DEPARTMENT OF
ARCHAEOLOGY &
HISTORIC PRESERVATION
Protect the Past. Shape the Future

Allyson Brooks Ph.D., Director
State Historic Preservation Officer

November 18, 2013

Ms. MBTL Coal Export Terminal
MBTL Coal Export Terminal EIS
C/o ICF International
710 Second Ave., Suite 550
Seattle, WA 98104

In future correspondence please refer to:
Log: 110413-50-CW
Property: Cowlitz County Revised SEPA Determination of Significance & Request for Comments on Scope of EIS for Millennium Bulk Terminals Longview LLC Coal Export Terminal Revised
Re: Cultural Resources

We are contacting you regarding the EIS scoping for the proposed Millennium Bulk Export Terminal Project, Longview, Cowlitz County, Washington.

We request that archaeological and historic resources be clearly identified and addressed in the proposed Environment Impact Statement. The scope of this project is quite large and there have previously been no thorough surveys of the project area or sufficient cultural resources survey efforts to identify the presence of archaeological and/or cultural resources. The Millennium Bulk Terminal project area has a high probability for containing cultural resources as depicted by the Statewide Predictive Model (see Figure 1). The Coffin Hills Site 45CW3 is approximately 2,700 feet from the proposed bulk terminal (Figure 2). Over 3,000 Native American burials were identified at this site in 1948. Although anecdotally these burials were removed, no information exists that corroborates this story. No precise information exists on the dimensions of the 45CW3 and it is possible that it may extend into the terminal project area. The proposed dredging is troubling from our standpoint based on the proximity of 45CW3 in conjunction with the historically fluctuating water levels.

We understand that the scope of the proposed EIS identifies the study area to include only the actual terminal facility itself and associated areas within the river to be dredged. We disagree with this approach. There are clearly identifiable and reasonable foreseeable effects of the Millennium Bulk Export Terminal Project that indicate a greatly expanded geographic scope which would include rail routes and seaward carriers.

A reasonably foreseeable effect that requires an expanded geographic scope includes effects from the increased rail traffic, and coal cars that are proposed along the rail routes in Washington State. The scope of this project, and the associated train traffic, pose unique issues when developing the necessary cultural resource studies.

The geographic scope must include a consideration of the potential impact of the rail portion of the undertaking upon National Register listed or eligible historic districts, Main Street program communities, and those jurisdictions with local historic preservation programs (i.e. Certified Local Governments).

Local preservation programs may have locally designated historic properties along the routes and the potential socioeconomic impacts to these resources should be part of the analysis. Therefore, the EIS must include all communities bisected or traversed by the rail routes in Washington. Please see the attached Figure that documents the location of Historic Districts, Main Street Program Communities, and Certified Local Governments.

Panamax and Cape-sized dry bulk carriers along the Washington Coast and entering the Columbia River are clearly a reasonable and foreseeable effect of the Project that should create a seaward boundary of the EIS. The increased vessel traffic, associated wakes, waves, and shoreline erosion of these vessels and the increased risk of accidents, oil spills and damage all need to be considered.

Further considerations that should be within the EIS include construction of additional track right of way and spurs, direct and indirect effects of train traffic including vibration to historic structures, noise and traffic upon historic districts, and the impact to archaeological and historic properties due to derailments. Please see Figure that documents the location of archaeological sites and districts along the rail routes from Spokane to Longview.

Other considerations are the potential impacts from the Rail Safety Improvement Act of 2008. This Act mandates the requirement for Positive Train Control Technology (PTC) for high volume freight traffic with toxic hazardous materials. The needed infrastructure along the rail lines is a reasonably foreseeable effect of this project and should be included in the EIS. There will also be substantial coordination with federal agencies who oversee changes and upgrades to the rail lines. Will there be a lead federal agency for this undertaking or will all agencies conduct separate Section 106 consultations for this project?

These comments are based on the information available at the time of this review and on the behalf of the State Historic Preservation Officer. Should additional information become available, our assessment may be revised. Thank you for the opportunity to comment and a copy of these comments should be included in subsequent environmental documents.

Sincerely,

Gretchen Kaehler
Assistant State Archaeologist
(360) 586-3088
gretchen.kaehler@dahp.wa.gov

cc. dAVe Burlingame, Cultural Resources, Cowlitz Tribe
Richard Bellon, General Manager, Chehalis Tribe
Chris Jenkins, Regulatory Branch, Seattle District, Corps of Engineers
Allyson Brooks, SHPO, DAHP
Rob Whitlam, State Archaeologist, DAHP

Figure 1: Archaeological Predictive Model for the Millennium Bulk Terminal Longview Project Area

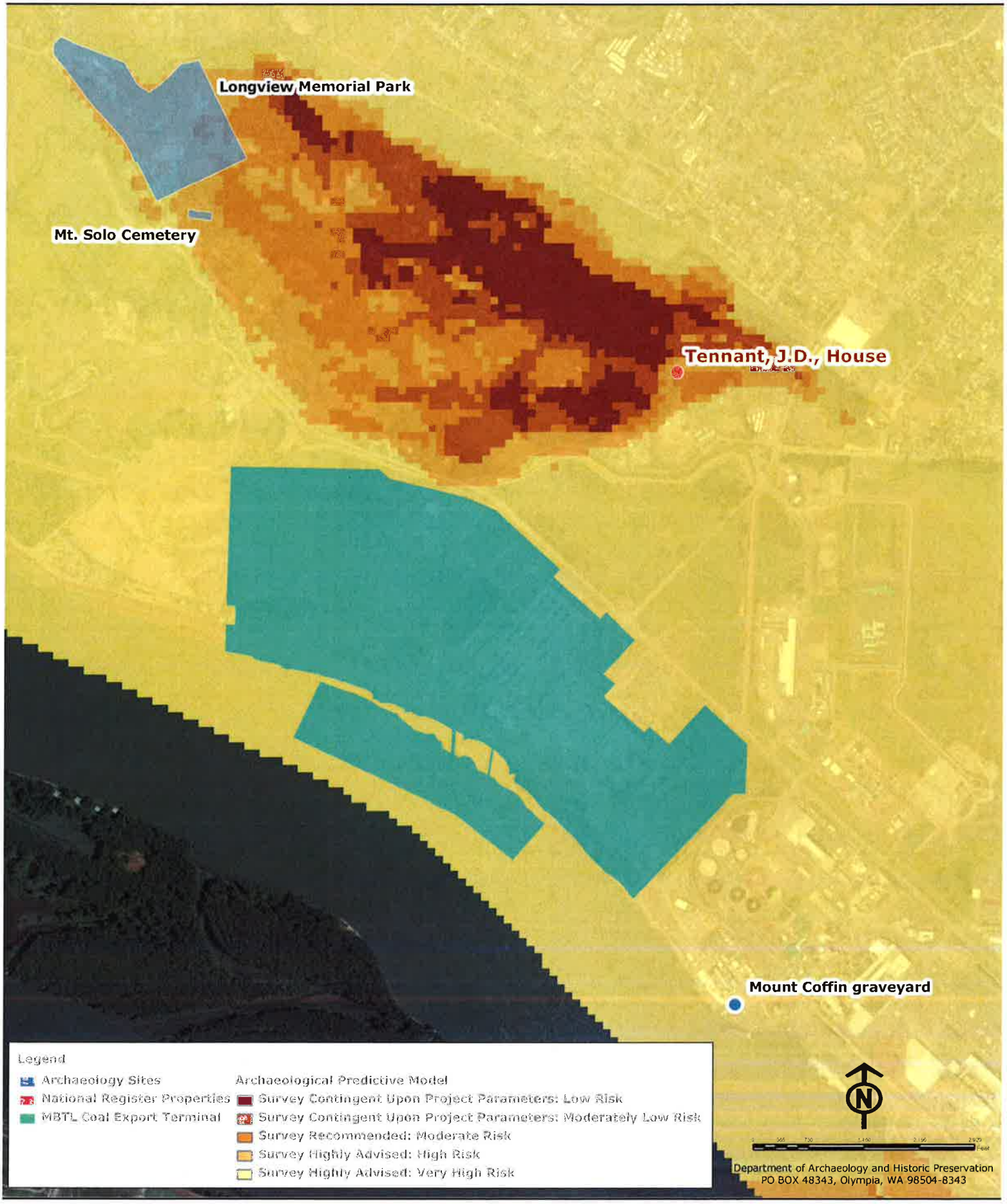

Figure 2: Cultural Resources within the Vicinity of Millennium Bulk Terminal Longview Project Area

Archaeological Sites, National Register properties, and Local Historic Preservation Programs on Rail Line Corridors

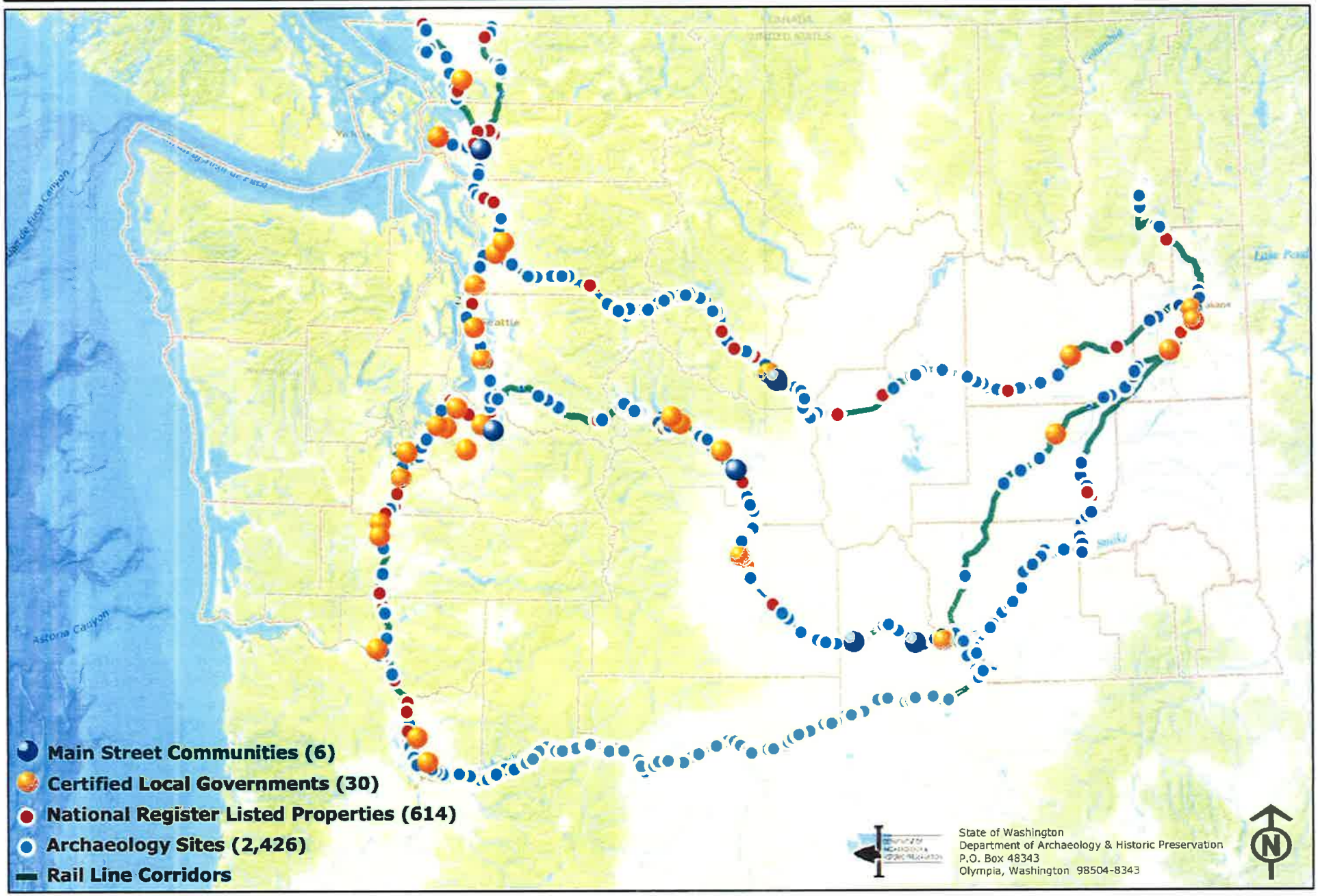

Figure 3

REQUEST FOR CHAIRMAN'S SIGNATURE

1. Department: Natural Resource Department

2. Program: Environmental Programs Office

3. Description of Correspondence Requiring the Chairman's Signature :
   A comment letter regarding the proposal to expand coal shipments through the Tribe's aboriginal territory and expand a coal shipping terminal in Longview, WA to ship U.S. coal to Asia.

4. Submission Deadline: November 18, 2013

5. If letter is one page include a copy of the contents of this letter.

6. If the letter is longer than one page, include letter reference and brief description of content on this page.

7. Sign Where Applicable:

- Originator Amy Anderson
  Program Tiffany Allsoul
- for Director _____
- Admin Dir _____

Please return this correspondence to:

Originator AA 11/14/13 Program NR-EPO Extension x 68802

This Form To Be Filed In The Administrative Director's Office

REFERENCE:

COEUR D'ALENE TRIBE

850 A STREET
P.O. BOX 408
PLUMMER, IDAHO 83851
(208) 686-1800 • Fax (208) 686-1182

Danette Guy
U.S. Army Corps of Engineers, Seattle District
Regulatory Branch
Southwest Washington Field Office
2108 Grand Boulevard
Vancouver, WA 98661

Mike Wojtowicz
Cowlitz County Department of Building and Planning
207 4th Avenue North
Kelso, WA 98626

Diane Butorac
Department of Ecology, Southwest Regional Office
P.O. Box 47775
Olympia, WA 98504October 31, 2013

Millennium Bulk Terminals-Longview EIS, c/o ICF International
710 Second Avenue, Suite 550
Seattle, WA 98104

November 8, 2013

RE: Coeur d'Alene Tribe's Comments on Millennium Bulk Terminals (MBTL) Longview, LLC's coal export terminal at Longview, in Cowlitz County, Washington Proposal

Dear Collective "Parties":

The Coeur d'Alene Tribe stands with the Affiliated Tribes of Northwest Indians (ATNI), The Confederated Tribes and Bands of the Yakama Nation, The Upper Columbia United Tribes, The Northern Cheyenne Tribe, The Nez Perce Tribe, The Confederated Tribes of the Umatilla Indian Reservation, The Lummi Nation, the National Congress of American

Indians, The Columbia River Inter-Tribal Fish Commission and others and is unequivocally opposed to the proposed Millennium Bulk Terminals (MBTL) Longview, LLC's coal export terminal at Longview, in Cowlitz County, Washington.

The Coeur d'Alene Tribe (Tribe) resides on the Coeur d'Alene Reservation in the panhandle of Northern Idaho. The Coeur d'Alene Reservation covers approximately 345,000 acres and spans the rich farming country of the Palouse to the western edge of the Northern Rocky Mountains. The Reservation encompasses the beautiful Coeur d'Alene and St. Joe Rivers and the lower half of Coeur d'Alene Lake itself. The Reservation is home to a vast number of native flora and fauna species that exist and thrive in the abundant habitat types found throughout the Reservation. The Tribe's aboriginal territory extends north to encompass the entirety of Pend Oreille Lake and east to the amazing mixed conifer woodlands of the Clark Fork River and the Bitterroot Range and as far south as the Clearwater mountains of north central Idaho .

The Coeur d'Alene Tribe is a sovereign nation and the sovereignty of Indian Tribes is *inherent* and has existed since time immemorial. Tribes were here many thousands of years before there was a United States or even an Idaho, Washington or Oregon. The sovereignty of Indian Tribes is recognized in the Constitution of the United States and Tribes have equal legal and constitutional status in their dealings with the U.S. federal government.

As such, Indian Tribes are considered collective owners, co-tenants of the public commons and are required in concert with the federal government to look after and uphold the public trust.[1] The Coeur d'Alene Tribe was entrusted by the Creator to be the caretaker of the Tribe's Reservation and aboriginal territory of over 5 million acres. Native peoples are considered "stakeholders" in the debate over the fate of public lands; indeed it is a fact that these federal "public lands" are the same lands that were appropriated from Native people by military force during the "Indian Wars" of the nineteenth century.[2] The public trust obligation represents the encompassing obligation of the government to government relationship that the Tribes entered into with the federal government when they originally ceded their lands into the public trust and were relegated to designated reservation lands.[3]

The trust framework is a promise by the federal government that the vast acres of ceded lands would always be protected and it is the principal of the public trust that the federal

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[1] Mary Christina Wood, *Natures Trust: Environmental Law for a New Ecological Age*(Cambridge University Press 2013)

[2] Rebecca T. Tsosie, *Conflict between the Public Trust and the Indian Trust Doctrines: Federal Public Land Policy and Native Indians*, 39 Tulsa L. Rev. 271 (2003)

[3] Mary Christina Wood, *Indian Land and the Promise of native Sovereignty: The Trust Doctrine Revisited, 1994 Utah L. Rev. 1471, 1504.*

government is required to maintain these resources in perpetuity for the public use. Further, the trust equates to a legal obligation that where a project harms Indian and or public lands the federal government *must* protect these lands. This moral and contractual obligation is supported by indisputable legal and constitutional authority.[4]

The Coeur d'Alene Tribe is exercising its Tribal co-management authority/co-tenant/co-trustee rights and maintains that the proposed coal export terminals in Longview, Bellingham and Belleview Washington would be a violation of the public trust and constitute the unwise stewardship of common resources. The proposals to dramatically increase the number of coal trains (currently 2-6 trains per day to 18 plus) running through the Tribe's aboriginal territory will lead to damages from coal dust and potential train derailments with the consequential ill effects on human health, as well as contamination of the natural, environmental and cultural resources of the Coeur d'Alene Tribe and the people of the inland Northwest. The Coeur d'Alene Tribe retains rights on federal lands within the Tribe's aboriginal territory.

The Coeur d'Alene Tribe has witnessed the devastation of the legacy of mining impacts on the Coeur d'Alene Basin from irresponsible mining activities for over a century. Historic mining activities have left area ecosystems tattered and native wildlife populations poisoned and in decline. In an effort to restore these critical ecosystems and wildlife populations the Tribe is heavily involved in the Basin-wide clean-up of historic mining related contamination. The Tribe, as co-Trustee to natural resources, is also at the forefront of developing a basin wide Restoration Plan to restore those natural resources that were found injured due to the release of mining related heavy metals. As the original stewards of Coeur d'Alene Lake the Tribe understands and realizes that any more contamination to area ecosystems from the mining, transport and potential coal train derailment and spill of coal would imperil native ecosystems and wildlife potentially beyond human kind's ability to restore, replace, or rehabilitate.

Indeed, according to The International Union for Conservation of Nature (IUCN), more than a third (38%) of all species on the planet currently face possible extinction, natural ecosystems have declined by 33% and one-third of the planet's natural resources have been consumed. The Tribe understands the imminent threat to the very web of life that has sustained the Coeur d'Alene people for thousands of years is at risk and the best way to prevent possible ecological collapse is to prevent the increase in coal shipments through the Tribe's aboriginal territory.

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[4] *Documents of United States Indian Policy 7* (Francis Paul Prucha ed., 2d ed., U. Neb. Press 1990)

In *Lead Industries Association v Environmental Protection Agency*, the court held that 'Man's ability to alter the environment often far outstrips his ability to foresee with any degree of certainty what untoward effects these changes may bring.'[5] Accordingly, when an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.

If said proposal(s) is to be considered, the Coeur d'Alene Tribe calls for a *regional* Programmatic Environmental Impact Statement (PEIS) pursuant to the National Environmental Policy Act (NEPA) for all of the proposed export terminal applications in Longview, Bellingham and Belleview Washington. Stand-alone, disconnected studies at each site are not acceptable.

A PEIS is a comprehensive review of a series of projects with impacts that are significantly interrelated; programmatically, geographically, or environmentally. NEPA requires agencies to use this comprehensive method to review independent actions that have "cumulative" or "similar" impacts on an interrelated environment.[6] We urge your agency to carefully review what the law mandates regarding the comprehensive analyses required for regional, multifaceted plans of development involving several projects. For example, in *Kleppe v Sierra Club* the court held that "when several proposals for coal related actions that will have cumulative or synergistic environmental impact upon a region are pending concurrently before an agency, their environmental consequences *must* be considered together".[7]

In addition, federal statutes and executive orders recognize Tribal interests in protecting cultural resources and require consultation with Native nations and consideration of Native cultural interests as part of the agency process to undertake actions on federal lands.[8] These statutes and orders should be consulted by federal agencies concerned about the permissible scope of various land management activities.

As a lead federal agency, the U.S. Army Corps of Engineers (Corps) is charged with utilizing its "special competency" to make an informed decision on whether the applications for coal terminals in Longview, Bellingham and Boardman WA are part of a regional plan that is sufficiently programmatically, geographically, and environmentally interrelated to warrant a PEIS. Presently, your agency is reviewing the permits for the three proposed coal export terminals mentioned above and the Coeur d'Alene Tribe believes that these multiple coal

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[5] *See Lead Industries Association v. EPA* 647 F. 2d 1130 (D.C. Cir. 1980)

[6] See 40 Code of Federal Regulations (C.F.R.) § 1508.25

[7] *See Kleppe v. Sierra Club* 427 US 390 1976

[8] Francis Paul Prucha, *American Indian Policy in the Formative Years: The Indian Trade and Intercourse Acts*, 1790-1834, at 2 (U. Neb Press 1962)

terminals represent an undeniably interrelated plan to transform areas of the Pacific Northwest into a global hub for coal export.

The specific scope of analysis and prescribed contents of a regional PEIS should be determined through a full scoping process that includes public hearings around the region. The Tribe would like to further emphasize the federal government's duty under Executive Order 13175 to respect the "government to government" relationship[9] it has with Indian nations and actively consult with the Pacific Northwest Tribes including the Coeur d'Alene Tribe. The Tribe further requires direct mailings and/or emailings throughout the entire decision making process not only at the federal level but also at local (Cowlitz County) and state (Washington State Department of Ecology) levels.

The Coeur d'Alene Tribe would like the agencies to analyze, examine alternatives and propose mitigation for the projects' negative impacts on the following areas with specific consideration given (but not limited) to the effects coal mining, transport, shipping and burning would have on communities and the environment from 1) mine to rail, 2) rail to port, 3) port to plant and from 4) plant to the greater environment. Specifically the Tribe expects impacts analysis, alternatives and proposed mitigation activities during these four stages at each proposed coal export terminal to include (but not be limited to):

Environmental Justice

- How will ACOE, Cowlitz County Department of Building and Planning and the Washington State Department of Ecology ensure that area Tribes and other minority groups are not disproportionately impacted by the coal shipping terminal(s), mining, transport and shipping of Powder River Basin coal?

Human Health:

- What effects will coal dust and diesel fumes from trains, barges and ocean going vessels have on human health?
- After coal is burned what effects will mercury emissions have on Human Health?
- Will coal dust impact the food chain and harm animals (with special focus on fish species), including humans that eat these animals?

Tribal access to sacred and religious sites

- How will American Indian religious freedoms be ensured as well as impacted by the proposed coal shipping terminals?

[9] 65 Fed. Reg. 67249 9Nov 6, 2000)

Economic Analysis

- Who specifically benefits from coal shipments financially?
- Will the Pacific Northwest States see any direct tax revenue from these coal companies?
- Does it make sense from a national security perspective to ship American coal stocks out of the country as opposed to reserving this commodity for possible use in the U.S.?
- Does it make sense to provide unimproved and raw energy resources extremely inexpensively to an Asian market?
- With the known and documented drastic fluctuations of global coal prices does it make sense to invest in an unstable resource like coal?
- Historically, railroads have been accorded extraordinary rights in the form of "eminent domain" laws and protections (i.e. exempt from paying more than 10% of the costs related to safety and the mitigation of adverse effects due to rail usage).[10] How will eminent domain laws affect coal companies using public railway systems and will companies such as, Millennium Bulk Terminals (MBTL), SSA Marine (a Carrix Company) and Peabody Energy be given protections historically accorded to railways?
- Will taxpayers see any of the financial burdens as a result of necessary increased railway infrastructure upgrades and or remediation activities that would result from a coal train spill/derailment?
- Is selling coal to Asia cheaply the best way to provide incentive to further develop "clean coal" or will selling an inexpensive energy resource that can be utilized with existing technologies simply perpetuate the consumption of coal as we know it and reduce the incentive to pursue clean energies?
- How will mining, transport, shipping and burning Powder River Basin coal effect American taxpayers, property values, tourism, quality of life and local manufacturers from mine to port?

Global Environmental Impacts:

- Coal is the single largest source of CO2 emissions. How will the mining, transport, shipping and burning of Powder River coal stocks effect global warming, acid rain, mercury emissions, global ocean acidification & global biodiversity?
- The introduction of invasive marine species into new environments by ships' ballast water has been identified by the United Nations as one of the four greatest threats to the world's oceans.[11] How will invasive species brought from North America to Asia and vise-versa in cargo vessel ballast tanks be dealt with?

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[10] See httpwww.coaltrainfacts.org/docs/Cornell-Univ-Law-School.pdf

[11] See httpwww.maritimenorway.no/maritimenorway/vedlegg/OptiMarin_Allweiler20100719.pdf

- What affects will increased marine traffic have on important marine habitats such as those of mixed microalgae (critical for salmon and herring), kelp, eelgrass beds, shoreline habitats, wetlands, and salt marshes?

Air Quality (both before and after burning):

- What effects will coal dust and diesel fumes (from trains, barges and ocean going tankers) have on local (from mine to port) and global air quality?
  What effects to global air quality will occur after coal is burned in unregulated coal fired power plants in Asia?

Fisheries:

- What effects will coal dust have on local (mine to port) fisheries?
- What effects would a coal spill en route from Montana to port in Washington have on Pacific Northwest fisheries?
- What effects will the burning of coal and the increased acidification of global waters have on fisheries?
- How will coal export facilities effect and mitigate for the increased loss of Columbia River Estuary floodplain lands?
  How will shoreline and near-shore habitats be protected?
- How will increased vessel traffic in the Columbia affect already threatened and endangered species?
- How will the increase in water withdrawal from the Columbia River Basin (a single, modern cargo vessel can carry anywhere from 6-10 million gallons of water in its ballast tank)[12], which salmon, smelt and other aquatic species rely upon, be addressed?
- What kind/type of emergency environmental clean-up procedures are in place to deal with the effects of a coal spill en route into area waterways?
- How will coal dust, coal spills and increased global warming from the mining, transport, shipping and burning of coal effect Tribal and global fisheries?

Surface and Groundwater:

- How will the mining, transport, shipping and burning of coal from the Powder River area of Montana effect surface and groundwater throughout the entire route from the Powder River Basin to Washington?
- How will the process of strip mining that is used to extract Powder River coal affect area aquifers?
- How will potential contamination of rail corridor and beyond rail right-of-ways from polycyclic aromatic hydrocarbons and other toxics be dealt with?

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[12] See http://water.epa.gov/type/oceb/habitat/invasive_species_factsheet.cfm

Noise & Vibration

- Will the vibration and noise from trains and coal terminal operations cause ground settling, damage buildings and or disrupt households, businesses, schools and wildlife?

Transportation;

- How will the coal trains affect local traffic from mine to port especially in large en route cities like Spokane WA, Missoula and Billings MT?
- It has been determined that coal dust poses a serious threat to the stability of the railway track structure. How will track stability and the increased probability of a coal train derailment be dealt with?

Emergency service access;

- How will the increased coal train traffic (from mine to port) affect the ability of emergency response crews to carry out their duties and reach sites and individuals speedily?

The Coeur d'Alene Tribe believes that the Corps has a fundamental responsibility to consider *all* the impacts with the utmost attention said coal terminals would have on the Pacific Northwest as the Northwest is interconnected through the families, tribes, resources and waterways that these coal terminals and railway routes would traverse.

In closing, the Tribe is confident that a careful, informed, considerate examination of the regional impacts these proposed coal export terminals would have will illuminate the full costs of exporting coal through the Northwest and it will be determined that the true costs far outweigh the anticipated economic benefits to a few individuals.

Sincerely,

Chief J. Allan
Chairman

CJA: aa

Cowlitz Indian Tribe

November 18, 2013

Col. Bruce A. Estok
Seattle District Commander
US Army Corps of Engineers
PO Box 3755
Seattle, WA 98124-3755

Subject: Scoping Comments for Millennium Bulk Terminals - Longview, LLC (MBTL) Project NEPA/SEPA Environmental Impact Statement

Dear Colonel Estok,

I am writing on behalf of the Cowlitz Indian Tribe in regards to the proposed coal export facility by MBTL located in Longview, WA. We appreciate that the US Army Corps of Engineers(USACE), the Washington State Department of Ecology (WADOE), and Cowlitz County (through the Cowlitz County Building and Planning Department (CCBP)) are conducting an Environmental Impact Statement (EIS) on this proposal. We believe that this proposal could lead to significant impacts to the region and beyond.

The public scoping process for this EIS began August 16, 2013 and will close November 18, 2013. Appropriate to the Cowlitz Indian Tribe's federally-recognized status, we ask for continued meaningful government-to-government consultation in regards to this issue. Our comments and project review of the proposed Millennium Bulk Terminals – Longview (MBTL) provided through formal consultation do not constitute public comment, and are not limited to the term of the public comment period. We have scheduled a follow up consultation meeting with you for December 18, 2013 and intend to follow up with the Washington State Department of Ecology and Cowlitz County as the EIS process moves forward. We plan to follow up with additional information and questions throughout the development of the Draft EIS.

The proposed MBTL location is within the aboriginal lands of the Cowlitz Indian Tribe. It is located in an area that carries significant cultural values to us based on thousands of years of continuous occupancy and resource gathering. This proposal would have an impact that would further diminish the culture of the Cowlitz Indian Tribe.

There are several specific points we would like to make regarding the development of the Draft EIS of the MBTL proposal:

The Cowlitz Indian Tribe expects that the action agencies (USACE, WADOE, and CCBP) present a compelling case for the need and purpose associated with this proposal. We would like to understand further as to why there is a need for the agency(s) to take action on the proposal.

We expect that there are a robust number of reasonable alternatives developed that is clearly responsive to the purpose and need for action. We also expect that the alternatives are carefully analyzed and include both potential short term and long-term impacts that the alternatives would likely create. We expect that the alternatives development take into account the appropriate geographic scale of potential impacts of the proposed project that will need to be further analyzed and mitigated.

The Cowlitz Indian Tribe expects that the alternatives developed are analyzed thoroughly in respect to the affected environment and the potential environmental consequences. We expect that the environmental consequences of impacts include direct, indirect, cumulative, and induced impacts in the biological, physical, social, economic, cultural, and aesthetic environments. We expect the most thorough development of scientific analysis be conducted as to eliminate the need to describe having any lack of information or the need to draw assumptions associated to the proposed MBTL. We also expect that there is a clear and logical cost-benefit analysis conducted in connection to all the alternatives and associated environment. We expect that any and all analyses and studies be conducted by qualified individuals of their respective disciplines and to include other appropriate agencies.

The Cowlitz Indian Tribe believes the proposed MBTL would likely lead to significant impacts to culturally relevant resources to the Tribe and its members. the Cowlitz Indian Tribe supports resolutions of the Affiliated Tribes of NW Indians (ATNI resolution # 13-47 and # 12-53) which opposes the transport and export of fossil fuels in the Pacific Northwest and the resolution calling on the US White House Council on Environmental Quality to do a comprehensive impact analysis of all proposed coal transport facilities in the Northwest and beyond. We have also taken an official policy stance of opposing the proposed MBTL. We have and continue to invest heavily in restoring past damages to our environment due to the human developments within the Columbia Basin. The United States Government have invested and continues to invest with tax payer dollars to restore the environmental damages that human developments have caused for over a century within the Columbia Basin. The proposed project is likely to harm our current efforts of restoration of culturally significant species and place burdens on future restoration efforts.

Some of the impacts of a developed MBTL include:

1. Further loss of Columbia River Estuary floodplain lands,
2. Increased vessel traffic in the Columbia bringing concerns toward increased mortality of already endangered or threatened species, etc,
3. Increase in invasive species brought here from international shipping,
4. Decrease in air quality due to transport and movement of millions of tons of Coal within the Columbia Basin,
5. Increase in water withdrawal from the Columbia River Basin of which salmon and other aquatic species rely upon,
6. Decrease in the quality of life and cultural values for the Cowlitz People.

The Cowlitz Indian Tribe believes proposed MBTL will put a strain on existing capacity of established businesses in the region and inhibit future business capacity and growth for more environmentally appropriate business enterprises. The ultimate fate of transported coal shows a likelihood of reducing the air quality and increasing acidification of the waters within and surrounding the Pacific Northwest through oversees coal fired facilities. The Cowlitz Indian Tribe believes that no amount of monetary or other mitigation measures will be able to offset or eliminate the environmental impacts that the proposed MBTL would create.

We expect that the concerns listed are included in the development and analysis of the EIS as we move forward. We will likely continue with follow up concerns and issues as the process moves forward.

A copy of this letter is being provided to WADOE and CCBP. These comments are being provided to these other agencies to be part of the record for the State and Local governments. We expect that our comments will not be listed as part of the public record but handled as an affected tribal government and to be treated with sensitivity as we move forward. Taylor Aalvik, our Natural Resources Department Director, will be our contact in regards to follow up activities associated with this proposal. He can be contacted at: taalvik@cowlitz.org or 360-575-3306.

Sincerely Yours,

William Iyall P.E.
Chairman, Cowlitz Indian Tribe

Cc: Maia D. Bellon, Director WA Department of Ecology
Elaine Placido, Director Cowlitz County Building and Planning
Dannette L. Guy, USACE Biologist/Project Manager
Dian Butorac, WADOE regional planner
George Raiter, Cowlitz County Special Projects Manager
Lori Morris, Tribal Liaison USACE Seattle District
Tom Laurie, WA DOE Tribal Relations

Nez Perce

TRIBAL EXECUTIVE COMMITTEE
P.O. BOX 305 • LAPWAI, IDAHO 83540 • (208) 843-2253

November 18, 2013

By Electronic and Regular Mail

Millennium Bulk Terminals – Longview EIS
c/o ICF International
710 Second Avenue, Suite 550
Seattle, WA 98104

Re: Nez Perce Tribe's scoping comments on the U.S. Army Corps of Engineers, Washington State Department of Ecology ("Ecology"), and Cowlitz County intent to prepare an Environmental Impact Statements on the proposed Millennium Bulk Terminals—Longview Shipping Facility Project

Dear Responsible Officials:

The Nez Perce Tribe (Tribe) appreciates the opportunity to provide scoping comments on the US Army Corps of Engineers' (Corps), Washington State Department of Ecology's (Ecology), and Cowlitz County's intent to prepare Environmental Impact Statements under the National Environmental Policy Act (NEPA) and State Environmental Policy Act (SEPA) for the proposed Millennium Bulk Terminals –Longview Shipping Facility Project. These comments incorporate by reference Columbia River Intertribal Fish Commission's November 18, 2013 scoping comments.

I. Project Description

According to Department of Ecology's website and the materials available on it, Millennium Bulk Terminals LLC, (MBTL) and it members Ambre Energy North America, Inc. and Arch Coal, Inc., are proposing the construction, operation and maintenance of a coal export terminal near Longview, Washington adjacent to the Columbia River. The proposed coal export terminal would cover approximately 100 acres of the 416-acre site and would consist of rail unloading, storage, reclaiming and loading ships with coal. MBTL proposes to develop the coal export terminal in two separate stages. MTBT would construct two docks requiring 647 steel piles, one shiploader, two stockpile pads, one tandem rotary dumper, five rail lines, associated facilities and infrastructure in the first stage. Stage two facilities would consist of one additional shiploader on Dock 3, two stockpile pads, and there rail lines to complete the build out of the coal export terminal. The completed coal export terminal would consist of two docks, two shiploaders, four stockpile pads, one tandem rotary dumper, eight rail lines, and associated facilities, conveyors and equipment.

Dredging will be required to provide berthing access from the navigation channel and to provide an adequate turning basin in the vicinity of the docks. MBTL is requesting authorization to dredge and dispose of up to 385,000 cubic yards from within the project footprint. MBTL also seeks authorization to the extent required to perform routine maintenance dredging consistent with the proposed project dredge prism dimensions. Dredging and disposal may occur over one or two construction seasons. Because the site will continue to be subject to river sediment deposition, future maintenance dredging is anticipated on a 1 to 2 year basis to maintain adequate berthing and navigation depths for the facility.

The facility would be designed for 24-hour operation, seven days per week. During Stage 1 operations, approximately one vessel per day would be loaded. At maximum throughput, approximately two vessels per day would be loaded, totaling approximately 1,460 vessel transits through the lower Columbia River annually. Prior to or during loading, vessels would discharge ballast water. It is expected that vessels calling at the site would have exchanged or treated ballast water prior to discharge in accordance with state and federal regulations. Vessels would not typically withdraw ballast water from the Columbia River. The planned total capacity of the facility would be 44 million metric tons of coal annually.

II. General Comments

a. The Treaty of 1855

Since time immemorial the Nez Perce Tribe has used and occupied the lands and waters of north-central Idaho, southwest Washington, northeast Oregon, and portions of western Montana for subsistence, ceremonial, commercial and religious purposes. In Article 3 of the 1855 Treaty with the United States, the Nez Perce Tribe reserved, and the United States secured, the right to take fish and at all usual and accustomed fishing places, and to hunt, gather and pasture on open and unclaimed lands. Treaty of June 9, 1855, with the Nez Perce Tribe, 12 Stat. 957 (1859). The waters within the Tribe's aboriginal territory continue to be used by the Nez Perce. Tribal members exercise their treaty-reserved rights, as well as observe ceremonial, cultural and religious practices within the Columbia River Basin. Resident and anadromous species that rear, hold and migrate through the project area are subject to the Tribe's treaty-reserved fishing rights.

The Tribe's explicit treaty-reserved right to take fish at all usual and accustomed places includes, but is not limited to, a legally protected property interest in accessing all of its usual and accustomed places; and a legally protectable property interest in taking 50% of the fish that are destined to reach all of the Tribe's usual and accustomed places. In a sub-proceeding of United States v. Oregon, 302 F. Supp. 899 (D. Or. 1969, a treaty fishing rights case that has been under the court's continuing jurisdiction for over thirty years, Judge Belloni further clarified the Tribe's treaty-reserved fishing right:

> By "destined to reach the tribes' usual and accustomed grounds and stations," I am referring to that portion of the spring run which would, in the normal course of

> events, instinctively migrate to these places except for prior interception by non-treaty harvesters or other artificial factors.

Sohappy et al. v. State of Oregon (Civil No. 68-409, May 8, 1974) at 3. Treaty tribes, such as the Nez Perce Tribe, are also recognized as managers of their treaty- reserved resources. U.S. v. Washington, 384 F. Supp. 312, 339-40, 403 (W.D. Wash. 1974). Protecting rivers and flows for native resident and anadromous fish and wildlife populations is critically important to the Nez Perce Tribe. Resident and anadromous fish stocks that originate above, or rear and hold, within or adjacent to the proposed project are may be affected by the presence and operation of the project. Anadromous fish, including salmon, Pacific lamprey and steelhead as well as resident fish such as sturgeon have deep and lasting cultural and religious significance to the Tribe.

b. The Nez Perce Tribe's involvement in other coal proposals on the Columbia River

The Tribe has been actively engaged in monitoring the development of other coal proposals on the Columbia River. In 2012 the Tribe submitted comments to the Corps regarding the proposed coal off-loading facility at the Port of Morrow. The Tribe has requested that the Corps perform a full EIS for the proposal, and has expressed significant concerns regarding the project's impacts to treaty fishing, as well as the project's impacts on the environment. The Tribe has also provided testimony to the State of Oregon requesting that it acknowledge the project's impacts on treaty-reserved rights, and asked ODEQ to require a Clean Water Act 401 certification to consider all impacts of the entire project. Moreover, the Affiliated Tribes of Northwest Indians, of which the Tribe is a member, has requested a full environmental review and government-to-government consultation with affected tribes concerning proposed coal terminals on the Columbia.

c. NEPA

NEPA "declares a broad national commitment to protecting and promoting environmental quality." Robertson v. Methow Valley Citizens Council, 490 U.S. 332, 348 (1989); see 42 U.S.C. § 4331. "To insure this commitment is infused into the ongoing programs and actions of the Federal Government, the act also establishes some important 'action-forcing' procedures." Robertson, 490 U.S. at 348 (citing115 Cong. Rec. 40416 (remarks of Sen. Jackson)). NEPA directs that, to the fullest extent possible, all federal agencies must prepare an EIS whenever they propose "major federal actions significantly affecting the quality of the environment." Id.; 42 U.S.C. § 4332(C). NEPA's disclosure goals are two-fold: (1) to ensure that the agency has carefully and fully contemplated the environmental effects of its action, and (2) "to ensure that the public has sufficient information to challenge the agency." Robertson, 490 U.S. at 349; Idaho Sporting Congress v. Thomas, 137 F.3d 1146, 1151 (9th Cir. 1998). By focusing the agency on the environmental consequences of its proposed action, NEPA "ensures that important effects will not be overlooked or underestimated only to be discovered after resources have been committed or the die otherwise cast." Robertson, 490 U.S. at 349.

Through the NEPA process, a federal agency must "take[] a 'hard look' at the potential

environmental consequences of the proposed action." Oregon Natural Res. Council v. Bureau of Land Management, 470 F.3d 818, 820 (9th Cir. 2006) (internal quotations omitted). NEPA's regulations require that an EIS include a discussion of direct, indirect, and cumulative environmental impacts of the proposed action. Direct impacts are "caused by the action and occur at the same time and place." 40 C.F.R. § 1508.8(a). Indirect impacts are "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." Id. at § 1508.8(b). Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems. Id. Cumulative impacts result when the "incremental impact of the action [is] added to other past, present, and reasonably foreseeable future actions" undertaken by any person or agency. Id. at § 1508.7.

d. SEPA

The Washington State Environmental Policy Act, like its federal counterpart NEPA, was enacted to ensure that "'"...environmental amenities and values will be given appropriate consideration in decision making along with economic and technical considerations..." RCW 43.21C.030(2)(a) and (2)(b). To implement this purpose, the SEPA Rules direct agencies to "Identify and evaluate probable impacts, alternatives and mitigation measures, emphasizing important environmental impacts and alternatives (including cumulative, short-term, long-term, direct and indirect impacts). WAC 197-11-030(2)(b) and (g). Also like NEPA, the agencies must consider this information before committing to a particular course of action. WAC 197-11-055(2)(c).

III. Specific Comments

In determining the scope of the EISs, the Tribe requests that the Corps, State of Washington and Cowlitz County not only evaluate the impacts of construction and operation near the terminal, but also fully evaluate the direct, indirect and cumulative impacts of coal trains on a larger geographic scale. The Tribe therefore requests that the following issues be included in the EIS analyses.

a. Impacts to Tribal treaty rights

The Tribe is concerned that this project will negatively affect tribal treaty rights. The Tribe reserves treaty-fishing rights at all usual and accustomed fishing places, including those places along the Columbia and Snake Rivers and their tributaries that depend on fish that rear, hold and migrate through the lower Columbia River. As noted above, the project contemplates significant channel and maintenance dredging and will result in the destruction of wetlands. The lower Columbia provides crucial habitat for treaty-protected resources such as salmon, steelhead, lamprey and resident fish. There are several ESA-listed fish in the project corridor including Lower Columbia River Chinook Salmon ESU, Upper Willamette River Chinook Salmon ESU, Snake River Fall Chinook ESU, Columbia River chum salmon ESU, middle Columbia River steelhead DPS, and lower Columbia River steelhead DPS. These species are of critical importance to subsistence and culture of the Tribe. In addition, lamprey, although currently are not a listed species but are culturally significant to the Tribe, are also located in the project

corridor. These aquatic resources that rear, hold and migrate through the lower Columbia stand to be significantly affected by the project. A full evaluation of the impacts of the project on these treaty resources, therefore, must be performed as part of the EIS.

The application contemplates a significant increase in vessel and rail traffic. The analysis must include a thorough evaluation of the impacts of increased vessel traffic on anadromous and resident fish. This analysis should include impacts to aquatic resources caused by ballast intake and wake strandings, as well as threats posed by increased turbidity, noise, lighting, and impacts during operations like coal dust and other toxics. In addition, the increased rail traffic may affect Tribal member access to usual and accustomed fishing places and other traditional use areas as well as interfere with Tribal member use of those places through increased noise disturbances, coal dust, and diesel pollution. For all these reasons the Tribe believes that the increase in vessel and train has the potential to interfere with tribal treaty fisheries.

b. Impacts to Tribal member health

Given the large amount of coal that is contemplated to be transported by rail from the Powder River Basin and exported by vessel through the lower Columbia River to Asia, the Tribe is concerned about the project's potential impacts to Tribal member health. Coal dust and diesel emissions are known to cause respiratory disease, particularly affecting sensitive populations such as children and the elderly. In addition, the coal dust that settles on the water can have adverse environmental consequences to the river corridor. Coal dust can affect natural biological processes and can potentially affect fish and other biota that reside in the rivers.

c. Impacts to Tribal cultural resources

The action agencies need to evaluate the project's impacts on Tribal cultural resources, including historic properties under the National Historic Preservation Act. Section 106 of the NHPA requires the agency official to "determine and document the area of potential effect in consultation with the appropriate State Historic Preservation Officers and Tribal Historic Preservation Officers." 36 C.F.R. 800.4(a). The area of potential effect is defined as "the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The area of potential effects is influenced by the scale and nature of an undertaking and may be different for different kinds of effects caused by the undertaking." 36 C.F.R. 800.16(d).

As stated above, the geographic scope of the evaluation should be sufficiently broad to evaluate direct or indirect alterations to the character and use of historic properties. Therefore, the NHPA analysis should include transport of coal by rail to the facility as well as through the lower Columbia to Asia. This analysis should include, but not be limited to, evaluating the impacts of air pollutants and other toxics on historic properties.

d. Range of Alternatives

Agencies are to "rigorously explore and objectively evaluate all reasonable alternatives," and to explain why any alternatives were eliminated. 40 C.F.R. §1502.14(a). The regulations further state that agencies are to consider "reasonable alternatives not within the jurisdiction of the lead agency" and the no-action alternative. Id. at § 1502.14(d).

The agencies need to take a meaningful look at the no-action alternative. The Tribe also requests that the agencies consider an alternative or alternatives that identify alternate locations for the facility that are not on the Lower Columbia River and which do not require significant alteration of aquatic habitat that may be harmful to treaty-protected resources.

e. Environmental Justice

A Presidential memorandum accompanying Executive Order 12898 cites the NEPA process as an opportunity for agencies to address the environmental injustice of disproportionate impacts.

The CEQ also published guidance for environmental justice analyses to determine any disproportionately high and adverse human health or environmental effects to low-income, minority, and tribal populations. One of these principles is to "recognize the interrelated cultural, social, occupational, historical, or economic factors that may amplify the natural and physical environmental effects of the proposed action."

Currently, the Nez Perce Tribe harvests significantly less fish than traditional salmon harvest levels. The decimation of salmon runs and disappearance of other traditional foods have seriously affected the Tribal economy. Today, Tribal members face a high poverty and unemployment rates. The EISs need to include an environmental justice discussion of disproportionate impacts of the project on the Tribe or its members. Any impacts on salmon, steelhead, lamprey or other trust resources, will have a disproportionate impact on the Tribe due to their reliance on fish and the importance of fish to Tribal culture, spirituality and economy. Tribal members consume a substantially higher rate of fish than the non-Tribal communities.

f. Socioeconomics

The evaluation needs to include an economic analysis of the impact of the project on the Nez Perce Tribal economy and the health and welfare of its people. The analysis should fully address social and economic factors unique to the Tribe and its treaty rights and resources, which extend throughout the Columbia and Snake basins. This analysis should include the Tribe's efforts to restore fish runs in the Columbia River that rear in and migrate through the project area, and the economic benefits that will flow to the non-Tribal public from the re-establishment of healthy and harvestable fish runs in the area.

IV. Conclusion

Thank you again for the opportunity to review the proposed project. The Tribe anticipates consulting formally and through staff-to-staff interactions with the Corps throughout the development of this proposal. The Tribe also extends an invitation to the Department of Ecology

and Cowlitz County to contact the Tribe with any questions or to request a meeting between our staff or with the Nez Perce Tribal Executive Committee. Please contact Michael Lopez, Staff Attorney, Nez Perce Tribe Office of Legal Counsel, at (208) 843-7355 for assistance.

Sincerely,

Silas C. Whitman
Chairman

NISQUALLY INDIAN TRIBE
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November 18, 2013

Millennium Bulk Terminals-Longview EIS, c/o ICF International
710 Second Avenue, Suite 550
Seattle, Washington 98104

RE: Comments of Scoping Notice
Proposed Millennium Bulk Terminals Longview EIS

Dear Joint Agencies:

On behalf of the Nisqually Indian Tribe, I am providing comments on the appropriate scope of the Environmental Impact Statement to be prepared for the proposed Millennium Bulk Terminals Longview. This letter is limited to the scope of the EIS, not on the appropriateness of the proposed coal export facility itself.

Impact of Fisheries Habitat and the Nisqually Tribe's Treaty Rights

The Nisqually Indian Tribe, because of its treaty with the United States, codified by federal law and sustained by multiple federal court decisions, has the right to harvest fish and shellfish in its usual and accustomed and the right to hunt and gather on open and unclaimed lands. The Nisqually Tribe has strong cultural ties to both the Chehalis and Cowlitz Tribes and historically fished for smelt on the Cowlitz River. The Nisqually Tribe hunted a vast swath of Western Washington because of close relations with the Chehalis, Cowlitz, and Yakama Tribes, the perimeter of the area includes west to Grays Harbor, south to Longview, west along the Columbia River to Celilo Falls, north along the eastern edge of modern day Mountain Rainer National Park to Auburn, WA and then south along Puget Sound to Twana territory.

It is our understanding that, when fully operational, the proposed facility will result in substantially increased train traffic along the BNSF railroad mainline running west along the Columbia River, across the Cowlitz River before reaching the proposed terminal. Our traditional hunting and gathering areas are located directly adjacent to this route of travel. The EIS should:

1. Thoroughly document the possible and likely amount of increased train traffic on this southern route along the Columbia and Cowlitz Rivers, and more broadly upon the entire route of travel. Infrequently, BNSF has experienced derailment and spills along its routes. The EIS should evaluate the increased incidence risk associated with increased train traffic.

2. Thoroughly evaluate the risk of accident associated with the increase of train traffic and the possible direct impacts of such accidents. As part of the analysis of accident risk the EIS also should identify the age and current condition of the BNSF mainline, since we know that it was constructed approximately 100 years ago.

The risks we immediately identify are railroad accidents that spill coal and other materials, including hazardous materials, into water areas and game habitat, train accidents, train traffic shutdowns on the track, and the resulting loss of fish and game habitat, and culturally important plant species.

3. Thoroughly evaluate the risk of environmental and habitat damage, both short term and long term, that might result from the accidents described. In particular we would like to know more about the impact of substantial amounts of coal being dumped down river on the Cowlitz and the impact on up river fisheries including smelt, as well as the impact this may have on the lower Columbia River and the estuary. Our Nisqually River salmon returns are directly and inextricably linked to the success of salmon runs on the Columbia and therefore dependent on the quality and quantity of habitat in that basin.

Also, when evaluating habitat risk, the Nisqually Tribe is concerned about the entire line of travel along the Columbia River and Cowlitz River and the construction of a substantial export facility at Longview. We request that all associated impacts with this project be evaluated for its impacts on habitat, human health, traffic, and our treaty rights.

<u>Mitigation</u>

Once the possible and likely risks and impacts are evaluated, the agencies should address possible mitigation of the associated risks, including whether or not the risks and impacts can be adequately mitigated or must simply be avoided. The Nisqually Indian Tribe expects that it will be involved in these mitigation discussions.

In particular the Tribe requests that the agencies evaluate as possible mitigation the relocation of the route of travel away from Western Washington.

Cultural Resources

The agencies need to acknowledge that the Nisqually Indian Tribe, and other Tribes along the route of travel, may have valuable cultural resources at risk from increased train traffic and associate construction. These resources may be archaeological sites located or potentially located in the line of travel and construction, or cultural activities that may be negatively impacted by the increased train traffic.

As an element of federal law, the Army Corps of Engineers must conduct Section 106 consultation with affected Tribes, including the Nisqually Tribe, either as part of the EIS process or separately. That consultation should be initiated as soon as practical after the magnitude of possible and likely impacts are described in the EIS.

Global Issues

We understand that the coal proposed for shipment from the Millennium Bulk Terminal Longview will be exported and, ultimately, burned for electricity generation. While increased airborne carbon dioxide associated with coal generation may not be an immediate threat to the treaty rights and cultural resources of the Nisqually Tribe, we believe that it is a long-term threat that must be evaluated thoroughly as part of the EIS process. We are currently experiencing the impacts of climate change on our treaty reserved and protected resources and this EIS should explore whether this action will continue that trend and if so propose mitigation to the Tribe to offset that loss.

Please do not hesitate to contact me if the Nisqually Tribe can be of any further assistance in the scoping of the EIS for the proposed project.

Sincerely,

David A. Troutt

Natural Resources Director

Upper Columbia United Tribes
25 W. Main, Suite 434
Spokane, WA 99201

Phone: 509.838.1057
Fax: 509.209.2421

Coeur d'Alene Colville Kalispel Kootenai Spokane

November 14, 2013

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Seattle, WA 98104

Washington Department of Ecology
c/o Diane Butorac
PO Box 47775
Olympia, WA 98504

U.S. Army Corp of Engineers
c/o Danette Guy
2108 Grand Blvd.
Vancouver, WA 98661

Cowlitz County Building and Planning
c/o Elaine Placido
207 4th Ave. N.
Kelso, WA 98626

U.S. Army Corps of Engineers, Washington Department of Ecology, and Cowlitz County:

The Upper Columbia United Tribes (UCUT) provides a common voice for our region through the collaboration of five major area tribes, the Coeur d'Alene Tribe, the Kalispel Tribe of Indians, the Kootenai Tribe of Idaho, the Spokane Tribe of Indians and the Confederated Tribes of the Colville Reservation. UCUT was formed to ensure a healthy future for the traditional territorial lands of our ancestors and takes a proactive and collaborative approach to promoting Indian culture, fish, water, wildlife and habitat.

With this mission in mind the UCUT would like to share some of our reasons for opposing the proposed Millennium Bulk Terminal coal transport facility located in Longview, WA.

The major concern our member tribes have is in regards to the impacts to human health, fishery resources, air quality and water quality in the Columbia Basin. Coal dust is notoriously difficult to control. BNSF estimates that each uncovered car loses between 500 pounds and a ton of coal dust en route. The route between the Powder River in Wyoming and Longview, Washington is 1174 miles. The estimated number of trains expected to pass through Eastern Washington is sixty per day. Of which, thirty would be full and thirty empty. Therefore based on BNSF's own estimates of the 500 pounds per trip, there would be an average of nearly 1600 pounds of dust lost per mile per day. With what we know about the human health impacts of the coal dust and the various chemicals the dust contains as well as the known adverse effects on the development and survival of fish, the Upper Columbia United Tribes believe this proposal will seriously harm our members. In addition, we expect the Department of Ecology will conduct a thorough evaluation of the human health and environmental impacts to the UCUT's area of influence.

Impacts from the coal export terminals will likely lead to:

-A decrease in regional air quality, the city of Spokane has as many poor air quality days as the city of Seattle each year and is only a fraction of the size. The huge increase in both coal dust and diesel particulates would severely impact our region's air quality.

-According to UW scientists 15% to 20% of the Mercury being deposited on Washington State originates from Asian fossil fuel burning. This is why lakes in "pristine" watersheds harbor fish with high Hg levels. The citizens of this state are living with the environmental and human health impacts from Asian coal burning now, we don't need to add to the problem.

-A decrease in water quality in the Columbia River and its tributaries. There is an abundance of information which points to a continued decline in our region's water quality and an increase in listings of fish consumption advisories. A project of this scale which will disperse additional toxins into the environment in which this coal is transported through is likely to severely impact an already contaminated system.

- Impacts to the fisheries that are essential to our tribes. It is well known that chemicals in the coal and coal dust including PAHs are harmful to fish development and survival. We now know that these adverse effects result from 1000-time lower levels of PAHs than were previously thought to be of concern. Based on a study from NOAA fisheries scientists, after low dose exposures to PAHs the salmon fry that did survive had unusually high numbers of spinal deformities and skin lesions. When a cohort of seemingly healthy pink salmon fry that were exposed were selected and released they returned two years later in much lower numbers than the control group.

-Increase in invasive species in the Columbia River Basin brought here from international shipping.

-Coal burned in China will return to the West Coast as air pollution and the increased release in Carbon Dioxide will lead to increases in climate change.

-Coal burned in China is also one of the leading causes of Pacific Ocean Acidification which is already seriously impacting tribes and fisheries in the North West.

The UCUT also supports other Northwest tribes in their opposition efforts; a resolution that passed the Affiliated Tribes of Northwest Indians (ATNI resolution # 13-47) which opposes the transport and export of fossil fuels in the Pacific Northwest and (ATNI resolution #12-53) calling for a regional review of all six NW coal export proposals. Please refer to the attachments which include the two ATNI resolutions and a map of the UCUT area of influence.

Sincerely,

Chairman Matt Wynne

2012 Annual Convention
Pendleton, Oregon

RESOLUTION #12 - 53

"CALLING FOR FULL, TRANSPARENT ENVIRONMENTAL REVIEW OF THE PORT OF MORROW PROPOSAL, CONSULTATIONS, AND REGIONAL REVIEW OF ALL SIX NW COAL EXPORT PROPOSALS"

PREAMBLE

We, the members of the Affiliated Tribes of Northwest Indians of the United States, invoking the divine blessing of the Creator upon our efforts and purposes, in order to preserve for ourselves and our descendants rights secured under Indian Treaties, Executive Orders, and benefits to which we are entitled under the laws and constitution of the United States and several states, to enlighten the public toward a better understanding of the Indian people, to preserve Indian cultural values, and otherwise to promote the welfare of the Indian people, do hereby establish and submit the following resolution:

WHEREAS, the Affiliated Tribes of Northwest Indians (ATNI) are representatives of and advocates for national, regional, and specific tribal concerns; and

WHEREAS, ATNI is a regional organization comprised of American Indians/Alaska Natives and tribes in the states of Washington, Idaho, Oregon, Montana, Nevada, Northern California, and Alaska; and

WHEREAS, the health, safety, welfare, education, economic and employment opportunity, and preservation of cultural and natural resources are primary goals and objectives of the ATNI; and

WHEREAS, since time immemorial, our economy, culture, religion and way of life have centered around our fishing, hunting and gathering resources, and the lands and waters on which they depend, and we have been, and remain, careful and conscientious stewards over them to ensure their continued health and well-being; and

WHEREAS, the tribes of ATNI are sovereign and our people depend on the natural resources of this region; and

WHEREAS, the tribes of ATNI have an obligation to protect our First Foods and our most precious resource, water; and

WHEREAS, there are sweeping proposals for Powder River Basin coal to be shipped by rail and/or barge to West Coast ports: Cherry Point, Washington; Longview, Washington; Grays Harbor, Washington; Port of Morrow, Oregon; St. Helens, Oregon; and Coos Bay, Oregon; and

WHEREAS, the coal will then be shipped through our waters to Asia where it will then be burned in coal-fired power plants, emitting mercury and other toxins that return through the atmosphere to our homes; and

WHEREAS, the estimated coal export volumes from the proposed West Coast ports are unprecedented at over 150 million tons per year; and

WHEREAS, Northwest tribes have strong concerns about the impact of these proposals on tribal rights and resources, including but not limited to the following:

- Intrusions into traditional fishing, hunting and gathering sites;
- Destruction of our cultural and religious areas;
- Degradation of human health, related to fugitive coal dust and mercury poisoning;
- Interference with tribal business enterprises and opportunities, causing a loss of jobs, preventing jobs growth, and reducing tribal income, related to increased coal-train traffic;
- Declining water quality and loss of salmon and lamprey habitat from barging and shipping operations;
- Increases in emergency response times, interference with school functions, and fiscal impacts on other public services due to delays at train crossings;
- Filling of shorelines, wetlands, and streams, during expansion or reconstruction of rail lines along the Columbia River, the Salish Sea, and their tributaries;
- Climate change, sea level rise, and ocean acidification from coal-fired power plants; and
- Overall degradation of our natural resources and culture

; and

WHEREAS, Northwest tribes require transparency and ongoing consultation to ensure that the permitting and Environmental Impact Statements (EIS) for all of the proposed coal ports are consistent, in light of the fact that all of our waterways are connected to one another; and

WHEREAS, that ATNI hereby declares that a mere Environmental Assessment for the Port of Morrow facility, instead of an EIS, is completely unacceptable, based on a number of

deficiencies, including but not limited to the lack of Government-to-Government consultation required with all affected tribes in the region; now

THEREFORE BE IT RESOLVED, that ATNI hereby calls upon the White House Council on Environmental Quality to require immediate preparation of a comprehensive Environmental Impact Statement for the Port of Morrow proposed coal export facility; and

BE IT FURTHER RESOLVED, that ATNI hereby calls upon the White House Council on Environmental Quality to direct the U.S. Army Corps of Engineers (USACE) to develop a comprehensive EIS at the USACE Northwestern Division level, on the cumulative effects of all six currently proposed coal export proposals, and any future proposals, together, including analysis of the cumulative impacts of the proposals throughout the entire region and internationally, including their direct and indirect impacts on tribal cultural resources, treaty rights and interests (see attached letter); and

BE IT FURTHER RESOLVED, that ATNI hereby concludes that a separate EIS is also necessary for each of the coal export facilities individually; and

BE IT FINALLY RESOLVED, that ATNI hereby insists that the White House Council on Environmental Quality mandate all federal and state agencies to commence immediate Government-to-Government consultations with all tribes in the region, as our First Foods and resources, treaty rights and human health are directly impacted by the coal industry in the Northwest.

CERTIFICATION

The foregoing resolution was adopted at the 2012 Annual Convention of the Affiliated Tribes of Northwest Indians, held at Wildhorse Resort and Casino, Pendleton, Oregon on September 24 – 27, 2012 with a quorum present.

Fawn Sharp, President

Norma Jean Louie, Secretary

2013 Mid-Year Convention
Airway Heights, Washington

RESOLUTION #13 - 47

"OPPOSE THE PROPOSALS FOR THE TRANSPORTATION AND EXPORT OF FOSSIL FUELS IN THE PACIFIC NORTHWEST"

PREAMBLE

We the members of the Affiliated Tribes of Northwest Indians of the United States, invoking the divine blessing of the Creator upon our efforts and purposes, in order to preserve for ourselves and our descendants rights secured under Indian Treaties, Executive Orders, and benefits to which we are entitled under the laws and Constitution of the United States and several states, to enlighten the public toward a better understanding of the Indian people, to preserve Indian cultural values, and otherwise to promote the welfare of the Indian people, do hereby establish and submit the following resolution:

WHEREAS, the Affiliated Tribes of Northwest Indians (ATNI) are representatives of and advocates for national, regional, and specific tribal concerns; and

WHEREAS, ATNI is a regional organization comprised of American Indians/Alaska Natives and tribes in the states of Washington, Idaho, Oregon, Montana, Nevada, Northern California, and Alaska; and

WHEREAS, the health, safety, welfare, education, economic and employment opportunity, and preservation of cultural and natural resources are primary goals and objectives of the ATNI; and

WHEREAS, since time immemorial, our economy, culture, religion and way of life has centered around our fishing, hunting and gathering resources, and the lands and waters on which they depend, and we have been, and remain, careful and conscientious stewards over them to ensure their continued health and well-being; and

WHEREAS, the tribes of ATNI depend on the natural resources of this region to sustain our way of life, rights to fish, hunt and gather, our economies, human health and fulfill our sacred obligation to protect our First Foods and our most precious natural resource, water; and

WHEREAS, the tribes of ATNI have previously adopted Resolution No. 12-53, in September 2012, recognizing the potential impacts of coal export terminal proposals that have come to the Northwest and the action directed to the Army Corp of Engineers to conduct a full regional Environmental Impact Statement (EIS) to address the significant cumulative impacts of these proposals; and

WHEREAS, the Northwest is facing the advancement of more fossil fuel exports, including numerous oil-rail proposals in Oregon and Washington, which would bring 500,000 barrels of oil a day via rail line to and across Northwest waterways as well as expansion of pipeline capacity from Alberta to British Columbia and Washington State; and

WHEREAS, based on review of proposals at these sites these past twelve months, the tribes of ATNI believe these energy transportation and export proposals will diminish our salmon habitat, our fishing, hunting and gathering rights, our treaty, indigenous, and inherent rights and resources, our life way, and will destroy sacred places of the Pacific Northwest tribes; and

WHEREAS, the tribes of ATNI respect and honor our Sacred Places just as we do our natural resources, including the Lummi Sacred Site known as *Xwe'Chi'eXen* where our ancestors are at rest, and the sacred traditional reef net sites at Cherry Point, Washington; and therefore call upon agencies to fulfill their statutory and legal responsibility to fully comply with Section 106 of the Historic Preservation Act; and

WHEREAS, the Northwest Tribes' ancestral industry of fisheries relies on sustainable resources that will face detrimental impacts from the transportation and export of nonrenewable fossil fuel resources; now

THEREFORE BE IT RESOLVED, that ATNI is in opposition of the transportation and export of fossil energy in the Northwest based on infringement and endangerment upon indigenous, inherent, and treaty-protected resources, impacts on human health, economies, sacred places and our traditional way of life; and

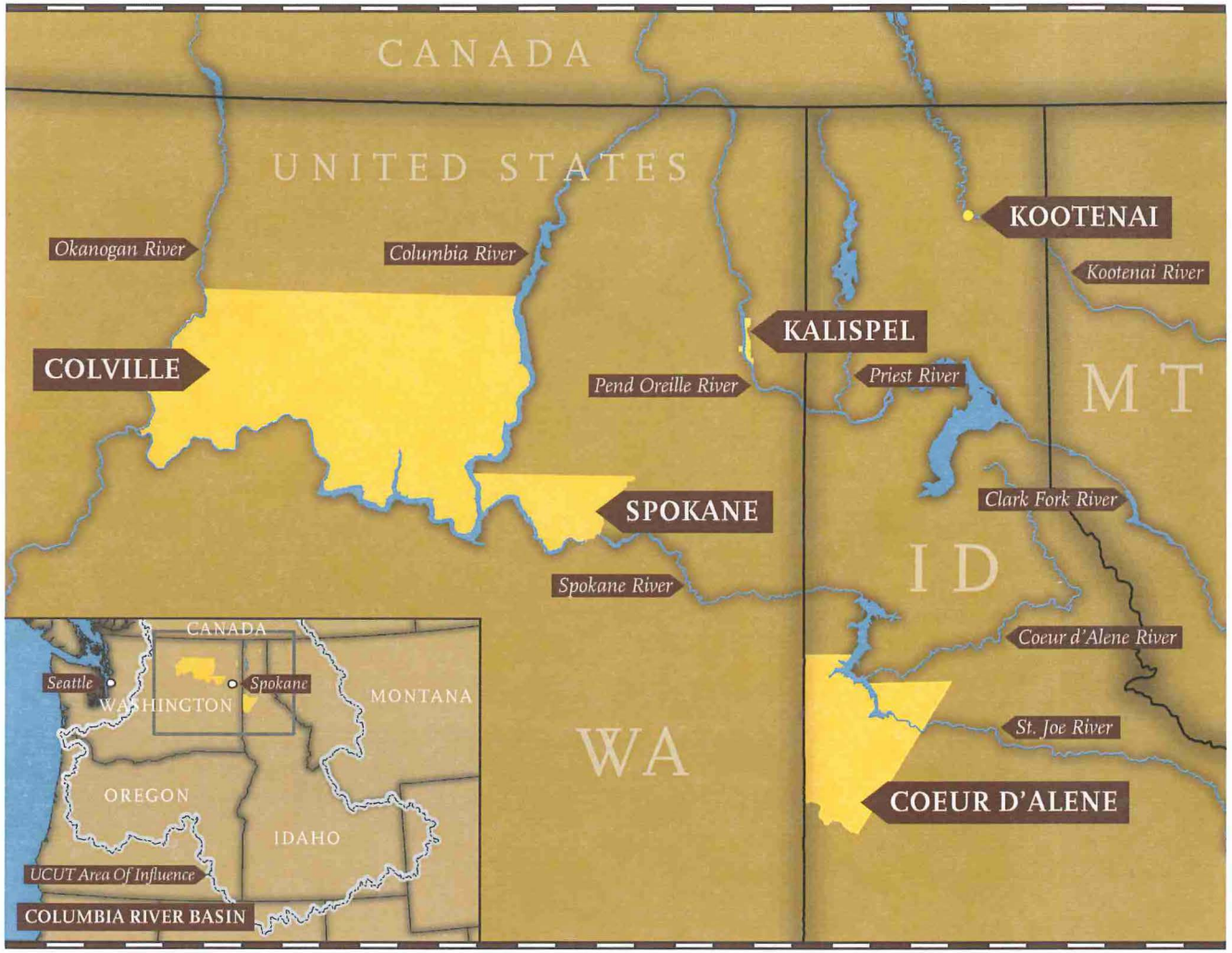
BE IT FURTHER RESOLVED, the tribes of ATNI support a strategy to document the impacts of these fossil fuel energy transport and export proposals, which includes baseline studies of science from a local approach, impacts to the economies, as well as legal and policy initiatives.

CERTIFICATION

The foregoing resolution was adopted at the 2013 Mid-Year Convention of the Affiliated Tribes of Northwest Indians, held at the Northern Quest Resort and Casino, Airway Heights, Washington on May 13-May 16, 2013 with a quorum present.

Fawn Sharp, President

Norma Jean Louie, Secretary


CANADA
UNITED STATES
Okanogan River
Columbia River
COLVILLE
KALISPEL
Pend Oreille River
KOOTENAI
Kootenai River
Priest River
MT
SPOKANE
Clark Fork River
ID
Spokane River
Coeur d'Alene River
St. Joe River
WA
COEUR D'ALENE
CANADA
Seattle
Spokane
WASHINGTON
MONTANA
OREGON
IDAHO
UCUT Area Of Influence
COLUMBIA RIVER BASIN

Confederated Tribes *of the*
Umatilla Indian Reservation
Department of Natural Resources
Administration

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November 18, 2013

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Subject: Scoping Comments on Proposed Millennium Bulk Terminals Longview Shipping Facility

Delivered Electronically to: comments@millenniumbulkeiswa.gov

To Whom It May Concern:

The Confederated Tribes of the Umatilla Indian Reservation (CTUIR) Department of Natural Resources (DNR) appreciates the opportunity to comment on the proposed Millennium Bulk Terminals Longview Shipping Facility Project (Project). The CTUIR DNR is concerned that the Project may impact tribal treaty fisheries, traditional use areas, and the habitats and cultural resources necessary to support and sustain them. We have additional concerns regarding the cumulative impacts of the Project and others proposed in the region.

The Environmental Impact Statement (EIS) should include adequate information to make an informed judgment as to the impacts to tribal Treaty Rights, traditional use areas and the near- and long-term health and sustainability of tribal First Foods. The EIS should also address how the federal government would be fulfilling it Trust Responsibility to the CTUIR and other Indian Tribes if a federal agency was to ultimately authorize this Project.

The U.S. Army Corps of Engineers (Corps), the Washington Department of Ecology (WDOE) and Whatcom County have begun an environmental review for a similar coal export terminal (Gateway Pacific) in Whatcom County. WDOE and the County have indicated their intent to examine all of the impacts of that project, including indirect effects such as increased rail traffic, vessel traffic, additional mining, and greenhouse gas emissions of coal combustion. This comprehensive approach should be followed in the case of the Millennium facility as well.

Impacts from the Project will be felt far and wide. Rail impacts (traffic, emissions, and derailment risks) will extend from the Powder River Basin to the Project site. Ocean transport will cause increased emissions, collision risks, and near-shore effects from Longview, through the Columbia River estuary, and across the sea. Greenhouse gas emissions will rise from the eventual combustion of the mined and transported coal, resulting in increasing temperatures, ocean acidification and mercury deposition in the Northwest. The Millennium facility will add to environmental burdens that will result if the many other coal and oil transport projects in the region come to fruition. It should not be analyzed in isolation, but in conjunction with the other proposed projects.

Fish and Fishing Site Impacts

The CTUIR has a treaty-secured "right of taking fish . . . at all . . . usual and accustomed stations" along the Columbia River and its tributaries. In order for this right to have any meaning, there must be fish to take, they must be healthy and sustainable, and access must be available. The Project will potentially negatively impact these sites and the fish that migrate past them. The additional trains may also adversely affect the ability of tribal members to access treaty reserved fishing sites along the Columbia River and other tributaries due to the increased danger at crossings. The EIS should assess these potential impacts. Fish are but one of the many tribal First Foods, and they all should be considered when weighing the effects of the Project.

Cultural Resources

Rail transit and operations associated with the Project will affect traditional cultural properties governed by the National Historic Preservation Act. The transit corridor will pass through or otherwise affect tribal trust lands and traditional use areas. Information pertaining to changes in rail usage is necessary to assess the effects the proposed undertaking will have on those properties.

Air Quality

Air quality may deteriorate as a result of the Project, from additional diesel emissions, coal dust, and the burning of the coal itself. Mercury deposition should be specifically examined; the CTUIR is particularly concerned about the alarming evidence of toxic contaminants in fish, water and across the landscape where we commonly obtain our First Foods.

Government-to Government Consultation

These are just a few of the CTUIR's many concerns; there are many more that cannot be fully detailed here. We request consultation on a government-to-government basis with the Corps on this Project. The EIS should include and incorporate adequate information for us and the region to make an informed decision regarding the merits and drawbacks of this and all the other projects that will have similar significant effects. Please contact Audie Huber, our Inter-Governmental Affairs Manager, at audiehuber@ctuir.org or (541) 429-7228.

Sincerely,

Teara Farrow Ferman

for Eric Quaempts
Director, Department of Natural Resources

THE CONFEDERATED TRIBES OF THE WARM SPRINGS RESERVATION OF OREGON

Warm Springs, Oregon 97761 / 541 553-1161

November 18, 2013

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U.S. Army Corps of Engineers
c/o Danette Guy
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Vancouver, WA 98661

Cowlitz County Building and Planning
c/o Elaine Placido
207 4th Ave. N.
Kelso, WA 98626

Re: Docket number 2013-19738: Comments on scope of EIS for Millennium Bulk Terminals Longview LLC Coal Export Terminal

To Whom It May Concern:

The Confederated Tribes of the Warm Springs Reservation is possessed of treaty reserved rights pursuant to the Treaty With the Tribes of Middle Oregon that was signed by those tribes and the United States on June 25, 1855. Therein the tribes reserved the right to fish at all usual and accustomed stations. That treaty is the basis for our co-management authority in the entire John Day Basin, the Deschutes Basin, the Hood River Basin, and the Willow Creek Basin extending from the west bank to the middle of the channel. This co-management authority extends

northward to the middle of the channel of the Columbia River between the mouth of Willow Creek and the Cascade Rapids.

Based upon the preceding cited rights and interests, the Confederated Tribes of the Warm Springs have substantial concerns regarding the submitted permit application. The environmental impact statement should include a consideration of unacceptable impacts to fisheries and fishing sites; adverse impacts to air and water quality; contribution to the adverse affects of climate change and the cumulative impacts throughout Oregon and Washington.

Fisheries

Coal negatively impacts fisheries resources. There are deleterious affects of increased ship traffic on migrating anadromous adult and juveniles. There will be an affect to tribal fishing sites that our fisherman use. Coal pollutants discharged into the Columbia River will negatively affect resident and anadromous fish. Mercury, emitted into the atmosphere from facilities that burn fossil fuel, travels thousands of miles before returning to Earth through rain, snow and dry depositions, ends up in the fish that tribal members consume.

Air and Water quality

Currently, coal dust is a problem in the Gorge, and would be exacerbated with an increase of coal traffic. Burlington Northern estimates that each car of coal loses 500 pounds of dust each trip, with each 100-car train potentially losing 50,000 pounds. Off-loading coal and coal pile storage at the terminal will result in dust spillage that would directly affect the river around the docks.

Coal dust contains arsenic and polycyclic aromatic hydrocarbons (PAHs), a known carcinogen. High levels of both contaminants have been found in the soil around coal piles, and arsenic can leach into water. A recent report signed by doctors in Washington noted that airborne coal dust has been associated with bronchitis, emphysema, and asthma.

Climate Change

Coal will be burned in northeastern Asia. Such power plants emit mercury, which travels the jet stream to the Northwest. Generating electricity through the burning of fossil fuels, in particular carbon-heavy coal, has a greater impact on the atmosphere than any other single human activity.

Cultural Resources

There is, along with a concern with the environmental laws and values, a concern for cultural values that fall under the cultural laws. Inasmuch as cultural and environmental (natural) values are intermingled, tribal members have always lived their lives such that the environmental elements have shaped their cultural and traditional beliefs. This Terminal project provides numerous concerns as the water in which fish are harvested, for subsistence, ceremonial or commercial purposes may be impacted negatively by the coal dust. Though the applicant assures reviewers that this is not the case, it is actually an unknown. The soils that the water will be in contact with grow cultural foods and fibers for traditional basket weaving, or Tules used in ceremonies. This uncertainty of the impacts is a concern to the membership as it may affect their livelihood, their traditions, and the passing on of knowledge to tribal youth. This uncertainty portends that there is likely an impact on our way of life.

Cumulative Impacts

The shipment of coal through the Northwest will have broad and pervasive impacts. These diverse and vast cumulative impacts will lead to serious, irreversible consequences on the water quality, air quality, and other treasured values throughout the region. NEPA was intended, to "foster and promote the improvement of environmental quality to meet the conservation, social, economic, health, and other requirements and goals of the Nation."

Conclusion

Accordingly, the Confederated Tribes of the Warm Springs Reservation requests that the responsible agencies undertake, within the context of the preparation of an environmental impact statement, the consideration of the impacts of the shipment of coal through Oregon and Washington, including, but not limited to, impacts to the air and water quality, climate change, fisheries resources, public health and safety, cultural traditions, and ecosystems

Sincerely,

Robert A. "Bobby" Brunoe

General Manager

Branch of Natural Resources

Confederated Tribes of Warm Springs

Confederated Tribes and Bands
of the Yakama Nation

Established by the
Treaty of June 9, 1855

November 18, 2013

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Re: Comments on the Scope of the NEPA & SEPA EISs for the Proposed Millennium Bulk Terminal at the Port of Longview

Dear Federal and State Officials:

On behalf of the Yakama Nation, I submit for the record the following information and positions regarding the scope of environmental analysis required for the proposed Millennium Bulk Terminal at the Port of Longview, in addition to the coal industry's proposed regional plans for our lands and waters.[1] The Yakama Nation is a federally recognized sovereign Nation created by the Treaty of 1855 with the United States (12 Stat. 951). The Treaty reserves for tribal members certain rights and resources that are necessary to maintain our customary way of life. Among these reserved rights is the right to fish at all Usual and Accustomed places, including the Columbia River. The proposed coal loading facility, dock, increased coal train traffic, and Panamax ships associated with this project would create direct adverse impacts — far beyond any *de minimis* threshold — to Treaty rights, including, among other things, Treaty-reserved salmon, steelhead, lamprey, and other resources critically important to the Yakama Nation and its People.

First and foremost, because of the significant and irreparable direct and indirect impacts that the proposed Millennium Bulk Terminal would have on the Yakama People and our Treaty-reserved rights and resources, the Yakama Nation requests that the U.S. Army Corps of Engineers (Corps), Washington State Department of Ecology (Ecology), and Cowlitz County each deny Millennium's

[1] The Yakama Nation expressly reserves its right to supplement or amend these comments and add to the record to whatever extent permissible under applicable laws and regulations.

applications to construct and operate a bulk terminal for coal export in Longview, Washington. The Millennium Bulk Terminal proposal would permanently violate the Yakama Nation's Treaty rights to fish, hunt and gather traditional foods. It will also potentially result in irreparable harm to the Yakama Nation's cultural resources.

Yakama Nation's Treaty rights in the Columbia River area have been recognized recently in federal court; notably through an injunction imposed to prohibit the shipment of Hawaiian garbage through Yakama ceded lands. In *Confederated Tribes and Bands of the Yakama Nation v. United States Department of Agriculture*, a case concerning the federal agencies' failure to adequately address the Yakama Nation's concerns in permitting a plan to ship garbage from Hawaii through Yakama ceded lands, Judge Shea held that the Yakama Nation was likely to "prevail on [its] NEPA claims that the EA and FONSI failed to adequately analyze the environmental impacts of shipment and receipt of Hawaiian garbage to the Roosevelt Landfill, **which is located on lands ceded by the Yakama Nation, wherein tribal members enjoy 'in common' usufructuary rights** … Further [the Court found that] there are serious questions about whether Defendants adequately consulted with the Yakama Nation as required by the Yakama Treaty of 1855 and federal Indian trust common law."[2] The situation before the permitting agencies is analogous to the 2010 Hawaiian garbage case. There, federal agencies did not seriously analyze Treaty-protected rights that would be impacted along the route proposed to transport Hawaiian garbage.

To be clear, Yakama Nation will not negotiate nor agree to so-called mitigation for any violations or actions resulting in the diminishment or destruction of its Treaty-reserved rights and Treaty-protected resources. Put simply, there is no mitigation adequate to compensate my Tribe and its People for the continued degradation of our sacred places, the incremental but constantly worsening damages to our natural resources that sustain our culture, and the threats to the livelihoods and cultural practices of many Yakamas.

As we previously requested (letter dated October 28, 2013), Yakama Nation expressly requests government-to-government consultation with the U.S. Army Corps of Engineers on all aspects of the proposed coal export projects, including the Millennium Bulk Terminal.

YAKAMA NATION CONTINUES TO ASK FOR A COMPREHENSIVE, REGION-WIDE ENVIRONMENTAL ANALYSIS OF ALL COAL EXPORT PROPOSALS

If your agencies do not deny the coal export permit applications outright, Yakama Nation again reiterates its request that a comprehensive, region-wide environmental impact statement (EIS) be completed by the Federal government. In our review of the three proposals[3] for coal-related actions pending before the Army Corps of Engineers — including the one that these comments are focused upon — it is self-evident that these proposals "will have cumulative or synergistic environmental impact[s] upon a region," and therefore "their environmental consequences must be considered together."[4] In turn, we submit that under long-standing Supreme Court precedent concerning the interplay between coal-related proposals and Federal agencies' environmental obligations under

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[2] *Confederated Tribes and Bands of the Yakama Nation v. United States Department of Agriculture*, 2010 WL 3434091 (E.D. Wash. 2010)(emphasis added).

[3] Coyote Island Terminal at Port of Morrow, OR; Gateway Pacific Terminal at Cherry Point, WA; Millennium Bulk Terminal at Port of Longview, WA

[4] *Kleppe v. Sierra Club, et al.*, 427 U.S. 390, 410, 96 S.Ct. 2718 (1976).

federal law, "[o]nly through comprehensive consideration of pending proposals can the [permitting] agency evaluate different courses of action."[5]

In any event, because of the significant impacts this particular proposal will have, federal law requires agency consideration of the "cumulative impacts" resulting from the proposed project. Federal regulations define cumulative impacts as:

> the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.[6]

Therefore, even if the agency determines that a comprehensive region-wide EIS is not required in this instance, the cumulative impacts of the Millennium Bulk Terminal proposal in addition to all other coal-related projects in the region, plus all separate *current, past, and reasonably foreseeable future* environmentally taxing uses of the area — and in particular, the Columbia River and adjoining lands — all should be considered as the permitting agencies execute their respective duties to analyze cumulative impacts with respect to the Millennium Bulk Terminal project under federal and other applicable laws.[7]

Given the fragile and already damaged ecosystem immediately surrounding the proposed site of the Millennium Bulk Terminal and the entire region, as well as the long history of Treaty violations from energy development in the region that permanently and irreparably have harmed my People, it is imperative for the permitting agencies to analyze all impacts from the coal's origins in the Powder River Basin or otherwise, through our Ceded and Usual and Accustomed Use Areas, to burning the coal in Asia. Failure to complete such critical analyses is an unacceptable derogation of your responsibilities at the expense of our people, the environment, and our economy.

COMMENTS ON THE SCOPE OF THE MILLENIUM BULK TERMINAL EIS

As you are aware, the proposed Millennium Bulk Terminal would be located on a now defunct aluminum production facility that is currently undergoing a remedial investigation under Washington State's Model Toxics Control Act (MTCA). The state cannot short-cut cleanup of the current contamination onsite to accommodate a new use. Some of the contaminants at the proposed Millennium Bulk Terminal site include fluoride, cyanide, metals, and PCBs, which have all been shown to be toxic to aquatic receptors. The EIS should include a full description of the extent of the contamination and how a coal port can be constructed without impeding the implementation of a remedy that is fully protective of Yakama Nation's resources. It seems impossible that a proper EIS can be completed if the nature of the contamination is still being characterized and the method of cleanup, including cleanup levels, has not been determined. Yakama Nation expects that the post-remedy conditions of the site will be fully resolved and disclosed in the environmental review of the

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[5] *Id.*

[6] 40 C.F.R. § 1508.7.

[7] *Lands Council v. Powell*, 395 F.3d 1019, 1027 (9th Cir. 2005); *see also Mountaineers v. United States Forest Service*, 445 F.Supp.2d 1235, 1247 (W.D. Wash. 2006)(finding that cumulative impacts analyses are required even in federal agencies' preparations of EAs).

Millennium Bulk Terminal proposal.

With that, Yakama Nation recommends that the scope of the Millennium Bulk Terminal EISs to be completed under the National Environmental Policy Act (NEPA) and the State Environmental Policy Act (SEPA) include evaluations of all potential impacts to our cultural and Treaty-reserved resources, our environment, public health and safety, and to our economies. We also request that these cumulative impacts be studied on a region-wide level, from the coal's origins in the Powder River Basin, through our homelands, to the final destination, including the impacts to our region from the intended use of the coal at its final destination. From our initial assessment and understanding, the potential impacts associated with transporting and burning the coal would result in direct and indirect damages to our People, natural and cultural resources, economies, and our ability to exercise our Treaty-reserved rights.

We commend the Washington State Department of Ecology on its decision to identify and analyze the full range of impacts associated with the Cherry Point coal-related proposal, including transportation-related impacts through the state, climate change effects, etc. We not only urge, we request the permitting agencies here to follow this same leadership and responsible governance, to the extent Millennium's permits are not denied outright. The U.S. Army Corps of Engineers cannot ignore nor defer its Trust and legal responsibilities to analyze all project impacts, including direct and cumulative impacts under NEPA, the National Historic Preservation Act (NHPA), and other applicable federal laws. By delegating its responsibilities to the State, as the Corps seems to be choosing to do with the Gateway Pacific Project at Cherry Point, the Federal government is failing to uphold its Trust responsibilities to the Yakama Nation. It is the Federal government's responsibility to ensure that the Yakama Nation's Treaty rights, resources and People are protected, as guaranteed under the Treaty of 1855.

Accordingly, Yakama Nation requests that the Millennium Bulk Terminal EISs prepared by the U.S. Army Corps of Engineers under NEPA and Washington State Department of Ecology under SEPA include, in addition to the general scope of issues described above, shall include, but not be limited to an analysis of impacts to and a discussion of geology and soils; vegetation, fish and, wildlife; water quality, runoff/absorption; air quality, climate, and climate change; energy and natural resources; environmental health, noise, risk of fire or explosion, releases of potential releases of toxic or hazardous materials; land and shoreline use; economic, population, housing, and employment; historic and cultural resources; aesthetics; transportation, including vehicular, waterborne, and rail traffic; and public services and utilities. Specific examples include, but are not limited to:

- A safety analysis of the potential impacts at current and projected levels of rail traffic to tribal fishers, their customers, and tribal members on and near the Yakama Reservation and especially through the Columbia River Gorge. Tribal members are exposed to train-strike risk when crossing rails to access homes, fishing sites, and markets for the sale of harvested fish. A sad history of train-related fatalities at current levels of rail traffic naturally suggests that elevated levels of rail traffic in the Columbia Basin, particularly through the Columbia Gorge, will increase mortalities to tribal members attempting to exercise Treaty reserved fishing and food gathering rights at usual and accustomed places. The probability of train-strike fatalities, injuries, and property damage can be quantified based on these tragic statistics, and the EIS should analyze the expected additional mortalities to tribal members and others that would be caused by the projected increase in rail traffic associated with this proposal. Similarly, tribal members and others would be exposed to increased health and safety risks created by the empty

coal trains transiting the Yakama Reservation and other rail lines in central Washington on the return trip to the Powder River Basin.

- An assessment of track capacity and traffic control measures necessary to handle the projected 16 additional unit trains that would deliver coal to the Millennium Bulk terminal. This should include an assessment of vehicle traffic delays and economic costs to communities bisected by rail lines.

- An analysis of the likelihood and frequency of coal train derailments, shipping spills, and fire and explosion probabilities, and the impacts that such incidents would have on the terrestrial and aquatic environments. This risk analysis can and needs to be quantified. Coal train derailments are common and their impacts are real. The EISs shall also include a discussion of how such incidents would be handled, who would respond, and which parties and/or agencies would be responsible for clean-up.

- An analysis of the emissions from rail and ship traffic, terminal operations, and combustion by the end users. This emissions analysis needs to include types, quantities and effects to human health and the environment. Specific examples include how these emissions would exacerbate the currently compromised air quality in the Columbia River Gorge (from local and Asian sources), toxicity levels in our rivers and fish, as well as climate change and ocean acidification.

- An analysis of the amounts and effects of the fugitive coal dust that would be deposited upon our lands and waters at the terminal and during transport through the Columbia Basin and across the Northern Pacific Ocean. We have observed and it has been documented that current coal trains are already depositing coal dust on our lands and into our waters in the region. Further, fugitive dust onsite poses direct threats to the aquatic environment. Stormwater management and fugitive dust suppression methodologies need to be discussed. These cumulative impacts need to be quantified and discussed in relation to Clean Water Act requirements, among other applicable laws, regulations, and Treaty rights.

- An analysis of impacts to all cultural resources, including Traditional Cultural Properties. As with the scope of analysis under NEPA and SEPA, Yakama Nation expects that the Area of Potential Effect (APE) for the Millennium Bulk Terminal shall include the entire transportation route, including impacts from the coal's origins through our Usual and Accustom areas and our Ceded Lands to its final destination in Asia. There are over 10,000 historic properties documented along the entire route, and many more that are yet to be identified. We expect that the APE will not be limited to the Millennium Bulk Terminal site, but will also include the proposed Port of Morrow and Cherry Point coal export terminal sites, in addition to the entire route from Montana to Asia. Yakama Nation expects that all impacts to cultural and archaeological resources will also be analyzed under the NHPA and any other laws applicable to archaeological and cultural resources.

- An analysis of all impacts to aquatic and terrestrial species and habitat along the transportation route, at the proposed site of the Millennium Bulk Terminal, and adjacent to the shipping channel westward of the terminal. The proposed Millennium Bulk Terminal is located adjacent to the Lower Columbia River. This section of river is designated as Critical Habitat for Endangered Species Act (ESA)-listed salmon and steelhead populations and is so designated because every single salmon originating above this point migrates through this section of river as a juvenile and

as a returning adult. The construction and operation of this facility poses threats to populations of salmon, steelhead and other aquatic species of cultural importance such as the Pacific Lamprey. Further, the operation of Panamax-class ships is certain to increase the incidence of wake-stranding juvenile salmonids and lamprey in the lower Columbia adjacent to the shipping channel. The EIS should assess the potential magnitude of additional wake stranding mortality associated with the project proposal.

Thank you for your time and consideration. Yakama Nation stands prepared to help provide any information you may need in developing your respective EISs. To arrange our government-to-government meeting between the Corps and Yakama Nation, please contact Philip Rigdon, Deputy Director of Yakama Nation Department of Natural Resources at (509) 865-5121 extension 4655.

Sincerely,

Harry Smiskin, Chairman
Yakama Nation Tribal Council

CC: Honorable Governor Jay Inslee, Washington State
Honorable Governor John Kitzhaber, Oregon State
Paul Cloutier, U.S. Army Corps of Engineers
Dennis McLerran, U.S. Environmental Protection Agency
Will Stelle, National Marine Fisheries Service
Robyn Thorson, U.S. Fish & Wildlife Service
Daniel Elliot III, Surface Transportation Board
Nancy Sutley, Council on Environmental Quality
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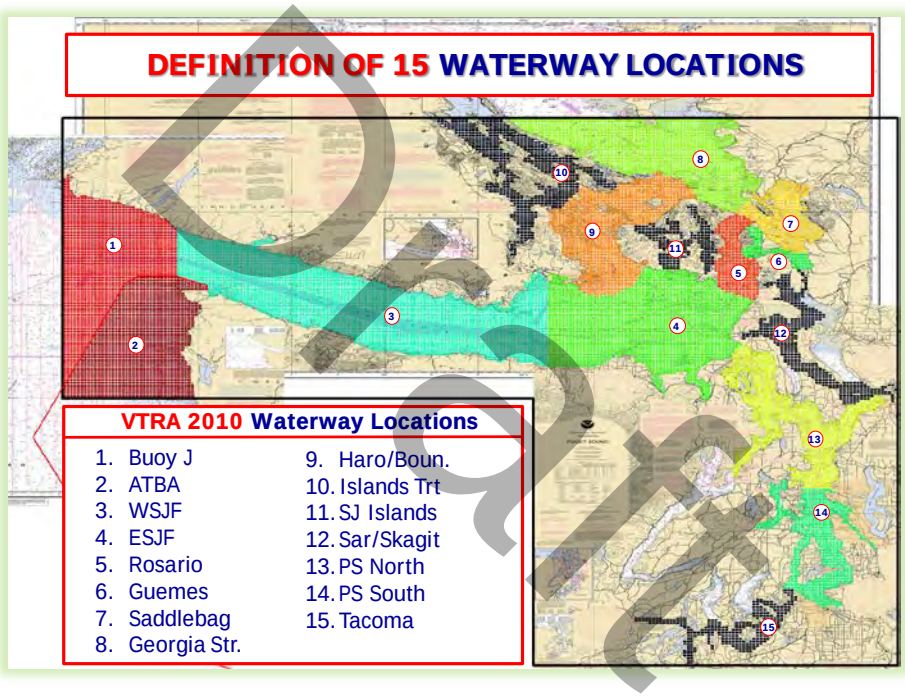
Paul Lumley, Columbia River Inter-Tribal Fish Commission

Final Report

Vessel Traffic Risk Assessment (VTRA):

Preventing Oil Spills from Large Ships and Barges

In Northern Puget Sound & Strait of Juan de Fuca



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THE GEORGE WASHINGTON UNIVERSITY
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September 2013

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Washington State Puget Sound Partnership

Draft

Final Report

Vessel Traffic Risk Assessment (VTRA):

Preventing Oil Spills from Large Ships and Barges

In Northern Puget Sound & Strait of Juan de Fuca

September2013

Draft

Approved by:

Signature: Date

Johan Rene Van Dorp, George Washington University

Signature: Date

Jason Merrick, Virginia Commonwealth University

Signature: Date

Todd Hass, Contract Manager, Puget Sound Partnership

Publication Information

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The contents of this document do not necessarily reflect the views and policies of the EPA or the PSP, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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PREFACE

This report is submitted by Johan Rene van Dorp (GW) and Jason R.W. Merrick (VCU). The content of the report describes the 2010 Vessel Traffic Risk Assessment (VTRA). To distinguish the study described herein from the previous 2005 VTRA study conducted 2006-2008 it will be labeled the 2010 VTRA or VTRA 2010. The starting point for the 2010 VTRA analysis is the updated 2005 VTRA model with 2010 VTOSS data, as agreed upon in the scope of work between GWU and the PSP. The update of VTRA Maritime Transportation System (MTS) simulation model from using 2005 Vessel Traffic Operational Support System (VTOSS) data to using 2010 VTOSS data was separately funded by the Makah Tribal Council.

Both this Puget Sound Partnership (PSP) and the Makah effort utilize the extensive technical work already completed by the George Washington (GW) University and Virginia Commonwealth University (VCU) under previously funded maritime risk assessment (MRA) projects. Specifically, the Prince William Sound Risk Assessment (1996), The Washington State Ferry Risk Assessment (1998), The San Francisco Bay Exposure Assessment (2004) and the 2005 Vessel Traffic Risk Assessment (VTRA). GW/VCU's VTRA analysis tool evaluates the duration that vessels travel through the VTRA study area by vessel type (referred to as exposure hereafter) and the potential accident frequency and oil losses from a pre-defined class of focus vessels. The inclusion of a time on the water element in the evaluation of exposure sets the GW/VCU methodology apart from count based approaches that focus on, for example, number of annual/monthly vessel transits, visits or calls. The GW/VCU VTRA analysis methodology has been well documented and peer-reviewed in the academic literature and continuously improved over the course of these MRA projects. A reference list is provided at the end of this document.

The VTRA study area includes: (1) portions of the Washington outer coast, (2) the Strait of Juan de Fuca and (3) the approaches to and passages through the San Juan Islands, Puget Sound and Haro-Strait/Boundary Pass. The VTRA area is divided in 15 separate waterway locations outlined on the cover of this report. This study has been funded wholly or in part by the United States Environmental Protection Agency (EPA) through their National Estuary Program, via a grant agreement (#2013-028) with the PSP.

From the outset of this project the support from the United States Coast Guard (USCG) District 13, including Sector Puget Sound, and the Puget Sound Harbor Safety Committee (PSHSC) have been unwavering. In particular, Mark Ashley's (USCG), John Veentjer's (Chair of the PSHSC), Del Mackenzie's (Puget Sound Pilots) and Norm Davis' (Department of Ecology) support have been instrumental in providing the necessary data for both the Makah funded VTRA update and the PSP funded VTRA 2010. The PSHSC unselfishly extended their hospitality to allow GW/VCU to present their progress over the course of this project during their meetings every two months starting in October 2012. The PSHSC provided GW/VCU a public platform to obtain feedback from and access to the maritime community during the VTRA update and the 2010 VTRA. A PSHSC steering committee served as an advisory group during both studies.

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EXECUTIVE SUMMARY

PLACE HOLDER
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1. INTRODUCTION

Washington State shares the Salish Sea with the province of British Columbia. A large number of ships and barges operate in these shared waters, placing the area at risk for major and catastrophic oil spills. While citizens in the region enjoy a relatively safe marine transportation system compared to most other port states in the world, the potential for catastrophic spills continues to be a huge concern for the region's environment, economy and quality of life, and the impact of a major spill would likely be devastating on the long-term restoration and protection of Puget Sound.

The purpose of the 2010 VTRA is to inform the State of Washington and the United States Coast Guard on what potential actions should be taken to mitigate any increase in oil spill risk from large commercial vessel oil spills in the northern Puget Sound and the Strait of Juan de Fuca areas. The VTRA study area includes: (1) portions of the Washington outer coast, (2) the Strait of Juan de Fuca and (3) the approaches to and passages through the San Juan Islands, Puget Sound and Haro-Strait/Boundary Pass. The VTRA study area is divided in 15 separate waterway locations outlined on the cover of this report and is expected to experience significant changes in deep draft vessel traffic during the next decade. The 2010 VTRA is also intended to inform federal agencies, tribes, local governments, industry and non-profit groups in Washington State and British Columbia on potential risk management options and facilitate their input into achieving consensus risk management decisions regarding vessel operations in the study area

The development of the 2010 VTRA followed the collaborative analysis approach [1] involving coordination with a Puget Sound Advisory group/steering committee of stakeholders selected early on in the VTRA 2010:

"*In collaborative analysis, the groups involved in a policy debate work together to assemble and direct a joint research team, which then studies the technical aspects of the policy issue in question. Representative from all the participating groups are given the ability to monitor and adjust the research throughout its evolution. Collaborative analysis aims to overcome suspicions of distorted communication giving each group in the debate the means to assure that other groups are not manipulating the analysis. The ultimate goal is to generate a single body of knowledge that will be accepted by all the groups in the debate as a valid basis for policy negotiations and agreements. – George J. Busenberg, 1999.*"

In this study, the Puget Sound Advisory group/steering committee chose to model only the traffic level impacts of planned expansion and construction projects that were in advanced stages of a permitting process. Each planned project forms a What-If scenario and What-If vessels are added to a maritime simulation of the 2010 Base Case year. Four What-If scenarios were modeled in the study:

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- The Gateway bulk carrier terminal
- The Trans-Mountain pipeline expansion
- The combination of proposed changes at Delta Port
- All three of above scenarios operating at the same time

The steering committee determined that the following numbers of What-If vessels would be added to the 2010 Base Case simulation in each scenario:

- The Gateway bulk carrier terminal
    - 487 bulk carriers (318 Panama class and 169 Cape Max class)
- The Trans-Mountain pipeline expansion
    - 348 crude oil tankers (each 100,000 DWT)
- The combination of proposed changes at Delta Port
    - 348 bulk carriers and 67 container vessels
- All three of above scenarios operating at the same time

Moreover, the steering committee recommended that bunkering operations supporting these potential expansion projects be represented as well in the 2010 VTRA.

The VTRA 2010 utilizes the extensive technical work already completed by the George Washington (GW) University and Virginia Commonwealth University (VCU) under previously funded maritime risk assessment (MRA) projects. Specifically, the Prince William Sound Risk Assessment (1996), The Washington State Ferry Risk Assessment (1998), The San Francisco Bay Exposure Assessment (2004) and the 2005 VTRA. GW/VCU's VTRA analysis tool evaluates the duration that vessels travel through the VTRA study area by vessel type (referred to as exposure hereafter) and the accident frequency and oil losses from a pre-defined class of focus vessels. The inclusion of a time on the water element in the evaluation of exposure sets the GW/VCU methodology apart from count based approaches that focus on, for example, number of annual/monthly vessel transits, visits or calls. The GW/VCU VTRA analysis methodology has been well documented and peer-reviewed in the academic literature and continuously improved over the course of these MRA projects. A reference list is provided at the end of this document.

A summary of the 2005 VTRA methodology is provided in Section 2 with references to peer-reviewed publications and technical report dispersed throughout this summary. Needless to say, to more closely approximate the present-day patterns in traffic for What-If scenario analysis representing potential traffic expansions, it would be desirable for the GW/VCU VTRA 2005 analysis model to be updated with the most recent VTOSS dataset. The 2010 year is the last full year of traffic data recorded for VTOSS. The items below summarize the improvements made to 2005 VTRA methodology while updating the GW/VCU VTRA analysis model using the VTOSS 2010 efforts over the course of both the Makah and PSP funded efforts:

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1. The total focus vessel class in the VTRA 2010 accounts for approximately 25% of the total traffic picture, whereas the VTRA 2005 only accounted for 1% of the total traffic. The VTRA 2005 only considered BP Cherry point tankers, ATB's and ITB's within the focus vessel class[1]. As per the PSP SOW this focus vessel class was expanded to include all tankers, ATB's and ITB's, bulk carrier, container vessels and oil barges. Over the course of the VTRA 2010, also "Chemical Carriers" and "Other Cargo" were added to the VTRA 2010 focus vessel class. The chemical carrier class is about as large as the ATB one. The "Other Cargo" class is combined about as large as the container focus vessel class. The inclusion of both "chemical carrier" and "other cargo" to the focus vessel class provides for an even more comprehensive analysis.
2. Individual vessel routes segments are used in the VTRA 2010, rather than using representative routes that were used back in the VTRA 2005 to create a much more accurate traffic picture.
3. VTOSS 2010 data, which serves as the basis for the VTRA 2010, was validated against AIS 2010 data. This was not possible for the VTRA 2005 since at that time no AIS data was available. To accommodate this validation we:
    a. Introduced the notion of a vessel master type (Cargo-FV and Tank-FV) necessitated by vessel type misclassifications observed both in the VTOSS 2005 and VTOSS 2010 datasets.
    b. Added crossing line counting to the VTRA model to duplicate exactly the AIS 2010 crossing line count procedure.
4. Calculated speeds are used in VTRA 2010 model as opposed to sampled speeds in the VTRA 2005 to more accurately reflect exposure times of focus vessel classes.
5. In terms of potential oil outflow analysis we are considering overall oil loss, cargo oil loss and fuel oil loss and we are providing separate analyses for each. This is a change from the former "persistent oil" and "non-persistent oil" classification used in the VTRA 2005 and mentioned in the PSP SOW. However, the oil loss, cargo oil loss and fuel oil loss classification is more meaningful given the focus vessel class expansion.
6. Analysis capability was created to not only include more vessel types to the focus vessel class, but also allow for separation of the analysis by each focus vessel type, as well as the Tank-FV and Cargo-FV master type. Allowing for separation of analysis by focus vessel type may prove useful during the risk management phases.
7. The notion of What-If focus vessels was introduced to model the added traffic to the 2010 base year to represent the potential addition of Gateway, the Trans Mountain and Delta-Port expansions. This allows for a separation of added system risk into What-If focus vessel risk and risk added to the Base Case focus vessel class (as a result of adding What-If focus vessels).
8. A bunkering model was added to the VTRA 2010 model. Inclusion of a bunkering model to support these What-If focus vessels is an important part of the What-If analysis. The bunkering model addition to the VTRA model for What-If scenarios was not foreseen during

[1] During the 2005 VTRA, focus vessels were referred to as Vessels Of Interest (VOI's)

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the initial SOW negotiations and was not included in 2005 VTRA. Analysis capability was created to allow for separation of What-If risk into "bunkering risk" and "Other What-If FV" risk.

9. The comprehensiveness of the analysis makes synthesis into an overall system view that highlights important aspects of analysis results more challenging. A great deal of time was spent to develop an analysis presentation format to arrive more easily at such a systems view of risk. Most importantly, these synthesized presentation and analysis results will allow stakeholders (hopefully) to still see "the forest through the trees". It is important for stakeholders to have this overall systems view prior to devising risk management suggestions.
10. Progress presentations and detailed scenario result presentations are available in electronic portable document format (pdf) from a VTRA 2010 project web-page:

    http://www.seas.gwu.edu/~dorpjr/tab4/publications_VTRA_Update.html

In Section 3, we describe the updating of the 2005 VTRA model to the 2010 VTRA in more detail. In Section 4, the validation of GW/VCU model crossing line counts using AIS 2010 crossing line counts is described. Section 5 describes VTRA 2010 focus vessel traffic movement and the movement of oil volume that these focus vessels carry. The information described in Section 5 serves as the starting point for the base case VTRA 2010 potential accident frequency and oil outflow analysis described in Section 6. The modeling of What-If scenario's and the changes in potential accident frequency and potential oil outflow from the VTRA 2010 Base Case is presented in Section 7. In Section 8, similar analysis results are presented for a variety of risk management scenario, whereas Section 9 describes the construction of two bench mark scenarios to compare the What-If and risk management scenario's against. The comparison of What-If, risk management and bench mark scenario's is presented in Section 10. We close the report with conclusions and recommendations in Section 11.

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2. SUMMARY OF 2005 VTRA MODEL METHODOLOGY

Is it safer for a river gambling boat in New Orleans to be underway than to be dockside? Should wind restrictions for outbound tankers at Hinchinbrook Entrance in the Prince William Sound Alaska be lowered from 40 knots to 35 knots? Is investment in additional life craft on board Washington State Ferries in Seattle warranted or should the International Safety Management (ISM) code be implemented fleet wide? Can enhanced ferry service in San Francisco Bay and surrounding waters alleviate traffic congestion on roadways in a safe manner? Do potential traffic increases made possible through the addition of a pier terminal at a refinery located north of the San Juan Islands in Washington State increase or reduce oil transportation risk?

The risk management questions above were raised in a series of projects over a time frame spanning more than 10 years and were addressed using a single risk management analysis methodology developed over the course of these projects by a consortium of universities. This methodology centers around stakeholder involvement and dynamic maritime risk simulations of a Maritime Transportation Systems (MTS) that also integrate incident/accident data collection, expert judgment elicitation and consequence models [2]-[3]. Our model represents the chain of events that could potentially lead to an oil spill (see Figure 1).

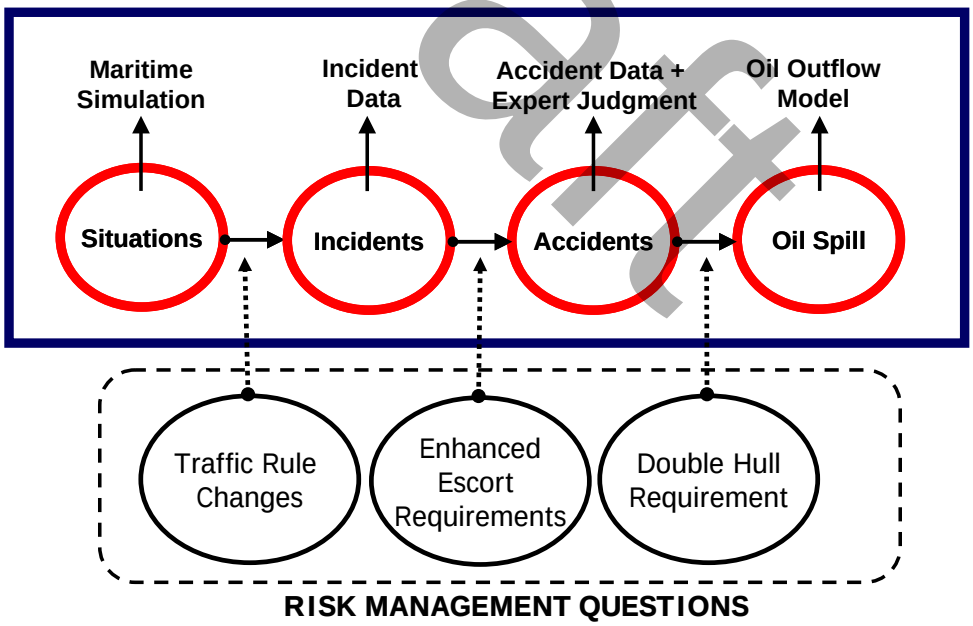

Figure 1.A causal chain of events inter-connected by causal pathways. Risk management questions attempt to block these causal pathways.

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It has been peer reviewed by the National Research Council [4], top experts in the field of expert elicitation design and analysis, and has been continuously improved over time since its initial development in 1996. The model has previously been used in the Prince William Sound Risk Assessment ([5]-[8]), the Washington State Ferries Risk Assessment[9], and the Exposure Assessment of the San Francisco Bay ferries [10]. The model was most recently used during the 2005 VTRA [11] - [13]. Prior to updating with 2010 VTOSS data, data use and model assumptions of the VTRA model have been peer-reviewed [2] - [13].

Our analysis approach of involving stakeholders has been referred to in [1]as the collaborative analysis approach:

"In collaborative analysis, the groups involved in a policy debate work together to assemble and direct a joint research team, which then studies the technical aspects of the policy issue in question. Representative from all the participating groups are given the ability to monitor and adjust the research throughout its evolution. Collaborative analysis aims to overcome suspicions of distorted communication giving each group in the debate the means to assure that other groups are not manipulating the analysis. The ultimate goal is to generate a single body of knowledge that will be accepted by all the groups in the debate as a valid basis for policy negotiations and agreements. – George J. Busenberg, 1999."

The following is a brief description of this modeling approach. The updating of the 2005 VTRA model using 2010 VTOSS data shall occur in the same collaborative manner by making progress presentations to the Puget Sound Harbor Safety Committee.

Situations (see Figure 1):

Accidents can only occur when vessels are transiting through the system. Our maritime simulation model attempts to re-create the operation of vessels and the environment for one calendar year within the geographic scope of the study through maritime simulation/ replication. The traffic modeled re-plays the movement of VTS participating vessels (using 2005 VTOSS data) and simulates the movement of smaller fishing vessels, whale watchers, and organized regatta events over a set of representative routes using representative vessel speeds. Representative vessel routes were constructed by vessel type using the 2005 VTOSS data set. Figure 2provides a graphic of the 158 representative routes constructed for Oil Tankers.Vessels speeds are sampled from representative speed distribution by vessel type estimated using the West Strait of Juan de Fuca 2005 VTOSS data. Figure 3 plots example representative speed distributions for oil tankers, container vessels, bulk carrier and navy vessels used in the 2005 VTRA study. From Figure 3 one observes that the speed profile for oil tankers and bulk carriers is quite similar, whereas container vessels typically travel at higher speeds. The speed profile for navy vessels indicates a lot of variation in

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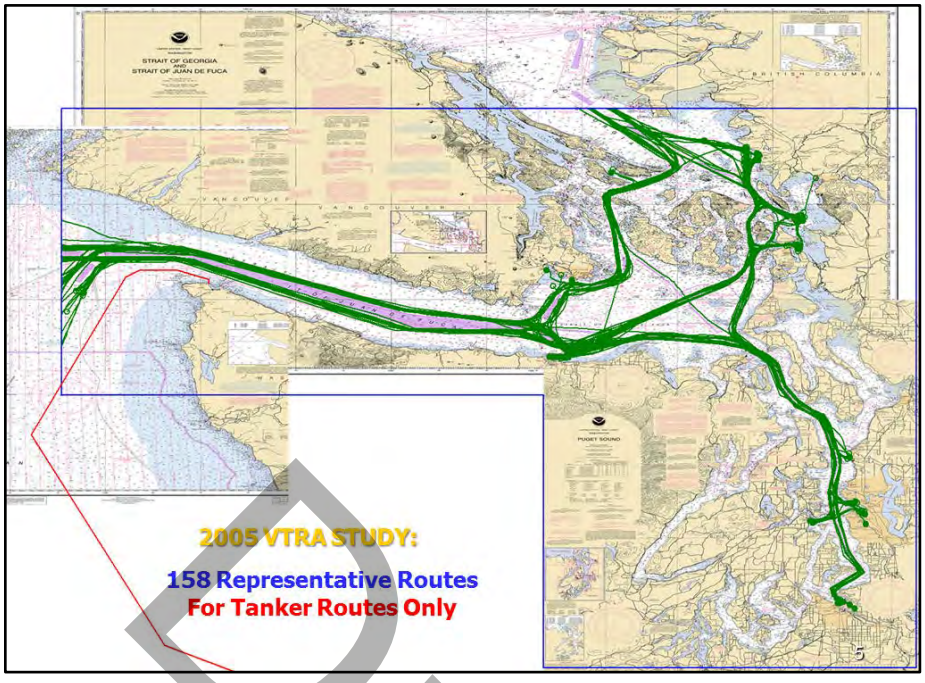

Figure 2.Graphic of 158 representative routes for oil tankers used in VTRA 2005 MTS simulation model.

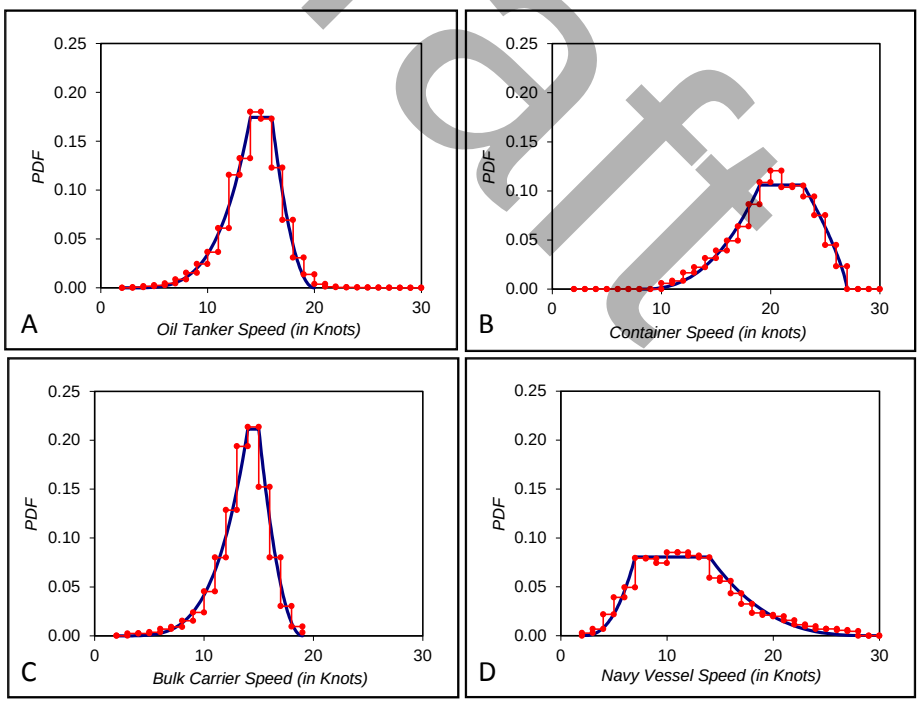

Figure 3.Example representative speed distribution for oil tankers (A), container vessel (B), bulk carriers (C) and navy vessels (D) estimated from VTOSS 2005 data. Step functions indicate the empirical probability distribution functions (pdf), whereas the solid lines are fitted Generalized Trapezoidal Distributions (GTD)[18].

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their speeds compared to the other vessel types in Figure 3. For each vessel type a representative speed distribution was fitted from vessel West Strait of Juan de Fuca speeds observed in the VTOSS 2005 data. A vessel's sample speed is assumed constant throughout its transit, but subject to location speed changes trumped by traffic rules speed changes according to study area traffic rules implemented in the 2005 VTRA model. Location speed multipliers were estimated by comparing average speeds by vessel type for locations East Strait of Juan de Fuca, Haro-Strait/Boundary Pass, Rosario Strait, Georgia Strait, Guemes Channel, Saddelbag. Puget Sound North, and Puget Sound South to the average West Strait of Juan de Fuca speeds.

The environmental factors modeled include wind, fog, and current. They are replayed hourly using publicly available data sources, such as e.g. the National Climatic Data Center. (See, also [11], AppendixC). The update of the 2005 VTRA also includes updating to 2010 current tables. Other environmental conditions from the 2005 VTRA model are retained as well as traffic modeled therein not calling into VTS centers. Specifically, tribal and commercial fisheries, scheduled and USCG permitted regatta events and whale watching movements from the 2005 VTRA model are retained.

Every minute over a simulation calendar year, the 2005 VTRA model counts situations of moving vessels in which there is the potential for an accident to occur if things start to go wrong (see, e.g., [2]). The traffic conditions and environmental conditions are recorded in these situations and stored in a database representing a one year analysis scenario (for example the base case and various What-If traffic scenarios).

Incidents (see Figure 1):

Incidents are the events that immediately precede the accident. The types modeled include, propulsion losses, total steering losses, loss of navigational aids, and human errors. An exhaustive analysis of all possible sources of study area relevant accident, near miss, incident, and unusual event data was performed (see, e.g. [11], Appendices A and B).

Accidents (see Figure 1):

The accident types included in this study are collisions between two vessels, groundings (both powered and drift), and allisions that involving the FV's. The simulation counts the situations in which accidents could occur, while recording all the variables that could affect the chance that an accident will occur; these include the proximity of other vessels, the types of the vessels, the location of the situation and its wind, visibility and current. We know how often accidents do occur from our analysis of incident and accident data, but there is not enough data to say how each of these variables affect the chances of an

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accident; accidents are rare[2]! The VTRA model is calibrated to historically observed, but geographically restricted accident and incident data (see [11], Appendix E). As such, the annual accident and incident rates generated by the VTRA model for the base case scenario coincide with geographically restricted historically observed accident and incident rates.

To determine how accident situations differ in terms of relative accident likelihood, we must turn to the experts due to this lack of data. We ask experts to assess the differences in risk of two similar situations that they have extensive experience of (See Figure 4 for an example question). In each question we change only one factor and through a series of questions we build our accident probability model, incorporating the data where we can. Our expert judgment elicitation procedure is described in detail in [2], [14]. The experts involved include typically tanker masters, tug masters, pilots, Coast Guard VTS operators, and ferry masters. A full description of the process, experts and series of questionnaires conducted during the 2005 VTRA is provided in [11], Appendix E. No additional expert judgment elicitation is conducted forthe update of the 2005 VTRA Model using 2010 VTOSS data.

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Oil Spill (see Figure 1):

An oil outflow model [3]for collision and grounding accidents explicitly links input variables such as hull design (single or double, see Figure 5), displacement and speed, striking vessel displacement and speed, and the interaction angle of both vessels to output variables (see Figure 6): longitudinal and transversal damage extents of the tanker. Overlaying these damage extents on a vessel's design (see Figure 6) yields an oil outflow volume totaling the capacity of damaged tank compartments. A similar model was developed for grounding accidents during the 2005 VTRA. A total of 80,000 simulation accident scenarios described in the National Research Council SR259 report [15]published in 2001 served as the joint data set of input and output variables used in this "linking" process. The oil outflow model was designed keeping computational efficiency in mind to allow for its integration with a maritime transportation system (MTS) simulation. A full description of the oil outflow model developed during the 2005 VTRA including its parameters and their estimation is provided in [11], Appendix D.

Format of Scenario Analysis Results and Comparisons (See Figure 7)

A potential risk mitigation scenario to be analyzed with the VTRA update is whether from a vessel risk perspective it makes sense to allow for bulk carriers docking at the Gateway

[2] Over the course of our various studies typically less than ten accidents were observed in a time frame of ten years or more to calibrate the VTRA model.

Situation 1	TANKER DESCRIPTION	Situation 2
Strait of Juan de Fuca East	**Location**	-
Inbound	**Direction**	-
Laden	**Cargo**	-
1 Escort	**Escorts**	-
Untethered	**Tethering**	-
	INTERACTING VESSEL	
Shallow Draft Pass. Vessel	**Vessel Type**	-
Crossing the Bow	**Traffic Scenario**	-
Less than 1 mile	**Traffic Proximity**	-
	WATERWAY CONDITIONS	
More than 0.5 mile Visibility	**Visibility**	-
Along Vessel	**Wind Direction**	-
Less than 10 knots	**Wind Speed**	25 knots
Almost Slack	**Current**	-
Direction	**Current Direction**	-

Complete Propulsion Loss		
More? : ____	**9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9**	**____ : More?**
Situation 1 is worse	**<==========X==========>**	**Situation 2 is worse**

Complete Steering Loss at a Moderate Angle		
More? : ____	**9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9**	**____ : More?**
Situation 1 is worse	**<==========X==========>**	**Situation 2 is worse**

Complete Navigational Aid Loss		
More? : ____	**9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9**	**____ : More?**
Situation 1 is worse	**<==========X==========>**	**Situation 2 is worse**

Human Error		
More? : ____	**9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9**	**____ : More?**
Situation 1 is worse	**<==========X==========>**	**Situation 2 is worse**

Nearby Vessel Incident (but you do not know the specifics)		
More? : ____	**9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9**	**____ : More?**
Situation 1 is worse	**<==========X==========>**	**Situation 2 is worse**

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Figure 4.Example question during 2005 VTRA of a paired comparison questionnaire of situations for tanker collision accident attribute parameter assessment given all incidents.

facility being considered to travel north through Haro-Strait Boundary Passes as opposed to only using a northerly route through Rosario Strait. The 2005 VTRA only modeled a northerly route for Gateway vessels through Rosario Strait. 2005 VTRA model output allows for a visual assessment of the effectiveness of a risk mitigation scenario by comparing its geographic profile of vessel risk to that of other vessel traffic risk mitigations scenarios to a baseline geographic profile of vessel traffic risk (see Figure 7 for an example of such a geographic profile of vessel risk). An advantage of the geographical profile display format in Figure 7 is that it allows for a direct visual assessment of the distribution of the analysis results and thus provides for an understanding of system risk. For example, we immediately observe from Figure 7larger risk levels in the areas of Rosario Strait, Haro-Strait Boundary Pass, Guemes Channel and at route convergence locations at Buoy J and Port Angeles. A visual comparison of a baseline scenario generated geographic profile and

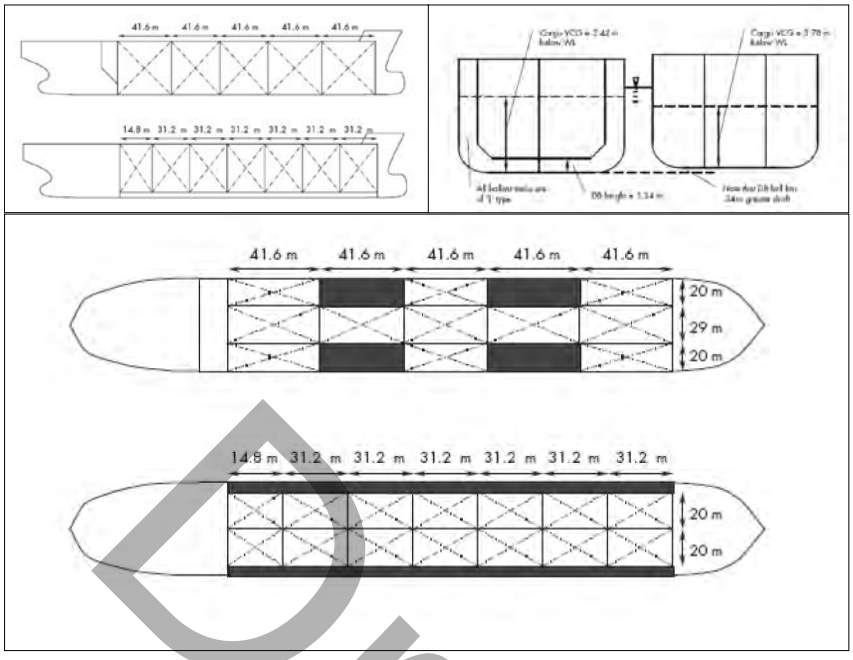
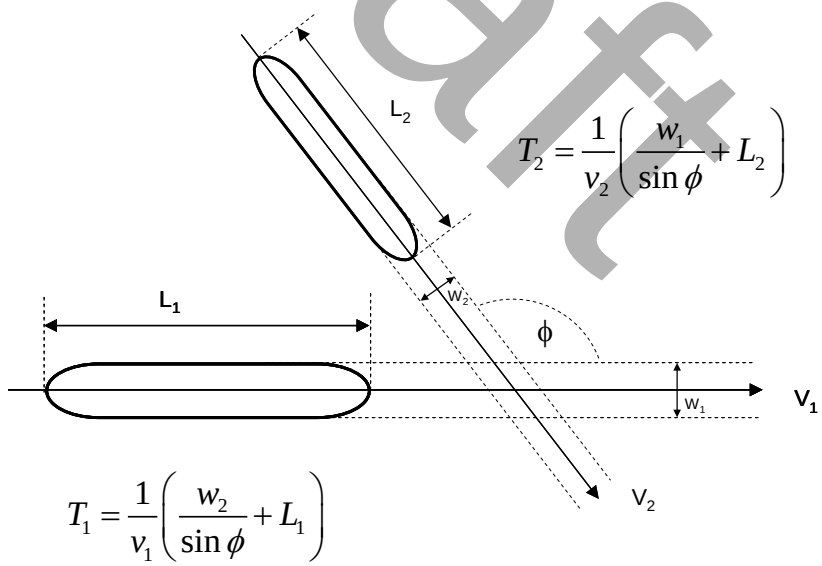


Figure 5. Single hull and double hull 150.000 DWT tanker designs used in 2005 VTRA taken from the National Research Council SR259 report [15].



$$T_2 = \frac{1}{v_2}\left(\frac{w_1}{\sin\phi} + L_2\right)$$

$$T_1 = \frac{1}{v_1}\left(\frac{w_2}{\sin\phi} + L_1\right)$$

Figure 6.A schematic of a striking ship-struck ship probability model used in the 2005 VTRA.

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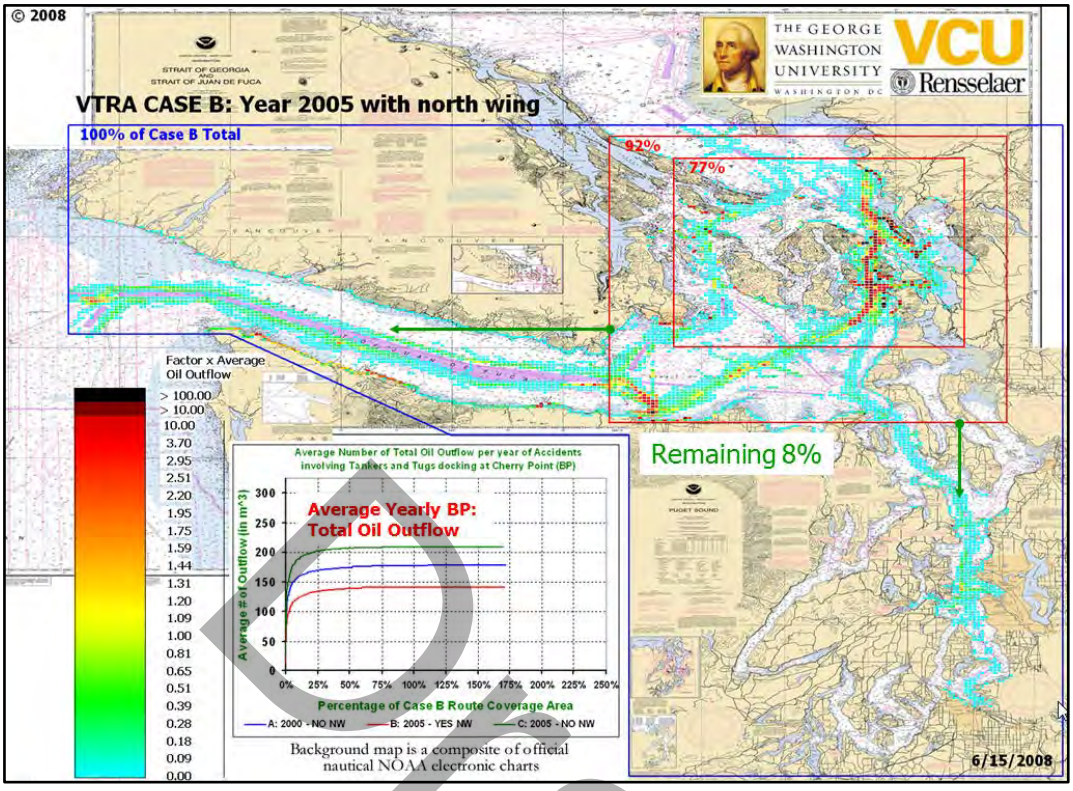

Figure 7.An example of a geographic profile of oil spill risk (generated during the 2005 VTRA).

that of a What-If and risk mitigation scenario allows for a visual assessment of potential increases and decreases in risk and their location. The percentages in the top left corners of the red rectangles and blue border of the study area in Figure 7 allow for a more quantitative evaluation of system risk and its changes from a baseline scenario to What-If and risk mitigation scenario analysis results. The fact that in Figure 7 the percentage in the top left of the blue border equals 100% implies that this is a baseline geographic profile. For a more detailed explain of geographic risk profile interpretation see [12].

Sensitivity and Uncertainty of Analysis Results

More data is being made available electronically over time allowing for an even more accurate representation of the movement of vessel traffic and modeling of the accident scenarios within an MTS simulation. As a result, the movement of traffic within the MTS simulation more resembles a replication of how vessels actually moved rather than simulating them. An example being that every vessel in the MTS simulation arrives and departs as per the VTOSS 2010 data while retaining its route segments and vessel characteristics, such as e.g. its own vessel name. No doubt, this added level of detail reduces

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model uncertainty to a great extent. The evaluation of model uncertainty is not accounted for in traditional sensitivity/uncertainty analysis approaches.

With the increased availability of this electronic data, however, the time to prepare it in an electronic format that can serve as input to an MTS simulation increases as well. Despite these advances, one should always bear in mind that any model is an abstraction of reality in which simplifying assumptions are often necessitated to maintain computational efficiency. The increase of computational complexity to reduce model uncertainty within the 2005 VTRA methodology, does unfortunately not allow for the application of traditional sensitivity/uncertainty analysis of output analysis results. We are pushing computational boundaries of existing computation platforms that the 2005 VTRA model runs on. As a result, we find that solely relative comparisons across accident types, across oil outflow categories and across risk intervention scenarios are particularly enlightening and informative and we concentrate less on the absolute values of the results in our analysis comparisons.

That being said, uncertainty of output analysis results for the 2005 VTRA methodology has been studied and funded by the National Science Foundation for smaller analysis context instances (See,[16],[17]). In these studies it was concluded that ranking of scenarios/alternatives are robust within our analysis methodology with respect to changes in vessel traffic.

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3. UPDATING THE 2005 VTRA GW/VCU MODEL USING VTOSS 2010 DATA

By updating the 2005 VTRA model to a 2010 base year, it will more closely approximate the present-day patterns in traffic when using the GW/VCU VTRA analysis model to inform, for example, the State of Washington and the United States Coast Guard on what potential actions should be taken to mitigate increases in oil spill risk from large commercial vessel oil spills in the northern Puget Sound and the Strait of Juan de Fuca areas. The data source for modeling Vessel Traffic Service (VTS) responding traffic in the 2005 VTRA model was VTOSS 2005 data. Figure 8 displays the VTOSS coverage area including the Seattle, Tofino and Victoria VTS that service this area covering both US and Canadian waterways. An advantage of the VTOSS data is that it provides a single US -Canadian cross boundary data source for the three VTS providers. However, this too provides for one of the challenges when modeling vessel traffic as recording across these three VTS providers in the VTOSS data set is not consistent. For example, a vessel travelling through these three VTS areas on a single transit is assigned three separate trip ID's, one for each VTS.

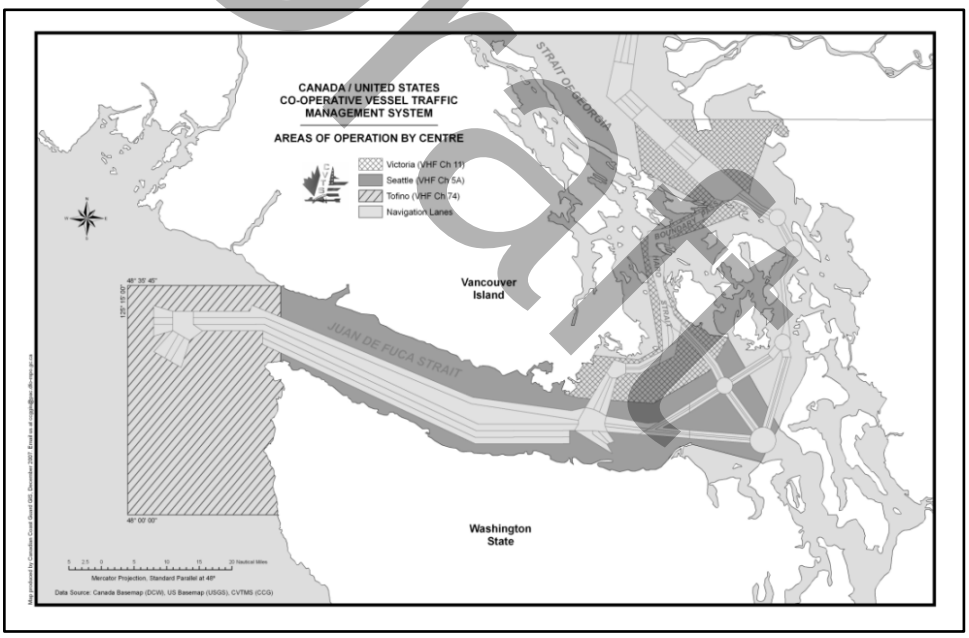

Figure 8.Coverage area of the Vessel Traffic Operational Support System (VTOSS).

To deal with thisparticulardata issue, a modeling decision was made during the 2005 VTRA to resort to the construction of representative vessel routes by vessel type. In total,1756 representative vessel routes, depicted in Figure 9, were constructed to model all VTS responding traffic (both US and Canadian). Of that, a relative large number of 158 representative routes, depicted in Figure 3, were constructed to model the movement of oil

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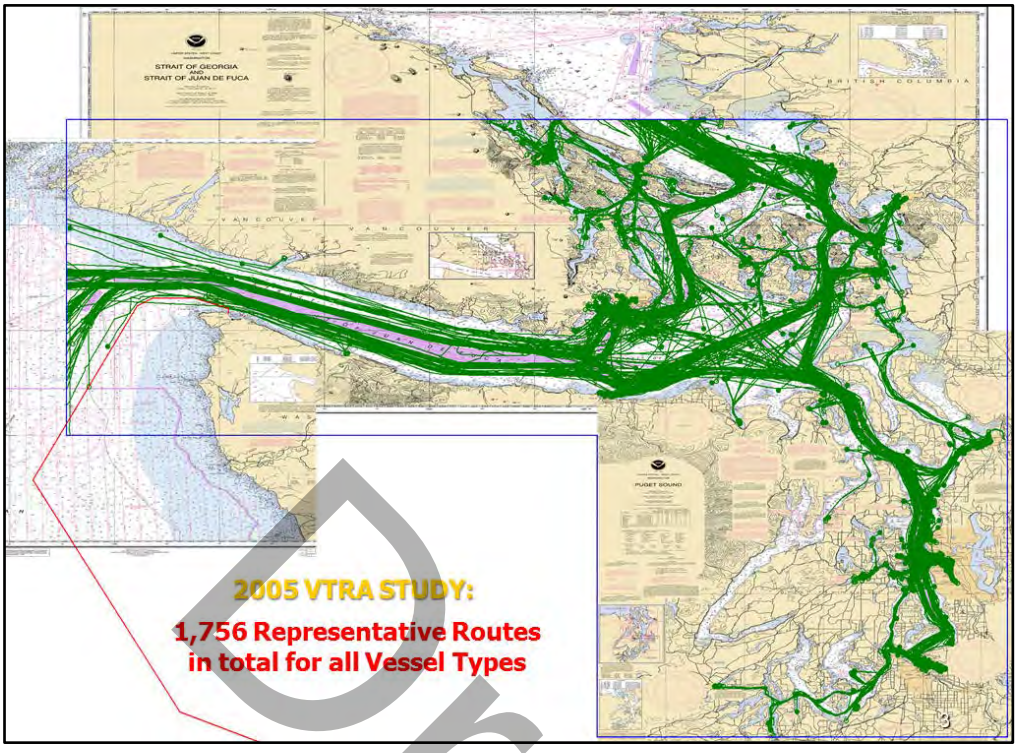

Figure 9. In total 1756 representative vessel route were constructed from 2005 VTOSS data during the 2005 VTRA to model the movement of VTS responding traffic in the GW/VCU MTS simulation model.

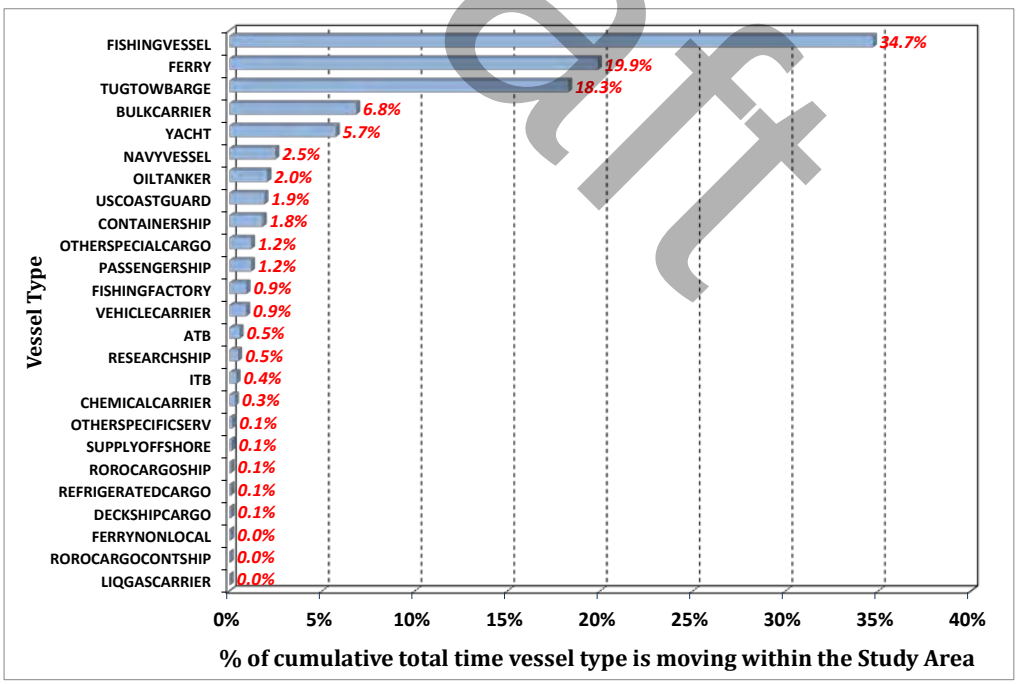

Figure 10. Tornado diagram displaying the cumulative percentage of time a vessel of a certain type is moving with the study area in the 2005 VTRA model over the course of one simulation year.

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tankers (≈ 2% of all traffic, see Figure 10). For example, only 22 representative routes were utilized to model container traffic (≈ 2% of all traffic, see Figure 10) and 47 to model bulk carrier traffic (≈ 7% of all traffic, see Figure 10). The specific routes for container vessels and bulk carrier in the 2005 VTRA are depicted in Figure 11. A relative large number of representative routes was selected in modeling oil tanker traffic during the 2005 VTRA since oil tankers were part of the FV group in that study, whereas container vessels and bulk carriers were considered IV's, not FV's.

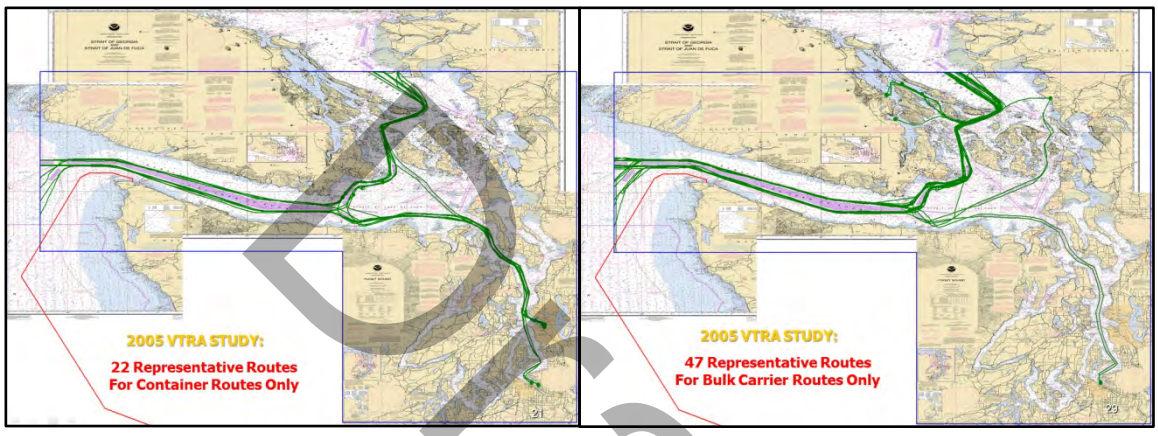

Figure 11. In total 22 (47) representative vessel route were constructed from 2005 VTOSS data during the 2005 VTRA to model the movement of container vessel (bulk carrier) traffic in the GW/VCU MTS simulation model.

To allow for inclusion of container vessel and bulk carriers in the focus vessel group for further analyses with the GW/VCU VTRA model, it would appear that a higher number of routes for these vessel types would be desirable. To that end, a modeling decision was made in updating the 2005 VTRA model to 2010 VTOSS data to attempt to retain a vessel's individual route throughout its transit rather than resorting to representative routes by vessel type. In that manner, FV group selection is not affected by a route modeling approach.

Algorithmic cleaning of VTOSS 2010 data

The VTOSS 2010 data consists of a set of waypoints of vessels along with identifying information about the vessel and the VTS center that collected the data point. Since 2005, VTOSS also added a trip identification number that indicates a set of waypoints for a particular vessel transiting through one VTS center's area. However, each VTS center assigns a different trip identification number to a vessel as it transits through the system leaving route segments and not complete routes. In addition, frequent alternative spellings of vessel names were observed. Once the vessel names were disambiguated, as many route segments as possible were connected algorithmically to make complete routes of vessels

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transiting the system.Figure 12's shows the result of algorithmically connecting route segments and depicts the remaining modeling challenges alluded to previously. Needless to say, remaining errors are apparent in the Figure 12.

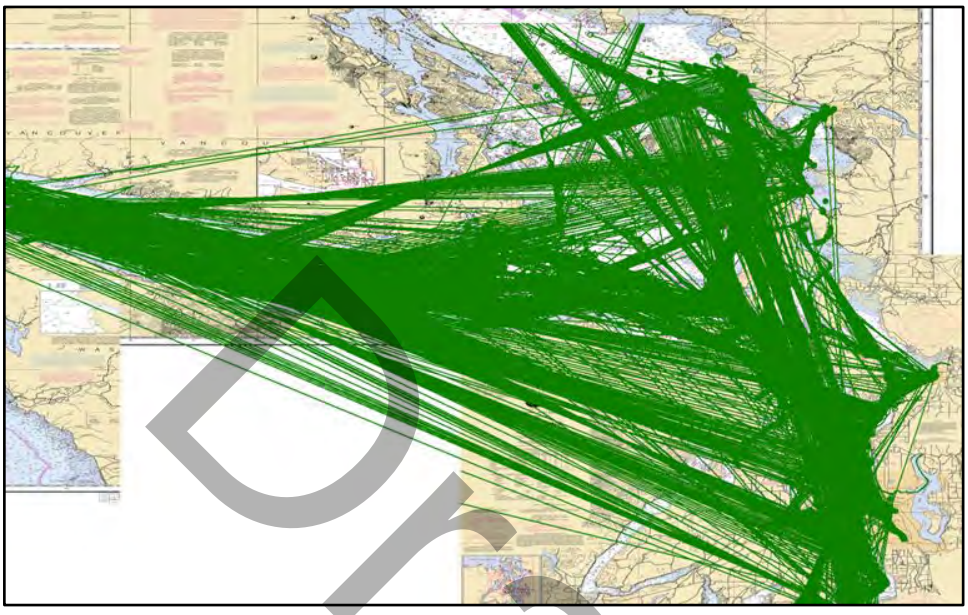

Figure 12. Route plots of the VTOSS 2010 data after algorithmically joining route segments.

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Multiple VTOSS data phenomena cause the errors observed in Figure 12. Firstly, the time of collection of each waypoint is recorded in the VTOSS data and is used to sort the waypoints in order to form a route. The time is recorded using a 24 hour clock, but points occurring in the hour after midnight are frequently recorded as 12:xx instead of 00:xx. This causes the points recorded as 12:xx to be a mixture of the vessel's location after midnight and after midday, causing the route to zigzag back and forth as shown inFigure 13.Another problem was caused by pieces of a route not being recorded by VTOSS, leaving non-contiguous pieces of a route connected by a straight line. In yet other cases, the same VTS center can assign a new identification number half way through a vessel's transit through their waters. Also simple errors were observed in identifying the location of the vessel as shown inFigure 14.

Additional algorithms were developed to remove a large proportion of the data inaccuracies depicted in Figure 12, Figure 13 and Figure 14. These algorithms were also designed to reduce the size of the VTOSS dataset by removing intermediate points when a vessel was in fact movingin a straight line. Once developed, these algorithms took one

month to run on the approximately 50GBs of VTOSS 2010 data on a MacBrook Pro with a 2.7 Ghz Intel Core i7, 16 GB of 1600 Mhz DDR3 RAM, and 768GB SSD hard drive.

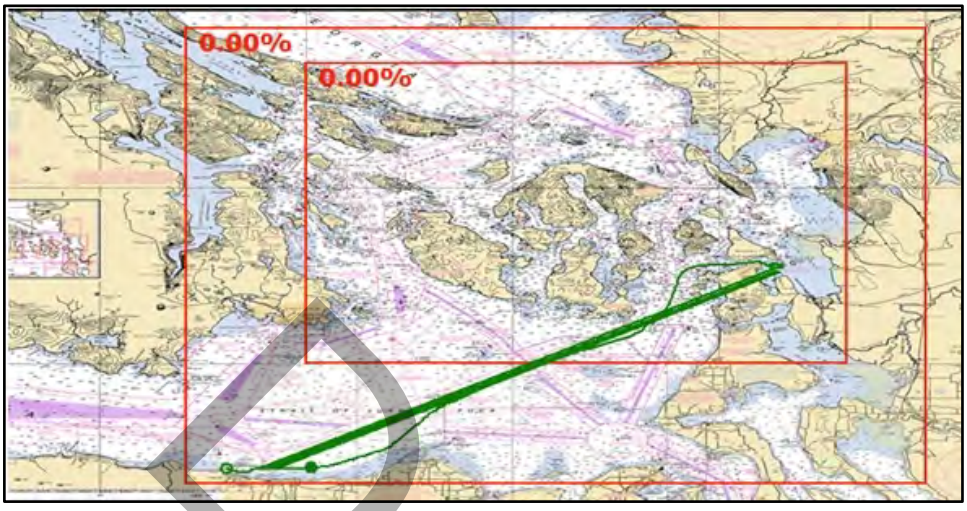

Figure 13.A route affected by the time problem after midnight in the VTOSS 2010 data.

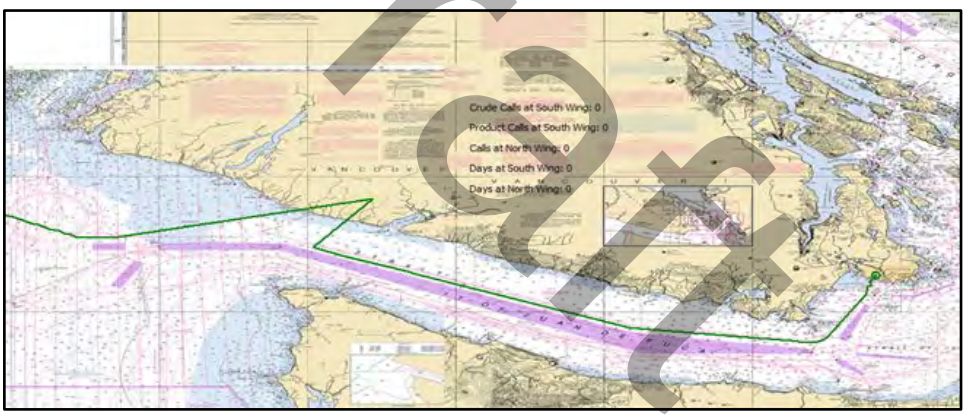

Figure 14.A route affected by problems identifying the correct location of the vessel.

Manual cleaning of VTOSS 2010 data

Unfortunately, as shown in Figure 15'sleft panel not all data inaccuracies can be resolved mathematically and removed algorithmically. Despite algorithmically cleaning the VTOSS 2010 data to construct contiguous routes for a single transit, some route segmentation remains. Algorithmic cleaning of oil tanker routes resulted in 2,345 route segments for oil tankers (see left panel of Figure 15). Observe from of Figure 15's left panel that following algorithmic cleaning only, oil tanker routes segments still display errors as a result of electronic transmission problems when recording a vessel transit in the VTOSS data. To further correct for those errors these 2345 route segments were manually cleaned resulting in 2328 route segments for oil tankers depicted in Figure 15's right panel using

the VTOSS 2010 dataset. Recall that during the VTRA 2005 analysis a total of 1756 representative routes were constructed for all vessel types.

Comparing Figure 15's right panel with Figure 2 one observes a larger dispersion of oil tanker routes in of Figure 15 than in Figure 2. The same observation can be made when comparing the algorithmically and manually cleaned routes for container vessels and bulk carriers in Figure 16 using VTOSS 2010 data, with the representative routes depicted in Figure 11 for these vessel types in the 2005 VTRA. In total, following algorithmic cleaning only of VTOSS 2010 data to construct route segments by vessel type, 79,500 route segments remained. Needless to say, it would simply be too time consuming to subject all these route segments to a manual cleaning process. Instead, it is suggested to manually clean routes, as demonstrated in Figure 15 for oil tankers and for those vessel types that are selected to be in a FV group. In anticipation of inclusion of container vessels and bulk carriers in a FV group for scenario analyses their routes were manually cleaned as depicted in Figure 16.

Figure 17's left panel plots a route density for oil tankers generated using only the algorithmically cleaned routes displayed in Figure 15's left panel. Figure 17's right panel plots a route density for oil tankers using the both algorithmically and manually cleaned routes depicted in Figure 15's right panel. In Figure 17's left panel 99.6% of the tankers movements have a waterway location (see Figure 17) assigned, whereas in its right panel 100% of tanker movements have a location assigned. In plotting this density, vessel movements that have no assigned waterway location are not plotted. Figure 18 plots a graphic of the fifteen waterway location definitions to be used in the updated GW/VCU MTS model.

The locations ATBA (2), Islands Trust (10), San Juan Inlands (11), Saragota Skagit (12) and Tacoma were added as separate locations in the updated VTRA model. The location ATBA (2) was assigned an equivalency of the WSFJ (3) location for the purposes of accident probability model, whereas the other added locations were assigned an equivalency with the Guemes Channel location. The expansion of the number of waterway locations to accommodate an analysis for a larger class of focus vessels also required an expansion of the shoreline definition. The updated and expanded shoreline definition used in the VTRA 2010 model is depicted in Figure 19. Both the Department of Ecology and Puget Sound Pilots provided feedback on the shoreline definition in Figure 19 which plays an instrumental role in the analysis of grounding frequencies.

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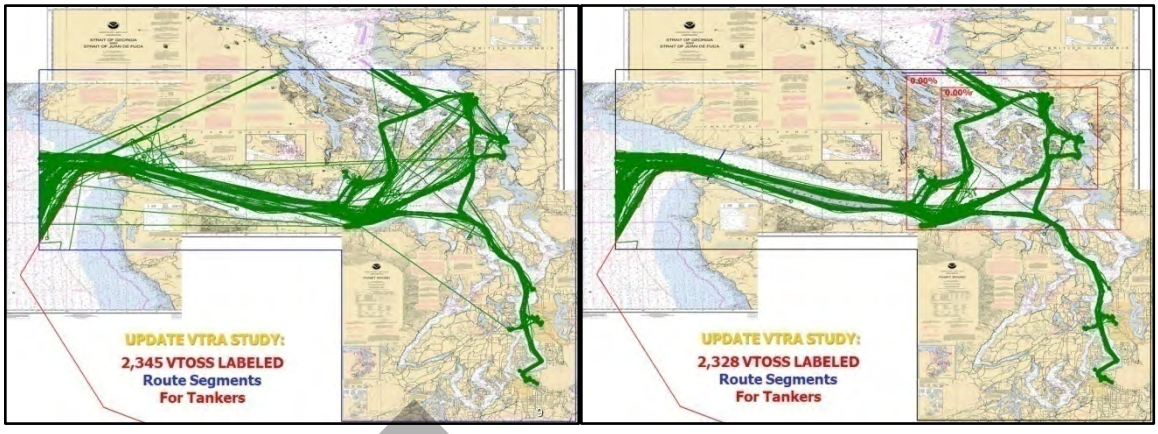

Figure 15. Left panel: 2,345 route segments after algorithmic cleaning of oil tanker routes. Right panel: 2328 route segments following manual cleaning of tankers routes following algorithmic cleaning.

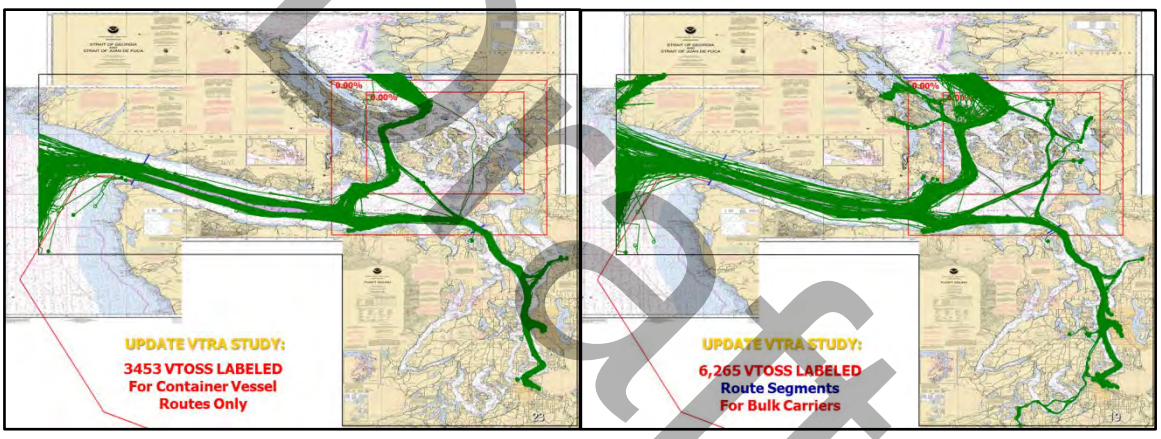

Figure 16. Left panel: 3,453 route segments after algorithmic and manual cleaning of container vessel routes. Right panel: 6265 route segments following algorithmic and manual cleaning of bulk carrier routes.

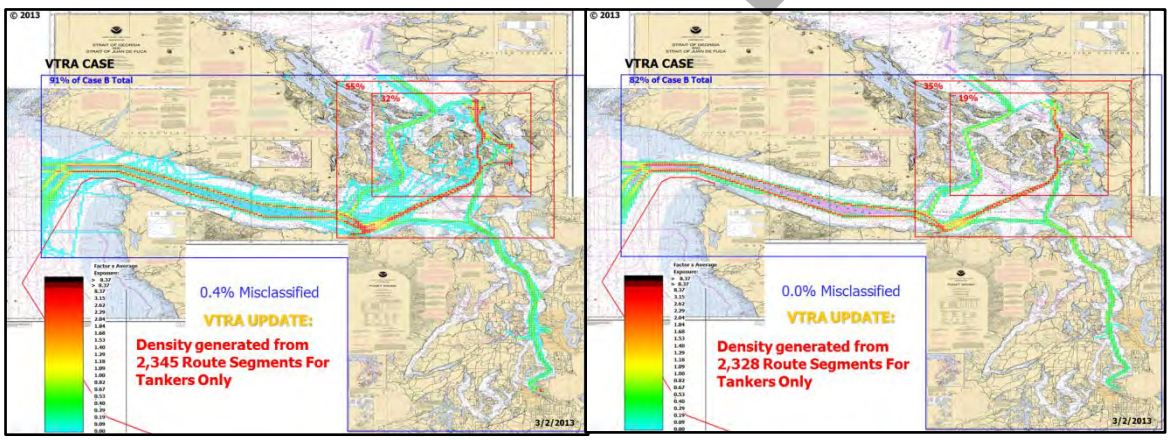

Figure 17.Left panel: Oil density tanker geographic profile generated using left panel routes in Figure 15. Right panel: Oil density tanker geographic profile generated using right panel routes in Figure 15.

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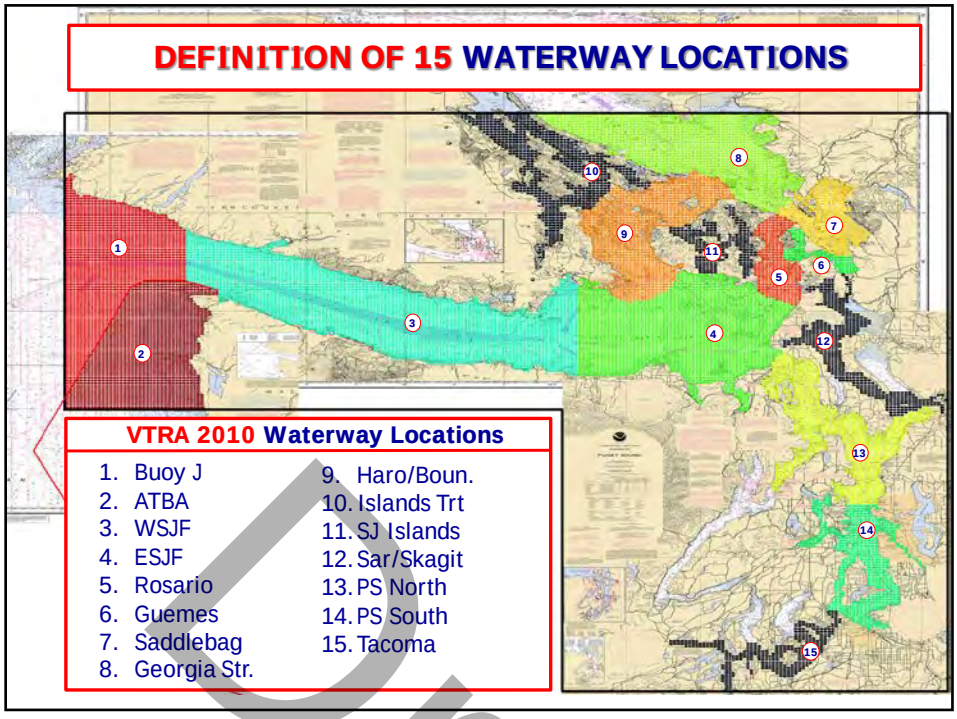

Figure 18. Location definitions used for the update of the GW/VCU MTS simulation from VTOSS 2005 to VTOSS 2010 data.

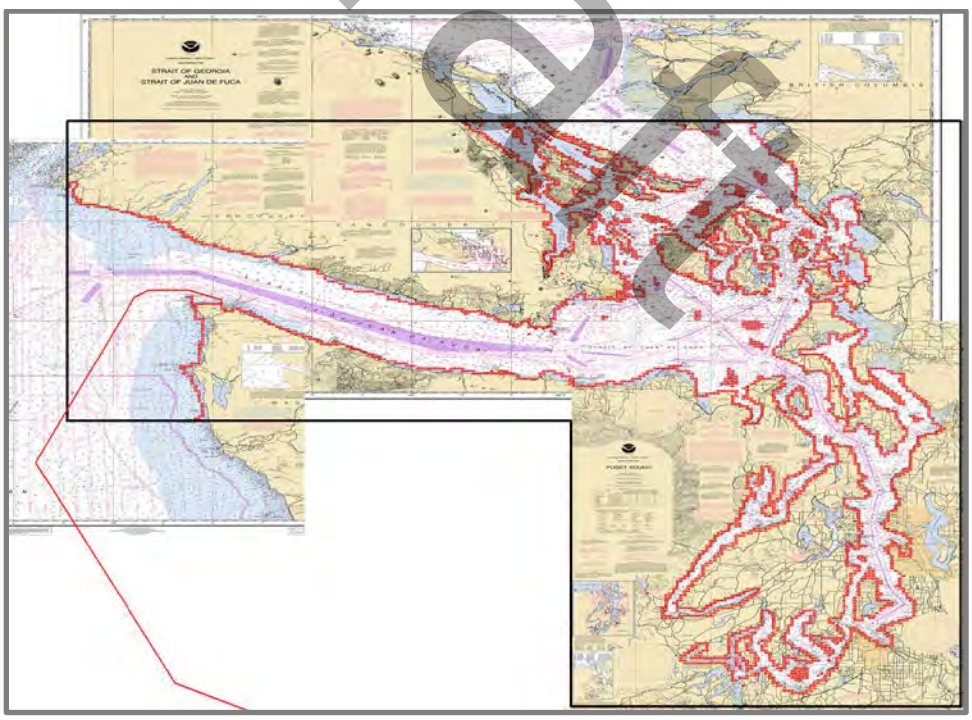

Figure 19. Expanded and revised shore line definition in VTRA 2010 model

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Vessel master type definition

Table 1 shows a sample list of vessel names in the VTOSS 2010 data for which different vessel types are assigned. The number of route segments for each alternative vessel type is provided in the second columns. An examination of Table 1reveals different vessel types that are commonly assigned to the same vessel name.

Some of the entries in Table 1 will indeed refer to different vessels that share the same name. In that case the different vessel types may be correctly assigned to the same vessel name. One suggestion to differentiate between vessels sharing the same name is to use Lloyd's identification numbers or other vessel identification numbers. Unfortunately, these identification numbers are not consistently entered across the three VTS centers Seattle, Tofino and Victoria providing the data for the VTOSS datasets. Thus, complete disambiguation of vessel names to vessel types is not possible.

Further examination of Table 1 also reveals vessel names that are assigned similar vessel types. Frequent groups of vessel types assigned to the same vessel names are:

1. Tanker and chemical carrier.
2. Ferry, non-local ferry, and passenger vessel.
3. Passenger vessel and yacht.
4. Container, bulk carrier, deck ship cargo, other special cargo, ro-ro cargo ship, ro-ro cargo container ship, vehicle carrier.
5. Research ship and other specific service vessel.

These similar classifications may also have been used differently across the three different VTS centers included in VTOSS 2010 dataset. To allow for this similar misclassification of vessel types, the vessel master type definition in Table 2 is introduced for the 26 vessel types in the VTOSS data sets. Observe from Table 2 that the vessel types in the first entry in the list above are counted as tankers, the second and third entries as passenger vessels, the fourth entry as cargo vessels, and the fifth entry as service vessels. This allows for meaningful comparisons between the VTOSS 2005 dataset and VTOSS 2010 dataset that are not affected by these similar vessel type misclassifications.

Misclassification of vessel types described above was also observed in the VTOSS 2005 data. However, about twice the number of route segments was involved as compared to the VTOSS 2010 dataset. Moreover in the VTOSS 2005 set misclassification across the vessel master type definitions in Table 2 were observed as well. For example, Table 3 shows a sample in the VTOSS 2005 dataset of cargo vessels that were sometimes classified as passenger vessels. Observe that in Table 3 that 50 transits (or route segments) were classified as passenger vessels when they should have been classified as cargo vessels. Moreover, in the VTOSS 2005 dataset route segments of vessels classified as passenger vessels were observed that did not have route segments classified as cargo vessels, but

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turned out to be cargo vessels when researched further. This problem was not apparent in the VTOSS 2010 data.

Table 1. A sample list of vessel names that are designated as different vessel types in VTOSS 2010

Vessel Name	# Route Segments	Vessel Type	Vessel Name	# Route Segments	Vessel Type
ABAKAN	3	BULK CARRIER	ALEXANDRIA BRIDGE	1	BULK CARRIER
ABAKAN	2	OTHER SPECIAL CARGO	ALEXANDRIA BRIDGE	2	CONTAINER SHIP
ADMIRAL PETE	22	FERRY (NONLOCAL)	ALIOTH LEADER	1	OTHER SPECIAL CARGO
ADMIRAL PETE	3	PASSENGER SHIP	ALIOTH LEADER	2	VEHICLE CARRIER
ADRIA ACE	1	OTHER SPECIAL CARGO	ALJALAA	3	CHEMICAL CARRIER
ADRIA ACE	2	VEHICLE CARRIER	ALJALAA	1	OIL TANKER
ADVENTURE	3	FISHING VESSEL	ALPINE PENELOPE	4	CHEMICAL CARRIER
ADVENTURE	1	YACHT	ALPINE PENELOPE	15	OIL TANKER
AEGEAN LEADER	4	OTHER SPECIAL CARGO	ALUMINATOR	14	FISHING VESSEL
AEGEAN LEADER	4	VEHICLE CARRIER	ALUMINATOR	2	TUG TOW BARGE
AFFINITY	5	CHEMICAL CARRIER	AMBA BHAVANEE	3	CHEMICAL CARRIER
AFFINITY	2	OIL TANKER	AMBA BHAVANEE	3	OIL TANKER
AKEMI	3	FISH(ING) FACTORY	AMERICAN BEAUTY	3	FISH(ING) FACTORY
AKEMI	1	FISHING VESSEL	AMERICAN BEAUTY	1	FISHING VESSEL
ALASKAN LEGEND	43	OIL TANKER	AMERICAN HIGHWAY	1	OTHER SPECIAL CARGO
ALASKAN LEGEND	1	YACHT	AMERICAN HIGHWAY	1	VEHICLE CARRIER
ALEUTIAN BEAUTY	2	FISH(ING) FACTORY	AMERICAN NO. 1	4	FISH(ING) FACTORY
ALEUTIAN BEAUTY	1	FISHING VESSEL	AMERICAN NO. 1	1	FISHING VESSEL
ALEUTIAN LADY	1	FISH(ING) FACTORY	AMETHYST ACE	3	OTHER SPECIAL CARGO
ALEUTIAN LADY	1	FISHING VESSEL	AMETHYST ACE	1	VEHICLE CARRIER
ALEX GORDON	5	SUPPLY (OFFSHORE)	AMY USEN	1	FISH(ING) FACTORY
ALEX GORDON	4	TUG TOW BARGE	AMY USEN	6	FISHING VESSEL
ALEXANDRIA BRIDGE	1	BULK CARRIER	ANDES	1	CHEMICAL CARRIER
ALEXANDRIA BRIDGE	2	CONTAINER SHIP	ANDES	1	OIL TANKER

Table 2. Master vessel type definition for the 26 VTOSS vessel type classification used in the GW/VCU MTS simulation model.

#	VESSEL TYPE	MASTER TYPE	#	VESSEL TYPE	Master Type
1	BULKCARRIER	Cargo	14	PASSENGERSHIP	Passenger
2	CHEMICALCARRIER	Tanker	15	REFRIGERATEDCARGO	Cargo
3	CONTAINERSHIP	Cargo	16	RESEARCHSHIP	Service
4	DECKSHIPCARGO	Cargo	17	ROROCARGOSHIP	Cargo
5	FERRY	Passenger	18	ROROCARGOCONTSHIP	Cargo
6	FERRYNONLOCAL	Passenger	19	SUPPLYOFFSHORE	Service
7	FISHINGFACTORY	Fishing	20	TUGTOWBARGE	Tugtow
8	FISHINGVESSEL	Fishing	21	UNKNOWN	Service
9	LIQGASCARRIER	Tanker	22	USCOASTGUARD	Service
10	NAVYVESSEL	Cargo	23	VEHICLECARRIER	Cargo
11	OILTANKER	Tanker	24	YACHT	Passenger
12	OTHERSPECIALCARGO	Cargo	25	ATB	Tanker
13	OTHERSPECIFICSERV	Service	26	ITB	Tanker

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Table 3.Cargo vessels that were classified as passenger vessels in the VTOSS 2005 dataset

Vessel Name	Cargo Transits	Passenger Transits	Vessel Name	Cargo Transits	Passenger Transits
BRIGHT STATE	15	3	MIDNIGHT SUN	8	3
BRIGHT STREAM	16	7	MORNING MELODY	3	2
CAPE HORN	7	5	NORTH STAR	4	4
DONG FANG GAO SU	2	2	REINA ROSA	3	3
GREAT LAND	3	4	SKAUBRYN	17	6
IGARKA	3	3	SKAUGRAN	18	2
IVORY ARROW	4	2	UNITED SPIRIT	5	4
Total	**50**	**26**	**Total**	**58**	**24**

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Comparing representative routes approach to the route segment approach

The fifth column in Table 4 provides by vessel master type the percentage of time that a waterway location is assigned to a vessel movement for the GW/VCU MTS simulation model using VTOSS 2005 data. Similarly, the fifth column in Table 5 provides by vessel master type the percentage of time that a waterway location is assigned to a vessel movement for the updated GW/VCU MTS simulation model using VTOSS 2010 data. Recall Table 2 provides the vessel master type definition used in the generation of Table 4 and Table 5 for the 26 vessel types in the VTOSS data sets. These percentages (in Table 4 and Table 5) are evaluated by dividing the number of minutes per year a vessel is moving within the MTS simulation with a waterway location assigned by the total number of minutes a vessel is moving (see the third and fourth columns in Table 4 and Table 5).

Table 4. Route and density data for 6 vessel master types generated using the GW/VCU MTS simulation model with 2005 VTOSS data and location definitions in Figure 18.

Vessel Master Type	# Represent. Routes	# Minutes per Year	# Minutes per year No Location	% Time Location Assigned	% of Traffic	Average # Vessels
Cargo	106	5344799	6821	99.9%	13.7%	10.2
Tanker	164	1313096	444	100.0%	3.4%	2.5
TugTow	1185	7272609	17925	99.8%	18.7%	13.8
Service	5	1039769	942	99.9%	2.7%	2.0
Passenger	164	9701338	54771	99.4%	25.0%	18.5
Fishing	132	14201790	64223	99.5%	36.5%	27.0
Total	1756	38873401	145126	99.6%	100.0%	74.0

Table 5. Route and density data for 6 vessel master types generated using the updated GW/VCU MTS simulation model with 2010 VTOSS data and location definitions in Figure 18.

Vessel Master Type	# Represent. Routes	# Minutes per Year	# Minutes per year No Location	% Time Location Assigned	% of Traffic	Average # Vessels
Cargo	14640	7468850	51583	99.3%	18.5%	14.2
Tanker	3340	1287457	2838	99.8%	3.2%	2.4
TugTow	40704	7927747	171967	97.8%	19.7%	15.1
Service	2458	614972	6730	98.9%	1.5%	1.2
Passenger	14521	9090031	40756	99.6%	22.6%	17.3
Fishing	3837	13920520	68899	99.5%	34.5%	26.5
Total	79500	40309577	342773	99.1%	100.0%	76.7

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The second column in Table 4 and Table 5 provides the number of route segments and representative routes used in the GW/VCI MTS simulation model using VTOSS 2005 and VTOSS 2010 data respectively. Although a slightly higher accuracy is observed in the fifth column in Table 4 (2005) compared to the fifth column in Table 5 (2010), a definite improvement in vessel route dispersion is observed by going from Figure 11 (2005) to Figure 16 (2010) for container vessels and bulk carriers. Thus by retaining a vessel's individual route using the VTOSS 2010 data, vessel movements in the updated GW/VCU MTS simulation are more representative than the former GW/VCU MTS model using the 2005 VTOSS dataset.

The percentage of total moving traffic by vessel master type, depicted in the sixth columns in Table 4 and Table 5, are evaluated by dividing the number of minutes in the third columns by the total sum of the third column. The average number of moving vessels by master type at any arbitrary point in time is evaluated by dividing the minutes in the third column in Table 4 and Table 5 by the total number of minutes in a calendar year. Thus in Table 4 (2005) the GW/VCU MTS model evaluated an average of 74.0 moving vessels in the system at any arbitrary point in time, whereas in Table 5 (2010) an average of 76.7 vessels was evaluated.

To illustrate the fluctuation in the number of vessels moving in the study area over a calendar year, however, Figure 20 plots the time series (every 15 minutes) of the number of vessels excluding ferries, yachts and fishing vessels for the GW/VCU MTS simulation model using VTOSS 2005 and VTOSS 2010 data. Figure 21 on the other hand plots this time series comparison for ferries, yachts and fishing vessels.

Both Figure 20 and Figure 21 serve as a reminder that "the world is not average" and that vessel risk, of which number of vessels moving in the system is a driver, is not a constant but a dynamic quantity that changes over time. The larger goal of vessel risk management

is to reduce the overall average risk level while managing the variation of the time series of risk by avoiding "high" risk spikes.

Moving from Sampled Speeds to Calculated Speeds

As discussed in Section 2, the 2005 simulation sampled speeds from the distribution of all vessel speeds of a given type of vessel in the 2005 VTOSS database. So a given container vessel may actually transit at the speed of another container vessel in the database. The vessel also transited along a representative route for all vessels of that type traveling between its departure and destination points. In the 2010 simulation, the vessel travels along its own route and we have the time start time and the end time for that transit in the 2010 VTOSS database. Figure x shows one such route for the Westwood Rainier cargo vessel

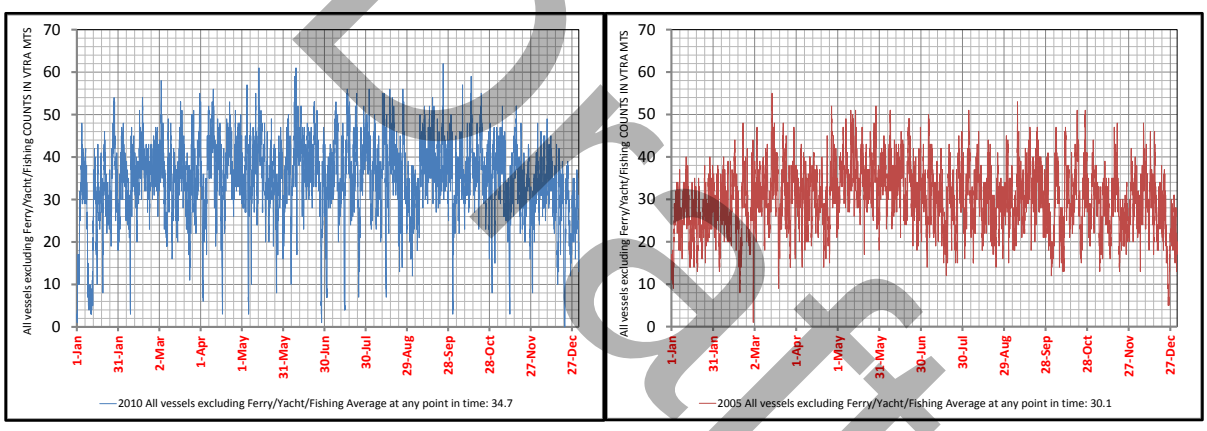

Figure 20.Left panel: Time series of counts of all vessels excluding ferries, yachts and fishing vessels in the system for the GW/VCU MTS simulation model using the VTOSS 2010 dataset; Right panel: Same using the VTOSS 2005 dataset.

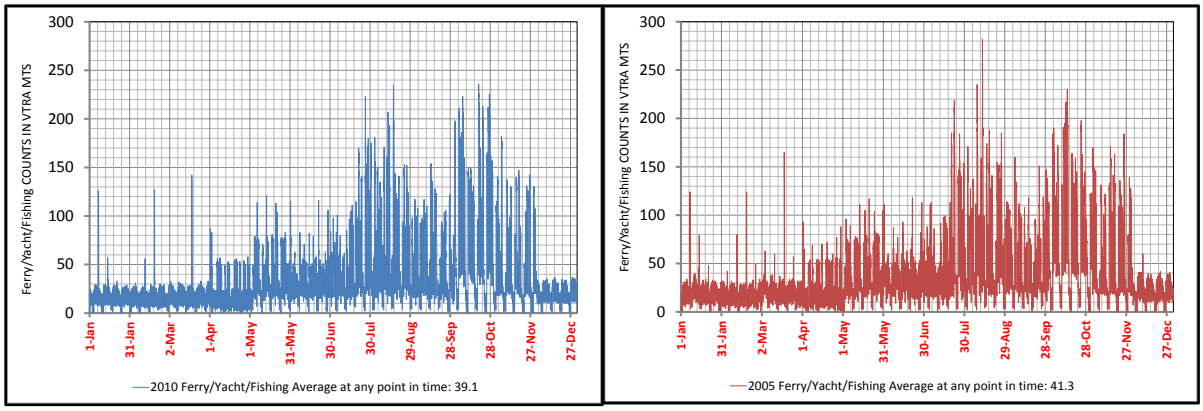

Figure 21. Left panel: Time series of counts of all ferries, yachts and fishing vessels in the system for the GW/VCU MTS simulation model using the VTOSS 2010 dataset; Right panel: Same using the VTOSS 2005 dataset.

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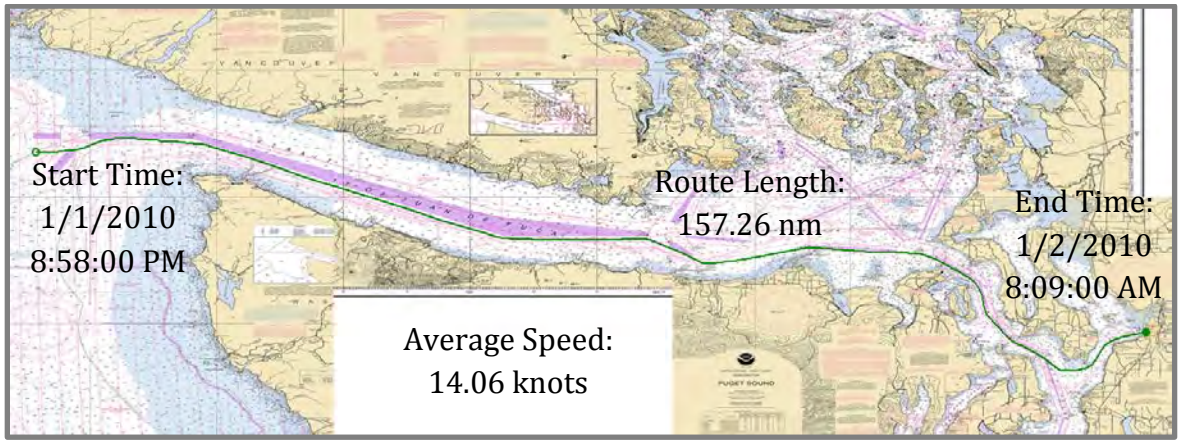

Figure 22. A route followed by the Westwood Rainier cargo vessel and its calculated average speed.

In the simulation, we can calculate the length of the route, so we can calculate the average speed of the vessel on that transit. The Westwood Rainier started its transit at 8:58 pm on January 1st, 2010 and ended its transit the next morning at 8:09 am. The transit took 11 hours and 11 minutes and was calculated (after the route cleaning discussed above) to be 157.26 nautical miles. This means the vessel average 14.06 knots over the transit. The Westwood Rainier has a maximum speed of 16.1 knots and an average speed of 14.1 knots (according to www.marinetraffic.com), so this calculation appears quite accurate.

One must consider, however, that the vessel would have slowed around the pilot station and as it approached dock, so it would not have moved at this average speed throughout the transit. It also had moderately strong currents in the direction it traveled throughout the transit, so it would have made more than 14.1 knots over land for other parts of the transit. Thus, we must start the simulated transit at a higher speed and then reduce the speed based on the location of the vessel and the traffic rules (one-way zones, pilot station, approaching dock, etc.). For each transit, we calculated a speed accuracy factor by taking the simulated length of the transit using the average speed as the starting point and divided by the length of the transit in the 2010 VTOSS database. We calculated speed calibration multipliers for each vessel type to ensure that the speed accuracy factor was as close to 1 as possible.

Figure 23 shows the overall distribution of the speed accuracy factor for all vessels once the speed calibration multipliers were used for the initial speed of the vessel. The mean is 1.0003 with a 95% confidence interval of [0.9995,1.0012]. It is not possible to achieve a value of 1 as each change to the speed calibration factors can change the dynamics of the system, but the calculations are accurate on average to four decimal places. This does not mean that every transit is accurate to four decimal places. However, only 10% had a speed accuracy factor below 0.9 and only 10% had a speed accuracy factor over 1.1. Speeds that were clearly inaccurate based on the VTOSS data were sampled from the original speed

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distributions. Thus, we could accurately model the actual speed for a given transit and only sample general vessel type speeds for a few transits.

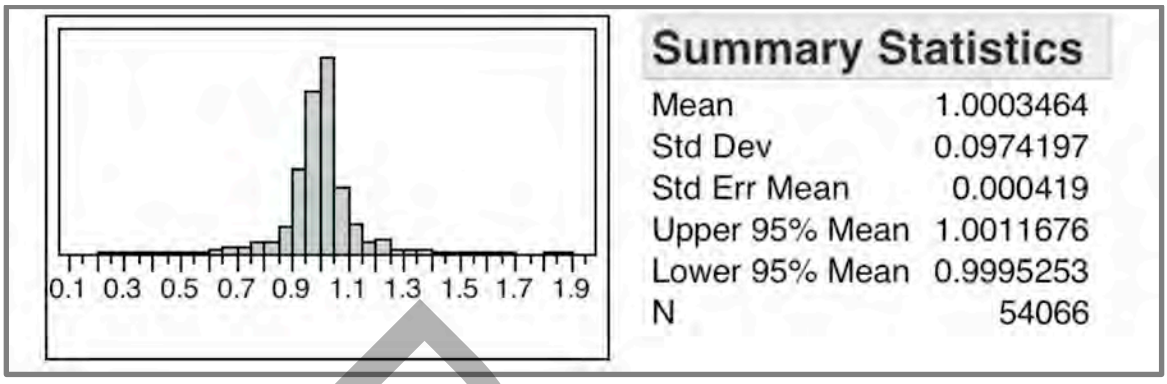

Figure 23. The distribution of the speed accuracy factor for all transits..

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Extending VTRA 2005 incident and accident probability models

During the VTRA 2005 accident probability models given the occurrence of an incident were developed separately for tankers and ATB's. To accommodate the expansion of the focus vessel class to include also bulk carriers, container vessels, chemical carriers and oil barges, the tanker accident probability models shall be utilized for the container, bulk carrier and chemical carriers, whereas the ATB models shall be utilized for the barges.

In the VTRA 2005 annualized historical incident data was collected for the tankers and ATB's that visit the cherry point terminal and were carefully vetted incident by incident. The VTRA 2005 simulation model incident rates were calibrated to the annualized statistics and converted to an incident rate per unit time on the water, taking advantage of the VTRA 2005's model capability of distinguishing short routes from long ones while taking into account vessel speeds as well.

While incident data was collected for freighters as a vessel class during the VTRA 2005, it was not broken down by container, bulk carrier or any of the other 5 cargo vessel types and were not as carefully vetted as the incident date for tankers and ATB's. Hence, to accommodate the expansion to a larges focus vessel class we shall assume that the incident rates by unit time of the water for tanker apply also to the container, bulk carrier and other cargo vessel classes, whereas we shall apply the incident rates for ATB's to the oil barge class. Figure 24 visualizes the effect of these assumptions on the annualized incident rates

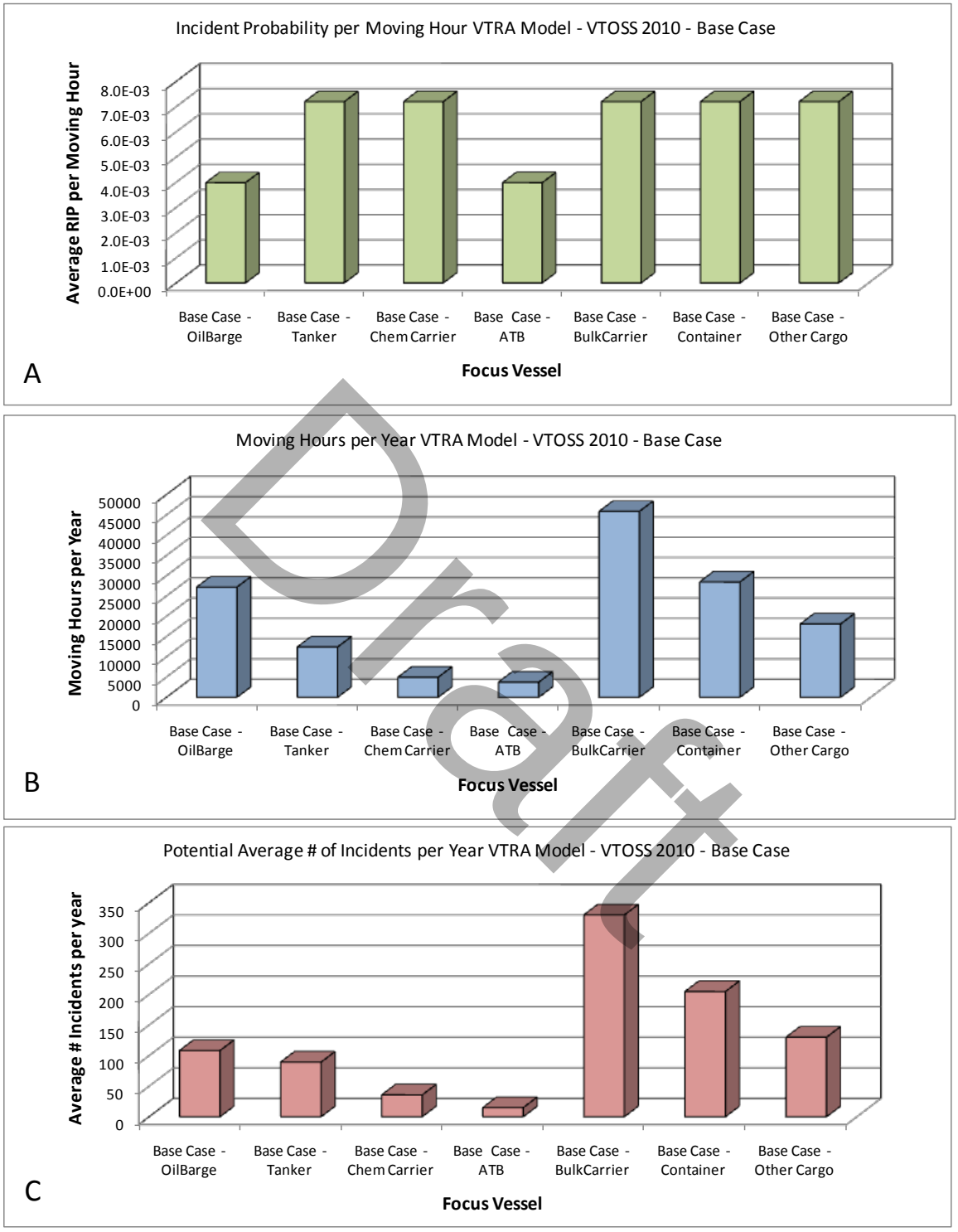

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Figure 24. A: Incident rate per moving hour by focus vessel; B: Moving hours in VTRA 2010 model by focus vessel; C: Potential number incidents per year by focus vessel

by vessel class taking into account the amount of travel time of each vessel class in the VTRA 2010 model. Figure 24A displays the incident rates by moving hour and demonstrates that bulk carrier, container, other cargo and chemical carriers are assigned the same incident rates as tankers, whereas oil barges are assigned the same incident rate per moving hour as the ATB;s. Combining these rates per moving hour with the amount of moving hours per year (Figure 24A) in the VTRA 2010 model, results in the average number of incidents per year as depicted in Figure 24C. Observe from Figure 24C that the bulk carrier class has the largest potential number of incidents per year in the VTRA 2010 model which is primarily driven by the fact that the largest portion of the focus vessel traffic in the VTRA study area are in fact bulk carriers.

Oil carrying assumptions for focus vessels

Of the tank focus vessels, tankers and chemical carriers are identified in the vessel type record in VTOSS. ATBs and ITBs are not specifically identified, but there are a limited number of them, so they can be identified by name. However, oil barges are only listed a tug tow barge in VTOSS. The records for tugs sometimes indicate the barge type as bulk cargo, derrick, light, log barge, petroleum, or wood chip. However, a blank record can either mean there is no barge or that the data was not recorded by the VTS. To identify oil barges, we collected the list of all tug names that were listed as towing a petroleum barge at some point in 2010. These names were then provided to the Puget Sound Pilots who indicated whether they were exclusively used for petroleum based on their extensive knowledge of vessels in the study area. They were also asked to identify other tugs that were exclusively used for petroleum. In this manner, we could use the non-blank VTOSS records to identify the tug's barge and use the Puget Sound Pilot's information to identify oil barges with blank records.

The culmination of the oil barge movement modeling effort is depicted in Figure 25. Please observe from Figure 25 that oil barge movement modeling in the VTRA 2010 model accounts for about 54.5% of the movements of all tankers, chemical carriers and oil barges combined. The predominant movement of oil barges is a north south movement between the Cherry point, Ferndale and Anacortes refineries and the southern Puget Sound. However, quite a significant number of oil barges travel north and south to Canada. A lesser density is observed entering/leaving the Strait of Juan de Fuca.

Unfortunately, no information is collected within the VTOSS 2010 data set regarding the volume of cargo oil or type of cargo oil on board a particular tank vessel. While vessel traffic density movement is a driver of accident frequency analysis, the oil that vessel carry is a driver for oil outflow analysis. To represent oil movement within the VTRA 2010 model we have had to therefore rely on set of overarching assumptions regarding the amount and type of oil moved through the study area by vessels. These assumptions were made based

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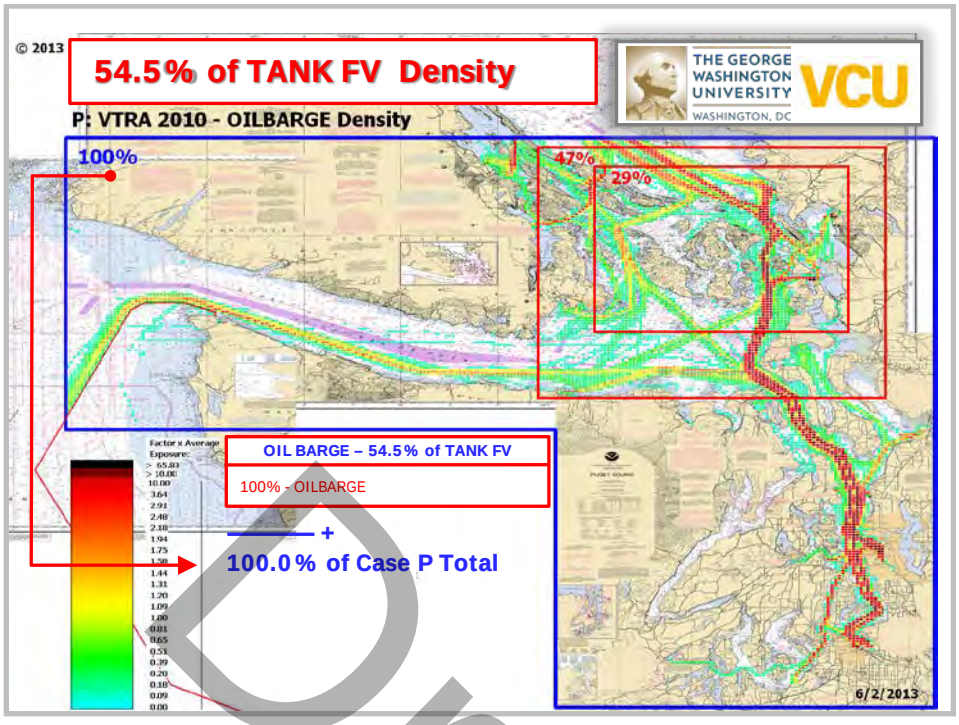

Figure 25. Traffic density of tugs towing/pushing oil barges in the VTRA 2010 model.

on interactions with the PGHSC committee and other stakeholders over the course of the study and are listed below.

List of oil carrying assumptions in VTRA 2010 model:

1. Tankers are classified as crude or product carriers by name
2. Chemical carriers transport product.
3. Oil barges are assumed to transport product.
4. Focus vessels fuel tanks are 50% full
5. US bound crude tankers are assumed fully laden as they arrive in study area and drop of equal amounts at their stops and leave empty.
6. Canadian bound crude tankers are assumed empty as they arrive and fully laden as they depart.
7. Product tankers and ATB's are assumed fully laden asthey depart study area, empty as they arrive.
8. Chemical carriers are assumed fully laden as they arrive in the study area, empty when they leave the study area
9. When ATB's go back and forth between two destinations within the study area they are assumed 50% full
10. Oil barges are assumed fully laden as they travel through study area.
11. Tank focus vessels not covered by 1-10 are assumed fully laden.

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Combined with a validated picture of vessel traffic and data recorded in the VTOSS 2010 dataset regarding vessel size in terms of dead-weight tonnage, we hope the set of assumptions adds realism to the movement of oil throughout the VTRA study area. Such realism is important when comparing a base case scenario to another What-If traffic scenario in terms of oil spill transportation risk. The effect of these assumptions are summarized in separate geographic density profiles of product, crude and fuel movements which serve as a starting point of the VTRA 2010 potential oil loss analyses.

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4. VALIDATION OF 2010 VTOSS AND AIS 2010 CROSSING LINE DATA

AIS data is collected on a regular basis by the MXPS. Amongst other reports the Marine Exchange AIS system is able to produce crossing line count reports by cargo, tanker and passenger vessel at a line drawn on a nautical map. At our request, the MXPS produced these reports for three counting lines depicted in Figure 26 for the year 2010. Panel A, provides an overview look of the three counting lines, whereas Panels B, C and D provide a close-up view of these three counting line separately. For the West Strait of Juan de Fuca line the crossing line count data separates eastbound and westbound traffic, whereas for the Georgia Strait and Puget Sound crossing lines count data is separated in north and southbound traffic as depicted in Panels B,C and D in Figure 26. Unfortunately, no AIS data is available for the year 2005 for the geographic area in Figure 26A.

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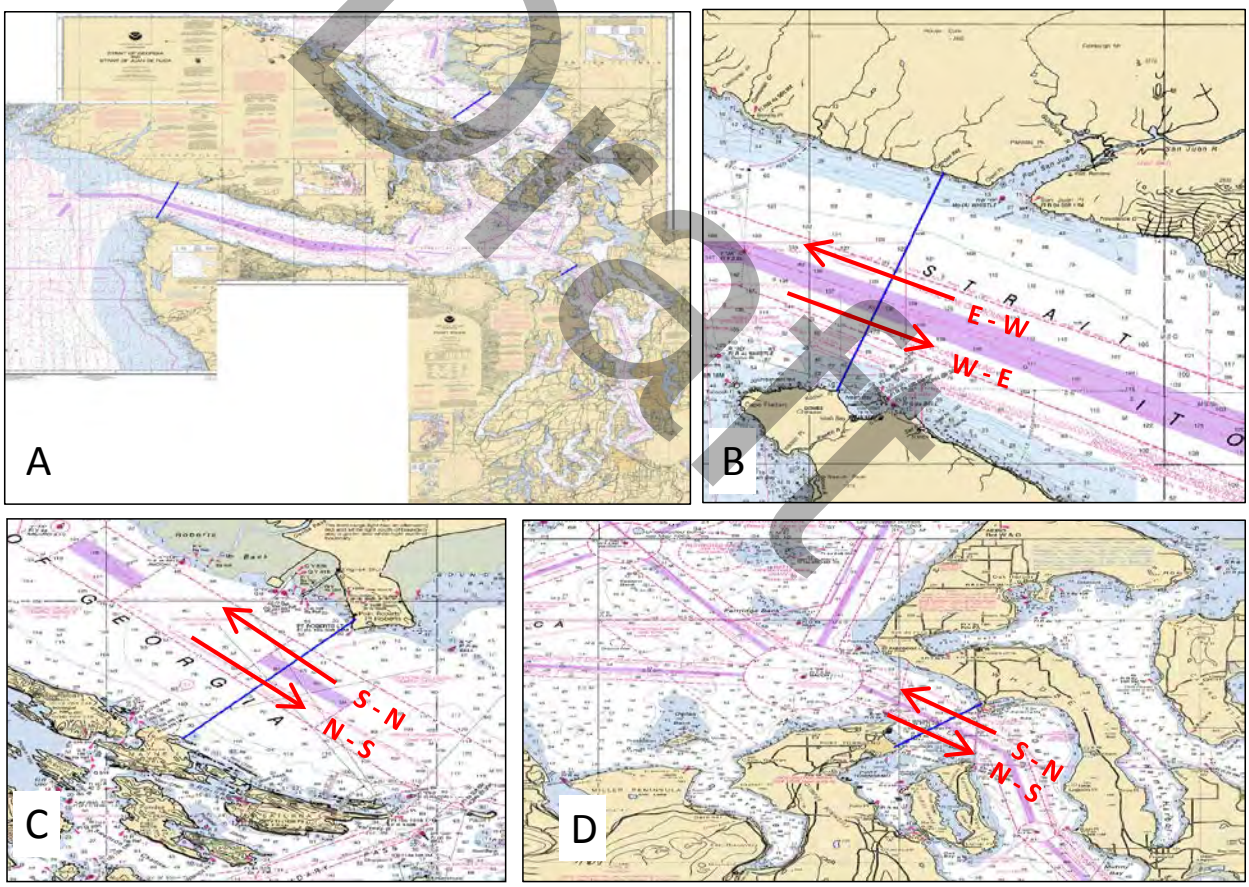

Figure 26. A: Overview of three AIS crossing definitions; B: Close-up view of crossing line at the West Strait of Juan de Fuca Entrance; C: Close-up view of crossing line at the George Strait entrance; D: Close-up view of the crossing line at the Puget Sound entrance.

Crossing line analysis of AIS 2010 data.

Table 6 provides the AIS 2010 crossing line counts for the three crossing lines depicted in Figure 26. From Table 4 one observe that per this data source it appears more traffic traveled north bound at the Georgia Strait Entrance (100%) than south bound (85%). For the West Strait of Juan de Fuca and Puget Sound crossing lines one observe a much more even distribution with about the same amount of traffic travelling in both directions. Moreover, a larger amount of traffic crosses the WSFJ crossing line (8217 – 150%), followed by the Puget Sound crossing line (5639 – 103%) and Georgia Strait crossing line (5471 – 100%). Hence, approximately 50% more traffic crosses the WSJF crossing line than the Georgia Strait crossing line, whereas only 3% more crosses the Puget Sound crossing line.

Table 6. AIS 2010 Crossing line counts by vessel types: cargo, tanker and passenger vessel. A: West Strait of Juan de Fuca crossing Line counts; B: Georgia Strait crossing Line counts; C: Puget Sound crossing line counts.

A: WSJF CROSSING LINE

Ship Type	East Bound	West Bound	Grand Total
Cargo	3216	3157	6373
Tanker	694	685	1379
Passenger	244	221	465
Grand Total	4154 - 100%	4063 - 98%	8217

B: GEORGIA STRAITE CROSSING LINE

Ship Type	North Bound	South Bound	Grand Total
Cargo	2278	2133	4411
Tanker	267	266	533
Passenger	414	113	527
Grand Total	2959 - 100%	2512 - 85%	5471

C: PUGET SOUND CROSSING LINE

Ship Type	North Bound	South Bound	Grand Total
Cargo	1754	1766	3520
Tanker	95	95	190
Passenger	958	971	1929
Grand Total	2807 - 100%	2832 - 101%	5639

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Matching VTOSS 2010 Vessel Types to AIS 2010 Vessel Types.

The AIS crossing line counting feature depicted in Figure 26 was programmed into the GW/VCU MTS simulation model to mimic the same counting procedure for each of the 26

different vessel type classifications listed in Table 2. Table 7provides the crossing counts by vessel type and Table 8by vessel master type as defined in Table 2using the VTOSS 2010 dataset.

Table 7. GW/VCU MTS Crossing line counts using VTOSS 2010 data by 26 different vessel type classifications.

VESSEL TYPE	Master Type	TOT WSJF W-E	TOT WSJF E-W	TOT G_STR N-S	TOT G_STR S-N	TOT PS N-S	TOT PS S-N
BULKCARRIER	Cargo	1446	1493	1034	1023	300	309
CHEMICALCARRIER	Tanker	152	155	142	127	18	18
CONTAINERSHIP	Cargo	1045	1047	440	547	1004	994
DECKSHIPCARGO	Cargo	2	26	2	17	10	35
FERRY	Passenger	0	0	0	0	572	572
FERRYNONLOCAL	Passenger	1	5	1	3	423	450
FISHINGFACTORY	Fishing	83	117	20	51	108	133
FISHINGVESSEL	Fishing	3368	3330	227	220	320	329
LIQGASCARRIER	Tanker	2	4	0	0	0	0
NAVYVESSEL	Cargo	49	101	215	239	136	153
OILTANKER	Tanker	406	415	33	86	83	76
OTHERSPECIALCARGO	Cargo	251	253	334	166	102	4
OTHERSPECIFICSERV	Service	7	26	1	9	7	18
PASSENGERSHIP	Passenger	241	62	56	40	164	43
REFRIGERATEDCARGO	Cargo	0	5	0	22	15	27
RESEARCHSHIP	Service	35	51	1	6	42	45
ROROCARGOSHIP	Cargo	5	72	0	10	9	79
ROROCARGOCONTSHIP	Cargo	147	47	0	14	118	46
SUPPLYOFFSHORE	Service	0	5	0	2	33	27
TUGTOWBARGE	Tugtow	333	319	1201	1052	1631	1696
UNKNOWN	Service	0	0	0	0	0	0
USCOASTGUARD	Service	35	49	48	41	72	43
VEHICLECARRIER	Cargo	197	97	5	119	103	130
YACHT	Passenger	29	37	45	21	71	82
ATB	Tanker	58	74	45	48	34	35
ITB	Tanker	0	0	0	0	0	0
	Total	7892	7790	3850	3863	5375	5344

Table 8.GW/VCU VTRA model crossing line counts using VTOSS 2010 data by vessel master type.

Master Type	TOT WSJF W-E	TOT WSJF E-W	TOT G_STR N-S	TOT G_STR S-N	TOT PS N-S	TOT PS S-N
Cargo	3142	3141	2060	2158	1797	1777
Tanker	618	648	222	261	135	129
TugTow	333	319	1206	1053	1631	1696
Service	77	131	49	57	154	133
Passenger	271	104	97	60	1230	1147
Fishing	3451	3447	249	272	428	462
Total	7892 - 100%	7790 - 99%	3883 - 100%	3861 - 99%	5375 - 100%	5344 - 99%

Observe from the last row in Table 8 that contrary to Table 6 the same flow is observed going north bound and south bound at the Georgia Strait crossing line. In contrast for the AIS data in Table 6 85% is travelling southbound . Similarly, one observes that at the WSJF and Puget Sound crossing lines about the same amount of traffic flows in both directions.

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Comparing VTOSS 2010 crossing line counts to AIS 2010 crossing line counts.

Observe from Table 7and Table 2that the master type category "tanker" includes: chemical carrier, oil tanker, atb and itb. This is consistent with the "tanker" category definition used in the generation of the AIS crossing count data in Table 6. The VTOSS classification "Navyvessel" was given a master type "cargo" classification also for consistency between the VTOSS 2010 master crossing line and AIS 2010 crossing line counts. For the remainder of the 26 vessel types in Table 7, its vessel master type was assigned based on the vessel type classification in Table 7andTable 2.

In Figure 27, Figure 28 and Figure 29 a comparison is provided between the VTOSS 2010 GW/VCU MTS crossing line counts and AIS 2010 crossing line in Table 6 and Table 8 for cargo, tanker and passenger vessels. The "tug-tow" master type crossing line counts in Table 8are not included in the AIS 2010 crossing line counts. The "fishing" VTOSS 2010 master type counts in Table 8 includes the "Fishingvessel" counts from Table 7 that result from fishing vessel tribal and commercial fishing openers that are modeled in the GW/VCU MTS simulation model, but are not recorded in the VTOSS 2010 data, nor the AIS 2010 data. Final, no service vessel classification is provided in the AIS 2010 crossing line counts. Hence, only the comparison provided for the three crossing lines in Figure 26 for the vessel types: cargo, tanker and passenger.

From Figure 27 one observes that the crossing line counts for these three vessel types agree between the two datasets AIS 2010 and VTOSS 2010 both in the east and west bound directions. Overall, one observe a general agreement for the cargo and tanker vessel types in Figure 28 and Figure 29, except for the cargo category travelling northbound in the Georgia Strait where a higher number of crossing counts are reported for the AIS 2010 data. Certainly, some discrepancies are observed for the passenger vessel classification for both the Georgia Strait and Puget Sound crossing lines. We attributed those discrepancies to vessel type misclassification in the VTOSS 2010 dataset. For example, at times the same oil tanker travelling is both classified as a cargo vessel and as a tanker across the three different VTS systems recorded in the VTOSS 2010 dataset. Similar misclassifications are observed for the passenger vessel category. Overall, however, especially when concentrating on the cargo and tanker classifications, there is more agreement between the AIS 2010 and VTOSS 2010 crossing line counts in Figure 27, Figure 28 and Figure 29 than there is disagreement, leading to the conclusion that these two dataset reconcile well. Hence, the validation of VTOSS 2010 crossing line counts in the GW/VCU MTS simulation model by AIS 2010 crossing line counts.

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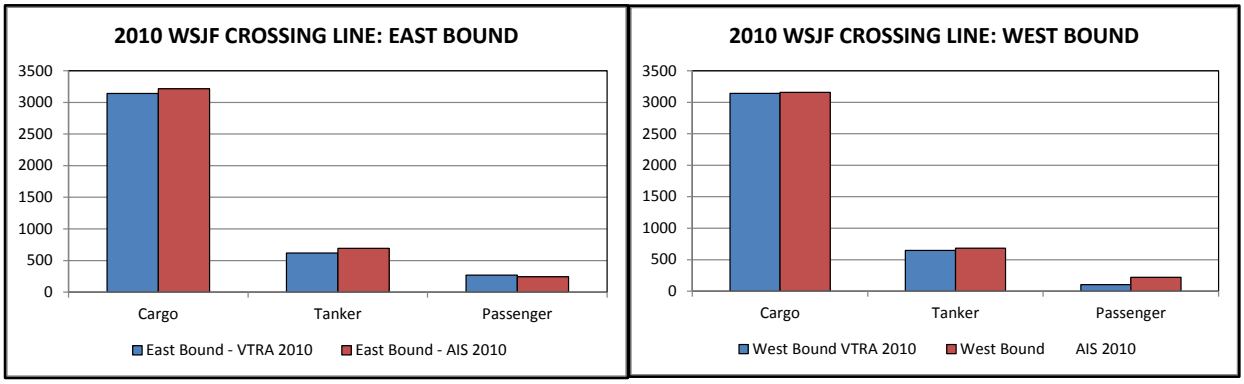

Figure 27. Comparison of AIS 2010 and VTOSS 2010 crossing line counts for cargo, tanker and passenger vessels for the West Strait of Juan de Fuca crossing line depicted in Figure 26B.

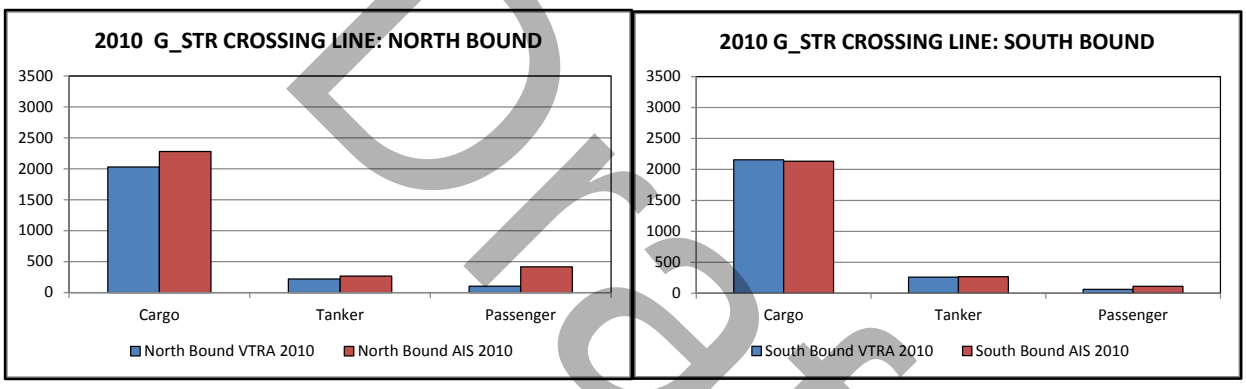

Figure 28. Comparison of AIS 2010 and VTOSS 2010 crossing line counts for cargo, tanker and passenger vessels for the Georgia Strait crossing line depicted in Figure 26C.

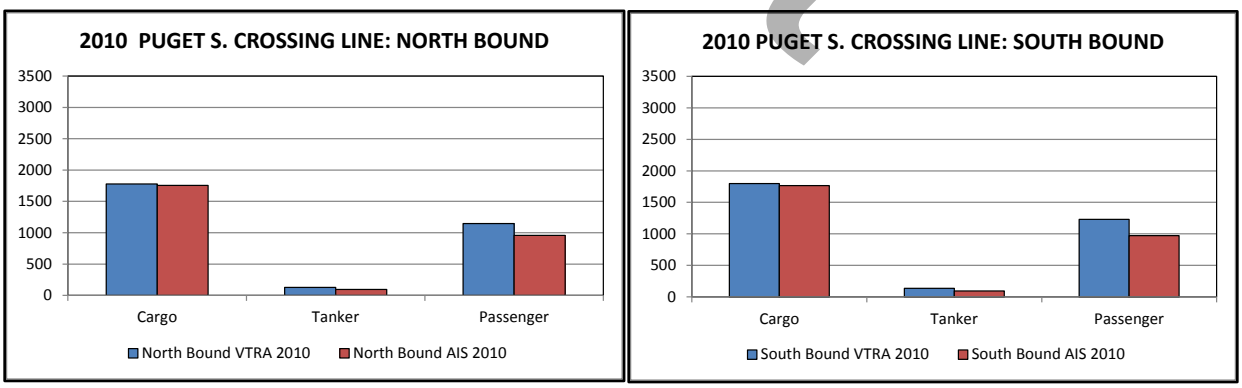

Figure 29. Comparison of AIS 2010 and VTOSS 2010 crossing line counts for cargo, tanker and passenger vessels for the Puget Sound crossing line depicted in Figure 26D.

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5. TRAFFIC PATTERNS AND OIL MOVEMENTS IN VTRA 2010 BASE CASE

Running a simulated year 2010 using the methods discussed in Sections 2 and 3, we obtain a comprehensive picture of vessel traffic in the study area. We classify vessel traffic in the VTRA 2010 as focus vessel traffic and non-focus vessel traffic. For focus vessel traffic potential collision and grounding accident frequencies and oil losses shall be evaluated in the remainder of this report. Focus vessel traffic consists of the vessel types: Oil Tankers, ATB's, Chemical Carriers, Bulk Carriers, Container Vessels and a class Other Cargo, capturing other larger cargo vessels. The non-focus vessel traffic is an important modeling aspect of the VTRA 2010 model to evaluate focus vessel collision risk since focus vesselscan potentially collide with non-focus vessels[3]. In fact, 75.2% of the total traffic modeled in the 2010 VTRA model is non-focus vessel traffic; the remainder 24.8% is focus vessel traffic. Figure 30 summarizes the focus vessel classification of vessel types in the VTRA 2010 model.

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#	VESSEL TYPE	FOCUS VESSEL?	#	VESSEL TYPE	FOCUS VESSEL?
1	BULKCARRIER	CARGO - FV	14	PASSENGERSHIP	NO
2	CHEMICALCARRIER	TANK - FV	15	REFRIGERATEDCARGO	CARGO-FV
3	CONTAINERSHIP	CARGO - FV	16	RESEARCHSHIP	NO
4	DECKSHIPCARGO	CARGO - FV	17	ROROCARGOSHIP	CARGO-FV
5	FERRY	NO	18	ROROCARGOCONTSHIP	CARGO-FV
6	FERRYNONLOCAL	NO	19	SUPPLYOFFSHORE	NO
7	FISHINGFACTORY	NO	20	TUGTOWBARGE	NO
8	FISHINGVESSEL	NO	21	UNKNOWN	NO
9	LIQGASCARRIER	TANK - FV	22	USCOASTGUARD	NO
10	NAVYVESSEL	NO	23	VEHICLECARRIER	CARGO-FV
11	OILTANKER	TANK - FV	24	YACHT	NO
12	OTHERSPECIALCARGO	CARGO - FV	25	ATB	TANK - FV
13	OTHERSPECIFICSERV	NO	26	OIL BARGE	TANK - FV

Figure 30. Focus Vessel Classification of VTRA 2010 vessel types.

Figure 31 displays a geographic profile of non-focus vessel traffic, which predominantly consists of fishing vessels (31.0%), Tug-barge traffic[4] (17.2%) and ferry traffic (15.7%). The remaining 11.2% comprises of yachts, navy vessels, passenger ships and service vessels. In the sections to come, we shall provide separate geographic profile analyses for

[3] Of course focus vessel can also potential collide with other focus-vessel.
[4] This 17.2% does not include oil barge traffic which is consider a focus vessel class

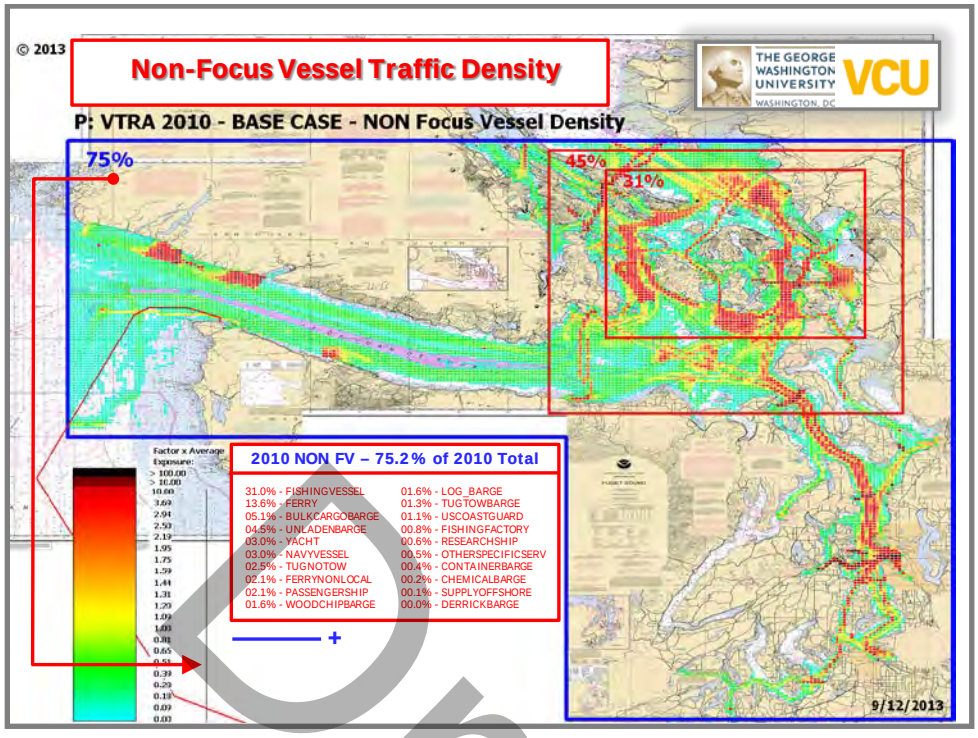

Figure 31. The traffic density for all non-focus vessels.

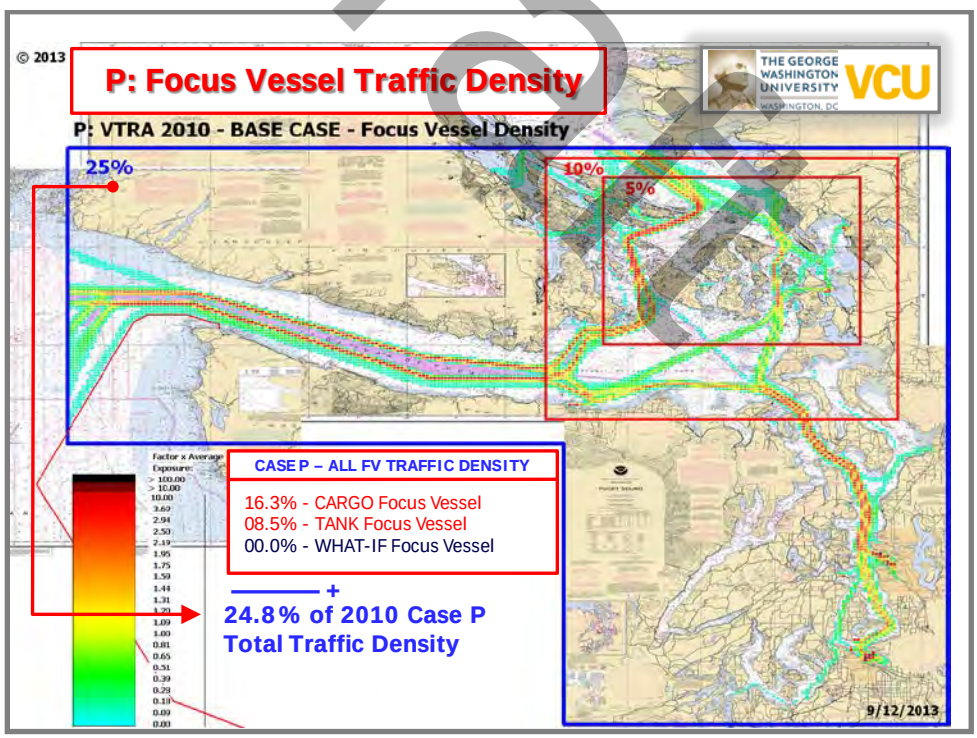

Figure 32. The traffic density for all focus vessels.

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the focus-vessel class (24.8% of total traffic) of which its traffic density is depicted in Figure 32.

In sections to come, traffic movements representing time of focus vessels on the water are summarized in terms of cargo focus vessel (bulk carrier, container and other cargo) density profiles and tank focus vessel (oil barge, oil tanker, chemical carrier and atb) density profiles. The oil (crude, product and fuel) that cargo and tank focus vessels transport are summarized in oil movement density geographic profiles. For contrast purposes focus-vessel density profiles shall be presented using their own color legend rather than the color legend used in Figure 31 and Figure 32.

Focus Vessel Time of Exposure

Let us first examine the time each type of focus vessel spends in the system; 65.7% of the focus vessel total time of exposure is cargo focus vessels, with the remaining 34.3% being tank focus vessels. Of the cargo focus vessels total time of exposure, 49.6% is bulk cargo, 30.8% is container vessels, and 19.6% is other cargo vessels. Of the tank focus vessels total time of exposure, 56.3% is oil barges, 25.7% tankers, 10.3% chemical carriers, and 7.7% articulated tug barges. To find the contribution of oil barges, for example, to the focus vessel total time of exposure, we consider that 34.3% of the focus vessel total is tank focus vessels and 56.3% of the tank focus vessel total time of exposure is oil barges, so 34.3% multiplied by 56.3% gives 19.3% of the focus vessel total time of exposure. Figure 33 shows the contribution of each focus vessel type to the total focus vessel time of exposure calculated in this manner.

Oil Time of Exposure

Thus far, we have examined the focus vessel time of exposure, where we count the amount of time that vessels move through study area by grid cell. Rather than focusing on vessels it is also instructive to examine the amount of time a unit of oil (measured in either barrels or cubic meters) is moving through the study area. This includes cargo (product and crude) oil and fuel oil that focus vessels transport; so all focus vessels contribute to the total oil time of exposure; 39.4% of the total oil time of exposure is product, 36.9% is crude, and 23.7% is fuel. Figure 34 shows the total oil time of exposure broken down by vessel type. Tankers comprise almost half of the total oil time exposure at 48.1%. Oil barges comprise about a fifth at 20.6%. However, the vessel type with the next largest contribution is container vessels, which carry only fuel oil, at 8.9% and not chemical carriers. This is of course a result of the fact more container vessels travel through the VTRA study area than chemical carriers. In fact, overall fuel oil from cargo focus vessels comprises 19.7% of the total oil time exposure.

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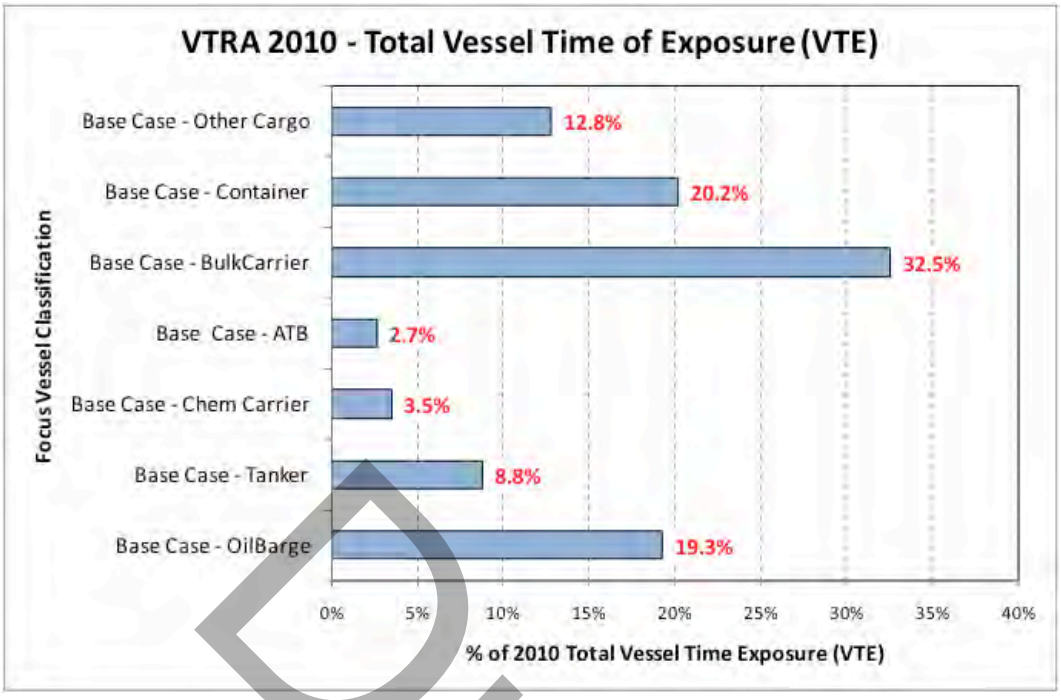

Figure 33. Comparison of the total vessel time of exposure by focus vessel classification

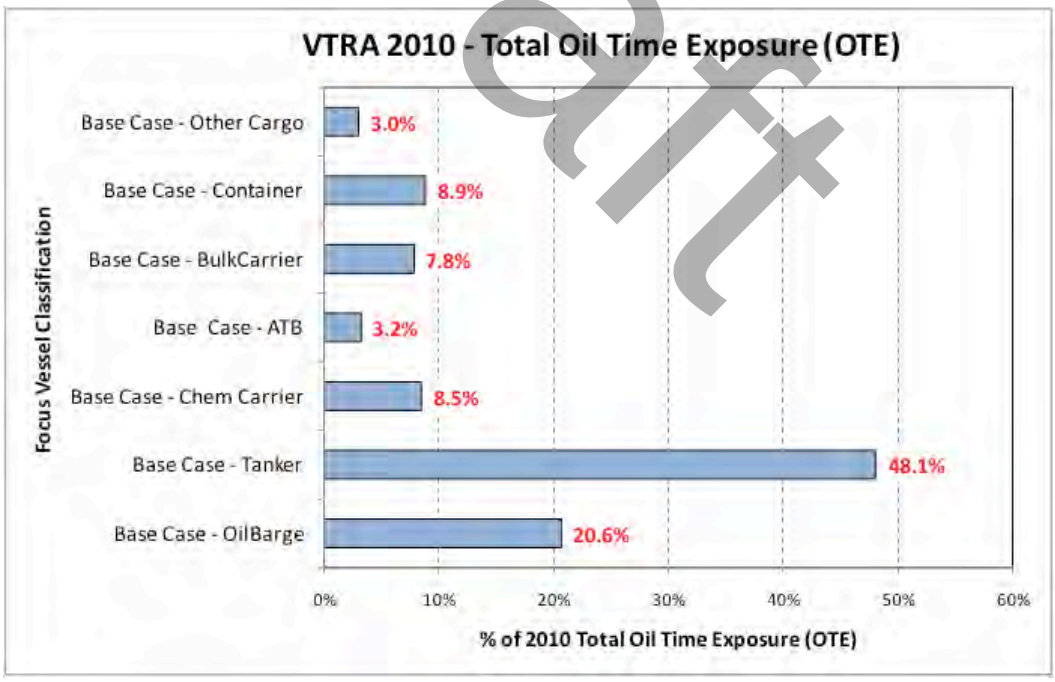

Figure 34. Comparison of the total oil time of exposure by focus vessel classification

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Traffic Densities Profiles

Figure 33 shows that bulk carriers spend the most time transiting the study area at 32.5% of the total, followed by container vessels at 20.2%, and oil barges at 19.3%. Oil tankers comprise 8.8% of the total. While these aggregate statistics are useful, we are also interested in where these vessels spend time in the VTRA study area. Figure 35 and Figure 36 show the cargo focus vessel and tank focus vessel traffic densities respectively.

Comparing Figure 35 and Figure 36 is quite instructive. Apparently, cargo focus vessels transit the Straits of Juan de Fuca and then Haro Strait, Boundary Pass, and Georgia Strait going north and the Puget Sound going south. Meanwhile, the traffic density for tank focus vessels is most significant in Rosario Strait and Puget Sound (and near the pilot station in Port Angeles). Thus, cargo and tank focus vessels mostly transit different areas of the system, except for the Puget Sound where they converge.

Oil Movement Density

Again it is instructive to view the geographic spread of the oil movement exposure, called the oil movement density. Figure 37, Figure 38, Figure 39 shows the oil movement densities for product, crude, and fuel oil respectively. Figure 40 shows the total oil movement density. Figure 38 shows that crude oil moves predominantly from Buoy J to the Cherry Point, Ferndale, and Anacortes refineries. Figure 39 shows that fuel oil moves predominantly in the areas where cargo focus vessels transit in Figure 35. Product oil moves throughout the system in Figure 37. Thus, Figure 40 shows the oil moves on all major traffic lanes in the study area. The highest density areas are on the approaches to refineries and near the pilot station.

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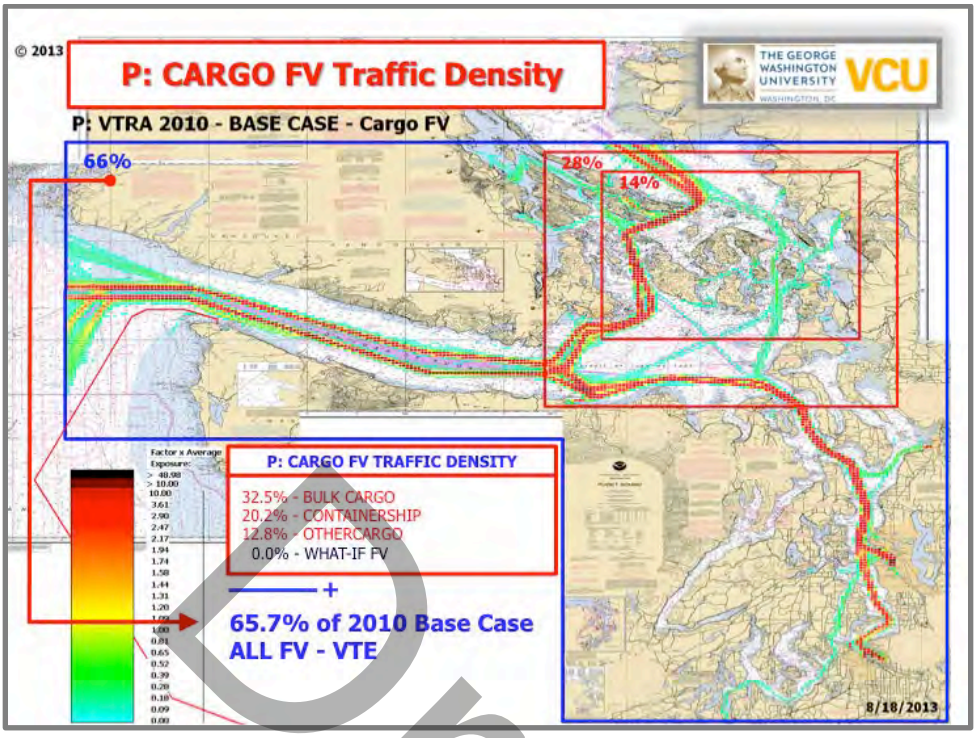

Figure 35. The traffic density for cargo focus vessels.

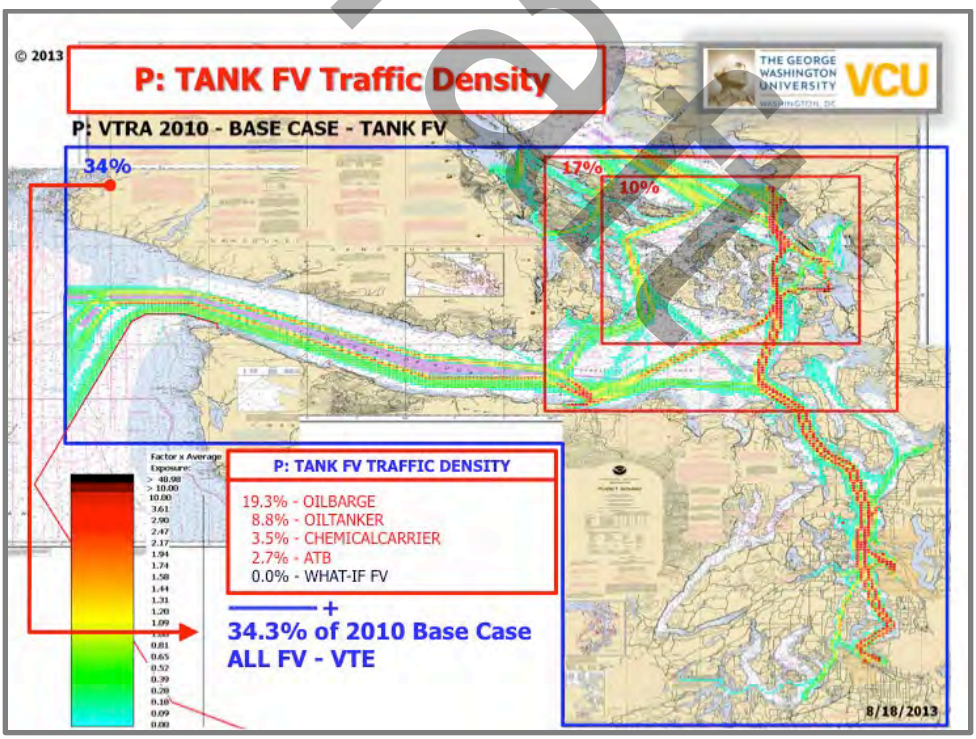

Figure 36. The traffic density for tank focus vessels.

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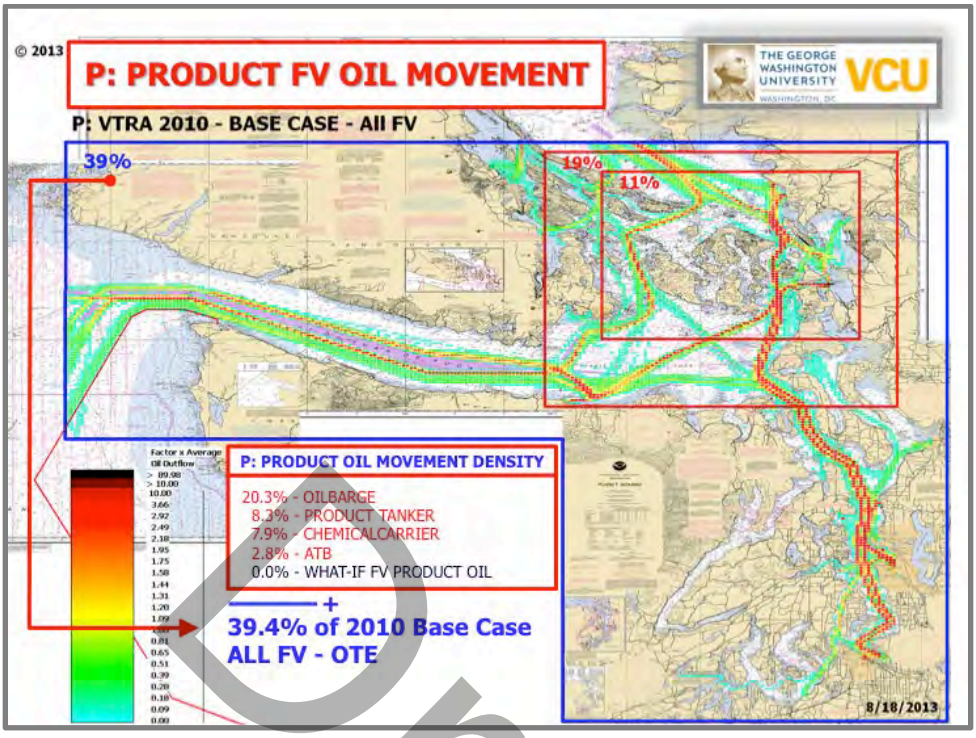

Figure 37. The product oil movement density for all focus vessels.

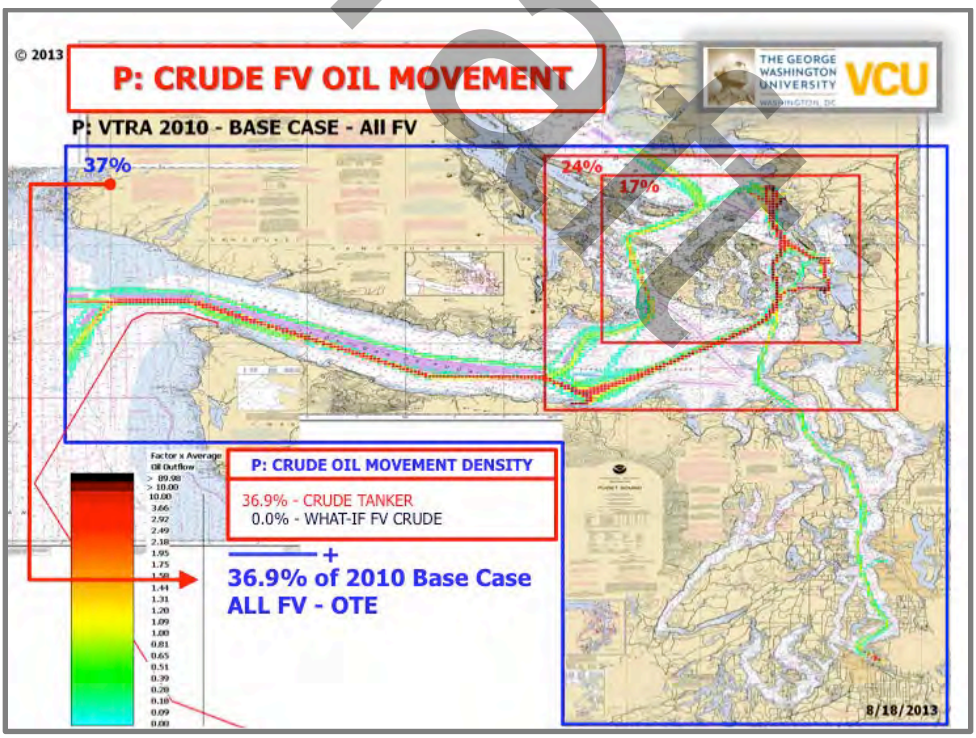

Figure 38. The crude oil movement density for all focus vessels.

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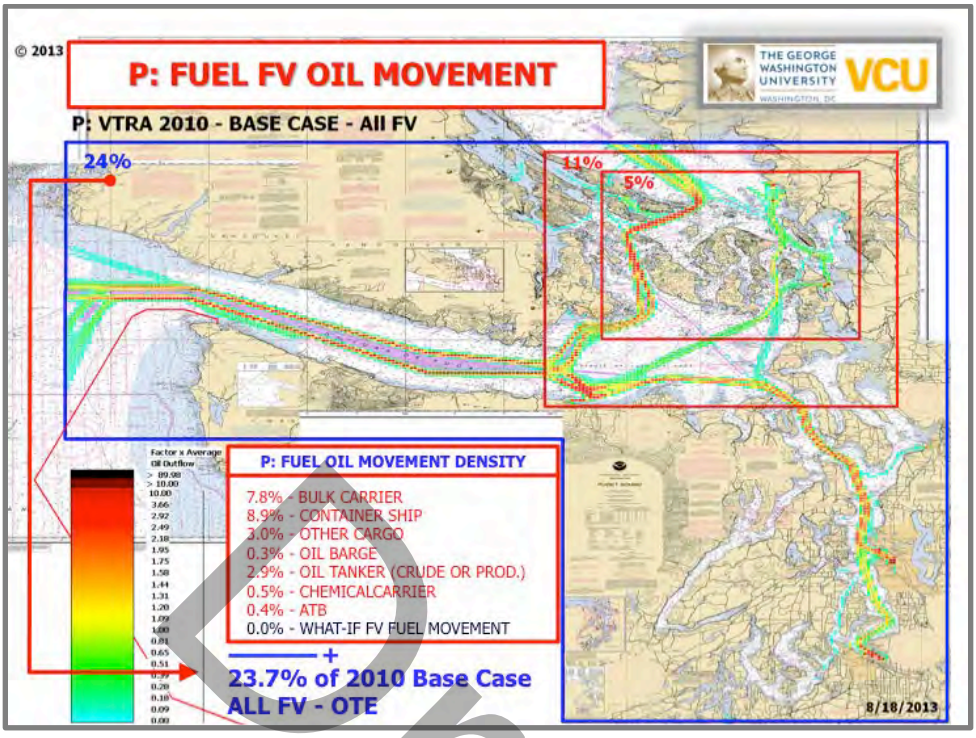

Figure 39. The fuel oil movement density for all focus vessels.

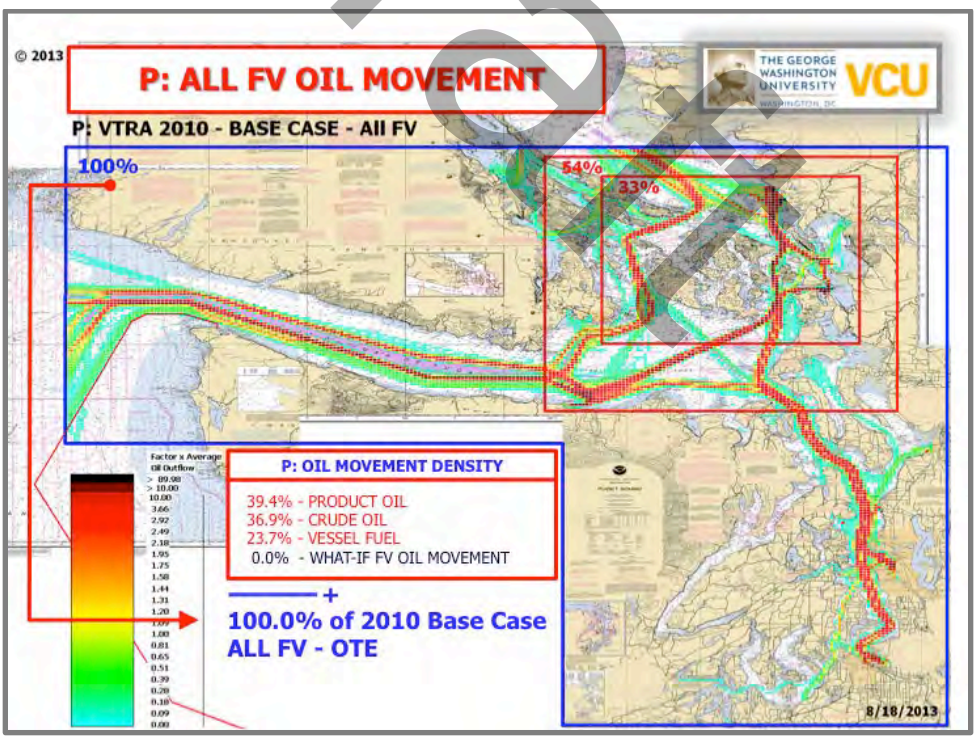

Figure 40. The total oil movement density for all focus vessels.

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6. ACCIDENT FREQUENCY AND OIL OUTFLOW RESULTS FOR VTRA 2010 BASE CASE

Figure 1 shows the accident causal chain, with the situations in which an accident can occur, the incident that causes the accident, the accident itself, and the consequences of the accident. We call the situations in which an accident could occur an accident exposure. For each accident exposure, the incident and accident probability models are used to calculate the POTENTIAL accident frequency. This is not a prediction of an accident, but shows a relative propensity that an accident could occur in one accident exposure versus another or the relative propensity for one type of accident versus another. The accident exposure and the POTENTIAL accident frequency are then combined with the oil outflow model to calculate the POTENTIAL oil outflow.

Overall Accident and Oil Outflow Results

Figure 41 shows the accident exposure (A), the POTENTIAL accident frequency (B), the POTENTIAL accident cargo oil loss (C), and the POTENTIAL accident fuel oil loss (D) for each accident type. Figure 41A shows that more power grounding accident exposures are counted in the 2010 simulation than other accident types, with drift grounding accident exposures next as the vessel drifts assure after losing power, and collision accident exposures next as two vessels must interact to be counted. Allisions have the lowest exposure as they only occur as the vessel is near to the dock.

All exposures do not have the same potential for an accident, however. Figure 41B shows that collisions have a higher POTENTIAL accident frequency than either grounding even though the collision accident exposure is lower. The accident probability varies from accident exposure to accident exposure based on the specifics of the situation in which it occurs, but on average the collision exposures have a higher potential to result in an accident than the grounding exposures. Powered groundings have the next highest potential. In fact, collisions and powered groundings together comprise 79.7% of the POTENTIAL accident frequency.

Again, not all accidents have the same potential for oil outflow. While collisions have a higher POTENTIAL accident frequency, powered groundings have the highest POTENTIAL accident cargo oil loss (Figure 41C) and the highest POTENTIAL accident fuel oil loss (Figure 41D).

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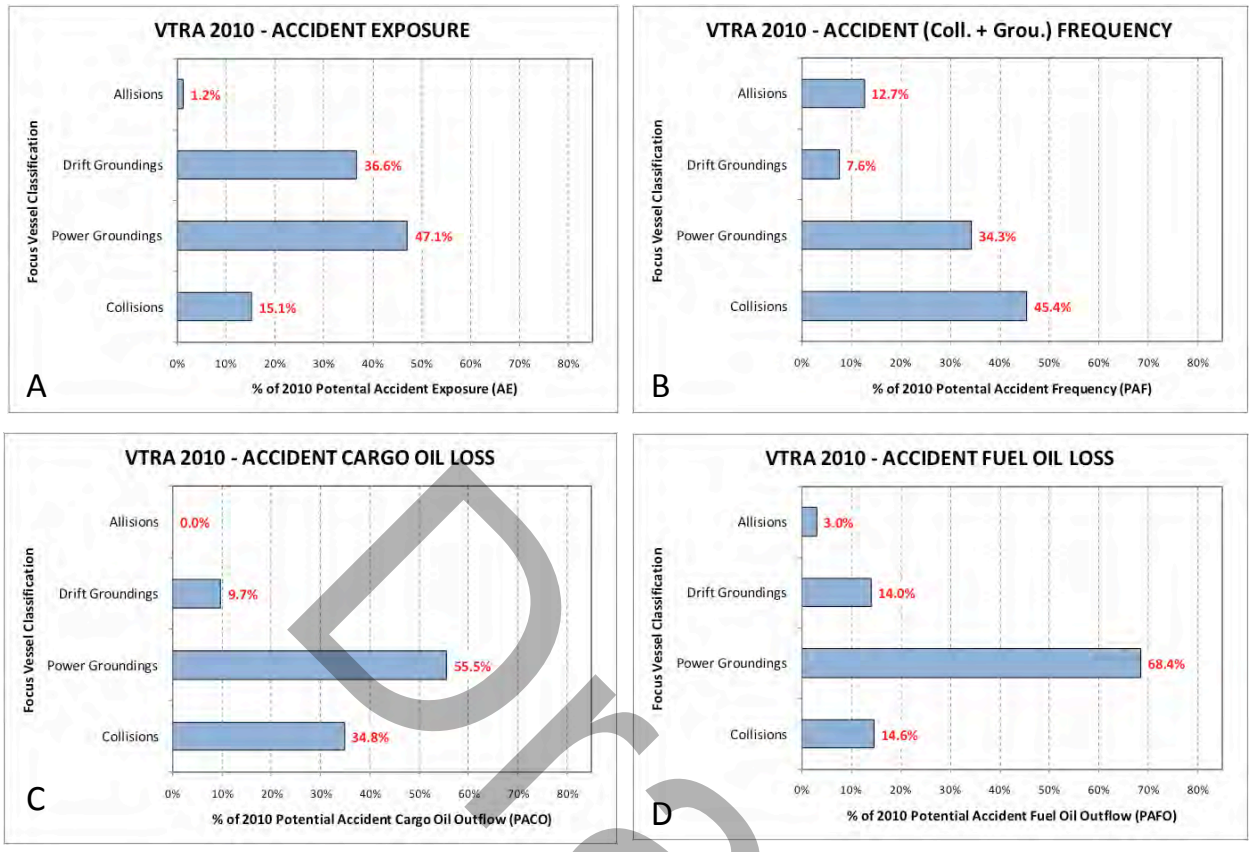

Figure 41. Accident exposure (A), accident frequency (B), cargo oil loss (C), and fuel oil loss (D) contributions by accident type..

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Accident and Oil Outflow Results by Focus Vessel Type

Figure 42 breaks down the POTENTIAL accident frequencies by the type of focus vessels that has the initiating incident. This is the first figure to have an accidents-per-year scale. However, this is again not a prediction of a number of accidents each year, but a relative propensity for each accident type involving each focus vessel type. The highest potential is for collisions involving oil barges, with as much collision potential as tankers, chemical carriers, and cargo vessels combined. Powered grounding potential is more spread across oil barges and cargo vessels.

Figure 43 breaks down the POTENTIAL oil loss by the type of focus vessels that has the initiating incident. This figure has a cubic-meters-per-year scale. Again this is not a prediction of an amount of oil outflow each year, but a relative propensity for oil outflow for each accident type involving each focus vessel type. Clearly, tankers have the highest potential as they carry the highest volume of cargo. However, container vessel powered groundings have the next most contribution as they carry the most fuel oil. Oil barges do

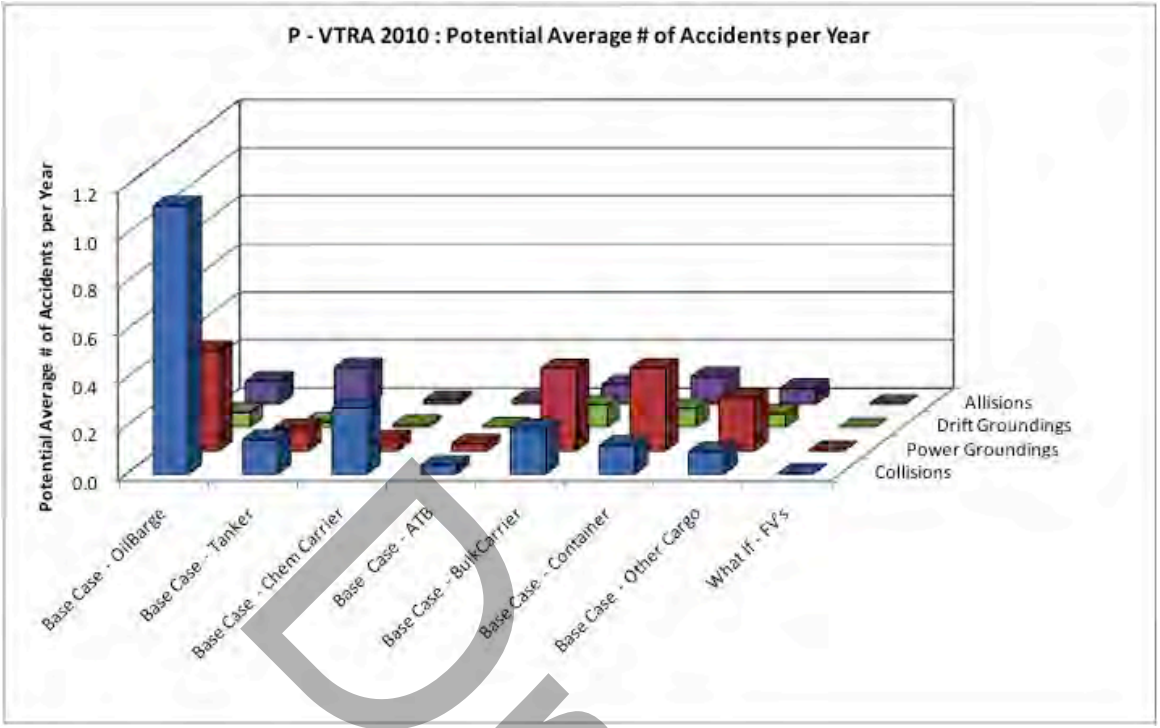

Figure 42. The potential accident frequency by accident type and focus vessel type.

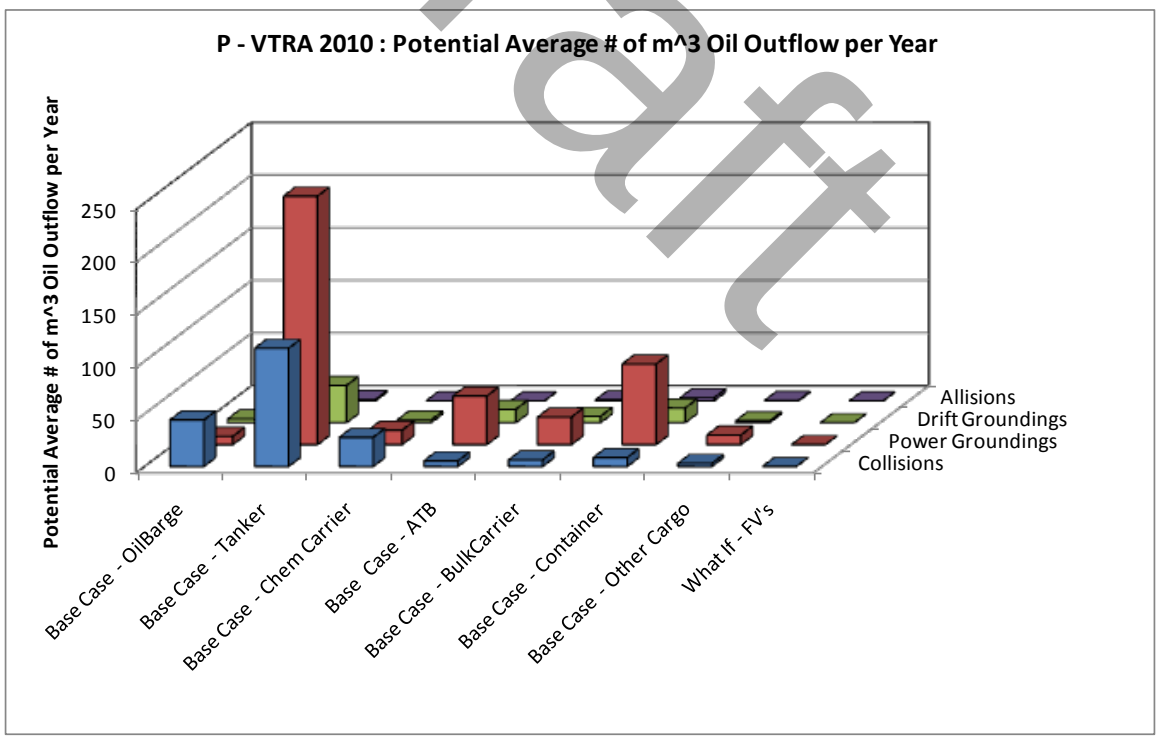

Figure 43. The potential oil loss by accident type and focus vessel type.

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not have the same contribution to POTENTIAL oil loss as they do to POTENTIAL accident frequency, as they do not carry as much cargo or fuel oil.

Geographic Profiles of Accident and Oil Outflow Results

Figure 44 through Figure 49 show the same progression of accident exposure, POTENTIAL accident frequency, and POTENTIAL oil loss, but as geographic profiles. Figure 44, Figure 45 and Figure 46 show the geographic profiles of collision exposure, POTENTIAL collision frequency, and POTENTIAL collision oil loss respectively. Figure 47, Figure 48 and Figure 49 show the geographic profiles of grounding exposure, POTENTIAL grounding frequency, and POTENTIAL grounding oil loss respectively.

These figures demonstrate the importance of thinking about all phases of the accident event chain depicted in Figure 1. Figure 44 shows that there is exposure to collisions in the Straits of Juan de Fuca, while Figure 45 shows that exposure does not lead to as much POTENTIAL collision frequency as other areas with exposure. In fact, the POTENTIAL collision frequency appears in Haro Strait/Boundary Pass, Rosario Strait, and the Puget Sound. Comparing these figures to Figure 46, we can see that while the area around the Pilot Station does not have a relatively high POTENTIAL collision frequency it does have a concentration of POTENTIAL collision oil loss due to the size of the vessels involved. Rosario Strait, Guemes Channel, and Haro Strait all have concentrations of POTENTIAL collision oil loss. In fact, the inner red box contains 67% of the POTENTIAL collision frequency and 53% of the POTENTIAL collision oil loss. Similarly, the outer red box contains 83% of the POTENTIAL collision frequency and 70% of the POTENTIAL collision oil loss. In Rosario Strait and Guemes Channel, the vessels involved are oil tankers (with larger oil cargos) and ferries and other vessels that are large enough to penetrate the hull, but are not restricted by the one-way zone.

A similar effect is seen in Figure 47 through Figure 49. Again there is exposure to grounding along the shore of the Straits of Juan de Fuca, but there is not much POTENTIAL grounding frequency as the time to shore is relatively long in this area. The relatively more significant POTENTIAL grounding frequency and POTENTIAL grounding oil loss are in the red boxes. The inner red box contains 41% of the POTENTIAL collision frequency and 58% of the POENTIAL collision oil loss. Similarly, the outer red box contains 79% of the POTENTIAL collision frequency and 61% of the POTENTIAL collision oil loss.

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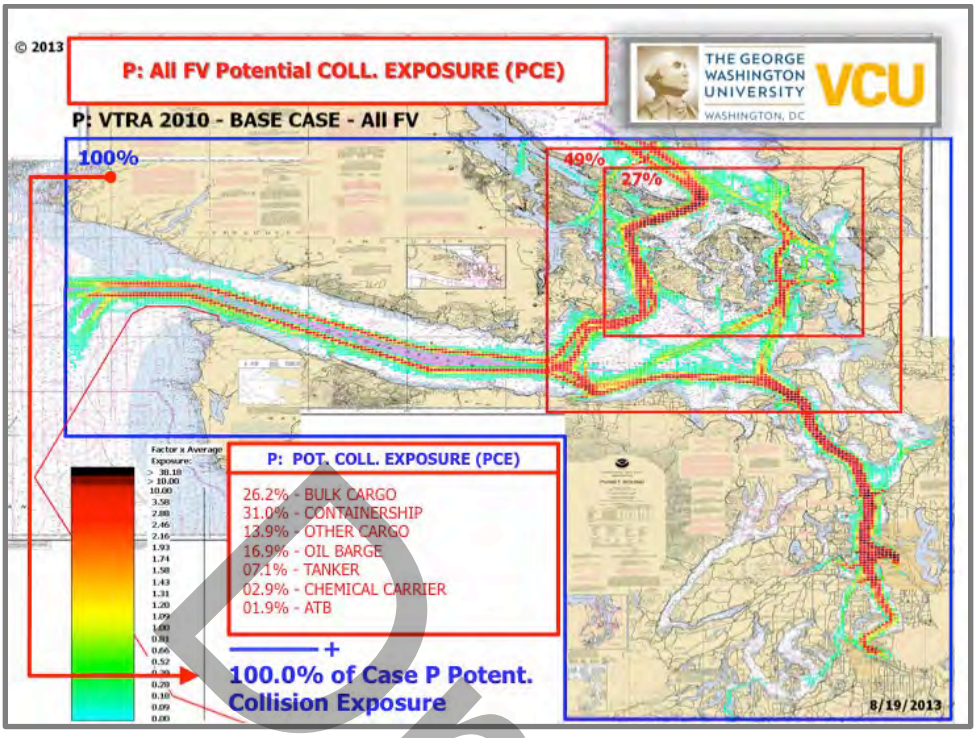

Figure 44. The geographic profile of the collision exposure.

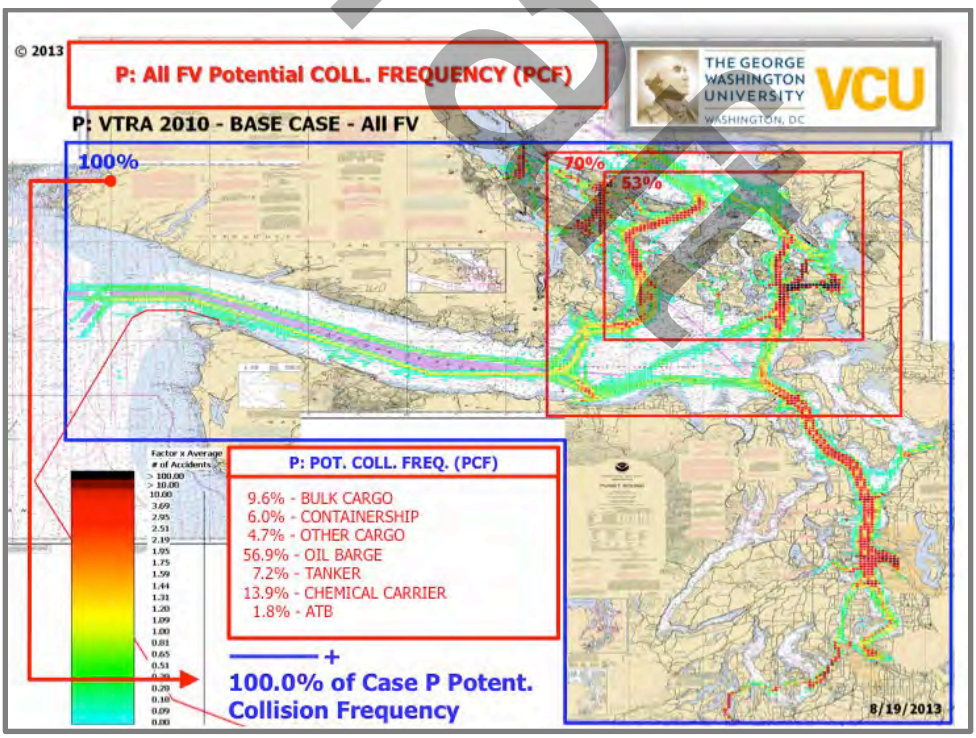

Figure 45. The geographic profile of the POTENTIAL collision frequency.

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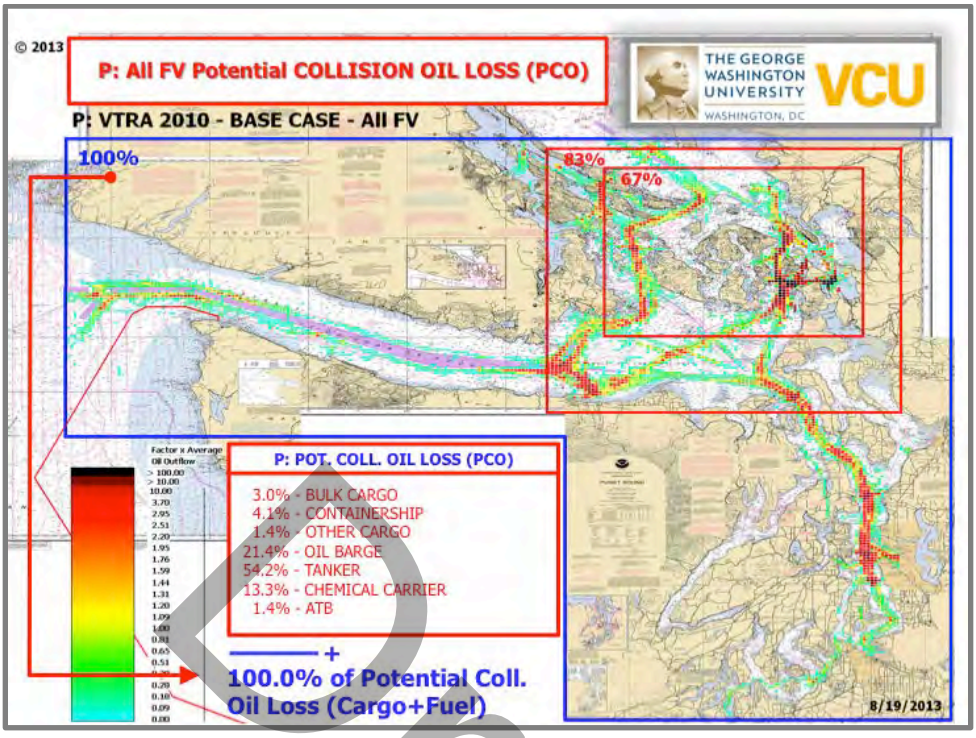

Figure 46. The geographic profile of the POTENTIAL collision oil outflow.

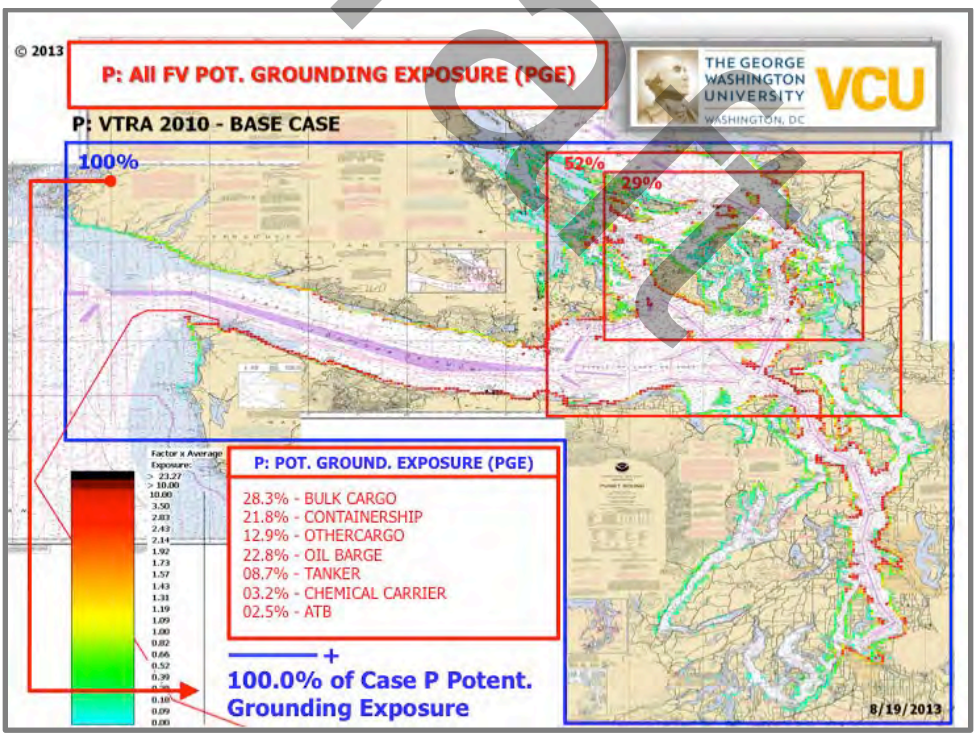

Figure 47. The geographic profile of the grounding exposure.

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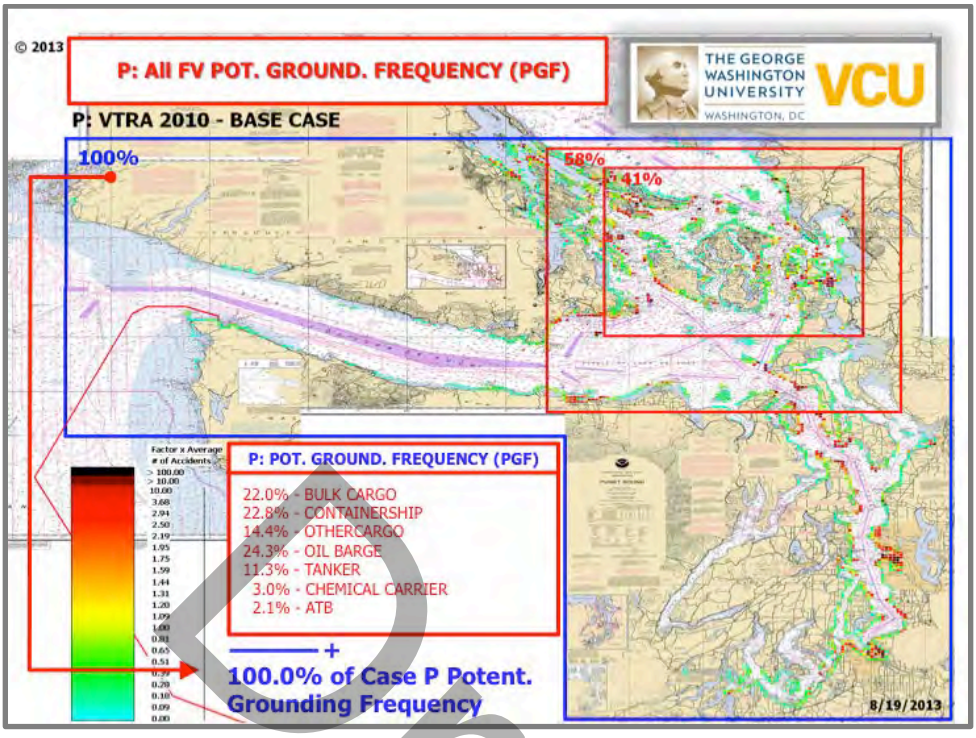

Figure 48. The geographic profile of the POTENTIAL grounding frequency.

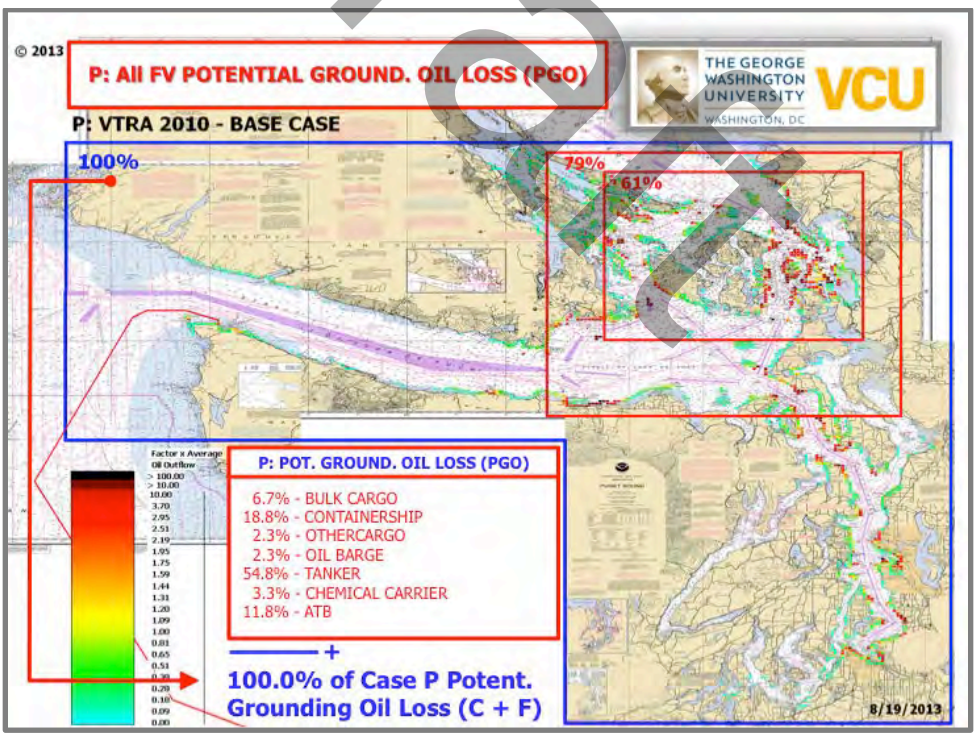

Figure 49. The geographic profile of the POTENTIAL grounding oil outflow.

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7. WHAT-IF SCENARIOS

This study does not attempt to predict the future of vessel traffic in the study area. Such predictions are often made based on observable trends in the traffic levels or projections of potential economic changes and their possible impacts on traffic levels. As we have seen in the last decade, predicting global economic changes is difficult and unpredictable economic changes can lead to unforeseen changes in traffic levels and reversals in previously observed trends. This means predictions can prove to be inaccurate, particularly in the medium to long term.

Modeling the What-If Scenarios

In this study, the Steering Committee chose to model only the traffic level impacts of planned expansion and construction projects that were in the permitting process. Each planned project forms a What-If scenario and What-If vessels are added to the simulation of the 2010 Base Case year. Four What-If scenarios were modeled in the study:

- The Gateway bulk carrier terminal
- The Trans-Mountain pipeline expansion
- The combination of proposed changes at Delta Port
- All three of above scenarios operating at the same time

The steering committee determined that the following numbers of What-If vessels would be added to the 2010 Base Case simulation in each scenario:

- The Gateway bulk carrier terminal
    - 487 bulk carriers (318 Panama class and 169 Cape Max class)
- The Trans-Mountain pipeline expansion
    - 348 crude oil tankers (each 100,000 DWT)
- The combination of proposed changes at Delta Port
    - 348 bulk carriers and 67 container vessels
- All three of above scenarios operating at the same time

The next step in modeling the What-If scenarios is to determine the routes that the vessels will take in the simulation. Routes were chosen from the VTOSS 2010 data for vessels actually transited the system to each location. The only change to an actual route that was made was for the Gateway routes as the coal terminal is not yet in operations, so routes that went close to the planned terminal were chosen and modified to the correct location. Figures Figure 50, Figure 51, and Figure 52 show the What-If vessel routes for the Gateway case, the Trans-Mountain Pipeline Expansion case, and the Delta Port case respectively.

Adding this number of additional vessels will also lead to additional bunkering operations in the study area. The steering committee determined that 47% of Gateway vessels would bunker on the inbound transit and as a first analysis the bunkering would take place at the

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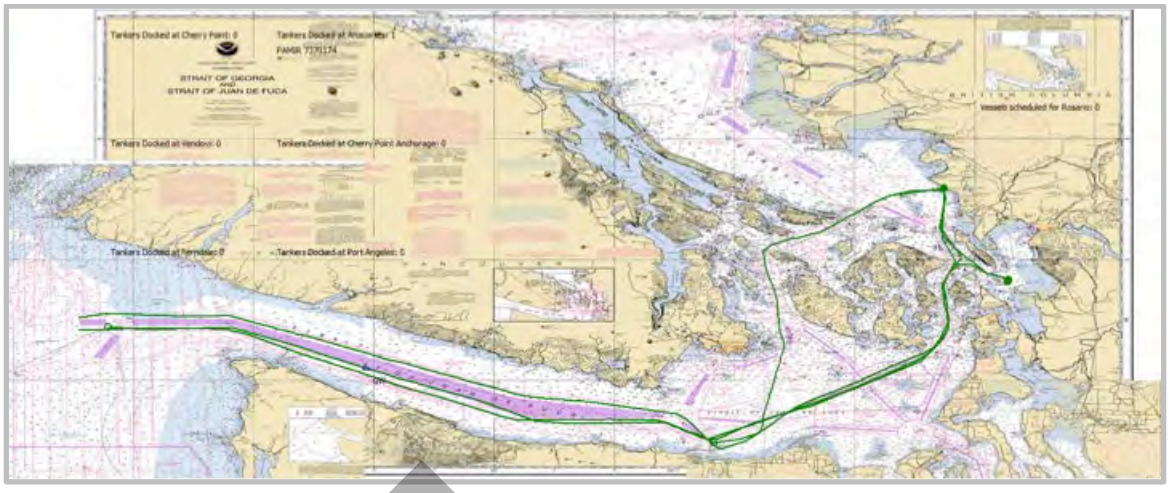

Figure 50. The routes used for the What-If vessels in the Gateway case.

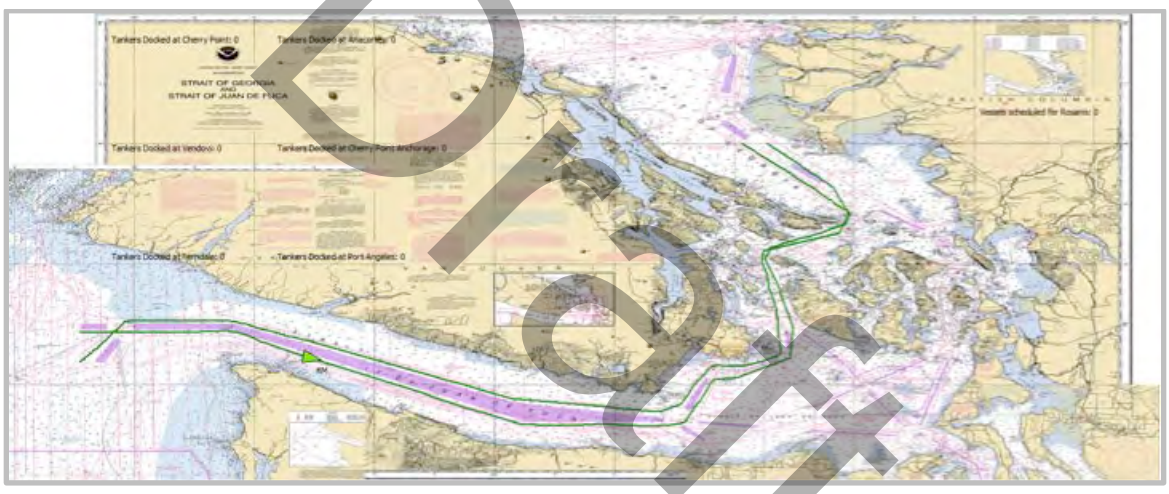

Figure 51. The routes used for the What-If vessels in the Trans-Mountain Pipeline Expansion case.

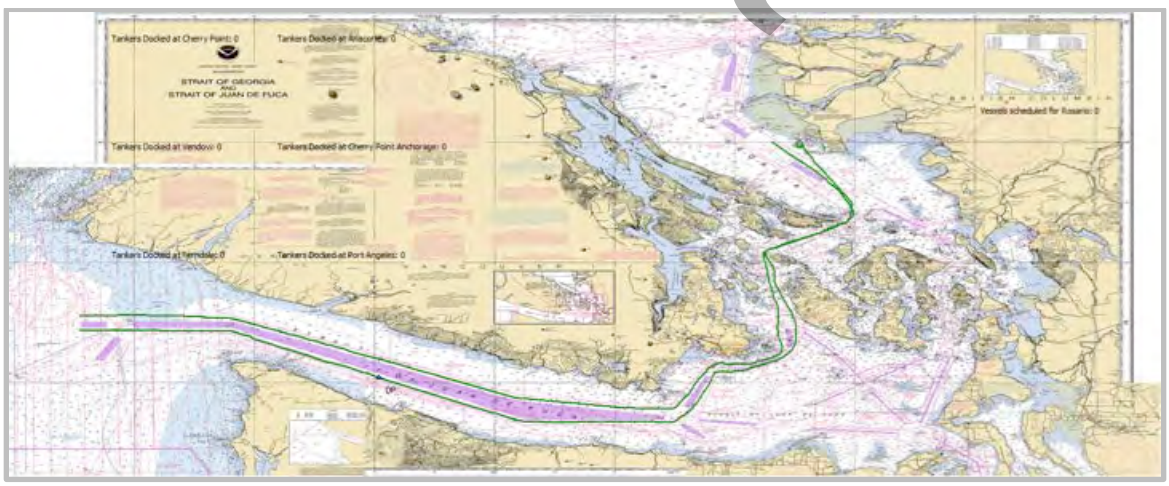

Figure 52. The routes used for the What-If vessels in the Delta Port case.

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Vendovi anchorage. The bunkering tug would transit from Seattle to Vendovi anchorage laden and then return to Seattle. The steering committee decided that bunkering for the Trans-Mountain pipeline expansion scenario and the combination of proposed changes at Delta Port would take place out of the study area, but would require additional bunkering supply transits, 34 for the Delta Port bulk carriers, 6 for the Delta Port container vessels, and 21 for the Trans-Mountain pipeline expansion oil tankers. As a first analysis, the bunkering supply transits are modeled as transiting from the Cherry Point area and out of the study area to the north. Figure 53 shows the bunkering tug routes used for the what-of scenarios.

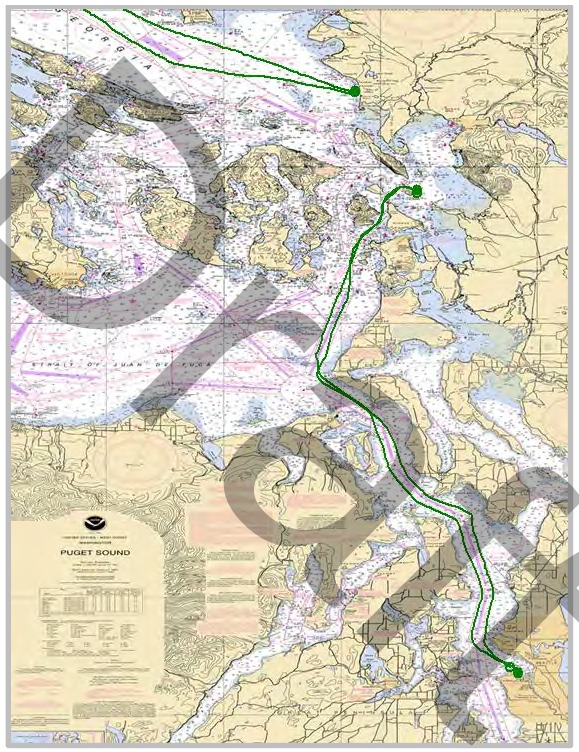

Figure 53. The tug routes used for additional bunkering in the What-If scenarios.

The final decision concerning modeling What-If scenarios is the arrival patterns. While knowing the count of the number of vessels of each type calling at a given dock or port is informative, to simulate the vessels over time one must know the time between one such vessel arriving in the system and the next. The variability in these inter-arrival times changes from destination to destination and from vessel type to vessel type. The variability in inter-arrival times for each of the projects in the What-If scenarios will not be known until the projects have been underway for a period of time. In modeling, if the specifics of a situation are unknown and there is no data upon which to base modeling decisions, the simplest assumption is preferable. In this case, the simplest assumption is to assume that the inter-arrival times are all equal and that the vessels arrive at a constant rate. This

assumption can be changed in later analysis, but it is a reasonable approach to start modeling the What-If scenarios.

Summary of What-If Scenarios Results

Adding What-If vessels to the 2010 Base Case can have multiple effects. First, it directly increases the vessel exposure time and the oil exposure time. This means the What-If vessel will add to the collision and grounding exposure. With additional exposure the What-If vessels can have a triggering incident and so add to the POTENTIAL collision and grounding frequencies. Second, while the What-If vessel interacts with another vessel, the other vessel also may have a triggering incident and so there is another source of increase in the POTENTIAL collision and grounding frequencies. This source of increase is attributed to the vessel having the triggering incident, but would not be there without adding the What-If vessel to the simulation. Third, the What-If vessel passes through the one-way zone at Rosario Strait and the exclusion zone at Boundary Pass, which can cause delays or slow down other vessels that are part of the original 2010 Base Case. This changes the 2010 Base Case vessel's transit through the system and can either increase or decrease their exposure and hence collision and grounding POTENTIAL. As an example, Figure 54 shows two screenshots that occurred within a simulated hour of one another in a What-If simulation. The figure shows one northbound (left) and one southbound (right) tanker interacting with a fleet of fishing vessels returning to port at the end of the day. If the tankers transits had occurred two hours earlier (as occurred in the Base Case 2010 simulation) then the interactions would not have occurred. These interactions occurred because of a change in the timing of tankers and lead to an increased exposure and so an increased POTENTIAL for collision that is not caused directly by a What-If vessel. Thus, there are direct and indirect effects of adding What-If vessels to the 2010 Base Case simulation.

Figure 55 shows three graphs. Each shows the percentage change in a given simulation output from the 2010 Base Case results. The change is shown for each What-If scenario and for completeness the 2010 Base Case is shown as a 0% change from itself. The change is shown as a bar graph, but the actual percentage change is also shown in text. The top graph in Figure 55 shows the change in vessel time exposure, the middle graph shows the change in POTENTIAL collision frequency, and the bottom graph shows the change in POTENTIAL grounding frequency. One can observe in Figure 55 that the changes in both POTENTIAL collision frequency and POTENTIAL grounding frequency are driven by the changes in exposure time. The changes in POTENTIAL collision frequency are larger than the changes in POTENTIAL grounding frequency.

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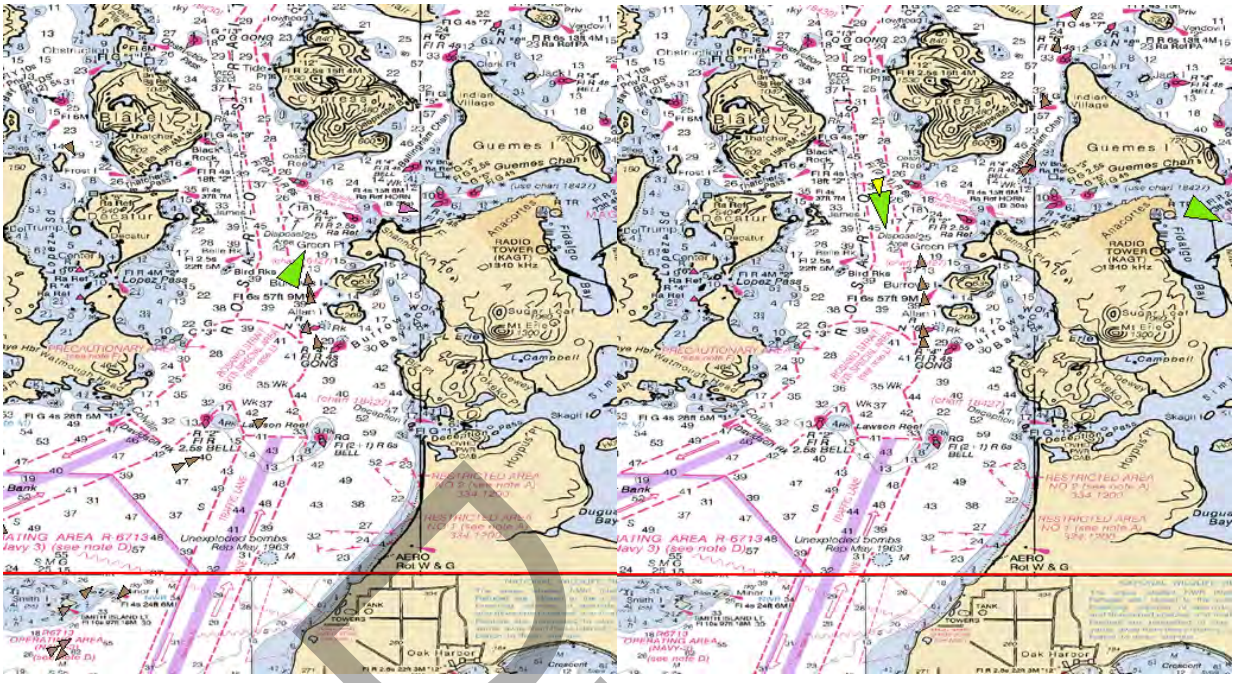

Figure 54. An indirect effect of a What-If scenario – the change in timing of the tanker transits causes two tankers to interact with a fishing fleet returning to port at the end of the day.

Figure 56 shows a similar set of graphs as Figure 57, but this time showing the changes in fuel oil time exposure in the top graph, POTENTIAL collision fuel oil loss in the middle graph, and POTENTIAL grounding fuel oil loss in the bottom graph. The exposure changes for fuel oil are not exactly the same as vessel time exposure changes in value (as different vessel types carry different amounts of fuel), the overall pattern across the What-If scenarios, however, is the same and the ensuing changes in POTENTIAL collision and grounding fuel loss display a similar pattern.

Figure 57 shows a similar set of graphs as Figure 55 and Figure 56, but this time showing the changes in cargo oil time exposure in the top graph, POTENTIAL collision cargo oil loss in the middle graph, and POTENTIAL grounding cargo oil loss in the bottom graph. The patterns in exposure changes shown in Figure 57 are not the same as in Figure 55 and Figure 56 as the bulk carriers and container vessels in Gateway and Delta Port What-If scenarios do not carry cargo oil. Thus, the Trans Mountain Pipeline Expansion project leads to the greatest increases in cargo oil time exposure. This leads to the higher increases in POTENTIAL collision cargo oil loss and POTENTIAL grounding cargo oil loss. However, there is another interesting result as the change in POTENTIAL collision cargo oil loss for the Gateway scenario is not proportional to the change in cargo oil time exposure. The additional What-If bulk carriers in the Gateway scenario do not carry cargo oil. There is only a modest increase in POTENTIAL collision frequency for the Gateway scenario in Figure 55, so this result must be cause by a change in the mix of vessels interacting with

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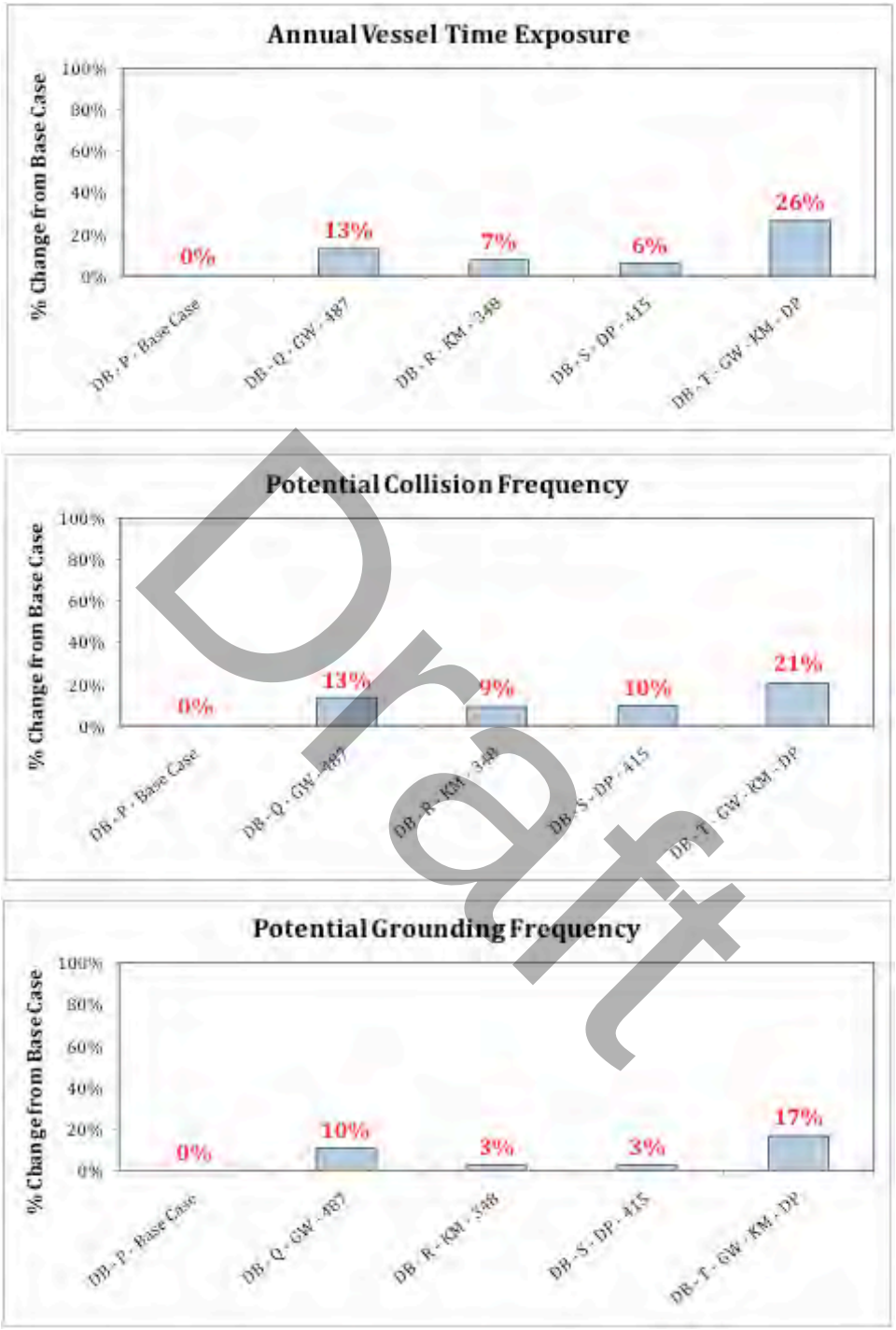

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Figure 55. An overview comparison of the changes from the 2010 base case for each What-If scenario in terms of vessel time of exposure, POTENTIAL collision frequency, and POTENTIAL grounding frequency.

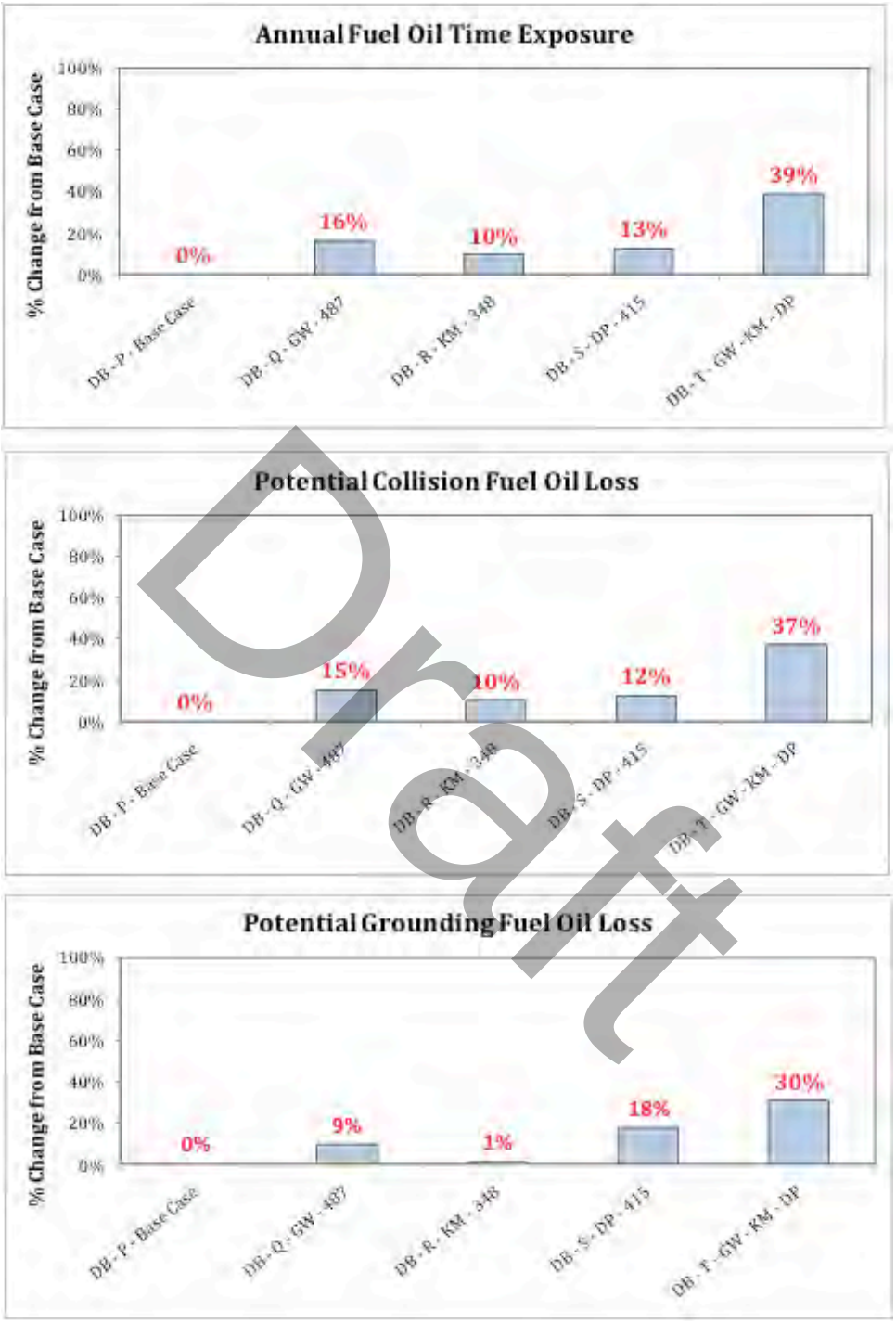

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Figure 56. An overview comparison of the changes from the 2010 base case for each What-If scenario in terms of fuel oil movement exposure, POTENTIAL collision fuel oil loss, and POTENTIAL grounding fuel oil loss.

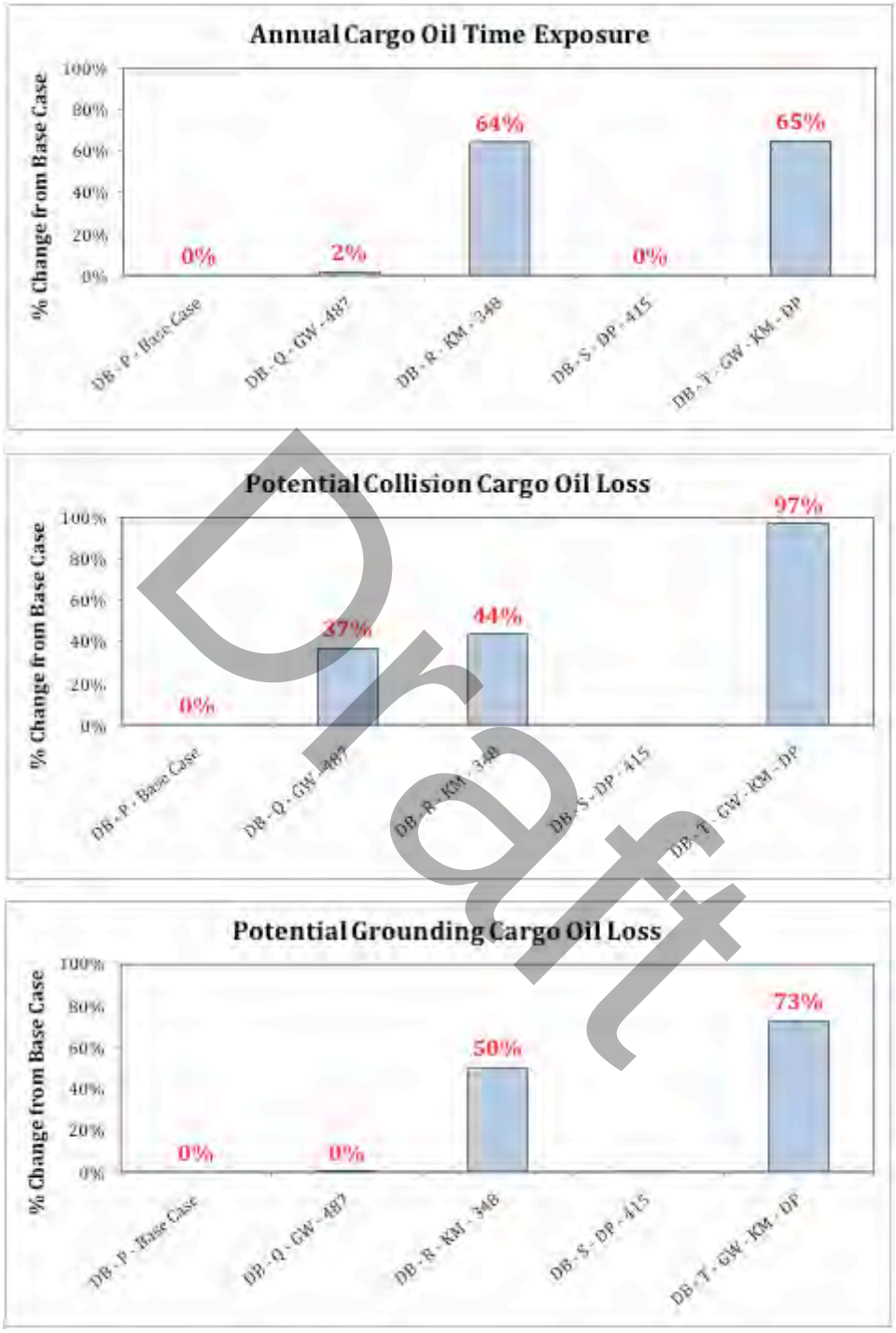

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Figure 57. An overview comparison of the changes from the 2010 base case for each What-If scenario in terms of cargo oil movement exposure, POTENTIAL collision cargo oil loss, and POTENTIAL grounding cargo oil loss.

Base Case tank vessels that do carry cargo oil. One would expect that this result is driven by increased interactions between Base Case tank vessels and Gateway bulk carriers. However, the result is not so simple. There is a change in mix of interactions in the Gateway What-f Scenario with multiple types of vessels around the Rosario Strait one-way zone, including other oil tankers, ferries, fishing vessel and barges etc. This is the indirect effect discussed at the beginning of this section where the What-If vessel pass through the one-way zone at Rosario Strait, cause delays or slow down of other vessels that are part of the original 2010 Base Case, and leads to a change in the mix interacting with tank vessels. This is an interesting result and could not be found without building a detailed simulation model of the system to capture such indirect effects.

Gateway Terminal geographic profile results

Figure 58 to Figure 61 each show the geographic profile for the Gateway What-If scenario results for POTENTIAL collision frequency, POTENTIAL collision oil loss, POTENTIAL grounding frequency, and POTENTIAL grounding oil loss. Respectively. The locations of major changes from the 2010 Base Case results to the Gateway What-If scenario results are circled in black. One can observe that the major changes in terms of POTENTIAL collision frequency, POTENTIAL collision oil loss, and POTENTIAL grounding frequency are concentrated around Rosario Strait. Recall from the previous section that the changes in POTENTIAL collision and grounding frequency are proportional to the changes in vessel exposure from the additional What-If bulk carriers. However, the change in POTENTIAL collision oil loss is an indirect effect of the What-If vessels using Rosario Strait and causing more interactions of tank vessels with other vessels large enough to penetrate the hull.

Trans Mountain Pipeline geographic profile results

Figure 62 to Figure 65 show the geographic profile for the Trans-Mountain Pipeline Expansion What-If scenario results for POTENTIAL collision frequency, POTENTIAL collision oil loss, POTENTIAL grounding frequency, and POTENTIAL grounding oil loss. The locations of major changes from the 2010 Base Case results to the Trans-Mountain Pipeline Expansion What-If scenario results are circled in black. Neither the POTENTIAL collision frequency nor the POTENTIAL grounding frequency has as large a change as the POTENTIAL collision oil loss or the POTENTIAL grounding oil loss. There as not as many tankers added in this case as there are bulk carriers in the Gateway What-If scenario and apparently they do not cause as much increase in POTENTIAL accident frequency. However, their impact on POTENTIAL oil loss is more significant due to their cargo oil. The main increase is in Haro Strait and Boundary Pass, although there is an increase in POTENTIAL collision oil loss at the entrance to the Straits of Juan de Fuca.

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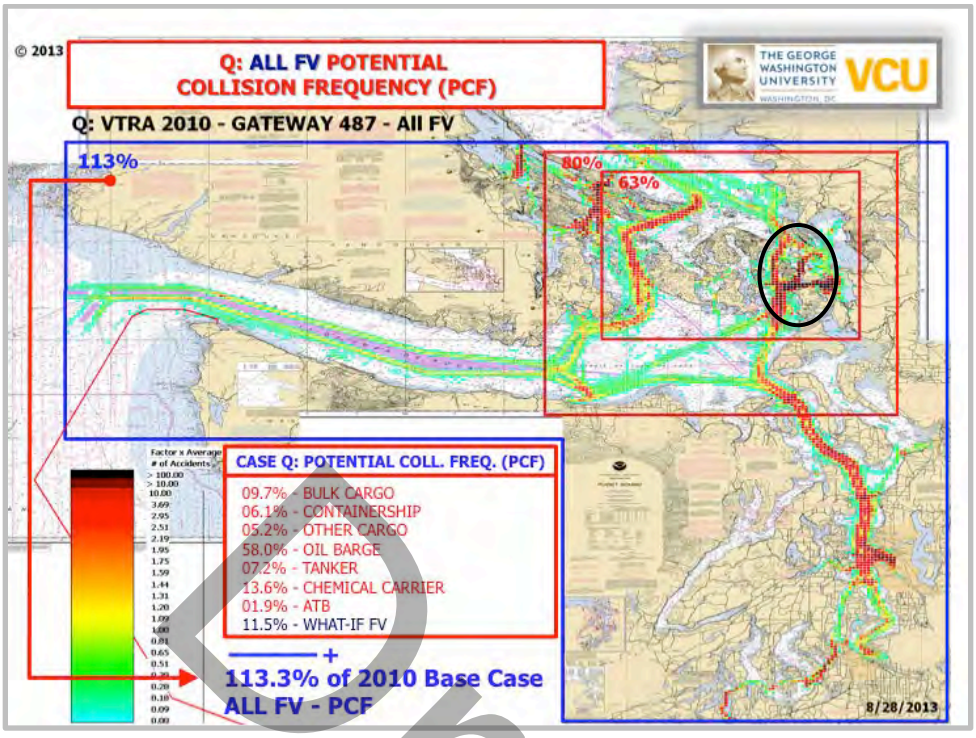

Figure 58. The geographic profiles of POTENTIAL collision frequency for the Gateway What-If scenario.

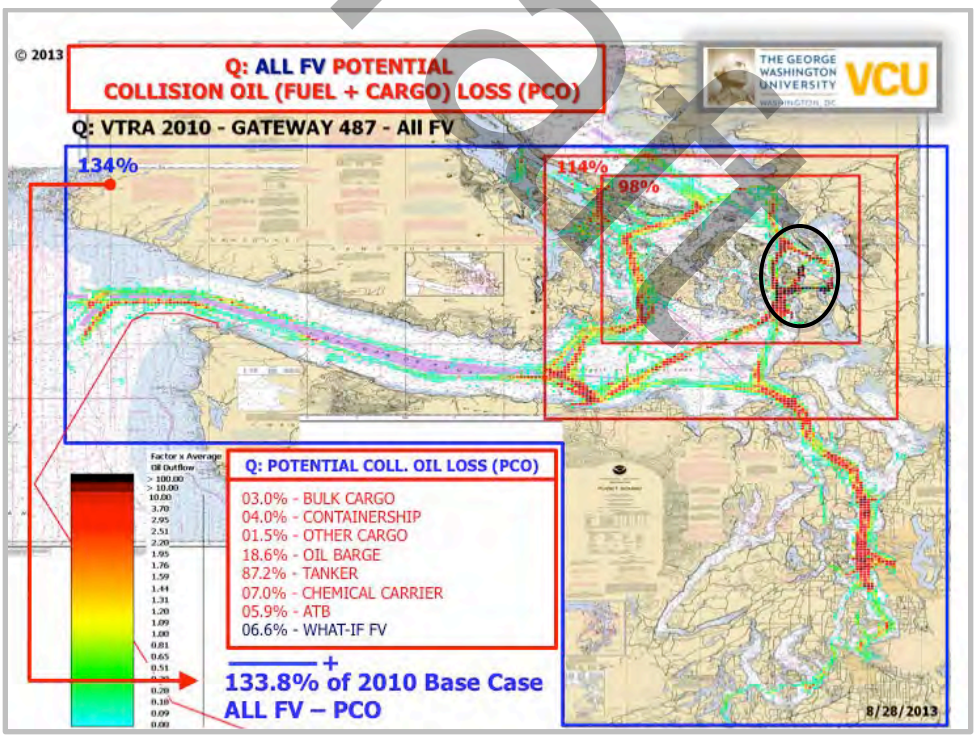

Figure 59. The geographic profiles of POTENTIAL collision oil loss for the Gateway What-If scenario.

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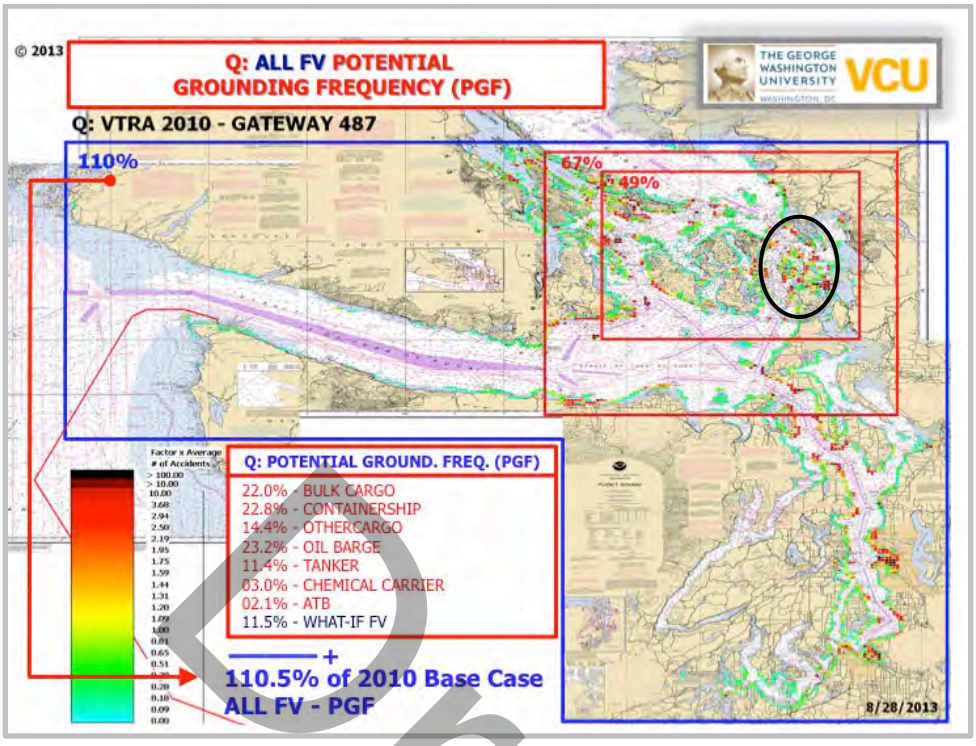

Figure 60. The geographic profiles of POTENTIAL grounding frequency for the Gateway What-If scenario.

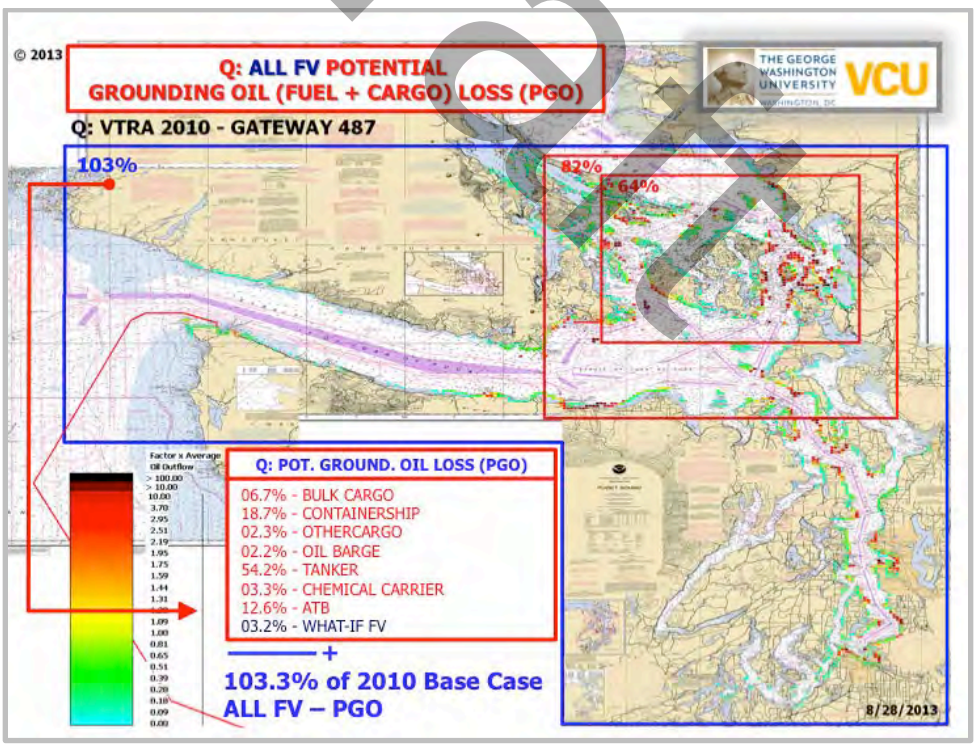

Figure 61. The geographic profiles of POTENTIAL grounding oil loss for the Gateway What-If scenario.

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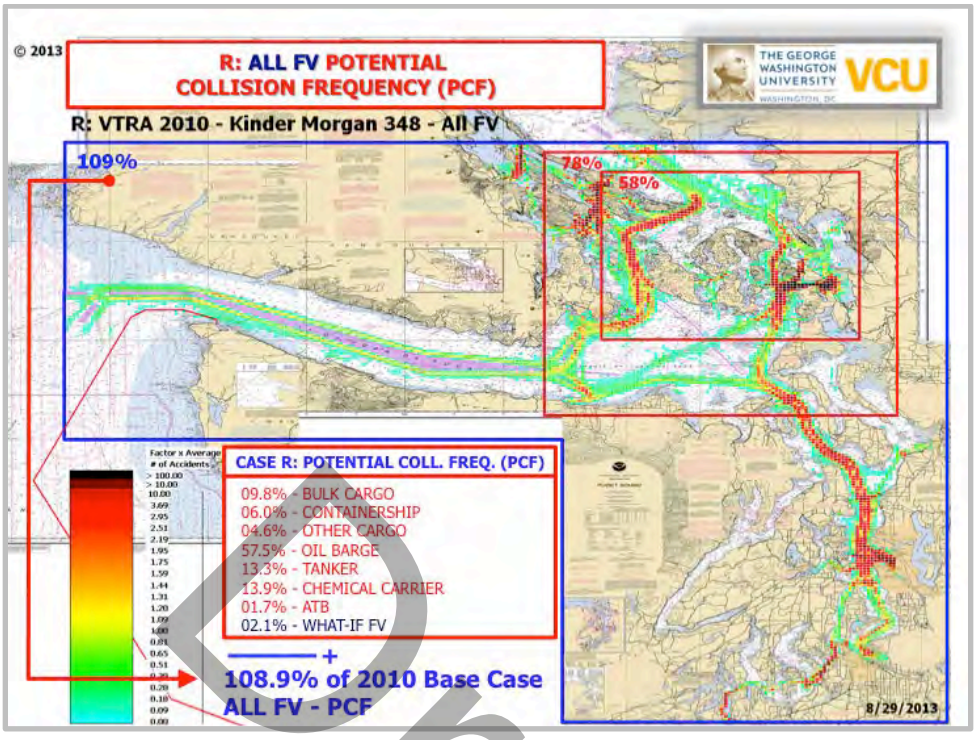

Figure 62. The geographic profiles of POTENTIAL collision frequency for the Trans-Mountain Pipeline Expansion What-If scenario.

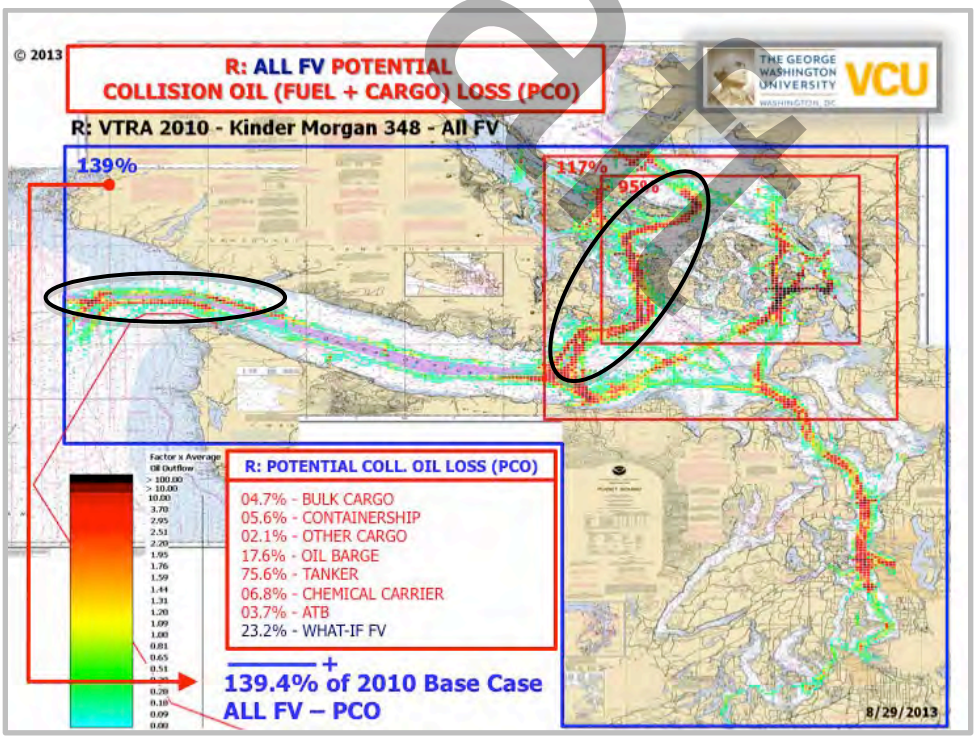

Figure 63. The geographic profiles of POTENTIAL collision oil loss fort the Trans-Mountain Pipeline Expansion What-If scenario.

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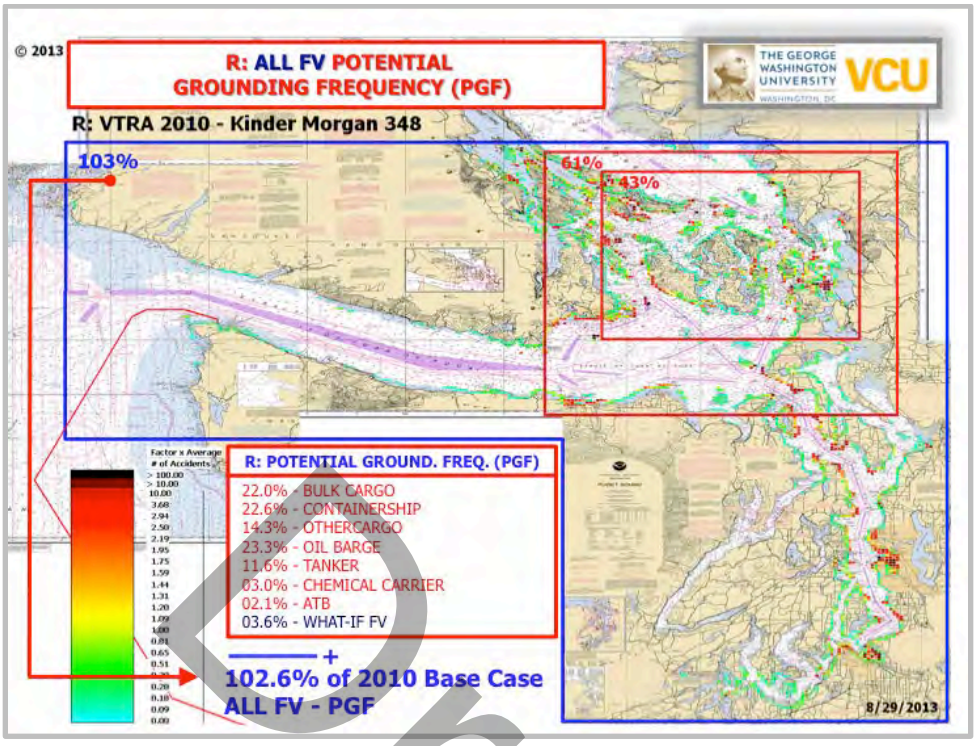

Figure 64. The geographic profiles of POTENTIAL grounding frequency for the Trans-Mountain Pipeline Expansion What-If scenario.

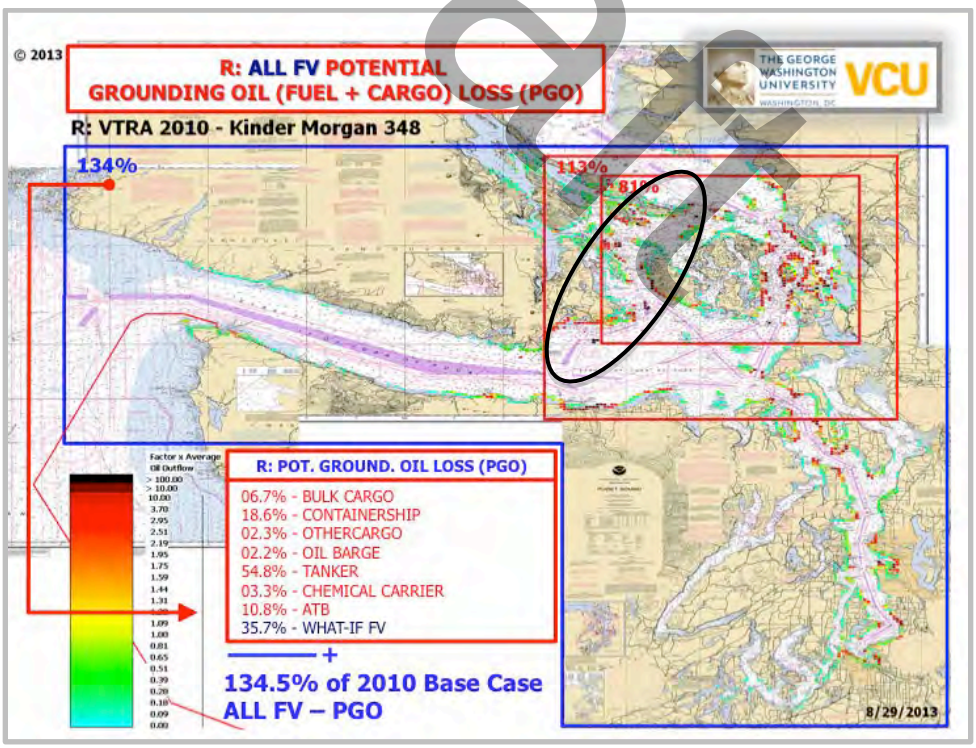

Figure 65. The geographic profiles of POTENTIAL grounding oil loss for the Trans-Mountain Pipeline Expansion What-If scenario.

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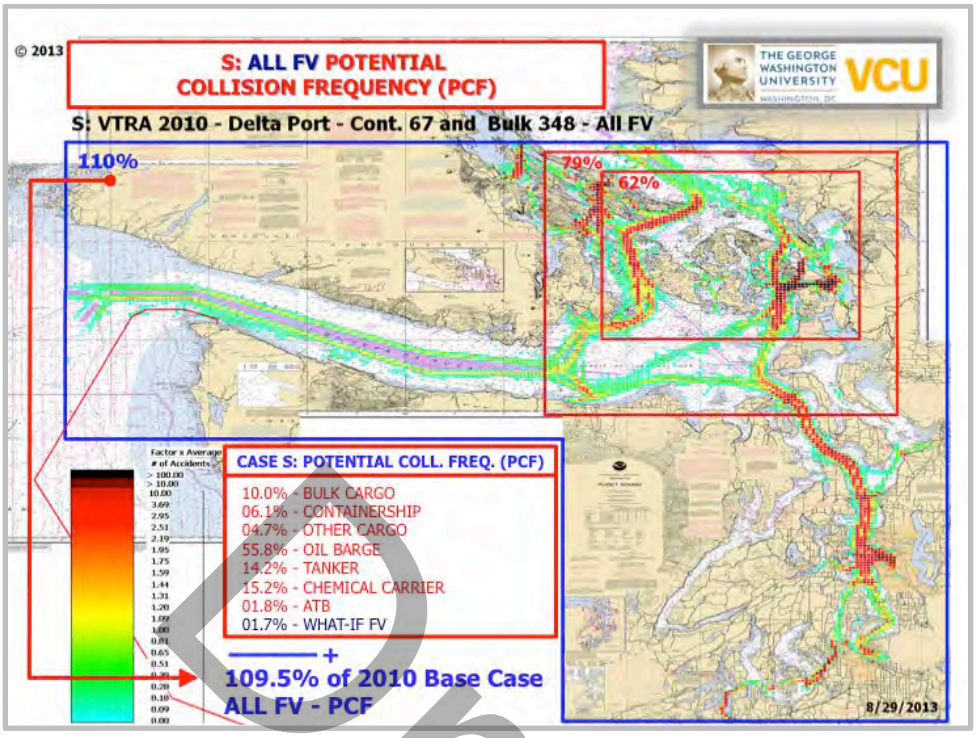

Figure 66. The geographic profiles of POTENTIAL collision frequency for the Delta Port What-If scenario.

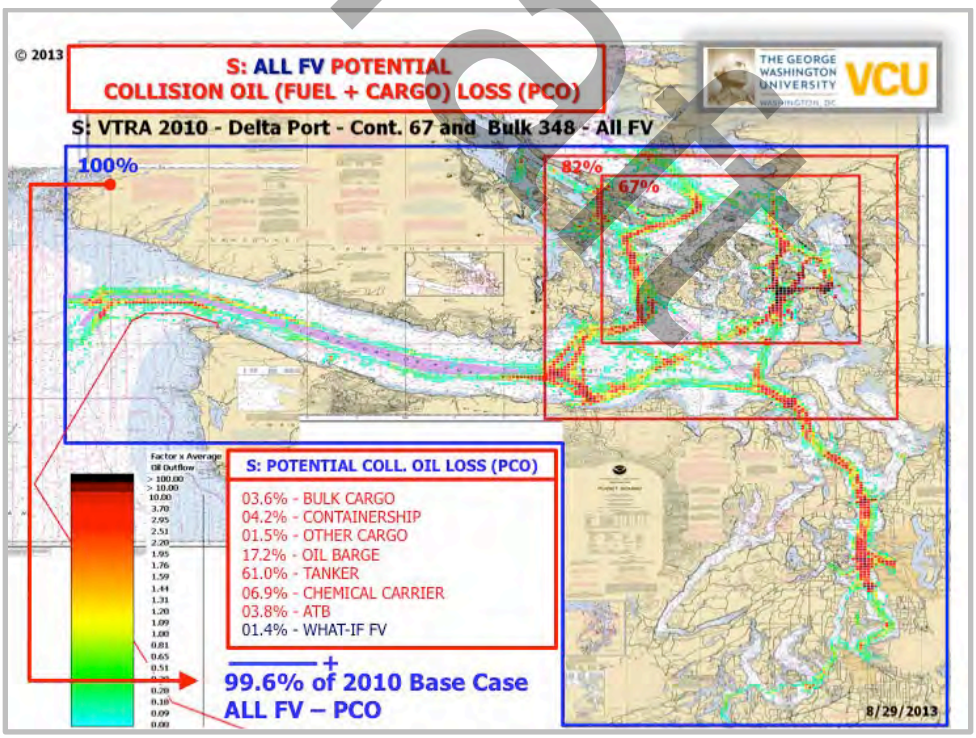

Figure 67. The geographic profiles of POTENTIAL collision oil loss for the Delta Port What-If scenario.

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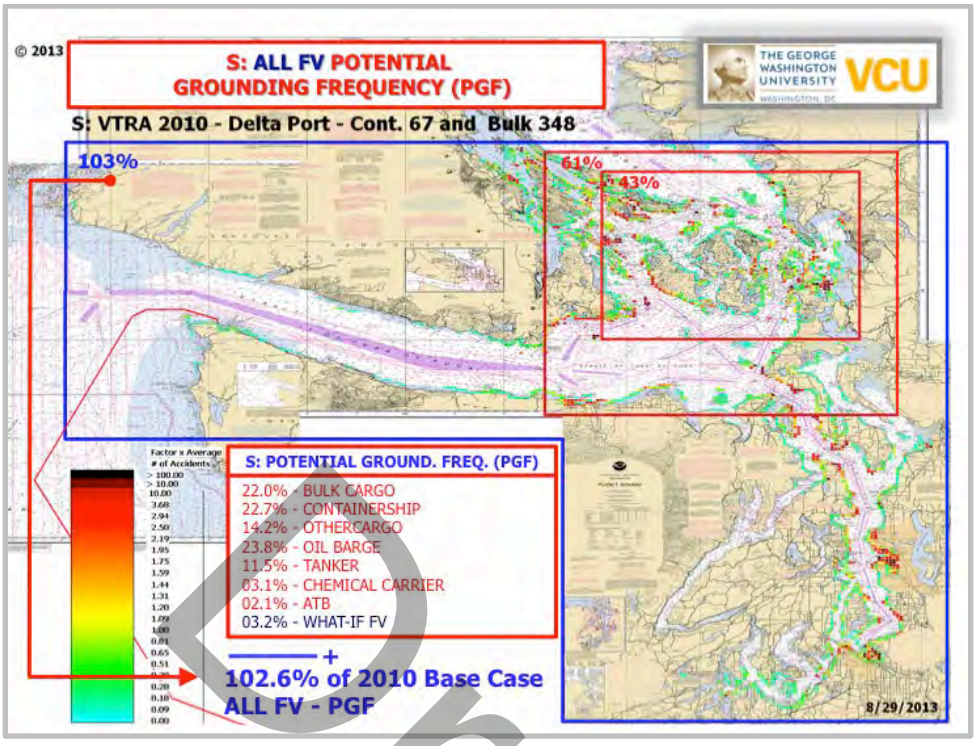

Figure 68. The geographic profiles of POTENTIAL grounding frequency for the Delta Port What-If scenario.

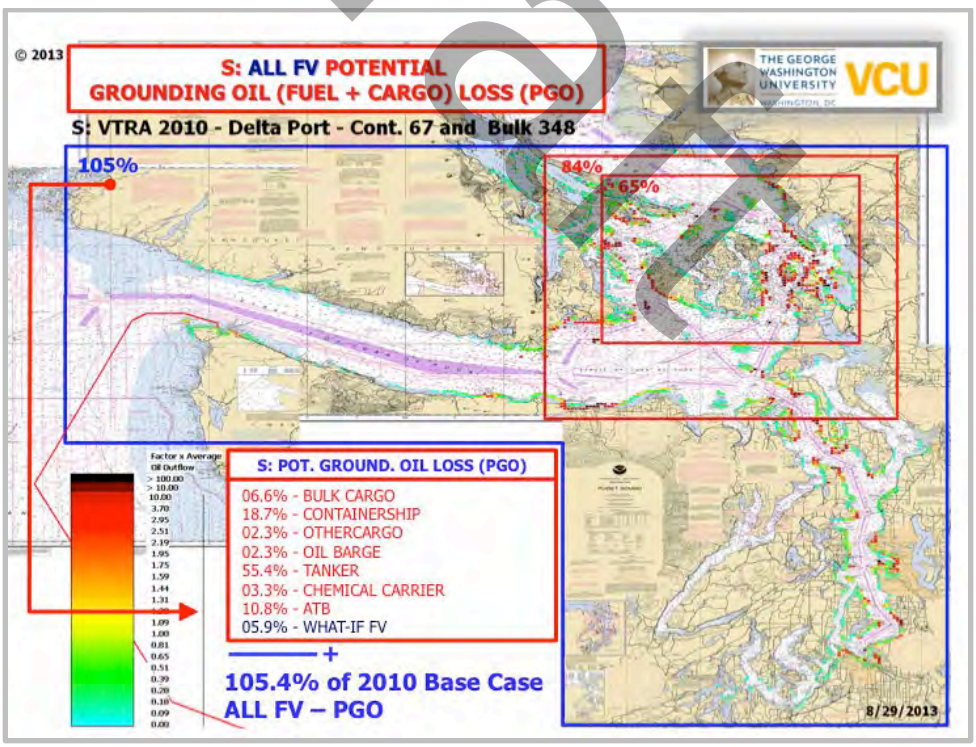

Figure 69. The geographic profiles of POTENTIAL grounding oil loss for the Delta Port What-If scenario.

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Delta Port geographic profile results

Figure 66 to Figure 69 show the geographic profile for the Delta Port What-If scenario results for POTENTIAL collision frequency, POTENTIAL collision oil loss, POTENTIAL grounding frequency, and POTENTIAL grounding oil loss. The major changes from the 2010 Base Case results to the Trans-Mountain Pipeline Expansion What-If scenario results are smaller than other cases. The number of added in the Delta Port What-If scenario and the study area affected are similar to the Trans-Mountain Pipeline What-If scenario. The effects on POTENTIAL accident frequency are, therefore, similar. However, the containers and bulk carriers added do not cargo oil, so the impact on POTENTIAL oil loss is less. There is in fact a very small reduction in the POTENTIAL cargo oil loss. This seems anomalous as adding vessels to the 2010 Base Case decreases this measure. This effect is caused by a small change in the mix of vessels interacting with tank vessels.

Geographic profile results from adding all three What-If Scenarios

Figure 70 to Figure 73 show the geographic profile for the combinedWhat-If scenario results for POTENTIAL collision frequency, POTENTIAL collision oil loss, POTENTIAL grounding frequency, and POTENTIAL grounding oil loss. The major changes from the 2010 Base Case results to the combinedWhat-If scenario results are circled in black. The changes in POTENTIAL collision frequency are caused by vessels from all three What-If scenarios that have been combined. The changes in POTENTIAL collision oil loss are located where major changes from the Gateway What-If scenario and the Trans-Mountain Pipeline Expansion What-If scenario are located. The changes in POTENTIAL grounding frequency are again the located where major changes from the Gateway What-If scenario and the Trans-Mountain Pipeline Expansion What-If scenario are located. However, the changes in POTENTIAL grounding oil loss are only located where the major change for the Trans-Mountain Pipeline Expansion What-If scenario is located.

An interesting consideration is whether the changes caused by the combined What-If scenario is just the sum of the changes caused by each of the three separate What-If scenarios or whether there is an interaction between the scenarios. The changes in the POTENTIAL collision frequency from the three separate What-If scenarios add up to 13.3% + 8.9% + 9.5% = 33.7%. The change from the combined What-If scenario is only 20.6%. Thus the dynamics of the system are changed in a way that reduces collision risk.

The changes in the POTENTIAL collision oil lossfrom the three separate What-If scenarios add up to 33.8% + 39.4% - 0.4% = 72.8%. The change from the combined What-If scenario is 89%. Thus the mix of vessels from the three cases involved in interactions with tank vessels must lead to more oil spill. A plausible cause for this effect is the combination of

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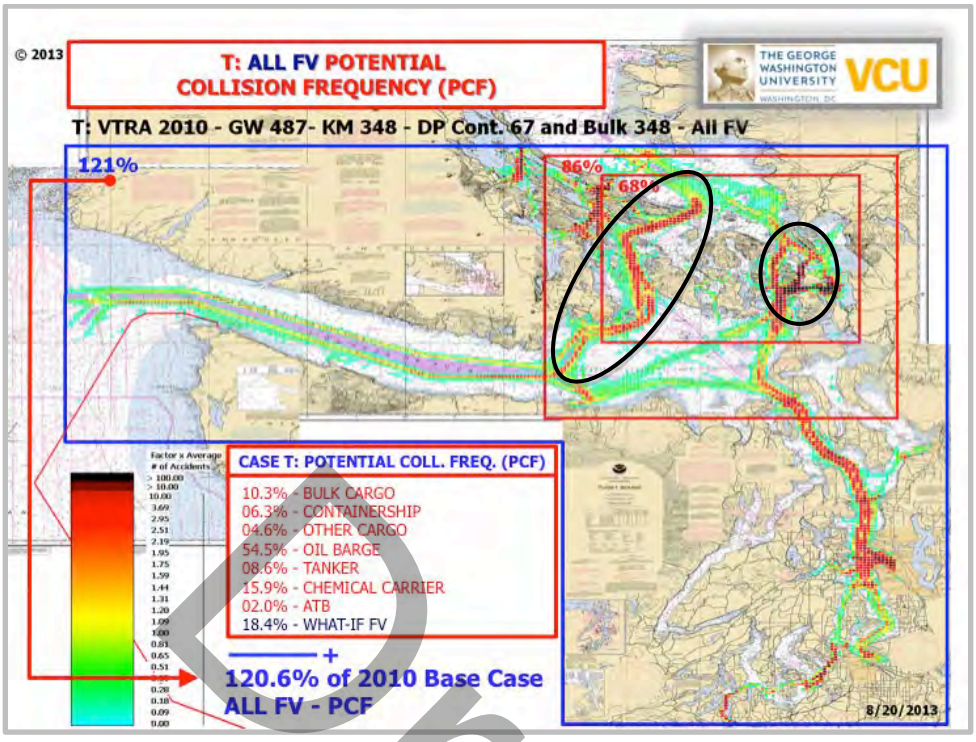

Figure 70. The geographic profiles of POTENTIAL collision frequency for the CombinedWhat-If scenario.

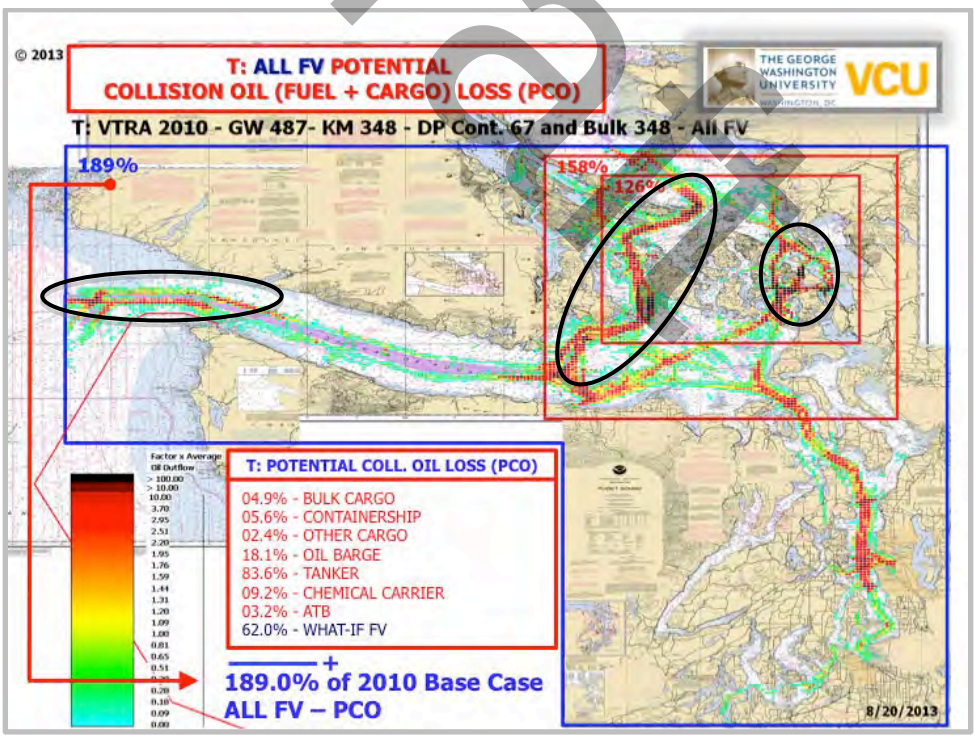

Figure 71. The geographic profiles of POTENTIAL collision oil loss for the CombinedWhat-If scenario.

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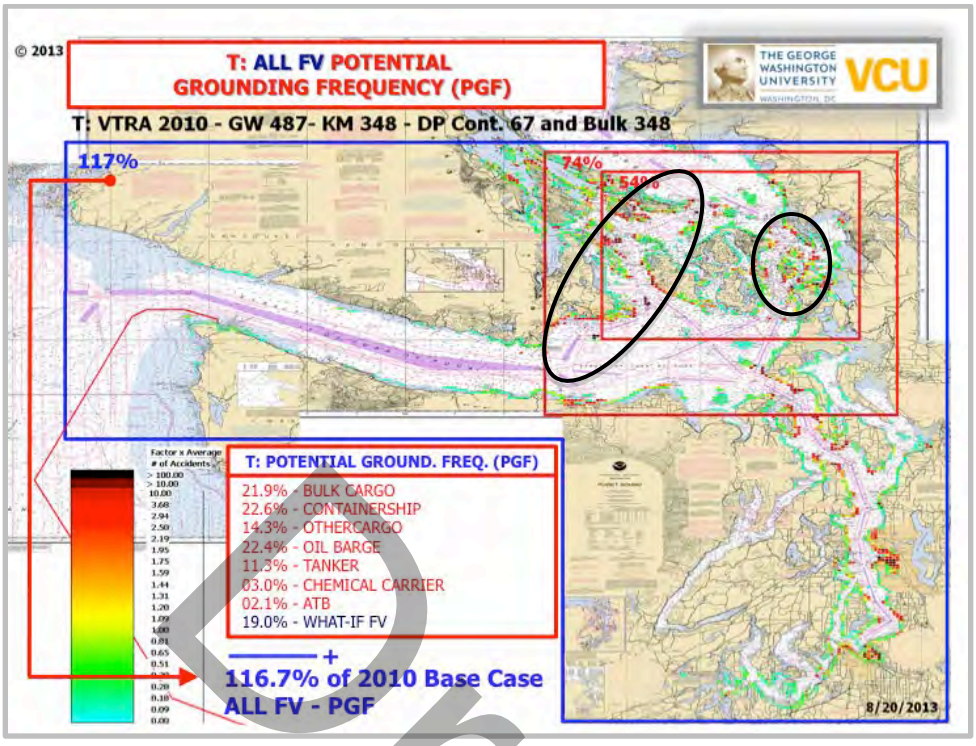

Figure 72. The geographic profiles of POTENTIAL grounding frequency for the CombinedWhat-If scenario.

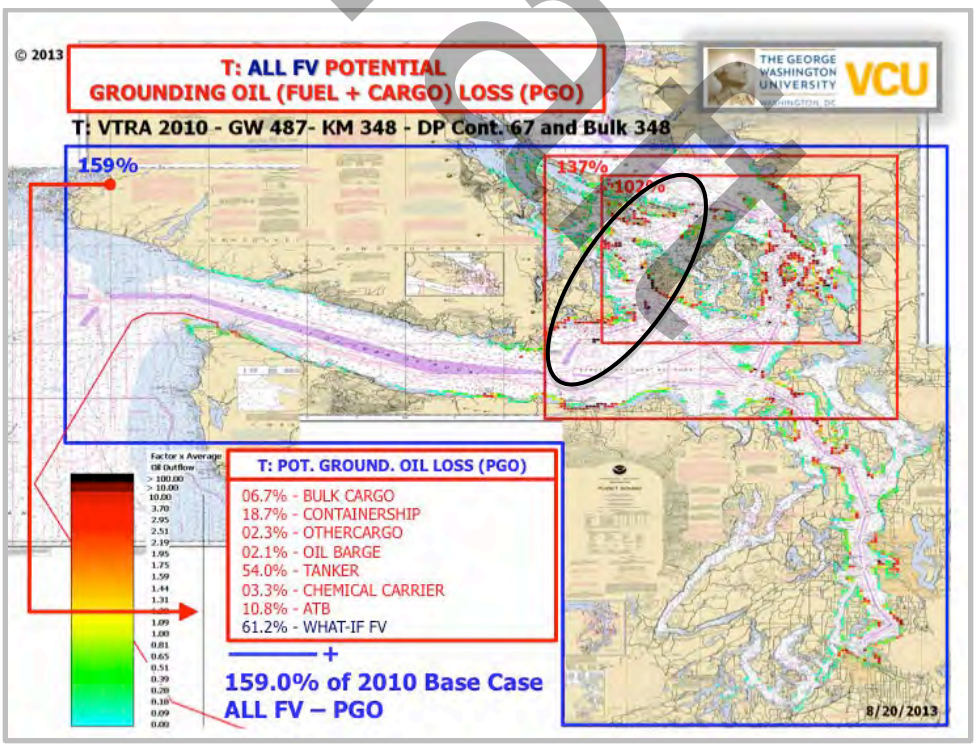

Figure 73. The geographic profiles of POTENTIAL grounding oil loss for the CombinedWhat-If scenario.

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containers and bulk carriers using Haro Strait to transit to Delta Port and tankers using Haro Strait to transit to Vancouver.

The changes in the POTENTIAL grounding frequency from the three separate What-If scenarios add up to10.5% + 2.6% + 2.6% = 15.7%. The change from the combined What-If scenario is 16.7%. These are close, with a small interaction effect.

The changes in the POTENTIAL grounding oil loss from the three separate What-If scenarios add up to3.3% + 34.5% + 5.4% = 43.2%. The change from the combined What-If scenario is 59%. So again we have an increase beyond the sum of the three individual What-If scenarios, which must mean that the vessels involved in the additional grounding potential are tank vessels.

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8. RISK MANAGEMENT SCENARIOS

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9. BENCH MARK SCENARIOS

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10.A COMPARISON OF WHAT-IF, RISK MANAGEMENT AND BENCH MARK SCENARIOS

PLACE HOLDER
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11.CONCLUSIONS AND RECOMMENDATIONS

PLACE HOLDER
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Appendix: Glossary and List of Acronyms

- Allision–The collision of a vessel with its intended docking berth.
- ATB – Articulated Tug Barge
- Ecology – The Washington Department of Ecology's Spill Prevention, Preparedness and Response Program which is the primary state organization with authority and accountability for managing oil and hazardous material spill risk state-wide. Ecology is assisting PSP in conducting the VTRA with its expertise and experience.
- EPA – Environmental Protection Agency.
- MTS – Maritime Transportation System.
- FV – Focus Vessel.
- ITB – Integrated Tug Barge.
- IV – Interacting Vessel.
- MXPS – Marine Exchange Puget Sound.
- NGO – Non-Governmental Organization.
- NPO – Non-Persistent Oil
- Study Area – The Washington waters of Puget Sound east of Cape Flattery, north of Admiralty Inlet and west of Deception Pass, and their approaches.
- GW – George Washington University is the prime subgrant awardee.
- VCU – Virginia Commonwealth University is a sub-awardee to GW.
- GW/VCU – The technical team composed of GW and VCU.
- PO – Persistent Oil.
- PSP – The Puget Sound Partnership is the Washington state agency responsible for developing a Puget Sound Action Agenda, convening a Cross Partnership Oil Spill Work Group and for coordinating work to restore and protect Puget Sound.
- PSHSC – The Puget Sound Harbor Safety Committee.
- PSP Advisory Group – A steering committee of stakeholders advising the Puget Sound Partnership and GW/VCU over the course of this study.
- QAPP – Quality Assurance Project Plan
- USCG – US Coast Guard Sector Seattle, District 13.
- VTOSS – Vessel Traffic Operational Support System
- VTRA – Vessel Traffic Risk Assessment
- VTS – Vessel Traffic Service is thereal-time marine traffic monitoring system used by the USCG, similar to air traffic control for aircraft.

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