VTRA 2015 US - KM - CA – 1598 Case and VTRA 2015 Base Case Comparison
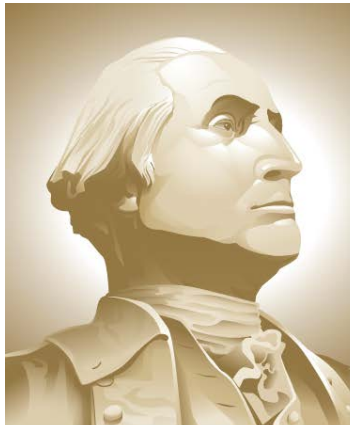
Jason R.W. Merrick (VCU) and J. Rene van Dorp (GW)

August 9th – 10th, 2016

DEFINITION OF 15 WATERWAY ZONES
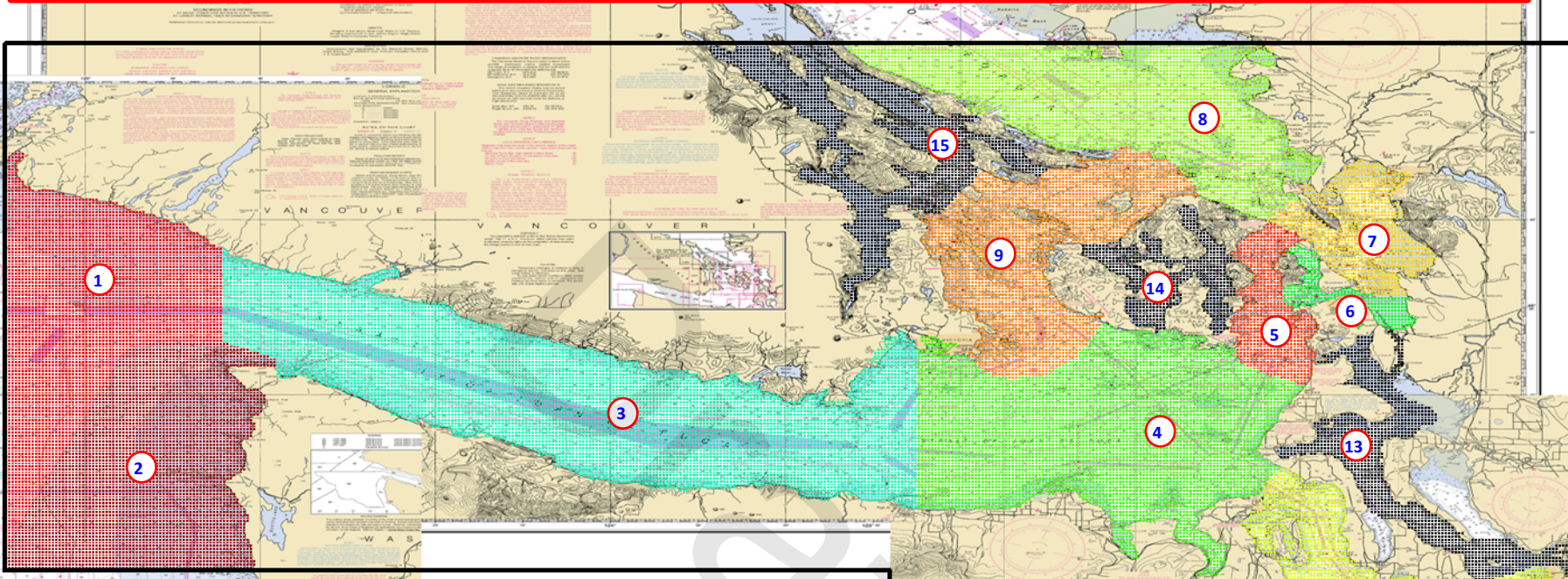
VTRA 2015 Waterway Zones

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

VTRA 2015 Routes for What-If Case:
US - KM - CA -1598

	VTRA 2015
TOTAL WHATIF - CA PROJECTS (without Bunkering)	1020
TOTAL WHATIF - KM (without Bunkering)	348
TOTAL WHATIF - US PROJECTS (without Bunkering)	230
SUBTOTAL WHAT-IF (without Bunkering)	1598
TOTAL BUNKERING SUPPORT - CA PROJECTS	111
TOTAL BUNKERING SUPPORT - KM	17
TOTAL BUNKERING SUPPORT - US PROJECTS	49
SUBTOTAL Bunkering Support	177
TOTAL WHAT-IF FOCUS VESSELS	1775

7/29/2016 © GW-VCU : DRAFT

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

THE GEORGE
WASHINGTON
UNIVERSITY
WASHINGTON, DC

VCU

VTRA 2015 – What If FV
Scheduled Random Arrival Pattern Model
(See Example Graph below)
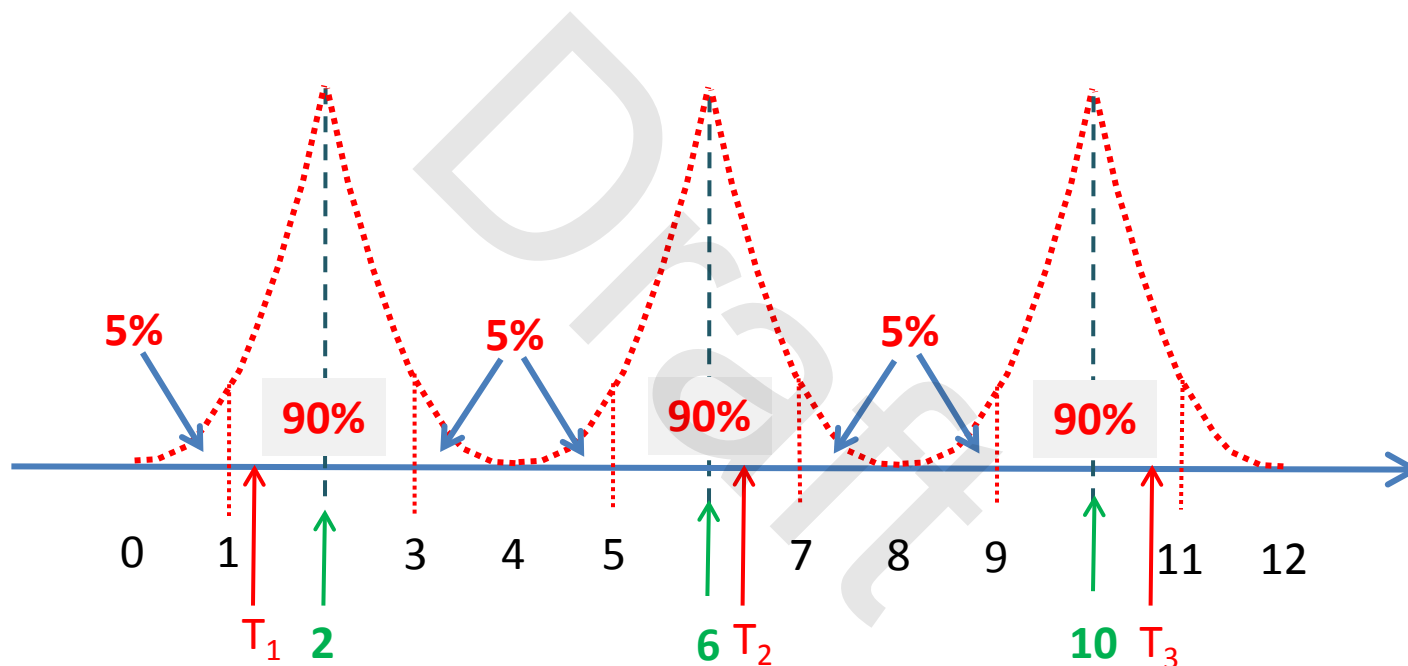
VTRA 2010 Equidistant Fixed Arrival Pattern (one every 4 days)

VTRA 2015 Random Arrival Pattern (3 Random Times in 12 days)

By Waterway Zone
Risk Comparison

Oil Spill Size Category:
ALL SPILL SIZES

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

VTRA 2015 BASE CASE - ALL FV

100.0% of VTRA 2015 Base Case Total
Annual Potential Oil Loss: ALL SPILL SIZES (including accid. with zero oil loss)

78.2%
61.3%
1.2%
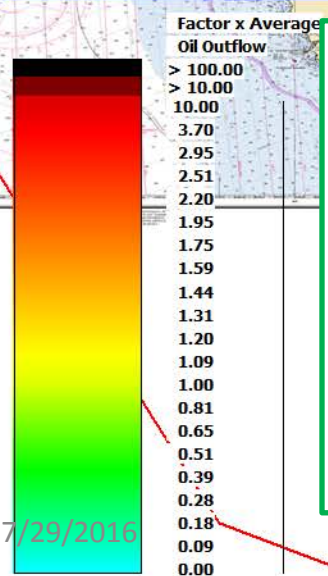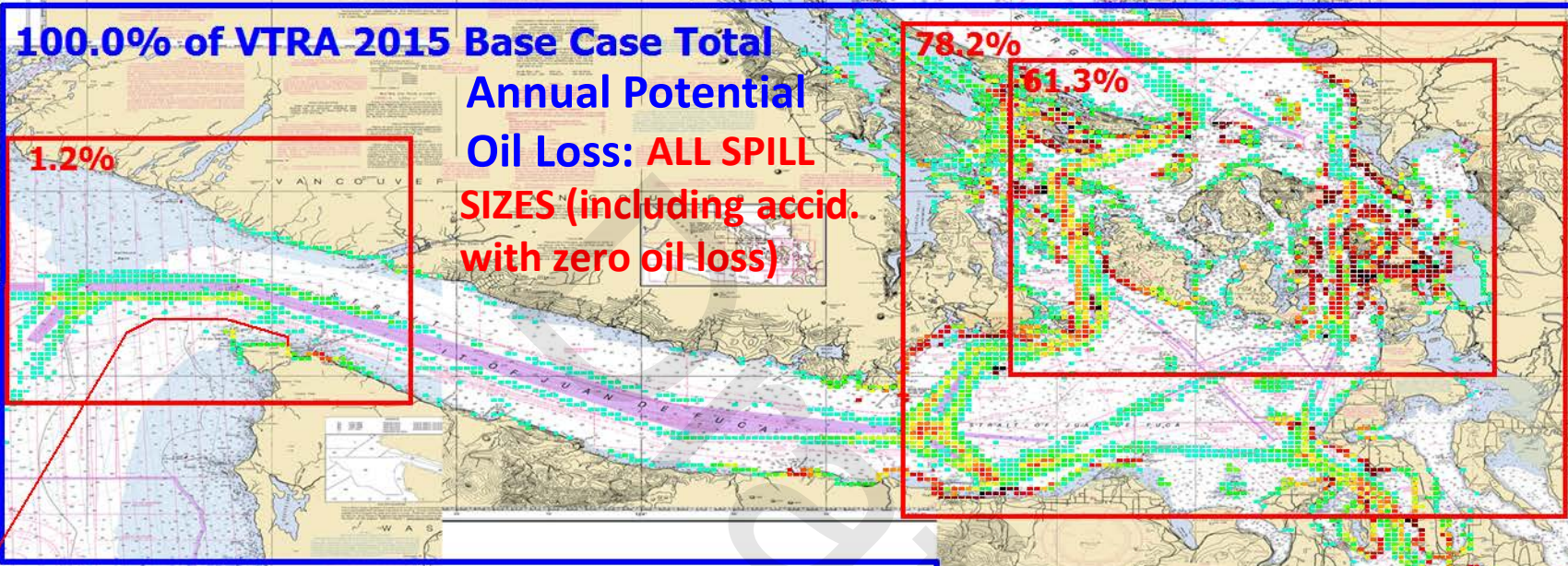
VTRA '15 Case:
BASE CASE

GEOGRAPHIC PROFILE OF POTENTIAL ANNUAL OIL LOSS OF ACCIDENTS IN SPILL SIZE CATEGORY
ALL SPILL SIZES

Factor x Average Oil Outflow
> 100.00
> 10.00
10.00
3.70
2.95
2.51
2.20
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.39
0.28
0.18
0.09
0.00

7/29/2016

© GW-VCU : DRAFT

7/28/2016
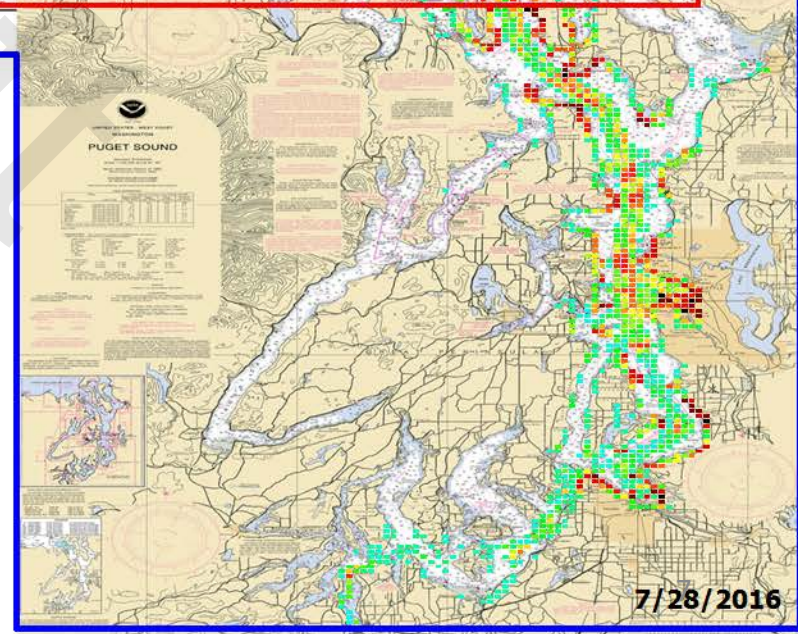
VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

VTRA 2015 Case: US-KM-CA-1598 - ALL FV

184.1% of VTRA 2015 Base Case Total

Annual Potential Oil Loss: ALL SPILL SIZES (including accid. with zero oil loss)

158.3%

123.9%

4.3%

Factor x Average Oil Outflow

> 100.00
> 10.00
10.00
3.70
2.95
2.51
2.20
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.39
0.28
0.18
0.09
0.00

**VTRA '15 Case:
US - KM - CA - 1598**

GEOGRAPHIC PROFILE OF POTENTIAL ANNUAL OIL LOSS OF ACCIDENTS IN SPILL SIZE CATEGORY **ALL SPILL SIZES**
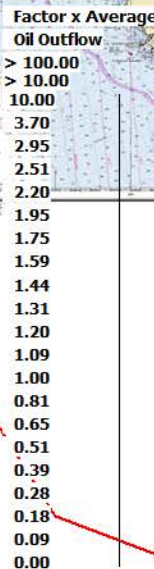
7/29/2016

© GW-VCU : DRAFT

7/29/2016

VTRA '15: Base Case   3D Risk Profile All FV - Pot.C+G+A.Oil Loss: 100% of Base Case POL

Legend:
23-24, 22-23, 21-22, 20-21, 19-20, 18-19, 17-18, 16-17, 15-16, 14-15, 13-14, 12-13, 11-12, 10-11, 9-10, 8-9, 7-8, 6-7, 5-6, 4-5, 3-4, 2-3, 1-2, 0-1
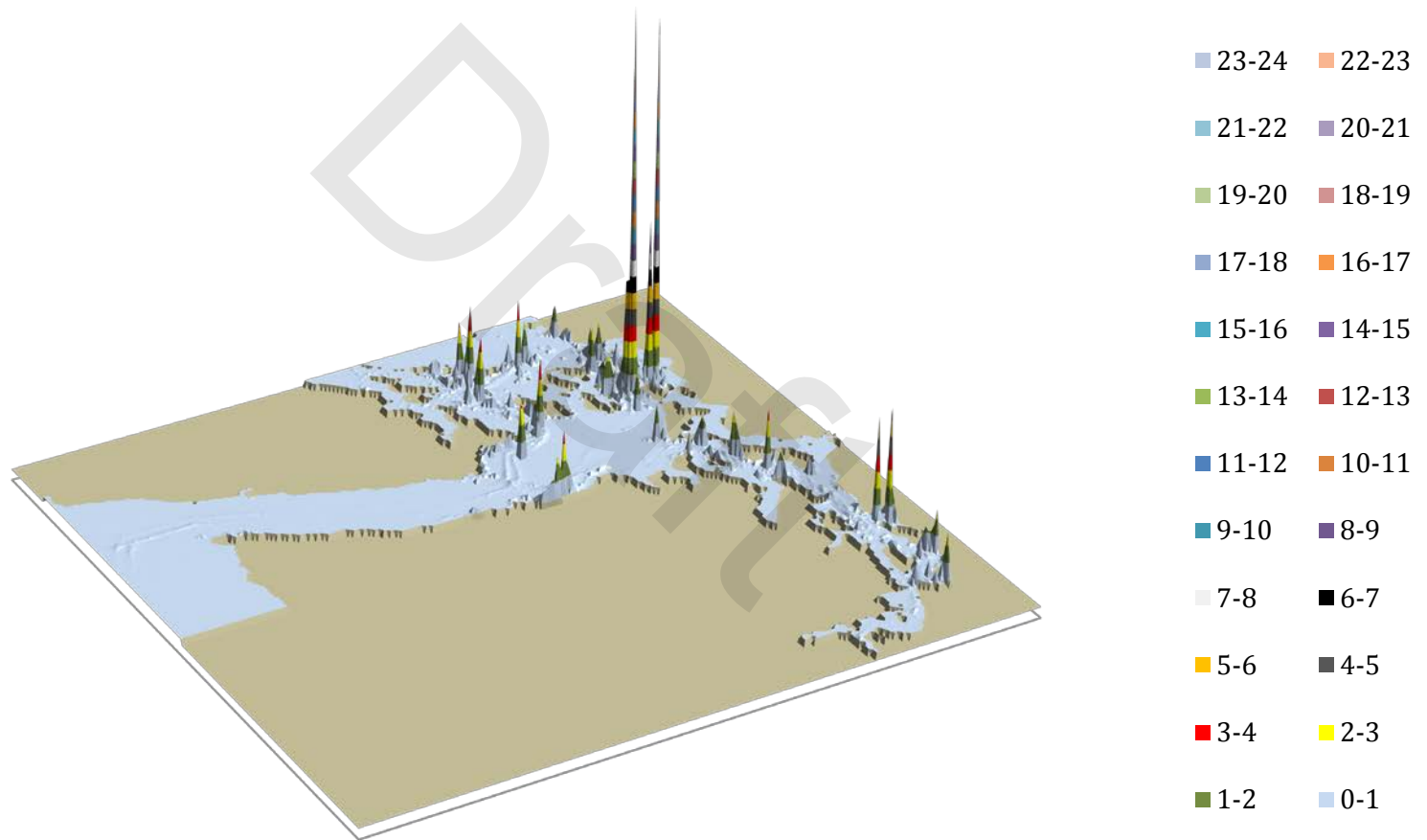
US - KM - CA - 1598   3D Risk Profile All FV - Pot.C+G+A.Oil Loss: 184% of Base Case POL
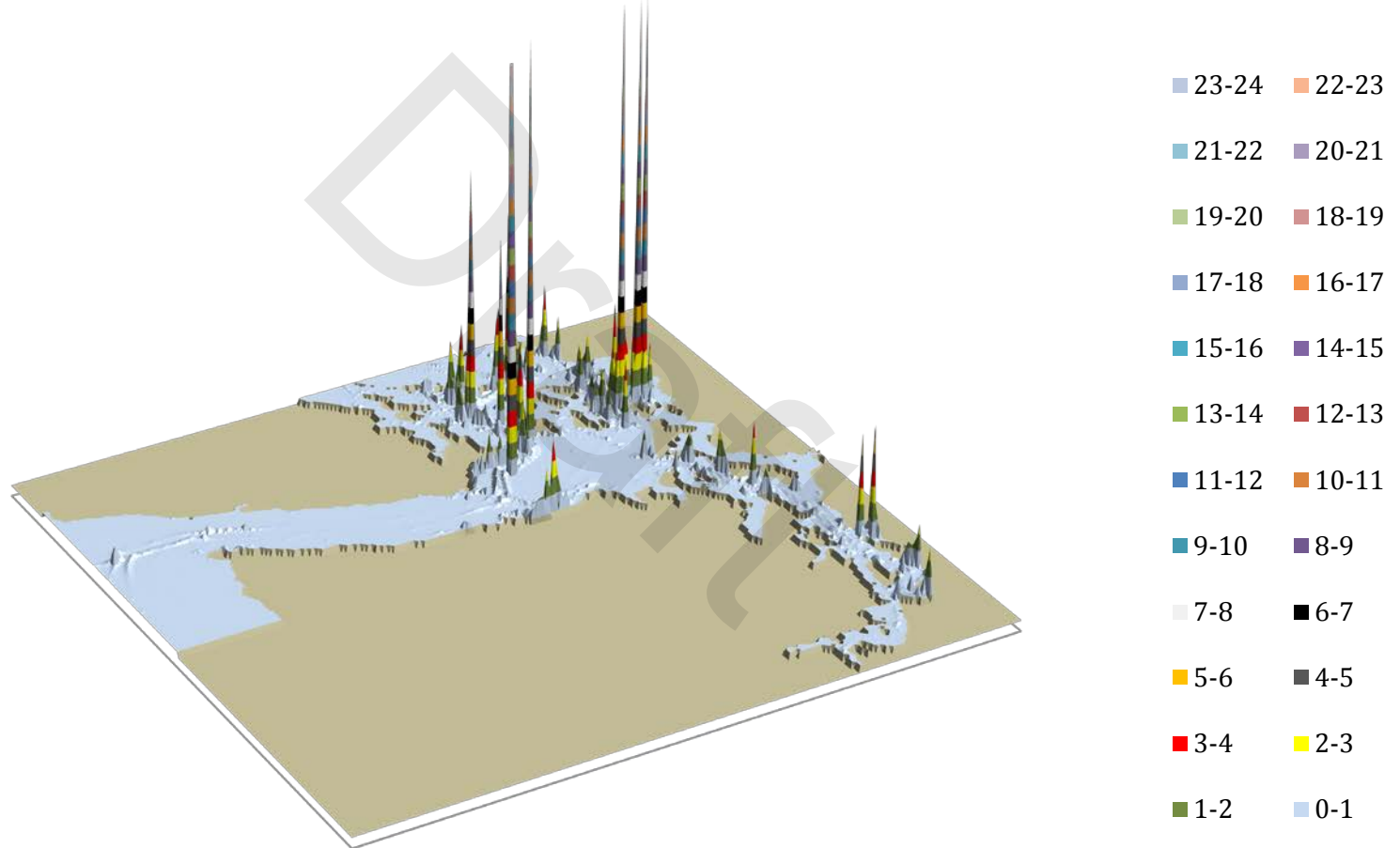
% Base Case Pot. Oil (C + G + A) Loss - ALL_FV

Location	US-KM-CA 1598	VTRA '15 Base Case
Guemes : +13.2% | x 1.82	29.2%	16.0%
Haro/Boun. : +35.8% | x 3.53	50.0%	14.2%
PS South : +0.0% | x 1.00	11.6%	11.5%
Rosario : +2.6% | x 1.23	13.6%	11.0%
Saddlebag : +6.7% | x 1.62	17.5%	10.8%
PS North : +0.3% | x 1.03	10.9%	10.6%
ESJF : +14.5% | x 2.64	23.4%	8.9%
Sthrn. Glf. Isl. : +1.2% | x 1.19	7.5%	6.3%
WSJF : +5.1% | x 2.08	9.8%	4.7%
Georgia Str. : +3.2% | x 1.83	7.1%	3.9%
Buoy J : +1.9% | x 4.09	2.6%	0.6%
Tac. South : 0.0% | x 0.97	0.6%	0.6%
SJ Islands : +0.0% | x 1.02	0.6%	0.6%
Sar/Skagit : +0.0% | x 1.12	0.2%	0.1%
ATBA : +0.0% | x 1.44	0.1%	0.1%

% Base Case Pot. Oil (C+G+A) Loss (OL) - ALL_FV

■ US - KM - CA - 1598 : 185% (+84.7% | x 1.85)   ■ VTRA '15: Base Case : 100%
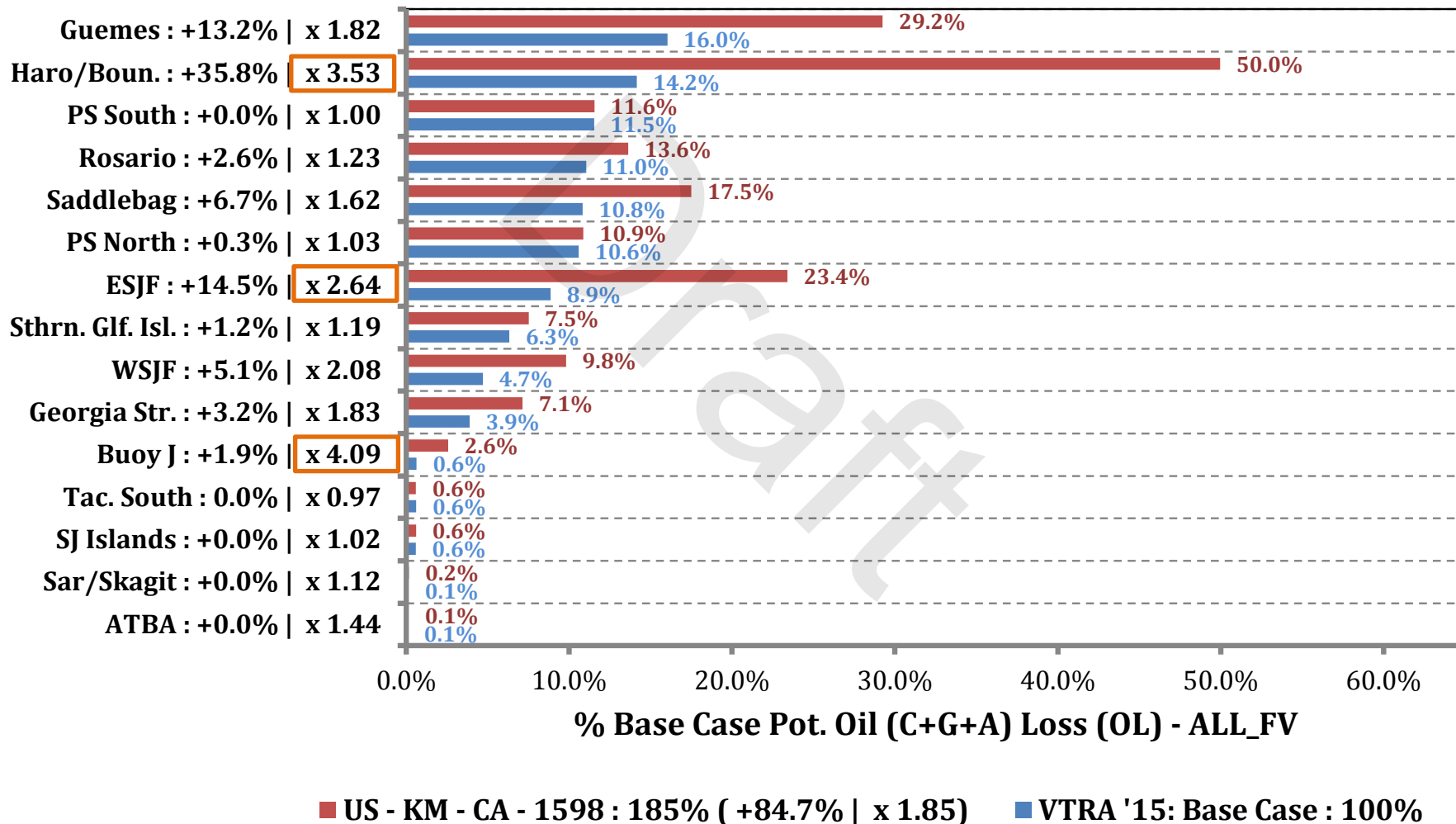
% Base Case Pot. Accident (C+G+A) Frequency - ALL_FV

Region	US - KM - CA - 1598	VTRA '15: Base Case
PS South : +1.0% | x 1.02	45.9%	44.9%
Sthrn. Glf. Isl. : 0.0% | x 1.00	13.2%	13.3%
Guemes : +1.9% | x 1.18	12.2%	10.3%
Haro/Boun. : +4.8% | x 1.62	12.7%	7.8%
PS North : +0.1% | x 1.01	7.3%	7.3%
WSJF : +1.1% | x 1.29	4.8%	3.7%
Georgia Str. : +0.3% | x 1.09	3.9%	3.6%
ESJF : +1.2% | x 1.40	4.2%	3.0%
Tac. South : +0.0% | x 1.00	2.3%	2.3%
Rosario : +0.1% | x 1.05	1.4%	1.3%
SJ Islands : +0.1% | x 1.10	1.2%	1.1%
Saddlebag : +0.1% | x 1.12	1.0%	0.9%
Buoy J : +0.3% | x 1.70	0.7%	0.4%
Sar/Skagit : +0.0% | x 1.05	0.2%	0.2%
ATBA : +0.0% | x 1.07	0.0%	0.0%

X-axis: **% Base Case Pot. Accident Freq. (AF) - ALL_FV** (0% to 50%)

Legend: ■ US - KM - CA - 1598 : 111% (+10.9% | x 1.11)   ■ VTRA '15: Base Case : 100%

By Waterway Zone Risk Comparison

Oil Spill Size Category:
2500 m³ or more

THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC
VCU

VTRA 2015 BASE CASE - ALL FV

42.0% of VTRA 2015 Base Case Total

Annual Potential Oil Loss:

SPILL SIZES LARGER THAN 2,500 m³
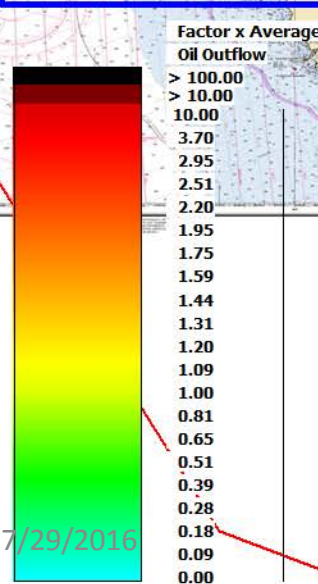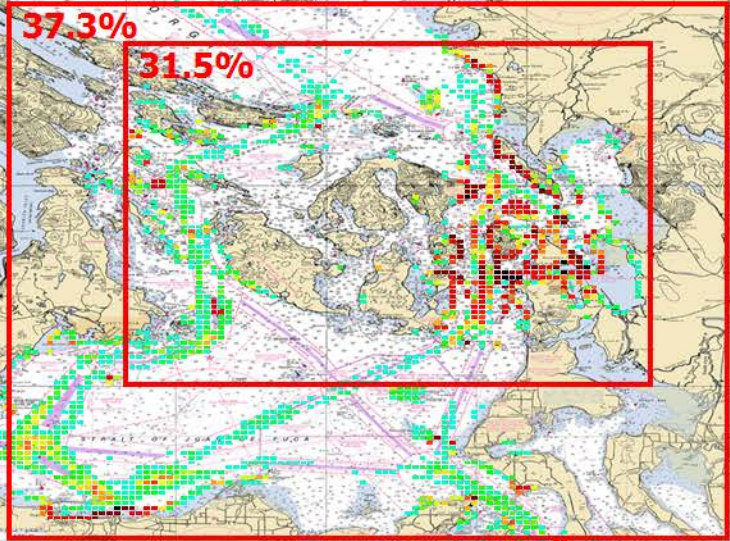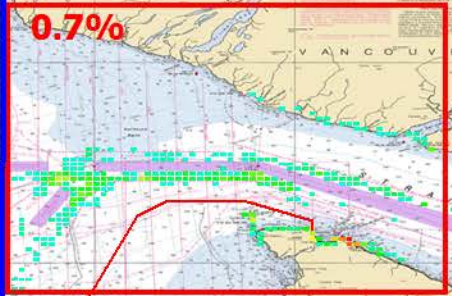
0.7%

37.3%

31.5%

Factor x Average Oil Outflow

| > 100.00 |
| > 10.00 |
| 10.00 |
| 3.70 |
| 2.95 |
| 2.51 |
| 2.20 |
| 1.95 |
| 1.75 |
| 1.59 |
| 1.44 |
| 1.31 |
| 1.20 |
| 1.09 |
| 1.00 |
| 0.81 |
| 0.65 |
| 0.51 |
| 0.39 |
| 0.28 |
| 0.18 |
| 0.09 |
| 0.00 |

VTRA '15:
BASE CASE
GEOGRAPHIC PROFILE
OF POTENTIAL
ANNUAL OIL LOSS
OF ACCIDENTS
WITH SPILL SIZE
2,500 m³ or more

≈ 0.50% Probability
of Spill Occurrence
in 10 years

Average of ≈ 6,798 m³
Per Potential Spill
(≈ 5,846 Metric. Tons)

7/29/2016

7/28/2016

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

Prob. Estimate At Least One Accident in 10 Years - ALL_FV - Oil Spill Size Category: 2500 cubic meters or more
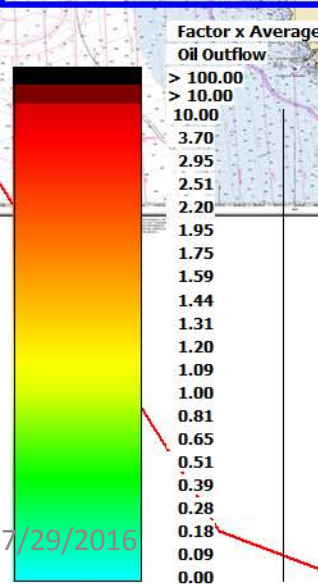
Location	US - KM - CA - 1598	VTRA '15: Base Case
Guemes : +0.15% | x 2.43	0.258%	0.1064%
Rosario : +0.02% | x 1.23	0.1320%	0.1075%
Saddlebag : +0.06% | x 1.71	0.1395%	0.0815%
ESJF : +0.21% | x 5.06	0.2614%	0.0516%
Haro/Boun. : +0.29% | x 11.19	0.3217%	0.0287%
PS South : +0.00% | x 1.04	0.0323%	0.0311%
PS North : +0.00% | x 1.04	0.0320%	0.0308%
WSJF : +0.05% | x 3.10	0.0692%	0.0223%
Georgia Str. : +0.04% | x 2.40	0.0622%	0.0259%
Buoy J : +0.02% | x 5.25	0.0252%	0.0048%
Sthrn. Glf. Ils. : +0.02% | x 6.04	0.0190%	0.0031%
Tac. South : 0.00% | x 0.96	0.0009%	0.0009%
ATBA : +0.00% | x 1.17	0.0007%	0.0006%
SJ Islands : +0.00% | x 1.23	0.0041%	0.0033%
Sar/Skagit : +0.00% | x 1.49	0.0004%	0.0003%

Prob. Estimate At Least One Accident in 10 Years

■ US - KM - CA - 1598 : 1.35% (+0.85% | x 2.71) ■ VTRA '15: Base Case : 0.50%

Potential Spill Size (m3) per Accident -
ALL_FV - Oil Spill Size Category: 2500 cubic meters or more

Location	US - KM - CA	VTRA '15 Base Case
Guemes : -997.1 | x 0.88	7,201	8,198
Rosario : +250.8 | x 1.04	7,063	6,812
Saddlebag : +269.1 | x 1.04	7,430	7,161
ESJF : -2587.6 | x 0.59	3,653	6,240
Haro/Boun. : -896.2 | x 0.80	3,692	4,589
PS South : -100.9 | x 0.98	5,855	5,956
PS North : +148.0 | x 1.03	5,122	4,974
WSJF : -833.8 | x 0.88	5,888	6,721
Georgia Str. : -741.3 | x 0.89	5,952	6,694
Buoy J : +570.9 | x 1.10	6,444	5,873
Sthrn. Glf. Ils. : -1914.9 | x 0.59	2,761	4,676
Tac. South : -+1247.9 | x 0.81	5,467	6,715
ATBA : +2781.8 | x 1.31	11,848	9,066
SJ Islands : -4149.6 | x 0.57	5,406	9,556
Sar/Skagit : +502.0 | x 1.09	6,190	5,688

Potential Spill Size (m3) per Accident

■ US - KM - CA - 1598 : 5412 m3 (-1386.1 | x 0.80)   ■ VTRA '15: Base Case : 6798 m3

By Waterway Zone
Risk Comparison

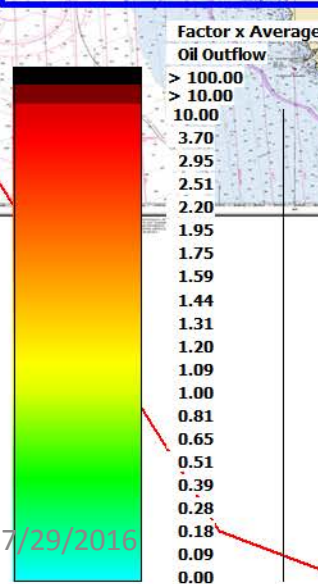# Oil Spill Size Category:
1000 m³ - 2500 m³

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

VTRA 2015 BASE CASE – ALL FV

12.3% of VTRA 2015 Base Case Total
Annual Potential Oil Loss:
SPILL SIZES BETWEEN 1,000 m³ - 2,500 m³

10.7%

9.1%

0.1%

Factor x Average Oil Outflow
> 100.00
> 10.00
10.00
3.70
2.95
2.51
2.20
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
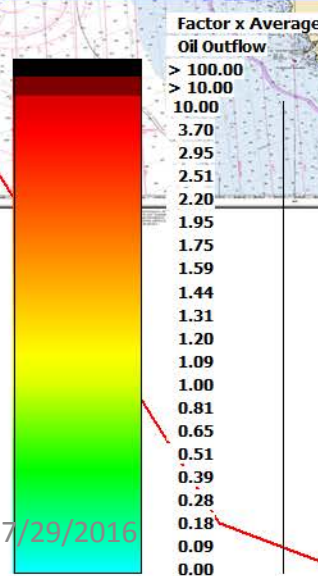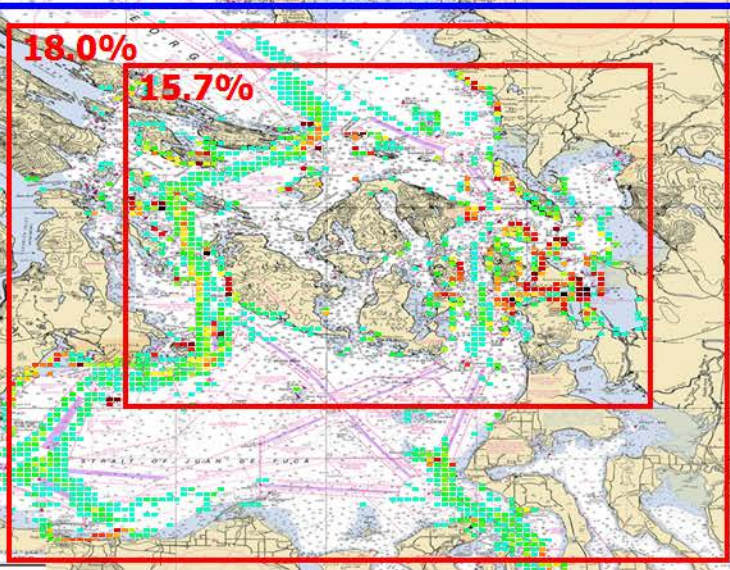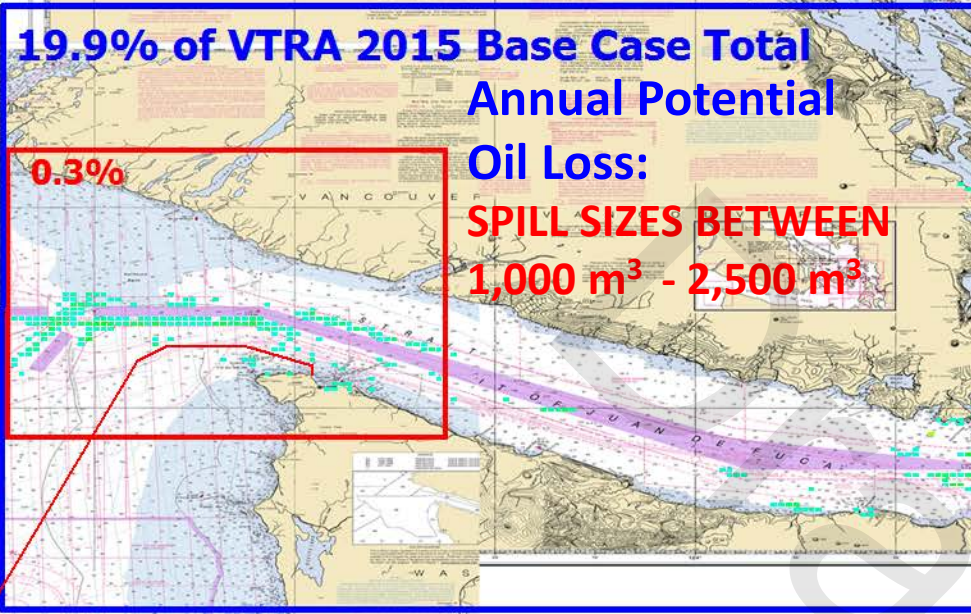0.65
0.51
0.39
0.28
0.18
0.09
0.00

VTRA '15: BASE CASE
GEOGRAPHIC PROFILE OF POTENTIAL ANNUAL OIL LOSS OF ACCIDENTS WITH SPILL SIZE **BETWEEN 1,000 m³ - 2,500 m³**

≈ 0.61% Probability of Spill Occurrence in 10 years

Average of ≈ 1,619 m³ Per Potential Spill (≈ 1,392 Metric Tons)

7/29/2016

7/28/2016

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

THE GEORGE WASHINGTON UNIVERSITY — WASHINGTON, DC — VCU

VTRA 2015 Case: US-KM-CA-1598 - ALL FV

19.9% of VTRA 2015 Base Case Total

18.0%

15.7%

0.3%

Annual Potential Oil Loss:

SPILL SIZES BETWEEN 1,000 m³ - 2,500 m³

Factor x Average Oil Outflow

> 100.00
> 10.00
10.00
3.70
2.95
2.51
2.20
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.39
0.28
0.18
0.09
0.00

VTRA '15 Case:
US - KM - CA - 1598
GEOGRAPHIC PROFILE
OF POTENTIAL
ANNUAL OIL LOSS
OF ACCIDENTS
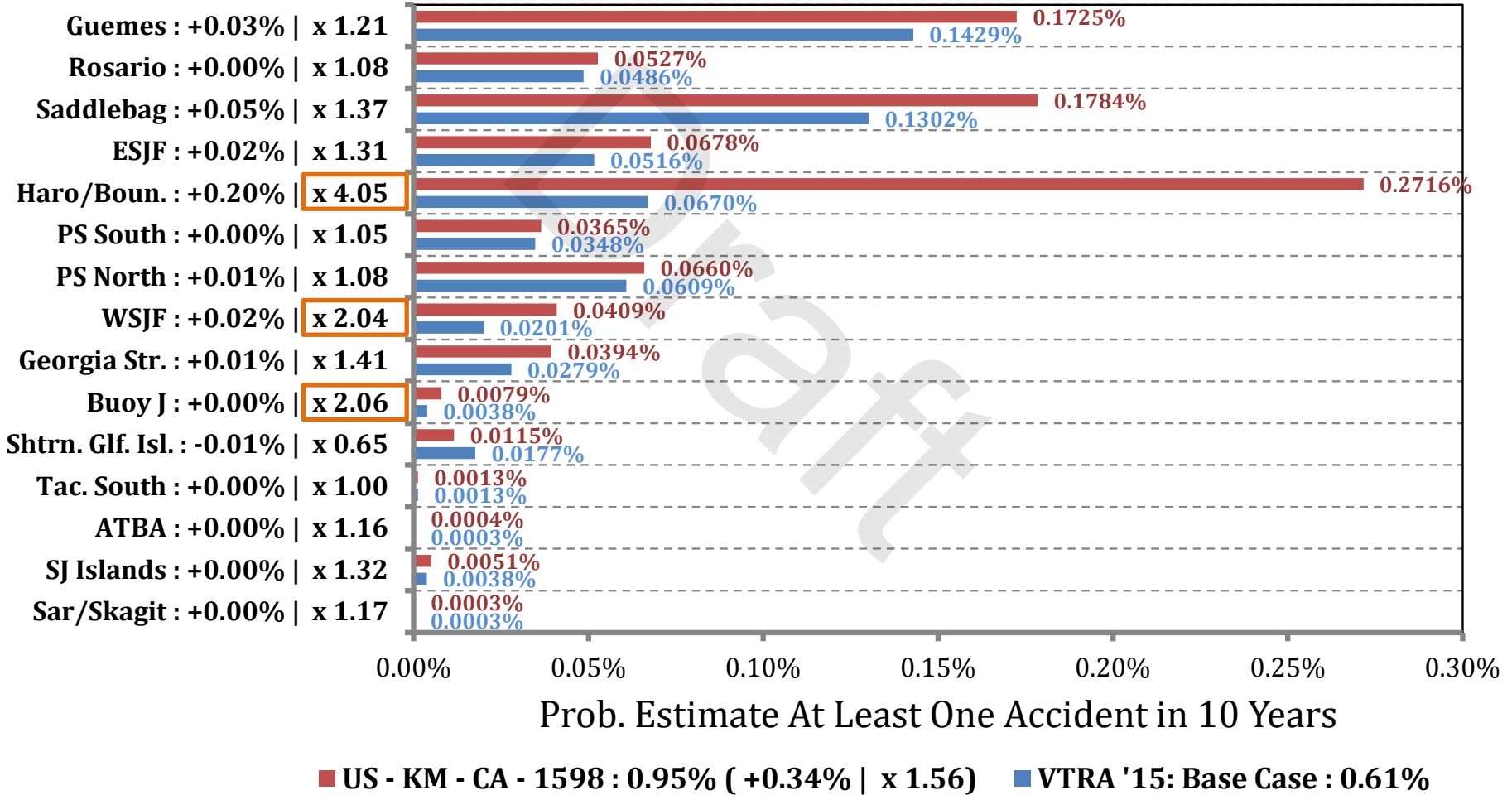WITH SPILL SIZE **BETWEEN**
1,000 m³ - 2,500 m³

≈ 0.95% Probability of Spill Occurrence in 10 years

Average of ≈ 1,694 m³ Per Potential Spill (≈ 1,457 Metric Tons)

7/29/2016

7/29/2016

Prob. Estimate At Least One Accident in 10 Years - ALL_FV - Oil Spill Size Category: 1000 - 2500 m3

Location	US - KM - CA - 1598	VTRA '15: Base Case
Guemes : +0.03% | x 1.21	0.1725%	0.1429%
Rosario : +0.00% | x 1.08	0.0527%	0.0486%
Saddlebag : +0.05% | x 1.37	0.1784%	0.1302%
ESJF : +0.02% | x 1.31	0.0678%	0.0516%
Haro/Boun. : +0.20% | x 4.05	0.2716%	0.0670%
PS South : +0.00% | x 1.05	0.0365%	0.0348%
PS North : +0.01% | x 1.08	0.0660%	0.0609%
WSJF : +0.02% | x 2.04	0.0409%	0.0201%
Georgia Str. : +0.01% | x 1.41	0.0394%	0.0279%
Buoy J : +0.00% | x 2.06	0.0079%	0.0038%
Shtrn. Glf. Isl. : -0.01% | x 0.65	0.0115%	0.0177%
Tac. South : +0.00% | x 1.00	0.0013%	0.0013%
ATBA : +0.00% | x 1.16	0.0004%	0.0003%
SJ Islands : +0.00% | x 1.32	0.0051%	0.0038%
Sar/Skagit : +0.00% | x 1.17	0.0003%	0.0003%

Prob. Estimate At Least One Accident in 10 Years

■ US - KM - CA - 1598 : 0.95% (+0.34% | x 1.56)   ■ VTRA '15: Base Case : 0.61%

Potential Spill Size (m3) per Accident - ALL_FV - Oil Spill Size
Category: 1000 - 2500 m3

Region	US - KM - CA - 1598 : 1694 m3 (+74.6 | x 1.05)	VTRA '15: Base Case : 1619 m3
Guemes : -13.0 | x 0.99	1,702	1,715
Rosario : +2.1 | x 1.00	1,719	1,717
Saddlebag : -96.4 | x 0.95	1,697	1,793
ESJF : +113.0 | x 1.08	1,575	1,462
Haro/Boun. : +380.8 | x 1.26	1,823	1,443
PS South : +29.6 | x 1.02	1,494	1,464
PS North : -1.8 | x 1.00	1,396	1,398
WSJF : +134.4 | x 1.08	1,738	1,603
Georgia Str. : +14.3 | x 1.01	1,613	1,599
Buoy J : +30.3 | x 1.02	1,671	1,641
Shtrn. Glf. Isl. : +103.7 | x 1.06	1,729	1,625
Tac. South : +0.8 | x 1.00	1,247	1,246
ATBA : +87.3 | x 1.06	1,650	1,562
SJ Islands : +15.2 | x 1.01	1,309	1,294
Sar/Skagit : -55.8 | x 0.96	1,333	1,389

Potential Spill Size (m3) per Accident

US - KM - CA - 1598 : 1694 m3 (+74.6 | x 1.05)   **VTRA '15: Base Case : 1619 m3**

By Waterway Zone
Risk Comparison

Oil Spill Size Category:
$1 \text{ m}^3 - 1000 \text{ m}^3$

THE GEORGE WASHINGTON UNIVERSITY · WASHINGTON, DC · VCU

VTRA 2015 BASE CASE - ALL FV

45.3% of VTRA 2015 Base Case Total
Annual Potential Oil Loss:
SPILL SIZES BETWEEN
1 m³ – 1,000 m³

0.4%

29.8%

20.3%

Factor x Average Oil Outflow

> 100.00
> 10.00
10.00
3.70
2.95
2.51
2.20
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.39
0.28
0.18
0.09
0.00
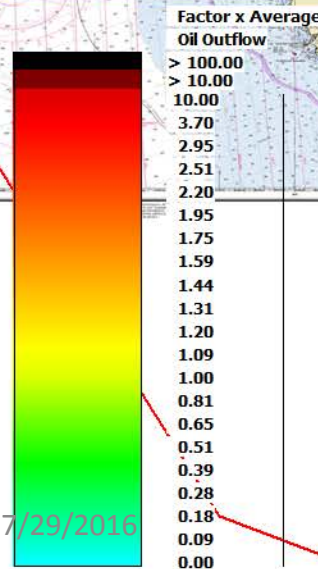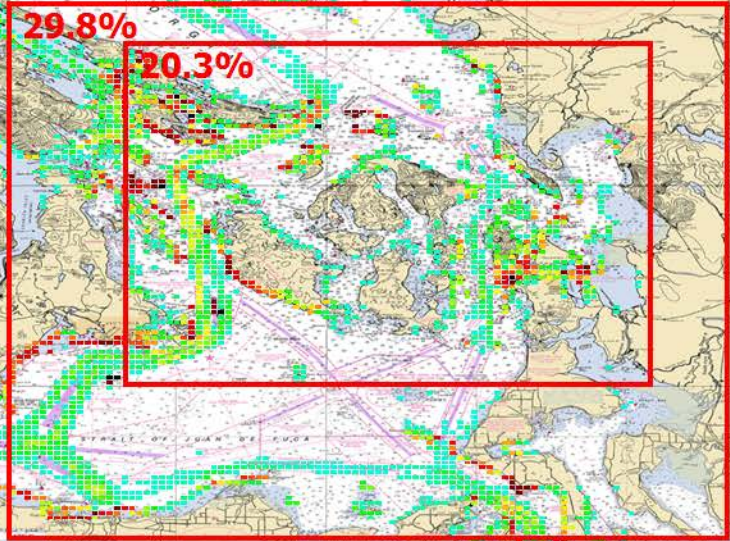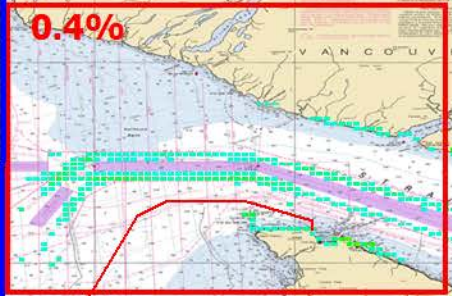
VTRA '15:
BASE CASE
GEOGRAPHIC PROFILE
OF ANNUAL
POTENTIAL OIL LOSS
OF ACCIDENTS
WITH SPILL SIZE
BETWEEN 1 m³ - 1000 m³

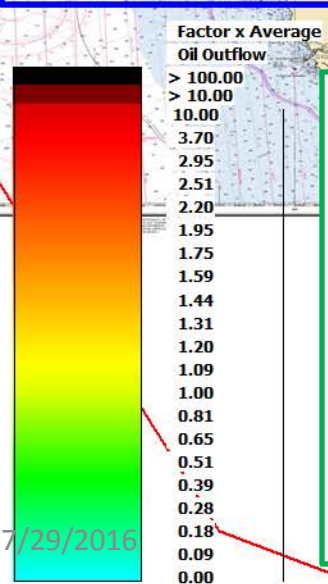≈ 54.2% Probability of Spill Occurrence in 10 years

Average of ≈ 47 m³ Per Potential Spill (≈ 295 Barrels)

7/29/2016

7/28/2016

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

VTRA 2015 Case: US-KM-CA-1598 - ALL FV

72.7% of VTRA 2015 Base Case Total

Annual Potential Oil Loss:

SPILL SIZES BETWEEN 1 m³ – 1,000 m³

56.6%

40.0%

0.7%

Factor x Average Oil Outflow

> 100.00
> 10.00
10.00
3.70
2.95
2.51
2.20
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.39
0.28
0.18
0.09
0.00

VTRA '15 Case:
US - KM - CA - 1598
GEOGRAPHIC PROFILE
OF ANNUAL
POTENTIAL OIL LOSS
OF ACCIDENTS
WITH SPILL SIZE
BETWEEN 1 m³ - 1000 m³

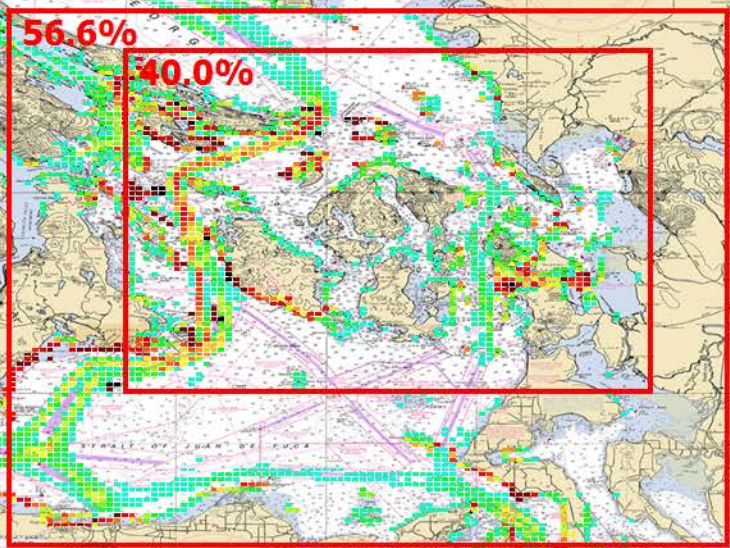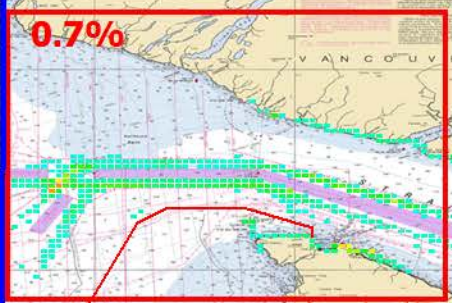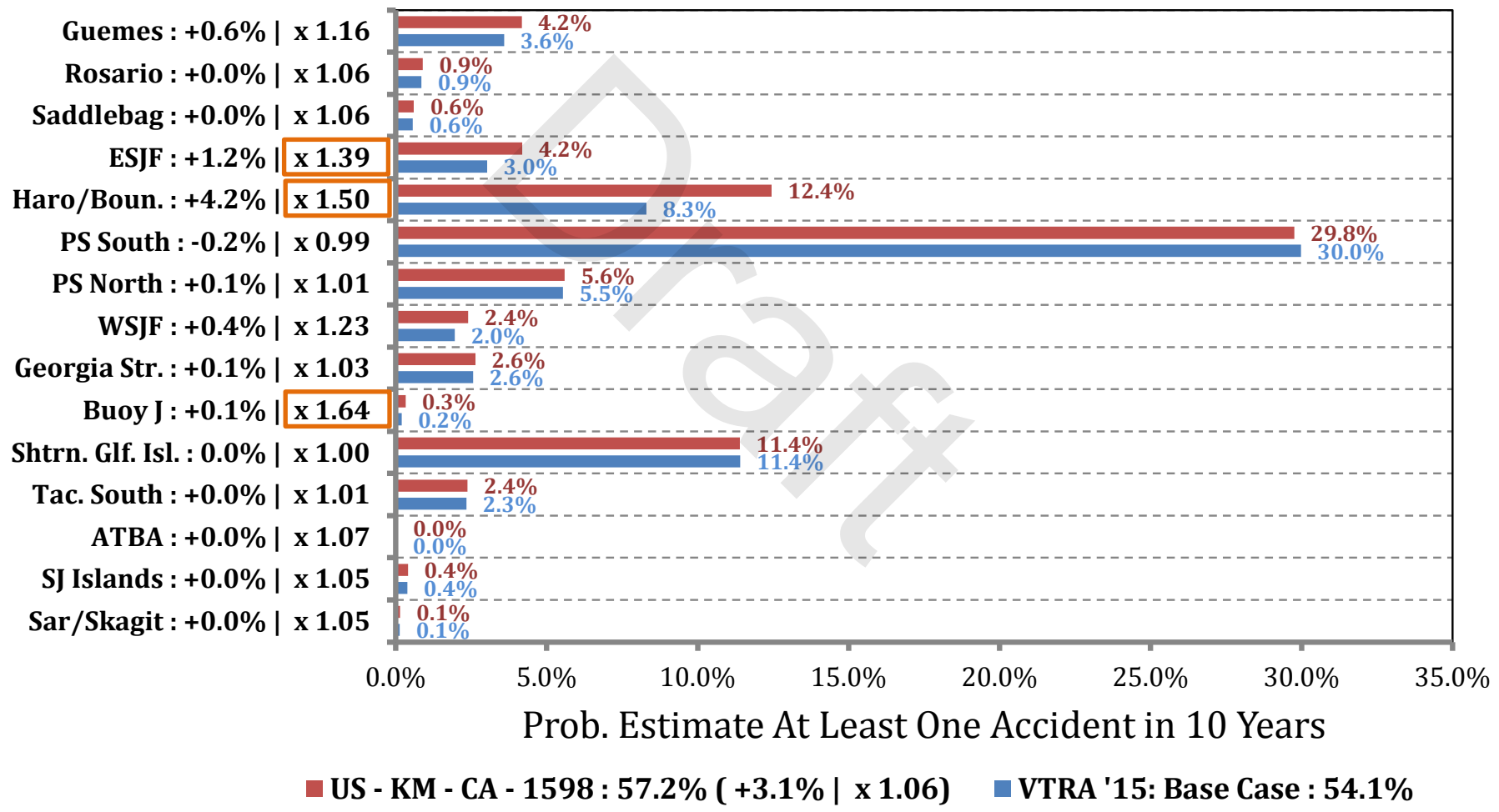≈ 57.2% Probability of Spill Occurrence in 10 years

Average of ≈ 69 m³ Per Potential Spill (≈ 436 Barrels)

7/29/2016

7/29/2016

THE GEORGE WASHINGTON UNIVERSITY WASHINGTON, DC

VCU

THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC
VCU

Prob. Estimate At Least One Accident in 10 Years -
ALL_FV - Oil Spill Size Category: 1 - 1000 m3

Category	US - KM - CA - 1598	VTRA '15: Base Case
Guemes : +0.6% | x 1.16	4.2%	3.6%
Rosario : +0.0% | x 1.06	0.9%	0.9%
Saddlebag : +0.0% | x 1.06	0.6%	0.6%
ESJF : +1.2% | x 1.39	4.2%	3.0%
Haro/Boun. : +4.2% | x 1.50	12.4%	8.3%
PS South : -0.2% | x 0.99	29.8%	30.0%
PS North : +0.1% | x 1.01	5.6%	5.5%
WSJF : +0.4% | x 1.23	2.4%	2.0%
Georgia Str. : +0.1% | x 1.03	2.6%	2.6%
Buoy J : +0.1% | x 1.64	0.3%	0.2%
Shtrn. Glf. Isl. : 0.0% | x 1.00	11.4%	11.4%
Tac. South : +0.0% | x 1.01	2.4%	2.3%
ATBA : +0.0% | x 1.07	0.0%	0.0%
SJ Islands : +0.0% | x 1.05	0.4%	0.4%
Sar/Skagit : +0.0% | x 1.05	0.1%	0.1%

Prob. Estimate At Least One Accident in 10 Years

■ US - KM - CA - 1598 : 57.2% (+3.1% | x 1.06)   ■ VTRA '15: Base Case : 54.1%

Potential Spill Size (m3) per Accident -
ALL_FV - Oil Spill Size Category: 1 - 1000 m3

Region	US - KM - CA - 1598 : 69 m3 (+22.4 | x 1.48)	VTRA '15: Base Case : 47 m3
Guemes : +0.4 | x 1.01	43	43
Rosario : -4.1 | x 0.95	78	82
Saddlebag : +20.8 | x 1.22	116	95
ESJF : +89.4 | x 1.87	192	103
Haro/Boun. : +70.7 | x 1.68	175	105
PS South : +0.0 | x 1.00	19	19
PS North : -0.1 | x 1.00	107	108
WSJF : +28.2 | x 1.28	128	100
Georgia Str. : +16.2 | x 1.44	53	37
Buoy J : +15.4 | x 1.19	96	80
Shtrn. Glf. Isl. : +5.5 | x 1.14	44	38
Tac. South : -+0.2 | x 0.99	17	17
ATBA : +9.6 | x 1.15	72	63
SJ Islands : +16.7 | x 1.64	43	26
Sar/Skagit : -1.3 | x 0.98	67	68

Potential Spill Size (m3) per Accident

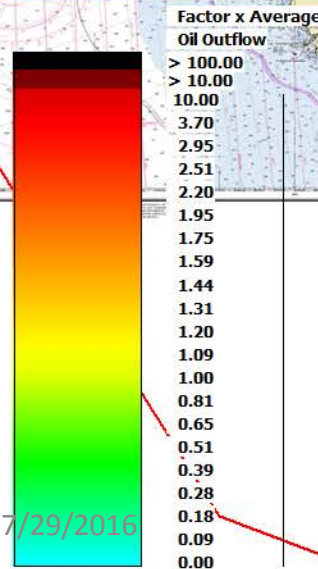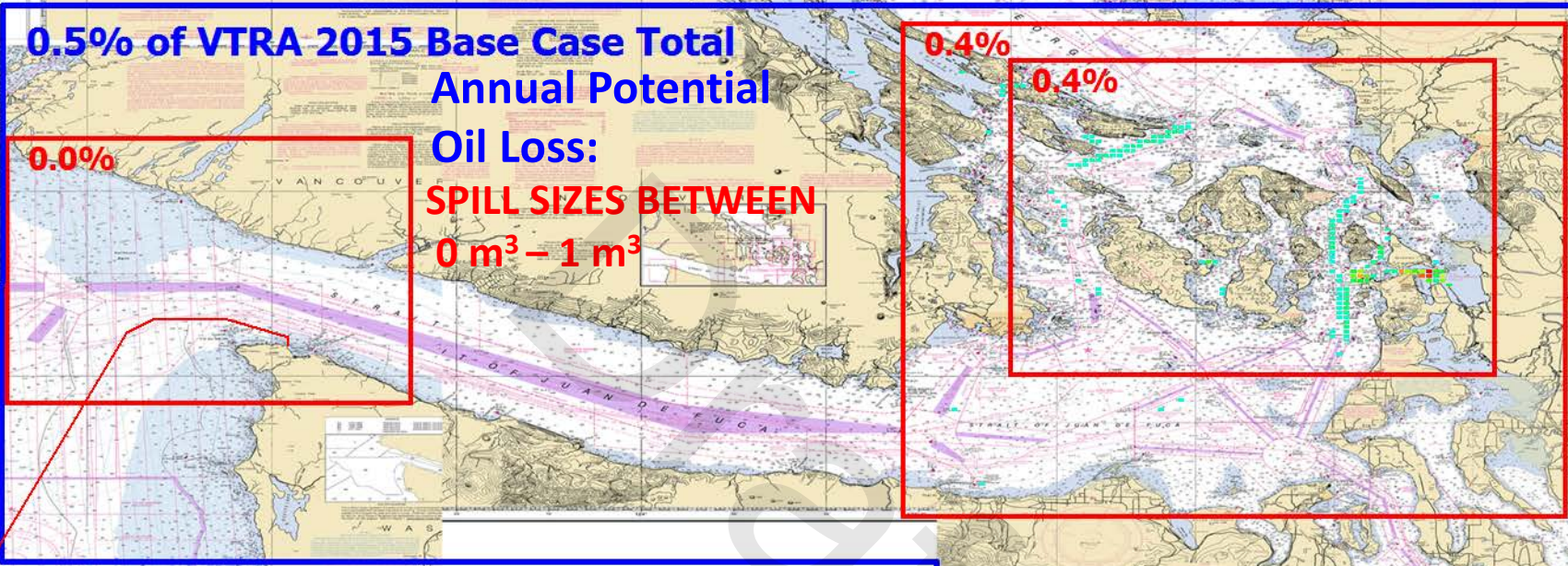**■ US - KM - CA - 1598 : 69 m3 (+22.4 | x 1.48)**   **■ VTRA '15: Base Case : 47 m3**

By Waterway Zone
Risk Comparison

Oil Spill Size Category:
$0 \text{ m}^3 - 1 \text{ m}^3$

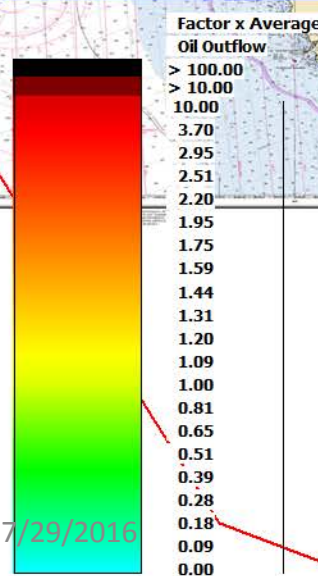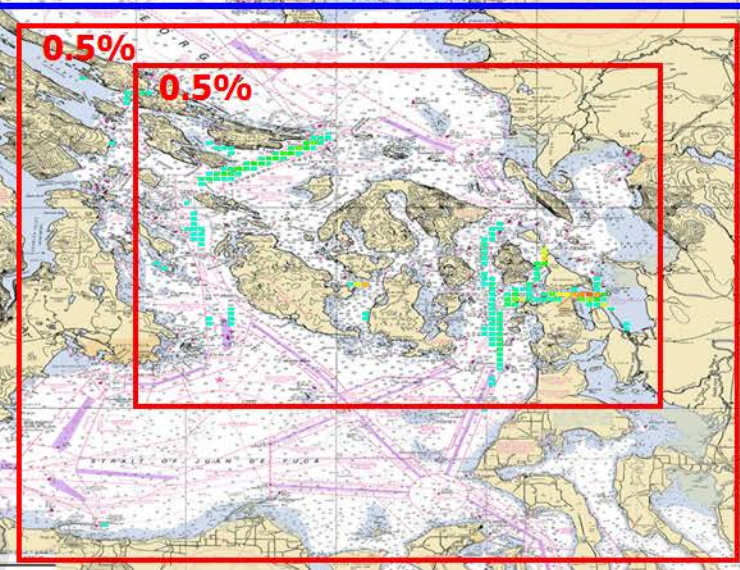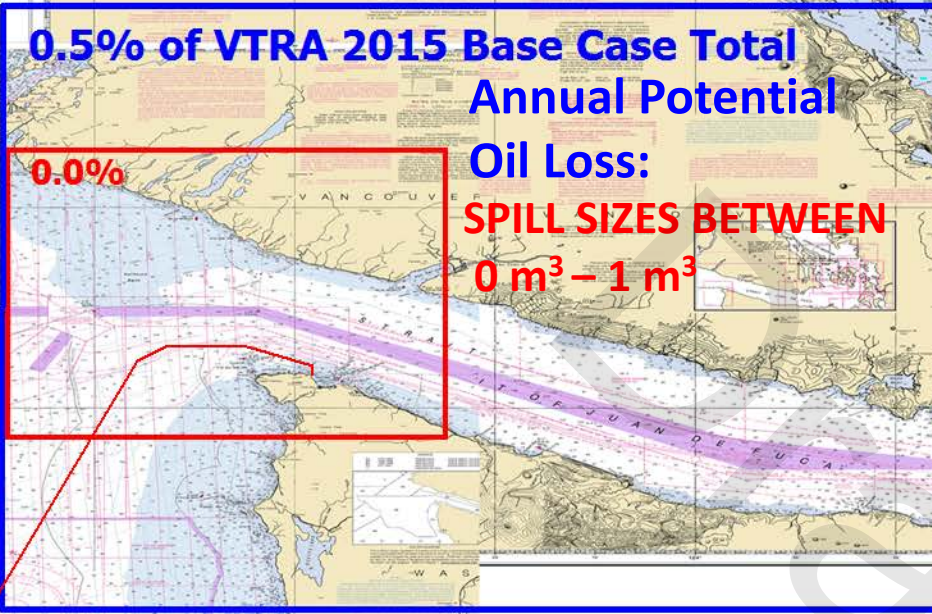# VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

VTRA 2015 BASE CASE - ALL FV

0.5% of VTRA 2015 Base Case Total

0.4%

0.4%

0.0%

Annual Potential Oil Loss:
SPILL SIZES BETWEEN
0 m³ – 1 m³

Factor x Average Oil Outflow
> 100.00
> 10.00
10.00
3.70
2.95
2.51
2.20
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.39
0.28
0.18
0.09
0.00

VTRA '15:
BASE CASE
GEOGRAPHIC PROFILE
OF ANNUAL
POTENTIAL OIL LOSS
OF ACCIDENTS
WITH SPILL SIZE
BETWEEN 0 m³ - 1 m³

≈ 100% Probability
of Spill Occurrence
in 10 years

Average of ≈ 0.01 m³
Per Potential Spill
(≈ 2.3 gallons)

7/29/2016

7/28/2016

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

THE GEORGE WASHINGTON UNIVERSITY
WASHINGTON, DC

VCU

VTRA 2015 Case: US-KM-CA-1598 - ALL FV

0.5% of VTRA 2015 Base Case Total

0.5%

0.5%

0.0%

Annual Potential Oil Loss:
SPILL SIZES BETWEEN
0 m³ – 1 m³

Factor x Average
Oil Outflow

> 100.00
> 10.00
10.00
3.70
2.95
2.51
2.20
1.95
1.75
1.59
1.44
1.31
1.20
1.09
1.00
0.81
0.65
0.51
0.39
0.28
0.18
0.09
0.00

VTRA '15 Case:
US - KM - CA - 1598
GEOGRAPHIC PROFILE
OF ANNUAL
POTENTIAL OIL LOSS
OF ACCIDENTS
WITH SPILL SIZE
BETWEEN 0 m³ - 1 m³

≈ 100% Probability
of Spill Occurrence
in 10 years

Average of ≈ 0.01 m³
Per Potential Spill
(≈ 2.4 gallons)

7/29/2016

7/29/2016

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

VESSEL TRAFFIC RISK ASSESSMENT (VTRA) 2015

VTRA 2015 Case: US-KM-CA-1598 - ALL FV

109.0% of VTRA 2015 Base Case Total

47.6%

36.8%

1.4%

Potential Annual
Accidents:
SPILL SIZES BETWEEN
0 m³ – 1 m³

Factor x Average Oil Outflow

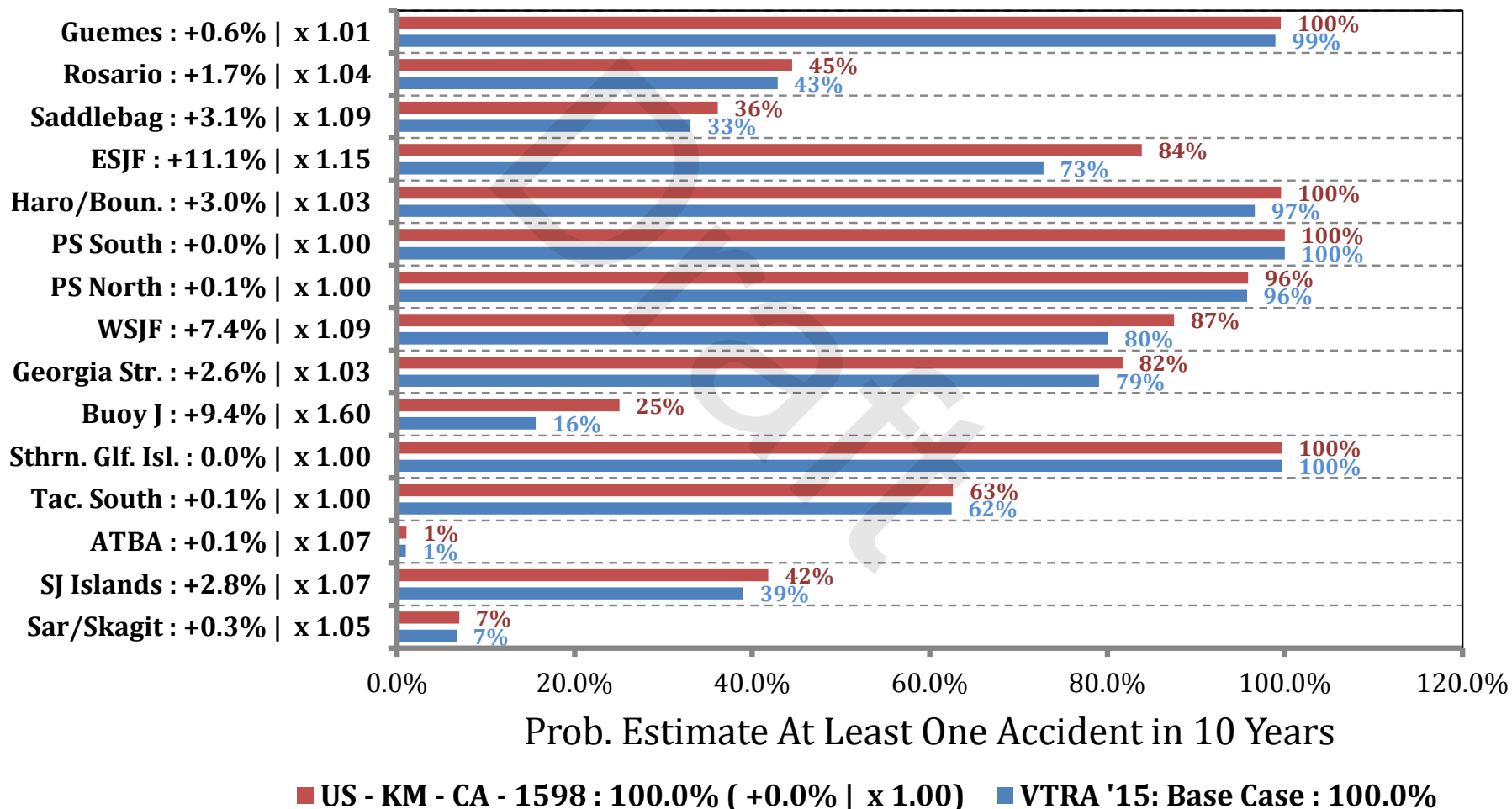| > 100.00 |
| > 10.00 |
| 10.00 |
| 3.71 |
| 2.95 |
| 2.51 |
| 2.20 |
| 1.95 |
| 1.76 |
| 1.59 |
| 1.44 |
| 1.31 |
| 1.20 |
| 1.09 |
| 1.00 |
| 0.81 |
| 0.65 |
| 0.51 |
| 0.39 |
| 0.28 |
| 0.18 |
| 0.09 |
| 0.00 |

VTRA '15 Case:
US - KM - CA - 1598
GEOGRAPHIC PROFILE
OF ANNUAL
POTENTIAL OIL LOSS
OF ACCIDENTS
WITH SPILL SIZE
BETWEEN 0 m³ - 1 m³

≈ 100% Probability
of Spill Occurrence
in 10 years

Average of ≈ 0.01 m³
Per Potential Spill
(= 2.4 gallons)

7/29/2016

7/29/2016

Prob. Estimate At Least One Accident in 10 Years - ALL_FV - Oil Spill Size Category: 0 - 264 Gallons

Location	US - KM - CA - 1598	VTRA '15: Base Case
Guemes : +0.6% | x 1.01	100%	99%
Rosario : +1.7% | x 1.04	45%	43%
Saddlebag : +3.1% | x 1.09	36%	33%
ESJF : +11.1% | x 1.15	84%	73%
Haro/Boun. : +3.0% | x 1.03	100%	97%
PS South : +0.0% | x 1.00	100%	100%
PS North : +0.1% | x 1.00	96%	96%
WSJF : +7.4% | x 1.09	87%	80%
Georgia Str. : +2.6% | x 1.03	82%	79%
Buoy J : +9.4% | x 1.60	25%	16%
Sthrn. Glf. Isl. : 0.0% | x 1.00	100%	100%
Tac. South : +0.1% | x 1.00	63%	62%
ATBA : +0.1% | x 1.07	1%	1%
SJ Islands : +2.8% | x 1.07	42%	39%
Sar/Skagit : +0.3% | x 1.05	7%	7%

Prob. Estimate At Least One Accident in 10 Years

■ US - KM - CA - 1598 : 100.0% (+0.0% | x 1.00)   ■ VTRA '15: Base Case : 100.0%

Potential Spill Size (Gallons) per Accident - ALL_FV - Oil Spill Size Category: 0 - 264 Gallons

Location	US - KM - CA - 1598	VTRA '15: Base Case
Guemes : -1.9 | x 0.82	8.6	10.4
Rosario : -0.5 | x 0.98	22.6	23.0
Saddlebag : -0.8 | x 0.87	5.1	5.8
ESJF : -0.7 | x 0.66	1.4	2.1
Haro/Boun. : +0.8 | x 1.19	5.0	4.2
PS South : 0.0 | x 0.99	0.3	0.3
PS North : +0.0 | x 1.04	1.1	1.1
WSJF : +0.1 | x 1.09	0.6	0.6
Georgia Str. : -0.1 | x 0.95	1.4	1.4
Buoy J : -0.2 | x 0.91	1.7	1.9
Sthrn. Glf. Isl. : +0.0 | x 1.07	0.7	0.7
Tac. South : +0.0 | x 1.00	1.1	1.1
ATBA : 0.0 | x 0.44	0.0	0.1
SJ Islands : +6.8 | x 2.75	10.7	3.9
Sar/Skagit : +2.3 | x 4.14	3.0	0.7

Potential Spill Size (Gallons) per Accident

■ US - KM - CA - 1598 : 2.4 gallons (+0.1 \| x 1.06) ■ VTRA '15: Base Case : 2.3 gallons

Summary
Risk Comparison

Oil Spill Size Category:
All Spill Sizes

Summary Risk Comparison

		OIL_2500_MORE	OIL_1000_2500	OIL_1_1000	OIL_0_1	TOTAL_OIL
VTRA '15 BASE CASE	Base Case % Potential Annual Oil Loss	42.0%	12.3%	45.3%	0.5%	100.0%
	Base Case % Potenial Annual Accident Frequency	0.01%	0.01%	1.8%	98.2%	100.0%
	Average potential spill size per accident (in m^3)	6,798	1,619	46.9	0.01	1.8
	Probability of at least one accident in 1 year by spill size	0.05%	0.06%	7.5%	98.7%	98.8%
	Probability of at least one accident in 10 year by spill size	0.50%	0.61%	54.2%	100.0%	100.0%
	Probability of at least one accident in 25 years by spill size	1.24%	1.52%	85.8%	100.0%	100.0%
		OIL_2500_MORE	OIL_1000_2500	OIL_1_1000	OIL_0_1	TOTAL_OIL
VTRA '15 US-KM-CA 1598	Base Case % Potential Annual Oil Loss	91.1% (+49.11%| x2.17)	20.0% (+7.71%| x1.63)	72.8% (+27.54%| x1.61)	0.5% (+0.08%| x1.17)	184.4% (+84.4%| x1.84)
	Base Case % Potenial Annual Accident Frequency	0.03% (+0.02%| x2.72)	0.02% (+0.01%| x1.56)	1.9% (+0.16%| x1.09)	108.9% (+10.7%| x1.11)	110.9% (+10.9%| x1.11)
	Average potential spill size per accident (in m^3)	5413 (-1385 | x0.80)	1693 (+75 | x1.05)	69.2 (+22.3 | x1.48)	0.01 (+0.00 | x1.06)	3.0 (+1.2 | x1.66)
	Probability of at least one accident in 1 year by spill size	0.14% (+0.09%| x2.72)	0.10% (+0.03%| x1.56)	8.2% (+0.64%| x1.09)	99.2% (+0.48% | x1.00)	99.3% (+0.45%| x1.00)
	Probability of at least one accident in 10 year by spill size	1.35% (+0.85%| x2.71)	0.95% (+0.34%| x1.55)	57.3% (+3.09%| x1.06)	100.0% (0.00%| x1.00)	100.0% (0.00%| x1.00)
	Probability of at least one accident in 25 years by spill size	3.35% (+2.10%| x2.70)	2.36% (+0.84%| x1.55)	88.1% (+2.27%| x1.03)	100.0% (0.00%| x1.00)	100.0% (0.00%| x1.00)