Tribal Science, Monitoring, and Partnerships to Address Environmental Issues

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National Tribal Water Council

NWQMC Webinar Series
April 19, 2011 @ 8:00 AM (PT)
April 21, 2011 @ 12:30 AM (PT)

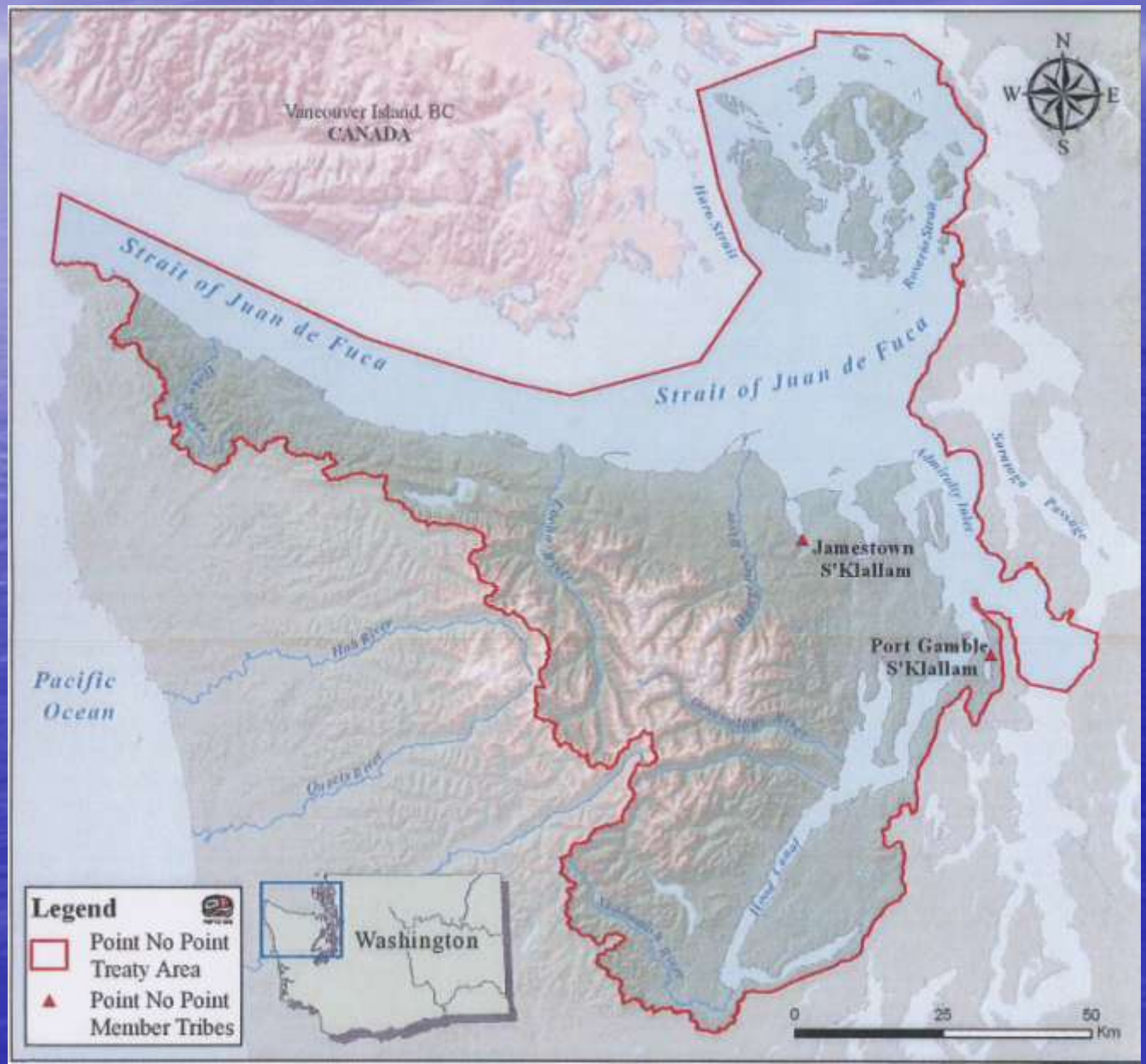
Tribes in North Western Washington

Port Gamble S'Klallam Tribe's Port Gamble Bay Homeland

- Ancestral Village Sites on the bluff at Port Gamble and on the spit below the bluff
- "Encouraged" to move to Point Julia by Pope & Talbot in 1853 for sawmill construction
- Tribe has occupied the Port Gamble Bay area for several thousand years
- Hunting, fishing and gathering subsistence traditional lifestyle continues

U.S. Coast and Geodetic Survey 1856 on 2008 Aerial Photograph

Usual & Accustomed Hunting, Fishing and Gathering Area



Regional Water Quality Challenges Facing the Tribes

- Safe drinking water
- Adequate and clean water for fish and shellfish habitat
- Clean water to maintain wetlands for wildlife and plants traditionally hunted and gathered by Tribal members
- All of the above with a seven generations (approximately 150 years into the future) context of protection and preservation

Examples of Threats to Water Quality Facing the Tribes

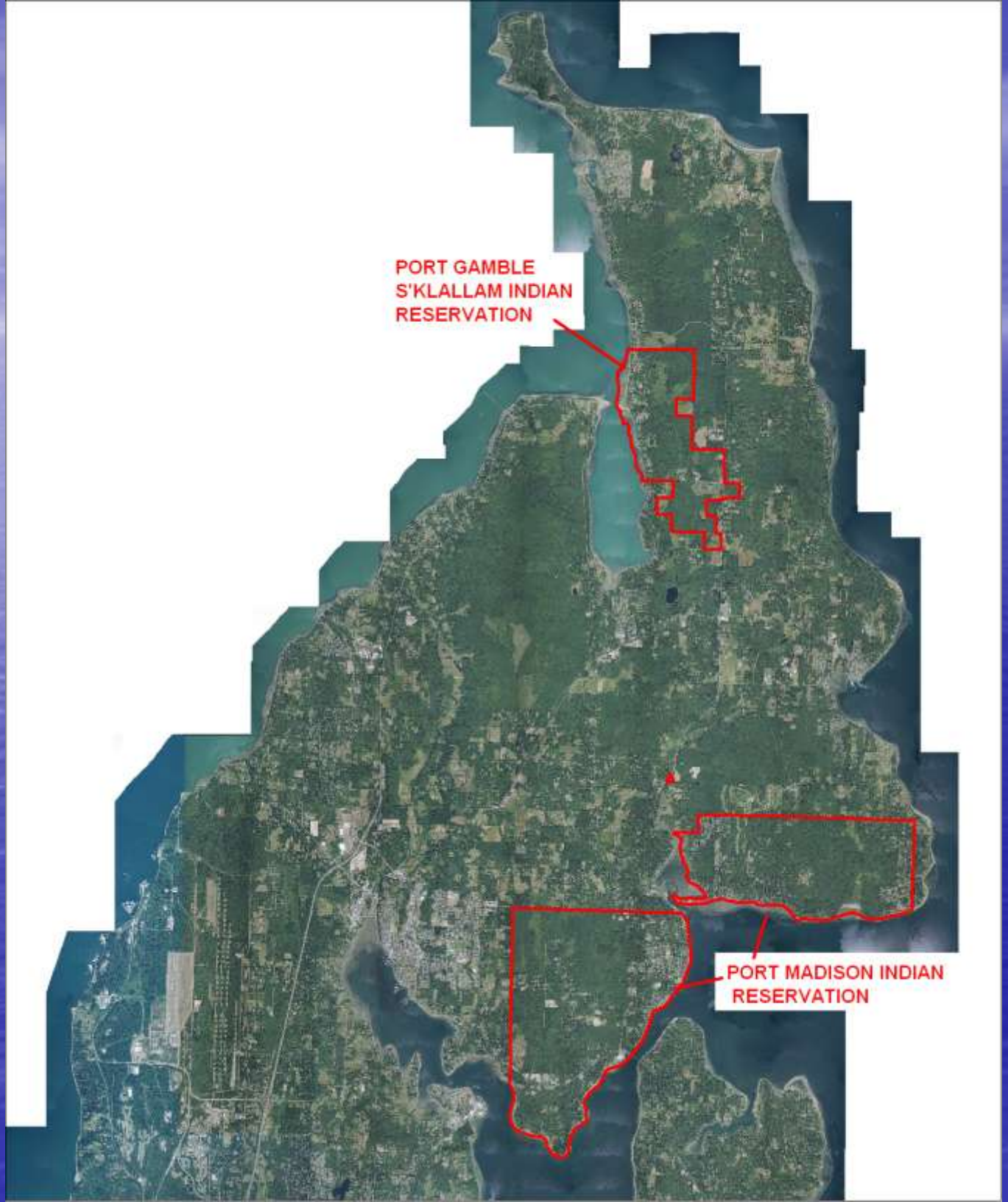
- Point Source Pollution (i.e., sewer outfalls)
- Non-Point Source Pollution (i.e., septic systems, storm water runoff, etc.)
- Rapid Development of Lands in Watersheds
- WA State MTCA & Other Toxic Sites
- Climate Change, both Management & Adaptation
- Ocean Acidification

Examples of Tools Used to Document the Resource

- Desk-top GIS (MapInfo, ArcGIS)
- GPS (Trimble, Magellan, Garmin)
- Hydrolab & YSI Multi-Parameter Water Quality Probes & Analytical Laboratory Services
- Geologic Software (Rockware, etc.)
- Flow meters
- Remotely Operated Vehicle (ROV)
- Electronic Data Node for Upload/Download of Water Quality Data to STORET/NWIS systems

Initial Basic Water Resource Mapping Data Collection

- Streams
- Wetlands
- Water wells with geologic logs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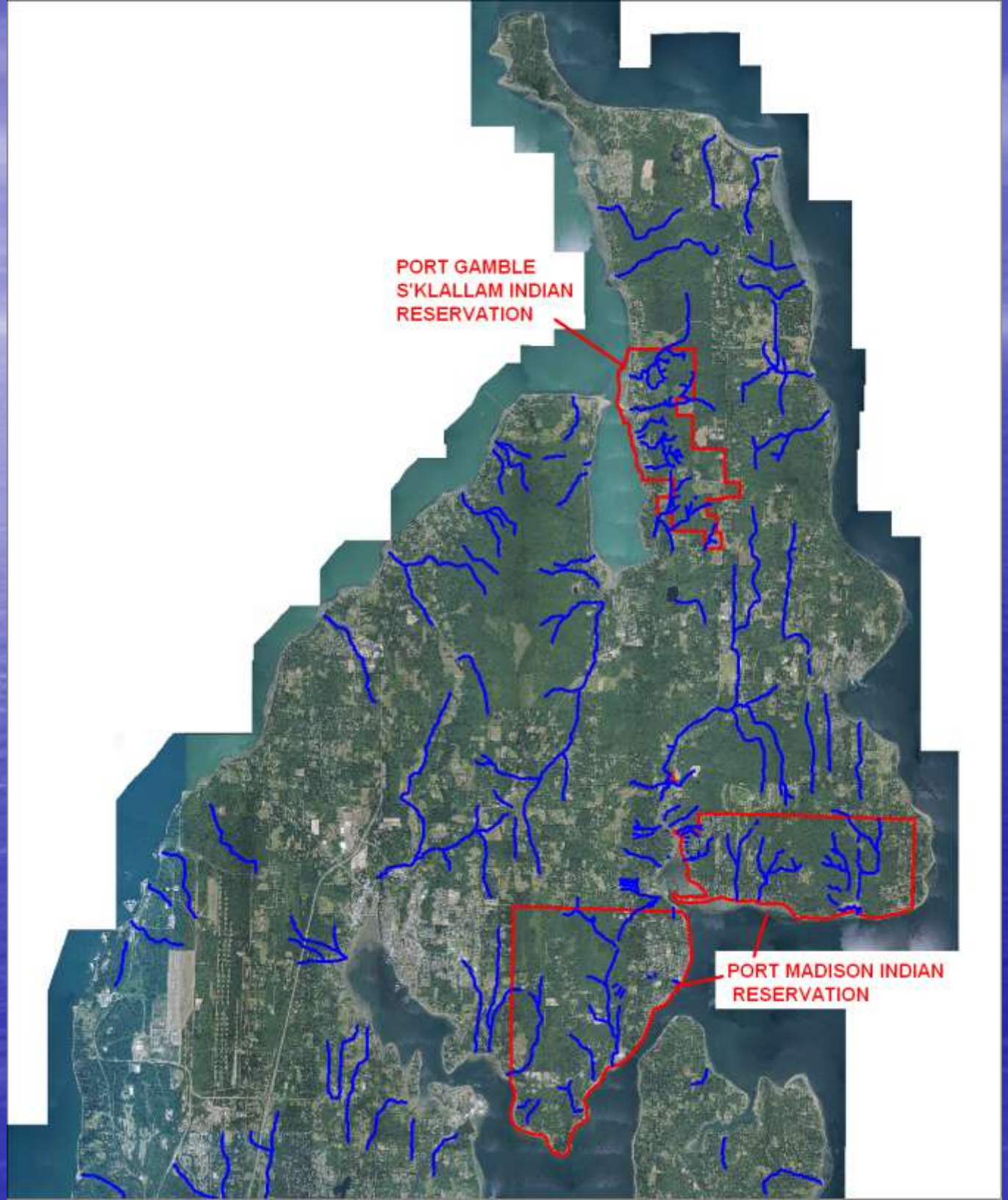
S'KLALLAM INDIAN
RESERVATION
PORT MADISON INDIAN
RESERVATION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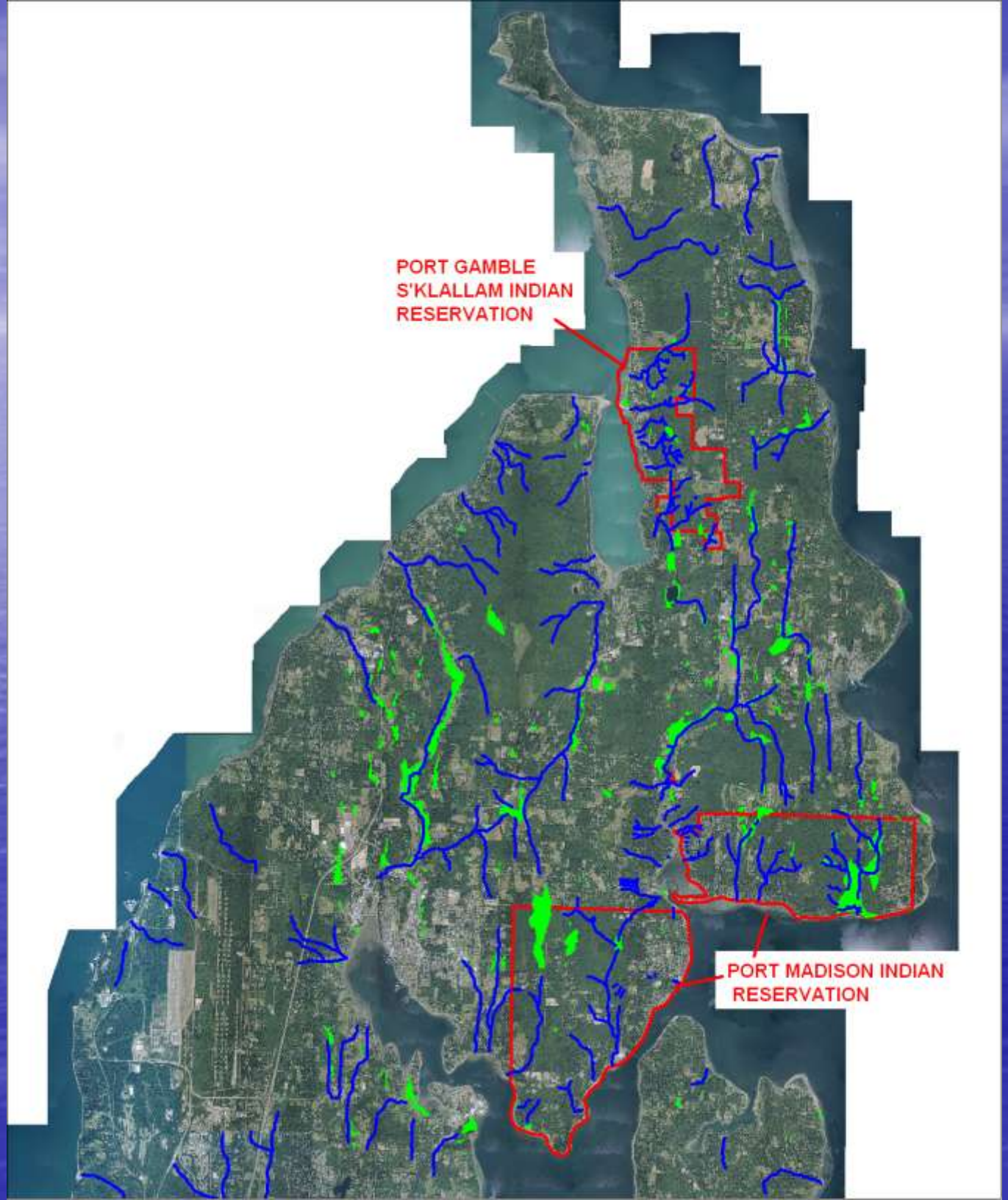
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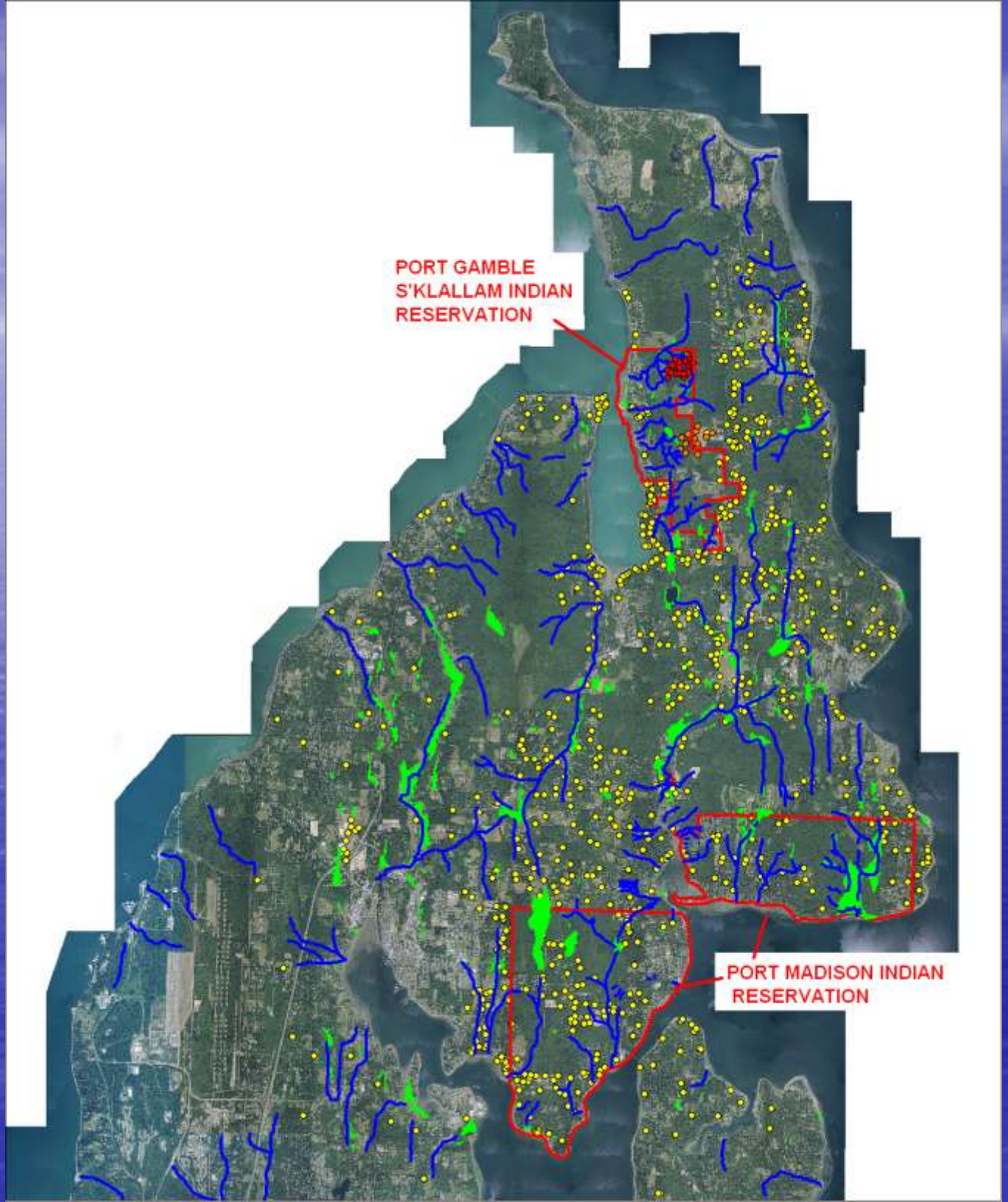
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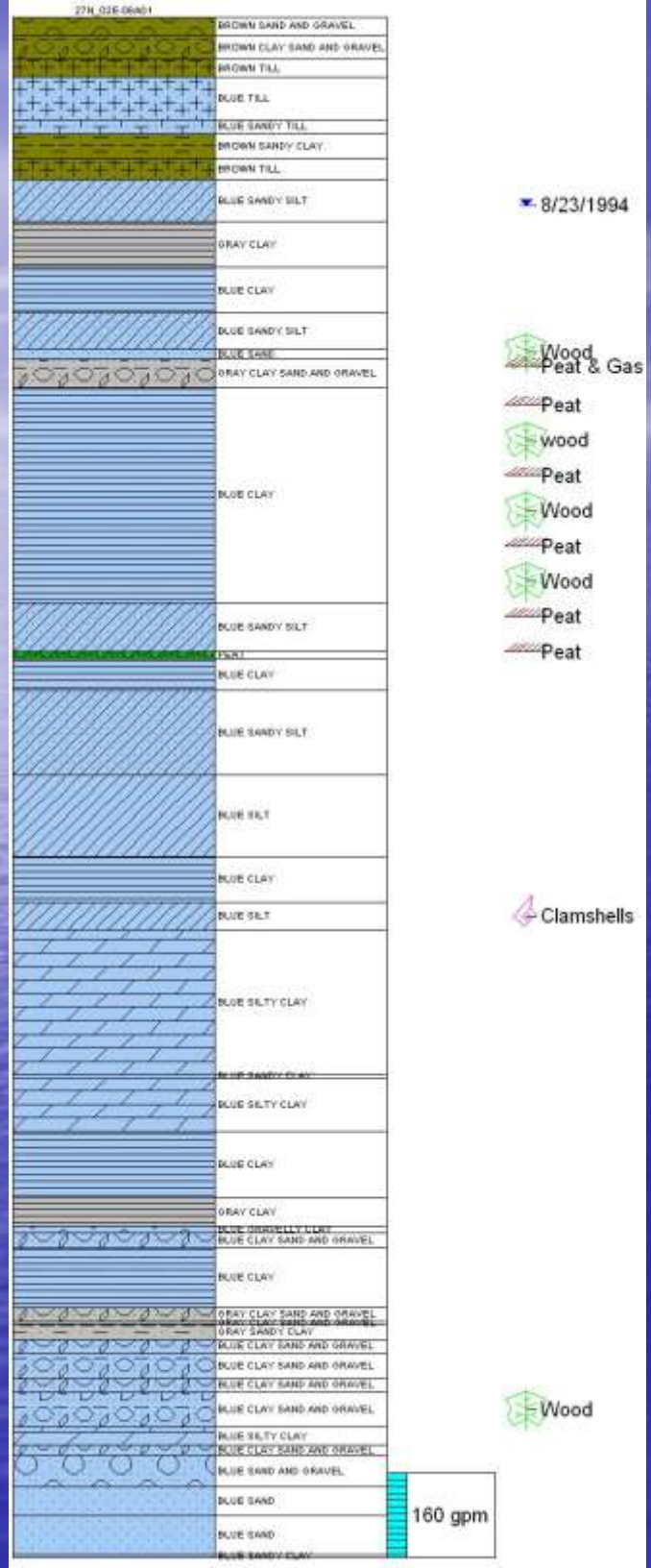

- Sample water well geologic log:
- Includes sediment types encountered
- Water level of production horizon
- Pumping rate of aquifer
- Additional characteristics (i.e., peat, wood fragments, shells, etc.)

Port Gamble S'Klallam Tribe Toxic Sites of Immediate Concern

- Hansville Landfill
- Pope & Talbot Mill Site
- Port Gamble Bay Sediments from 150 years of mill, wood waste and toxic contamination

Hansville Landfill

- Unlined landfill in vadose zone of an unconfined sand aquifer
- Chemicals of concern (in groundwater): Vinyl Chloride, Arsenic and Manganese
- Groundwater discharges to surface waters
- Shellfish beds in Port Gamble shoreline


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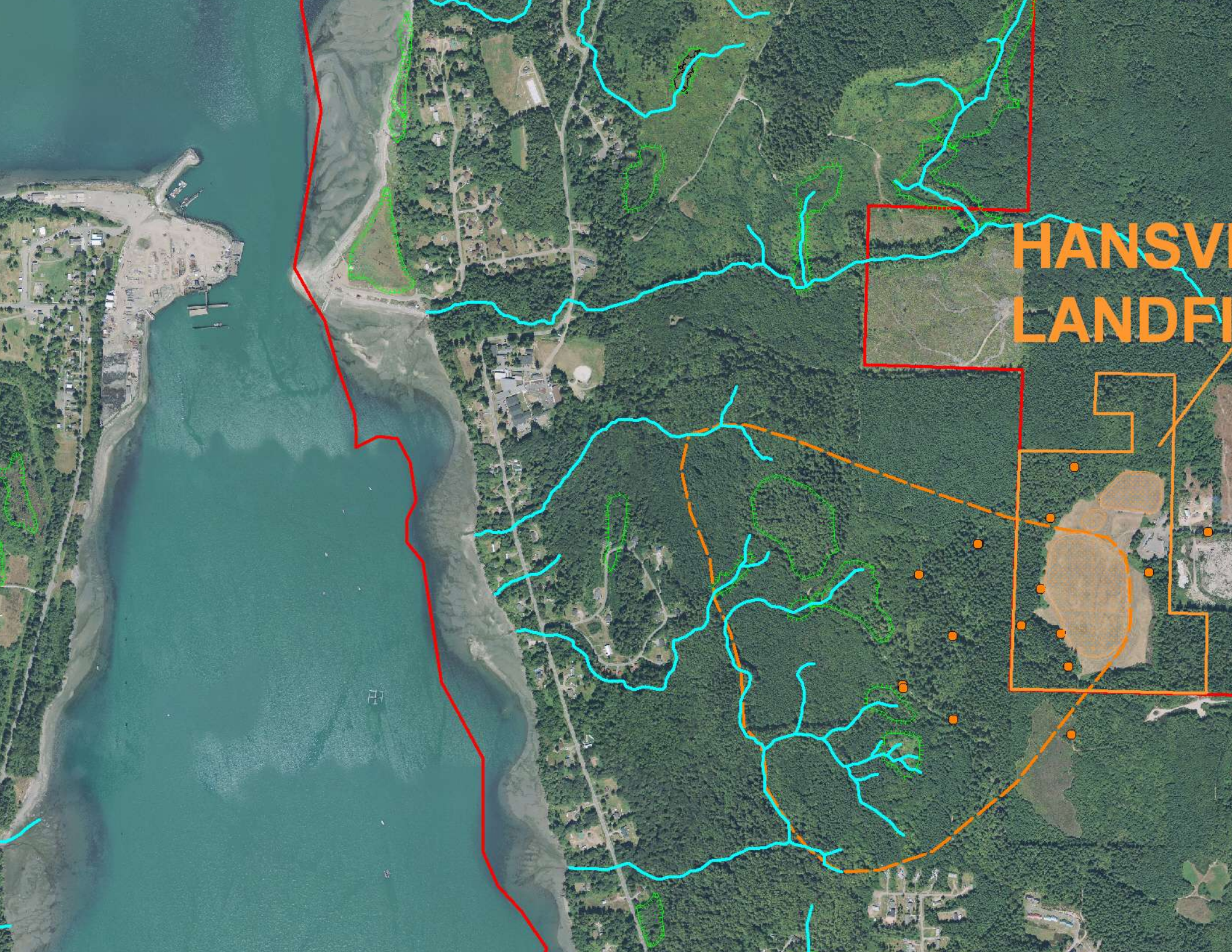
LANDFI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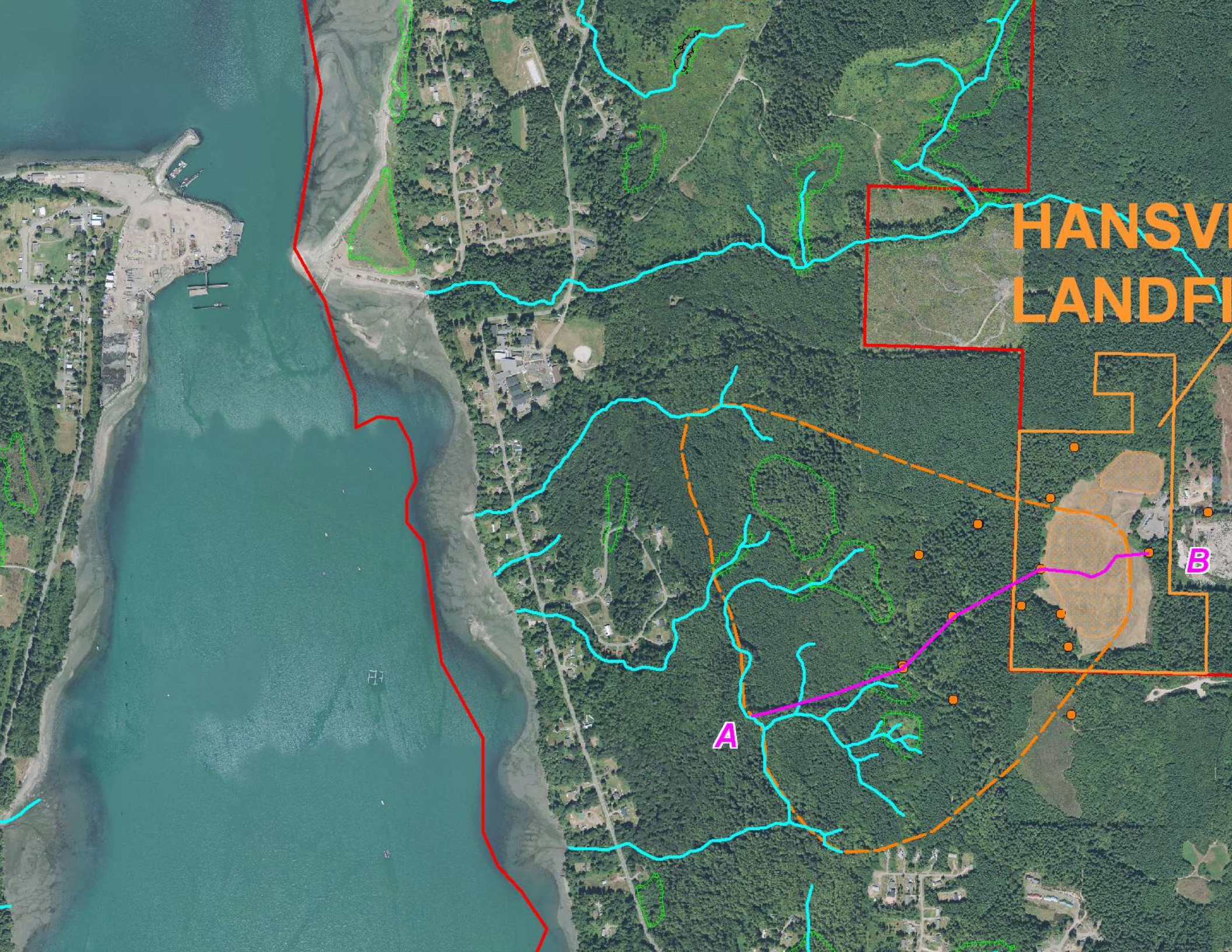
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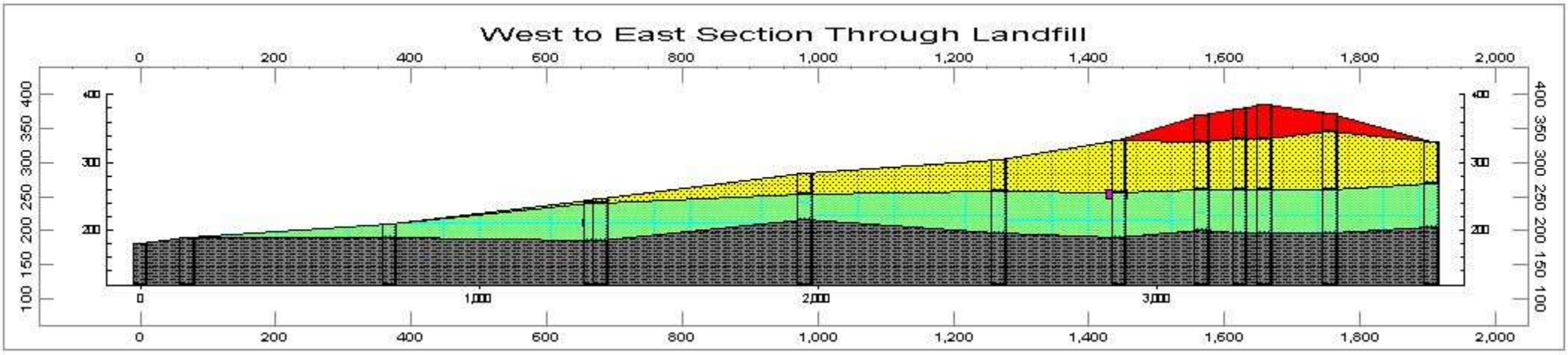
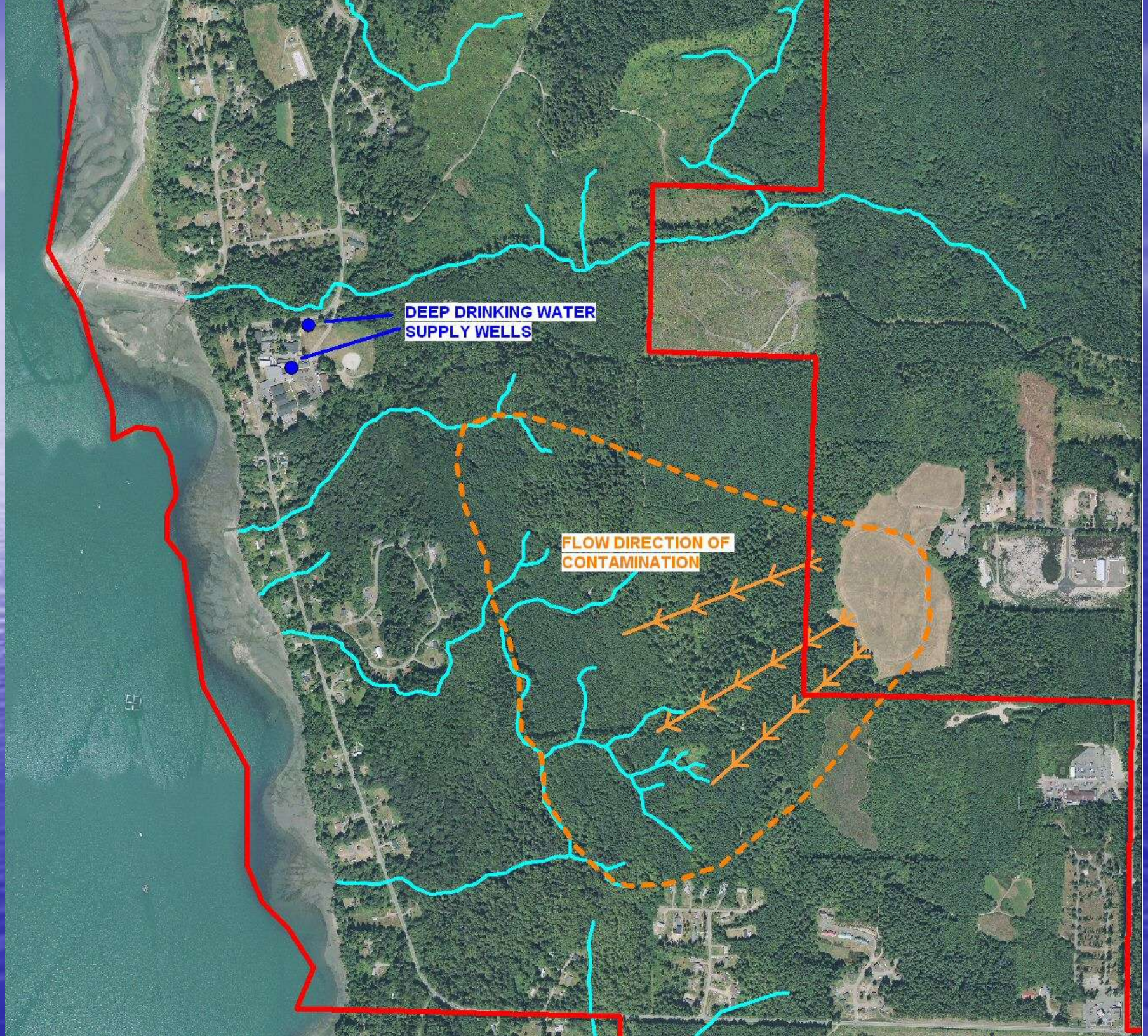

West to East Section Through Landfill
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
100 150 200 250 300 350 400
400 350 300 250 200 150 100

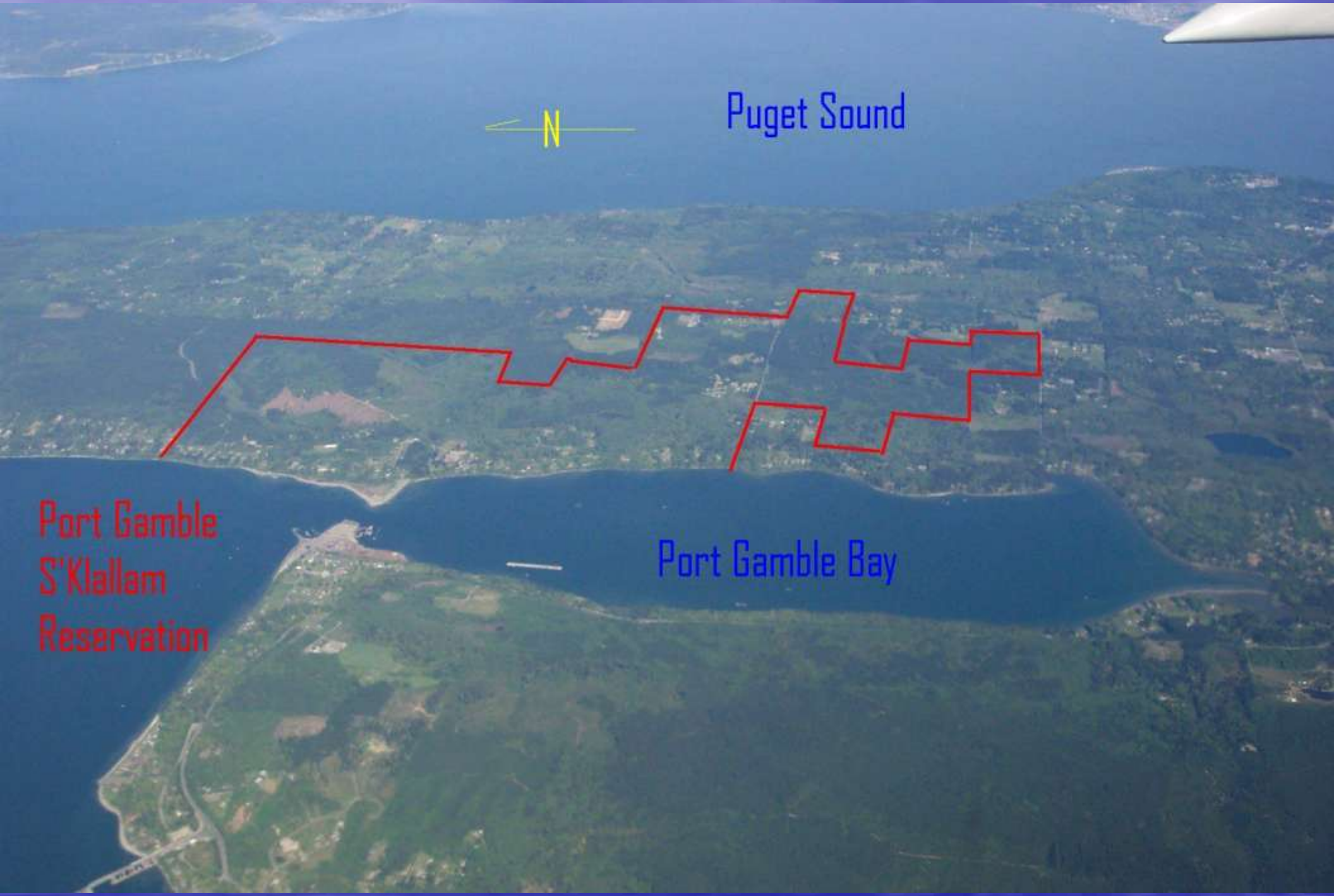

DEEP DRINKING WATER
SUPPLY WELLS
FLOW DIRECTION OF
CONTAMINATION

Tribal Surface Water Quality Standards

- Port Gamble S'Klallam developed Federally approved surface water quality (SWQ) standards, as State standards do not apply to Reservation Lands
- The SWQ standards had the fastest Federal approval of Tribal WQ standards to date
- At time of approval the SWQ standards had the highest fish consumption values in the country (currently second highest).
- Water quality standards drive human health risk assessments

Tribal Monitoring, Analysis and Collaborative Activities

- Surface water quality monitoring
- Marine water monitoring in Port Gamble Bay and Northern Hood Canal
- In-Stream Flow monitoring
- Watershed Planning Processes, including the Puget Sound Partnership
- State MTCA site review and monitoring


N
Puget Sound
Port Gamble
S'Klallam
Reservation
Port Gamble Bay

Point Julia looking across to the Pope & Talbot Mill 1907

Point Julia looking across to the Pope & Talbot Mill Site 2004

“When the tide is out, our table is set”

Pope & Talbot Mill In Water Issues

- Up to 18 feet of woody debris
- Woody debris contains some of the highest toxic chemical hits within the thickness of material
- By products of woody debris degradation
- Dioxins and related compounds
- Metal debris

Pope & Talbot Saw Mill Low Tide

Sediment Profile Imaging (SPI) The First Look

General benthic habitat quality:

- Wood Waste
- Dissolved Oxygen
- depth of the apparent redox potential
- sedimentary methane
- infaunal successional stage

SPI Percent Wood Waste

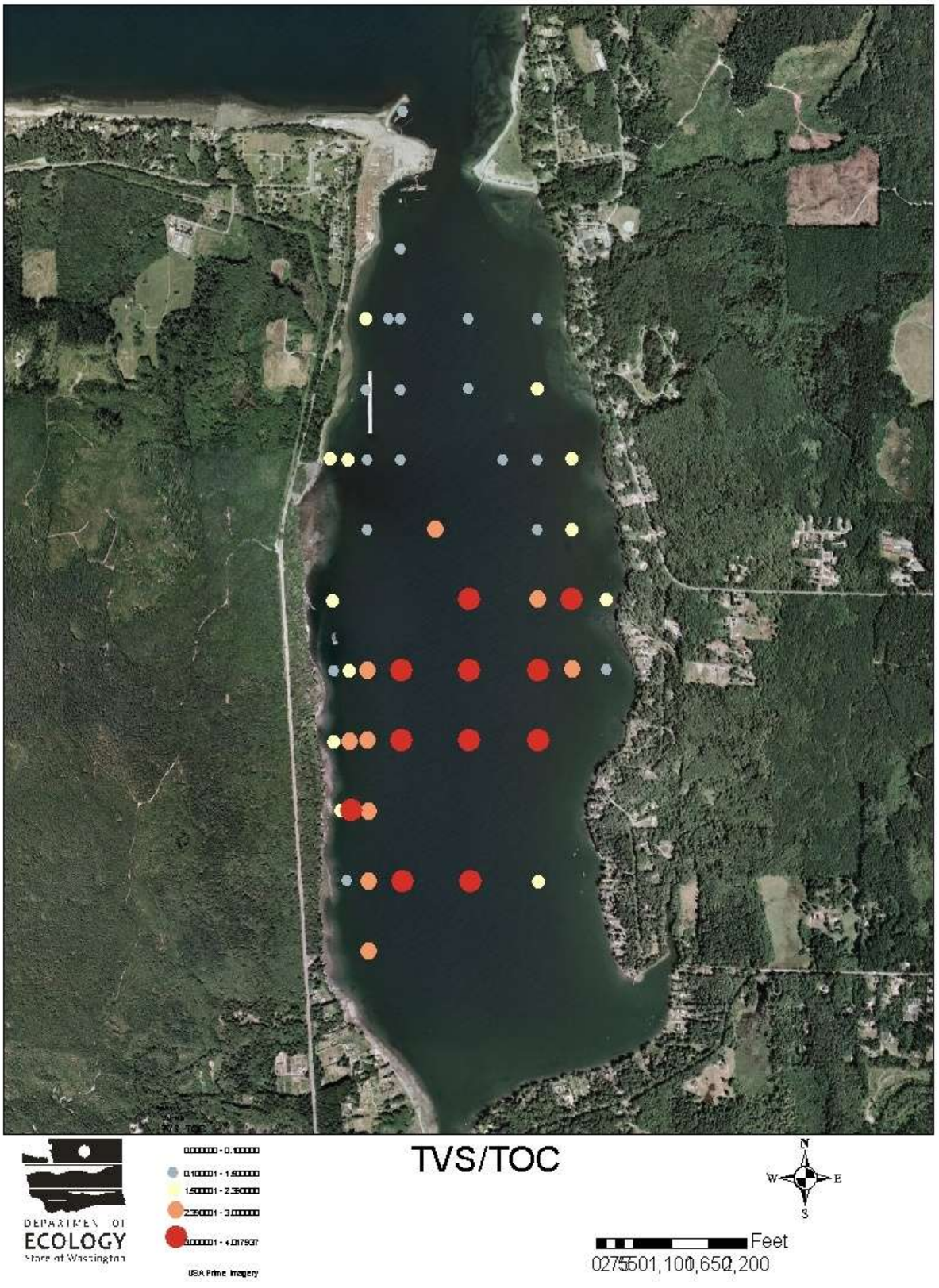
- 0%
- 0-5%
- 5-15%
- 15-30%
- 30-50%

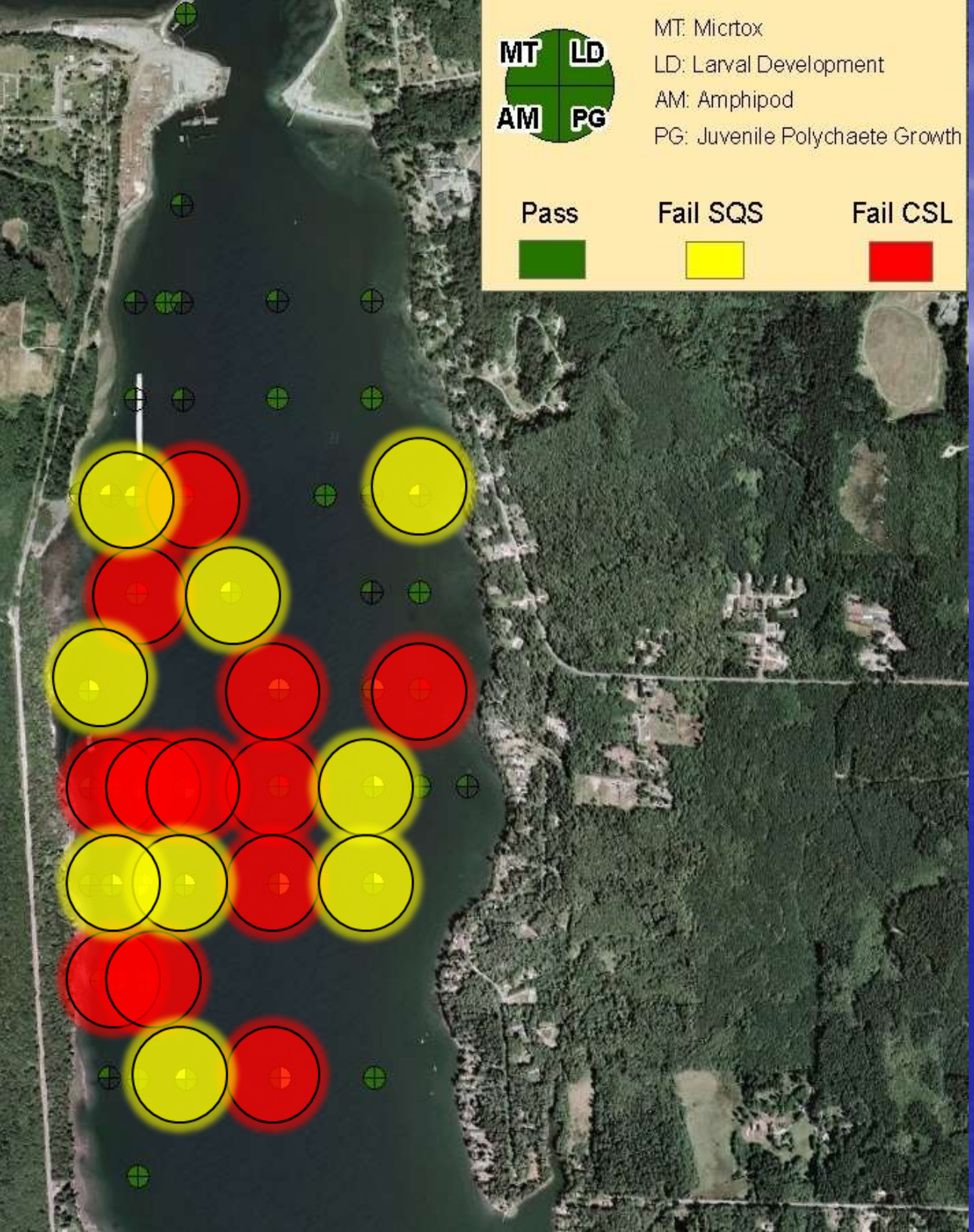
Port Gamble Bay Sediment Sampling Sites

Chemistry Results

Conventionals

- Sulfide
- TVS/TOC



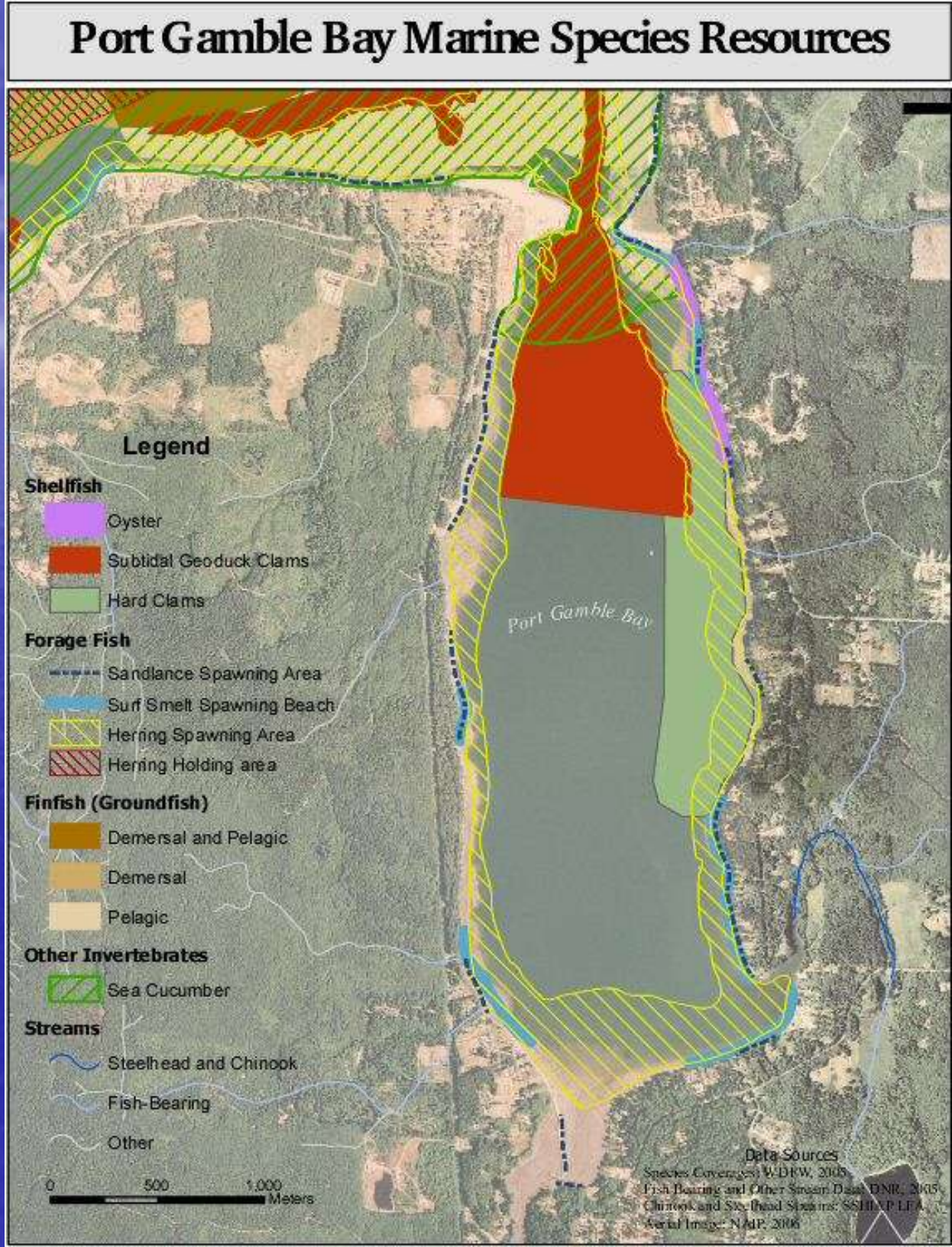


Biological Toxicity Testing

- 31 Stations
- 50 Microtox

- 12 CSL Hits

Map of the Biological Diversity that contributes to Port Gamble Bay as a Priority 1 "Clean up contaminated sites and sediments" of the Puget Sound Partnership



Human Health Concerns

- Finned Fish and Shellfish subsistence consumption
- Methodology of assigning risk
- Implications to individual Tribal Members
- Opportunities to reduce risk, while limiting impacts to the community and culture

EVALUATING RELATIVE RISK FROM MULTIPLE CHEMICALS IN SINGLE SPECIES

EXAMPLE CALCULATIONS FROM EPA NATIONAL GUIDANCE DOCUMENTS

Paul McCollum, Port Gamble S'Klallam Tribe

ABSTRACT

The following example calculations are to help demonstrate how best to review carcinogenic dietary limitations for all combined chemical contaminants based on available contaminant levels reported for a given species by using EPA's "Guidance for Assessing Chemical Data for Use in Fish Advisories, Volume 2, Risk Assessment and Fish Consumption Limits, Third Edition", November 2000 (herein referred to as "Guidelines"). The formula's and example text needed can be downloaded at: http://www.epa.gov/waterscience/fishadvice/volume2.with specific information from Volume 2, chapter three. These Guidelines provide tables for calculating carcinogenic and non-carcinogenic health endpoint based dietary limits for single chemicals in single species and further provide formulas for multiple chemicals in a single species. The first step is to convert all tissue concentration data to parts per million or mg/kg. Input the Risk Factors from Table 3-1 on page 3-3 or other sources (ATSDR, WHO etc.) for cancer slope factors (CSF). You can also run separate calculations for chronic impacts using the appropriate **reference doses for** (RfD) for each chemical of concern (COC). The combined chemicals in a single species formula (formula 3-10 on page 3-17) is the formula for calculating carcinogenic effects used in this paper. Calculations assume an average 70 kg adult size.

INTRODUCTION

- When eating fish and shellfish, we don't have magic tweezers to pull out specific chemical molecules to eat. We eat the flesh and ingest the nutrients along with any and all contaminants persisting in whatever portion(s) of the flesh we ingest.
- Expensive and time consuming studies can be done for "off the plate" as well as more generalized tribal fish consumption studies for risk analysis. These studies, when done correctly, can provide much more accurate exposure risk estimates and are certainly worth doing when resources allow.
- When there is enough data on contaminant levels in various fish and shellfish species of interest, anyone can reasonably calculate risk for single chemicals in each species they consume using the tables referred to above and more importantly, can calculate the boundaries of exposure for multiple chemicals in each species.
- This provides a relatively quick and easy process for calculating how many meals at a given size (6 oz, 12 oz etc.) can be "safely" eaten per month or year given a chosen risk level (1/10,000, 1/100,000 or 1/1,000,000).
- The examples listed here are for Dungeness Crab in outer Hood Canal and one stock of Puget Sound Chinook. Better data sources are likely available but these data are used here to demonstrate the formula's and results of the calculations.

Dungeness Crab Values

A recent analysis of Dungeness crab (small limited study) in outer Hood Canal resulted in the following chemical detections except that Dioxin values are half of the MDL (values in ppm):

Arsenic = 7.0; Cadmium = 0.04; Chromium = 0.1; Copper = 8.65; Dioxin/Furans = 0.0000004; Lead = 4.0; Methylmercury = 0.047; Silver = 0.19 and Zinc = 0.502.

Chinook Values

These data are from a 2008 paper "Persistent Organic Pollutants In Chinook Salmon (Oncorhynchus Tshawytscha): Implications For Resident Killer Whales Of British Columbia And Adjacent Waters" for organics and "Toxic Contaminants In Marine And Anadromous Fishes From Puget Sound, Washington Results Of The Puget Sound Ambient Monitoring Program Fish Component, 1989-1999" for a local puget sound chinook stock (organics as sums).

Arsenic = 1.03; Chlordane = 0.00475; Copper = 0.7; DDT = 0.01831; Dieldrin = 0.00075; Dioxin/Furans = 0.0000021; Endrin = 0.00038; Heptachlor Epoxide = 0.00028; Hexachlorobenzene = 0.00215; Lead = 0.03; Methylmercury = 1.02; Mirex = 0.00006 and PCB's = 0.03461 and PBDE's = 0.00643

$$CR_{COM} = \frac{ARL \cdot BW}{\sum_{j=1}^{N} (C_{SM} \cdot P_j) \cdot CSF} \qquad (3\text{-}10)$$

where

- CR_{COM} = maximum allowable fish consumption rate (kg/d)
- ARL = maximum acceptable lifetime risk level (unitless)
- BW = consumer body weight (kg)
- C_{SM} = concentration of chemical contaminant m in fish species j (mg/kg)
- P_j = proportion of a given species in the diet (unitless)
- CSF = cancer slope factor, usually the upper 95 percent confidence limit on the linear term in the multistage model used by EPA ([mg/kg-d]$^{-1}$).

CALCULATIONS

- Note example 11 on page 3-22 and 3-23 and print out for reference
- Start on page 3-16 under section 3.4.1 (Carcinogenic Effects) and use equation 3-10
- Multiply each COC times its associated CSF and then sum them all up
- Select the maximum acceptable lifetime risk (1/1,000,000) used here, and avg. weight of target human population (70 kg) used here
- The result in maximum allowable kg/day consumption (CR_{COM}) is
  - Hood Canal Crab = 0.0041818 kg/day @ 1/1,000,000 cancer risk
  - Puget Sound Chinook = 0.00035490 kg/day @ 1/1,000,000 cancer risk

$$CR_{COM} = \frac{CR_{COM} \cdot T_{AT}}{MS} \qquad (3\text{-}9)$$

where

- CR_{COM} = maximum allowable fish consumption rate (meals/mo)
- CR_{COM} = maximum allowable fish consumption rate (kg/d)
- MS = meal size (0.227 kg fish/meal)
- T_{AT} = time averaging period (365.25 d/12 mo = 30.44 d/mo).

CALCULATIONS Cont'd

- Convert to 8 oz (.227 kg) meals per month by multiplying the kgs/day by 30.44 (days per month) and then dividing by .227 (kgs in 8 ounce meal) based on equation 3-2 on page 3-5
- The result in maximum allowable kg/day consumption is:
  - Hood Canal Crab = 5.61 meals per month at 1/100,000 cancer risk and 0.0561 meals per month (0.67 meals per year) at 1/1,000,000 cancer risk
  - Puget Sound Chinook = 0.476 meals/month (just under half a meal) at 1/100,000 risk and 0.00476 meals/month (0.0571 meals per year i.e. unsafe to eat) at **1/1,000,000 cancer risk**

RESULTS – Hood Canal Crab Meals per Month Limit

- **5.61 meals per month at 1/100,000 cancer risk**
- **0.67 meals per year at 1/1,000,000 cancer risk**

RESULTS – Puget Sound Chinook Meals per Month Limit

- **0.476 meals per month at 1/100,000 cancer risk**
- **0.057 meals per year at 1/1,000,000 cancer risk**

SUMMARY

- Multiple chemicals in any species consumed will always have additive effects in both carcinogenic and chronic impacts.
- Calculating relative risk regarding the allowable number of meals per month is important for those wanting to insure a given species that is regularly consumed is "safe" based on all combined chemicals with available cancer slope factors (CSF) for carcinogenic risk and similarly for chemicals with available reference doses (RfD) for chronic health impacts.
- The dietary limitation calculations in this paper were only from carcinogenic risk and chronic health impacts would need to be added for a more complete dietary health analysis. These formula's are also provided in the EPA Guidelines document.
- Full sets of these dietary limitation calculations should be run for both carcinogenic and chronic health impacts for each species by stock where data is available.

CONCLUSION

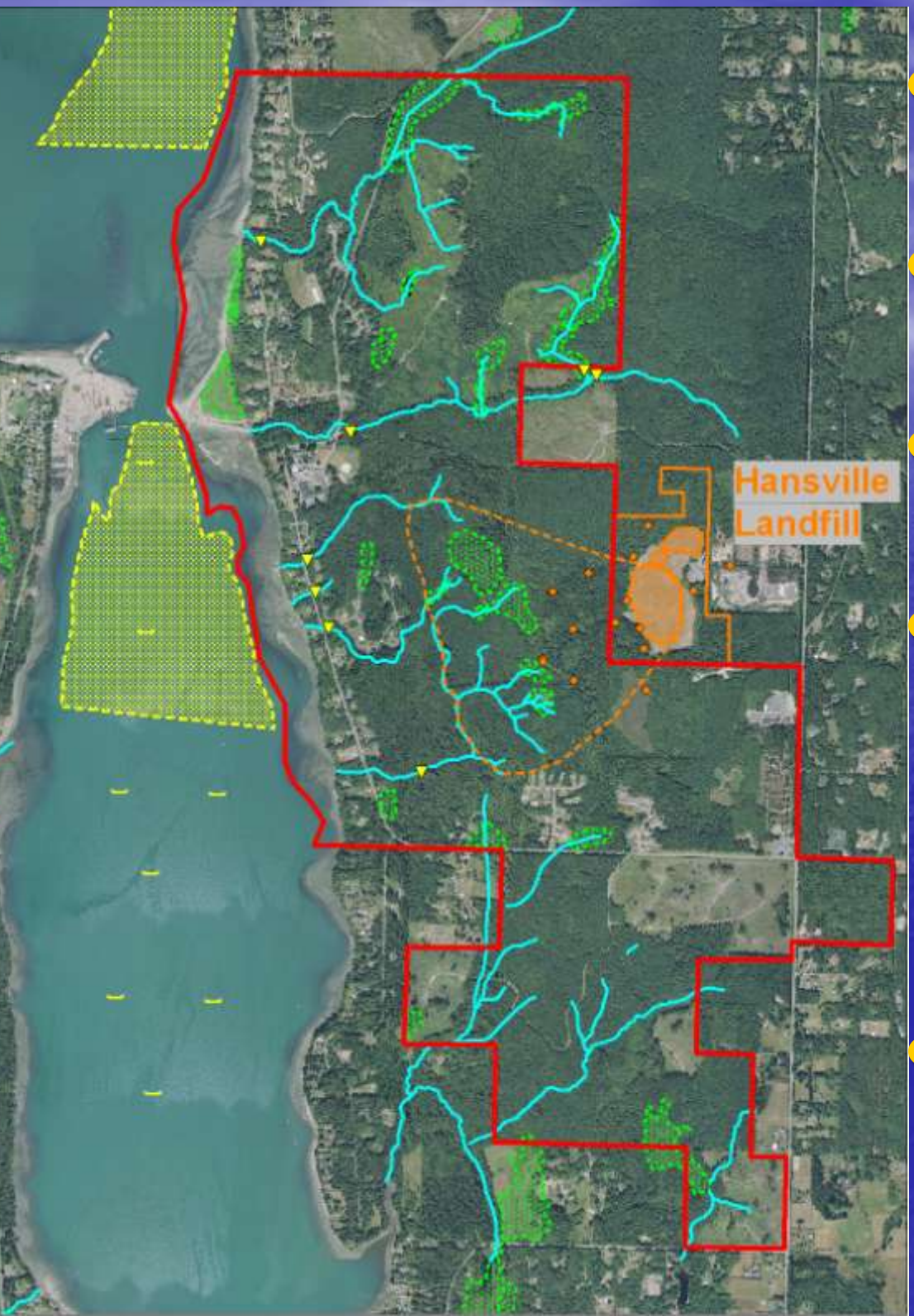
All of these dietary limitations get down to a persons willingness or unwillingness to expose themselves to potential risk as well as to cross-check all available food sources to see what appears to be the safest and most healthy. The other side of this issue is that current levels of contaminated tribal subsistence and commercial fish and shellfish are clearly outrageous and should never have become contaminated to any significant level of potential health threat. This in itself needs to be hoisted up as a giant red flag to challenge and potentially minimize the massive point and non-point source discharges regulatory officials are allowing into these once pristine Puget Sound waters.

REFERENCES

1. EPA, 2000, Guidance for Assessing Chemical Data for Use in Fish Advisories, Volume 2, Risk Assessment and Fish Consumption Limits, Third Edition.
2. Cullon et. al, 2008, Persistent Organic Pollutants In Chinook Salmon (Oncorhynchus Tshawytscha): Implications For Resident Killer Whales Of British Columbia And Adjacent Waters, Environmental Toxicology and Chemistry, Vol. 28, No. 1, pp. 148–161, 2008
3. Watt et. al, 2001, Toxic Contaminants In Marine And Anadromous Fishes From Puget Sound, Washington Results Of The Puget Sound Ambient Monitoring Program Fish Component, 1989-1999
4. WDOH, 2006, Human Health Evaluation of Contaminants in Puget Sound Fish

Examples of Current and Formative Partnerships

- Fish Consumption and Human Health Risk – UW Dept of Environmental Health and Center for Public Health Informatics
- Traditional environmental knowledge - CWU
- HCDOP sampling and monitoring - UW
- Geological mapping of north Kitsap Co - USGS
- Groundwater modeling of the Kitsap Peninsula - Kitsap PUD No. 1/USGS
- Fisheries habitat and restoration – PNPTC/ NWIFC
- Climate Change – USEPA
- Hood Canal LDO Biota – HCSEG, HCCC, WDFW
- Hood Canal Intensive Fresh Water Monitoring – HCSEG, LLTK
- Puget Sound Biota - NOAA



- CWA fishable & swimable
- Finfish habitat and migration
- Subsistence gathering of shellfish
- 4.4 million pounds of commercial geoducks (shared management with the State of Washington)
- Traditional wetland plants for food and crafts

QUESTIONS?

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