



Port Gardner Regional Background

Phase II Supplemental Sampling

Data Workshop

September 8, 2014

Goals For Today

- Provide a brief overview of the regional background work in Port Gardner Bay – bit of history for context.
- Present the data and analysis results.
- Provide information on time line for completing the work and next steps.
- Answer any questions.
- Discuss your thoughts about our data analysis approach and any identified errors or technical issues with the data and / or data analysis.

Acknowledgements

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Why We Conducted Supplemental Sampling

- Port Gardner is essentially our “pilot” embayment – it was our first attempt at establishing regional background.
- Your comments and feedback helped us refine the sampling framework and design as well as the intent and SMS rule definition of regional background.
- We want to get this right to see how the lessons learned can be applied to future regional background work, with the acknowledgement that bay or area specific flexibility is necessary.

Phase II - Revisions



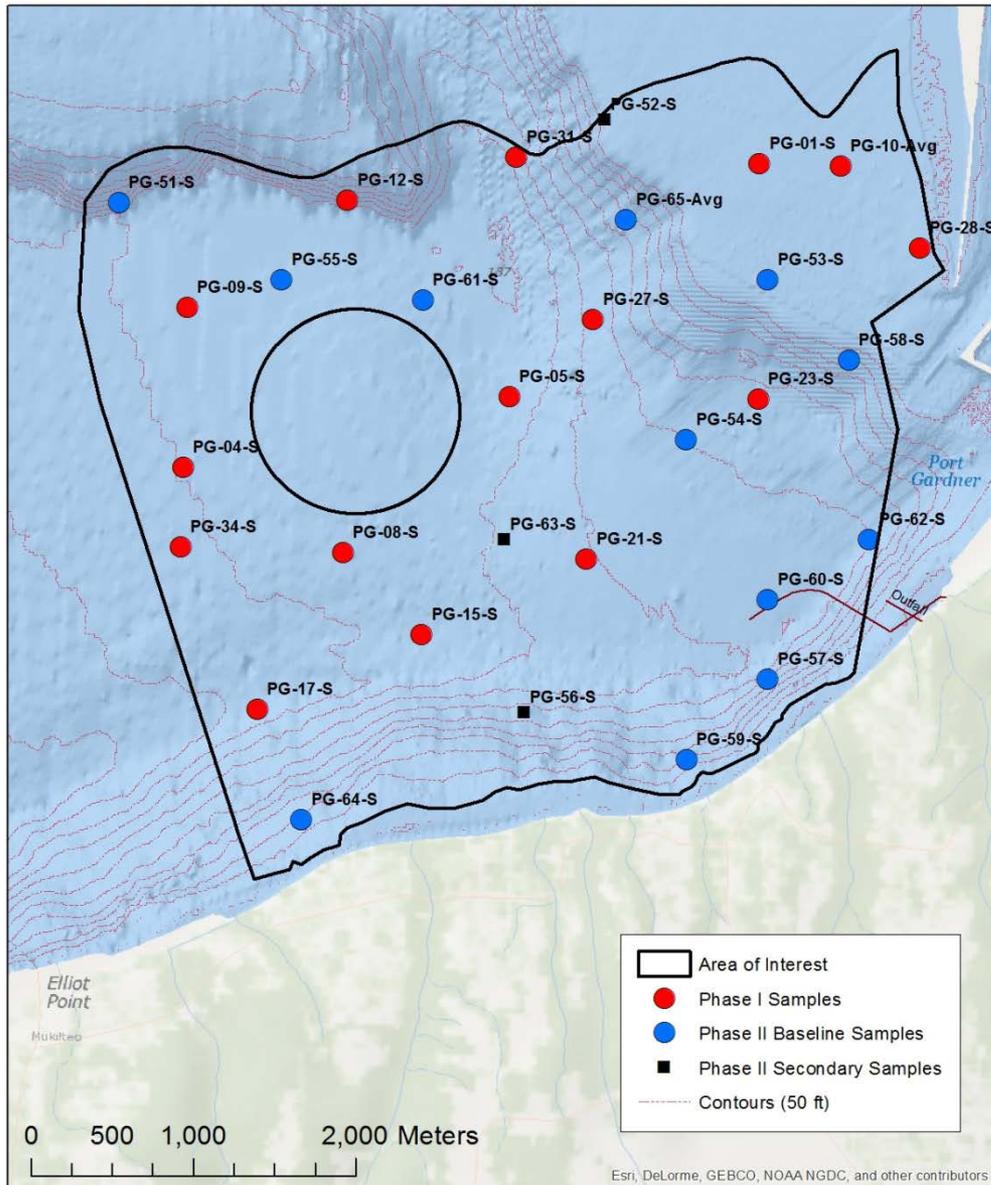
In 2013, Phase I sampling included (white dotted outline):

- 25 baseline & 25 secondary stations.

In 2014, Phase II sampling included (yellow outline):

- Additional stations in the nearshore areas to be more representative of regional background.
- Exclusion of stations from the Phase I Area of Interest not considered representative of regional background:
 - From the Snohomish Delta
 - From the NW corner of the Phase I AOI

Phase II Study Design

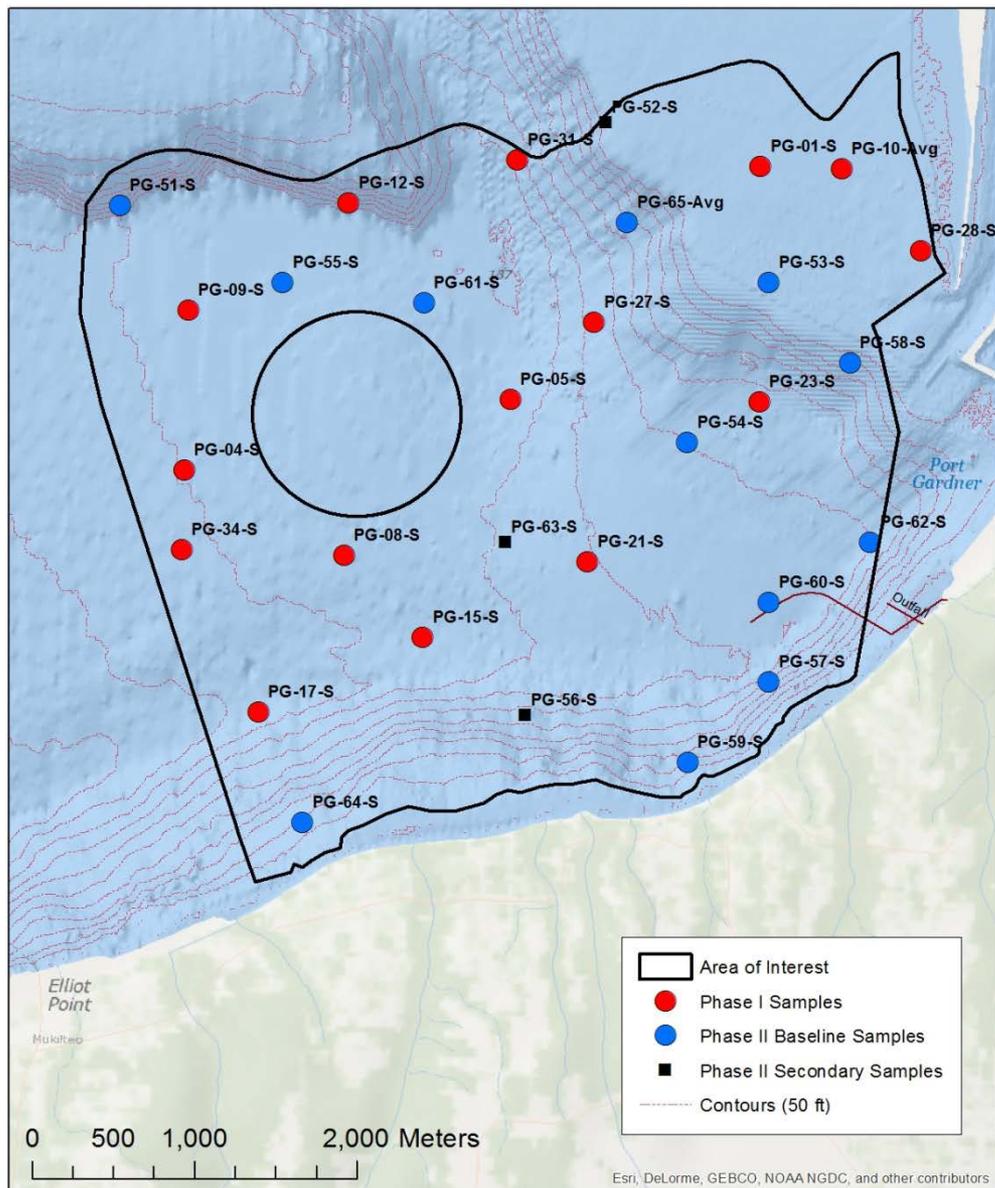


The Phase II regional background data set is a mixture of Phase I (2013) and new Phase II (2014) stations.

Samples analyzed for the full suite of CoCs:

- 11 baseline samples from Phase I.
- 4 secondary samples from Phase I.
- 12 baseline samples from Phase II.
- Samples only analyzed for mercury:
 - 3 secondary samples - Phase II.
 - Phase I secondary mercury samples excluded because not all locations met the minimum distance criteria.

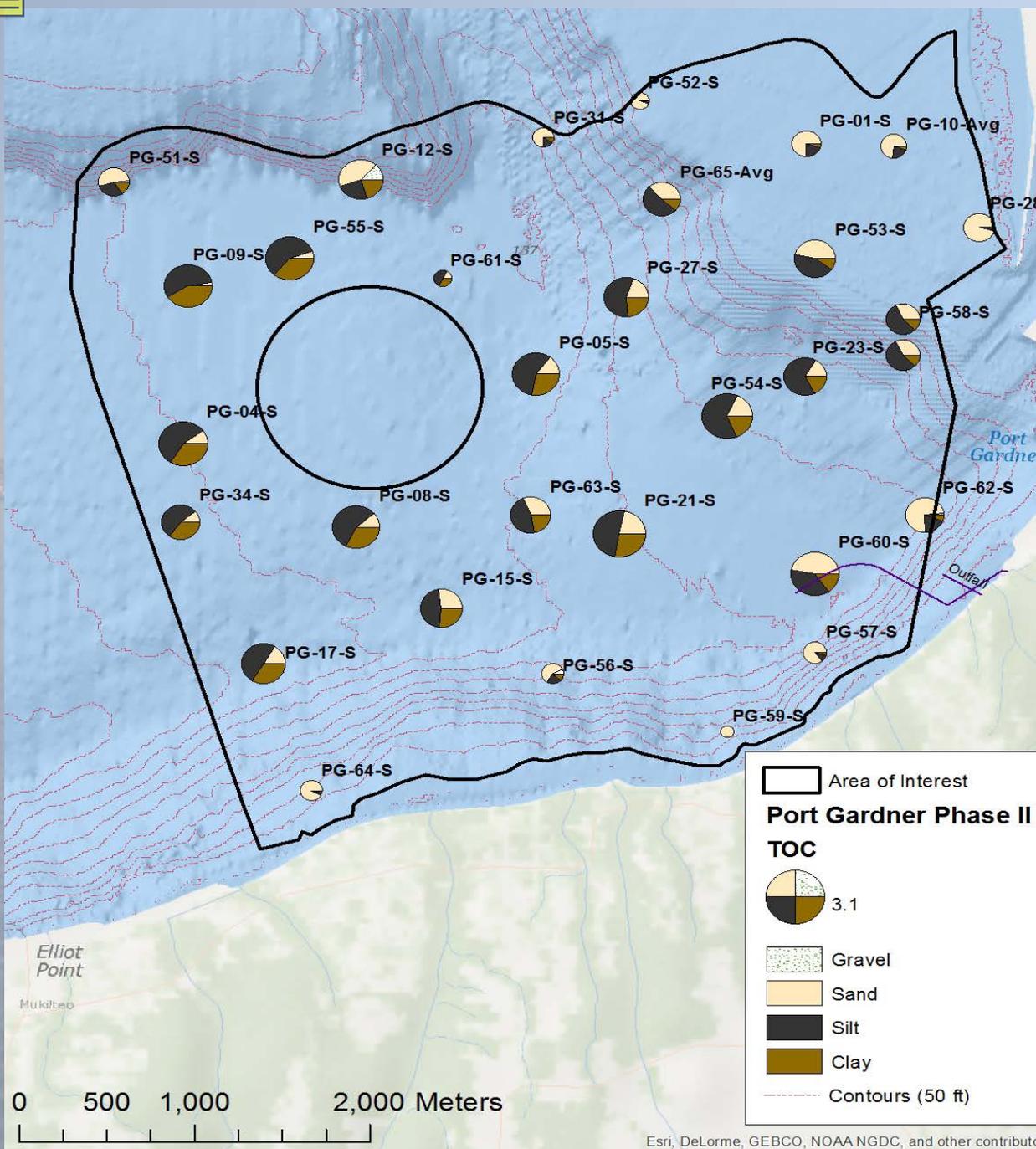
Chemistry Data Observations



- Lowest concentrations were observed along the shoreline and in the delta.
- Chemical concentrations were generally correlated with fines.
- Higher-concentration stations were randomly distributed within deeper, finer-grained areas – indicative of a single distribution without strong trends or source/site influences.

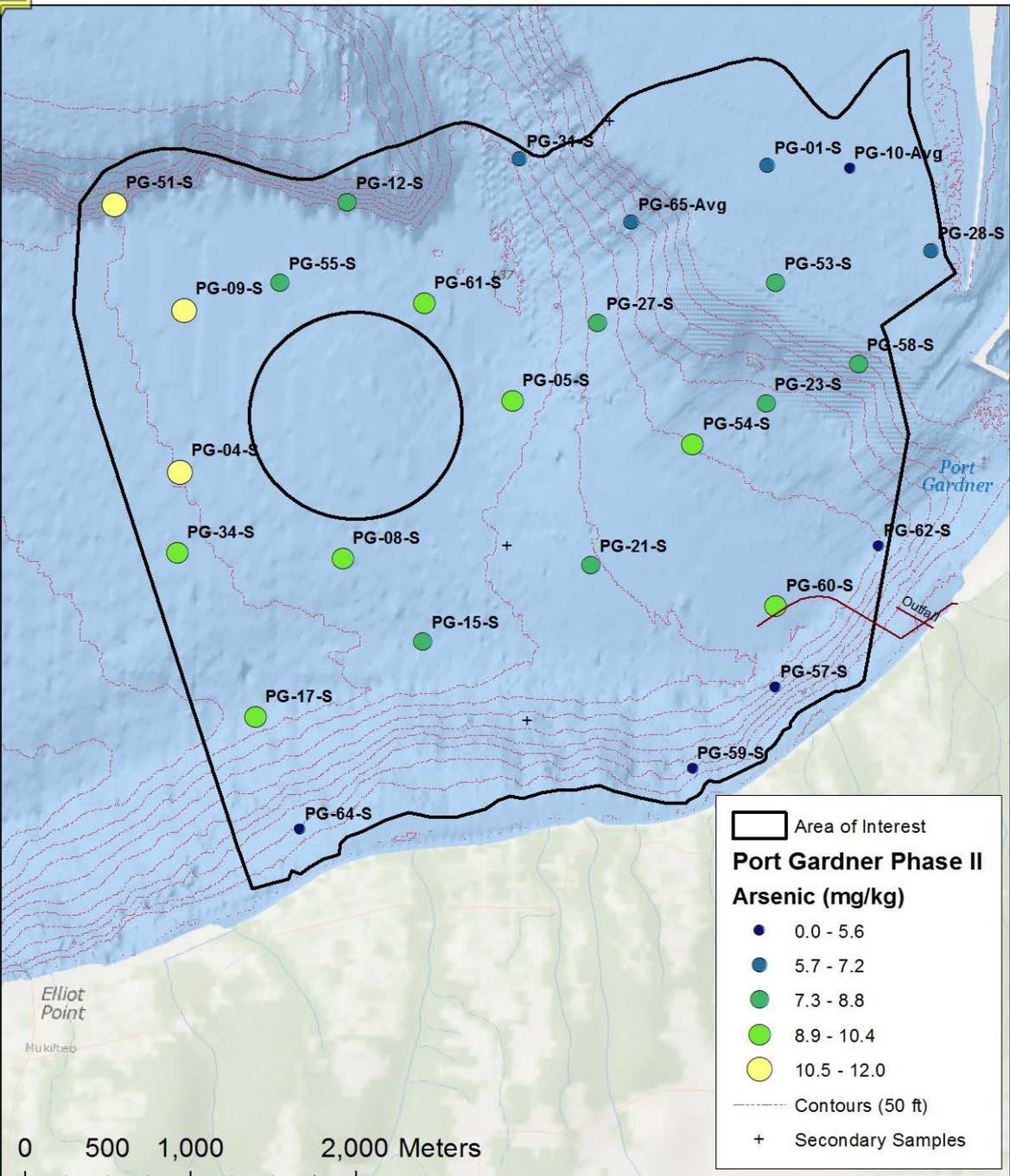
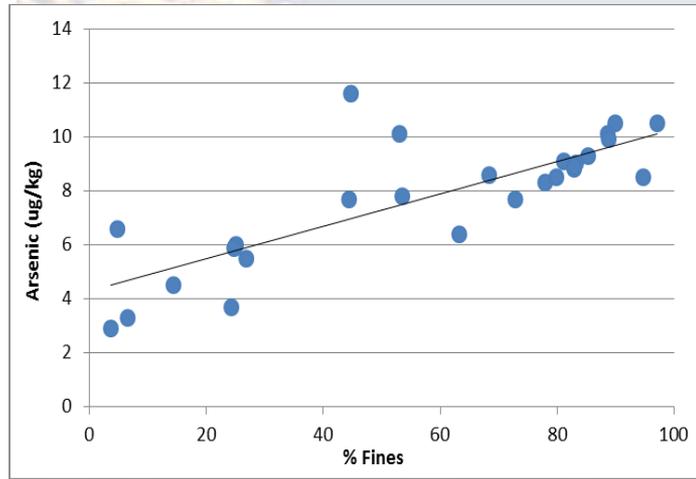
Percent Fines/TOC

- Fines (4 % to 97%)
- Sandy/low TOC sediments were present near the Snohomish River Delta and the SE nearshore area.
- Deeper samples typically had higher TOC.



Arsenic

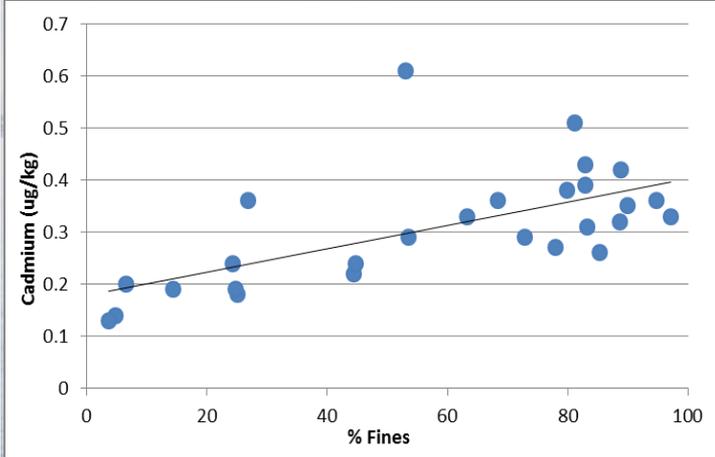
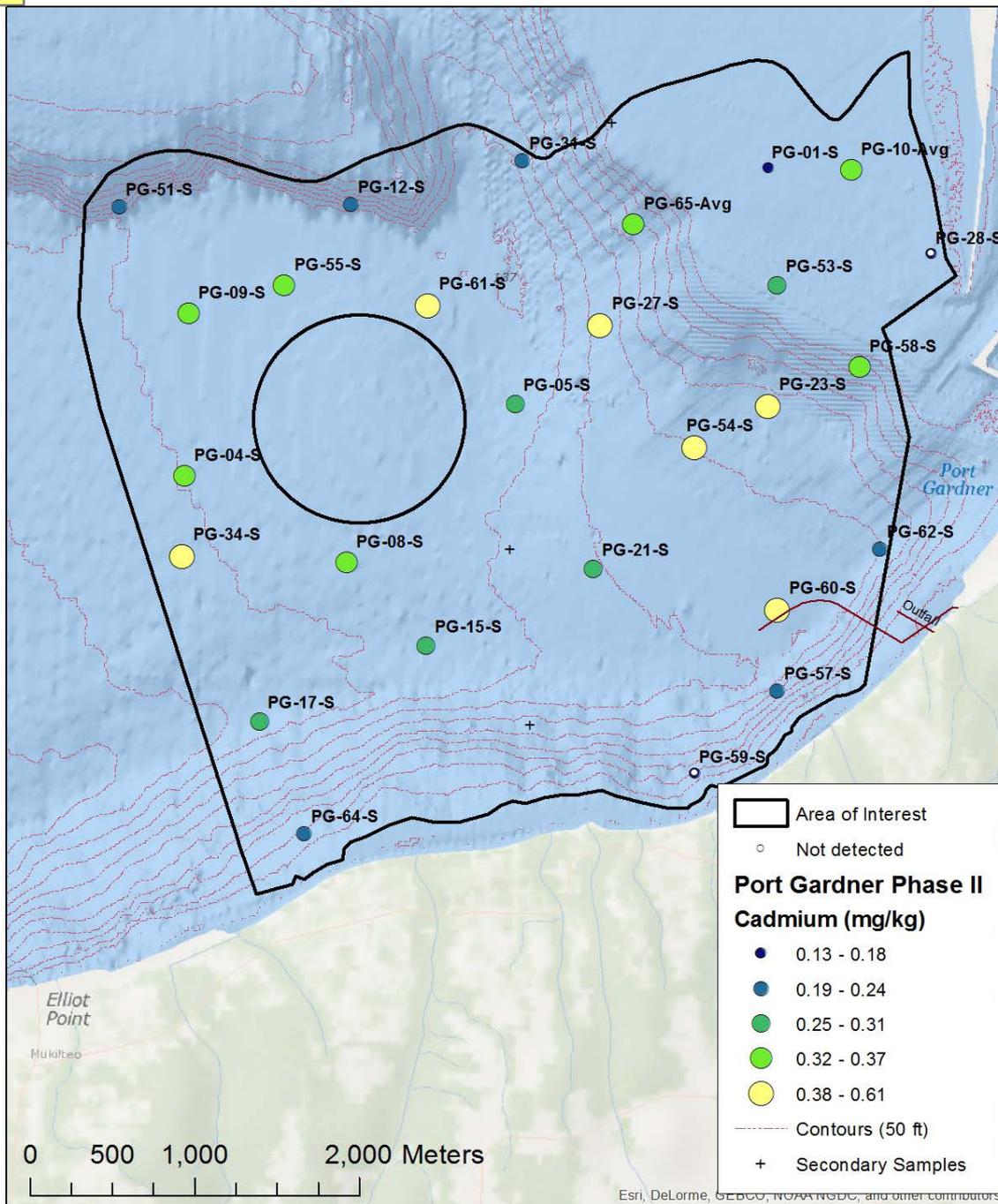
- Correlation w/ fines:
 - r-value = 0.800
- Correlation w/ TOC:
 - r-value = 0.635



	Arsenic
	mg/kg DW
Summary Statistics	
Sample Size	27
Minimum	2.9
Average	7.8
Median	8.5
Maximum	11.6

Cadmium

- Correlation w/ fines:
 - r-value = 0.628
- Correlation w/ TOC:
 - r-value = 0.519

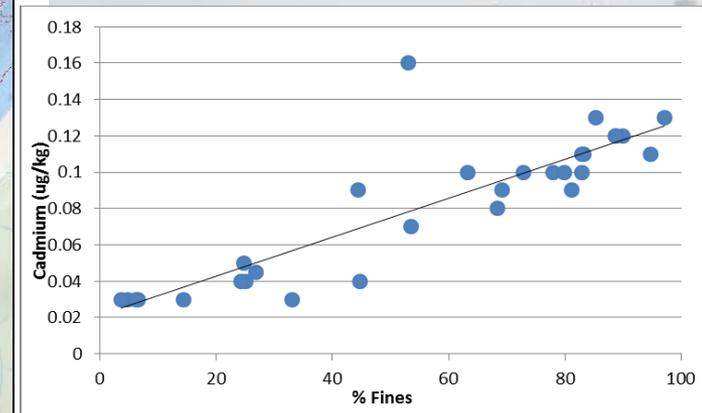
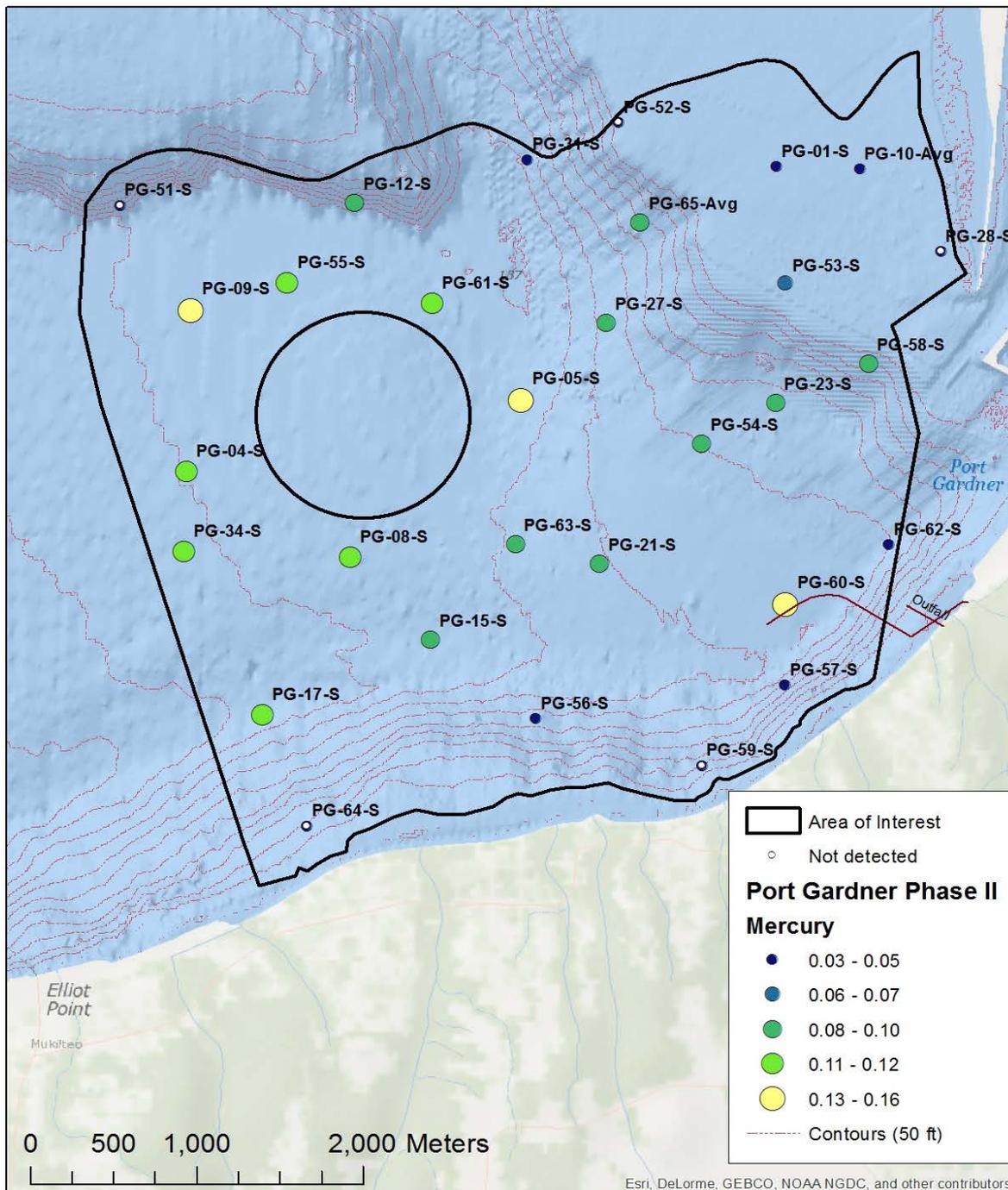


	Cadmium
	mg/kg DW
Summary Statistics	
Sample Size	27
Minimum	0.13
Average	0.31
Median	0.31
Maximum	0.61

Esri, DeLorme, GEBCO, NOAA/NGDC, and other contributors

Mercury

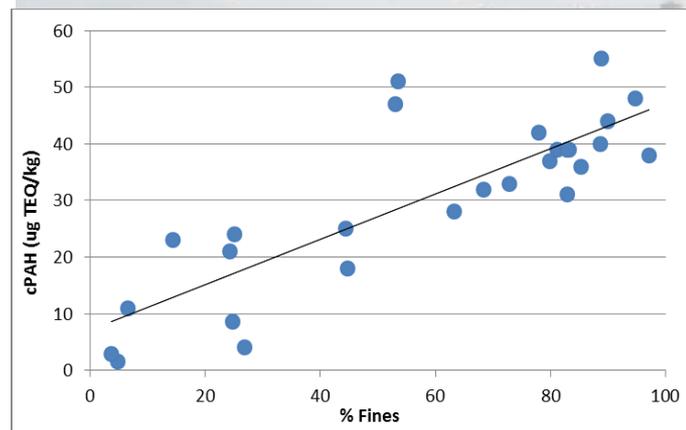
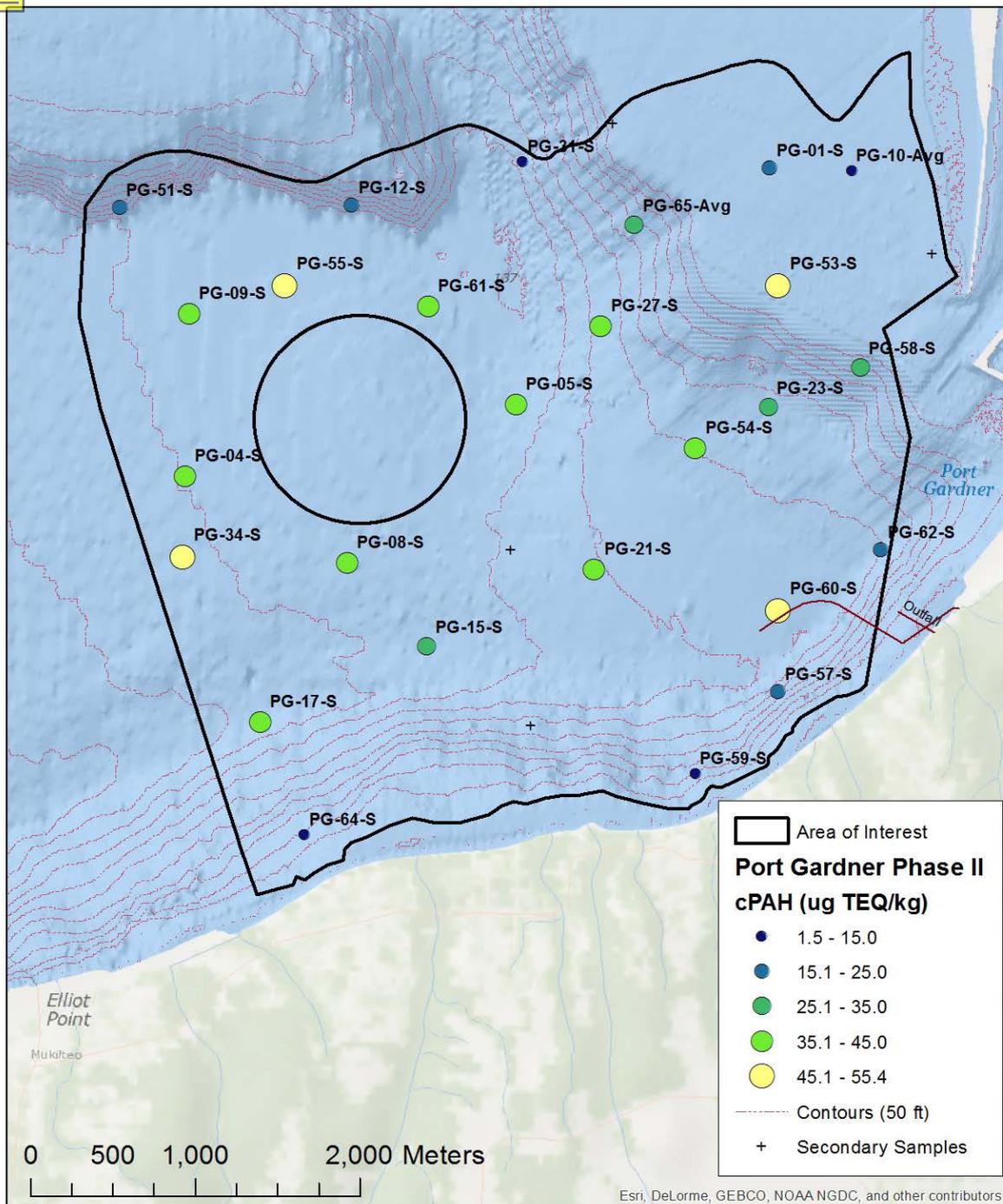
- Correlation w/fines:
 - r-value = 0.871
- Correlation w/TOC:
 - r-value = 0.778



	Mercury
	mg/kg DW
Summary Statistics	
Sample Size	30
Minimum	0.030
Average	0.081
Median	0.090
Maximum	0.16

Carcinogenic PAH TEQ

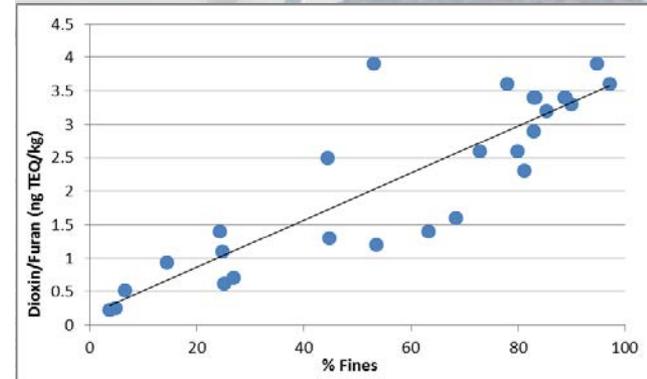
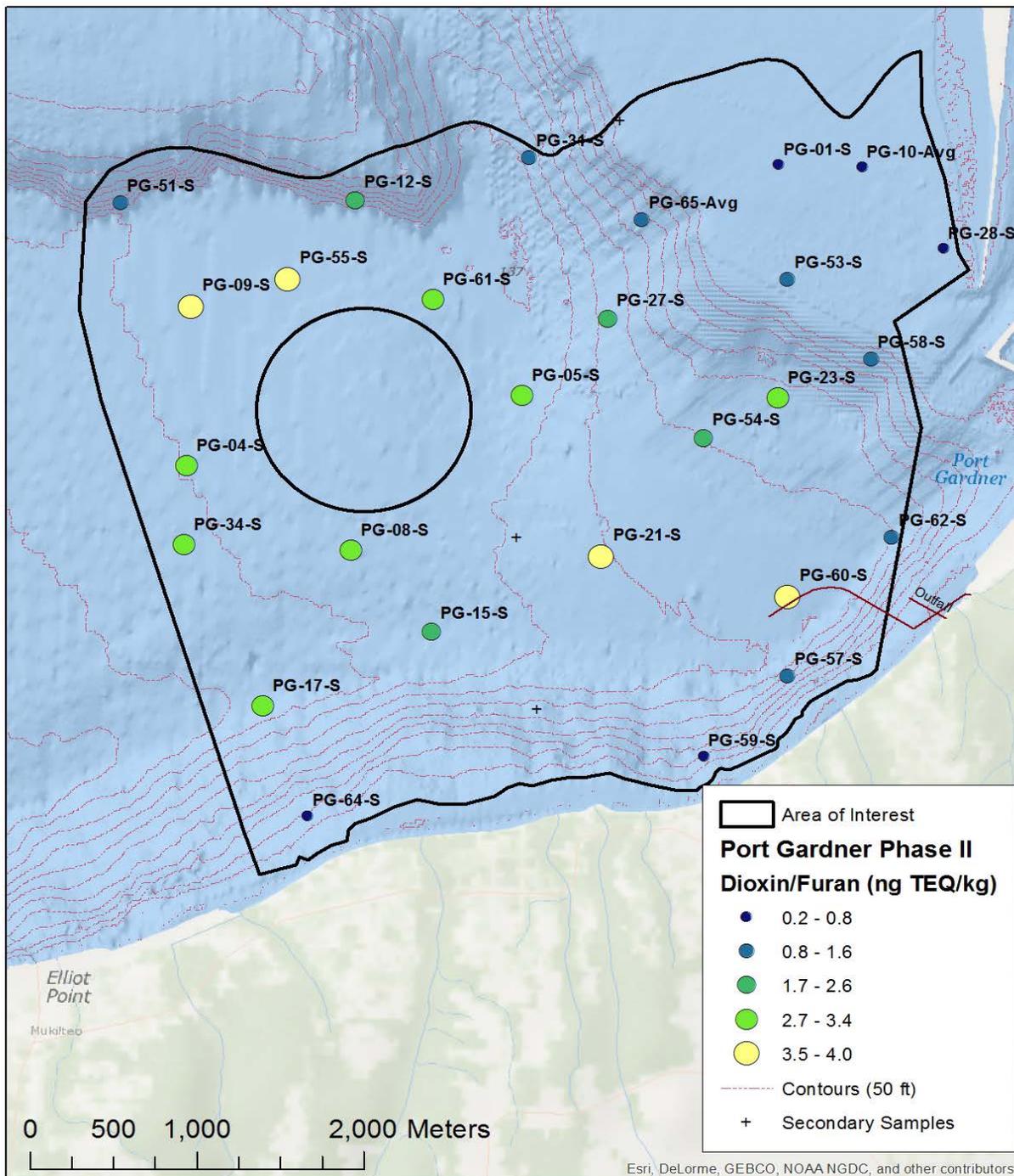
- Correlation w/ fines:
 - r-value = 0.831
- Correlation w/ TOC:
 - r-value = 0.712



	cPAH TEQ
	µg/kg
Summary Statistics	
Sample Size	27
Minimum	1.5
Average	30
Median	33
Maximum	55

Dioxin/Furan TEQ

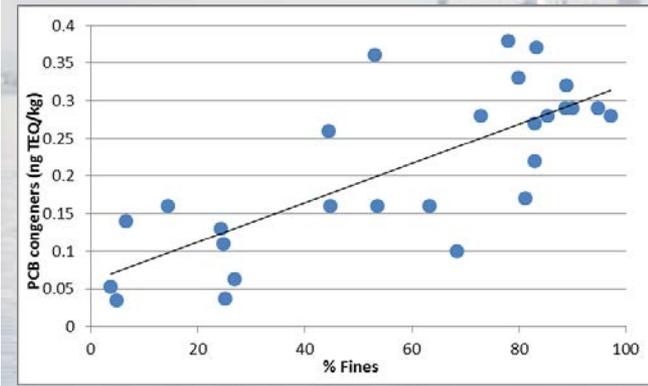
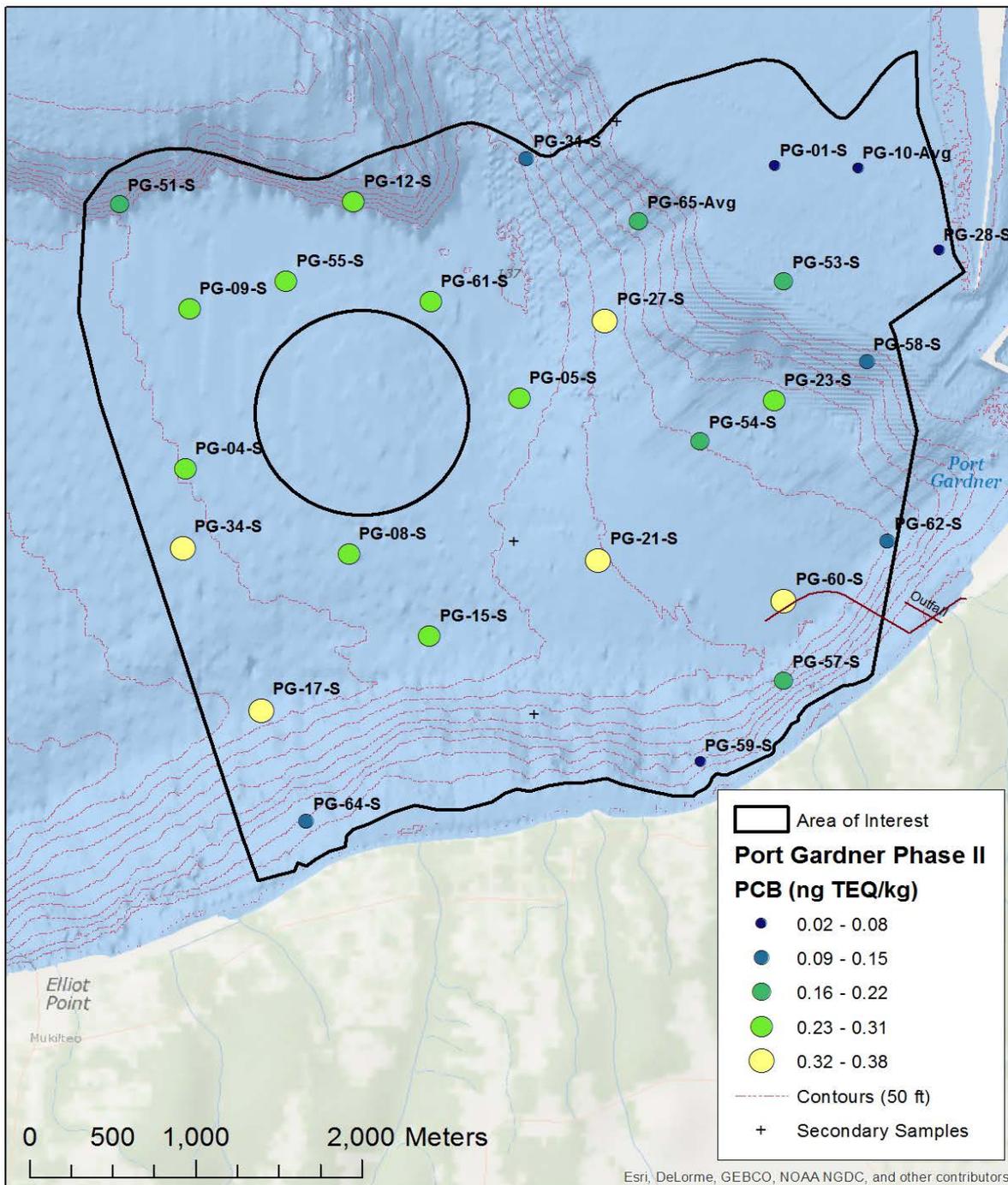
- Correlation w/fines:
 - r-value = 0.879
- Correlation w/ TOC:
 - r-value = 0.782



Location ID	D/F TEQ
Units	ng/kg
Summary Statistics	
Sample Size	27
Minimum	0.23
Average	2.2
Median	2.5
Maximum	3.9

PCB Congener TEQ

- Correlation w/fines:
 - r-value = 0.764
- Correlation w/ TOC:
 - r-value = 0.749

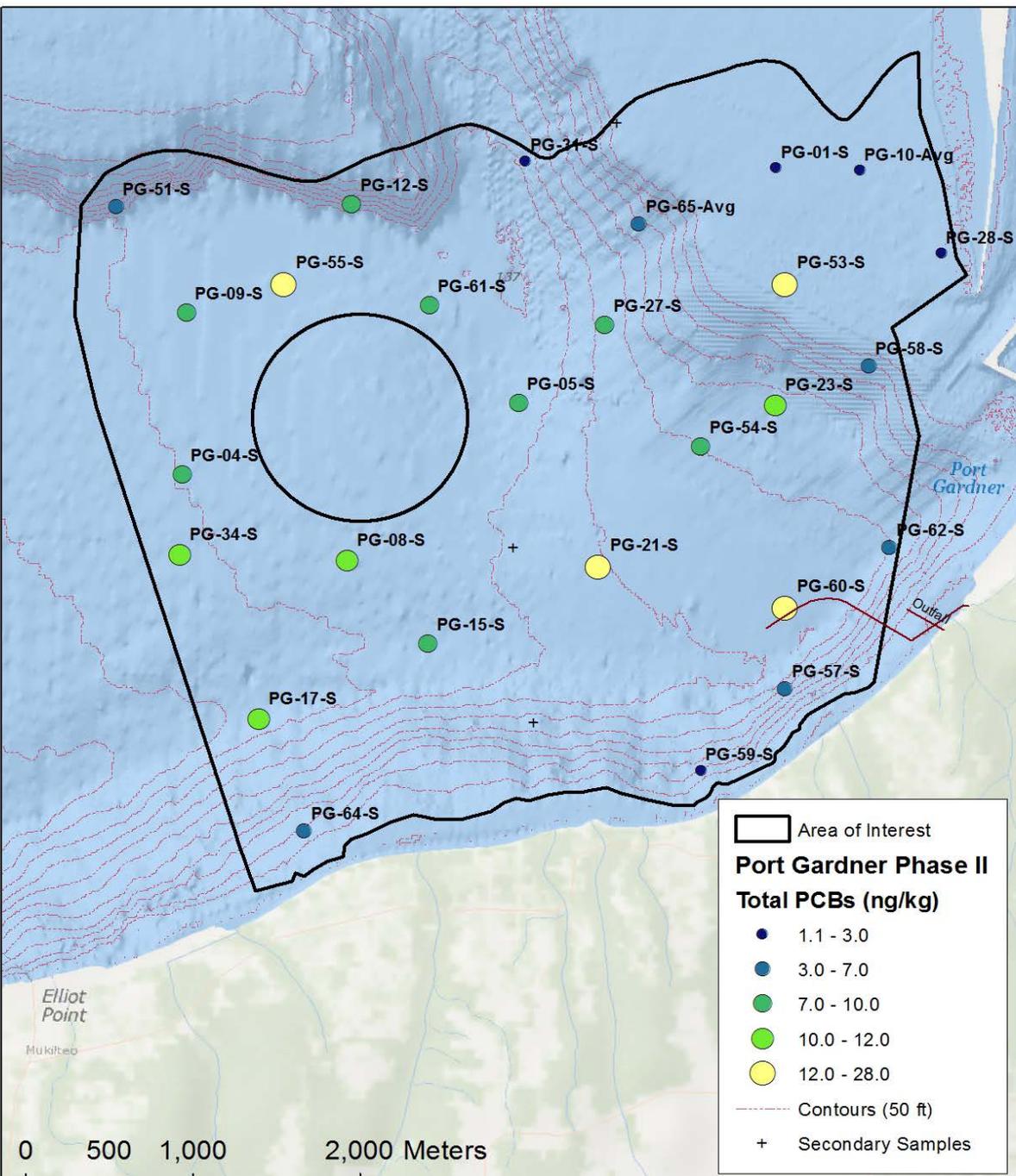
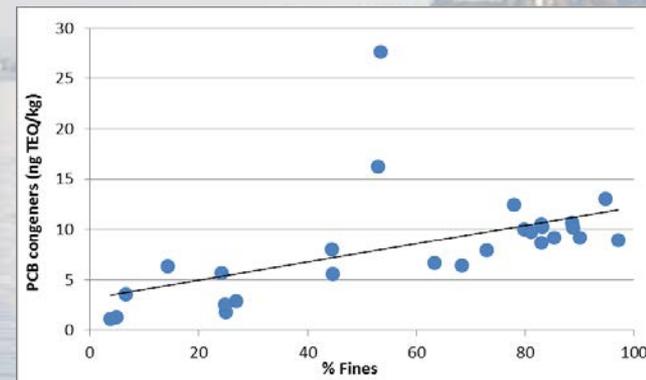


	PCB TEQ
	ng/kg
Summary Statistics	
Sample Size	27
Minimum	0.035
Average	0.20
Median	0.16
Maximum	0.38

Total PCBs

(sum of detected congeners)

- Correlation w/fines:
 - r-value = 0.525
- Correlation w/TOC:
 - r-value + 0.597



	Total PCBs
	µg/kg
Summary Statistics	
Sample Size	27
Minimum	1.13
Average	8.37
Median	8.65
Maximum	27.6

Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors



Statistical Analysis of Results

Lorraine Read

TerraStat Consulting Group

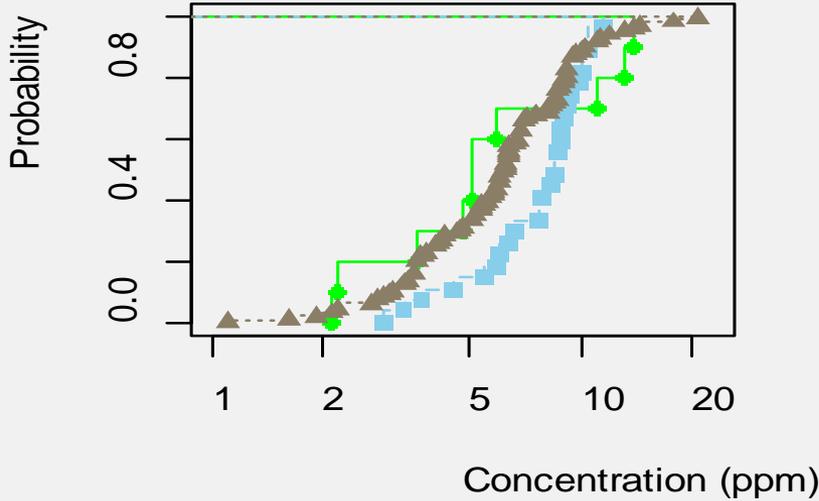
Statistical Analysis of Results

The results were evaluated using Empirical Cumulative Distribution Functions (ECDF) plots:

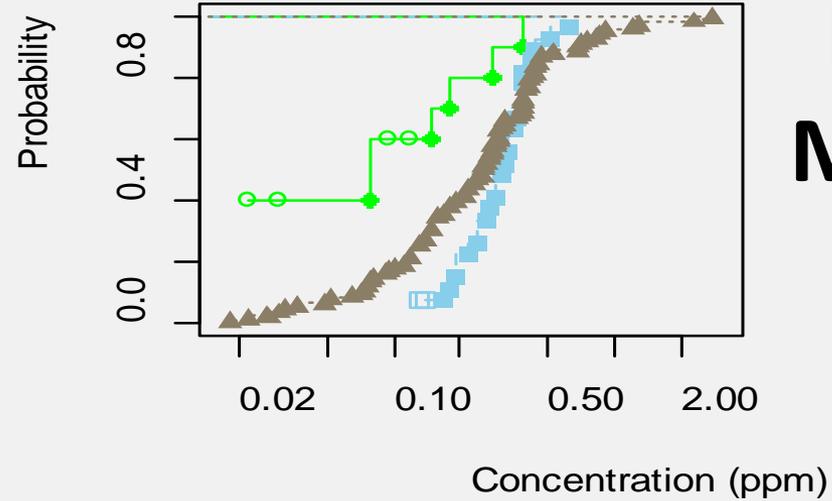
- The concentration is shown on the x-axis.
- The cumulative probability is shown on the y-axis.
- The shape of the curve describes the distribution of the data:
 - Curves shifted to the right indicate higher concentrations.
 - Steeper curves have less variance (i.e., many samples within small concentration range).
 - Flatter or skewed curves have larger variance (i.e., fewer samples across a large concentration range).
- Port Gardner results were compared to the Bold Plus data set using ECDF plots.

ECDF Plots Metals

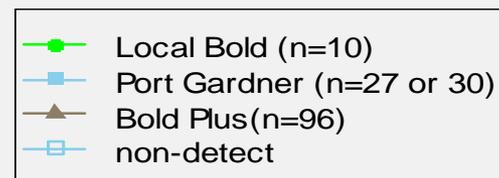
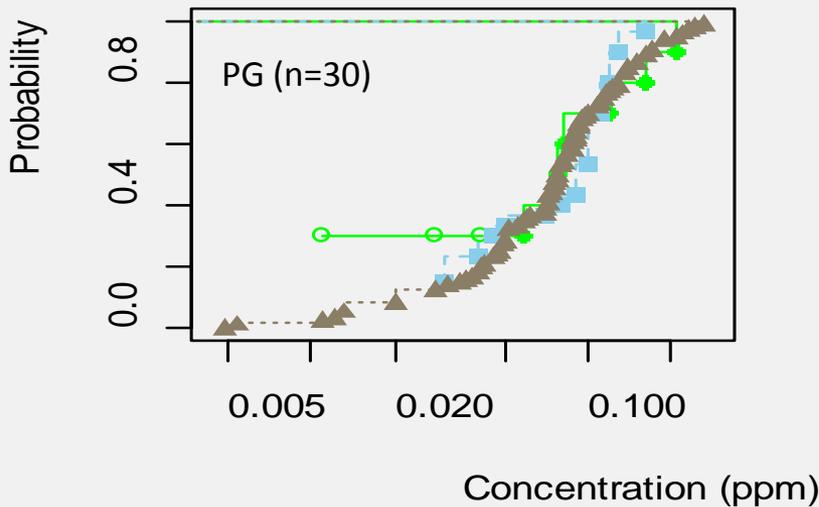
Arsenic



Cadmium



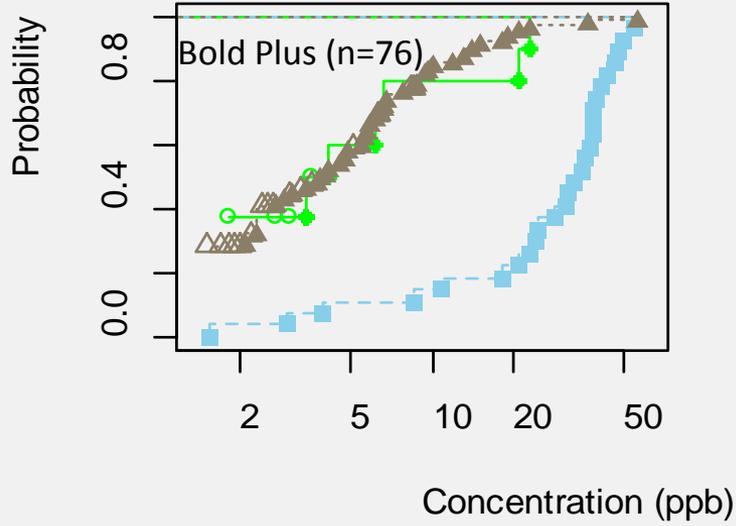
Mercury



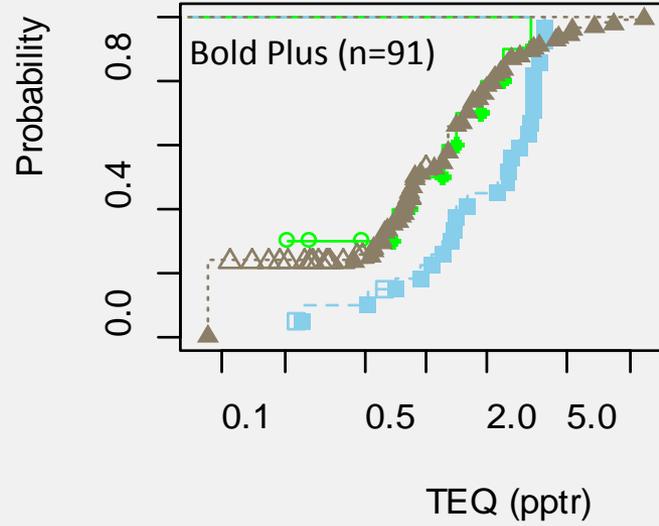
*The 'Local Bold' data set is comprised of 5 samples from Port Susan (PSPS) and 5 samples from North Central Puget Sound (NCPS) – a subset of the Bold dataset.



cPAH TEQ

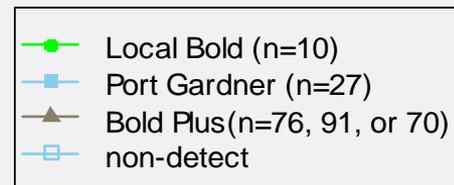
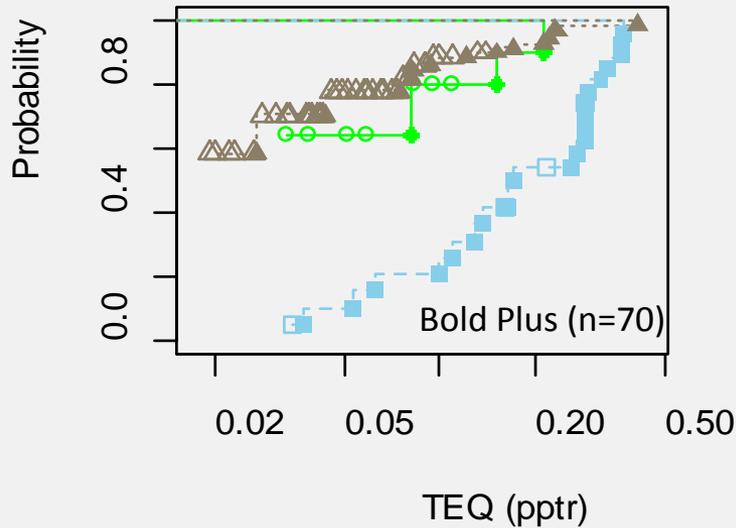


Dioxin/Furan TE



ECDF Plots Organics

PCBs TEQ



Dry Weight Concentrations

Outlier Analysis for PG-60

- An outlier evaluation was conducted because PG-60 was located near a potential point source - the diffuser outfall.
- Concentrations for all CoCs were within the upper tail of the distributions for both the Port Gardner and Bold Plus data.
- Cadmium was a statistical outlier for the Port Gardner data set.
- To test if the statistical outlier would influence the regional background values, the 90/90 UTL was calculated with and without the PG-60 data. Results did not show significant analytical differences:

Analyte	Units	With PG-60	W/O PG-60
cPAH TEQ	ppb	56	55
PCB TEQ	ppt	0.38	0.37
Dioxin/Furans TEQ	ppt	3.9	3.6
Mercury	ppm	0.14	0.13
Cadmium	ppm	0.49	0.46

Port Gardner Regional Background and BOLD Plus Natural Background

Analyte	Units	Port Gardner Phase I	Port Gardner Phase II	BOLD Plus
cPAH TEQ	ppb	42	56	16
PCB TEQ	ppt	0.43	0.38	0.2
Dioxin/Furans TEQ	ppt	3.6	3.9	3.6
Mercury	ppm	0.14	0.14	0.17
Cadmium	ppm	0.37	0.49	0.79
Arsenic	ppm	12	12	11
Total PCBs	ppb	11	14	3

- Arsenic, cadmium, mercury, and dioxin/furan concentrations in Port Gardner are consistent with natural background.
- cPAH TEQ and PCB TEQ have elevated regional backgrounds compared to Bold Plus.
- Values calculated at the 90/90 UTL

Timeline & Next Steps

August –
September 2014

Stakeholder
and tribal
review of
preliminary
data package &
convene
technical
workshop

Fall 2014

Ecology considers
comments received
to draft the
Regional
Background Report

Draft Regional
Background Report
submitted for
stakeholder and
tribal review

Early 2015

Ecology
finalizes the
Regional
Background
Report and
determines
Regional
Background