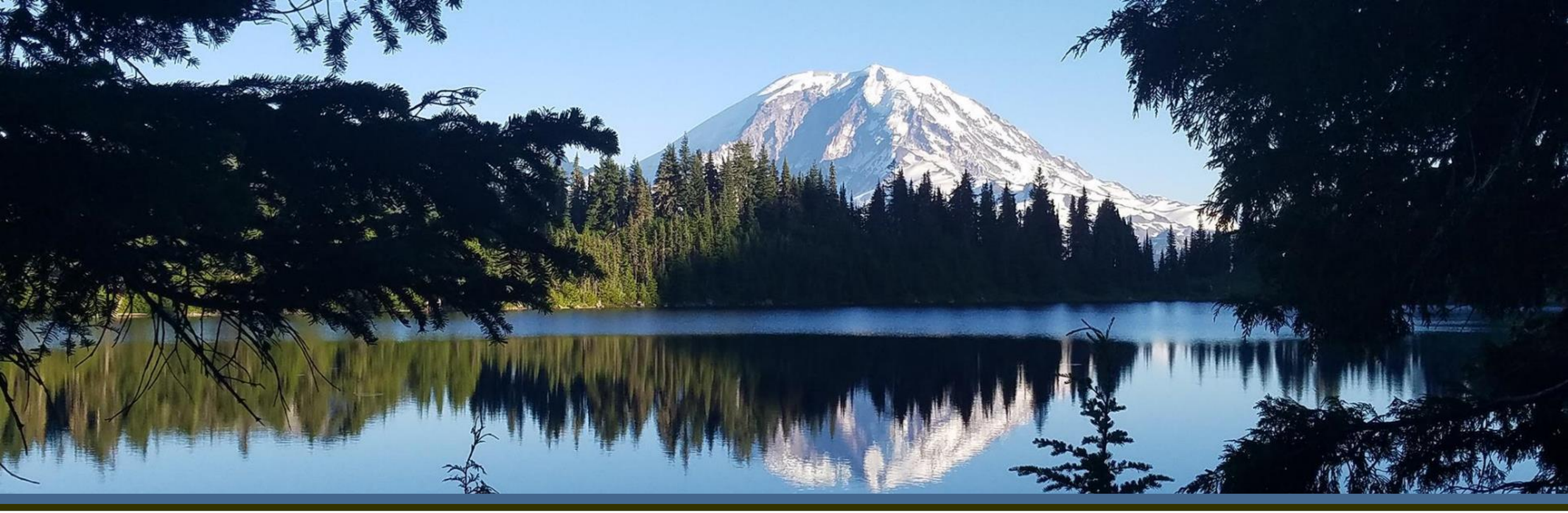

Tug Escort and ERTV Analyses: Preliminary Results

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DEPARTMENT OF ECOLOGY
State of Washington

April 4th, 2023

Today's agenda

1. Introduction and Results Preview
2. Model and Analysis Review
3. Tug Escort Analysis Results
4. ERTV Analysis Results
5. Questions and Comments

Model Analysis Projects

Tug Escort Analysis

"To inform rule making, the Board of Pilotage Commissioners must conduct an analysis of tug escorts using the model developed by the Department of Ecology"

ERTV Analysis

"Quantitatively assess whether an emergency response towing vessel serving Haro Strait, Boundary Pass, Rosario Strait, and connected navigable waterways will reduce oil spill risk"

Preview of Results: Drift Groundings

Drift groundings are rare events

- We identified 4 drift groundings in the local area between 2002 and 2019
- We identified 190 drift groundings in the coastal waters of US and Canada

Drift groundings account for 2% of selected marine incidents involving large commercial vessels

Drift groundings don’t often result in oil spills

- None of the drift grounding in the local area caused a spill, and 2.6% of the drift groundings in the US and Canada were associated with a spill

Preview of Results: Tug Escort Analysis

For the expansion of tug escorts for tank vessels between 5,000 and 40,000 DWT in Rosario and connected waters:

- We found a 2-3% reduction in oil spill risk from drift groundings

When we expanded tug escorts to the whole study area:

- We found an additional 0-2% reduction in oil spill risk
- Largest reductions were in Admiralty Inlet & Haro Strait and Boundary Pass

Expanding escort requirements produced an increase in escort underway time

- Escort underway time increased 134% when escorts were expanded in Rosario, and 263% when escorts were expanded to the whole study area
- We estimated an increase of 0.6 escort tug incidents per year for a Rosario expansion, and an increase of 3.0 escort tug incidents per year for the study area expansion

Preview of Results: ERTV Analysis

We modeled an ERTV for seven locations:

- Anacortes, Deltaport, Port Angeles, Port Townsend, Roche Harbor, Sidney, and Victoria

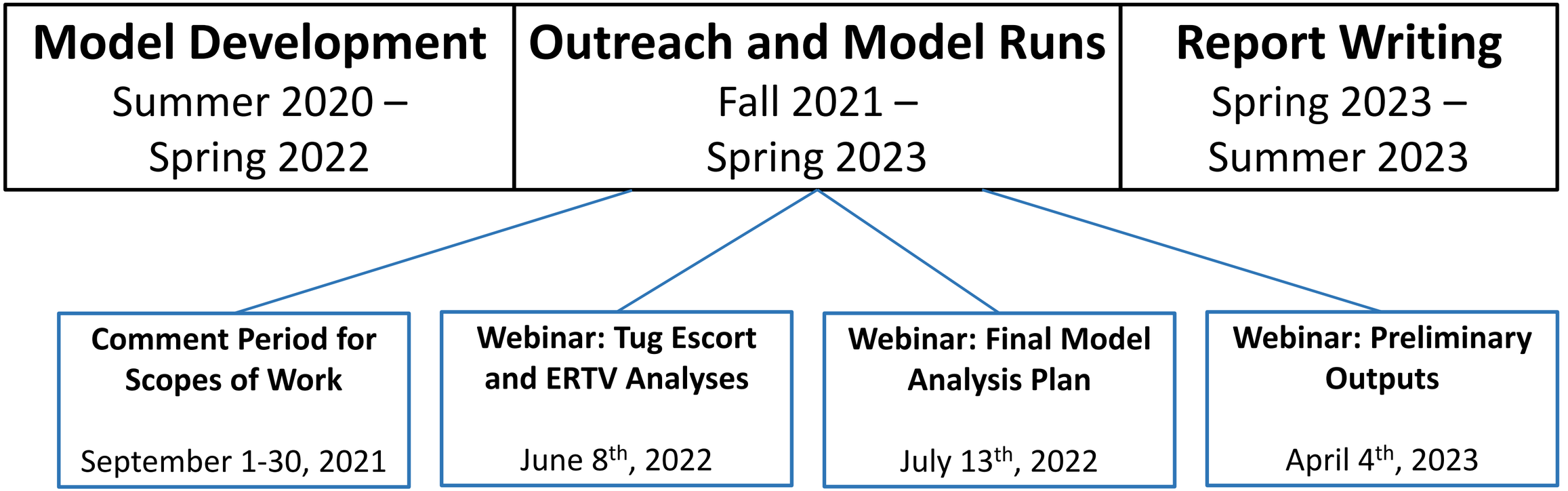
An ERTV in Roche Harbor provided the largest reduction in oil spill risk:

- The Roche Harbor ERTV reduced oil spill risk by 2%

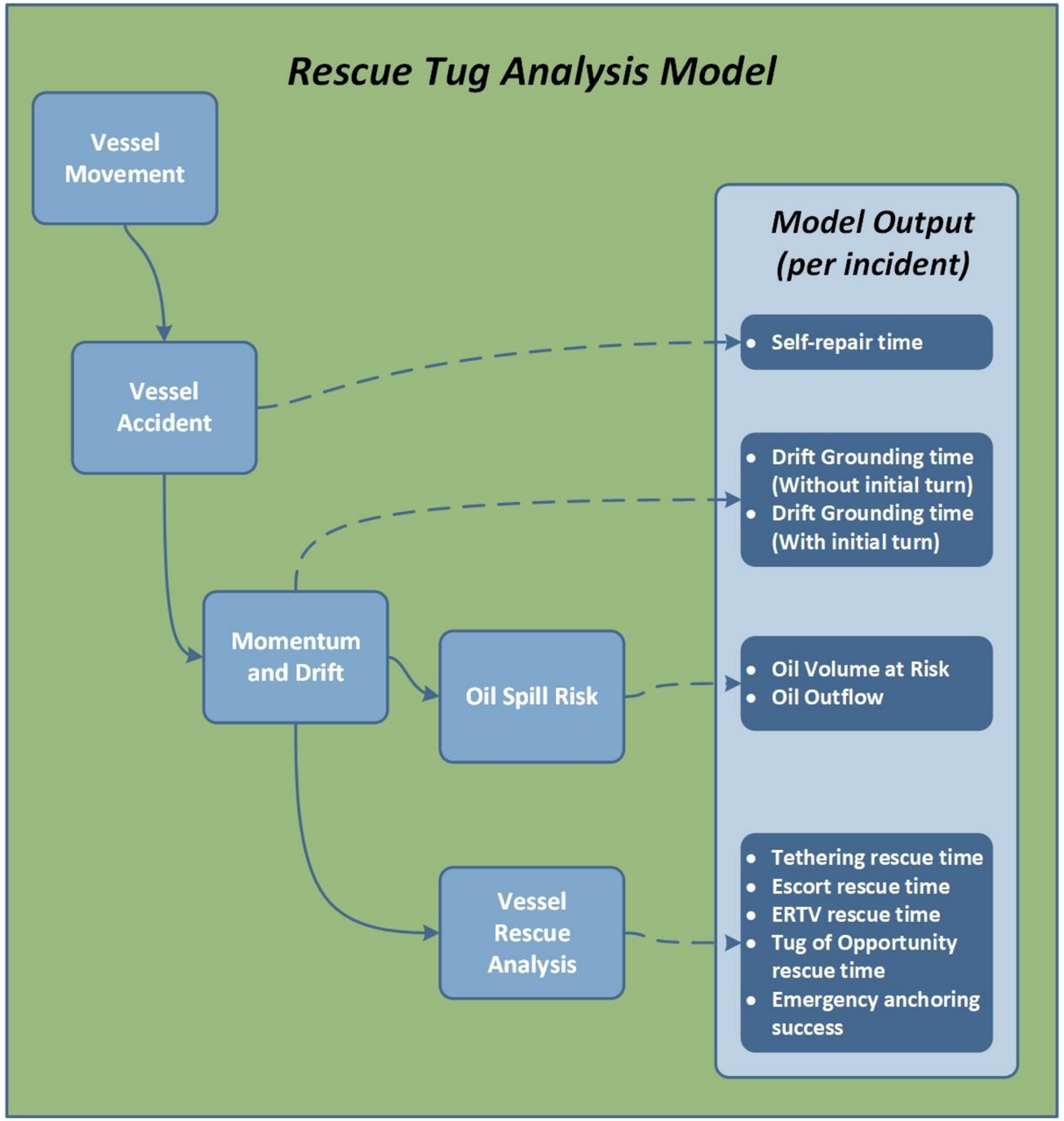
Roche Harbor remained the best location regardless of:

- Different tug escort scenarios
- Allowing or disallowing rescue by tugs of opportunity
- Presence or absence of Transmountain expansion project escort traffic

Outreach and Consultation Timeline



Model and Analysis Review



Analysis Approach

Loss of Propulsion Events

- Drift paths

Potential Internal Interventions

- Initial Turn
- Self Repair
- Anchoring

Potential External Interventions

- Tug Response

Image: https://gcaptain.com/the-amazing-race-to-save-the-modern-express-in-photos/

Inputs and Assumptions

1. **Loss of Propulsion Probabilities**
   - Based on loss of propulsion reports in the local area from 2002-2019

2. **Self Repair Distribution**
   - Based on a review of 98 reports detailing what happened after a local loss of propulsion event

3. **Emergency Anchoring Potential**
   - Ships must be under 3 knots, at least 500m plus own length from hazards

4. **Momentum and Drift Parameters**
   - Ships drift at max draft & displacement, using historical weather for the location

5. **Escort/Assist Tug Dispatching**
   - Escorts and assists dispatched based on historical transits to and from rendezvous locations

6. **Ladenness of Tank Vessels**
   - Ladenness is assigned based on whether observed transits were escorted or not, and additional assumptions

Oil Spill Risk Metrics

Drift Grounding Metric

- The drift grounding metric is designed to represent the likelihood of drift groundings. It is weighted by incident likelihood and the overall number of drift groundings identified in model outputs.

Oil Volume at Risk Metric

- Oil volume at risk is designed to represent risk of a maximum potential spill. It is based on the fuel and oil cargo capacity of an involved vessel. It is calculated by multiplying the maximum possible volume of oil (in gallons) aboard a simulated vessel, against the incident likelihood.

Oil Outflow Metric

- The oil outflow metric is designed to represent risk of an average potential spill. It doesn't produce specific outflows for individual events. It is based on the historical averages of spill size, and the historical probability of spills per incident, per vessel type. It is calculated by multiplying the average historical spill volume (in gallons) for a vessel type, against the spill probability per incident, against the incident likelihood.

Initial Review of Analysis Results

Exclusion of Initial Turn Results

- Based on our evaluation of outputs, we determined that the Initial Turn function was not working as expected. The hazard identification rules captured too many hazards and led to more initial turns than anticipated. As a result, we did not include initial turn results in the analysis.

Removal of Car Ferry Results

- The overwhelming volume of car ferry traffic in our simulated outputs put us at risk of missing important patterns for vessel types of interest. This discussion section only reviews the portion of the results that excluded car ferry traffic. Results with ferry traffic included will be available for review in report appendices.

Tug Escort Analysis

Evaluate the potential change in oil spill risk from covered vessels resulting from the use of tug escorts by specified tank vessels in waters east of New Dungeness Light/Discovery Island Light.

Tug Escort Analysis
Study Area

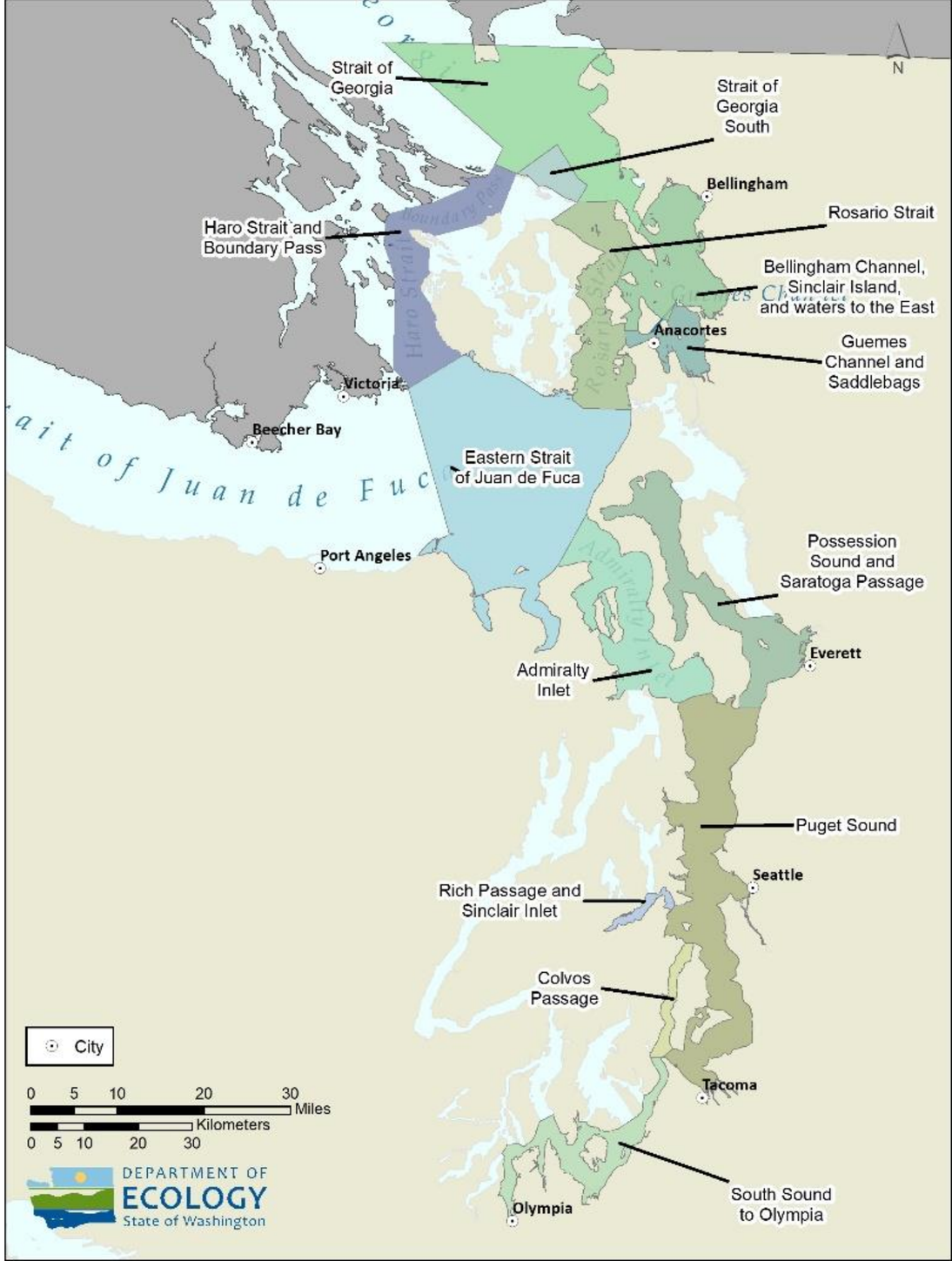
The study area included all Washington waters of the Salish Sea where the BPC might consider new tug escort rules.

It consisted of all connected marine waters east of a line from Discovery Island light to New Dungeness light in the Strait of Juan de Fuca and south of the 49th Parallel in the Strait of Georgia.

Interior waterways within the ports of Seattle and portions of the Duwamish River and Lake Washington are not included in the study area.

Tug Escort Analysis Geographic Zones

- Strait of Georgia
- Strait of Georgia South
- Haro Strait and Boundary Pass
- Rosario Strait
- Bellingham Channel, Sinclair Island, and waters to the East
- Guemes Channel and Saddlebags
- Eastern Strait of Juan de Fuca
- Admiralty Inlet
- Puget Sound
- Possession Sound and Saratoga Passage
- Rich Passage & Sinclair Inlet
- Colvos Passage
- South Sound to Olympia



Tug Escort Scenarios

Tank vessels in **Scenario 1** were simulated using the tug escort requirements in place prior to 2020.

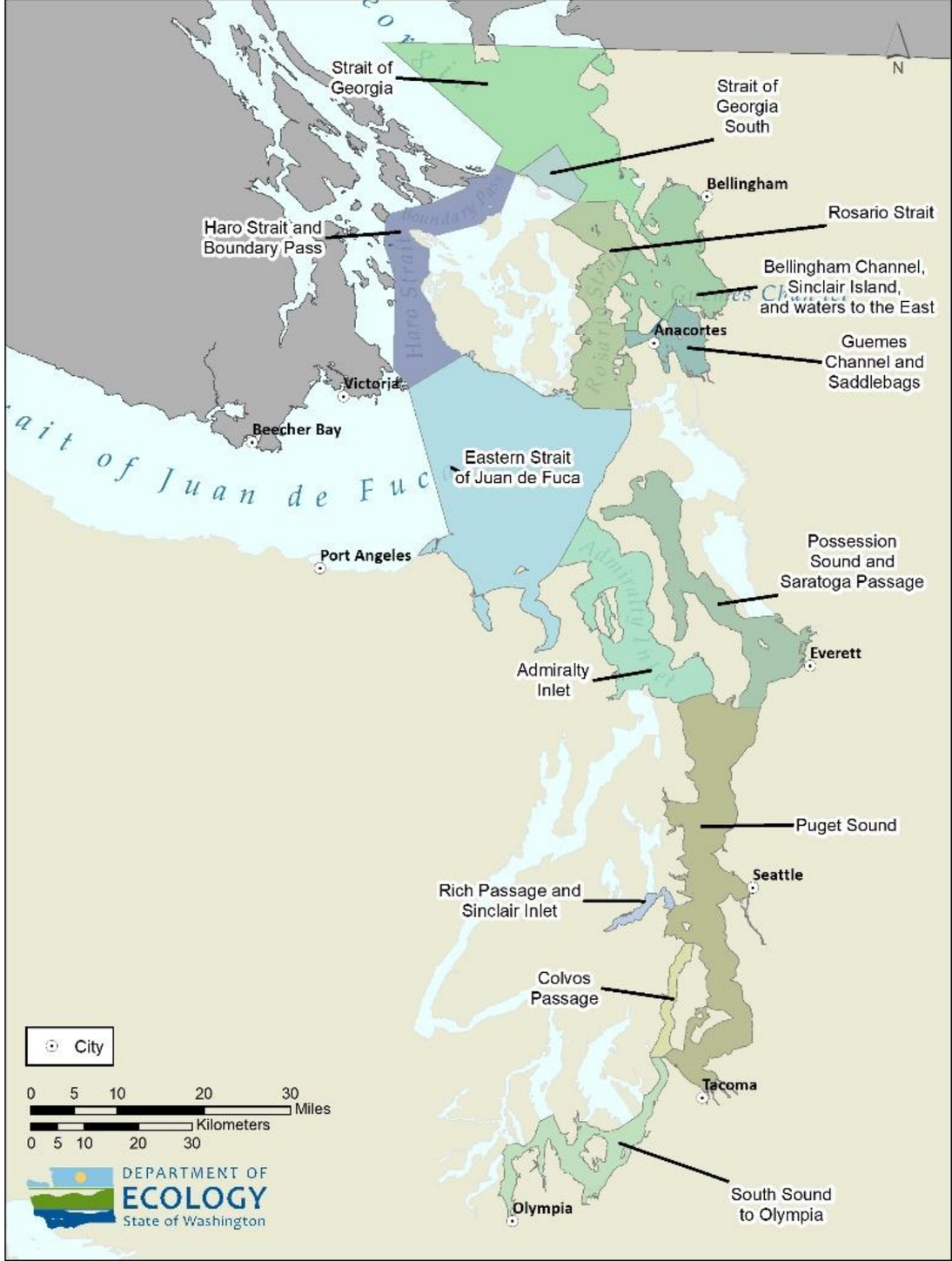
- Escorts required in study area for laden tank ships over 40,000 DWT

Tank vessels in **Scenario 2** were simulated using the tug escort requirements established in 2020.

- Escorts also required for laden ATBs, tank barges, and tank ships between 5,000 and 40,000 DWT in Rosario Strait and connected waters east.

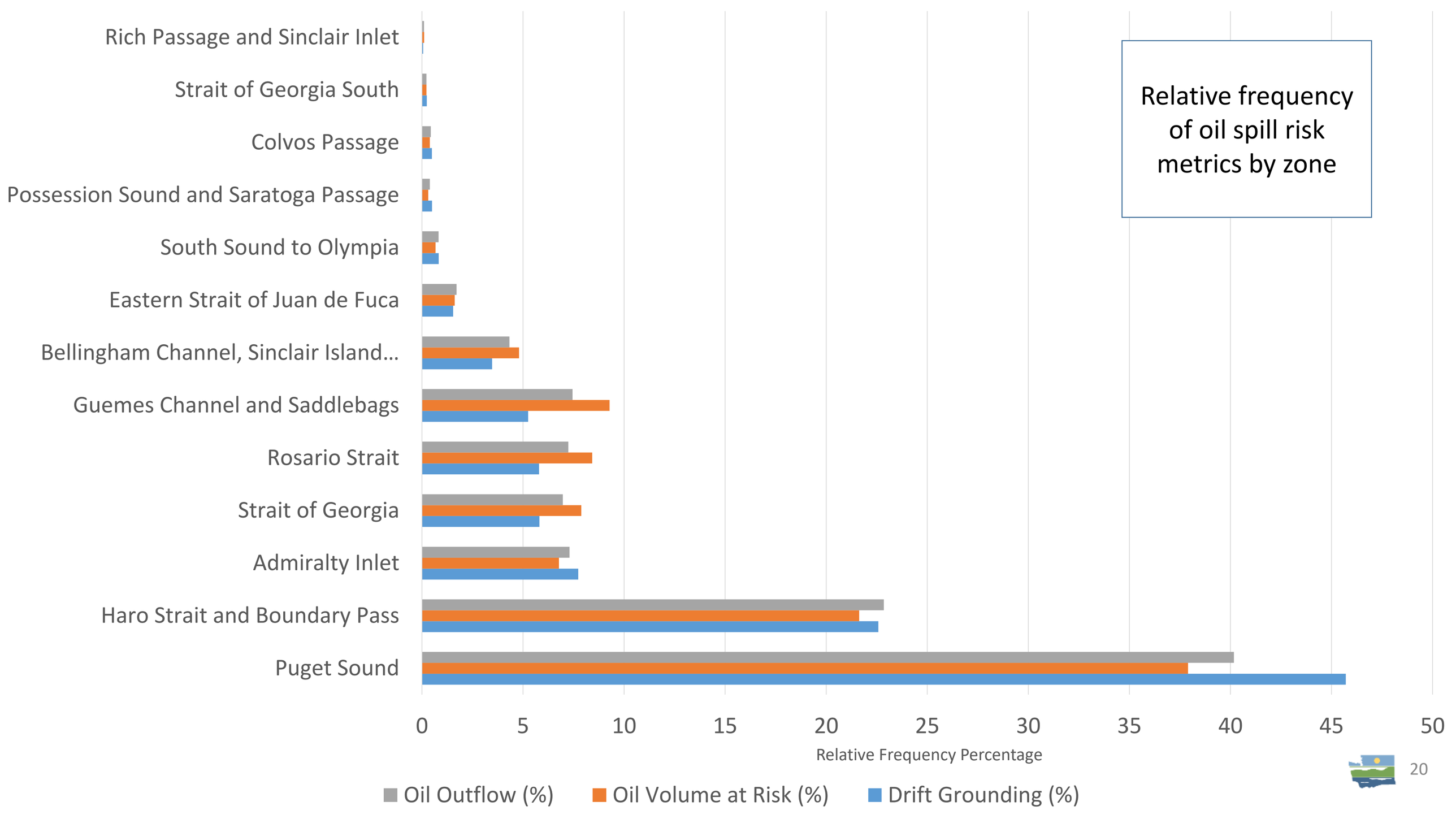
Tank vessels in **Scenario 3** were simulated using a theoretical expansion of tug escort requirements to the entire study area.

- Escorts also required for laden ATBs, tank barges, and tank ships between 5,000 and 40,000 DWT in the rest of the study area.



Tug Escort Analysis Preliminary Results

- Distribution of oil spill risk metrics
- Changes in oil spill risk from Rosario requirements
- Zones and vessel types that show most benefit from theoretical requirements of Scenario 3
- Risk from additional escort traffic
- Benefit of tethering
- Effect of Trans Mountain project on escorts
- How escort tugs may support loss of steering events


Relative frequency of oil spill risk metrics by zone
Rich Passage and Sinclair Inlet
Strait of Georgia South
Colvos Passage
Possession Sound and Saratoga Passage
South Sound to Olympia
Eastern Strait of Juan de Fuca
Bellingham Channel, Sinclair Island…
Guemes Channel and Saddlebags
Rosario Strait
Strait of Georgia
Admiralty Inlet
Haro Strait and Boundary Pass
Puget Sound
0
5
10
15
20
25
30
35
40
45
50
Relative Frequency Percentage
Oil Outflow (%)
Oil Volume at Risk (%)
Drift Grounding (%)

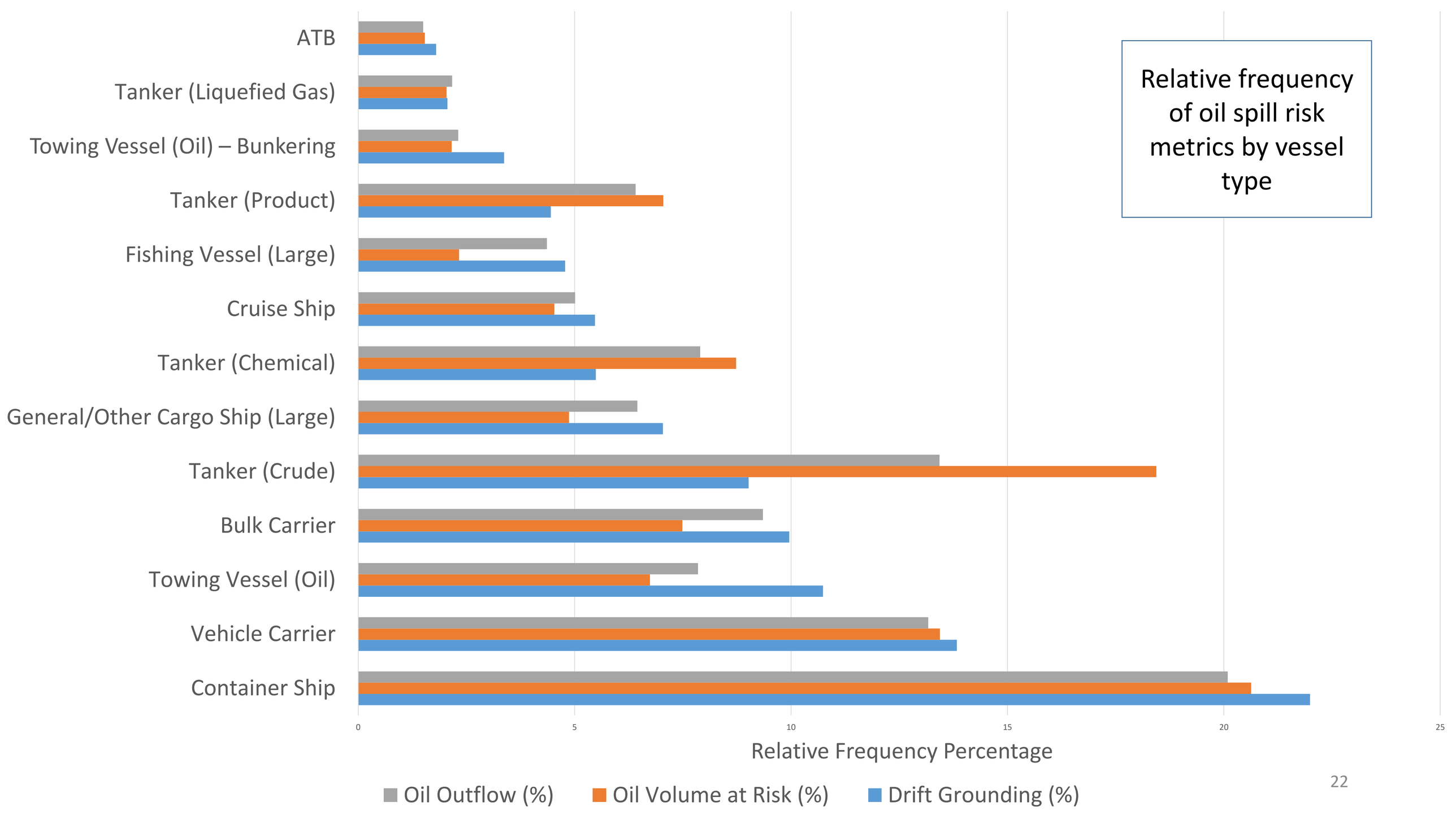
Distribution of Oil Spill Risk Metrics by Zone

Three zones account for less risk that might be expected based on their operational minutes:

- Eastern Strait of Juan de Fuca makes up 12% of the simulated traffic but only 2% of the oil spill risk.
- Admiralty Inlet and Strait of Georgia make up 12% of the simulated traffic, but only 6-7% and 6-8% of the risk, respectively.

Three zones account for more risk than their operational minutes would suggest:

- Haro Strait and Boundary Pass makes up 17% of the simulated traffic, but accounts for 22-23% of the risk.
- Guemes Channel and Saddlebags makes up 2% of the simulated traffic, but accounts for 5-9% of the risk
- Bellingham Channel, Sinclair Island, and waters to the East makes up 2% of the simulated traffic, but accounts for 3-5% of the risk.


Relative frequency of oil spill risk metrics by vessel type
ATB
Tanker (Liquefied Gas)
Towing Vessel (Oil) – Bunkering
Tanker (Product)
Fishing Vessel (Large)
Cruise Ship
Tanker (Chemical)
General/Other Cargo Ship (Large)
Tanker (Crude)
Bulk Carrier
Towing Vessel (Oil)
Vehicle Carrier
Container Ship
0
5
10
15
20
25
Relative Frequency Percentage
Oil Outflow (%)
Oil Volume at Risk (%)
Drift Grounding (%)

Distribution of Oil Spill Risk Metrics by Vessel Type

Some vessel types account for less risk than one would expect given their share of overall operational minutes:

- ATBs make up 9% of the simulated traffic and account for only 2 percent of the oil spill risk.
- Towed oil barges make up 24% of the traffic and 7-11% of the oil spill risk.
- Bulk carriers account for 20% of the simulated traffic, but only 7-10% of the risk.

Other vessel types account for more risk than one would expect given their share of overall operational minutes:

- Vehicle carriers make up 6% of the total simulated traffic but account for 14% of the oil spill risk.

Changes in oil spill risk from Rosario requirements

The expansion of tug escorts in Scenario 2 resulted in a small overall decrease in risk:

- Drift groundings declined 2.3%
- Oil volume at risk declined 3.1%
- Oil outflow declined 2.6%

In terms of absolute values:

- Drift groundings declined 0.0047 per simulation
- Oil volume at risk declined 22,430.1 gallons per simulation
- Oil outflow declined 1.5 gallons per simulation

Changes in oil spill risk from Rosario requirements

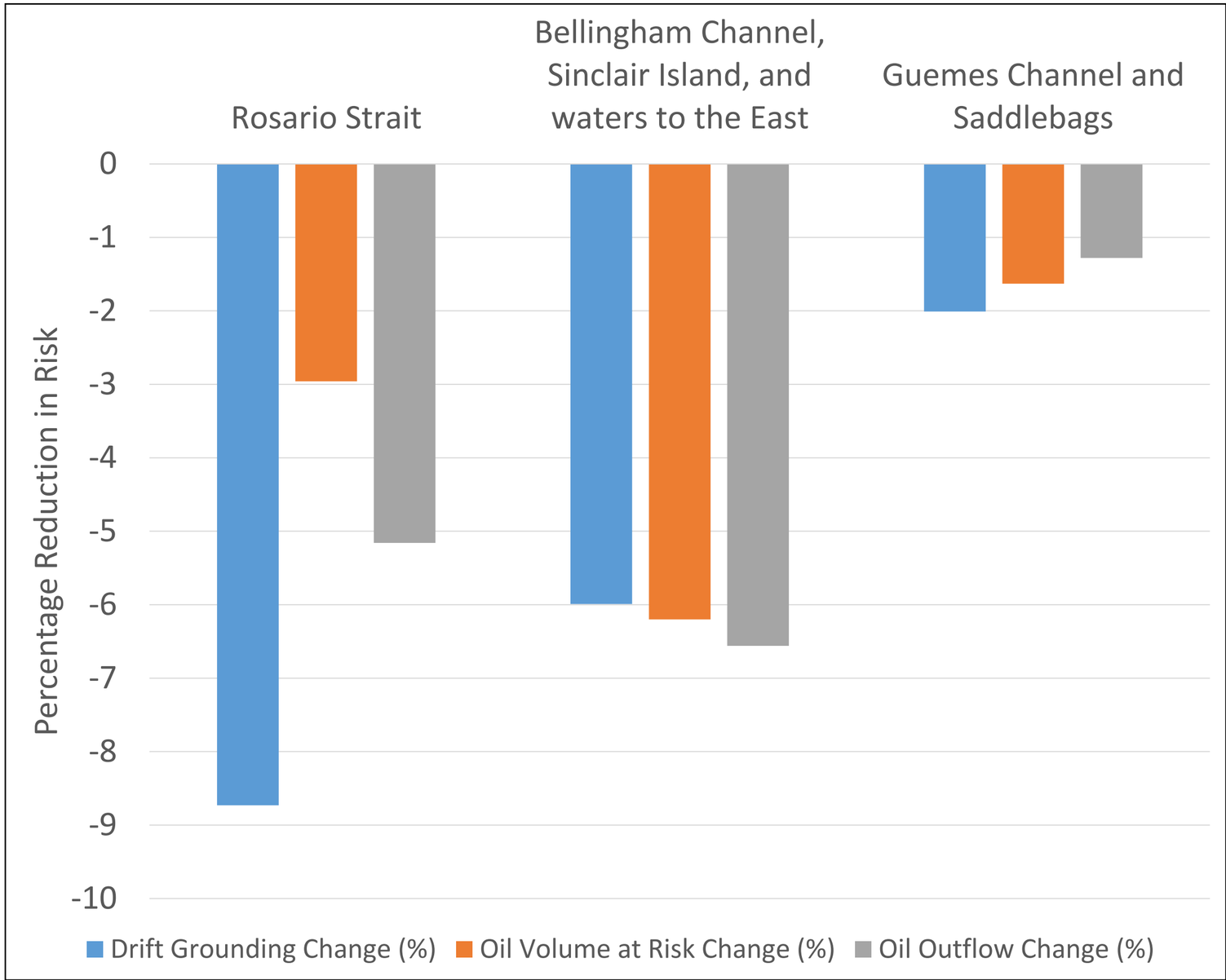
In Scenario 2, escorts were newly required for five vessel types:

- ATBs, towed oil barges, and chemical tankers, crude tankers, and product tankers under 40,000 DWT
- Each of these vessel types saw a reduction in oil spill risk.

Changes in oil spill risk from Rosario requirements

In Scenario 2, escorts were newly required in three zones:

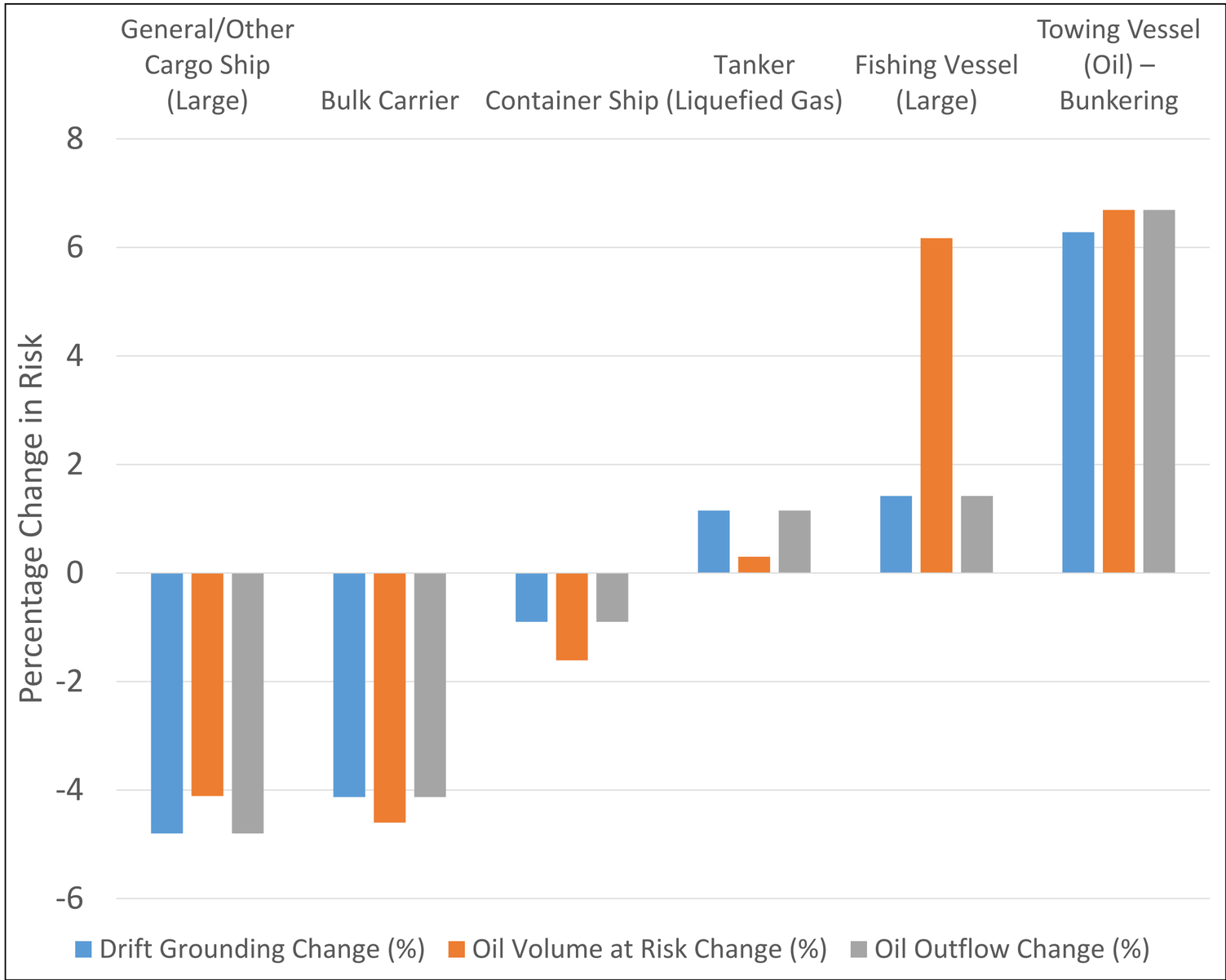
- Bellingham Channel, Sinclair Island and Waters East, Guemes Channel and Saddlebags, and Rosario Strait.
- Each of these zones saw small percentage reductions in oil spill risk.



Changes in oil spill risk from Rosario requirements

Changing escort requirements altered the geographic distribution of tugs in the system, which then affected the location of potential tugs of opportunity.

- As a result, vessel types without new escort requirements saw changes in oil spill risk.
- Some saw reductions and some saw increases.



Changes in oil spill risk for Scenario 3

Modeling the expansion of tug escort rules from Scenario 2 to Scenario 3 resulted in a small overall decrease in risk:

- Drift groundings declined 1.8%
- Oil volume at risk declined 0.1%
- Oil outflow declined 0.8%

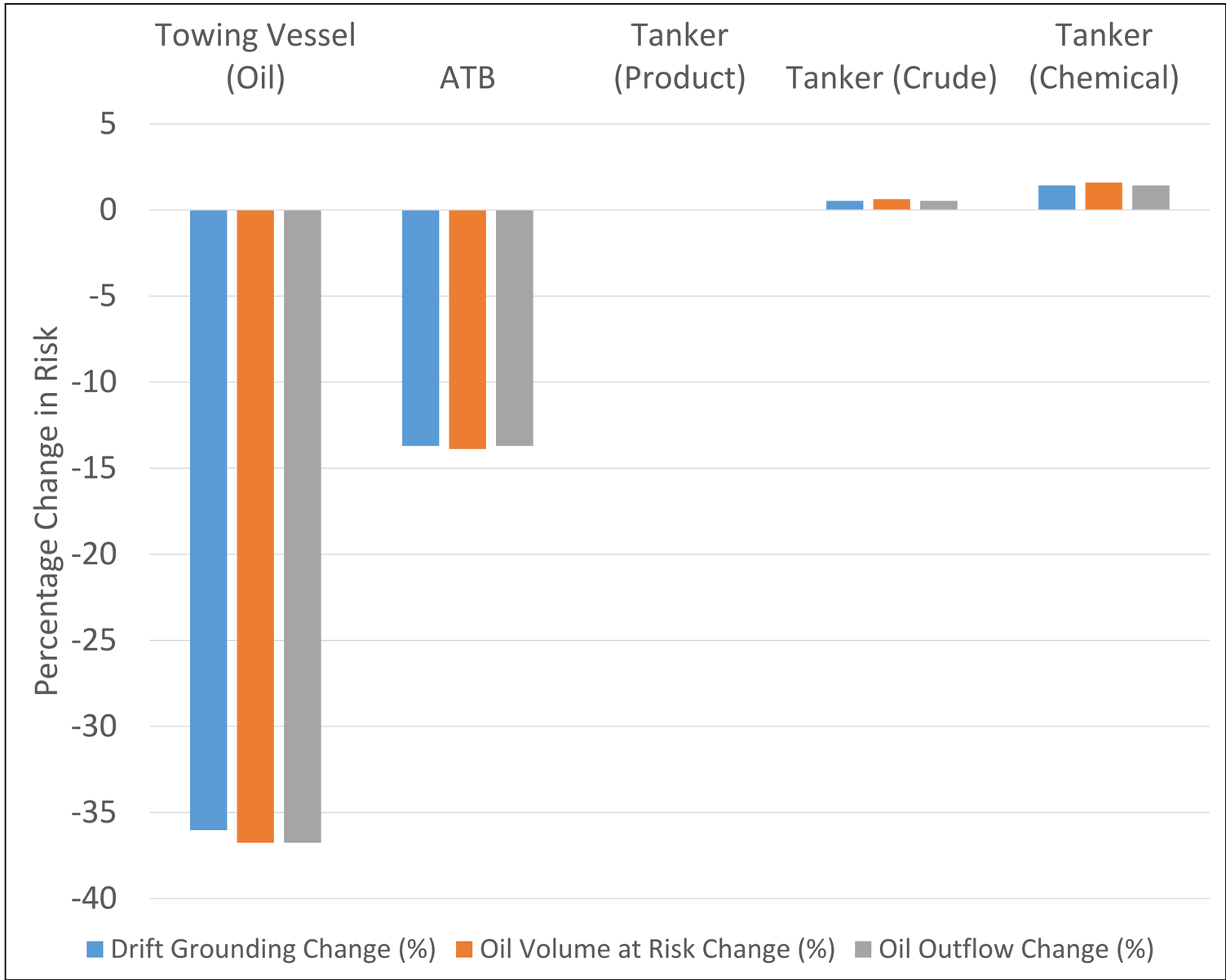
In terms of absolute values:

- Drift groundings declined 0.0035 per simulation
- Oil volume at risk declined 103.9 gallons
- Oil outflow declined 0.4 gallons

Changes in oil spill risk for Scenario 3

In Scenario 3, escorts were newly required for five vessel types:

- ATBs, towed oil barges, and chemical tankers, crude tankers, and product tankers under 40,000 DWT
- Only towed oil barges and ATBs saw an additional reduction in risk, beyond what we saw in Scenario 2.

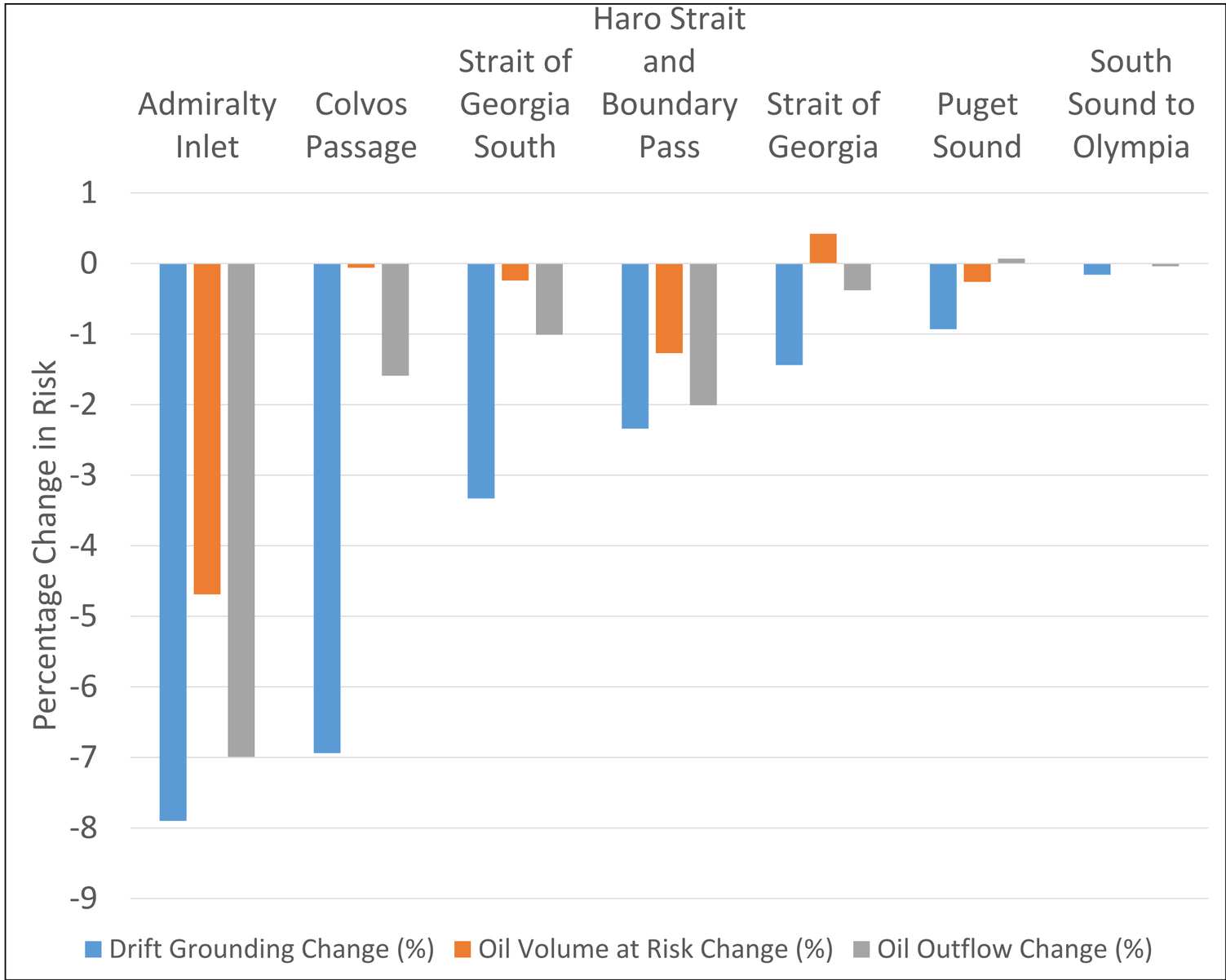


Changes in oil spill risk for Scenario 3

In Scenario 3, escorts were newly required throughout the rest of the study area

- In absolute terms, Haro Strait and Boundary Pass saw the biggest reduction in risk across all risk metrics:
  - 0.0015 decrease in drift groundings
  - 1,790.3 decrease in oil volume at risk
  - 0.35 decrease in oil outflow

- Admiralty Inlet was a close second:
  - 0.0015 decrease in drift groundings
  - 1,736.7 decrease in oil volume at risk
  - 0.29 decrease in oil outflow



Risk from additional escort traffic

Model results provided estimates of how expanding tug escorts requirements increase escort tug movements.

Based on historical incident rates for tugs*, that increase in underway time implies an increase in risk.

- For Scenario 2, we estimated a 134 percent increase in underway escort tug time
- For Scenario 3, we estimated a 263 percent increase in underway escort tug time

Incident Type	Incident Rate per operating minute	Number of additional incidents per year (Scenario 1 to Scenario 2)	Number of additional incidents per year (Scenario 2 to Scenario 3)
Allisions/Collisions	2.31×10^{-7}	0.1063	0.4917
Groundings	7.12×10^{-8}	0.0328	0.1515
Sinking/Capsize	1.78×10^{-8}	0.0082	0.0379
Other	1.09×10^{-6}	0.5016	2.3201

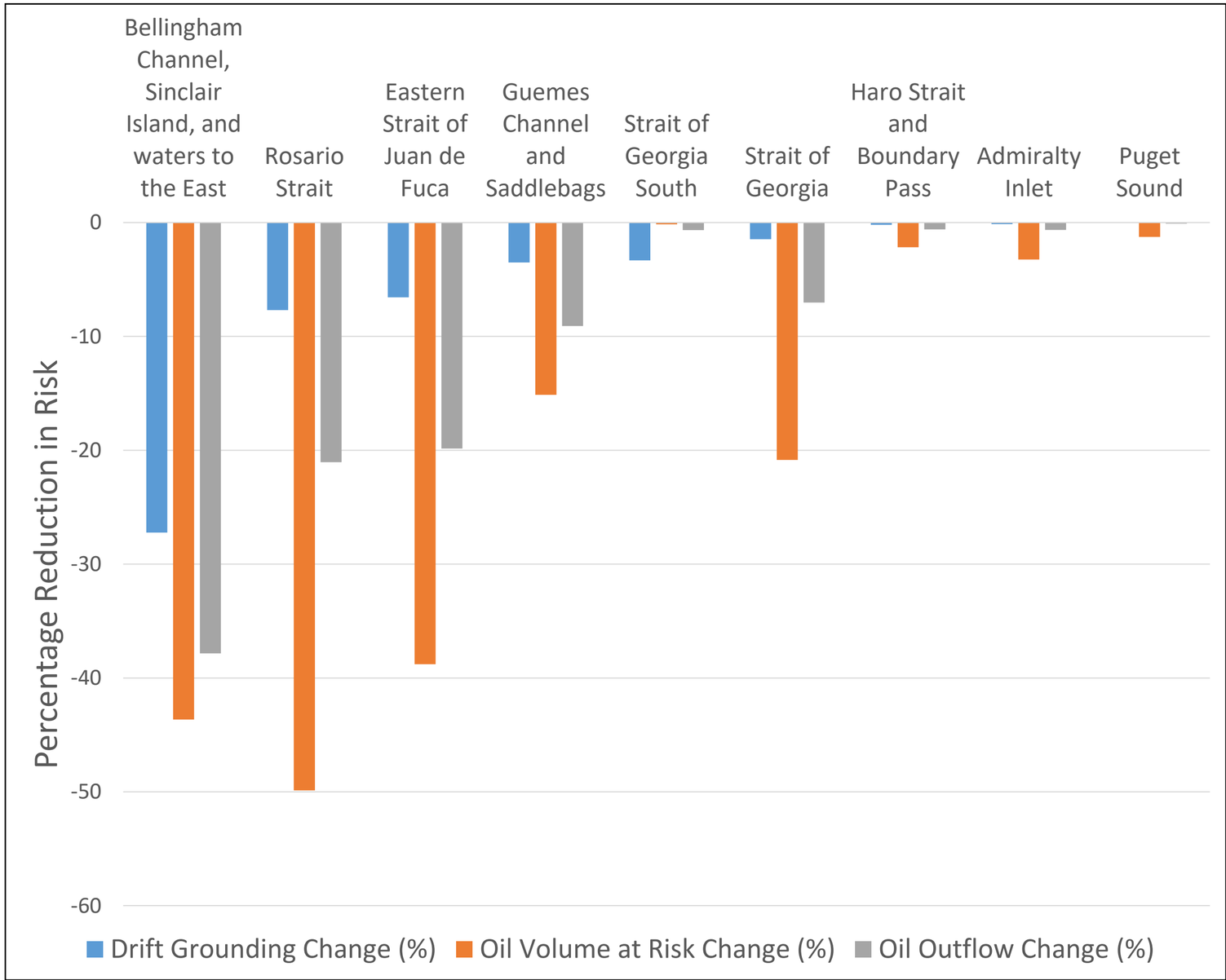
*The vessel categories that we used to calculate hazards included tugs that aren't specifically escort tugs. For the USCG MISLE database we included incidents associated with vessels classified as "towing vessels," including "harbor/ship assist (tug)", "pushing ahead (towboat)", "pushing ahead/hauling alongside", "ship/harbor assist", "towing astern", "towing behind (tug)". For the Canadian MARSIS database we included incidents associated with vessels with length greater than 50 feet classified as "tug."

How tethered escorts affect oil spill risk

When vessels required to be escorted under Scenario 2 are modeled as tethered the model shows an additional reduction in risk in the study area.

In our model, the tethering of escort tugs, reduces the time required for a tug to connect and control a disabled vessel from 30 minutes to 15 minutes.

- Bellingham Channel, Sinclair Island, and waters to the east and Rosario Strait saw the greatest percentage reductions in drift groundings due to tethering.



Effect of Trans Mountain Expansion Project on escorts

The TMEP proposal estimates 408 (an increase of 348) round-trip tanker transits per year to and from the Westridge Terminal in Burnaby, B.C.

We simulated escort transits to match the TMEP escort plan. We also simulated the planned oil spill response vessel at Beecher Bay as an ERTV.

- Model results indicated that the additional safety measures associated with the TMEP did not substantively change the potential risk reduction benefit of expanding tug escort requirements in Washington waters.

Source: https://www.kotugcanada.ca/application/files/8516/3835/4403/291121_KOTUG_TM_fact_sheet.pdf

How escort tugs may support loss of steering events

For loss of steering events, we assessed how frequently vessels are escorted when an event occurs.

We also examined how close the nearest tug of opportunity was to the event.

- Percentage of loss of steering events where an escort was present:
  - 38 percent in Scenario 1
  - 62 percent in Scenario 2
  - 99 percent in Scenario 3

- Model results indicated that on average the nearest tug of opportunity is over an hour away when a laden tank vessel loses steering.

Credit: U.S. Navy photo by Mass Communication Specialist 2nd Class Cameron McCulloch/Released Source: https://www.flickr.com/photos/navalsurfaceforces/35401626713

Tug Escort Rulemaking

Rulemaking will develop tug escort requirements for tank vessels between 5,000 and 40,000 DWT

This analysis is meant to inform rulemaking

These results are one of many inputs into the rulemaking process

Rulemaking was announced in February 2023, workshop dates will be announced soon

Emergency Response Towing Vessel Analysis

To quantitatively assess whether an emergency response towing serving Haro Strait, Boundary Pass, Rosario Strait and connected navigable waterways will reduce oil spill risk from covered vessels.

ERTV Analysis
Study Area

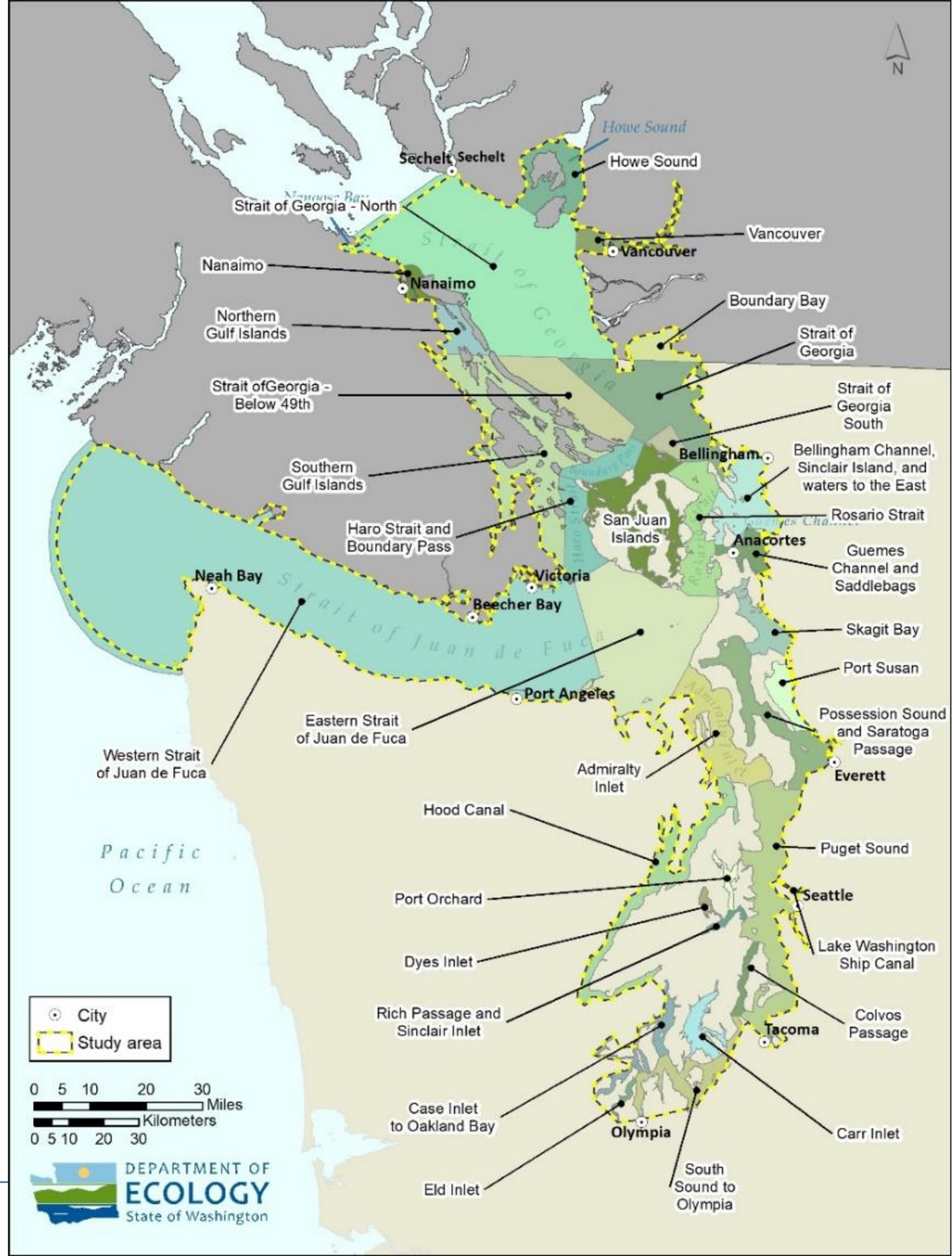
The study area is bounded on the west by an arc approximately 20 nautical miles past Buoy JA, and to the north with a line from Nanoose Bay to Sechelt.

Interior waterways within the ports of Seattle and Vancouver, such as the Fraser River, portions of the Duwamish River, and Lake Washington, are not included in the study area.

The study area also does not include upper Howe Sound due to a lack of consistent vessel traffic data in that area.

ERTV Analysis Geographic Zones

- Admiralty Inlet
- Bellingham Channel, Sinclair Island, and waters to the East
- Carr Inlet
- Case Inlet to Oakland Bay
- Colvos Passage
- Dyes Inlet
- Eastern Strait of Juan de Fuca
- Eld Inlet
- Guemes Channel and Saddlebags
- Haro Strait and Boundary Pass
- Hood Canal
- Howe Sound
- Lake Washington Ship Canal
- Nanaimo
- Northern Gulf Islands
- Port Orchard
- Port Susan
- Possession Sound and Saratoga Passage
- Puget Sound
- Rich Passage and Sinclair Inlet
- Rosario Strait
- San Juan Islands
- Skagit Bay
- South Sound to Olympia
- Southern Gulf Islands
- Strait of Georgia
- Strait of Georgia – Below 49th
- Strait of Georgia – North
- Strait of Georgia – South
- Vancouver
- Western Strait of Juan de Fuca



Potential ERTV Locations

We selected seven potential ERTV locations for evaluation:

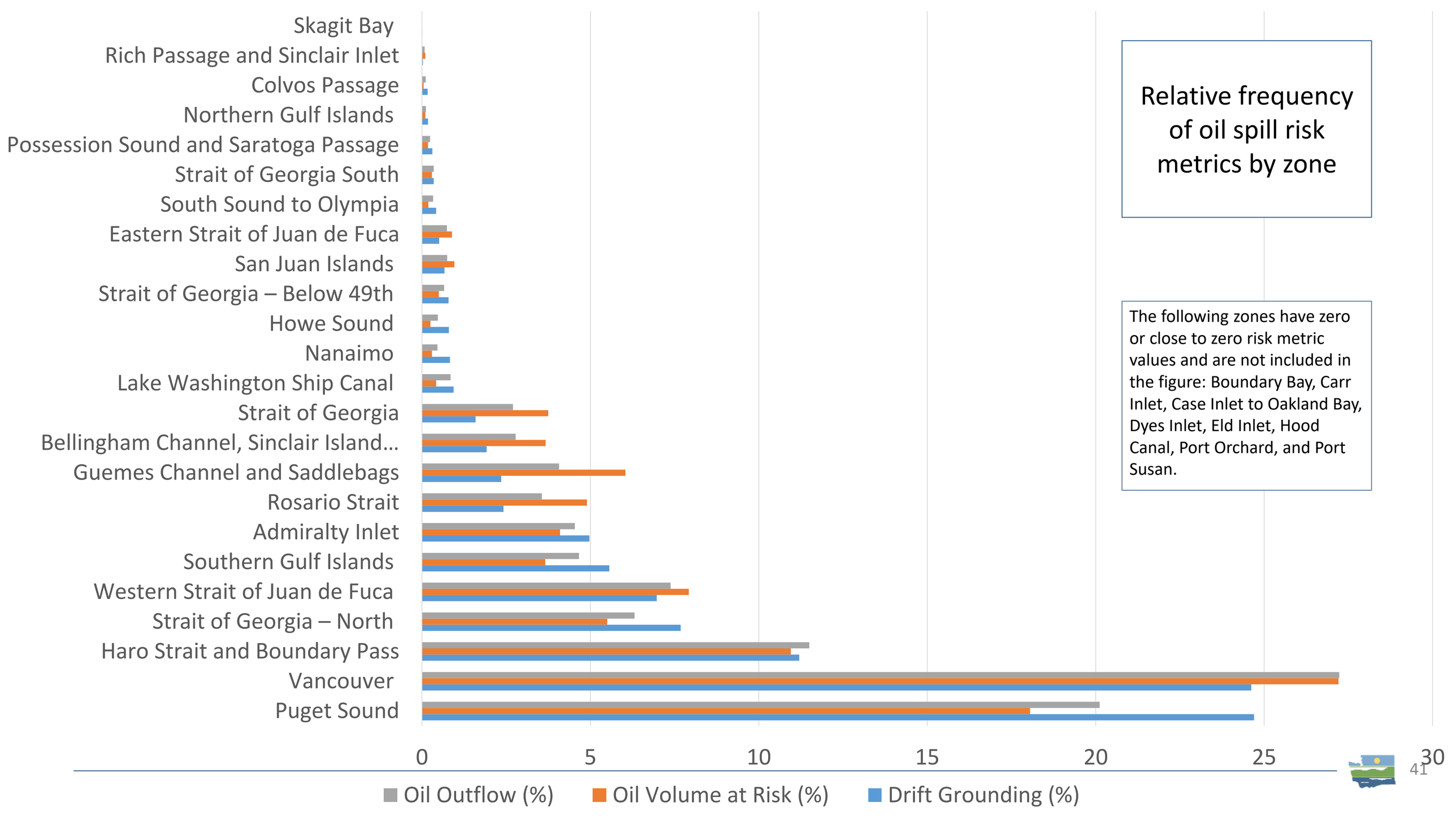
- Anacortes, Washington
- Deltaport, British Columbia
- Port Angeles, Washington
- Port Townsend, Washington
- Roche Harbor, Washington
- Sidney, British Columbia
- Victoria, British Columbia

Each location could potentially serve the waters of Haro Strait, Boundary Pass, Rosario Strait, and connected waters.

They are shown in Figure 1, along with the location of the existing ERTV in Neah Bay.

ERTV Analysis Preliminary Results

- Distribution of oil spill risk metrics
- Changes in oil spill risk with addition of an ERTV
- How different tug escort requirements affect the utility of different ERTV locations
- How the exclusion of tugs of opportunity affects the utility of different ERTV locations
- How escort traffic from the Trans Mountain Expansion Project (TMEP) affects the utility of different ERTV locations


Skagit Bay
Rich Passage and Sinclair Inlet
Colvos Passage
Northern Gulf Islands
Possession Sound and Saratoga Passage
Strait of Georgia South
South Sound to Olympia
Eastern Strait of Juan de Fuca
San Juan Islands
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Howe Sound
Nanaimo
Lake Washington Ship Canal
Strait of Georgia
Bellingham Channel, Sinclair Island…
Guemes Channel and Saddlebags
Rosario Strait
Admiralty Inlet
Southern Gulf Islands
Western Strait of Juan de Fuca
Strait of Georgia – North
Haro Strait and Boundary Pass
Vancouver
Puget Sound
0
5
10
15
20
25
30
Oil Outflow (%)
Oil Volume at Risk (%)
Drift Grounding (%)
Relative frequency of oil spill risk metrics by zone
The following zones have zero or close to zero risk metric values and are not included in the figure: Boundary Bay, Carr Inlet, Case Inlet to Oakland Bay, Dyes Inlet, Eld Inlet, Hood Canal, Port Orchard, and Port Susan.

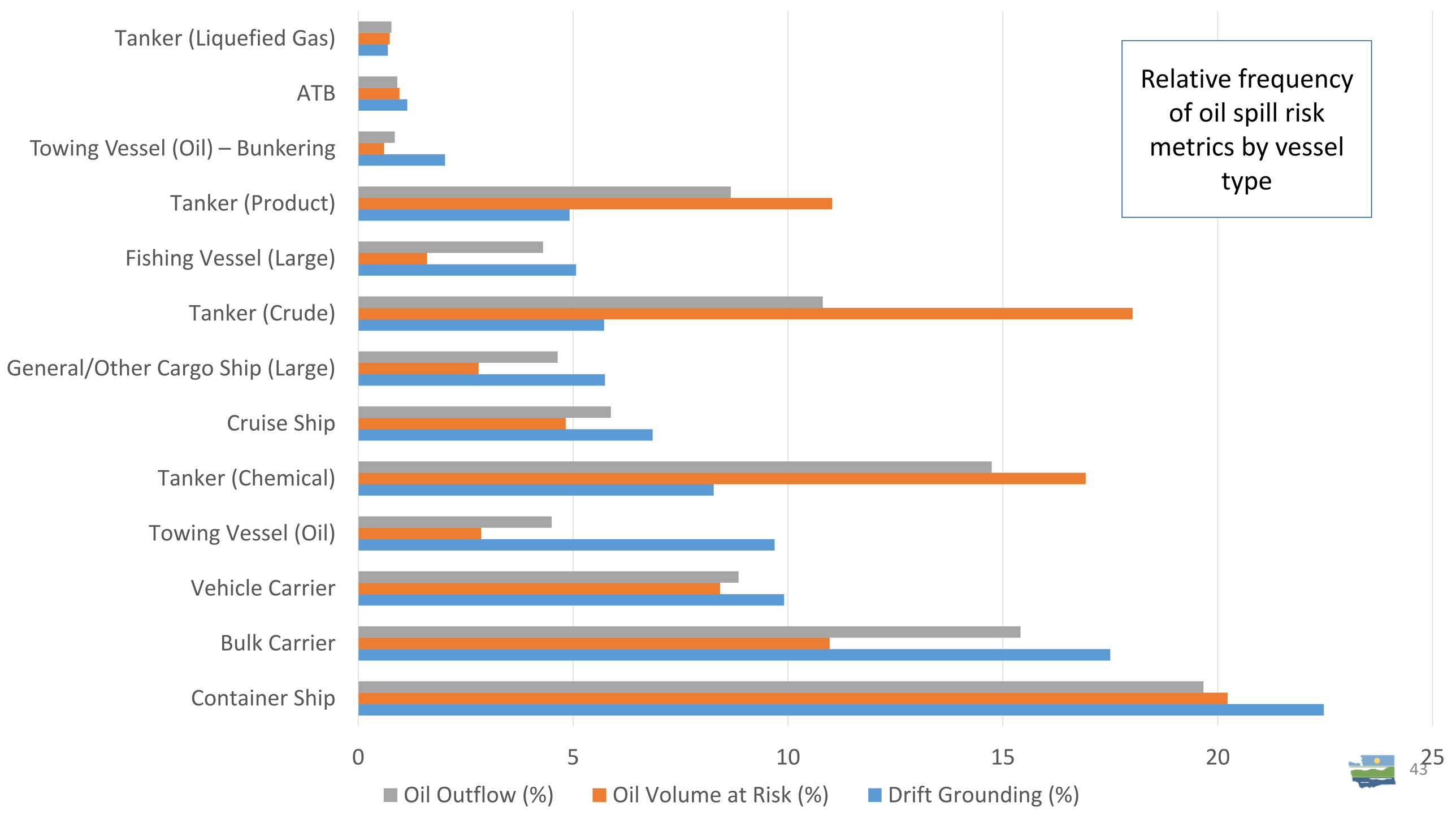
Distribution of Oil Spill Risk Metrics by Zone

Three zones account for substantially less risk that might be expected based on their operational minutes.

- Western Strait of Juan de Fuca makes up 38% of the simulated traffic but accounts for 7-8% of the oil spill risk
- Strait of Georgia North makes up 13% of the simulated traffic but accounts for 6-8% of the oil spill risk
- Eastern Strait of Juan de Fuca makes up 4% but accounts for 1% of the oil spill risk

Five zones account for more risk than their operational minutes would suggest.

- Vancouver makes up 8% of the simulated traffic, but accounts for 25-27% of the risk.
- Puget Sound makes up 13% of the simulated traffic, but accounts for 18-25% of the risk.
- Haro Strait and Boundary Pass makes up 6% of the simulated traffic, but accounts for 11-12% of the risk.
- Guemes Channel and Saddlebags and Bellingham Channel and waters to the East each make up 1% of the traffic and 2-6% and 2-4% of the risk, respectively.


Relative frequency of oil spill risk metrics by vessel type
Tanker (Liquefied Gas)
ATB
Towing Vessel (Oil) – Bunkering
Tanker (Product)
Fishing Vessel (Large)
Tanker (Crude)
General/Other Cargo Ship (Large)
Cruise Ship
Tanker (Chemical)
Towing Vessel (Oil)
Vehicle Carrier
Bulk Carrier
Container Ship
0
5
10
15
20
25
Oil Outflow (%)
Oil Volume at Risk (%)
Drift Grounding (%)

Distribution of Oil Spill Risk Metrics by Vessel Type

Some vessel types account for less risk than one would expect given their share of overall operational minutes:

- ATBs make up 7% of the simulated traffic and account for only 1% of the oil spill risk.
- Towed oil barges make up 21% of the traffic and 3-10% of the oil spill risk.
- Bulk carriers account for 28% of the simulated traffic, but only 11-18% of the risk.

Other vessel types account for more risk than one would expect given their share of overall operational minutes:

- Vehicle carriers make up 5% of the total simulated traffic but account for 8-10% of the oil spill risk.

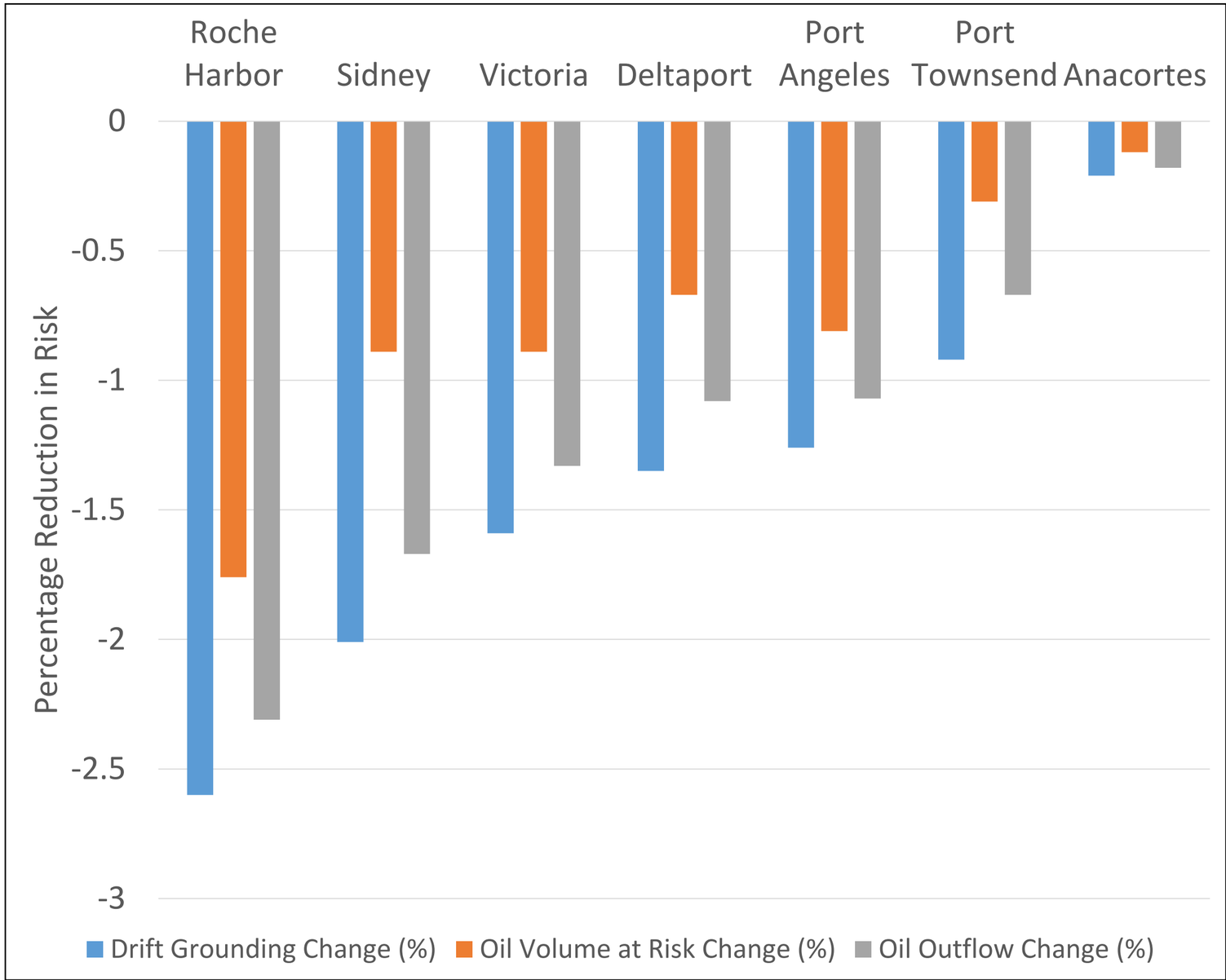
Changes in oil spill risk from addition of an ERTV

No potential ERTV location produced a large reduction in oil spill risk metrics, but every location provided some benefit.

- The placement of an ERTV in Roche Harbor provided the largest reduction in oil spill risk metrics (around 2%).

- In terms of absolute values, an ERTV in Roche Harbor resulted in
  - Decrease of 0.009 drift groundings
  - Decrease of 20,858.9 gallons in oil volume at risk
  - Decrease of 2.41 gallons in oil outflow

- An ERTV in Anacortes produced the smallest reduction in oil spill risk.

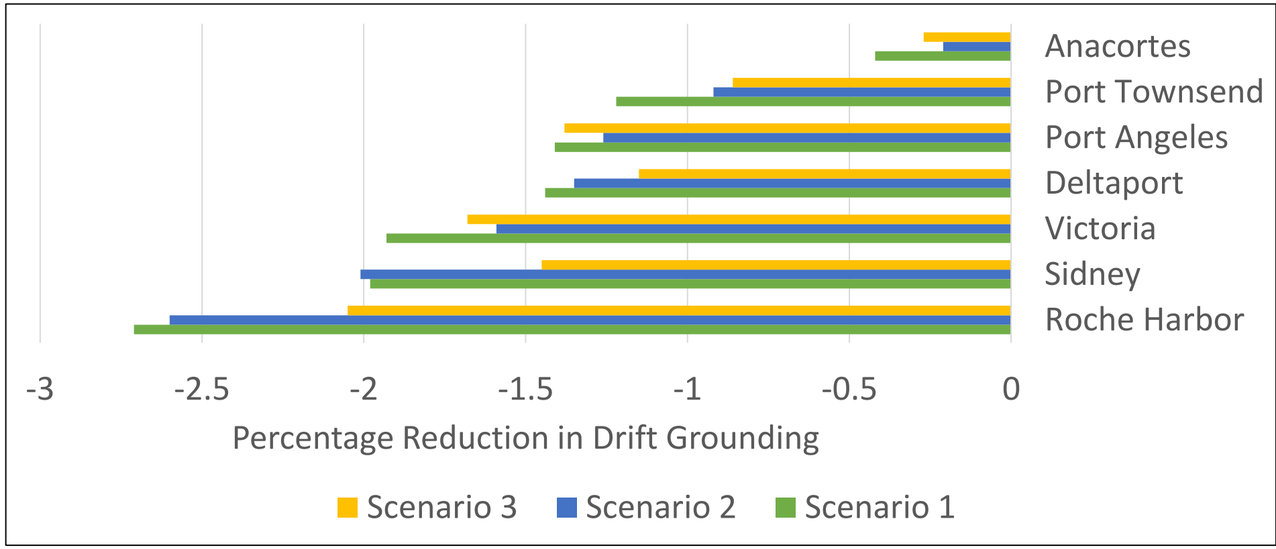


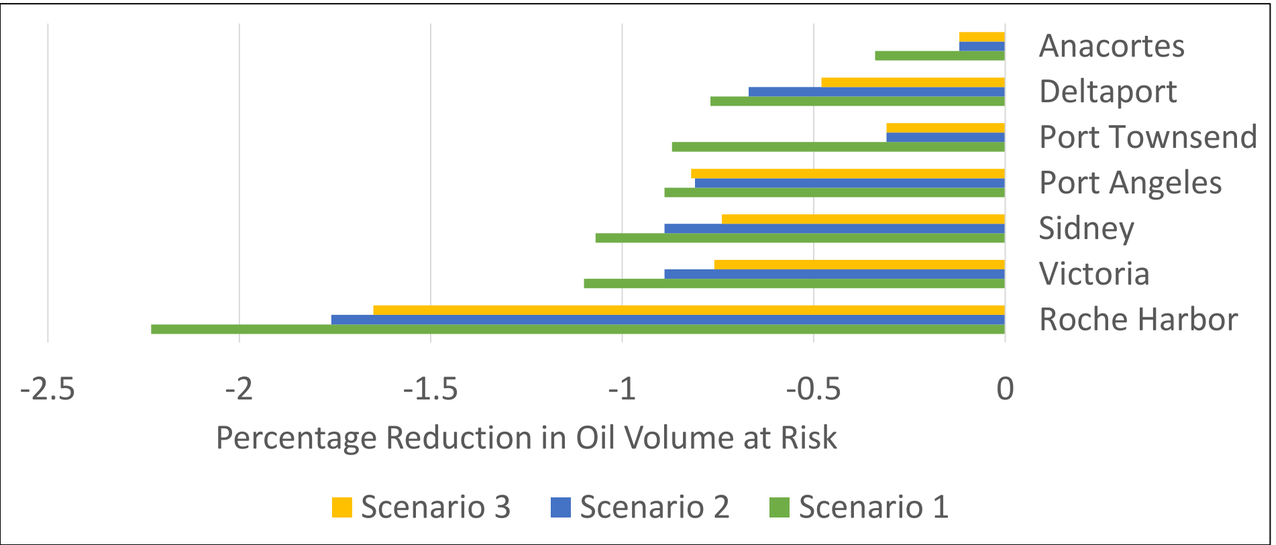
How tug escort requirements affect utility of ERTV locations

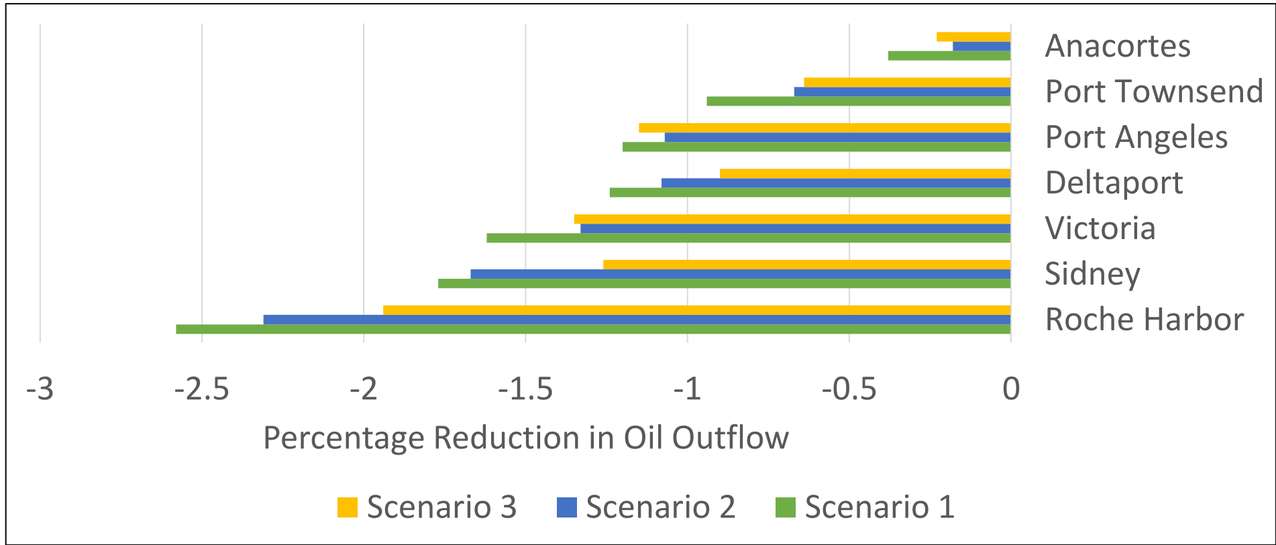
Different tug escort requirements produce different distributions of potential tugs of opportunity.

Do tug escort scenarios change which ERTV location provided the highest oil spill risk reduction benefit?

- Roche Harbor remains the most beneficial ERTV location regardless of tug escort scenario.







How exclusion of tugs of opportunity affects utility of ERTV locations

We also evaluated each ERTV location without allowing tugs of opportunity to intervene.

- We found that Roche Harbor remains the most beneficial location for an ERTV, with or without the potential for tugs of opportunity to intervene.

Credit: Sherwood411 Source: https://www.flickr.com/photos/sherwood411/7983287293

How escort traffic from TMEP affects utility of ERTV locations

We modeled safety measures associated with the TMEP. This increased the number of potential tugs of opportunity on the waterways and added a new rescue tug at Beecher Bay.

- Overall the benefit of the increase is either complementary to the ERTV benefits (as in the case of Anacortes and Port Townsend), or more redundant (as in the case of Roche Harbor).
- From our results, Roche Harbor is still the most beneficial locations for ERTVs even with the additional safety measures associated with TMEP.

Source: https://www.kotugcanada.ca/application/files/8516/3835/4403/291121_KOTUG_TM_fact_sheet.pdf

Next Steps

Reports Due to Legislature, September 1, 2023

Next webinar will be after submission of report

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