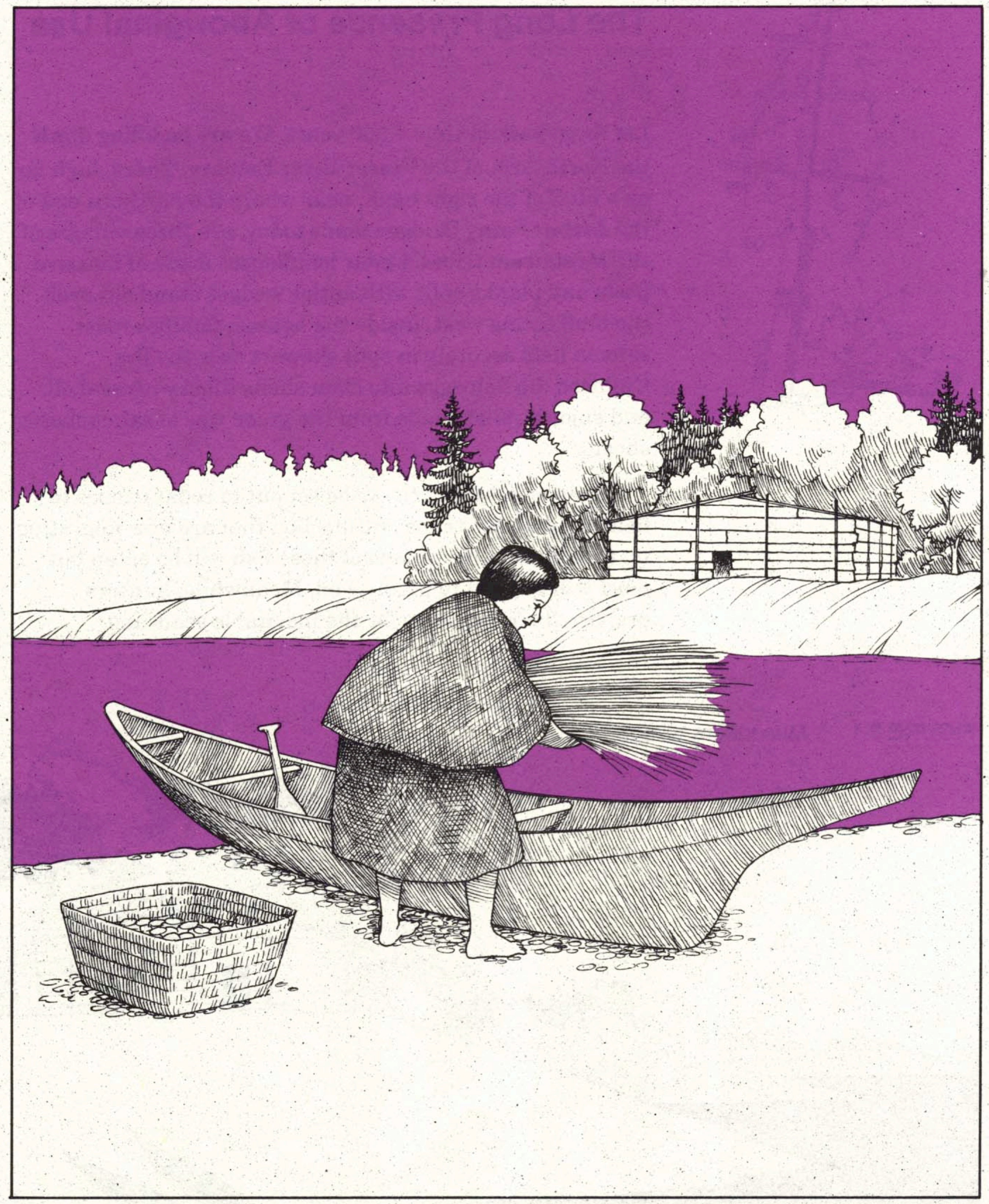
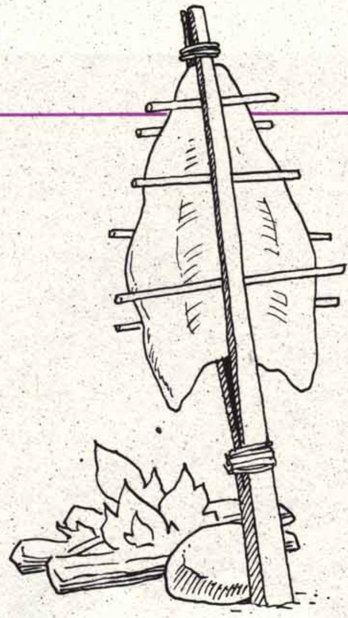


3. HUMAN HERITAGE

Much of what we see today in the Fraser River Estuary is the result of human activity. In this chapter we look at some of the ways people used the estuary from ancient to modern times.

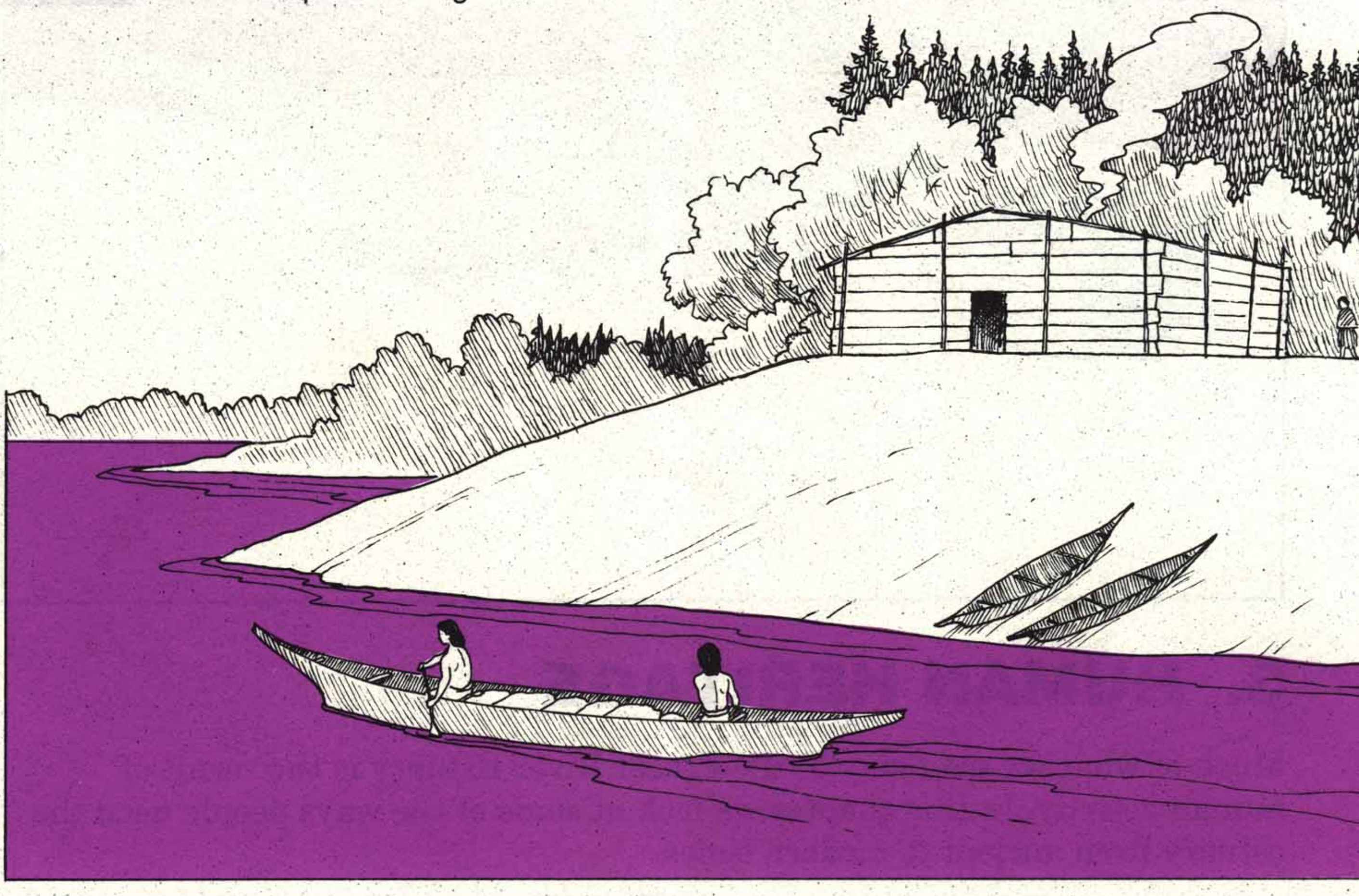


The Long Presence of Aboriginal Use

Let us go back in time 3 000 years. We are paddling down the North Arm of the Fraser River Estuary. There, high up on a bluff of the right bank, near where the northern end of the Arthur Laing Bridge stands today, are three villages of the Musqueam tribes. Cedar longhouses made of massive posts and planks split with antler wedges stand out over the bluff facing west. Inside the houses, families roast salmon held securely in split skewers over the fire. Children dip fish eggs into clam shells filled with seal oil, and enjoy a relish made from the green tips of salmonberry shoots.

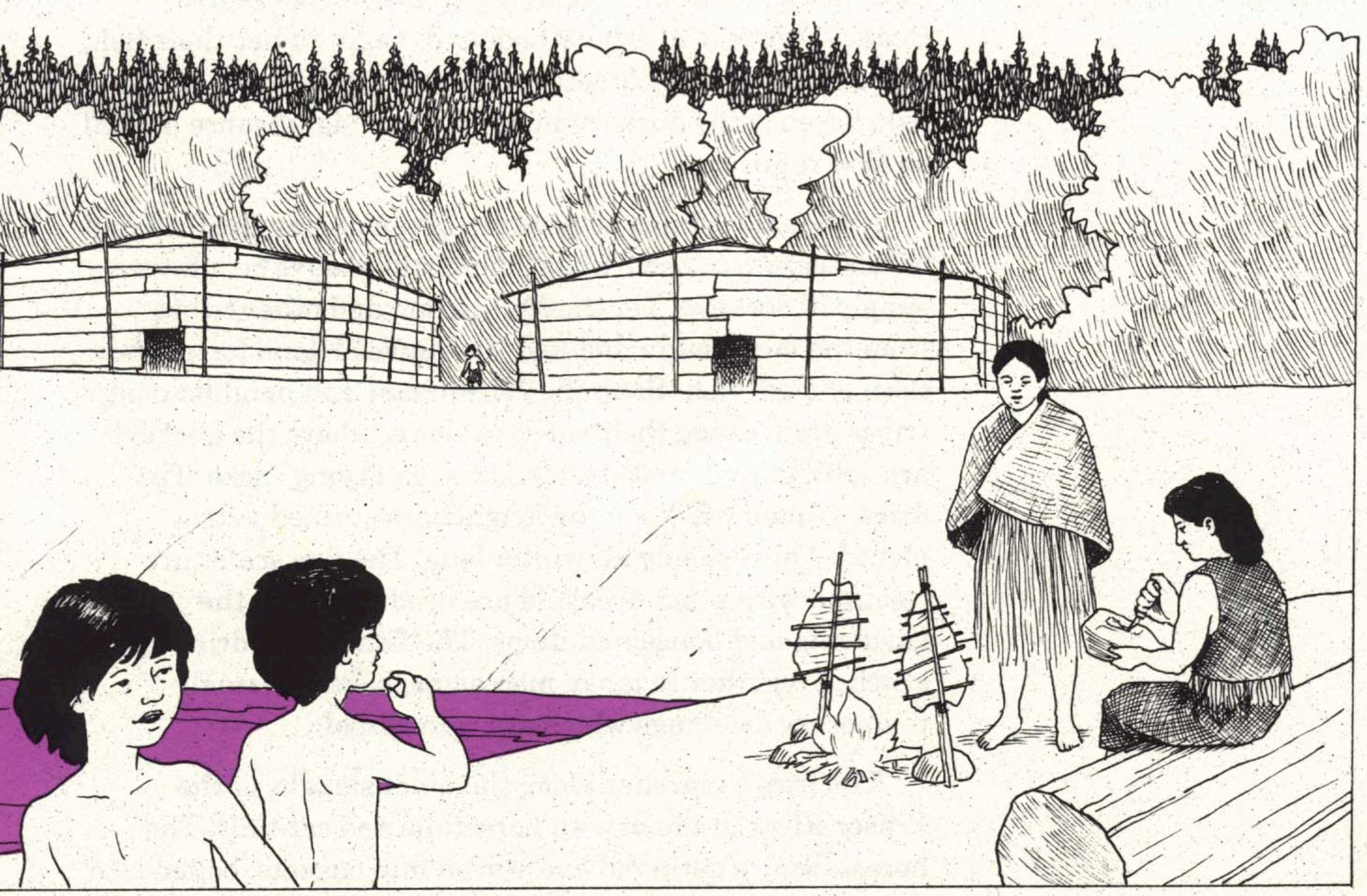
Some members of the tribe set out in cedar canoes to fish the abundant runs of Eulachon that are now migrating up the Fraser River. Some of these fish will be eaten but most will be used to produce oil. Meanwhile, hunters prepare their harpoons for the inevitable seals and

FIGURE 3-1 Musqueam Village



porpoises that follow the Eulachon into the estuary. Long harpoons are also used to probe the murky river bottom in search of the great sturgeon which can weigh hundreds of kilograms. Others are busy setting stationary traps out on the shallow mudflats. They are taking advantage of the tidal ebb and flow to bring great numbers of flat fish such as Starry Flounder into their traps.

As the summer progresses, the Musqueam paddle their canoes to their summer camps along the river banks. Leaving the North Arm, they set up camp on the Main Arm where Steveston is now, and position themselves for the immense numbers of salmon that will soon come up the river. Other tribes, at the invitation of the host tribe and during an abundant salmon cycle, also derive their food, shelter and clothing from the estuary. Neighbouring tribes from upstream of the Fraser River, from other areas along the lower mainland, from the northern and southern coast, and from Vancouver Island, journey all the way to the Fraser Estuary to set up summer camps for the great congregations of Sockeye Salmon.



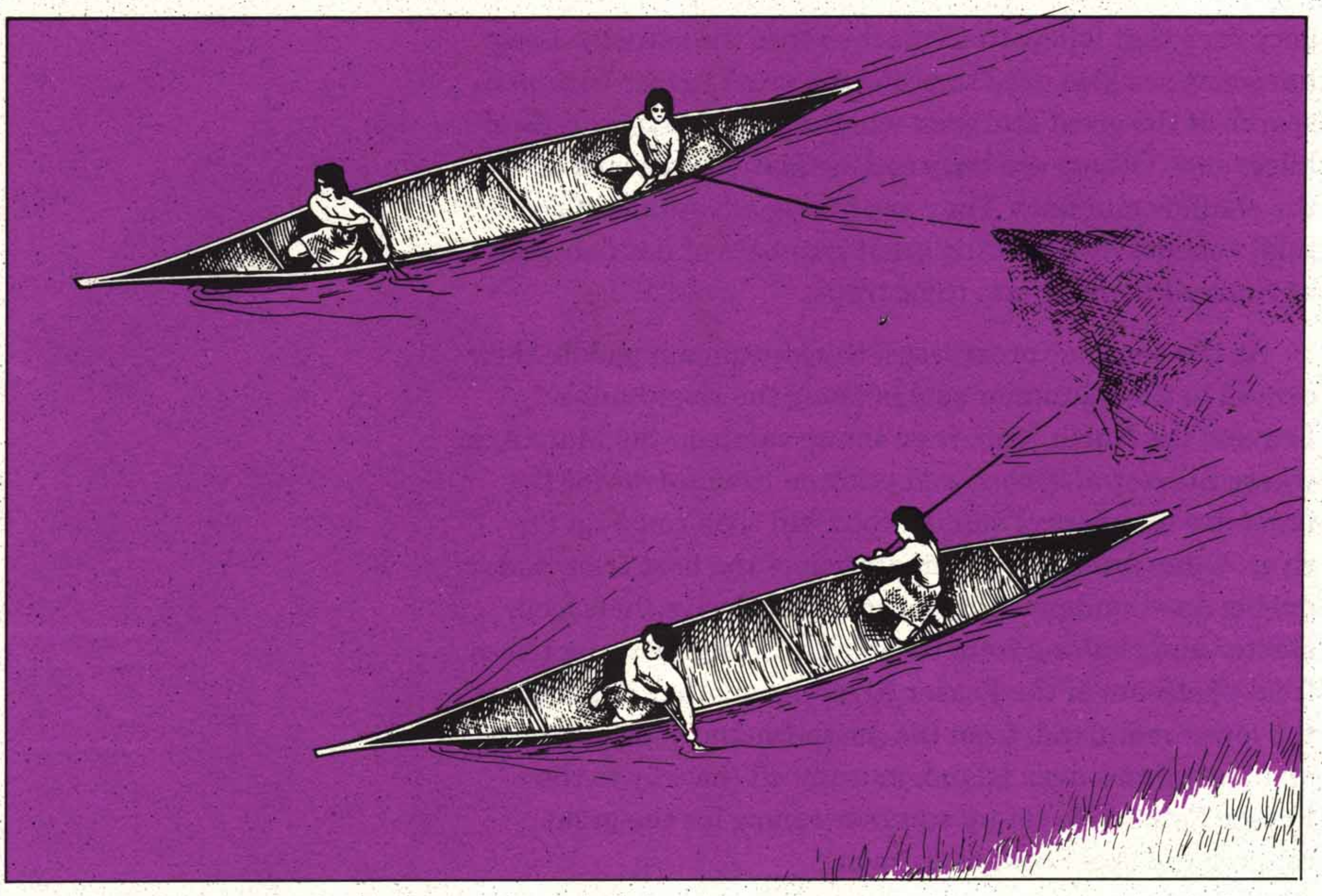


FIGURE 3-2
Sockeye fishing in the Fraser River

As the Sockeye enter the Fraser River, the Musqueam paddle out into the Main Arm and, between two canoes, set a gill net made from the shredded bark or root of Red Cedar (Figure 3-2). The Musqueam begin to net their fish, and as they do, they quietly and respectfully chant to the fish, because the Sockeye have spiritual significance as well as food value.

No female salmon or eggs are taken during the first half of the season, to ensure that there will always be a future supply of Sockeye. Yet the Musqueam and other tribes from the lower mainland and Vancouver Island have more than enough fish. Soon the Musqueam and neighbouring tribes are hauling their catch to shore, where the Sockeye are split, gutted, and stretched out on drying racks. The dried salmon will keep the longhouses stocked with a plentiful food supply all winter long. The fish scales are coloured with plant dyes and are used to design the garments and household items. The fish skin is dried and stitched together to make moccasins, bags and small temporary dwellings which are waterproof.

The fringe marshes along the quiet sloughs of the Fraser River are lush with horsetails and cat-tails. The horsetails are gathered and woven into baskets, boiled into hair wash, and the fluid used as an eyewash. The roots of the cat-tails provide yet another dish for the dinner table while the leaves are woven into mats and hats.

Lulu Island has always been endowed with a variety of berries such as strawberries and salmonberries. Large bog areas supporting cranberries and blueberries are easily reached from the river's edge. Women and other family members gather these berries into their horsetail and cat-tail baskets. Back at camp the berries will be mashed, dried, and kept for a winter food supply.

Beyond the tidal marshes and far out on the tidal mudflats, the Aboriginals use simple sticks to dig up a seemingly unending supply of clams. The shells of leftover clam feasts are piled up around the Musqueam village and have remained buried much as they were left. These ancient kitchen refuse piles, referred to as middens, are now the highly prized discoveries of modern-day archaeologists digging through old soil layers. Human settlements have been uncovered at Beach Grove and Crescent Beach, and the oldest site, located just a kilometre above the Alex Fraser Bridge, dates back 9 000 years.

In spite of harvesting by nearby tribes, and even by the regular summer visitors from Vancouver Island, the renewable resources of the estuary were sustained for thousands of years. The tribes using the Fraser Estuary considered it a highly valuable area because of the large concentration of edible resources, and an active aboriginal food fishery has remained to the present time.

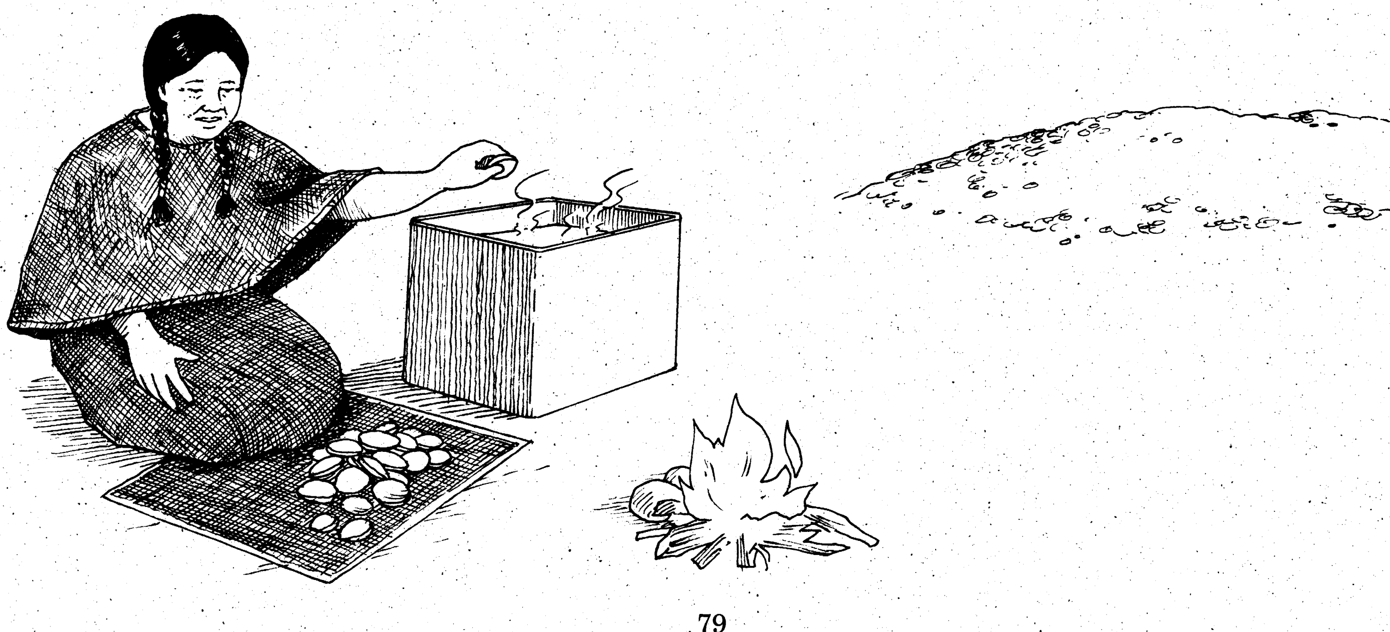
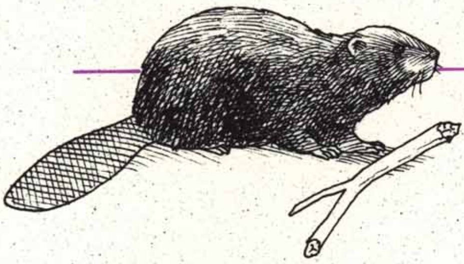


FIGURE 3-3
Origin of a midden

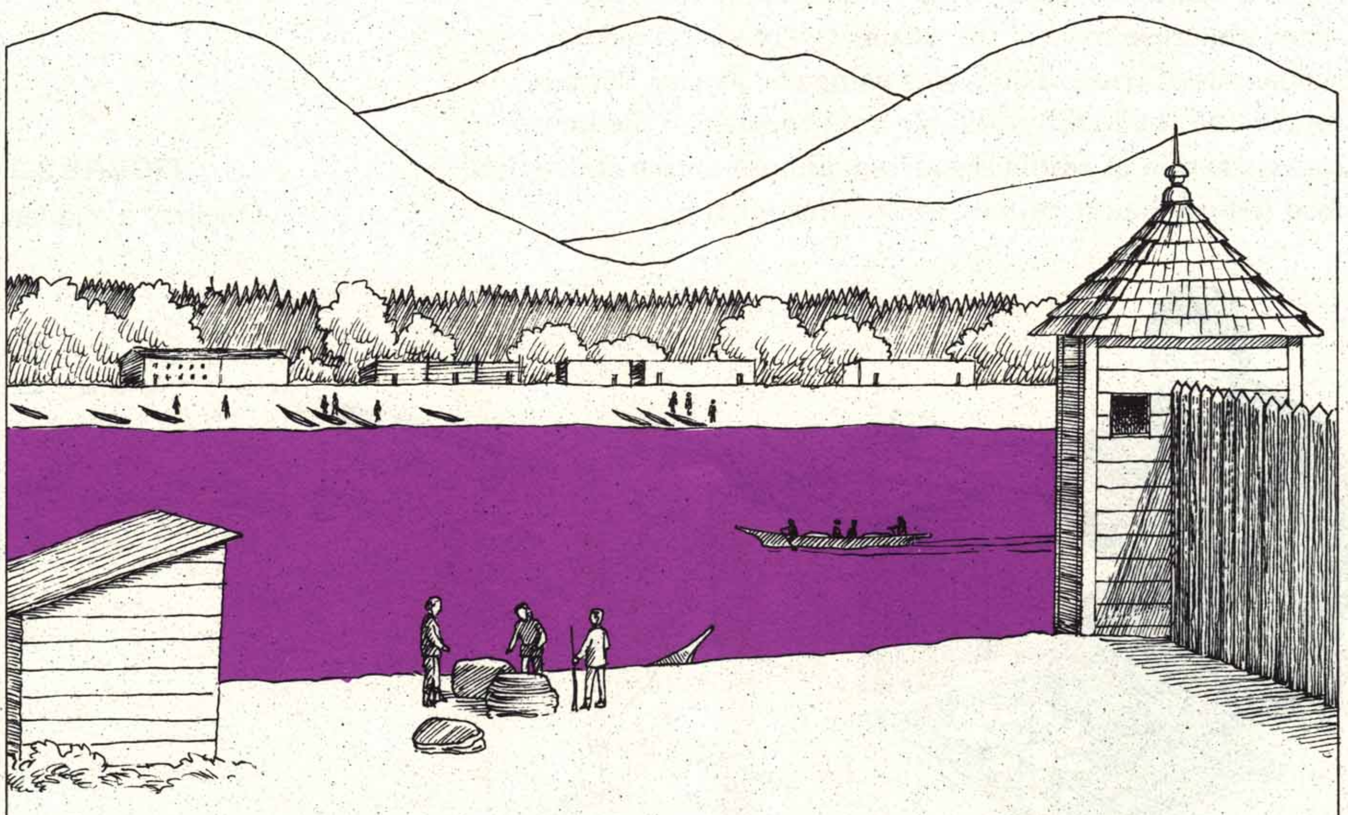
Settlement by Europeans



The estuary did not appear valuable to the first Europeans who saw it. The Spanish sailors who moved up from their bases in California did not explore the estuary, and Captain Vancouver sailed right past, thinking the estuary was a swamp rather than the delta marsh of a great river. Finally, in 1808 the Northwest Fur Company explorer Simon Fraser navigated the great river — but even he felt a sense of disappointment when he reached the estuary. He had originally hoped to explore down to the Columbia River, and was disappointed to find himself over 300 kilometers to the north.

Fraser's exploration, however, would change the nature of the estuary in ways that he could not have imagined. When settlers in the United States began moving into the Columbia estuary, the Hudson's Bay Company decided to relocate their fur-trading base for coastal shipping from Fort Kamloops in the interior to Fort Langley, near the mouth of the Fraser River. This was achieved after a road was built from Fort Kamloops through the mountains down to Fort Langley, which was established in 1827.

FIGURE 3-4
Fort Langley



Soon, furs from the interior were being transported on ships sailing from Fort Langley, through the estuary and out into the Pacific Ocean. When the fur trade began to fail, Fort Langley shipped salted salmon through the estuary to Hawaii and Asia. As an interesting historical footnote, some Hawaiian workers, the "Kanakas," came back with the Company to Fort Langley. Kanaka Creek, which flows into the Fraser River opposite Fort Langley, is named after these Hawaiians.

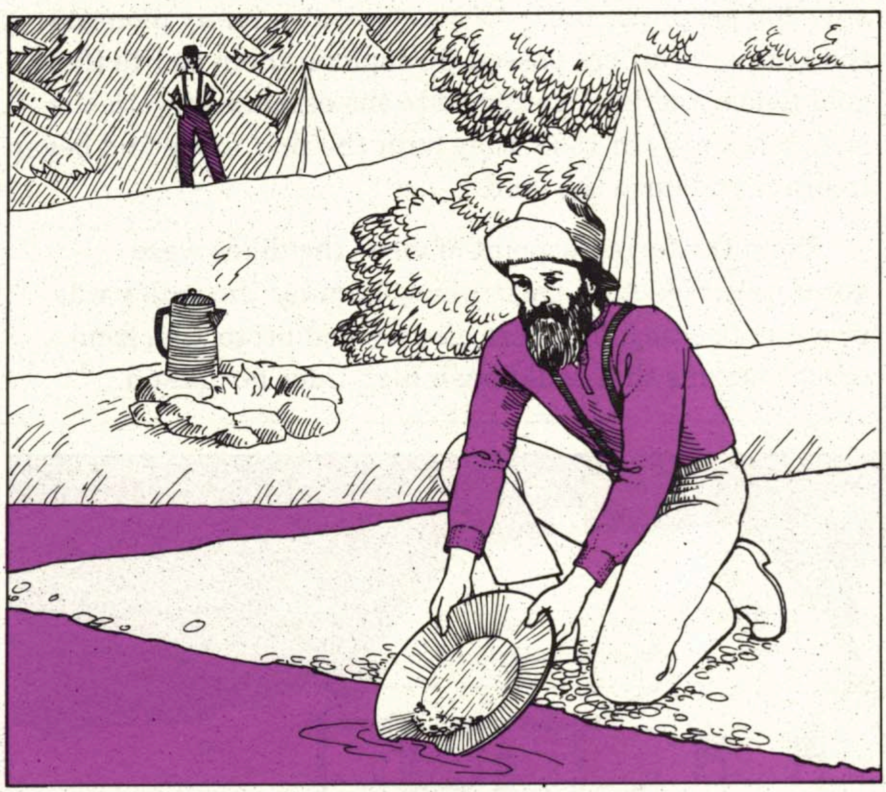
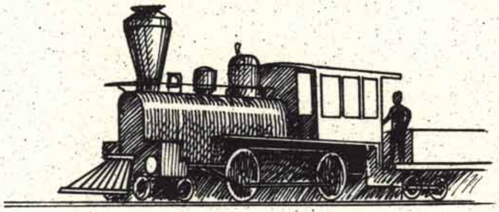


FIGURE 3-5
Panning for Gold

It wasn't many years before another important event affected the Fraser River Estuary. In 1856, a trader at Fort Kamloops learned of an Aborginal miner who had found a gold nugget on the stream bed of a tributary to the Thompson River. The word of gold in the Fraser River system spread like wildfire, and soon thousands of prospectors, many from the United States, made their way through the estuary and on up the Fraser River in search of gold (Figure 3-5). In fact, there were soon so many people from the United States working the Fraser River's gold deposits that Governor Douglas of the Vancouver Island colony felt he must assume jurisdiction over the Fraser River drainage. Canadian prime minister Sir John A. Macdonald knew that the new colony had to be brought quickly into the Canadian Confederation.



Within ten years, British Columbia was drawn into Confederation by the promise of a railroad that would follow the Fraser River through the mountains to the coast. After approximately 9 000 years of Aboriginal settlement, the Fraser River Estuary was about to experience significant alterations, as a result of the large influx of immigrants from other countries.

In the latter half of the 1800s, Europeans began to settle and farm in the valley, starting with a population of only 300 people in 1861. As was typical of many pioneers, the Ladner brothers passed through on their way to the gold fields, and later returned to the estuary to work the rich, black soil. In 1868, they built the first dikes and began to drain and farm the land.

From the farmers' point of view, the dikes were absolutely essential, particularly because the valley was prone to flooding. Farmers also needed protection from winter storms that could push high tides far inland.

FIGURE 3-6
The Great Flood of 1894

Diking efforts were stepped up after a catastrophic flood in 1894, which inundated the Fraser Valley right out to sea and flooded all of Richmond and Delta. The flood was so severe that it left Point Roberts once again (as it had been 5 000 years earlier) an island separated from the mainland. After the flood, with government help, dikes were constructed to surround the delta land, and water was drained off the land by drainage ditches and pumps.

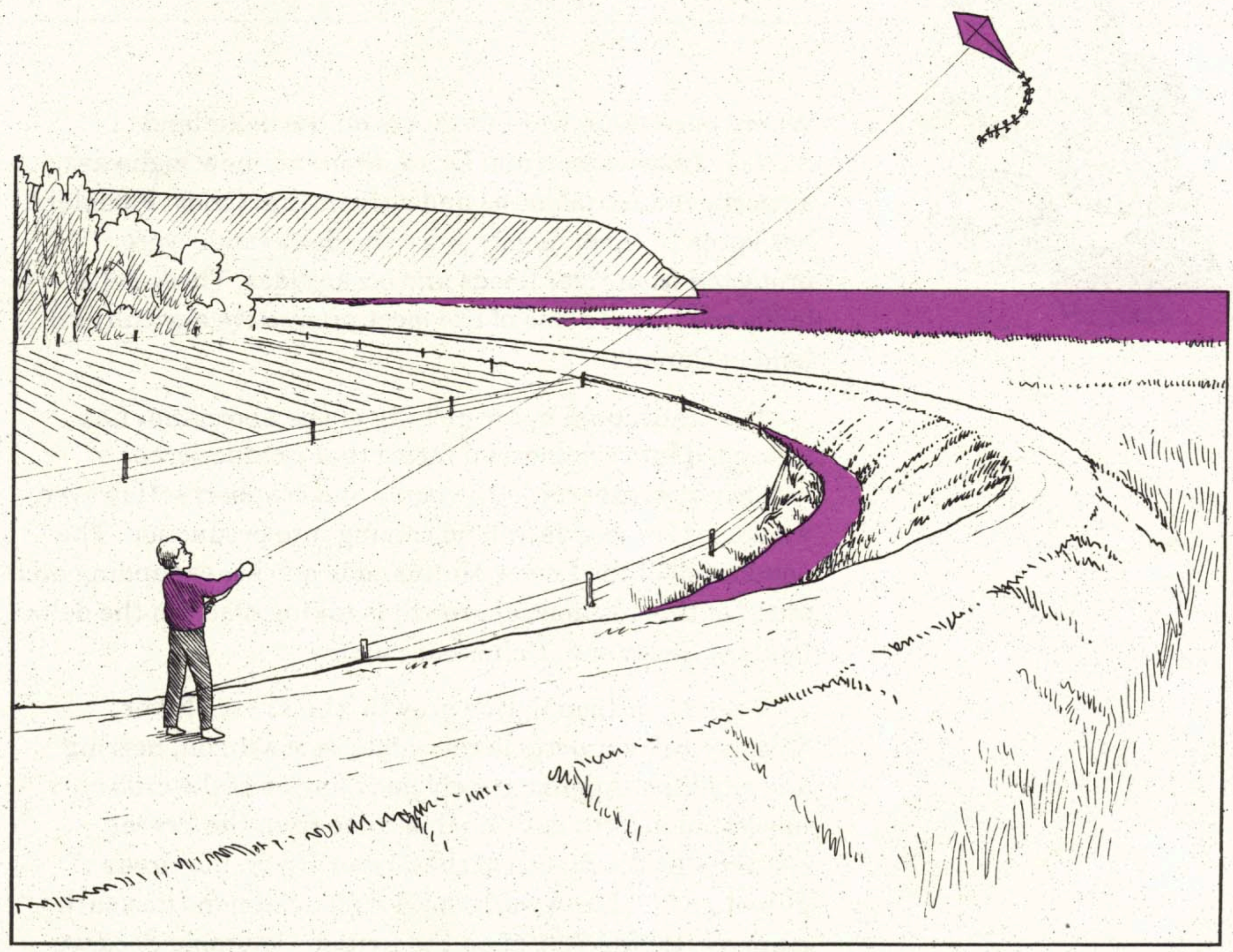
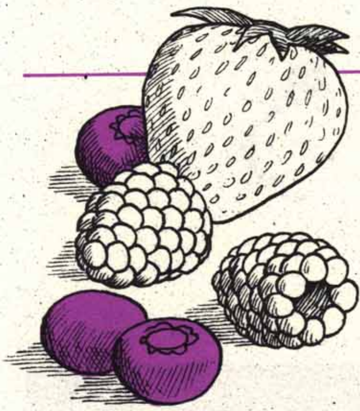


FIGURE 3-7
Foreshore Dike

This diking had a dramatic environmental impact. As a result, today we see a very different estuary than the one that existed only one hundred years ago. The size of the delta lands is of course very nearly the same, and the river still delivers a similar sediment load. However, with the barrier of dikes in place to protect the farmlands, the Fraser River and the tides no longer deliver their vital floodwater and sediments to the delta's marshes and wet meadows.

Over the past century, approximately one half of the original wetland habitats have been lost to agriculture, and urban and industrial development. Virtually all of the seasonal wet meadows have disappeared, along with most of the bogs and floodplain forest. Only the outer brackish wetlands which were too difficult to dike and saltmarshes which were too salty to cultivate remain.



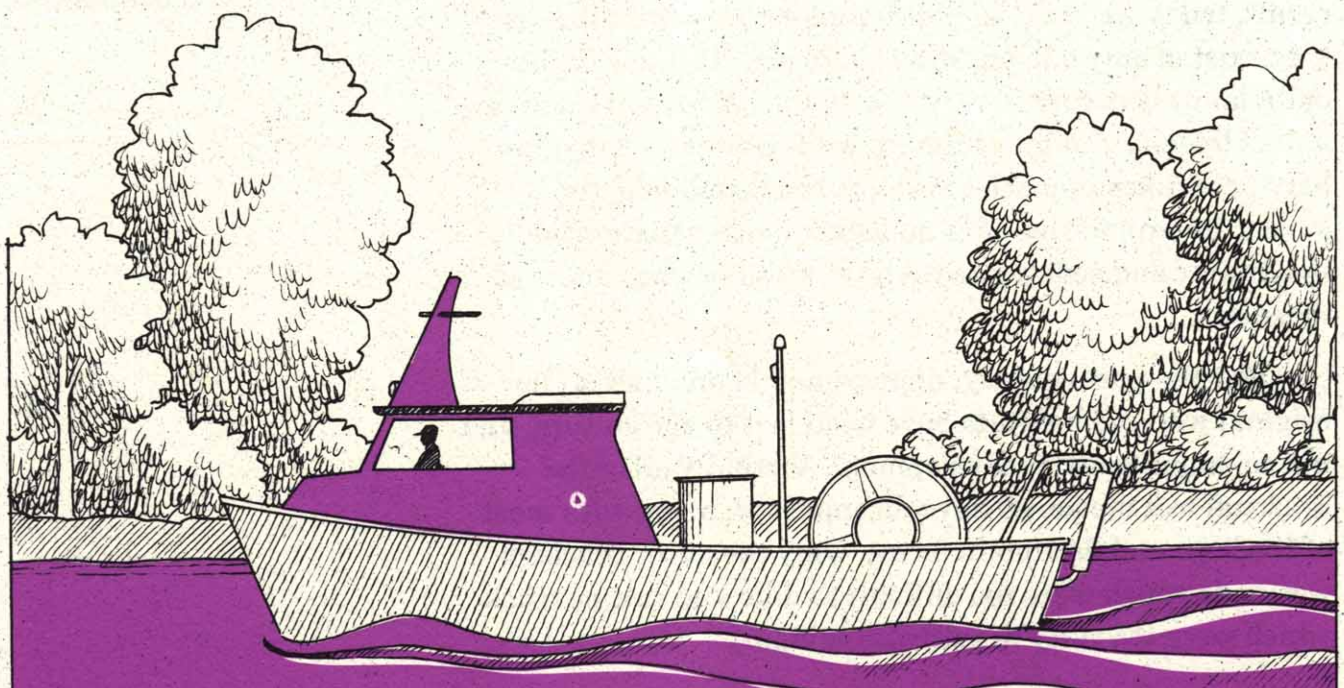
Present-Day Use

Where once there were wetlands on the delta land of Surrey, Tsawwassen and Delta, there are now highways, airports, industrial areas and agricultural lands. Farmland has spread tremendously since the delta lands were protected from river floods and ocean tides. These delta lands constitute some of the most productive agricultural land in Canada.

The traditional berry picking of the aboriginal has expanded into commercial farms that produce crops of raspberry, blueberry, strawberry and cranberry. However, we do not see new farmland coming into production. The population of the Lower Mainland is quickly expanding and much of this residential growth is taking place on the delta lands of Richmond, Delta and Surrey.

Despite the population growth, the Fraser River Estuary still supports large numbers of salmon, herring and shellfish. Approximately one quarter of the crab harvested in British Columbia come from the Fraser Estuary. At the mouth of the Fraser River, hundreds of gillnetter fish boats work the Sockeye Salmon runs each summer, taking 70% of all the British Columbia Sockeye. Well over 50% of all British Columbia salmon come from the Fraser River.

FIGURE 3-8
A Gillnet Fishing Boat



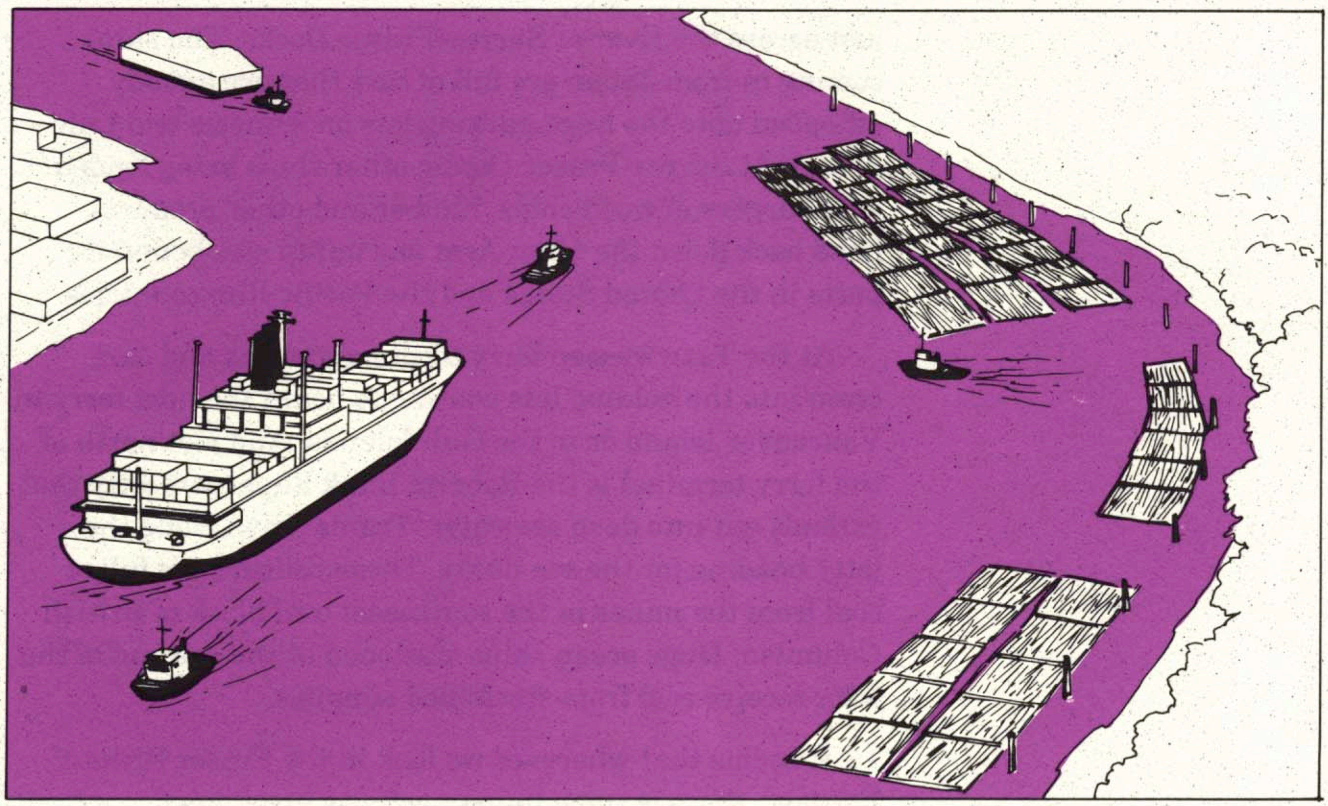


FIGURE 3-9
Logbooms, Tugs, Freighter and Barge using the Fraser Estuary

The Fraser Estuary also supports commerce and industry, particularly the forest industry. The traffic on the river is constantly busy with tugs hauling huge log booms and towing barges filled with woodchips. Along the river, saw mills and paper mills produce lumber, shakes, shingles and plywood for building homes, paperboard for packaging, newsprint for newspapers, and even paper to produce this book.

Almost all these mills produce and store wood chips that are then loaded into barges, some of which are towed to pulp and paper mills where the wood chips are transformed into paper. Wood chips are also transferred to ocean vessels for shipping to Japan, where they are used in paper production.

Because of the fiords and the rugged coastline of British Columbia, there are no coastal highways. Logs are therefore taken down to the sea where they are bundled into booms and towed by barge to be stored in the Fraser River Estuary. The estuary protects these log booms from ocean storms and wood boring, marine invertebrates until they are needed by the mills.

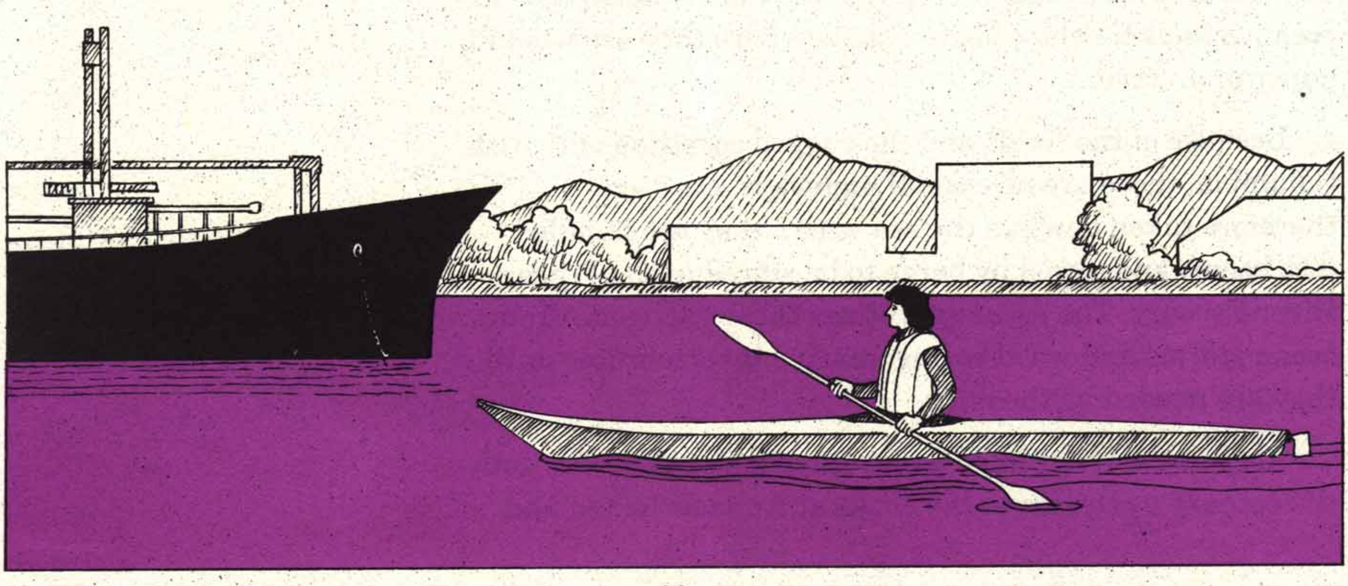
Also on the river, huge ocean ships make their way into the estuary upstream to the docks at Annacis Island and just across the river at Surrey-Fraser Docks. The ships coming in from Japan are full of cars that are quickly offloaded onto the huge parking lots on Annacis and Lulu Island. At Surrey-Fraser Docks, other ships being loaded with cargoes of wood chips, lumber and other products head back down the Main Arm and out to sea, bound for ports in the United States and the Pacific Rim countries.

At the Tsawwassen ferry terminal, trucks and cars cram into the holding lots waiting to board the next ferry to Vancouver Island or to the Gulf Islands. And just north of the ferry terminal is the Roberts Bank Superport jetty that extends out into deep seawater. Trains crawl along the jetty heading for the sea docks. These railcars are full of coal from the mines in the south-east coal block of British Columbia. Huge ocean ships stationed at the sea end of the jetty receive coal from stockpiled supplies.

It seems that wherever we look in the Fraser River Estuary, there is some human activity involving commercial fishing boats, tugs and barges, log booms, dredging operations, police boats, Harbour Commission boats, sailboats and pleasure craft, ocean-going ships from around the world, and coastal ships moving wood products.

River-frontage is also becoming increasingly popular for housing and condominium projects and commercial retail businesses. These new foreshore users are displacing or coexisting with long established facilities such as wood mills, log booms, fishing boat marinas, fish processing plants and barge terminals.

FIGURE 3-10



ACTIVITY 8:
THE CHANGING ESTUARY

The fertile deltas of estuaries have attracted human use and settlement throughout the ages. Over the centuries, wetlands, floodplain forests, river channels and sloughs have been used by people in many different ways.

The objective of this activity is to match different historical time periods for the Fraser River Estuary with the type of non-leisure human activites that occurred then.

Place the numbers of the human activities listed below into the appropriate historical time period shown in Figure 3-11. You can use an activity in more than one time period.

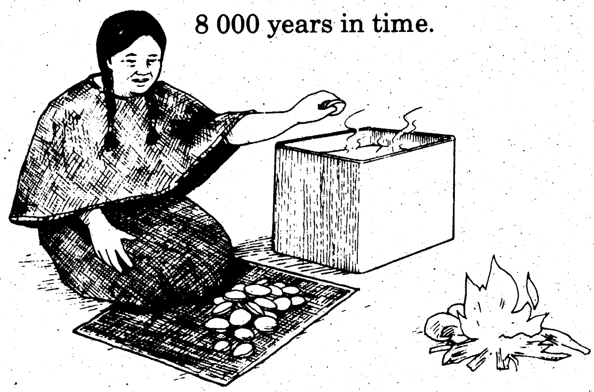
1. Industrial Development
2. Land Clearing
3. Exploring
4. Freighter Traffic
5. Surveying
6. Gillnet Fishing
7. Floodplain Logging
8. Upland Logging
9. Fur Trading
10. Food Gathering
11. Hunting
12. Road Building
13. Diking
14. Fishing
15. Steamboat Travel
16. Dredging
17. Port Development
18. First Railway Development
19. Urban Development
20. Airport Development
21. Farming
22. Fish Canning
23. Gold Rush Traffic
24. Add some more of your own . . .

Answers in Appendix 1, page 111.

Figure 3-11. The Changing Estuary

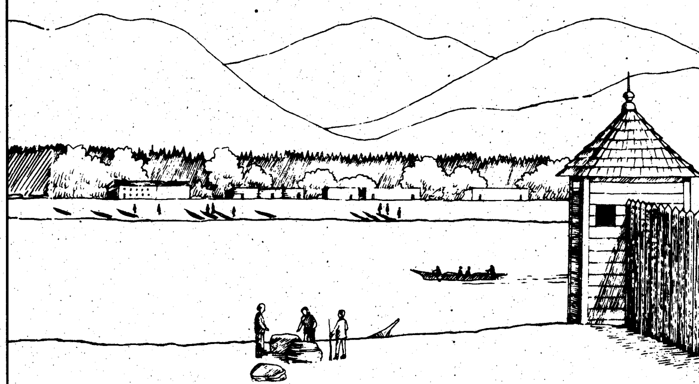
Period of Pre-white Settlement

Use of the estuary by Coast Salish people goes back 8 000 years in time.



1820's to 1830's

In 1827 Fort Langley was established on the banks of the Fraser River.

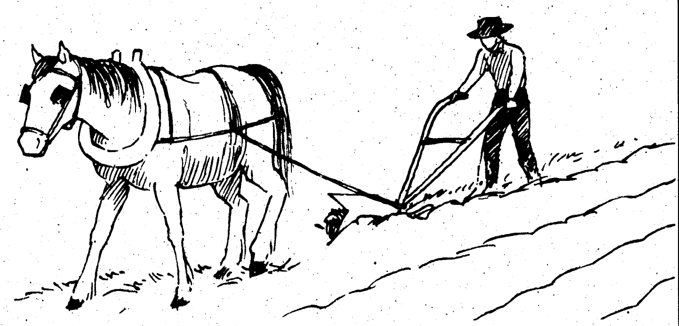


1840's to 1860's

The gold rush of 1858 brought new people into the estuary, some of whom stayed.

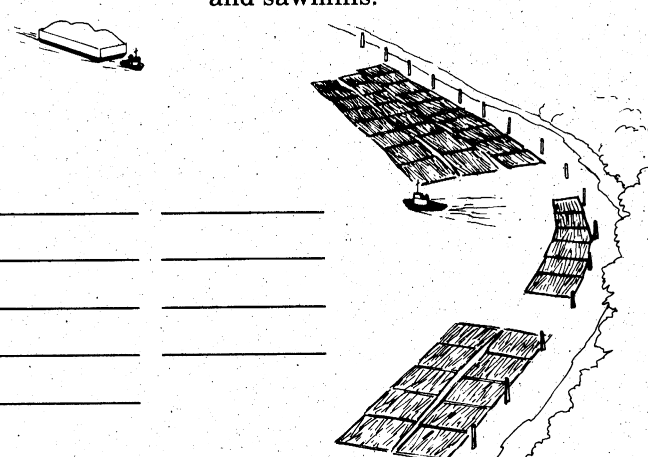
1870's to 1890's

Pioneers began to farm the rich delta lands and form small communities.



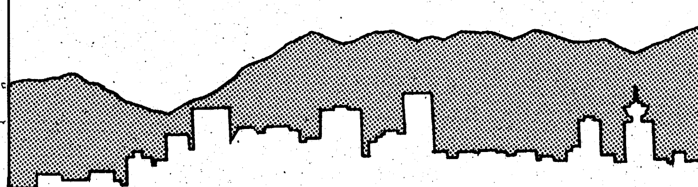
1900's to 1940's

The estuary became an important area for agriculture and sawmills.



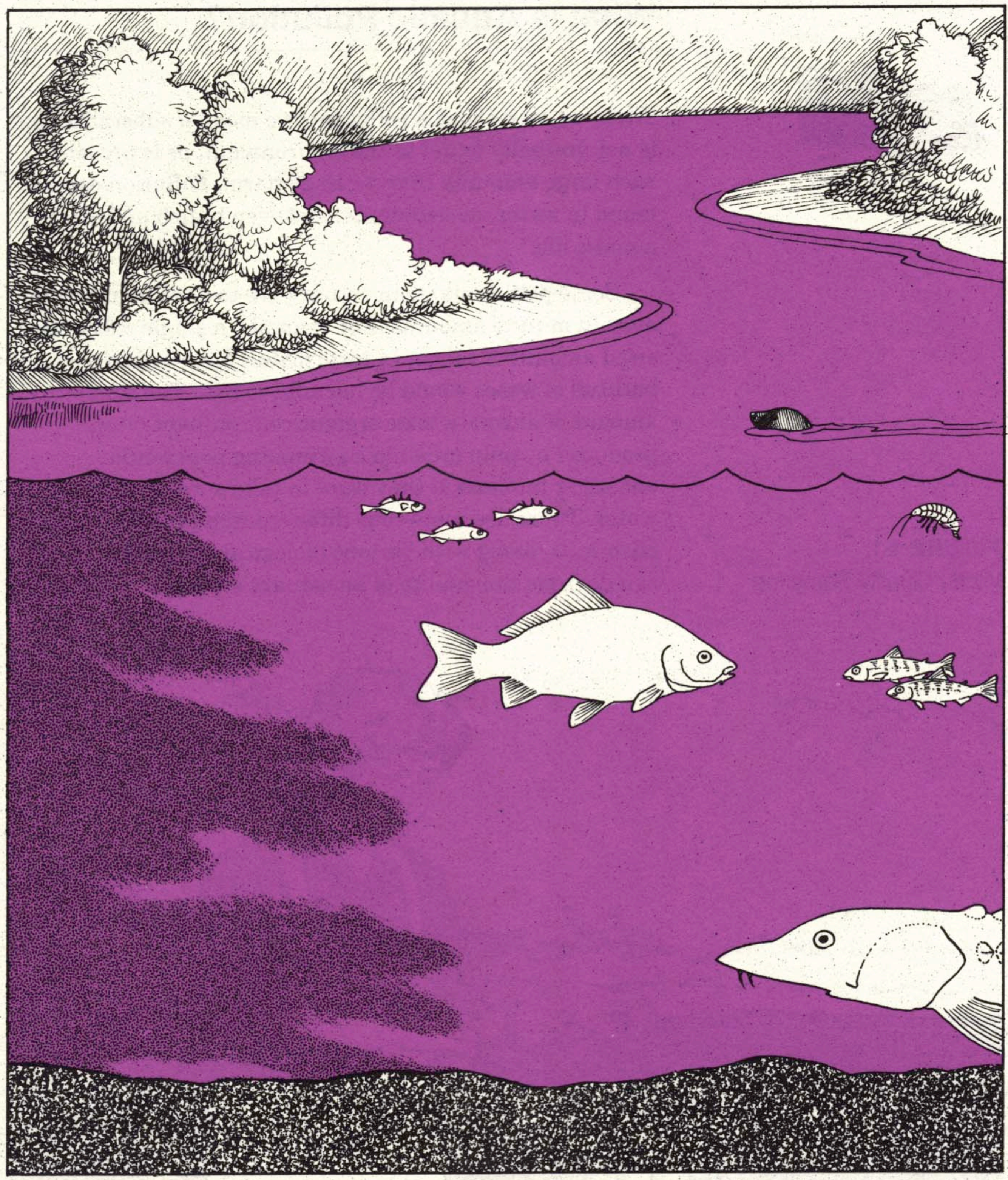
1950's to Present

The growing population of the Lower Mainland expanded onto the delta lands.



Once you have matched the human activities with the correct historical periods, think about the following important questions:

1. How have these human activities affected the estuary?
2. What type of habitats do you think were most affected?
3. What has been the benefit of these activities to humans?
4. What do you think people did about protecting and conserving fish, wildlife and habitat in each of the historical periods?
5. Which present-day human activities do you think are, and which are not, a problem in the estuary?



4. AQUATIC POLLUTION

Water is essential to aquatic habitats in estuaries because it provides many of the life-sustaining chemicals required by aquatic plants and animals. So we should be concerned about the potential effects of pollution on the estuary's aquatic habitat. This chapter describes some of the characteristics of pollutants.

What is Aquatic Pollution?

When we talk about a pollutant, we mean a substance that is not normally found in the environment, or is present in such large amounts that it can do harm. Pollution can be found in water, in sediments, and even in fish and other aquatic life.

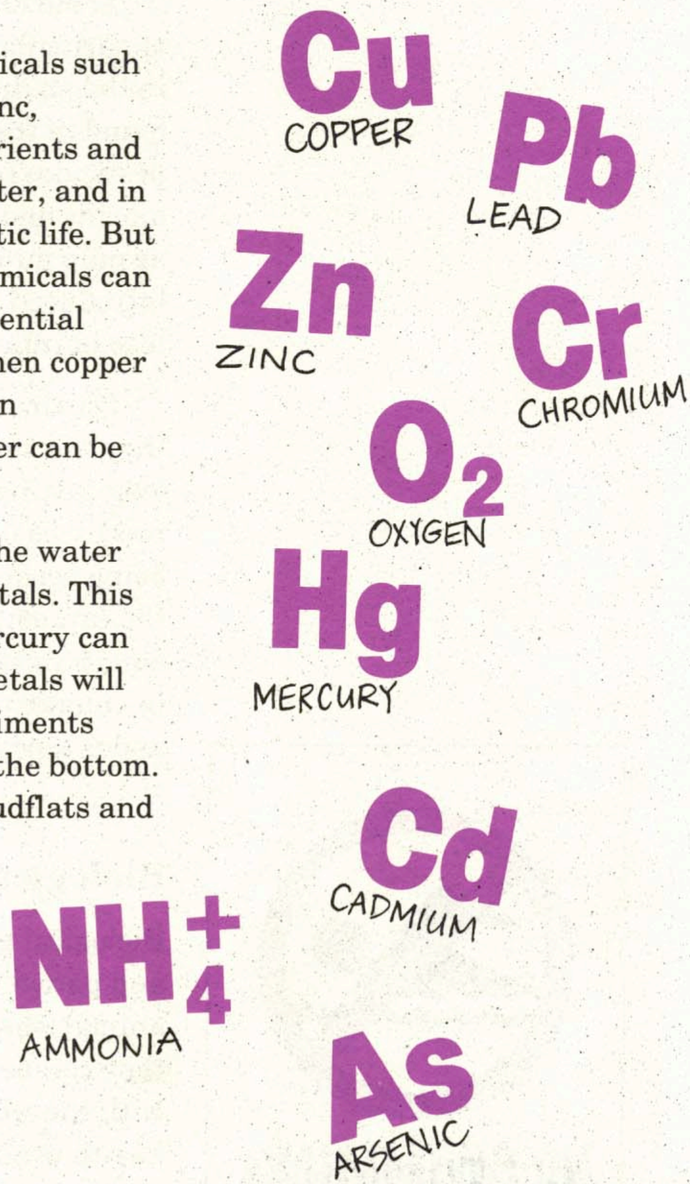
Some pollutants in an estuary are toxic to aquatic life even in minute amounts. For example, a single salt-grain-sized amount of copper (a toxic metal) dissolved in a bathtub of water would be harmful to fish. The same tiny amount of dioxin (a toxic organic contaminant often produced by pulp mills) in a swimming pool would endanger humans, if they were to take a drink of this water. There are numerous different inorganic and organic chemicals, along with various biological substances, that can degrade the quality of an estuary's water.

FIGURE 4-1
Water Quality Sampling

Inorganic Pollutants

Inorganic pollutants may include nutrient chemicals such as ammonia, and metals such as copper, lead, zinc, chromium, cadmium, arsenic and mercury. Nutrients and even metals occur naturally in fresh and sea water, and in proper and small amounts are essential to aquatic life. But when concentrations become too high, these chemicals can be harmful to life. Copper, for example, is an essential element in the blood of crabs and shrimp; yet when copper levels are elevated, it can kill the animal. Certain concentrations of ammonia dissolved in the water can be deadly to fish under certain conditions.

Sediment particles which are suspended in the water can serve as "attachment sites" for dissolved metals. This means that metal pollutants such as lead or mercury can become concentrated on suspended particles. Metals will then accumulate where these contaminated sediments settle out of the river flow and are deposited on the bottom. In this way, water pollution can contaminate mudflats and other places where sediment settles.



Organic Pollutants

Naturally occurring organic matter exists in particulate or dissolved form, and comes from living and dead plants and animals. This natural organic matter does not normally become a problem, because it is quickly recycled in the estuary by microorganisms and small detritus-eating invertebrates (see Food Chains and Food Webs in Chapter 1). However, even organic matter can cause pollution when too much accumulates and the estuary's natural recycling capacity is overloaded.

Too much organic matter stimulates the growth and activity of large numbers of bacteria and other microorganisms. As the bacteria "feed" on the organic matter, they use up much of the available oxygen in the water. This oxygen depletion can make it difficult for fish to breathe, and will often lead to their death.

Some organic pollutants are human-made, and these are of particular concern when they do not easily break down in the environment. PCBs (Polychlorinated biphenols, found in the cooling oil of large transformers); some pesticides (used to kill agricultural and garden pests); and dioxins and furans (chemical byproducts of industries such as pulp mills) are toxic organic pollutants that, once introduced into the environment, do not easily break down into harmless components.

Dioxins are an environmental hazard not only because they are very toxic, but also because they can be long-lasting in the environment. Natural recycling processes do not work very well with dioxins. Rather than being broken down into harmless products after they enter the estuary, they are often taken up and concentrated in aquatic organisms. This concentration of toxic substances in aquatic plants and animals is called "bioaccumulation," and is a potentially serious problem in any ecosystem.

Biological Pollutants

Biological pollutants consist of harmful bacteria, viruses and parasites that come from disease-carrying human and animal wastes. When these pollutants enter the estuary, they can be dangerous to people who come into contact with the water. Biological pollutants can cause a number of health problems in humans, including intestinal disorders (e.g., gastroenteritis), blood diseases (e.g., hepatitis) and parasitic infections (e.g., tape worms). To avoid the spread of human disease organisms, sewage is chlorinated (a disinfection process) before being discharged into the estuary during the summer months.

Those of us who like to eat oysters, clams and mussels must also be concerned about biological pollutants. This is because these animals feed by filtering large amounts of estuarine water through their gills. If the water is contaminated with biological pollutants, these animals will concentrate the pollutants in their body and pass them on to the person who eats them. This is precisely the reason why Boundary Bay, along with all other areas of the estuary, has long been closed to the harvesting of molluscan shellfish.

Bioaccumulation

As discussed in the section on dioxins, "bioaccumulation" is the term used to describe the uptake and retention of chemical contaminants which aquatic plants and animals obtain from food, water or sediments. Bottom-dwelling organisms such as worms, clams and groundfish that feed off the river bed can easily take up pollutants that have settled out with the sediment. Toxic organic pollutants which are not easily degraded by natural means tend to remain inside the bodies of these bottom-dwelling organisms.

Consider the case of a toxic chemical that is discharged into the estuary. It may enter the estuary in a number of ways: from a discharge pipe, from a ditch, from surface or groundwater, or even from the air. Once the chemical enters the water, it is usually diluted to a concentration that is too low to measure with even the most sensitive instruments. However, by providing numerous attachment sites on its surface (Figure 4-2), an organic sediment particle can concentrate the toxic chemical.

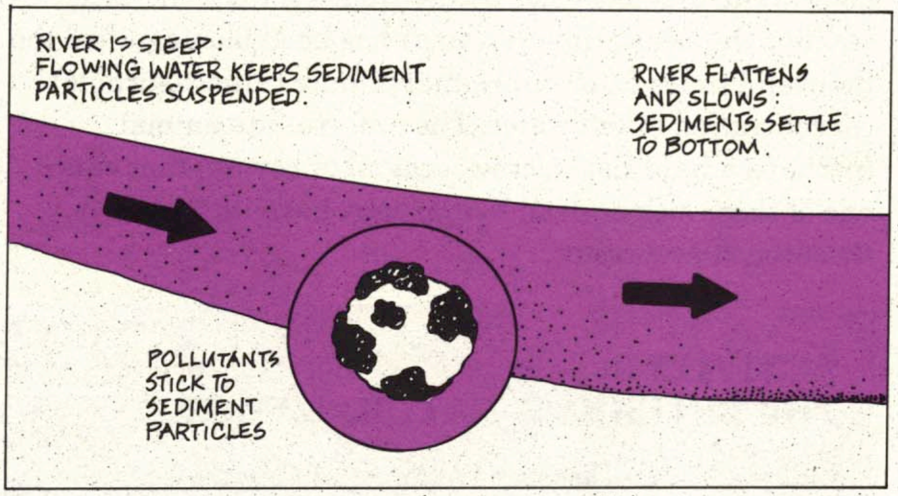
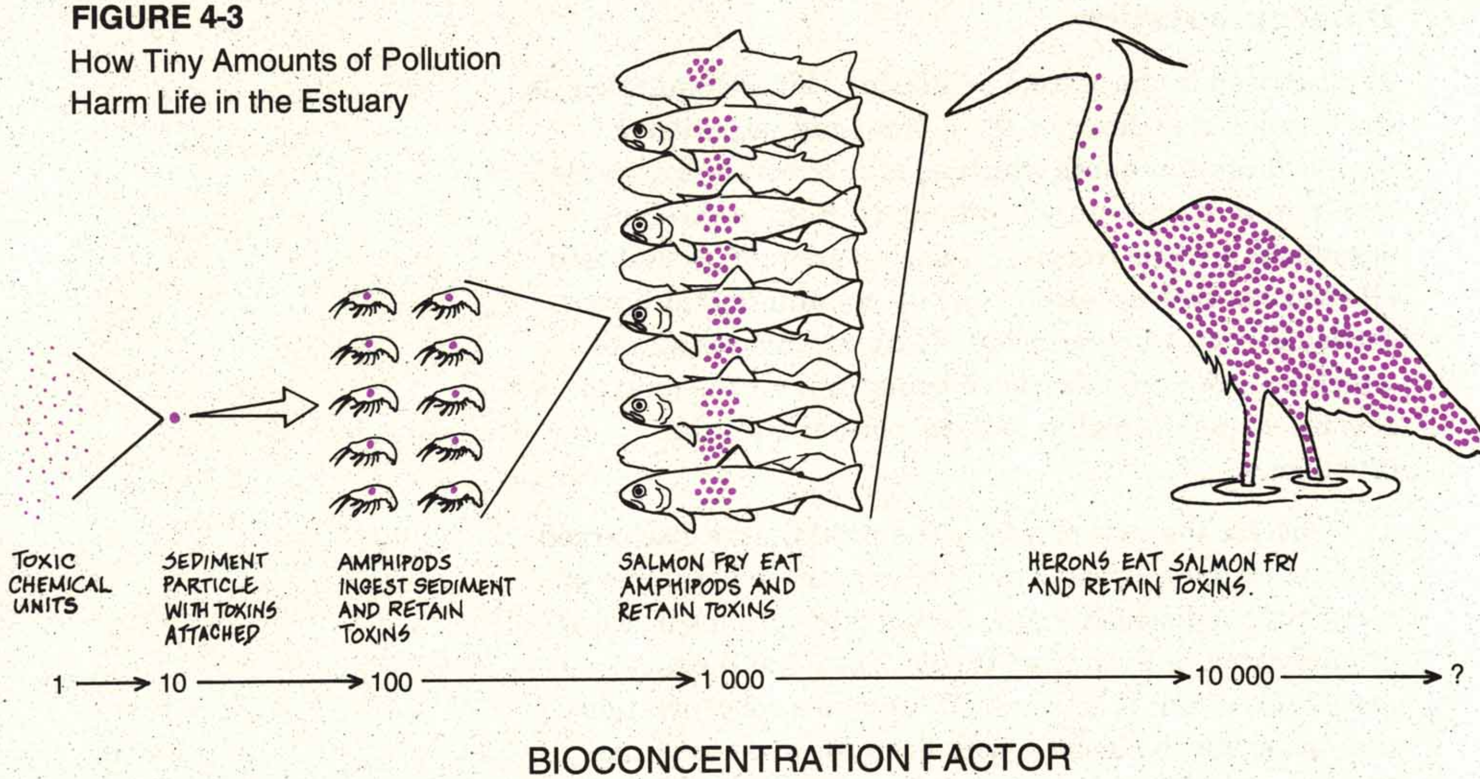


FIGURE 4-2
Pollution of Sediment Particles and River Bottom

The process of bioaccumulation is illustrated on the following page, Figure 4-3. In this example, a dissolved toxic chemical is concentrated ten-fold as it is attached to organic sediment particles which eventually settle to the bottom. There, bottom-dwelling amphipods are shown to consume ten of these contaminated particles. A small fish feeds on ten of these contaminated amphipods, and a Great Blue Heron then feeds on ten of the contaminated fish.

FIGURE 4-3
How Tiny Amounts of Pollution Harm Life in the Estuary



At each step of the food chain, the toxic contaminant is bioconcentrated ten-fold. By the time the toxic chemical reaches the Great Blue Heron, it has been biomagnified ten thousand times from its original minute (unmeasurable) concentration in the water. The unfortunate animal (perhaps a Bald Eagle, crow, seagull or coyote) that eats one of these sick or dead herons may have its life threatened as a result.

ACTIVITY 9: THE ESTUARY'S NATURAL FILTER

(adapted from: *Discover Wetlands, A Curriculum Guide*, Washington Department of Ecology, 1988)

Estuaries are the final receiving water for a wide variety of pollutants. Marshes help to keep the estuary's water clean and healthy by filtering and removing these harmful pollutants. This natural filter has the following properties:

1. As water currents are reduced in marshes, suspended sediments, along with any attached contaminants, settle to the bottom. Water flowing out of the marsh is therefore cleaner and purer.

2. Marsh plants can absorb most dissolved toxic contaminants. Some of these pollutants can actually be turned into harmless products inside the plants. Other pollutants end up below the soil in the plant roots. Here the pollutants are incorporated into the soil or are rendered harmless by bacteria.

Objective:

You can study the powerful ability of plants to absorb dissolved substances by doing the following experiment which simulates how pollutants can be absorbed into a living organism.

Procedure:

Step 1 and 2 of this experiment should be prepared one day ahead.

1. Prepare a coloured solution in a glass container by adding several drops of food coloring (red is a good color) to water. Think of the food coloring as representing pollution by a toxic substance.

2. Cut a small piece off the bottom of a celery stalk and place it in the water overnight (Figure 4-4). Over time, the colored water will visibly travel (by a process called osmosis) up the stalk. This shows how plants can absorb pollutants with the water they "drink." If the colored water is not visible on the outside of the stalk, break it open to reveal the color inside.

3. Imagine that the celery stalk represents a marsh plant, and that millions of these plants growing in a tidal marsh are absorbing pollutants from water in the estuary.

There is, of course, a limit! Plants can store and degrade only a limited amount of pollutants. Some of these stored pollutants can be released back into the aquatic environment as the plants die and decompose. Too much pollution, especially toxic chemicals which are persistent in the environment, will eventually harm and destroy life in the estuary. The best solution is to reduce pollution — or better yet, to eliminate it.

FIGURE 4-4

OTHER FACTS AND FIGURES

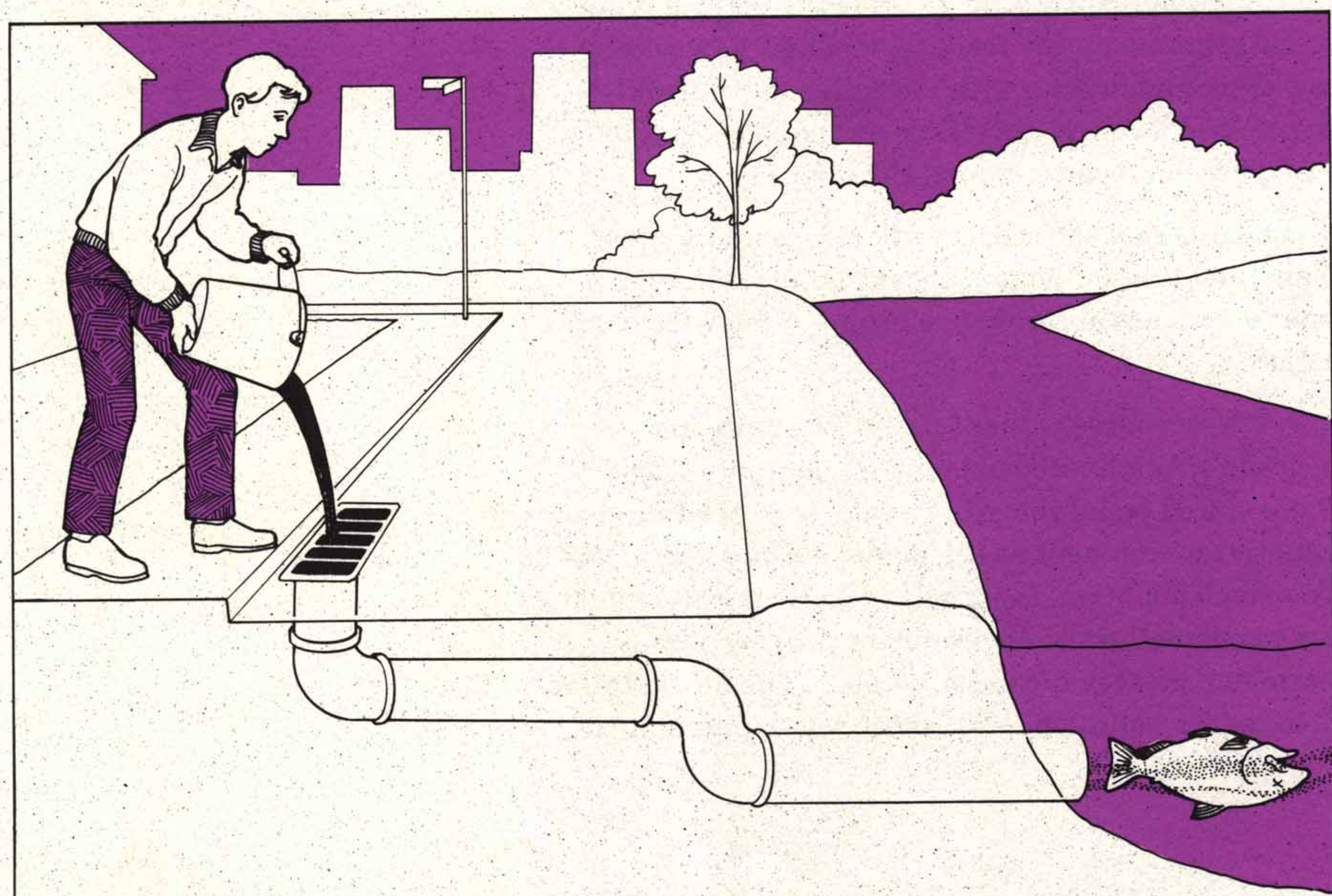
Down the Drain!

Many common household products contain substances that are toxic to aquatic life. Household chemicals such as toilet and oven cleaners, bleaches, household paints and thinners, insecticides, camping fuels and antifreeze all contain toxic chemicals.

Many people don't realize that these products are toxic to aquatic life and most of us don't know how to properly dispose of these hazardous materials once we are finished with them. As you can see in Figure 4-5, the worst way to get rid of left-over products is to flush them down the toilet, pour them into the kitchen sink, or dump them into a curbside stormdrain. If we do this, these toxic chemicals will eventually end up in our estuary where they can harm the aquatic life.

If you do not want toxic chemicals in household products to harm your estuary, dispose of them properly. Contact your local municipal hall or the Recycling Hotline (see Appendix 3) to find out the best way to dispose of your household chemicals.

FIGURE 4-5
Never Use a Storm Drain for Disposing Waste Materials!

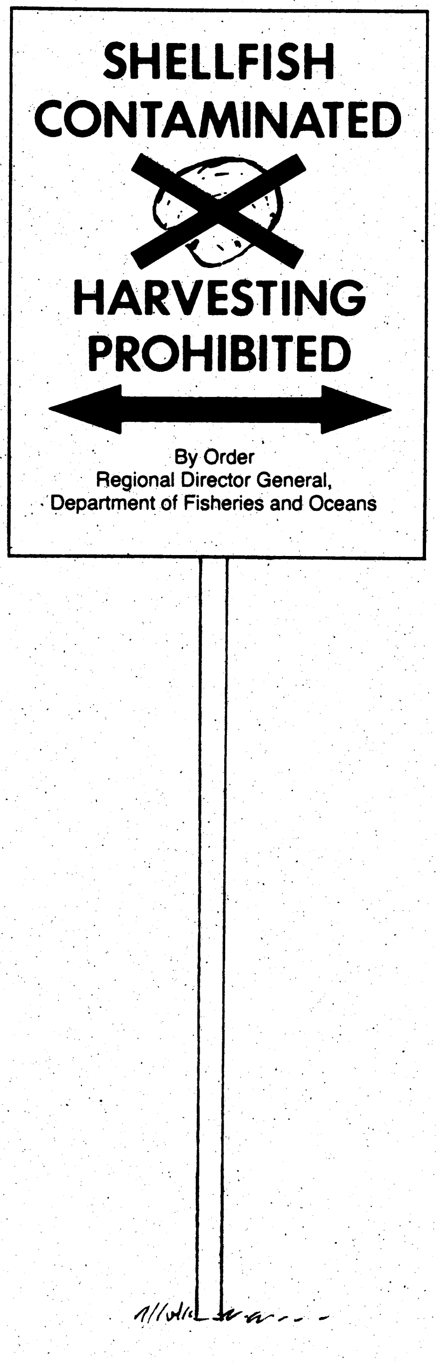


Too Much of a Good Thing!

It is a well known fact that animal manure serves as an excellent soil fertilizer by providing plant nutrients to enhance the growth of crops. However, too much nutrient supply in aquatic ecosystems will often result in problems. This was the case during the 1980's, when heavy rainfall flushed large amounts of nutrients (animal manure and other agricultural fertilizers) into drainage canals and sloughs that eventually fed into the Nicomekl and Serpentine Rivers. These nutrients stimulated excessive growths of algae. When the algae died off in the fall, there was a large biological oxygen demand which rapidly depleted the dissolved oxygen levels in the river water. This sequence of events resulted in major fish kills in the Serpentine and Nicomekl Rivers.

When animal manure is flushed into local drainages, it can introduce high numbers of coliform bacteria into adjacent parts of the estuary. Both the Serpentine and Nicomekl Rivers drain into Boundary Bay. The continuous high levels of coliform bacteria discharged each year into Boundary Bay have resulted in chronic bacterial contamination of molluscan shellfish. As a result, shellfish harvesting has been banned since 1962, eliminating one of the most important oyster production areas in British Columbia.

FIGURE 4-6



ACTIVITY 10: MATCHING POLLUTANTS AND SOURCES

The various types of pollution described in this chapter can originate from many different sources in the estuary. The nature of the pollutant usually provides some clues to its source. Identifying pollution sources is an important step towards protecting the water quality of the estuary.

The objective of this activity is to match the various pollutants with their potential sources, as shown in Table 4-7. Place a mark (X) in any box of the table where a pollutant matches a potential pollution source. Once you have filled in the table, think about the following questions.

How do these pollutants get from the source to the estuary?

Do you think this pollution could be prevented or reduced?

Can you think of any other potential pollution sources?

What type of pollutants could originate from these other sources?

Answers in Appendix 1, page 112.

TABLE 4-7
Chart for Matching Pollutants and Their Sources

POLLUTANTS	POLLUTION SOURCES			
	Household	Pulp Mill	Farm Field	Automobile
Bacteria				
Copper				
Dioxins				
Herbicides				
Lead				
Oil				