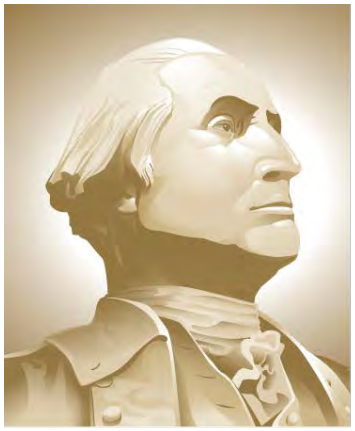
VTRA 2010 POTENTIAL COLLISION FREQUENCY BY ALL FV, CARGO – FV, TANK- FV AND WHAT-IF FV

Presentation by: J. Rene van Dorp



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CASE T: Gateway, Kinder Morgan, Delta Port

GWU Personnel: Dr. J. Rene van Dorp

VCU Personnel: Dr. Jason R. W. Merrick

AUGUST 5, 2013

PRELIMINARY

Table. Focus Vessel (FV) Classification for the 26 VTOSS vessel type classification used in the GW/VCU MTS simulation model.

NON – FV : Those vessels that Interacting Vessels (IV) with Focus Vessels (FV)

BASE CASE CARGO – FV : Bulk Carriers, Container Vessels, Other Cargo Vessels that travel in VTRA 2010 Base Case

BASE CASE TANK – FV : Oil Barge, Oil Tankers, Chemical Carrier, ATB 's that travel in VTRA 2010 Base Case

WHAT IF – FV : CARGO AND TANK FV'S added to VTRA 2010 Base Case to model What-If Scenario

Note: Focus Vessels (FV's) are also considered as Interacting Vessels (IV's) when interacting with another Focus Vessel.

#	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

IMPORTANT:

THE OPERATIVE WORD IN PRESENTING THESE ANALYSIS RESULTS IS THE USE OF THE WORD

POTENTIAL

TO INDICATE THAT THESE ANALYSIS RESULTS DO NOT FOLLOW FROM AN HISTORICAL DATA ANALYSIS, BUT THROUGH THE USE OF AN ANALYSIS TOOL THAT EVALUATES SUCH **POTENTIAL**.

THE 2010 YEAR IS CONSIDERED **THE BASE CASE YEAR** AND A BASE CASE YEAR POTENTIAL IS EVALUATED.

NEXT, **WHAT-IF SCENARIOS** ARE DEVELOPED FROM THE BASE CASE BY ADDING ADDITIONAL HYPOTHETICAL TRAFFIC AND A WHAT-IF POTENTIAL IS EVALUATED AND COMPARED **RELATIVE TO THE BASE CASE** TO INFORM **RISK MANAGEMENT.**

CASE T: GW 487, KM 348, DP 348 and 67:

BASE CASE 2010 TRAFFIC WITH FOLLOWING WHAT-IF FOCUS VESSELS

487 Gateway Bulk Carriers + Bunkering Barges

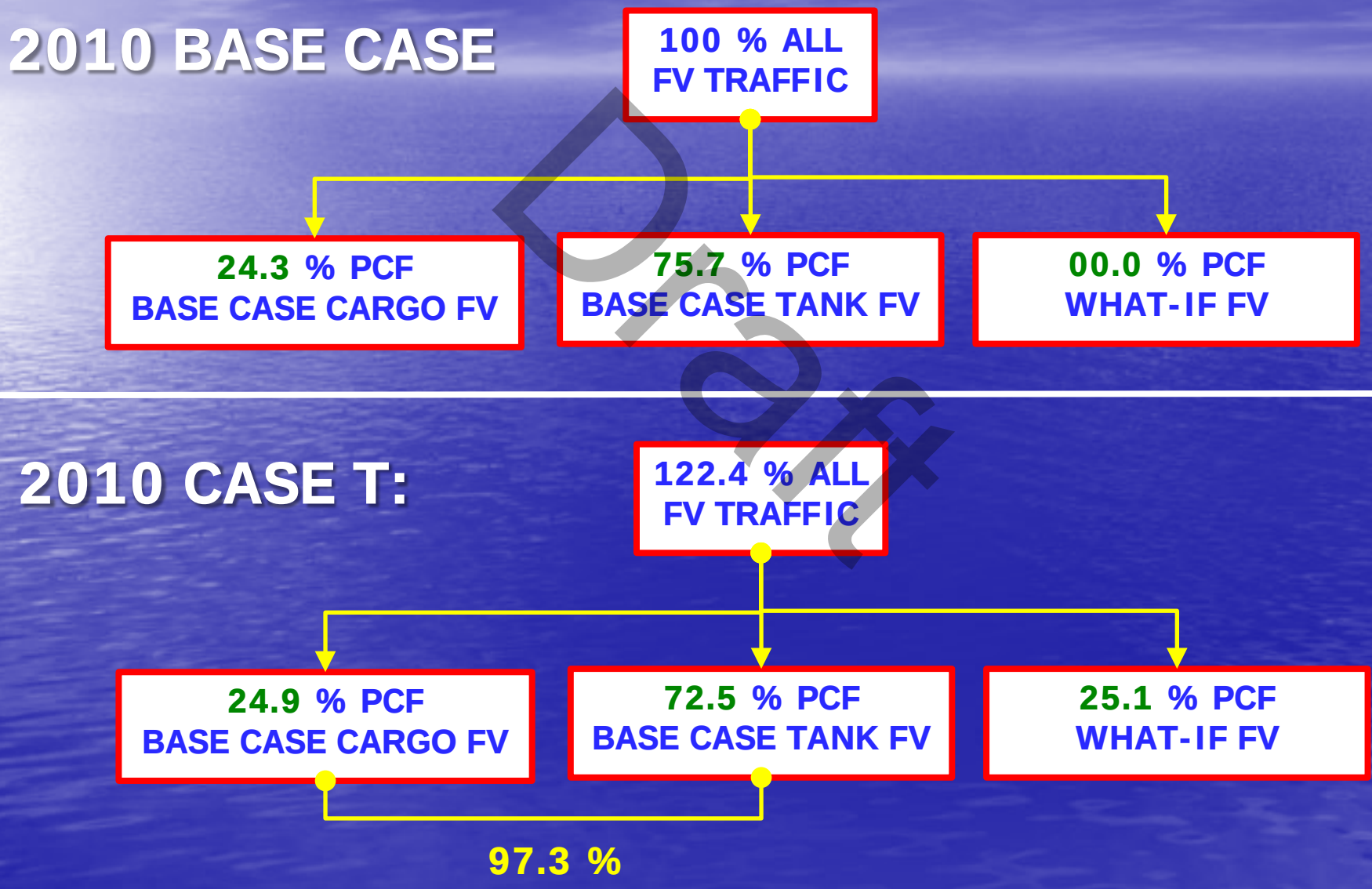
348 Kinder Morgan Tankers + Bunkering Barges

348 Delta Port Bulk Carriers + Bunkering Barges

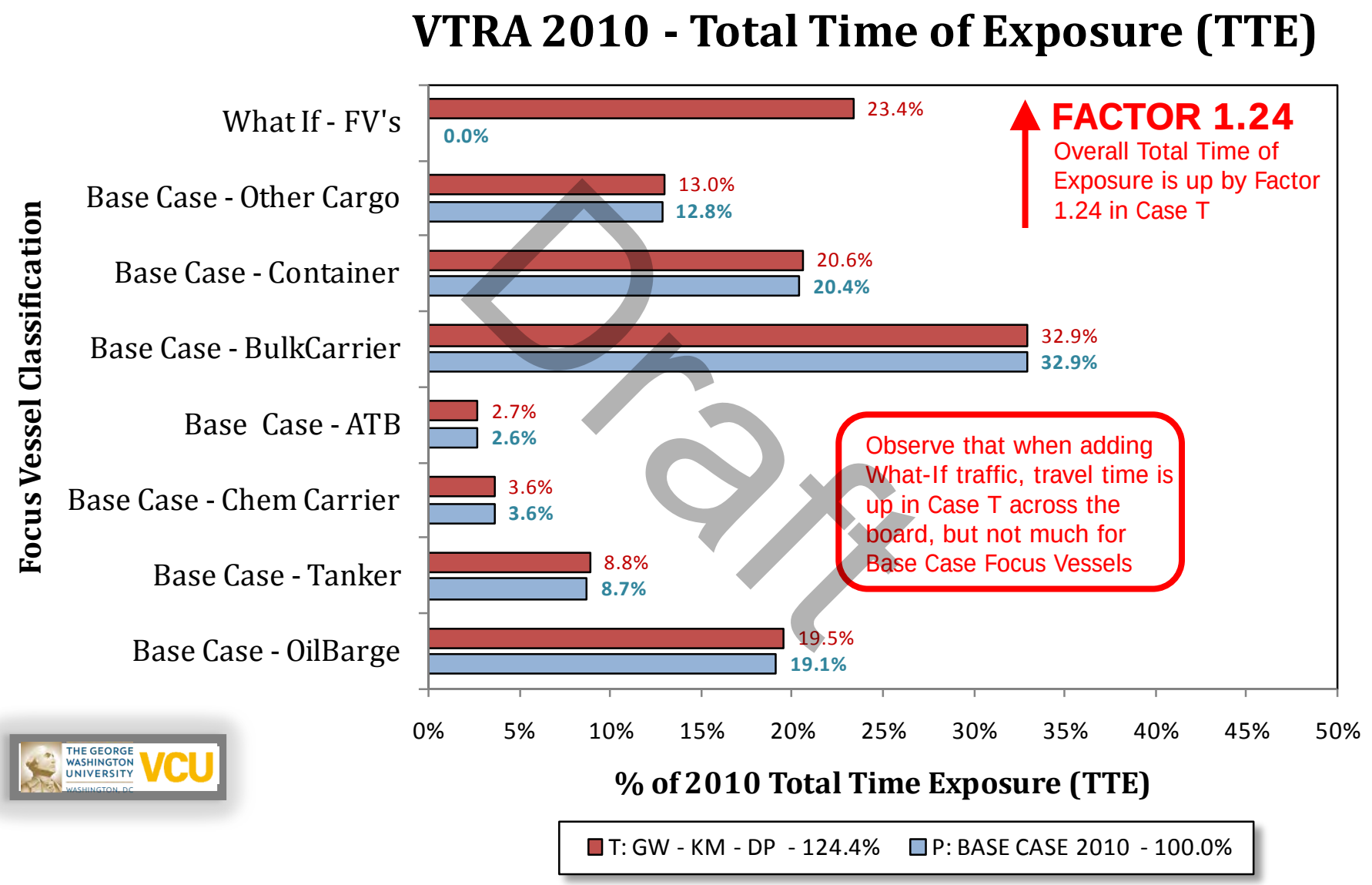
67 Delta Port Container Ships+ Bunkering Barges

A TAXONOMY OF 2010 FOCUS VESSEL POTENTIAL ANNUAL COLLISION FREQUENCY

PCF : POTENTIAL COLLISION FREQUENCY - PER YEAR



CASE T: GW 487, KM 348, DP 348 and 67:



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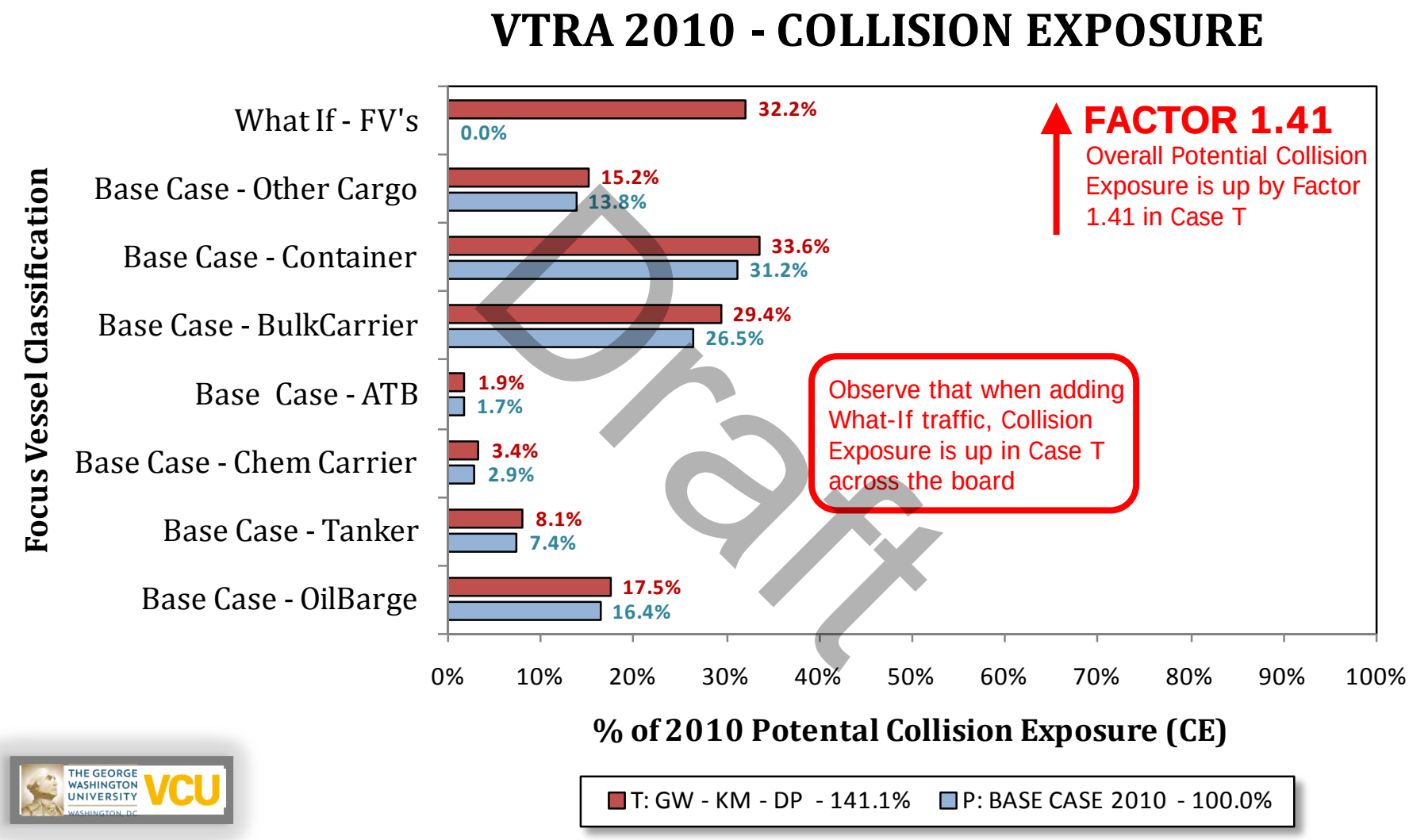
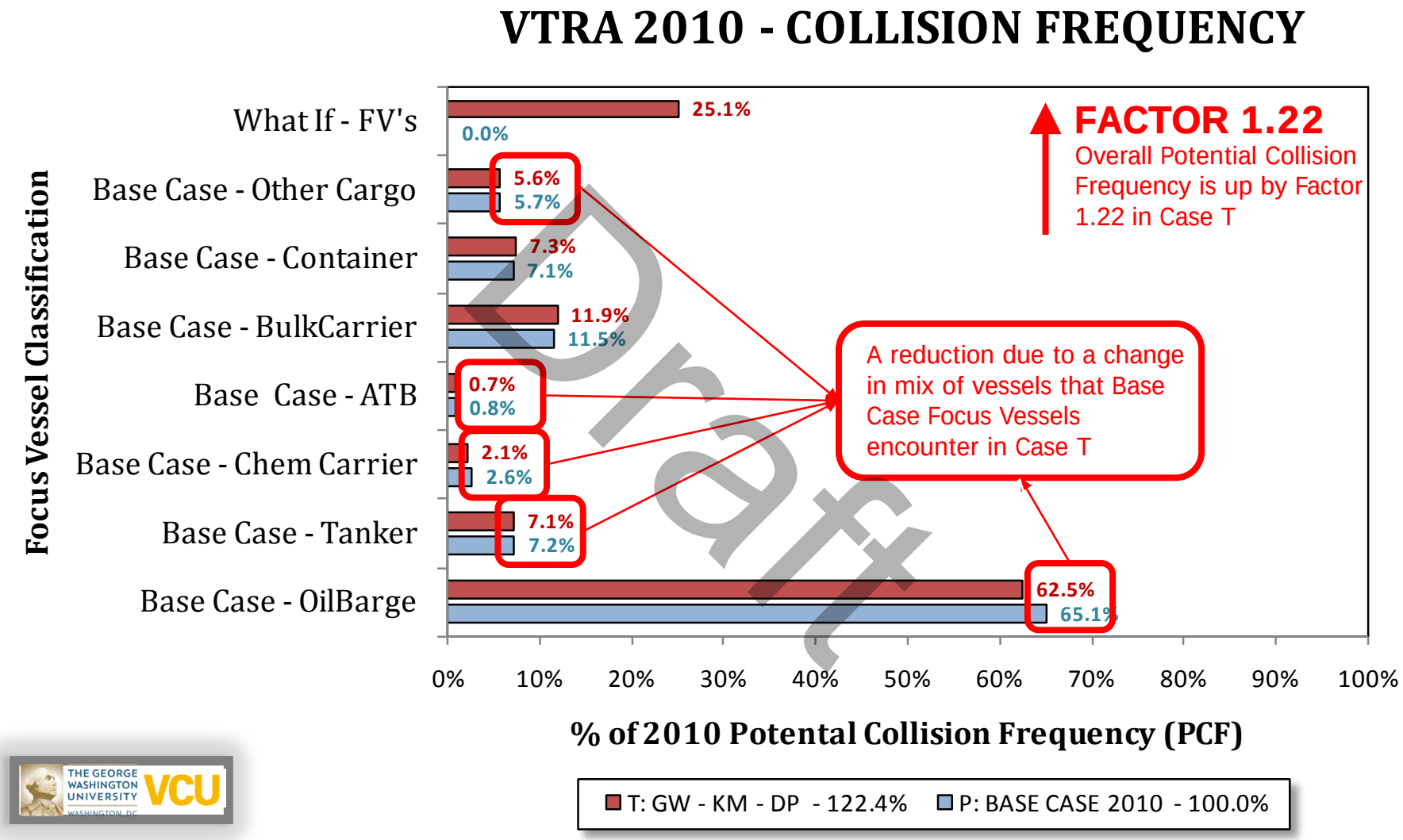
CASE T: GW 487, KM 348, DP 348 and 67:



CASE T: GW 487, KM 348, DP 348 and 67:



P: ALL FV POTENTIAL COLL. FREQUENCY (PCF)

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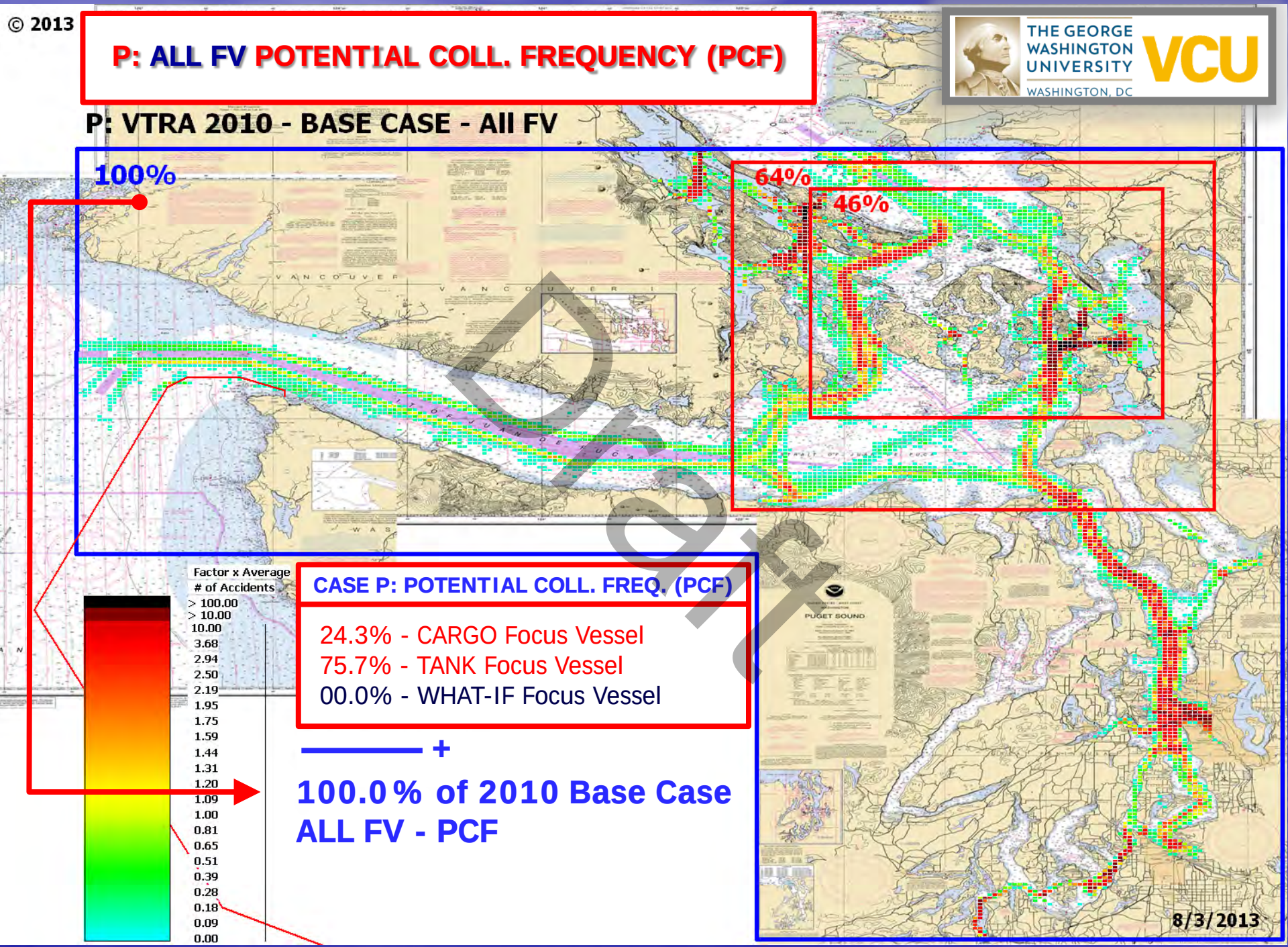
P: VTRA 2010 - BASE CASE - All FV



CASE P: POTENTIAL COLL. FREQ. (PCF)

24.3% - CARGO Focus Vessel
75.7% - TANK Focus Vessel
00.0% - WHAT-IF Focus Vessel

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100.0% of 2010 Base Case ALL FV - PCF

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T: ALL FV POTENTIAL COLL. FREQUENCY (PCF)

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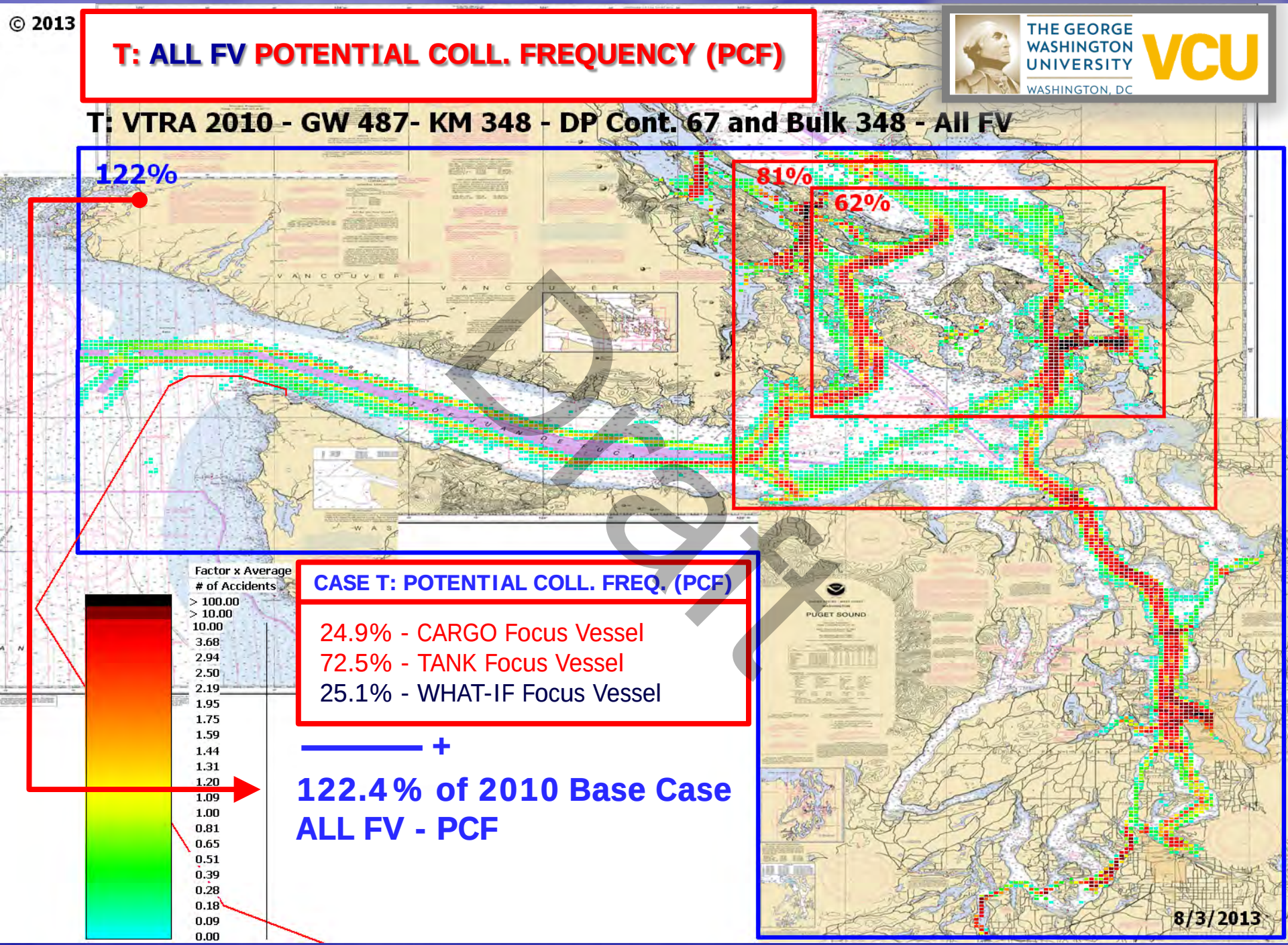
T: VTRA 2010 - GW 487- KM 348 - DP Cont. 67 and Bulk 348 - All FV



CASE T: POTENTIAL COLL. FREQ. (PCF)

24.9% - CARGO Focus Vessel
72.5% - TANK Focus Vessel
25.1% - WHAT-IF Focus Vessel

\+

122.4% of 2010 Base Case ALL FV - PCF

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T: WHAT-IF FV POTENTIAL COLLISION FREQUENCY (PCF)

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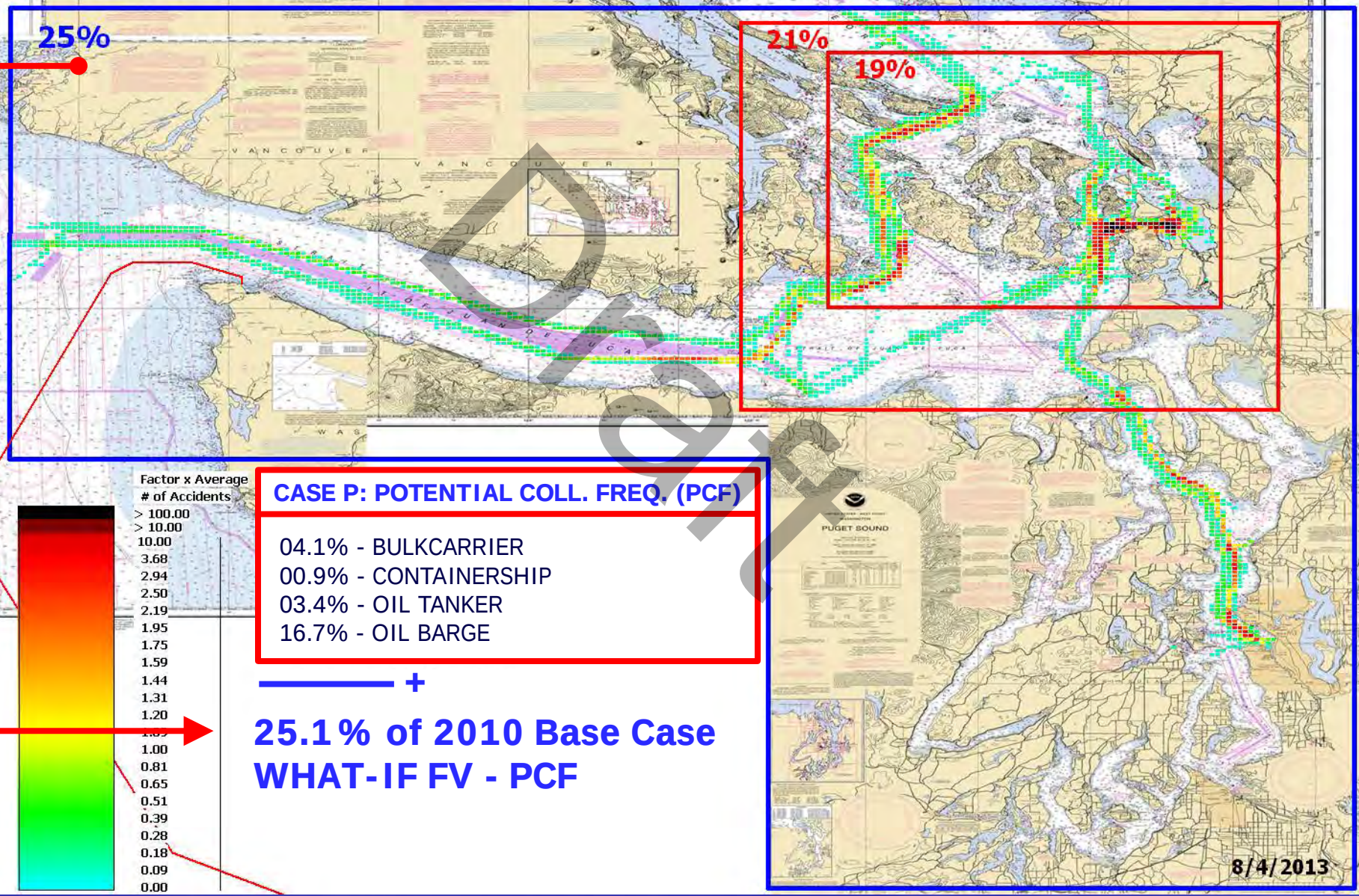
T: VTRA 2010 - GW 487- KM 348 - DP Cont. 67 and Bulk 348



CASE P: POTENTIAL COLL. FREQ. (PCF)

04.1% - BULKCARRIER
00.9% - CONTAINERSHIP
03.4% - OIL TANKER
16.7% - OIL BARGE

\+

25.1% of 2010 Base Case
WHAT-IF FV - PCF

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P: BASE CASE CARGO FV POTENTIAL COLLISION FREQUENCY (PCF)

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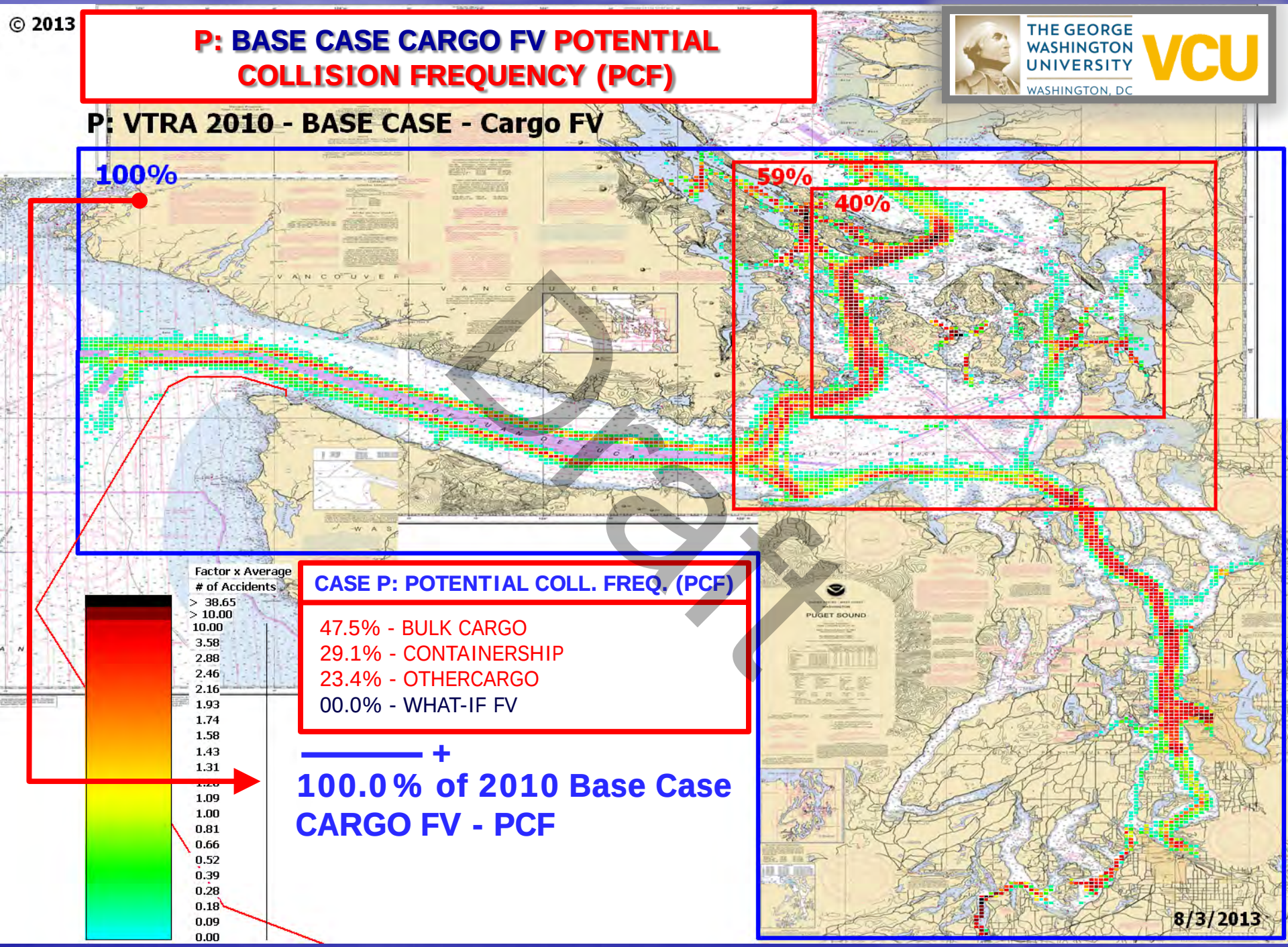
P: VTRA 2010 - BASE CASE - Cargo FV



CASE P: POTENTIAL COLL. FREQ. (PCF)

47.5% - BULK CARGO
29.1% - CONTAINERSHIP
23.4% - OTHERCARGO
00.0% - WHAT-IF FV

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100.0% of 2010 Base Case CARGO FV - PCF

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T: BASE CASE CARGO FV POTENTIAL COLLISION FREQUENCY (PCF)

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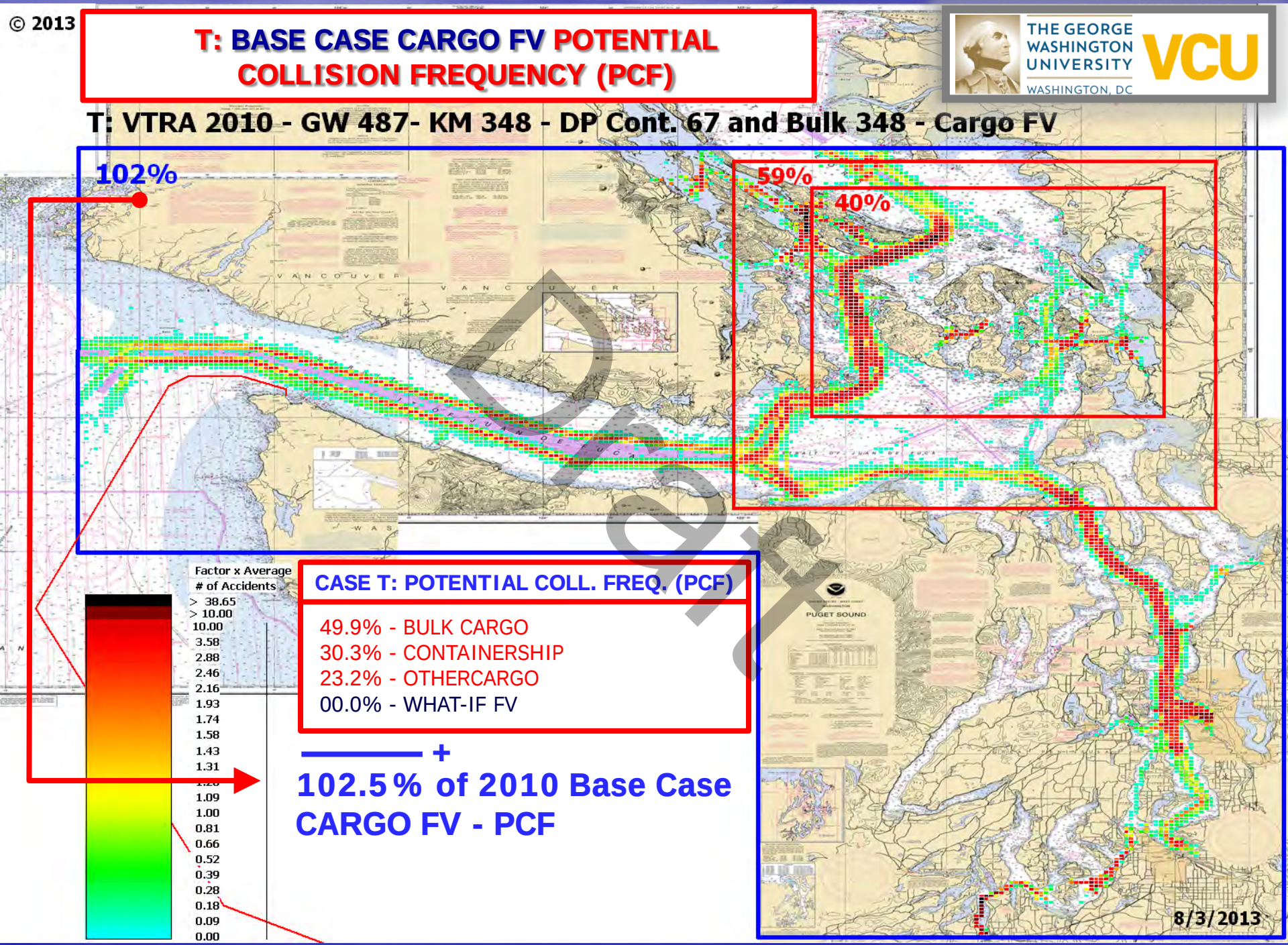
T: VTRA 2010 - GW 487- KM 348 - DP Cont. 67 and Bulk 348 - Cargo FV



CASE T: POTENTIAL COLL. FREQ. (PCF)

49.9% - BULK CARGO
30.3% - CONTAINERSHIP
23.2% - OTHERCARGO
00.0% - WHAT-IF FV

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102.5% of 2010 Base Case CARGO FV - PCF

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P: BASE CASE TANK FV POTENTIAL COLLISION FREQUENCY (PCF)

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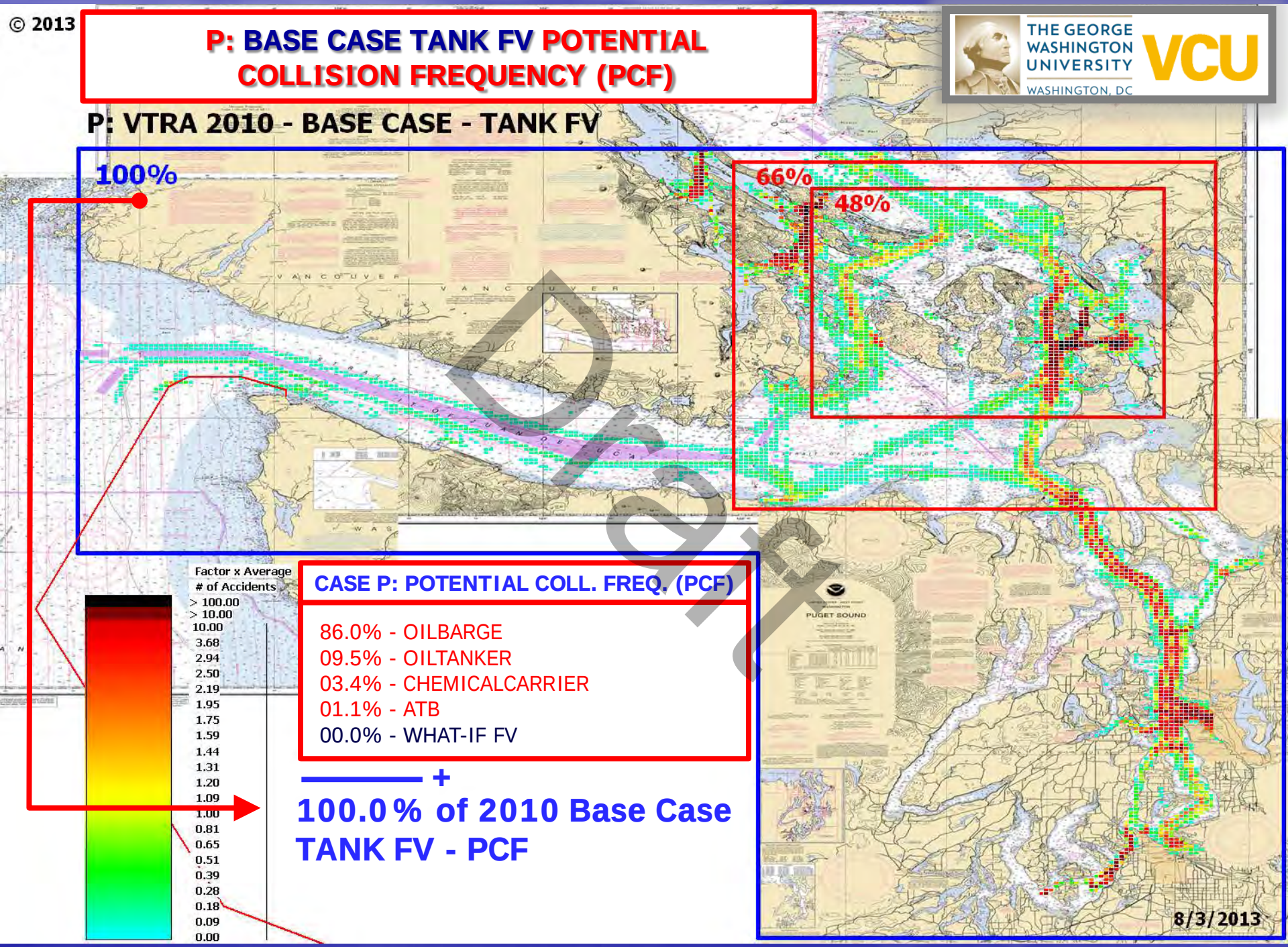
P: VTRA 2010 - BASE CASE - TANK FV



CASE P: POTENTIAL COLL. FREQ. (PCF)

86.0% - OILBARGE
09.5% - OILTANKER
03.4% - CHEMICALCARRIER
01.1% - ATB
00.0% - WHAT-IF FV

\+

100.0% of 2010 Base Case TANK FV - PCF

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T: BASE CASE TANK FV POTENTIAL COLLISION FREQUENCY (PCF)

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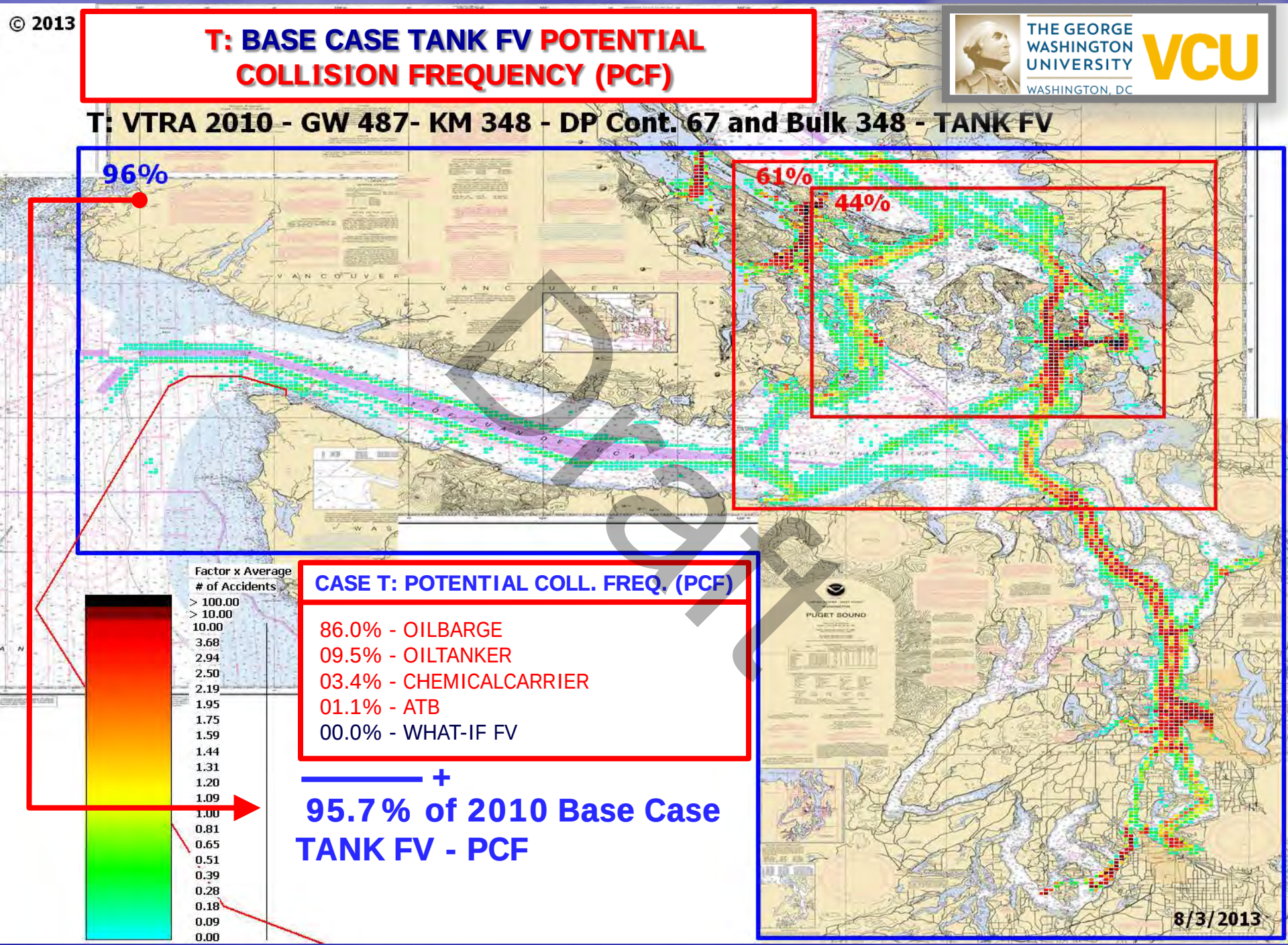
T: VTRA 2010 - GW 487- KM 348 - DP Cont. 67 and Bulk 348 - TANK FV



CASE T: POTENTIAL COLL. FREQ. (PCF)

86.0% - OILBARGE
09.5% - OILTANKER
03.4% - CHEMICALCARRIER
01.1% - ATB
00.0% - WHAT-IF FV

\+

95.7% of 2010 Base Case TANK FV - PCF

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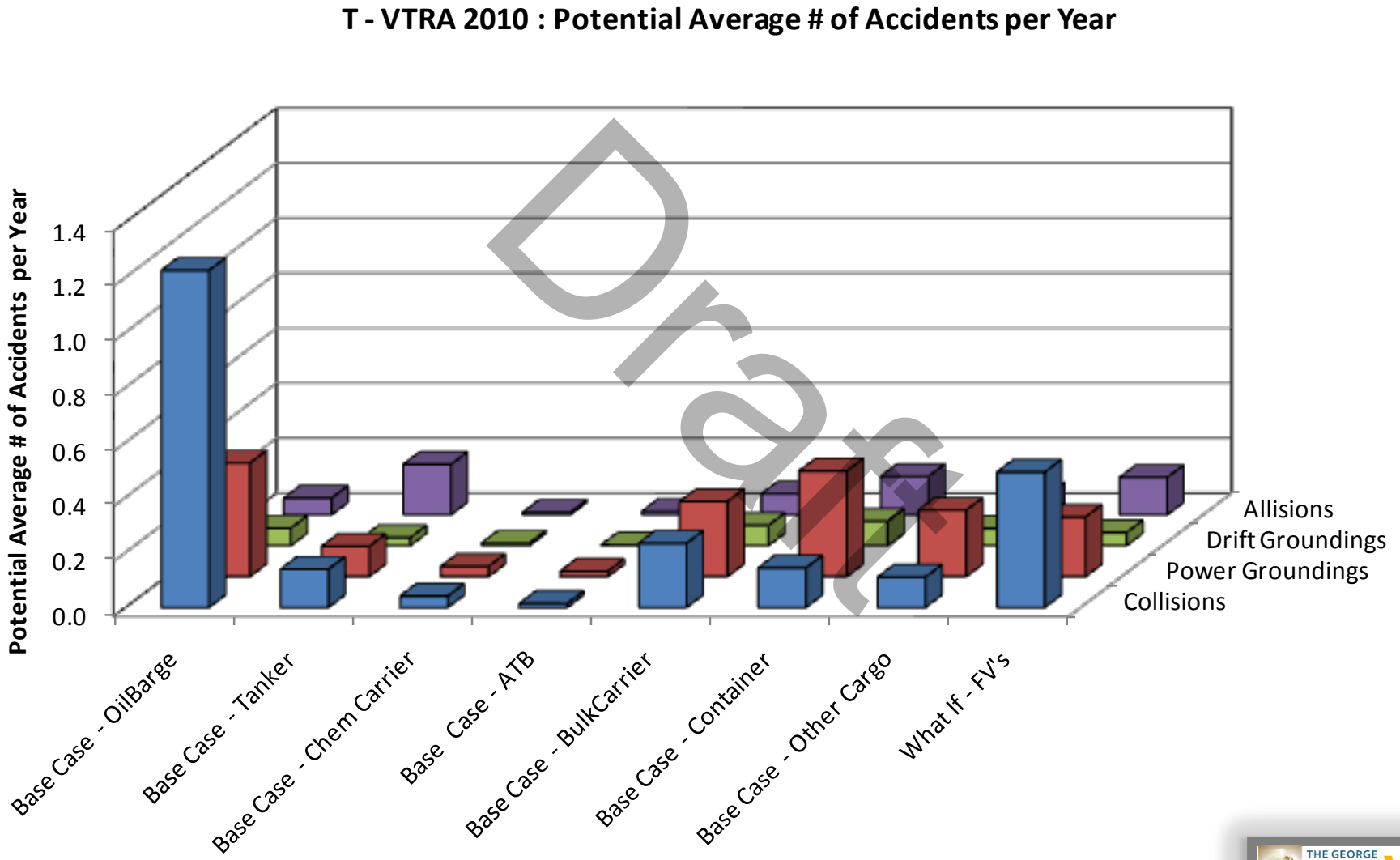
A TAXONOMY OF 2010 FOCUS VESSEL POTENTIAL ACCIDENT FREQUENCY AND ACCIDENT TYPE

CASE T: GW 487, KM 348, DP 348 and 67:



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CASE T: GW 487, KM 348, DP 348 and 67:

T - VTRA 2010 : Potential Average # of Accidents per Year

Focus Vessel	Collisions	Power Groundings	Drift Groundings	Allisions	Total
Base Case - OilBarge	62.5%	27.9%	19.4%	11.1%	40.8%
Base Case - Tanker	7.1%	7.4%	8.8%	33.5%	10.7%
Base Case - Chem Carrier	2.1%	2.5%	3.0%	1.6%	2.3%
Base Case - ATB	0.7%	1.3%	0.8%	2.4%	1.2%
Base Case - All Tank FV's	72.5%	39.1%	32.0%	48.5%	54.9%
Base Case - BulkCarrier	11.9%	18.4%	22.5%	13.9%	15.2%
Base Case - Container	7.3%	25.9%	27.0%	25.5%	17.5%
Base Case - Other Cargo	5.6%	16.3%	19.0%	13.3%	11.3%
Base Case - All Cargo FV's	24.9%	60.6%	68.5%	52.8%	44.0%
Base Case - All FV's	97.3%	99.7%	100.5%	101.3%	98.9%
What If - FV's	25.1%	14.6%	14.5%	24.8%	20.7%
Total - Base Case + What- IF	122.4%	114.3%	115.0%	126.1%	119.5%

T - VTRA 2010 : Potential Average # of Accidents per Year

Focus Vessel	Collisions	Power Groundings	Drift Groundings	Allisions	Total
Base Case - OilBarge	1.23	0.41	0.06	0.06	1.76
Base Case - Tanker	0.14	0.11	0.03	0.18	0.46
Base Case - Chem Carrier	0.04	0.04	0.01	0.01	0.10
Base Case - ATB	0.01	0.02	0.00	0.01	0.05
Base Case - All Tank FV's	1.42	0.58	0.10	0.27	2.37
Base Case - BulkCarrier	0.23	0.27	0.07	0.08	0.66
Base Case - Container	0.14	0.38	0.09	0.14	0.76
Base Case - Other Cargo	0.11	0.24	0.06	0.07	0.49
Base Case - All Cargo FV's	0.49	0.90	0.22	0.29	1.90
Base Case - All FV's	1.91	1.48	0.33	0.55	4.27
What If - FV's	0.49	0.22	0.05	0.14	0.89
Total - Base Case + What- IF	2.40	1.69	0.38	0.69	5.16