

# *Nisqually Delta Restoration Puzzle*



*by Lucia Harrison*

*Colophon: Lucia Harrison created the Nisqually Delta Restoration Puzzle based upon her observations watching for salmon at Braget Marsh and the Nisqually Wildlife Refuge. She created the 32 watercolor illustrations. You have her permission to download copies of the booklet and puzzle pieces for educational purposes from <https://sites.evergreen.edu/nisqually-puzzle/>*

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Nisqually Delta Restoration --nisquallydeltarestoration.org/science.php (scientific studies of the restoration)

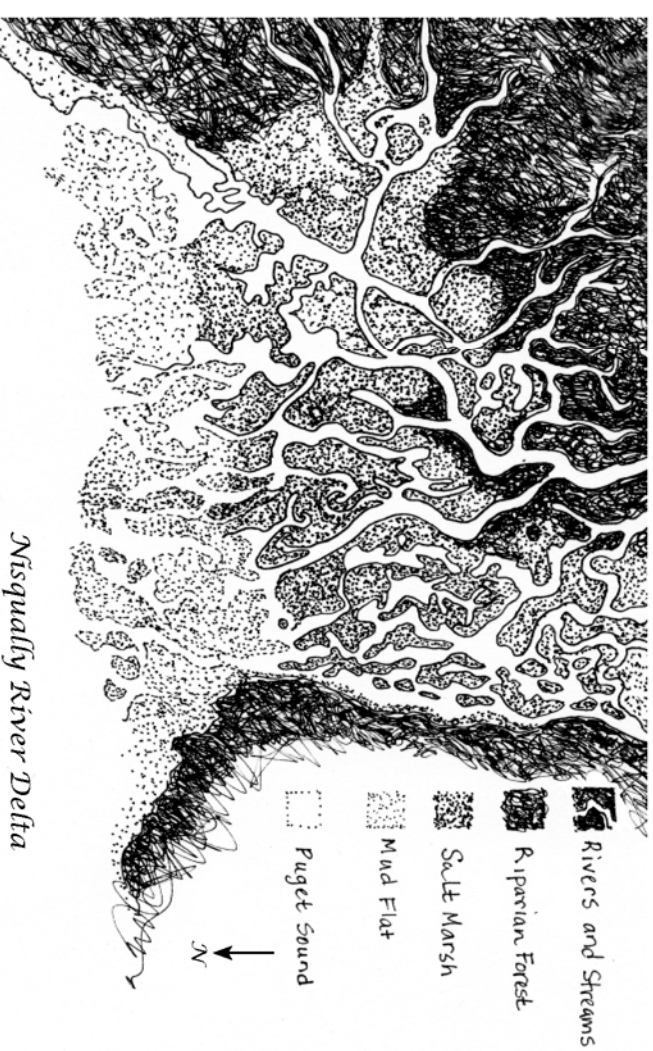
Sibley, David Allen, *The Sibley Field Guide to Birds of Western North America*, Chanticleer Press, 2003

Wilkinson, Charles, *Messages from Frank's Landings: A Story of Salmon, Treaties, and the Indian Way*, Seattle: University of Washington Press, 2000

Fish: [www.fws.gov/wafwo/fisheries/Publications/FP025.pdf](http://www.fws.gov/wafwo/fisheries/Publications/FP025.pdf) describes the Fishes of the Nisqually River, Reach and Estuary.

[wdfw.wa.gov/fishing/salmon/chum/life\\_history/index.html](http://wdfw.wa.gov/fishing/salmon/chum/life_history/index.html) describes the Chum Salmon life cycle

Birds: [www.allaboutbirds.org/](http://www.allaboutbirds.org/) (Cornell Lab of Ornithology offers up to date information about birds in the United States)



## Introduction

Discover with me the important estuary restoration at the Nisqually Delta in South Puget Sound, Washington. Estuaries, some of the most productive habitats on the planet, are places where rivers reach the sea. At the estuary the river slows down, drops its load of sand and silt and creates a fan shape of tiny little shifting creeks that look like the human circulatory system. Protected from battering waves and storms, this area of mixing of salt and fresh waters along tiny waterways provides food and shelter for hundreds of species of plants and animals. Healthy estuaries have a variety of habitats like salt marshes, mud flats, and eel grass beds that sustain a diversity of species. The incoming and outgoing tides are the lifeblood of the system.

Because of the rich soils brought down by rivers, people all over the world have farmed and lived near river deltas. The Nisqually watershed is the ancestral home to the Nisqually Indians who have lived here for thousands of years. They have fished in the Nisqually River, built seasonal villages along the banks, and used the estuary and mudflats to harvest shellfish. They have managed the land along the river and its tributaries to provide for their needs. In 1830, the Hudson Bay Company established Fort Nisqually up on the bluff where the city of DuPont is now and they began European-style farming in the area. In 1854, The Medicine Creek Treaty was signed here by representatives of the US government and the tribes of South Puget Sound. The treaty ceded Nisqually Tribal lands along the 78 mile river and its tributaries to the U.S. Government. It moved the Nisqually people to a tiny reservation (on a rocky bluff with no access to the river) and guaranteed them rights to hunt and fish in their usual and accustomed places. So small was the allocated reservation that tribal members, led by Chief Leschi, fought back. Eventually Leschi was falsely accused of murder and hung. But the Nisqually Reservation was moved and expanded. In 2004, Leschi was exonerated.

The Treaty opened the land to more settlement. The first were the McAllister and Shazer families. In 1904 the Brown family purchased the west side of the delta and built dikes to separate the rich farmland from the salty waters. The Braget family built dikes on the east side. At the time, salmon were plentiful so they did not care that they were closing

## *To Learn More*

### *Conservation Organizations*

Billy Frank Jr. Nisqually National Wildlife Refuge -- [www.fws.gov/refuge/billy\\_frank\\_jr\\_nisqually](http://www.fws.gov/refuge/billy_frank_jr_nisqually).  
Nisqually Land Trust -- [nisquallylandtrust.org](http://nisquallylandtrust.org)  
Nisqually River Council -- [nisquallyriver.org/](http://nisquallyriver.org/)  
Nisqually Tribe Department of Natural Resources -- [www.nisqually-nsn.gov/index.php/administration/tribal-services/natural-resources/](http://www.nisqually-nsn.gov/index.php/administration/tribal-services/natural-resources/)  
People for Puget Sound -- [pugetsound.org/](http://pugetsound.org/)  
Puget Sound Keeper Alliance -- [pugetsoundkeeper.org/](http://pugetsoundkeeper.org/)  
South Puget Sound Salmon Enhancement Group -- [spseeg.org/](http://spseeg.org/)  
South Sound GREEN -- [www.thurstoncd.com/south-sound-green.html](http://www.thurstoncd.com/south-sound-green.html)  
Puget Sound Partnership -- [www.psp.wa.gov/](http://www.psp.wa.gov/)

### *For Further Reading:*

Cooke, Sarah Spear, *A Field Guide to the Common Wetland Plants of Western Washington and Northwestern Oregon*, Seattle Audubon Society and Washington Native Plant Society, 2007  
Carpenter, Cecilia Svinth, *Where the Waters Begin: The Traditional Nisqually Indian History of Mount Rainier*, Seattle: Northwest Interpretive Association, 1994





**Red Breasted Mergansers (*Mergus serrator*)** are almost always found in the estuary closer to McAllister Creek.



**Reed Canarygrass (*Phalaris arundinacea*)** thrives in freshwater wetlands and was introduced as forage for cows and to bind the soil. In the Northwest it is invasive, crowding out other wetland species of plants and limiting waterways and make it difficult for fish and birds to pass. In the Nisqually, this invasive species was recently controlled by removing the agricultural dikes to allow flooding of the estuary with salt water.

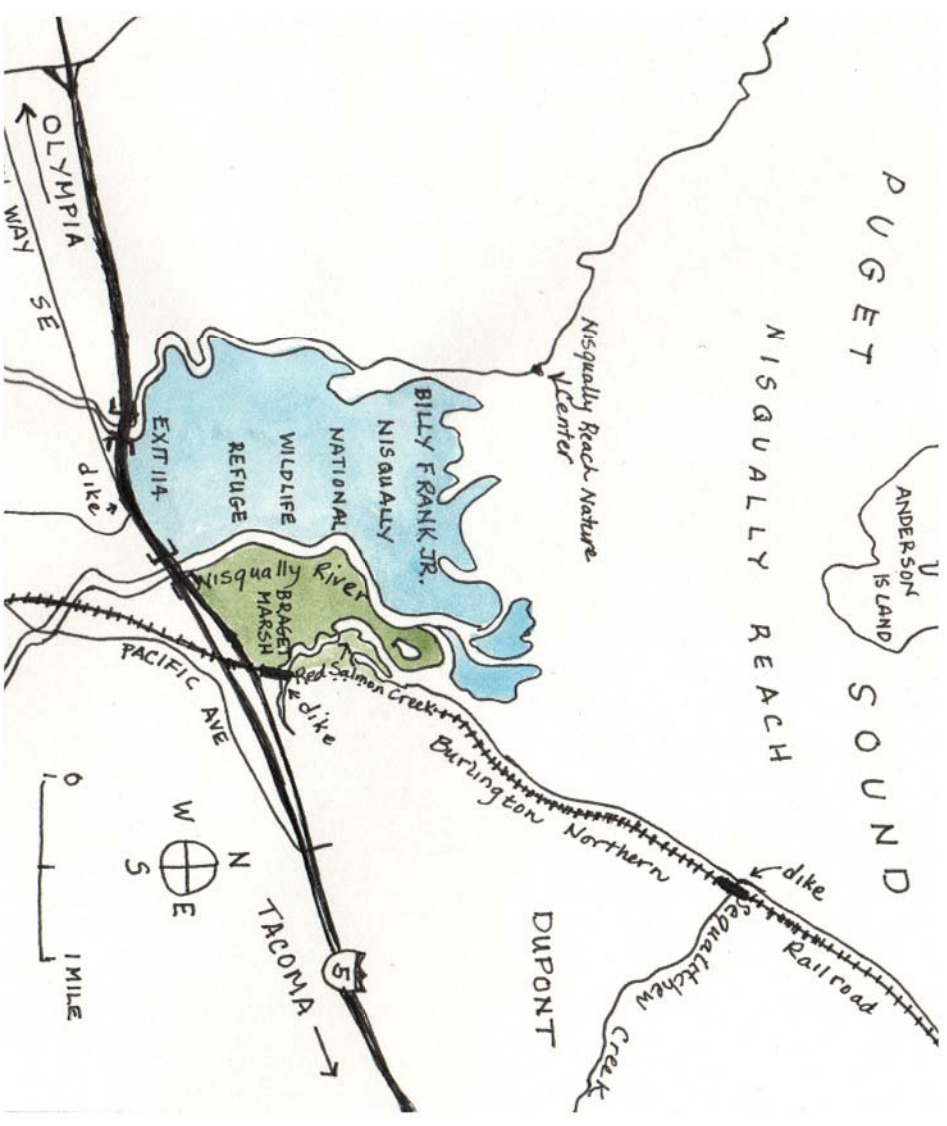


Figure 1: Location of Nisqually Delta (shown in blue and green). Adapted from Washington State Dept. of Natural Resources Map

off a productive saltwater nursery for salmon. They also imported their favorite pasture grasses, such as Reed Canary Grass, not realizing that these grasses would eventually spread along fresh waterways throughout the watershed choking stream flow and out competing the native plants.

The Puget Sound waterways have always been used for transportation, so when the railroads came, it made sense to build them along the Sound. Dikes rather than bridges were built across estuary entrances (all along Puget Sound). These dikes further constricted the flow of salt water through cement pipes in the dikes. State and Interstate Highway engineers created new dikes, such as those carrying Interstate 5.

While many people benefitted from the agricultural products and easy transportation, the habitat for wild species of plants and animals was severely restricted. Major species affected included the wild salmon that rely on the protection and food of the estuary before beginning their long sea journey. Due to over fishing, dams, agricultural runoff, pesticides, heavy logging near streams, and dikes, many species of salmon suffered. The local way of life for tribes and non-native fishing families became more difficult. The invasive Reed Canary Grass spread, restricting access to fresh waterways for diverse species of wildlife.

In 1974, with the concerted efforts of local citizen groups, the U.S. Government purchased the west side of the delta to create the Nisqually National Wildlife Refuge. In 2000, the Nisqually Tribe purchased the east side of the delta from farmer Kenny Braget.



The male (green head) and female **Mallards** (*Anas platyrhynchos*) are abundant nesters at Billy Frank Jr. Nisqually National Wildlife Refuge. They can adapt to both salt and fresh water.



**Belted Kingfishers** (*Ceryle alcyon*) are common birds at Billy Frank Jr. Nisqually National Wildlife Refuge and feed on the abundant small fish found there.



**Raccoons** (*Procyon lotor*) frequent salt marshes looking for bird hatchlings and eggs, fish, crabs and shellfish. **Glaucous-winged Gulls** (*Larus glaucescens*) guard their nests from these predators.





**Lynghy Sedge, (*Carex lynghyae*) and Pacific Silverweed (*Argentina anserina*)** grow in coastal salt marshes, a perfect habitat for the territorial **Red-winged Blackbird (*Agelaius phoeniceus*)**



**Pacific Silverweed (*Argentina anserina*)** flower in coastal salt marshes along with Lynghy sedge.



**Seaside Plantain (*Plantago maritima*)** is a common salt marsh plant.



After an initial pilot project in 1996, the Nisqually Tribe led the effort to remove agricultural dikes to flood the delta along the east side of the river, 31 acres in 2002 and 100 acres in 2006. The salt water flowed in to help restore the estuary. In 2009, the U.S. Government followed this lead by removing dikes at the refuge. A new boardwalk gives visitors access to the estuary's salt marsh. Future plans call for the elevation of Interstate 5 and restoring openings in the railroad dikes across stream entrances between Nisqually and Tacoma.

In 2015, the Billy Frank Jr. Tell Your Story Act changed the refuge name to Billy Frank Jr. Nisqually National Wildlife Refuge to honor Billy Frank Jr., a Nisqually tribal leader who challenged the state and federal government to honor the Medicine Creek Treaty. The act also established the Medicine Creek Treaty National Memorial within the boundaries of the refuge. Billy Frank Jr. was the architect of a cooperative system for fisheries management.

## The Puzzle

Watch the restoration happen by assembling this puzzle depicting the Nisqually River Delta between Olympia and DuPont, Washington. Each tile has two sides that represent different futures for the Delta. One side features dikes and the invasive dominant Reed Canary Grass; the other shows the impact of removing the dikes and restoring the salt marsh estuary to provide habitat for salt marsh plants and diverse species of wild plants and animals.

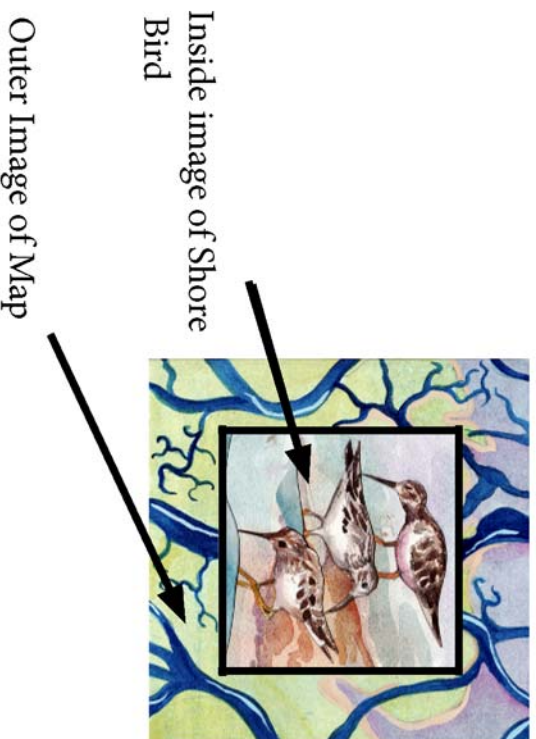


Figure 2: Sample Tile

Each tile has an outer map-like frame and an interior image of a plant or animal.



**Crab** (*genus Hemigrapsus*), **Mussels** (*genus Mytilus*), **Pickleweed** (*Salicornia virginica*), and **Worms** (*phylum Annelida, class Polychaeta*) are common in the salt marshes.

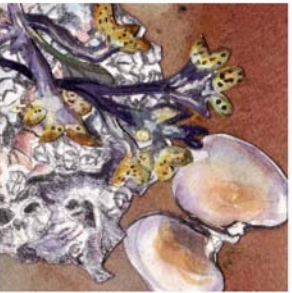


**Chum Salmon Alevins.** From November to January, Chum salmon lay eggs in the freshwater gravel of streams, such as Red Salmon Creek that flow into the estuary. The embryos develop inside the egg sack and hatch after about four months. They live in the gravel and absorb their egg sacks for another six weeks.

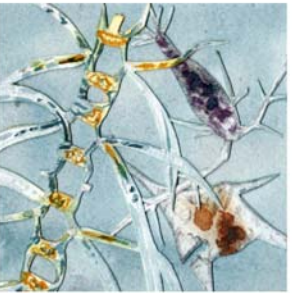


**Chum Salmon Fry.** Once the young salmon absorb their yolk sacks, they emerge from the gravel as fry. They are about 1 – 1.5 inches long. They head downstream toward the estuary where they live through the summer or longer before heading to the ocean. They seek shelter and food in the protected estuary channels.





**Rockweed** (*Fucus distichus*) and **Barnacles** (*genus Balanus*) grow along rocks in the mudflats. **Native Littleneck Clams** (*Leukoma staminea*) burrow underground.



**Microscopic organisms** -- **diatoms** (*genus Chaetocerus*), **dinoflagellates** (*genus Ceratium*) and **zooplankton** (*genus Acartia*) -- form the foundation of the estuary food chain. Some species are photosynthetic making energy from sunlight. Others eat plants. Some do both which makes it hard to classify them as a plant or animal.



**Greater Yellowlegs** (*Tringa melanoleuca*) are among the shorebirds that use the Billy Frank Jr. Nisqually National Wildlife Refuge as a migratory stopover and wintering grounds. They are common at Nisqually in the spring, fall, and winter.



Figure 3: Example: Line up these two red lines

To assemble the puzzle, turn each tile so that the Reed Canary Grass tiles all face up. Match the map area of the tiles (see Figure 3 above) to create the image of the Nisqually River Delta before the restoration when the agricultural dikes kept salt water out (see Figure 4 on the next page).



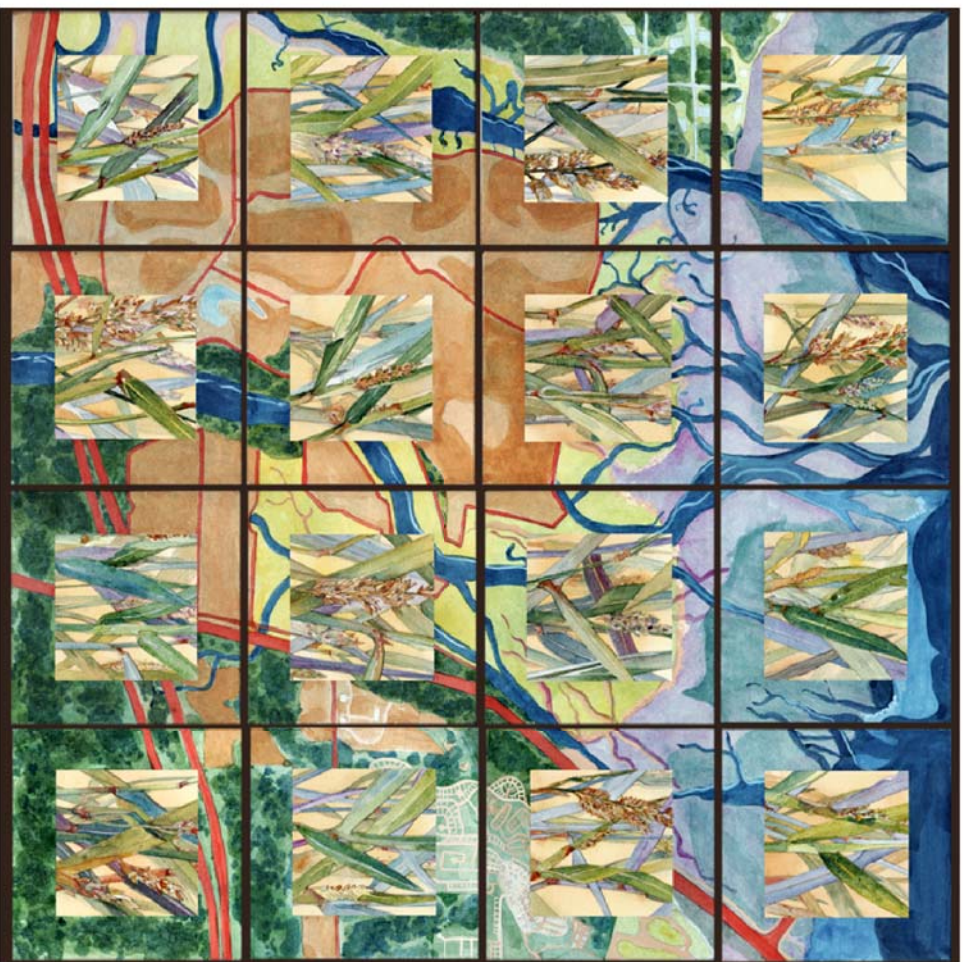


Figure 4: Before the Restoration

### Plant and Animal Key

**Bald Eagles** (*Haliaeetus leucocephalus*) can often be seen along the Nisqually River, especially when the salmon are spawning. They nest at the Refuge. Bald Eagles were Federally listed as a threatened species until 2007.



**Chum Salmon** (*Oncorhynchus keta*) spawn from November to January. They are one of 5 species of wild salmon in the Nisqually River. The others include Summer/Fall Chinook, Pink Salmon, Coho Salmon, and Steelhead. The River, Estuary, and Reach support over 90 species of fish from 30 different families. Once the adult Chum Salmon head out to deeper waters, they go to the Gulf of Alaska where they feed for 2-3 years before returning to spawn.



**Great Blue Herons** (*Ardea herodias*) nest at Billy Frank Jr. Nisqually National Wildlife Refuge and can be seen fishing at low tide, (both incoming and outgoing), especially along the boardwalk.





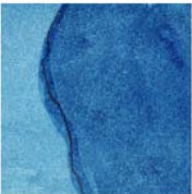

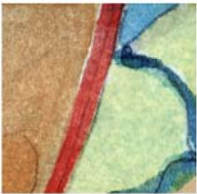



Can you identify the Plants and Animals in the center of each puzzle tile? Use the Plants and Animals Key to find out more. Notice that by removing the dikes you have allowed for more species diversity and a great habitat for wild salmon.



Figure 6: After the Restoration

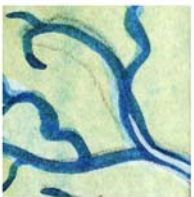
The puzzle illustrates the effects of dikes and one dominant invasive species. Read the map key below. Can you identify each feature of the map? Which features are missing or harder to identify? Can you identify the plant you see inside the map frame?

Map Key

Puget Sound		Rivers and Streams	
Agricultural Dike		Tide Flats	
Farmland with Pasture Grass		Boardwalk over Salt Marsh	



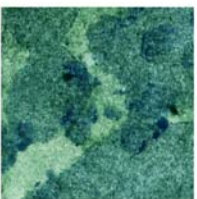
Salt Marsh



Railroad  
Dike



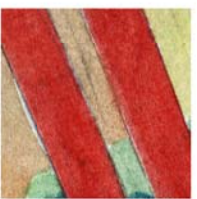
Riparian  
Forest



Housing  
Development



Interstate  
Highway



Reed Canary  
Grass



To represent the restoration, turn the tiles over so the inside im-  
ages show different plants and animals. Which images on the map  
changed? What map images are new? Which ones are larger?  
What is missing? What happens when you remove the agricultural  
dikes?

