environment

DFO Marine Guide to Preventing Shoreline Erosion

Best Management Practices (BMPs) for Marinas and Small Boatyards in British Columbia

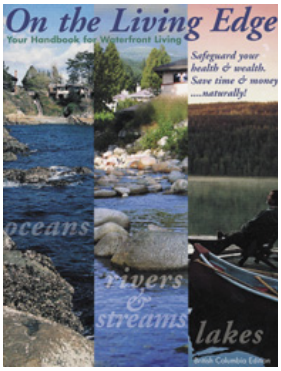
Issues	Some Things To Do	Resources (See next section for details)
Access You can avoid harm to the shore, while enhancing its beauty and enjoyment, if you choose your access route carefully.	~ Focus access points to just one or two hardy spots, to protect the rest of the shore from damage and trampling. ~ Avoid trail proliferation, such as spur trials or multiple access routes to the same area. Consider revegetating all but the one that can best handle increased foot traffic. ~ When building a trail on steep slopes, keep it narrow, choose "soft" surfaced soil, mulch or gravel rather than concrete or pavement and use gently angled switchbacks to reduce the risk of erosion. Minimize cutting into the bank. ~ Put stairs on pilings rather than cinching them to stumps and trees. Avoid cutting into the bank except to pour or install pilings. ~ On very steep slopes that may be destabilized by a trail or stairs, look for alternatives – like sharing with a neighbour whose property is less hazardous.	*On the Living Edge* *Access Near Aquatic Areas*
Docks, ramps, and floats Getting your boat to the water can also affect the shore.	~ See pages 65 and 66 of this guide for information on planning, designing and building docks. Perhaps there is an alternative to building a personal dock that requires a lot of maintenance and upkeep. ~ Don't use designs that require fill or dredging; docks should protect habitat and allow the free flow of water beneath them. Some ramps may be useable only at certain tides. ~ If you buy a property with a dock, ensure it has a lease or licence of occupation from the province and that it is transferred to you. ~ Maintain your dock using environmentally friendly products - check out the guides listed here for ideas.	*On the Living Edge* *Marine Guide to Small Boat Launches* *Marine Guide to Small Boat Moorage* *Shoreline Structures Environmental Design* *The Dock Primer* *Best Management Practices (BMPs) for Marinas and Small Boatyards in British Columbia*
Recreation Careful boating, camping and other recreational uses of the shore can avoid pollution, erosion and disturbance of wildlife and habitat.	~ Observe whales, sea lions, seals, otters and marine birds from a distance — avoid going too close to their haul outs and rookeries; do not feed, chase or harass them. Slow down and reduce your wake/wash and noise levels. ~ Do not disturb wildlife in estuaries or wetlands, avoid walking on vegetation in wetlands, and do not discharge any sewage, grey water or bilge near estuaries and coastal wetlands. ~ Respect shellfish growing sites - they may be someone's livelihood. (Look for stakes or cement blocks and signs marking shore based leases.) Do not remove shellfish, growing bags and other related structures from the water or the shore, don't discharge wastes from your boat near aquaculture sites, and watch your pets. ~ Don't overharvest any marine resources, including seaweed, as this can eliminate important habitats and cause populations to crash to below sustainable levels.	*Caring for Our Shores* *Guide to Green Boating* *Protecting the Aquatic Environment*

Stewardship Resources

Many excellent resources can help you learn how to live and work in harmony with the shore, whether you are an owner, planner, developer, regulator, or property manager.

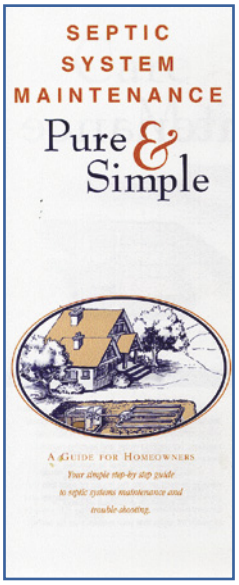
On the Living Edge: Your Handbook for Waterfront Living

On the Living Edge is a recent publication of the Living by Water Project (LWP). Focusing on shores of all types, the Project provides programs, services and materials to promote the value of keeping these shores healthy. Its emphasis is on what all of us can do to help care for our shores. On the Living Edge is written by and for waterfront residents, providing practical information for enjoying and protecting their natural surroundings and investments. For a copy of On the Living Edge, contact the *Living by Water Project*.



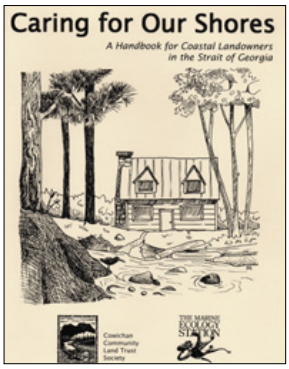
Septic Systems

Septic System Maintenance: Pure and Simple provides a simple, step-by-step guide for homeowners on septic system maintenance and trouble-shooting. Published by Environment Canada, it can be obtained from *the Simon Fraser University website.*



Caring for Our Shores handbook

This booklet advises coastal landowners in the Strait of Georgia on how to conserve the marine environment. Beginning with an introduction to marine life and habitats, it addresses various aspects of "living on the ocean." It covers mapping and monitoring the shore, and legal rights and responsibilities. Copies are available from the *Cowichan Community Land Trust Society* and the *Marine Ecology Station in Sidney*.



Washington State Department of Ecology

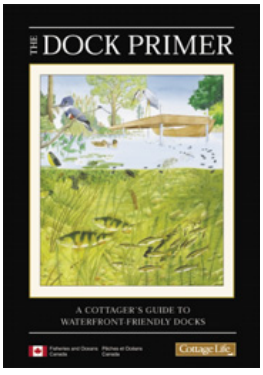
This agency has a series of useful web-based guides for landowners living on coastal bluffs:

- Slope Stabilization and Erosion Control Using Vegetation: A Manual of Practice for Coastal Property Owners.
- Vegetation Management: A Guide for Puget Sound Bluff Property Owners.
- Surface Water and Groundwater on Coastal Bluffs: A Guide for Puget Sound Property Owners.

For more information *visit their website*.

Dock Building

The Dock Primer, published by Fisheries and Oceans Canada and Cottage Life, is a cottagers' and homeowner's guide to waterfront-friendly dock construction and maintenance. It's based on the premise that a dock has to work in harmony with the natural shoreline and with the ways that landowners wish to use the shoreline. It's available *online from Fisheries and Oceans Canada.*



DFO Marine Guides

FACTSHEET

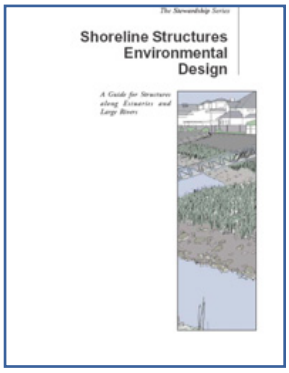
The Habitat and Enhancement Branch of Fisheries and Oceans Canada has published a series of "fact sheets" on marine activities, including:

- Marine Guide to Preventing Shoreline Erosion
- Marine Guide to Small Boat Launches
- Marine Guide to Small Boat Moorage

These guides briefly describe impacts to marine ecosystems, project considerations and regulatory requirements. Contact the local DFO office or download them from the *Pacific Region's website*.

Shoreline Structures Environmental Design

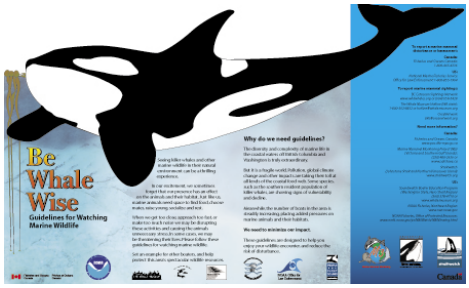
This extensive reference describes the structure and function of major nearshore and estuarine habitats, the regulatory review procedures associated with marine projects and environmental design criteria for piers, wharves, dikes and other structures. It also discusses marine plant restoration in detail. Copies are available from Fisheries and Oceans Canada and Environment Canada or on the *B.C. Stewardship Centre website.*



Be Whale Wise

This brochure provides guidelines for wise and careful marine wildlife viewing in order to minimize our impact on aquatic wildlife while permitting us to observe them in their natural environment

It is availble through The *Whale Museum website*.



Protecting the Aquatic Environment

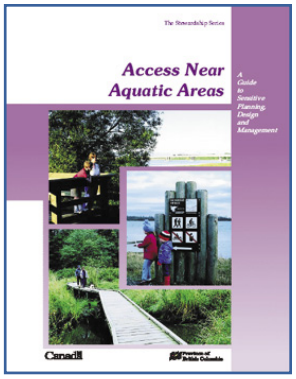
The Coast Guard also has a guide to help boaters preserve the marine heritage that they enjoy. It covers a range of topics about boating and wise use of the sea. Contact the Office of Boating Safety, or *visit the website* to download a copy.

Guide to Green Boating

The Georgia Strait Alliance's award-winning Green Boating Program helps boaters, clubs and marinas keep our coastal waters clean and enjoyable. The 16-page Guide to Green Boating is full of useful information and tips about environmentally friendly boat maintenance and use. Contact the Alliance for a copy or download it *from the website*.

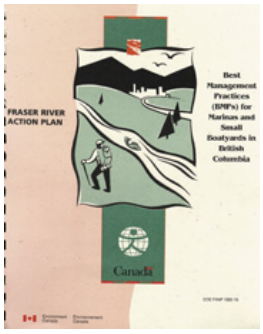
Managing Trails and Accesses

Another in the Stewardship Series, *Access Near Aquatic Areas: a Guide to Sensitive Planning, Design and Management* is applicable to freshwater, marine and estuarine environments. Its main audiences are parks planners and maintenance staff, landscape architects, consultants and community conservation groups. It is available at the *BC Stewardship Centre website*.



BMPs for Marinas and Small Boatyards

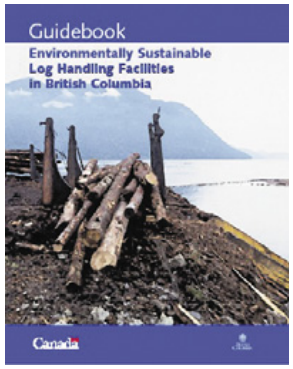
Best Management Practices (BMPs) for Marinas and Small Boatyards in British Columbia, a 1995 report prepared by PCA Consultants Ltd. for the Fraser River Action Plan, is aimed at all facilities where ship or boat building and repair activities are conducted near water. Waste minimization and the 3R's (recovery, recycle and reuse) are emphasized throughout the BMPs. It can be viewed *online.*



Guidebook: Environmentally Sustainable Log Handling Facifities in British Columbia

This guidebook is intended to assist proponents and regulatory agency staff to ensure compliance of log handling operations with environmental legislation. It provides information on application procedures, defines critical, important and marginal fish habitat and outlines a variety of best management practices for log handling in the aquatic environment.

It is available on the *BC Stewardship Centre website.*



Voluntary Stewardship Programs

Many non-profit organizations help to educate the public about coastal stewardship and work with communities and property owners to preserve the natural shorescape. Many groups act as watchdogs or wardens of their local areas, monitoring local conditions, restoring local shores, and organizing clean-up operations.

Programs such as Adopt-a-Beach or Oceans Day are often sponsored by local groups and governments to encourage people to monitor and maintain shores. Some organizations also hold conservation covenants with landowners, allowing them to oversee the resource management of a shore property.

Shorekeepers is a program funded by Fisheries and Oceans Canada. It helps people learn how to monitor physical, chemical and biological changes in coastal areas. *Learn more about it by visiting the Shorekeepers' website.*

You can find out more about stewardship organizations and programs in British Columbia and across the country by visiting the *B.C. Stewardship Centre* or the *Stewardship Canada website*.

Fisheries and Oceans Canada Shorekeepers Guide

Shorekeepers' volunteers survey sites in the Saanich Inlet where habitat restoration and salmon stock re-introduction is planned.

Community Events

There are a number of celebrations that take place in Canada and around the world that relate to coastal stewardship.

Oceans Day was first declared in 1992 during the Earth Summit in Rio de Janeiro. Oceans Day is more than a celebration of the oceans -- it is about learning and doing. Participants learn how the oceans give us life and discuss ways to restore and maintain the oceans' health. The purpose of Oceans Day is to raise public awareness about the role that the ocean plays in daily lives, even for those who live far from coastlines. Oceans Day celebrations are co-coordinated by the *Canadian Wildlife Federation*. For more information visit their website.

The **Great Canadian Shoreline CleanUp** is part of an international effort to help reduce debris in oceans and waterways. In the past 10 years, more than 1.5 million volunteers from 90 countries, including Canada, have participated in the annual International Coastal CleanUp. CleanUps do more than just collect trash: They get communities working together to create solutions to keep our oceans and waterways clean. Data on the types and amounts of debris collected are recorded and forwarded to the Vancouver Aquarium Marine Sciences Centre where the results for Canada are tallied and relayed to the Ocean Conservancy for global processing. *The Vancouver Aquarium organizes the Great Canadian Shoreline CleanUp each September*. For more information email them or visit their website.

At a local level, the communities along the north shore of the Fraser River welcome back the Coho salmon each fall with a **Coho Festival.** The main events take place the first Sunday after Labour Day. Call 604 926 6956 or *visit the website*.

The Brant Festival happens early each April, when the communities of Parksville and Qualicum celebrate the return of the Brant Geese, known as the talkative little sea goose. Art shows, nature walks and other activities help the visitors understand the web of life. For more information you can *visit their website*.

Educational Resources

There are many coastal education/stewardship resources. *The Marine and Aquatic Educator's Resources Guide* *lists most of them* – here is a sample:

- **Beside the Sea** - Produced by Fisheries and Oceans Canada, this package of marine-oriented science activities assists teachers in coastal communities to incorporate learning about the marine environment into their teaching curricula.
- **Once Upon a Seashore: A Curriculum for Grades K-6** by Gloria Snively – This beautifully illustrated resource uses the seashore as a source of inspiration for integrating the subject areas into art, creative writing, drama, music, science, mathematics and social studies. The curriculum focuses on teaching basic ecology concepts: tidal cycle, habitat, predator-prey, food chains, life cycles and, above all, conservation.
- **Beach Explorations: A Curriculum for Grades 5-10** by Gloria Snively – This resource guide helps students understand basic seashore ecology.
- **Salish Sea: A Handbook for Educators** - This is an innovative teaching tool for communicating marine conservation messages to students through the medium of music. The handbook includes a Salish Sea CD, featuring singer-songwriter Holly Arntzen, accompanied by choirs from the Saanich School District.
- **Wild B.C.** - is a B.C. government-sponsored education program seeking to foster appreciation, knowledge and understanding of the natural world in British Columbia. The program provides a collection of high-quality, experiential-learning education resources and programs. For more information *visit their website.*

- **Environmental Educators' Provincial Specialist Association** (EEPSA) - is a provincial specialist association of the B.C. Teachers Federation. In B.C., environmental education has been designated a non-core, integrated element of the school curriculum. Virtually every school subject has connections to environmental education. As a result, the spectrum of teachers and educational organizations involved in environmental education is vast. For more information *visit their website.*
- **Northwest Aquatic and Marine Educators** (NAME) - is a non-profit chapter of the National Marine Educators Association. NAME was founded to give marine and aquatic educators and other professionals a network to share their interest in and dedication to the water environment.
- **Vancouver Aquarium Marine Science Centre** - Besides hosting thousands of visitors each year, the Vancouver Aquarium provides a number of interesting public programs and events and conducts extensive research. For more information *visit their website.*
- **Shorekeepers and Reefkeepers** - is a citizen science program of Fisheries and Oceans Canada that trains volunteers to monitor shores and reefs and provide data to track ecosystem health. For more information *visit their website.*

Non-governmental Organizations

An array of non-governmental organizations can help with understanding the impact of coastal processes and promoting coastal stewardship. Here are a few:

- **Bamfield Marine Sciences Centre** – provides year-round research facilities and technical assistance to scientists from five western Canadian universities and visiting scientists, offers courses for undergraduate and graduate students in marine sciences, and runs a public education program for schools and interested groups of all ages. Its web site has educational material on oceans and marine animals. For more information *visit their website.*
- **Canadian Parks and Wilderness Society** – works to promote the protection of parks and other places of natural significance. For more information *visit their website.*
- **The David Suzuki Foundation** - has a Marine Conservation Program that addresses issues related to the conservation of oceans and marine habitat, sustainable fisheries and aquaculture. For more information *visit their website.*
- **Ducks Unlimited Canada** - aimed at conserving Canadian waterfowl by protecting, enhancing, and restoring and managing important wetlands and associated uplands. For more information *visit their website*
- **Georgia Strait Alliance** - formed to protect and restore the marine environment of the Strait of Georgia. It has been highly successful in promoting awareness of marine pollutants and in lobbying for marine protected areas: (250) 753 3459 or *visit their website*.
- **Islands Trust Fund**- a conservation land trust established through provincial legislation in 1990 and administered by the Islands Trust Board. The fund uses voluntary conservation methods (land donations, conservation covenants (easements), land acquisition, public education, etc.) to help preserve and protect the significant natural and cultural areas and the rural character in the Islands Trust Area. The fund now owns 12 properties and holds 26 conservation covenants. For more information *visit their website.*
- **Living by Water Project** - provides services and products for informing the public about shoreline stewardship. These include workshops, handbooks, videos, shoreline notes, posters, and an activity book on how to become a "shoreline ambassador." For more information *visit their website.*
- **The Living Oceans Society** – is a non-profit research and public education organization committed to conserving marine biological diversity, in order to ensure a healthy ocean and healthy coastal communities. For more information *visit their website*
- **Marine Ecology Station** – is dedicated to the exploration, understanding, and stewardship of Northeast Pacific marine life. The Station is in Sidney B.C., and provides hands-on laboratory and field activities for students of all ages in a unique floating lab. For more information *visit their website.*

John Austin

- **SeaChange Marine Conservation Society** – provides marine education leadership as well as stewardship programs. Students grow eelgrass in a classroom aquarium, monitor its growth, and then plant the young eelgrass: For more information *visit their website.*
- **Veins of Life Watershed Society** – develops education programs on marine mammals and do's and don't for safely watching them in the wild. For more information or for a Whale Wise poster *visit their website.*.

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Canadian Wildlife Service

A Season for Stewardship

By Kofi Annan

Action starts with governments. They bear the primary responsibility for fulfilling the commitments they made at the 1992 Earth Summit and since. But the richest countries must lead the way. They have the wealth and the technology, and they contribute disproportionately to global environmental problems. …

Governments cannot do the job alone, however. Citizens' groups have a critical role, as partners, advocates and watchdogs. So do commercial enterprises. I hope corporations understand that the world is not asking them to do something different from their normal business; rather, it is asking them to do their normal business differently…

The choice is not between development and environment… Development that does not sensibly manage the environment will prove short-lived. …One in every two jobs worldwide -- in agriculture, forestry and fisheries -- depends directly on the sustainability of ecosystems.

The world today, facing the twin challenges of poverty and pollution, needs to usher in a season of transformation and stewardship -- a season in which we make a long overdue investment in a secure future.

Kofi Annan is the Secretary-General of the United Nations

Glossary

A ACCRETION: Gradual growth of land or beach over a long period of time as natural processes of waves, currents, tides or winds deposit material

ALGAL BLOOM: Unusual growth of small planktonic algae. Blooms may colour the water and affect its taste.

ALTERED SHORES: Shores that have been modified by human activity, such as dredging, or building structures

ANADROMOUS: Migrating from the ocean to freshwater to spawn

AQUACULTURE: The rearing or cultivation of fin fish or shellfish for human consumption, primarily done in the sea but also may occur on land or the intertidal zone

ARCHIPELAGO: A group of islands separated by narrow channels

B BACKSHORE: The area of shore lying between the average high tide level and the vegetation, affected by waves only during severe storms

BASIN: A large watershed area that typically combines the drainage of several rivers and streams. The Georgia Basin is 4,755,671 hectares in size; the Nanaimo River watershed (basin) is 82,051 hectares.

BATHYMETRY: The measurement of the depths of water in the ocean

BEACH: A strip of unconsolidated sand or gravel on the coast line, which is created where wave action deposits sedimentary material

BEDROCK: Solid rock, often underlying looser material

BENCH: Level or gently sloping plain that slopes towards the water

BENTHIC: That part of the sea inhabited by marine organisms that live in or on the bottom

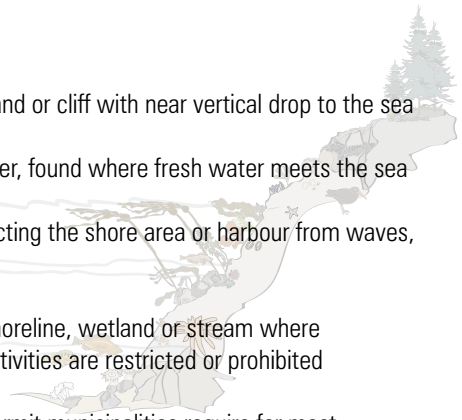
BERM: A terrace or shelf along the top or bottom of a slope. They can be manmade or formed by wave action along the backshore of a beach.

BEST MANAGEMENT PRACTICE (BMP): A recommended method for carrying out an activity so that it has the least impact on the environment: this can include the safest way to build a dock, control flooding, prevent erosion, or prevent algae on your deck.

BIODIVERSITY: The variety of plant and animal species found in a specific habitat, high biodiversity is generally considered a sign of a healthy environment

BIOTIC: Describes the animal and plant life of a specific habitat, and the biological, chemical and physical factors that determine their numbers and distribution

BIVALVES: Molluscs with a hinged shell, usually attached to rock or other structures or found burrowing into sediment



BLUFFS: Steep, prominent headland or cliff with near vertical drop to the sea

BRACKISH: Moderately salty water, found where fresh water meets the sea

BREAKWATER: A structure protecting the shore area or harbour from waves, usually built of rock or concrete

BUFFER: An area adjacent to a shoreline, wetland or stream where development or other harmful activities are restricted or prohibited

BUILDING PERMIT: The type of permit municipalities require for most construction projects.

BULKHEAD: Small low seawall designed to keep land from eroding behind it

C CHANNEL: A natural stream that conveys water or a ditch or other water conveyance structure excavated for the flow of water

COAST: The point where land, ocean and air meet, extending to the limit of the highest tide

CONDUIT: Any channel intended to convey water, whether open or closed

CONSERVATION COVENANT: A voluntary written agreement under the *Land Title Act* made between a landowner and a covenant holder, in which the landowner promises to protect the land as designated in the covenant

CONSERVATION EASEMENT: Voluntary agreements that allow an individual to set aside private property to limit the type or amount of development on their property. Easements relieve property owners of the burden of managing these areas by shifting responsibility to a private organization or government agency better equipped to handle maintenance and monitoring issues.

CONTAMINANTS: Harmful or undesirable substances that pollute the environment

CONTINENTAL DRIFT: The gradual movement of continents

CONTINENTAL SHELF: The section of the sea floor between the beach and where the sea floor starts to slope sharply

COVENANT: In real property law, a promise made by a landowner to do, or not do, something in relation to the land.

CURRENT: Horizontal movement of water

D DAM: A barrier constructed to confine or raise water for storage or diversion

DELTA: Area of deposited sediment, roughly triangular in shape, formed where a river or stream carrying sediment meets a low-energy body of water, such as a n ocean bay

DENSITY BONUS: A land use planning measure that allows more intensive development in exchange for something for the public good, such as a park

DEPOSITION: Accumulation of solid material, carried by and laid down by water

DEPOSITIONAL SHORE: Beaches or sand spits are examples of depositional shores, created by the accumulation of sediment carried in and deposited by water

DEVELOPMENT PERMIT AREAS: Municipalities can designate environmentally sensitive areas and require development permits before any land in those areas can be subdivided, altered or built upon

DIFFRACTION: The process that occurs when sand or water travelling in a straight path bends around an obstacle

DIKE: Any constructed embankment or levee intended to confine or control water; often one built along the banks of a river to prevent flooding of lowlands

DIOXINS: A group of highly toxic chlorinated organic compounds that can travel long distances and bioaccumulate in the fat of humans and wildlife

DISCHARGES: NON-POINT Diffuse pollution source that has no specific point of discharge. It may arise from such activities as agriculture, urban stormwater runoff, car washes, forestry or marine operations .

DISCHARGES: POINT Pollution which comes from a specific source and has a discrete and obvious point of discharge such as a sewage or stormwater pipe or an industrial outfall

DISTURBED AREA: An area in which the natural vegetation or soil cover has been removed or the landform has been altered making it more susceptible to erosion.

DOCK: A manufactured structure that either floats on water or is attached to the land, and is used for mooring boats or for recreation

DRAINAGE: The removal of excess surface water or ground water from land by means of surface or subsurface drains

DRAINAGE AREA (WATERSHED): The land area into which all water, including runoff from surrounding land, drains or discharges to a common point

DREDGING: The act of removing sediment from the sea bottom, usually to accommodate shipping

DUNE: A sandhill, on the landward side of the high tide limit, created by air-borne sand from the beach accumulating above the drift zone

E

ECOSYSTEM: All the living organisms in a biological community, and the chemical and physical factors that affect them

EELGRASS: Underwater marine grass (Zostera marina) with long narrow leaves, that provides ideal habitat for small fish, spawning herring and many other organisms

ENVIRONMENTAL IMPACT ASSESSMENT: The act of judging or evaluating the impact a human action will have on the environment

EROSION: Wearing away of the land surface by running water, wind, ice, or other geological agents, including gravity

ESTUARY: A coastal feature formed when a river or stream meets the sea and where fresh and salt water mix

EUTROPHICATION: The process of over-enrichment of water bodies by the addition of nutrients often typified by the presence of algal blooms

F

FECAL COLIFORM: *Escherichia coli* and similar bacteria that are found in the intestinal tract of humans and animals, the presence of which in water indicates fecal pollution and potentially adverse contamination by disease-causing organisms.

FLOODPLAIN: Areas adjacent to a stream or river that are subject to flooding or inundation during periods of high runoff or severe storms

FLUSHING: The process of water exchange. Areas with strong currents and high waves are flushed more frequently than those with less energetic processes.

FOOTPRINT: The space taken up by a structure that sits on the seabed or on the water surface

FORESHORE: The area of the shore that lies between the high and low water levels and that is flooded twice daily by the tide

G

GABION: A flexible woven-wire basket filled with small stones that may be arranged to form revetments, retaining walls and groynes, to prevent erosion.

GRAVEL: An unconsolidated aggregate consisting of small stones that range in size from 2-60mm in diameter.

GREENWAY: A linked and linear network of trails and accesses that are designed to suit one or a variety of compatible purposes (e.g., conservation of natural or environmentally sensitive areas, passive recreation, wildlife viewing, buffer between competing land uses, etc.)

GREY WATER: Waste water discharges other than sewage that originates from industrial or home sources including cooling water or water from sinks or showers

GROUND COVER: Plants that are low-growing and provide a thick vegetative mat that protects the soil as well as providing some beautification

GROYNE: A wall built perpendicular to the shoreline, intended to trap sand and deflect waves away from the beach. Sediments being carried by longshore drift will accumulate on the forward edge of a groyne and erode on the opposite side of the structure.

H

HABITAT: All parts of the natural environment that support an organism or set of organisms throughout its entire life cycle

HARDENED SHORE: A natural shore that has been altered by the addition of seawalls, riprap, sheet metal or other concrete, rock or "hard" structures

HEAVY METALS: Metals with high molecular weights that are generally toxic to animal life and human health if naturally occurring concentrations are exceeded. Examples include, arsenic, chromium, lead and mercury.

HERBICIDES: Chemicals developed to control or eradicate plants

HHW: High High Water mark, denotes the upper limit of tidal action, and is used to define property boundaries and public right of way

HIGH ENERGY SHORES: A shore exposed to considerable wave and current action

HYDROGRAPHER: A person who specializes in the measurement and description of the physical features of the ocean

I

INFAUNAL: Benthic fauna living in the substrate and especially in a soft sea bottom

INSECTICIDES: Chemicals developed to control or eradicate insects

INTERTIDAL: Similar to foreshore--the shore area bounded by the low low and high high tide levels

INVERTEBRATES: Animals without a backbone

K

KELP: Large blade shaped brown seaweed, (Nerocystis luetkeana) can grow as long as 60 m and provides useful habitat for fish and other marine organisms; has no roots but is anchored by tendrils up to 10 m long, which cling to rock. Gas filled bubbles on fronds act as floats to keep the kelp just below the surface.

L

LEE: The side away from the wind or waves, therefore more sheltered

LEGAL SURVEY: A study to ascertain the physical boundaries of a piece of land, carried out by a licensed surveyor

LOCK-BLOCK: System of interlocking concrete blocks sometimes used for seawalls or other coastal structures

LONGSHORE CURRENT: Current moving parallel to shore

LONGSHORE DRIFT: Sediment transported by wave and currents moving parallel to shore

LOT: A parcel of undivided land.

LOW ENERGY SHORES: Shores that are protected, for example, by an island from current or wave action

M

MEDIUM ENERGY SHORES: Shores with moderate exposure to current and wave action

MICROHABITAT: A small community, such as the space between rocks, that provides the features and functions that small organisms depend on to feed, rest or reproduce

MIGRATORY: Organisms that move from one place to another to complete their life cycle (eg; salmon, many species of waterfowl, marine mammals.)

MOORAGE: A secure place for boats to tie up

MUDFLAT: Gently sloping muddy or sandy bottom coastal area usually covered by water at high tide

N

NEARSHORE: The area of the continental shelf where the waves break. The region of land extending from the backshore to the beginning of the offshore zone.

NUTRIENT: A substance that provides food or nourishment, such as usable proteins, vitamins, minerals or carbohydrates. Phosphorus and nitrogen, which are contained in fertilizers, are the most common nutrients that contribute to eutrophication.

O

OCP (OFFICIAL COMMUNITY PLAN): A municipal statement of policy on permitted land use

OFFSHORE: Comparatively flat underwater zone that extends from the toe of the steeper shoreface to the edge of the continental shelf

OSMOREGULATORY: Maintaining a constant osmotic pressure in the tissues of living organisms. For anadromous species like salmon osmoregulation allows them to balance the salt or freshwater concentrations both inside and outside their bodies so they can become either freshwater or marine dwelling organisms.

OUTFALL: The point where water flows out of a constructed conduit or drain

OUTLET: The point at which water discharges from a stream, river, lake, tidal basin, channel or drainage area

P

POCKET BEACH: A beach tucked between rocky headlands

PRECIPITATION: Moisture in the form of rain, snow, dew, hail or sleet that returns to earth from the atmosphere through condensation

PREDATION: When one animal preys upon or eats another

PRETREATMENT: Techniques employed in stormwater management to provide storage or filtering to remove coarse materials in effluents before they enter the treatment system

PROTOZOANS: Single celled animals --the bottom of the food chain

R

REFLECTION: A wave that returns seaward when it hits a steep beach or a barrier such as a seawall

REFRACTION: The process by which the direction of the wave changes. The portion of the wave moving in shallower waters slows down, causing the wave crest to bend.

RESIDENTIAL DEVELOPMENT: Land area that has been zoned and subdivided into smaller parcels for the purpose of housing

REVETMENT: Hard, smooth masonry surface used to protect a bank or bluff from erosion

RIPARIAN: The land area that borders a stream or river or other water body that is frequently of inundated.

RIPARIAN AREA: Vegetation zone that separates land from water, consisting of various emergent aquatic plants, as well as grasses, sedges and shrubs that thrive near water

RIPARIAN RIGHTS: In common law, a person who owns land adjacent to water has certain rights to access and use the water. These are known as riparian rights. The landowner also owns any land that occurs through accretion.

RIPRAP: Broken rock, cobbles, or boulders placed on earthen surfaces, such as the face of a dam or the bank of a stream, for protection against the action of water (waves)

RUNOFF: Water originating from rain or melting snow that flows across the ground or other surface before reaching streams, rivers or the ocean

S

SALINITY: Measure of dissolved salt and minerals in water. The open ocean typically has 33 to 38 parts per thousand salinity.

SALT MARSH: Flat poorly drained coastal swamp that is flooded by most high tides

SAND: Loose material made up of particles of rock and shells, usually between .06 and 2 mm in diameter

SCOURING: Result of erosion of bottom sediments, usually by water flowing at high speed

SEAWALL: A freestanding structure, parallel to the shoreline, designed to protect buildings from the sea

SEDIMENT: Solid material, both mineral and organic, that is transported in suspension

SEDIMENTATION: Soil particles suspended in water that settle in stream beds or along the shoreline

SEPTIC FIELD: The on-site disposal of waste water and sewage into a below ground holding tank, the decomposed organic matter from which seeps into surrounding earth

SESSILE: An immobile organism that is attached to the sea floor, or to other substrate

SETBACK: The minimum distance requirement set by a government authority for location of a structure in relation to water bodies, wells, septic fields or other structures.

SHADING: Loss of sunlight caused by vegetative canopies or structures such as a docks, piers or materials such as suspended solids; which affect growth of vegetation and survival of aquatic organisms

SHELLFISH: Molluscs or crustaceans with hard external covering (crab, oyster, prawn, mussel) that are eaten by humans

SHOAL: An offshore shallow sandbank or bar that makes waves begin to curl and break before they reach the shore

SILT: Unconsolidated sediment with particle sizes 0.002-0.06 mm (between clay and sand).

SLUMPING: Slippage or sliding of a mass of unconsolidated sediment down an underwater slope, sometimes triggered by an earthquake

SMOLT: Young silver bright salmon making its first trip to the sea

SPECIES AT RISK: Animal and plant species that are declining or threatened with extinction.

SPIT: Small point of land or long narrow shoal, usually sand, extending like a finger from land into the sea.

STABILIZATION: Providing adequate measures, vegetative and/or structural, that will prevent erosion from occurring.

STAKEHOLDER: Any agency, organization, or individual who has an interest in or will be affected by process or decision

STEWARDSHIP: The act of caring for nature or taking responsibility for the environmentally friendly use of resources: Being a custodian of something we do not own

STORM SURGE: The temporary rise in local sea level caused by a storm, which can lead to flooding and erosion

STORMWATER OUTFALL: A discharge point for stormwater runoff that has been collected in pipes or ditches

STRAIGHTENED SHORES: Human alteration of the shorelines natural curves with structures as retaining walls, bulkheads, berms or dikes

SUBSTANTIAL PERFORMANCE: The point in the construction process when a structure is ready for use or occupancy

SUBSTRATE: The bottom layer or base upon which animals and/or plants live

SWALE: An open drainage channel or depression designed to detain and filter stormwater runoff.

T

TENURE: A condition under which real estate is held or used

TIDES: Change in sea level caused by the gravitational pull of the moon on the earth. There are two high tides and two low tides each day.

TOE (OF SLOPE): The bottom of a slope, where it meets the ground or levels out

TOE WALL: Subsurface portion of the downstream wall of a structure, built to prevent flowing water from eroding under the structure - otherwise known as a cutoff wall

TOPOGRAPHY: The precise detailed mapping of the surface features of a region

TOTAL SUSPENDED SOLIDS: The total amount of particulate matter that is suspended in the water column

TOXICS: Poisonous substances

TOXINS: Poison produced by a living organism. e.g., *Escherichia coli (E.coli)*

TRANSPORT: In marine terms, transport refers to the movement of sediment. Transport shores may appear stable to an observer but they only look that way because the wave action transports sediment in and out in relatively equal amounts.

TSUNAMI: A huge tidal wave usually generated by an underwater earthquake or volcano

TURBIDITY: Reduced water clarity caused by the presence of suspended sediment such as clay or sand in the water

U

UPLAND: The dryland area above and landward of the ordinary high water mark, and shoreward of the backshore

V

VARIANCE: A special allowance granted to a developer which permits the use of designs that are different from the requrements of the current code

VEGETATION: All the plant life in a particular region (flora) - the root systems of which are naturally useful in preventing erosion

W

WATERSHED: A geographic area of land bounded by the height of land that causes waters to drain to a shared destination. A watershed captures precipitation, filters and stores water, and determines its rate of release. A drainage basin

WATTLE: A bundle of cuttings from live woody material that are tied together with butt ends alternated and tapered. They are planted in shallow trenches, held in place by stakes, and then covered with soil. They are used to re-establish vegetation and prevent erosion.

WAVES: A moving ridge of water usually caused by the wind upon the surface of the ocean, which then curls and breaks on shore

WETLANDS: A low area where the land is saturated with water , often referred to as marsh, swamp, fen, bog

X

XERISCAPING: Landscaping that uses drought-tolerant vegetation instead of turf to reduce the amount of water required to maintain a lawn or flowerbed.

Z

ZONING: A set of regulations and requirements that govern the use, placement, spacing and size of buildings and lots within a specific area. Zoning on the ocean means identifying, permitting and regulating certain areas for certain human activities.

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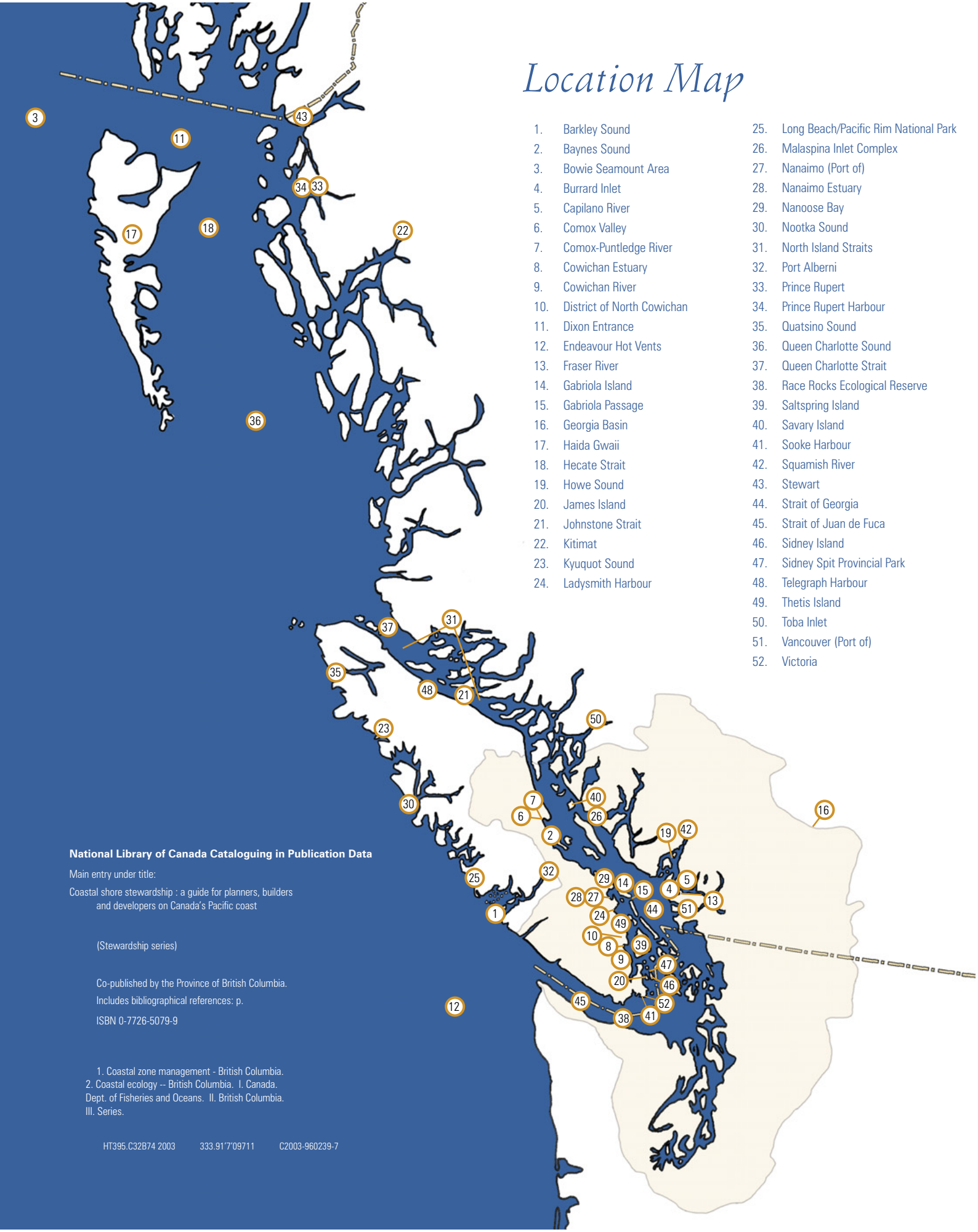
Location Map



1. Barkley Sound
2. Baynes Sound
3. Bowie Seamount Area
4. Burrard Inlet
5. Capilano River
6. Comox Valley
7. Comox-Puntledge River
8. Cowichan Estuary
9. Cowichan River
10. District of North Cowichan
11. Dixon Entrance
12. Endeavour Hot Vents
13. Fraser River
14. Gabriola Island
15. Gabriola Passage
16. Georgia Basin
17. Haida Gwaii
18. Hecate Strait
19. Howe Sound
20. James Island
21. Johnstone Strait
22. Kitimat
23. Kyuquot Sound
24. Ladysmith Harbour
25. Long Beach/Pacific Rim National Park
26. Malaspina Inlet Complex
27. Nanaimo (Port of)
28. Nanaimo Estuary
29. Nanoose Bay
30. Nootka Sound
31. North Island Straits
32. Port Alberni
33. Prince Rupert
34. Prince Rupert Harbour
35. Quatsino Sound
36. Queen Charlotte Sound
37. Queen Charlotte Strait
38. Race Rocks Ecological Reserve
39. Saltspring Island
40. Savary Island
41. Sooke Harbour
42. Squamish River
43. Stewart
44. Strait of Georgia
45. Strait of Juan de Fuca
46. Sidney Island
47. Sidney Spit Provincial Park
48. Telegraph Harbour
49. Thetis Island
50. Toba Inlet
51. Vancouver (Port of)
52. Victoria

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This guide will be helpful if you are:

- Interested in finding out about coastal shore processes,
- Concerned about nearshore water quality, and how it will affect ecosystem health or your recreational use and enjoyment of coastal areas,
- Wondering how a community planning process can protect coastal wetlands and estuaries,
- Interested in finding out more about how federal and provincial agencies are working with local governments and businesses to protect coastal resources,
- Planning a development on or near the shore.

Christy Wilson

Why Should we Care about our Shores?

The purpose of the guide is to:

- Identify some of the pressing concerns related to coastal resource management,
- Provide information about coastal processes, the various habitats types of the shore zone and the species that inhabit them,
- Describe a range of shore types and development sensitivities associated with each,
- Illustrate how local and regional land planning decisions are made and suggest how coastal resources can be protected as part of this process,
- Outline best management practices to guide coastal development and illustrate how coastal developments and activities can be undertaken without destroying fragile coastal processes.