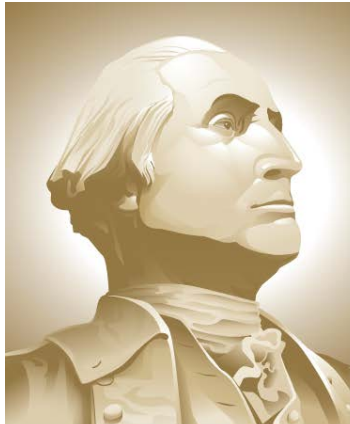


## BY WATERWAY ZONE SUMMARY OF VTRA 2015 WHAT-IF CASES BY POTENTIAL OIL SPILL SIZE



**THE GEORGE  
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UNIVERSITY**

WASHINGTON, DC

**VCU**

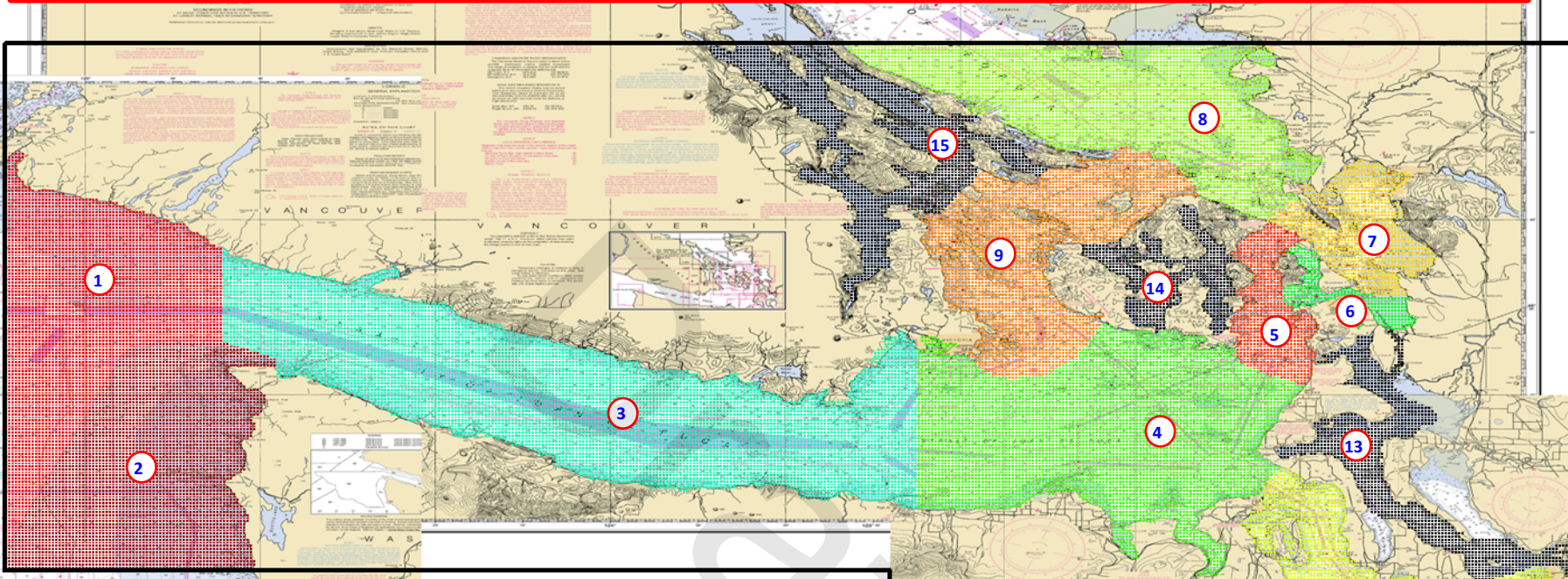
**Jason R.W. Merrick (VCU) and J. Rene van Dorp (GW)**

August 9<sup>th</sup> – 10<sup>th</sup>, 2016

# VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

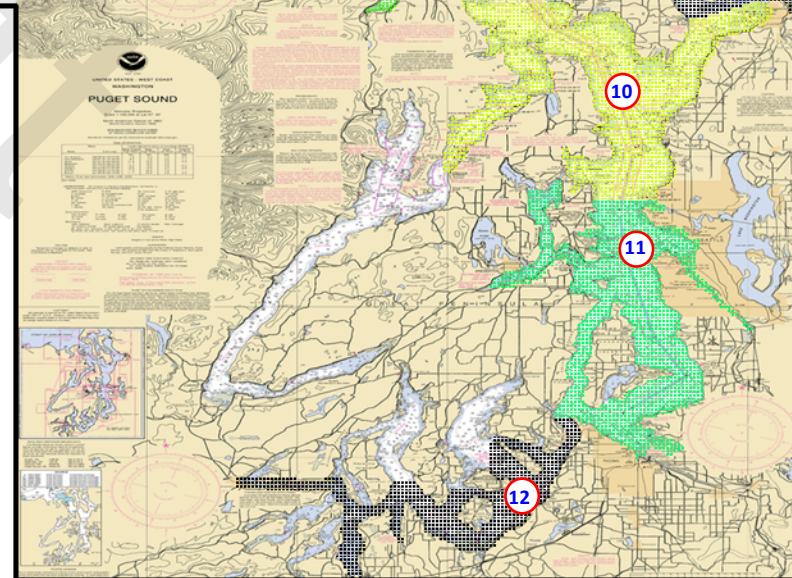


# DEFINITION OF 15 WATERWAY ZONES



## VTRA 2015 Waterway Zones

- |                 |                           |
|-----------------|---------------------------|
| 1. Buoy J       | 9. Haro/Boun.             |
| 2. ATBA         | 10. PS North              |
| 3. WSJF         | 11. PS South              |
| 4. ESJF         | 12. Tacoma                |
| 5. Rosario      | 13. Sar/Skagit            |
| 6. Guemes       | 14. SJ Islands            |
| 7. Saddlebag    | 15. Southern Gulf Islands |
| 8. Georgia Str. |                           |



1. By Waterway Zone Summary of VTRA 2015 Risk Metrics separated by Potential Oil Spill Sizes: (1) 2500 m<sup>3</sup> or More, (2) 1000 m<sup>3</sup> to 2500 m<sup>3</sup>, (3) 1 m<sup>3</sup> to 1000 m<sup>3</sup> and (4) 0 gallons to 264 gallons.
2. The Risk Metrics are reported in three tables, one for Multipliers Relative to the 2015 Base Case, one for The probability of one or more accident in 10 years and one for The Potential average spill size per accident.
3. The waterway zones considered are the VTRA Study area as a whole and the 15 Waterway Zones depicted in Slide 3. The Waterway Zones are ordered as per The Multipliers for the Probability of one or more accident in 10 years for the oil spill category 2500 m<sup>3</sup> or More for the What-If Case US – KM – CA 1598.
4. Each Column in each Table provides info for the four separate VTRA 2015 What-If Cases.
5. Each Column in each Table contains a Separate Color Scale by What-If Case with the highest number getting a red color and the lowest number a green color with a color gradient for numbers in between.
6. The use of a separate color scale by What-If Case in addition to the numerical values allows one to visually observe patterns by What-If Case in terms of the three risk metrics by the four potential oil spill size categories.

# Multipliers Relative To The 2015 Base Case by What-If Case and Potential Oil Spill Size Category

	USKMCALN2248	USKMCA1558	KM348	US230
<b>VTRA Study Area</b>				
<b>2500 m3 or More</b>	2.80	2.71	1.95	1.60
1000 m3 - 2500 m3	1.58	1.56	1.37	1.09
1 m3 - 1000 m3	1.10	1.06	1.00	1.00
0 gallons - 264 gallons	1.00	1.00	1.00	1.00
<b>2500 m3 or More</b>				
Haro/Boun.	11.86	11.19	9.39	0.90
Sthrn. Gif. IIs.	6.65	6.04	9.01	0.79
Buoy J	6.73	5.25	2.98	1.76
ESJF	5.03	5.06	4.60	1.12
WSJF	3.53	3.10	2.00	1.37
Guemes	2.34	2.43	0.82	2.59
Georgia Str.	2.52	2.40	1.51	1.59
Saddlebag	1.74	1.71	1.01	1.74
Sar/Skagit	1.35	1.49	1.19	1.30
SJ Islands	1.65	1.23	1.34	0.97
Rosario	1.31	1.23	0.95	1.35
ATBA	1.20	1.17	1.04	1.13
PS North	1.09	1.04	1.01	1.12
PS South	0.99	1.04	0.97	1.02
Tac. South	3.21	0.96	0.88	1.05
<b>1000 m3 - 2500 m3</b>				
Haro/Boun.	4.45	4.05	3.66	1.00
Sthrn. Gif. IIs.	0.78	0.65	1.21	0.62
Buoy J	2.40	2.06	1.50	1.19
ESJF	1.36	1.31	1.23	0.92
WSJF	2.28	2.04	1.72	1.03
Guemes	1.18	1.21	1.05	1.17
Georgia Str.	1.44	1.41	1.13	1.16
Saddlebag	1.28	1.37	1.04	1.22
Sar/Skagit	1.17	1.17	1.06	1.05
SJ Islands	1.23	1.32	1.07	0.49
Rosario	1.01	1.08	0.97	1.07
ATBA	1.04	1.16	0.92	0.84
PS North	1.04	1.08	1.00	1.04
PS South	1.00	1.05	0.99	1.02
Tac. South	1.00	1.00	1.00	1.01
<b>1 m3 - 1000 m3</b>				
Haro/Boun.	1.83	1.50	1.02	1.01
Sthrn. Gif. IIs.	1.00	1.00	0.99	1.00
Buoy J	2.02	1.64	1.03	1.05
ESJF	1.68	1.39	1.01	1.01
WSJF	1.37	1.23	1.01	0.97
Guemes	1.19	1.16	1.10	1.12
Georgia Str.	1.18	1.03	0.93	0.90
Saddlebag	1.07	1.06	1.03	0.99
Sar/Skagit	1.12	1.05	1.04	1.05
SJ Islands	1.16	1.05	1.03	1.00
Rosario	1.14	1.06	1.22	1.04
ATBA	1.06	1.07	1.03	1.00
PS North	1.03	1.01	1.00	1.01
PS South	0.99	0.99	0.98	1.00
Tac. South	0.99	1.01	1.01	1.02
<b>0 gallons - 264 gallons</b>				
Haro/Boun.	1.03	1.03	1.01	1.00
Sthrn. Gif. IIs.	1.00	1.00	1.00	1.00
Buoy J	1.96	1.60	1.09	1.07
ESJF	1.21	1.15	1.03	1.01
WSJF	1.13	1.09	1.02	1.00
Guemes	1.01	1.01	1.00	1.01
Georgia Str.	1.08	1.03	1.00	1.00
Saddlebag	1.07	1.09	1.02	1.06
Sar/Skagit	1.11	1.05	1.03	1.05
SJ Islands	1.12	1.07	1.07	0.99
Rosario	1.09	1.04	1.07	1.08
ATBA	1.06	1.07	1.03	1.00
PS North	1.00	1.00	1.00	1.00
PS South	1.00	1.00	1.00	1.00
Tac. South	0.99	1.00	1.00	1.00

# Probability of One or More Accidents in 10 Years by What-If Case and Potential Oil Spill Size Category

	USKMCALIN2248	USKMCAL1558	KM348	US230	BASE CASE
<b>VTRA Study Area</b>					
<b>2500 m3 or More</b>	1.3950%	1.3512%	0.9688%	0.7980%	0.4979%
1000 m3 - 2500 m3	0.9627%	0.9486%	0.8324%	0.6616%	0.6096%
1 m3 - 1000 m3	59.4176%	57.2343%	53.9923%	54.2289%	54.1445%
0 gallons - 264 gallons	100.0000%	100.0000%	100.0000%	100.0000%	100.0000%
<b>2500 m3 or More</b>					
Haro/Boun.	0.3409%	0.3217%	0.2699%	0.0258%	0.0287%
Sthm. Glf. IIs.	0.0209%	0.0190%	0.0283%	0.0025%	0.0031%
Buoy J	0.0323%	0.0252%	0.0143%	0.0085%	0.0048%
ESJF	0.2596%	0.2614%	0.2373%	0.0579%	0.0516%
WSJF	0.0788%	0.0692%	0.0445%	0.0305%	0.0223%
Guemes	0.2488%	0.2584%	0.0870%	0.2759%	0.1064%
Georgia Str.	0.0652%	0.0622%	0.0392%	0.0412%	0.0259%
Saddlebag	0.1422%	0.1395%	0.0824%	0.1420%	0.0815%
Sar/Skagit	0.0004%	0.0004%	0.0004%	0.0004%	0.0003%
SJ Islands	0.0054%	0.0041%	0.0044%	0.0032%	0.0033%
Rosario	0.1407%	0.1320%	0.1026%	0.1448%	0.1075%
ATBA	0.0007%	0.0007%	0.0006%	0.0007%	0.0006%
PS North	0.0335%	0.0320%	0.0309%	0.0345%	0.0308%
PS South	0.0308%	0.0323%	0.0301%	0.0318%	0.0311%
Tac. South	0.0030%	0.0009%	0.0008%	0.0010%	0.0009%
<b>1000 m3 - 2500 m3</b>					
Haro/Boun.	0.2987%	0.2716%	0.2455%	0.0670%	0.0670%
Sthm. Glf. IIs.	0.0138%	0.0115%	0.0214%	0.0109%	0.0177%
Buoy J	0.0092%	0.0079%	0.0058%	0.0046%	0.0038%
ESJF	0.0701%	0.0678%	0.0633%	0.0475%	0.0516%
WSJF	0.0458%	0.0409%	0.0345%	0.0208%	0.0201%
Guemes	0.1683%	0.1725%	0.1493%	0.1672%	0.1429%
Georgia Str.	0.0402%	0.0394%	0.0316%	0.0323%	0.0279%
Saddlebag	0.1664%	0.1784%	0.1357%	0.1583%	0.1302%
Sar/Skagit	0.0003%	0.0003%	0.0003%	0.0003%	0.0003%
SJ Islands	0.0047%	0.0051%	0.0041%	0.0019%	0.0038%
Rosario	0.0493%	0.0527%	0.0472%	0.0520%	0.0486%
ATBA	0.0003%	0.0004%	0.0003%	0.0003%	0.0003%
PS North	0.0633%	0.0660%	0.0606%	0.0636%	0.0609%
PS South	0.0349%	0.0365%	0.0344%	0.0356%	0.0348%
Tac. South	0.0013%	0.0013%	0.0013%	0.0013%	0.0013%
<b>1 m3 - 1000 m3</b>					
Haro/Boun.	15.18%	12.45%	8.46%	8.37%	8.30%
Sthm. Glf. IIs.	11.45%	11.39%	11.28%	11.41%	11.41%
Buoy J	0.40%	0.33%	0.21%	0.20%	0.20%
ESJF	5.09%	4.20%	3.06%	3.05%	3.03%
WSJF	2.67%	2.40%	1.97%	1.89%	1.95%
Guemes	4.26%	4.17%	3.95%	4.01%	3.59%
Georgia Str.	3.02%	2.64%	2.40%	2.31%	2.57%
Saddlebag	0.60%	0.60%	0.58%	0.56%	0.56%
Sar/Skagit	0.15%	0.14%	0.14%	0.14%	0.14%
SJ Islands	0.45%	0.40%	0.40%	0.38%	0.39%
Rosario	0.97%	0.90%	1.04%	0.88%	0.85%
ATBA	0.03%	0.03%	0.03%	0.03%	0.03%
PS North	5.68%	5.59%	5.55%	5.60%	5.54%
PS South	29.81%	29.76%	29.36%	29.86%	29.98%
Tac. South	2.33%	2.38%	2.36%	2.38%	2.35%
<b>0 gallons - 264 gallons</b>					
Haro/Boun.	99.9%	99.6%	97.4%	96.7%	96.6%
Sthm. Glf. IIs.	99.7%	99.7%	99.7%	99.7%	99.7%
Buoy J	30.6%	25.0%	17.1%	16.8%	15.6%
ESJF	88.5%	83.9%	74.9%	73.3%	72.8%
WSJF	90.6%	87.5%	81.4%	80.0%	80.1%
Guemes	99.6%	99.5%	99.1%	99.6%	98.9%
Georgia Str.	85.3%	81.7%	79.3%	78.7%	79.1%
Saddlebag	35.3%	36.1%	33.6%	35.2%	33.1%
Sar/Skagit	7.4%	7.0%	6.9%	7.1%	6.7%
SJ Islands	43.8%	41.8%	41.6%	38.6%	39.0%
Rosario	46.6%	44.5%	47.2%	46.4%	42.9%
ATBA	1.0%	1.1%	1.0%	1.0%	1.0%
PS North	95.9%	95.8%	95.8%	95.9%	95.7%
PS South	100.0%	100.0%	100.0%	100.0%	100.0%
Tac. South	62.0%	62.6%	62.4%	62.6%	62.5%

Average Potential Spill Size per Accident by What-If Case and Potential Oil Spill Size Category

	USKMCALN2248	USKMC1558	KW348	US230	BASE CASE
<b>VTRA Study Area</b>					
2500 m3 or More	5543.8	5412.1	4769.7	7290.3	6798.2
1000 m3 - 2500 m3	1691.9	1693.6	1708.4	1608.3	1618.9
1 m3 - 1000 m3	77.7	69.1	47.2	47.0	46.7
0 gallons - 264 gallons	3.0	2.4	2.2	2.4	2.3
<b>2500 m3 or More</b>					
Haro/Boun.	3709.0	3692.4	3432.5	4829.2	4588.6
Sthrn. Gif. IIs.	2813.6	2761.2	3479.9	4787.6	4676.1
Buoy J	6587.0	6444.4	6932.8	5691.9	5873.5
ESJF	3668.9	3652.6	3423.3	7160.5	6240.2
WSJF	5793.3	5887.5	6087.8	6634.7	6721.3
Guemes	7687.6	7201.3	8001.0	8001.0	8198.4
Georgia Str.	6065.1	5952.3	5650.7	6955.1	6693.6
Saddlebag	7513.9	7430.2	6993.2	7411.3	7161.1
Sar/Skagit	5759.9	6190.2	5597.1	5865.3	5688.2
SJ Islands	6609.0	5406.3	6172.4	9160.7	9555.9
Rosario	7252.2	7062.6	6835.8	7436.2	6811.8
ATBA	11225.3	11847.6	8816.7	10183.5	9065.8
PS North	5422.0	5122.3	4983.2	5131.9	4974.3
PS South	5997.3	5855.2	5917.1	5991.4	5956.2
Tac. South	8509.0	5467.0	5409.2	5535.1	6714.9
<b>1000 m3 - 2500 m3</b>					
Haro/Boun.	1800.8	1823.4	1829.7	1438.0	1442.6
Sthrn. Gif. IIs.	1811.3	1729.1	1715.9	1523.8	1625.4
Buoy J	1637.4	1671.1	1653.6	1642.3	1640.8
ESJF	1578.0	1578.0	1561.3	1463.6	1461.8
WSJF	1752.2	1737.5	1754.0	1600.4	1603.1
Guemes	1685.3	1702.2	1706.0	1681.2	1715.2
Georgia Str.	1597.9	1612.9	1602.2	1631.6	1598.6
Saddlebag	1712.4	1696.9	1782.5	1729.2	1793.3
Sar/Skagit	1352.8	1332.7	1451.4	1311.9	1388.6
SJ Islands	1332.9	1309.2	1314.0	1262.5	1294.0
Rosario	1707.0	1719.1	1732.7	1710.7	1717.0
ATBA	1630.4	1649.5	1616.3	1613.8	1562.2
PS North	1408.9	1396.1	1397.6	1403.4	1397.9
PS South	1477.9	1493.7	1469.0	1477.1	1464.1
Tac. South	1247.4	1246.8	1246.0	1245.3	1246.1
<b>1 m3 - 1000 m3</b>					
Haro/Boun.	186.8	175.5	107.2	104.8	104.7
Sthrn. Gif. IIs.	46.2	44.0	37.9	38.3	38.4
Buoy J	95.3	95.5	79.9	80.3	80.2
ESJF	214.3	192.1	115.5	103.5	102.7
WSJF	135.3	128.0	100.2	104.9	99.8
Guemes	39.0	43.1	35.7	41.9	42.7
Georgia Str.	53.6	52.7	38.3	40.2	36.5
Saddlebag	101.7	115.7	89.5	109.7	94.9
Sar/Skagit	63.6	66.9	67.7	66.0	68.2
SJ Islands	42.5	42.9	27.3	27.4	26.3
Rosario	77.1	77.5	49.3	70.5	81.6
ATBA	76.4	72.4	62.8	62.9	62.8
PS North	106.2	107.5	107.1	107.4	107.6
PS South	19.3	19.4	19.4	19.3	19.4
Tac. South	17.3	16.9	17.1	16.8	17.2
<b>0 gallons - 264 gallons</b>					
Haro/Boun.	5.2	5.0	4.6	4.8	4.2
Sthrn. Gif. IIs.	0.7	0.7	0.7	1.4	0.7
Buoy J	1.1	1.7	1.4	1.8	1.9
ESJF	1.4	1.4	1.7	2.0	2.1
WSJF	0.5	0.6	0.6	0.5	0.6
Guemes	12.0	8.6	8.8	8.7	10.4
Georgia Str.	1.7	1.4	1.5	1.6	1.4
Saddlebag	5.2	5.1	6.5	5.7	5.8
Sar/Skagit	4.1	3.0	1.0	3.2	0.7
SJ Islands	21.2	10.7	2.7	0.3	3.9
Rosario	23.4	22.6	21.4	24.1	23.0
ATBA	0.0	0.0	0.1	0.0	0.1
PS North	1.0	1.1	1.3	1.2	1.1
PS South	0.3	0.3	0.3	0.3	0.3
Tac. South	1.1	1.1	1.1	1.1	1.1