COPC Mapping Review

March 11, 2015

FOIA_001406_0079091

Topics Overview

- COPC Interpolation Model Performance
- Uncertainty in Use of Bathymetric Surveys
- SWAC vs RAL Calculations--Effects of Uncertainty
- Concentration and Area Ratios Constrain SWAC Reduction

FOIA_001406_0079092

COPC Interpolation Model Performance

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Semivariogram

Incorrect Estimate of Nugget Effect

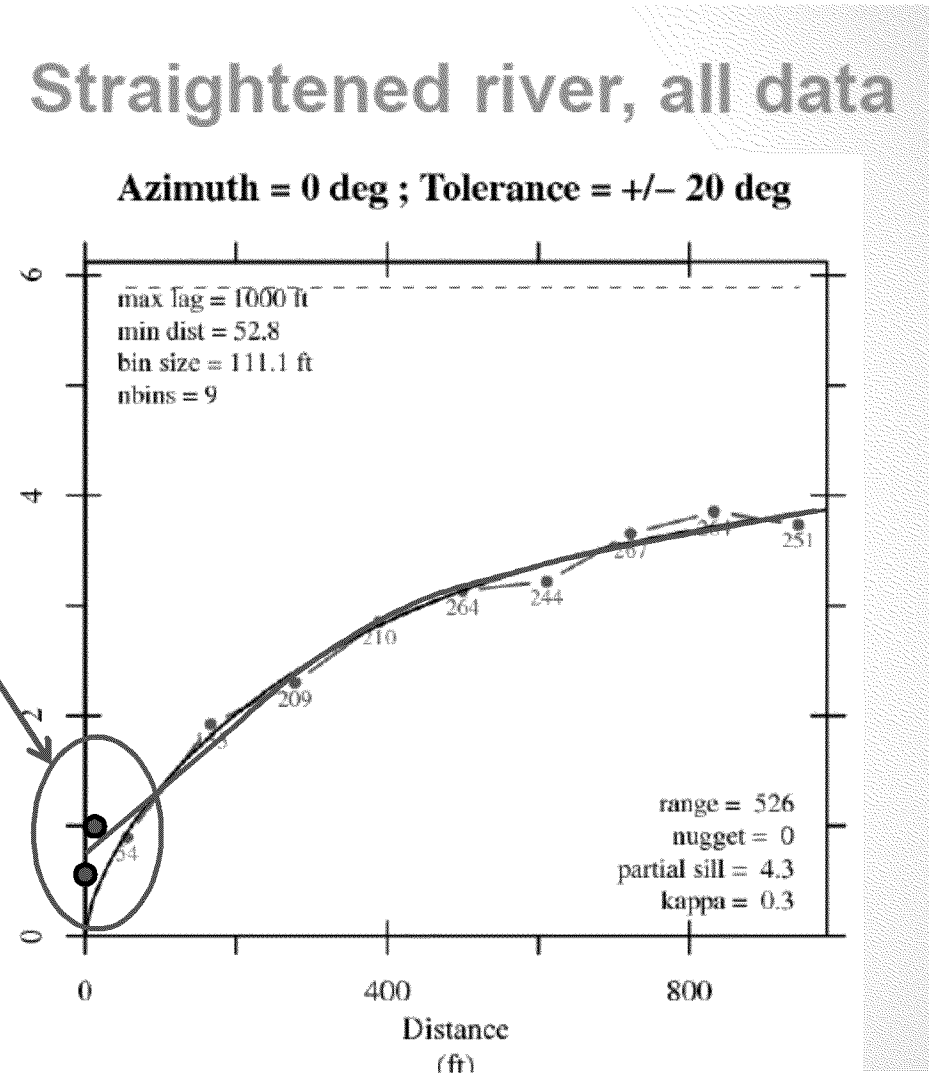
Reanalysis of Close Proximity Samples			
Metric	Number of Pairs	Average[1] Distance (ft)	Semi-variance Log(ng/kg)[2]
Log(TCDD)	25	0	0.57
Log(TCDD)	46	9.2 (2.9-20)	1.01

- Nugget effect on the order of 20% to 30% of the sill

$$\square^2 = (\square^2 + \square^2)(\square^2 - 1)$$

$$\square = 1{,}000 \text{ at } 200 \text{ feet}$$

- Average distance to the nearest point in the same CPG group = 360 ft



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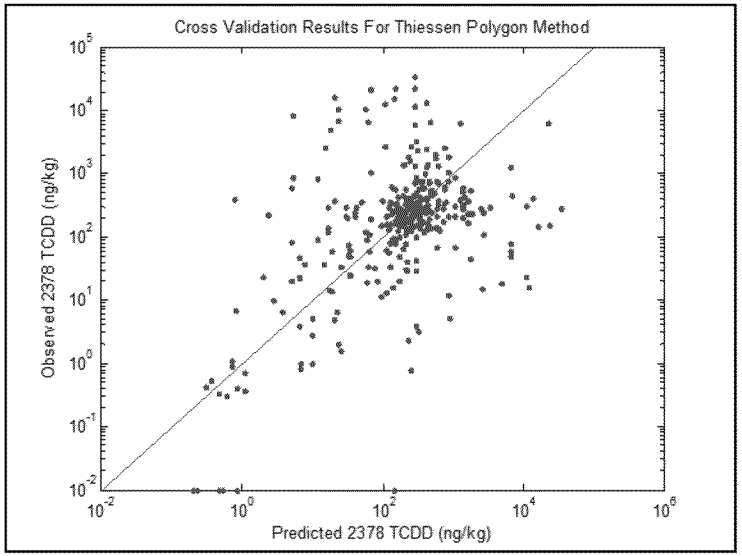
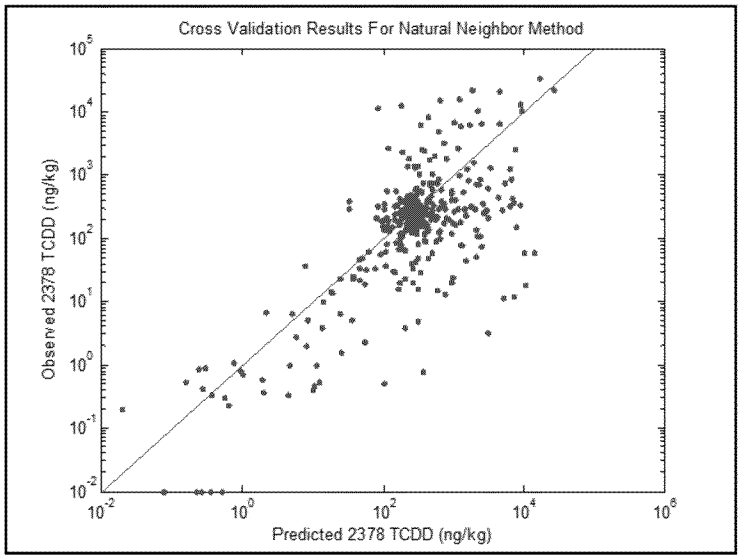
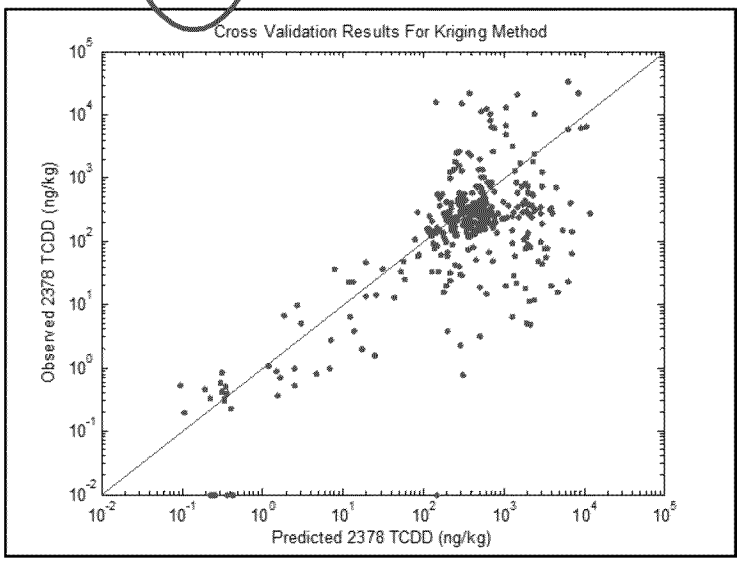
Method Comparison: Drop-One Cross Validation



Statistic	Thiessen Poly. (CPG)	Natural Neighbor	Kriging	Sample Mean
Bias (ng/kg)	-184.2	-25.6	68.8	0.0
RMSE (ng/kg)	2992	2086	2250	3322
Variance Explained (%)	40%	57%	55%	NA
Mean Abs. Diff. (ng/kg)	1215	1084	1147	1346
Honor Data Distribution	Yes	No	No	Yes





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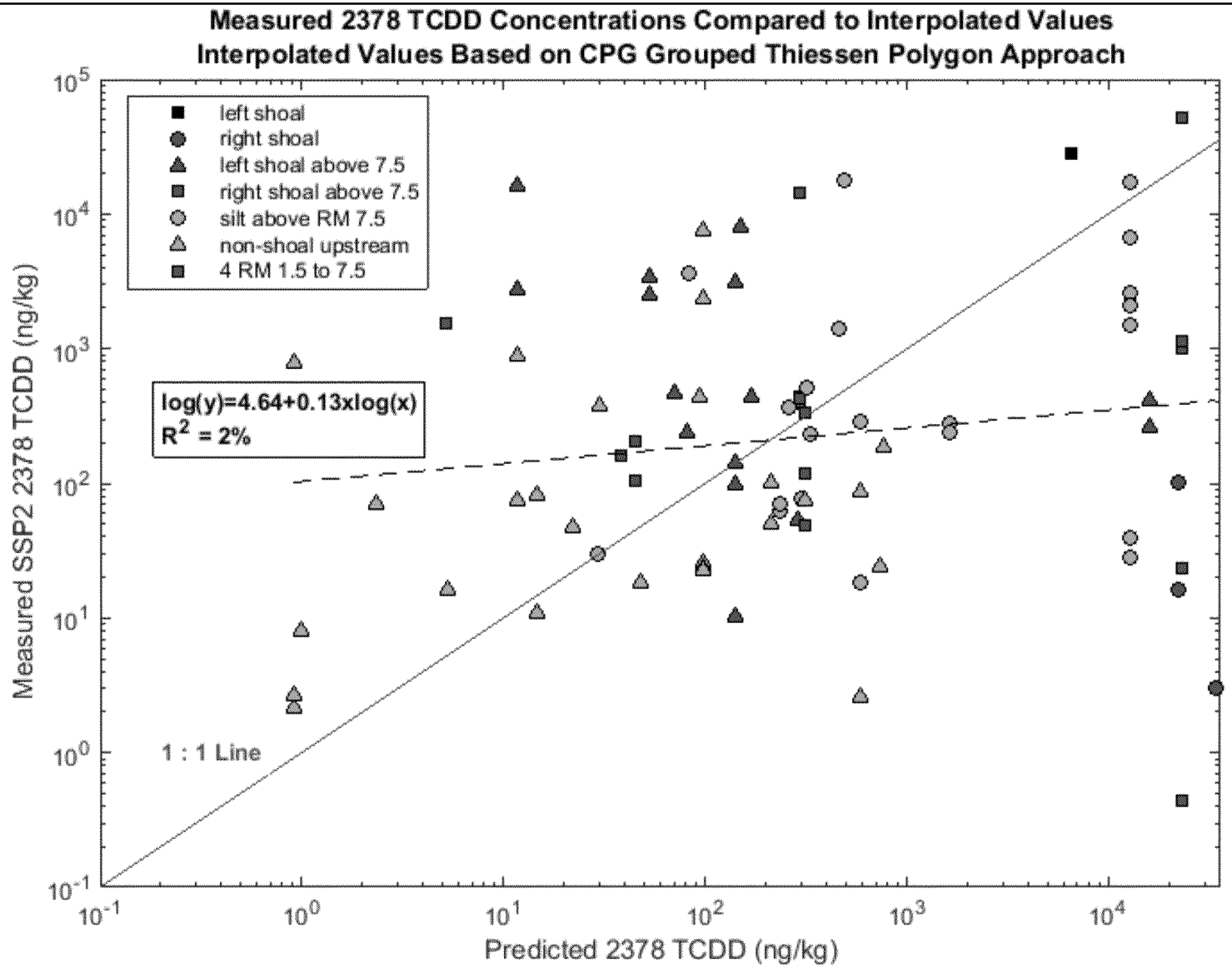
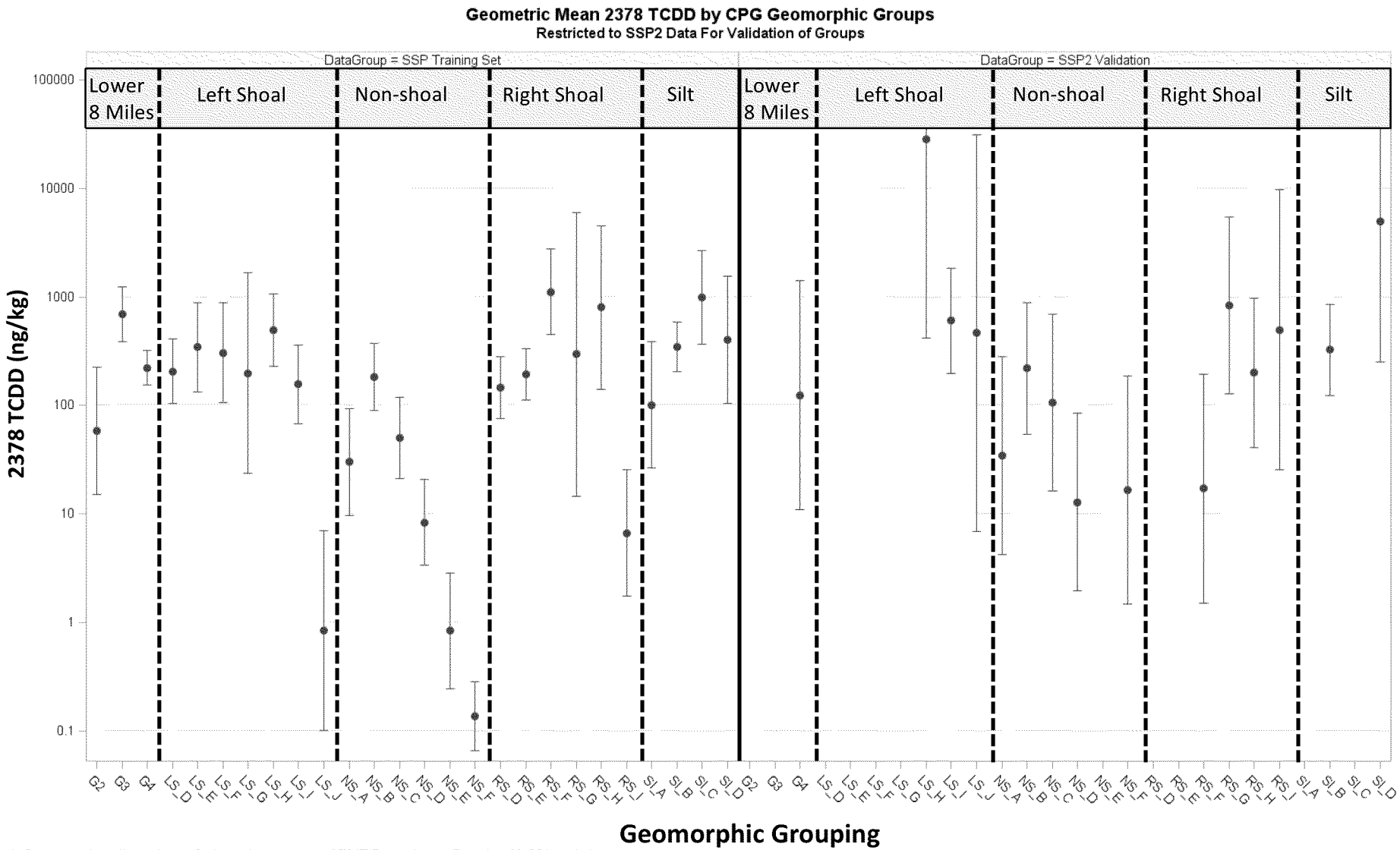
Measured vs Predicted 2378 TCDD

(Validation Using SSP2 Samples)





1) One sample collected on left shoal downstream of RM7.5 not shown (Result = 28,200 ng/kg)
2) Groups based on Group_RM_bins_for_kriging_20130923_LPR.shp
3) Error bars represent 95% confidence limits for the geometric mean

Uncertainty in Use of Bathymetric Surveys

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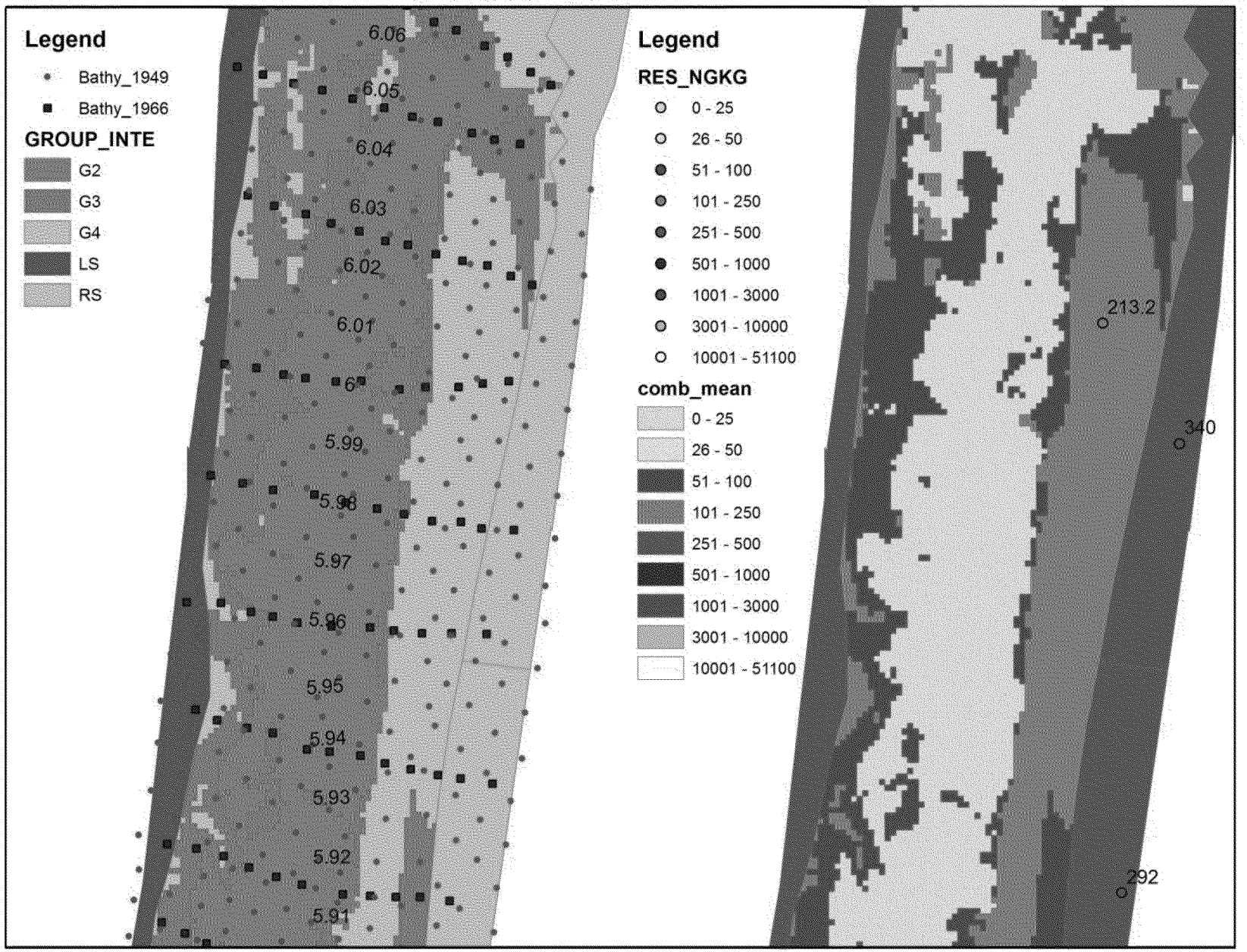
Bathymetry Survey Data



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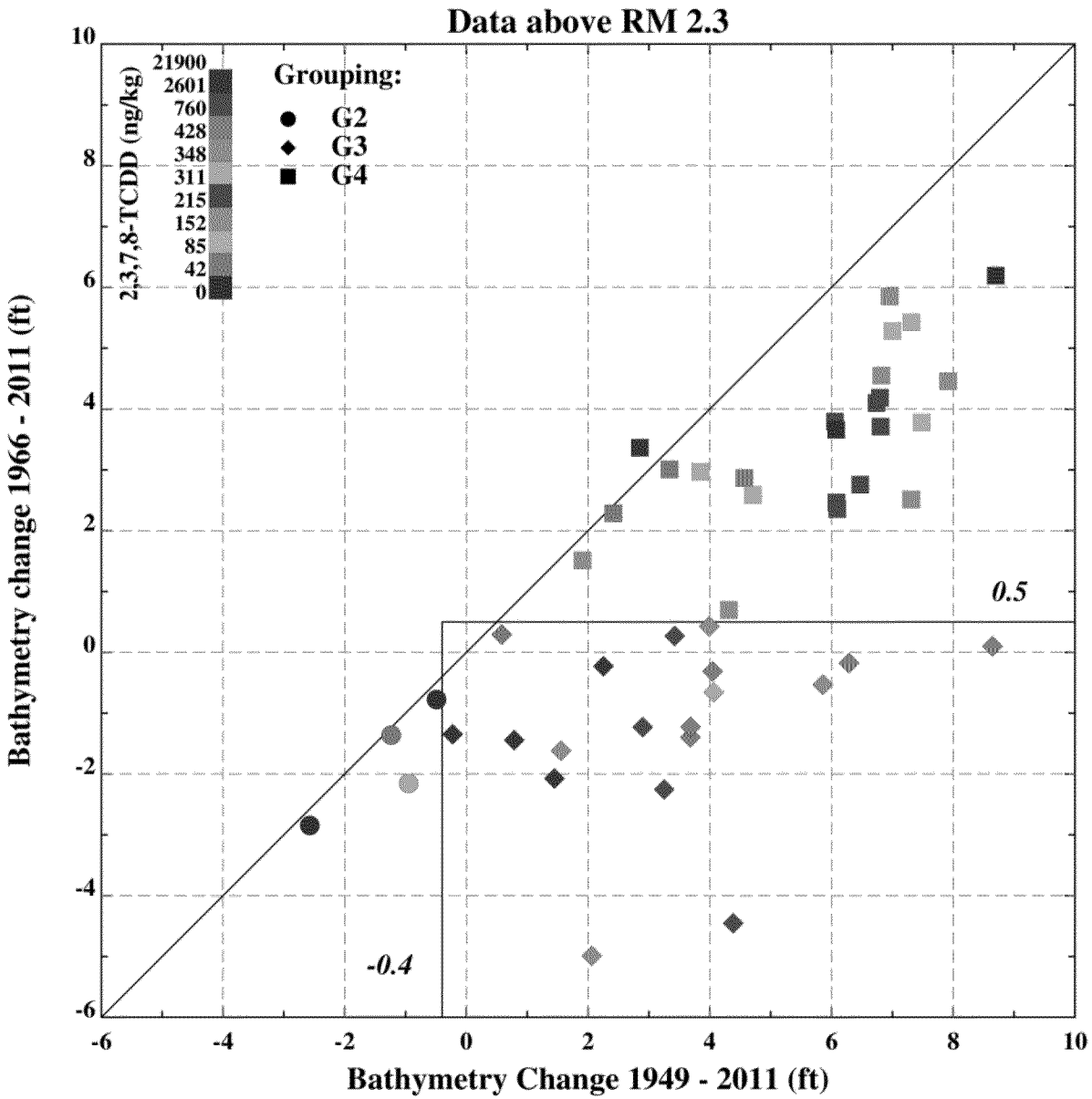
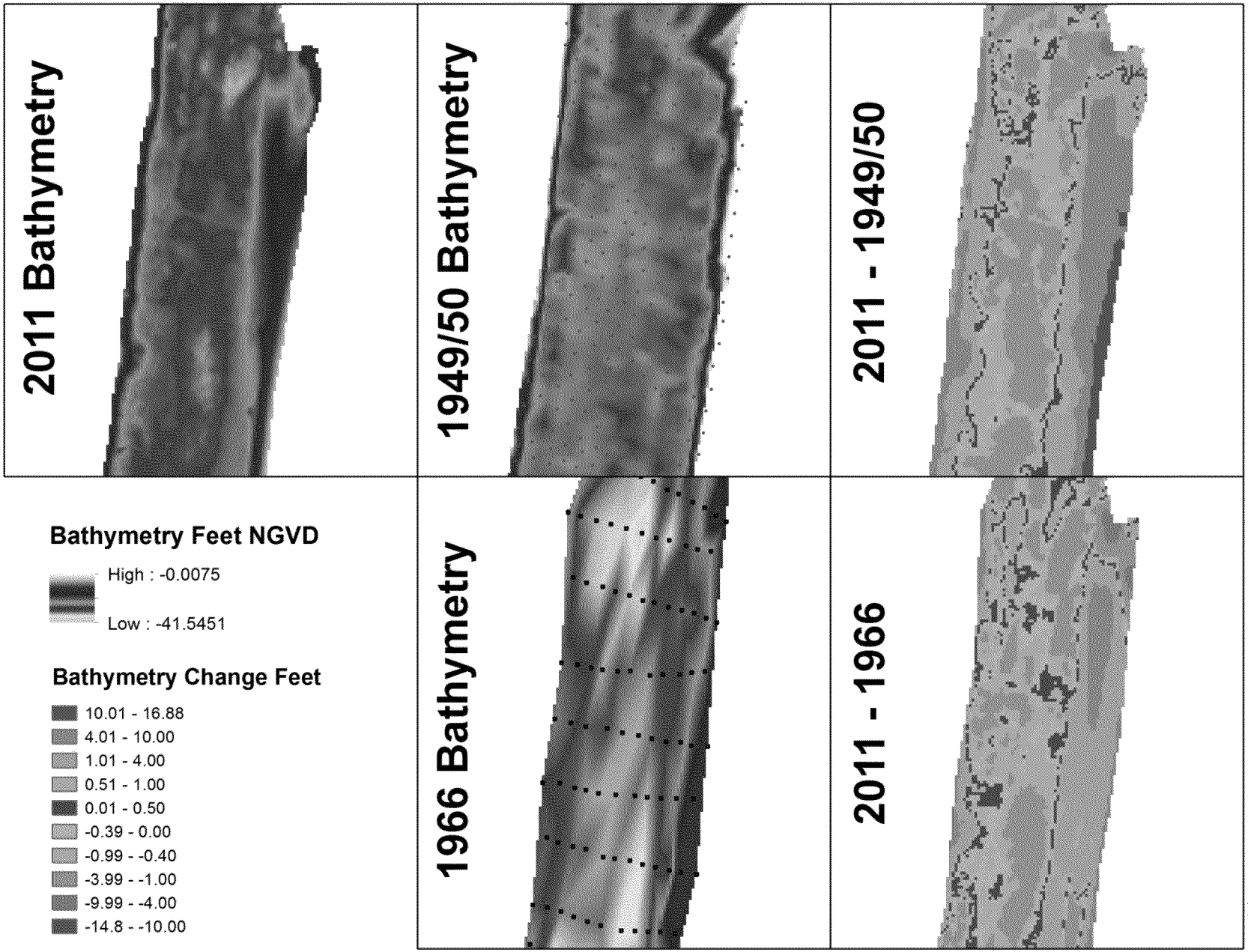
2,3,7,8-TCDD Data with Bathymetry Change



2,3,7,8-TCDD Data with Bathymetry Change



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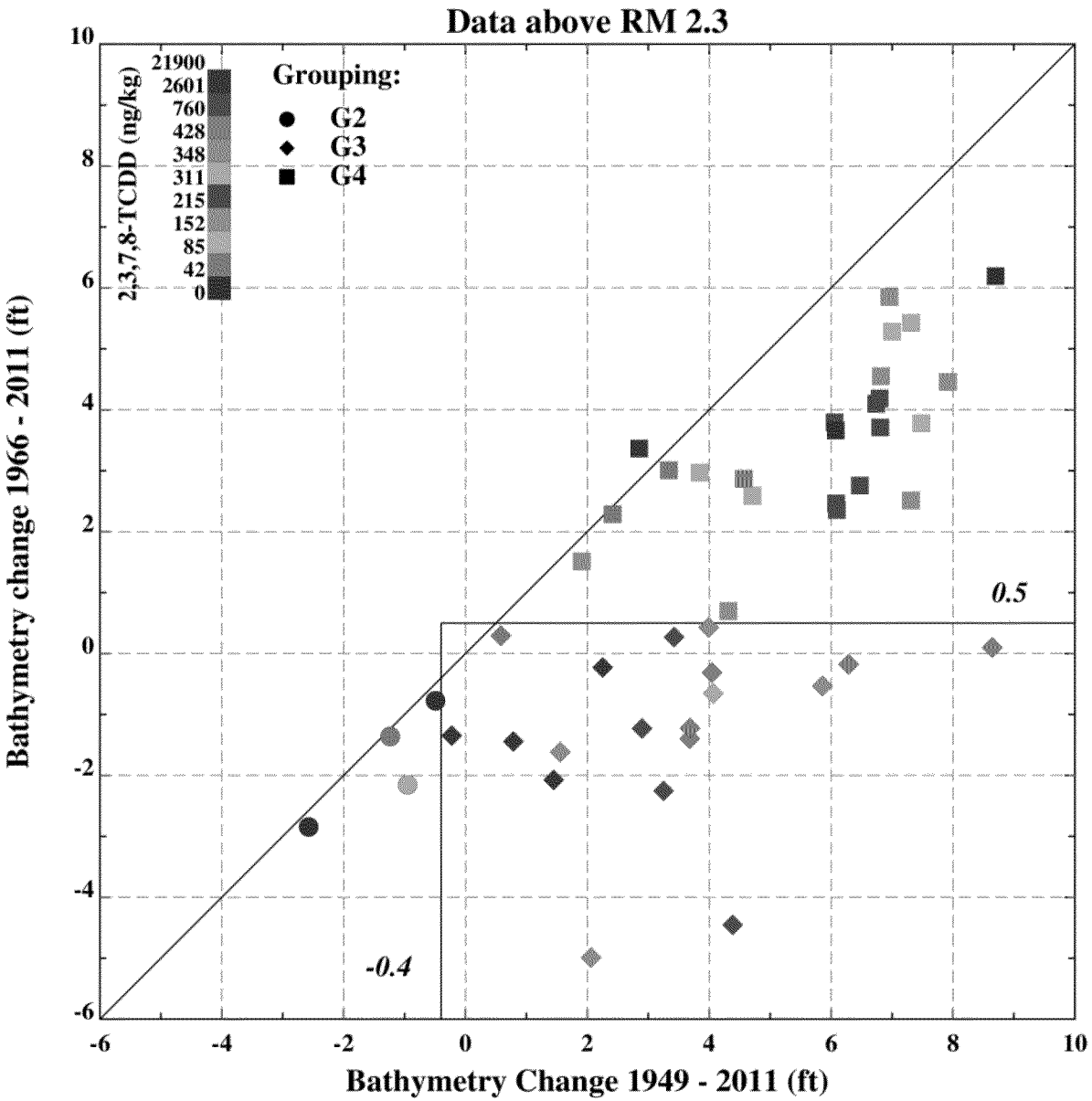
2,3,7,8-TCDD Data with Bathymetry Change



Number of Samples included in Grouping Analysis as a function of Time of Collection		
	2008-2009	2012
G2	2	2
G3	11	12
G4	34	23

Peak Flows at Dundee Dam (cfs)	
3/16/2010	16,300
4/01/2010	10,100
3/13/2011	16,800
4/18/2011	10,700
8/30/2011	24,700
9/10/2011	14,700

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SWAC vs RAL Calculations

Effects of Uncertainty

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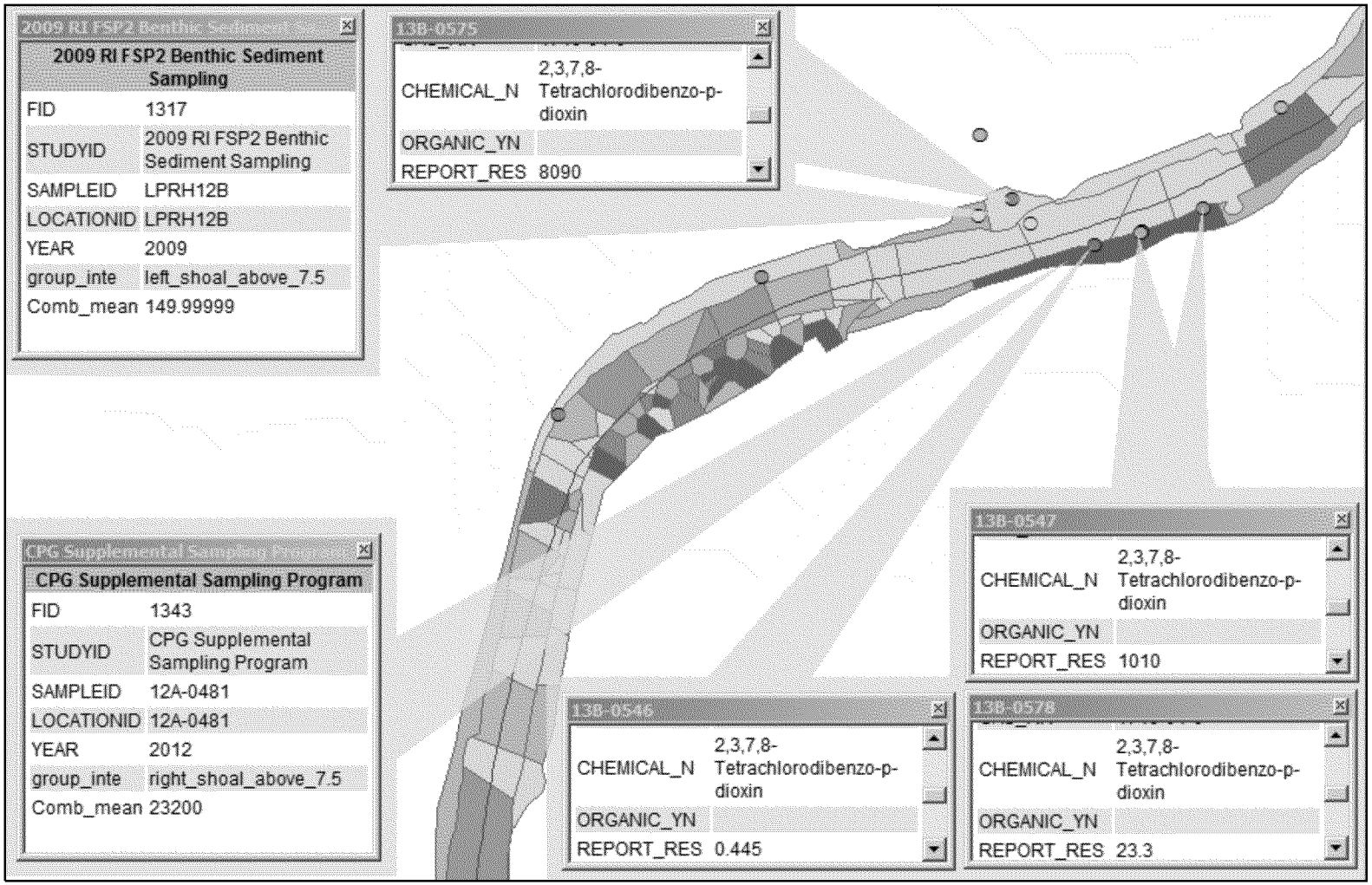
Imperfect Separation of High and Low Concentrations



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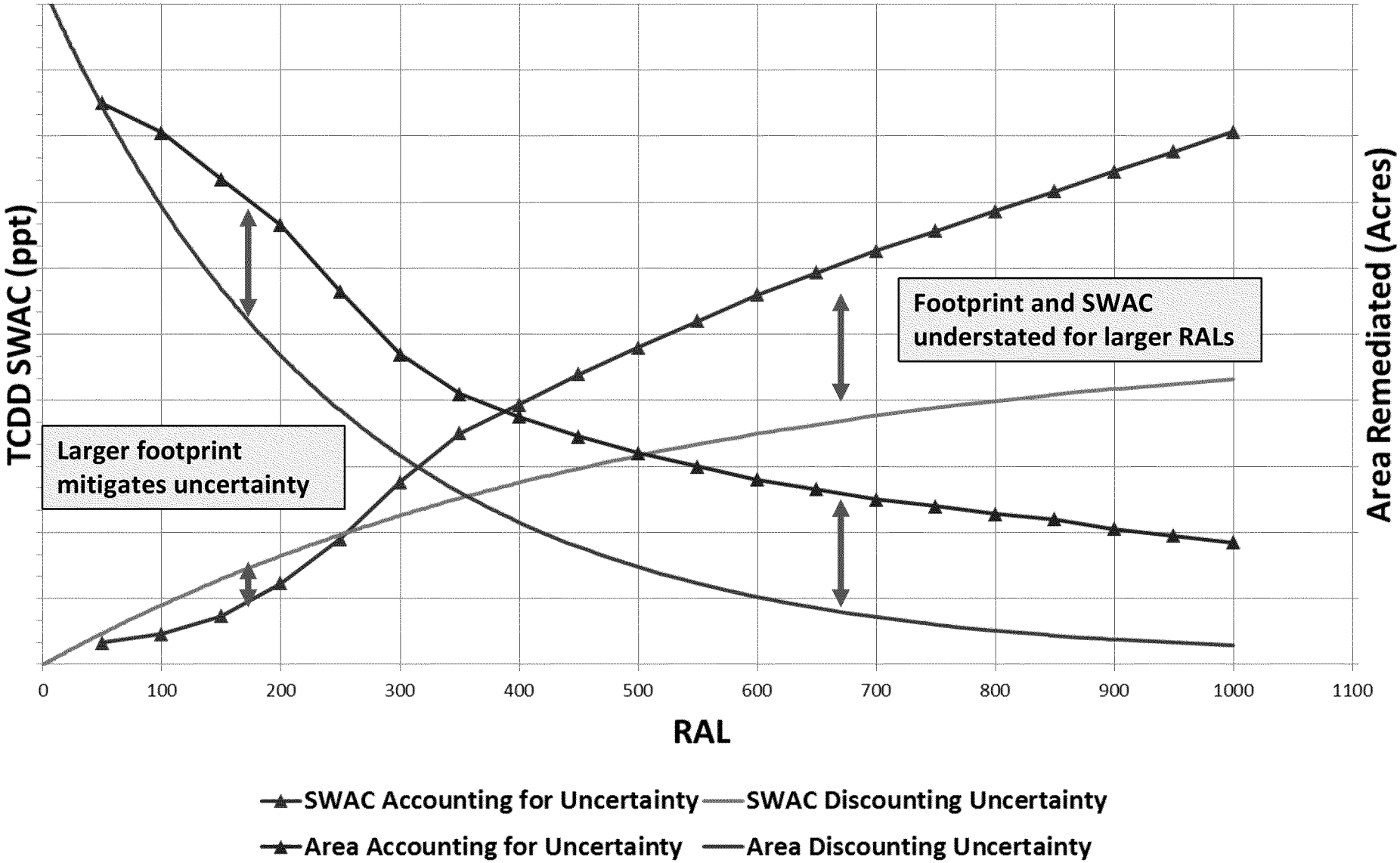
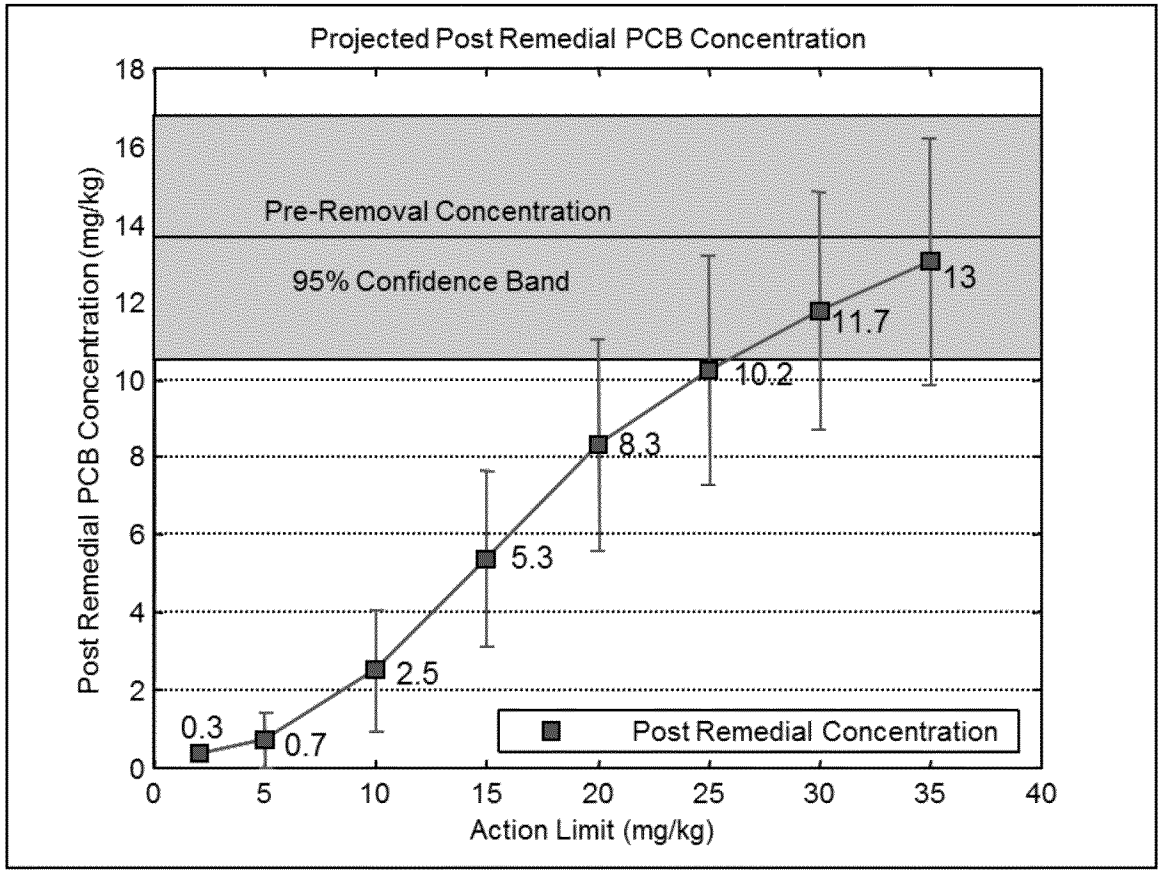
Area and SWAC vs. RAL
With and Without Consideration of Uncertainty



SWAC vs RAL With Uncertainty Bounds
Plainwell Impoundment (Kalamazoo River, MI)



Notes:

1) Note that action limits of 15 mg/kg or less are required for projected concentrations to differ significantly from pre-removal concentration.

3) Computations include the assumption that residual contamination would be 0.33 mg/kg or less.

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Concentration and Area Ratios Constrain SWAC Reduction

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Robust Planning Approach
Based on Relative Reduction in SWAC

A_U –Unremediated Area

[illegible] --Unremediated Concentration

A_R –Remediated Area

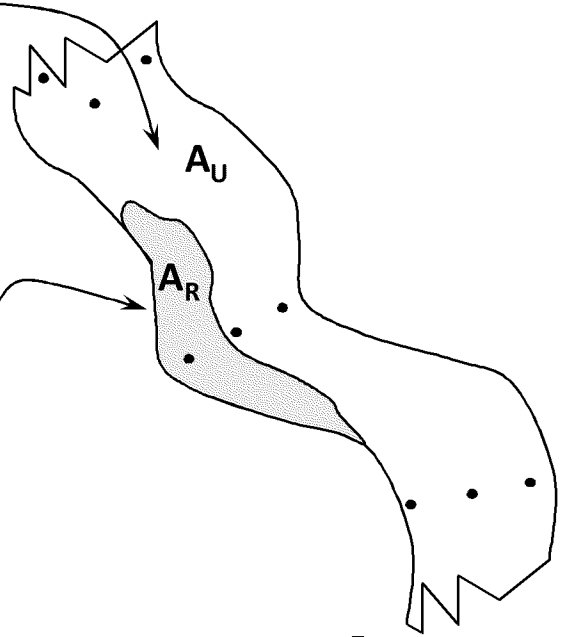
[illegible] -Remedial Footprint Concentration

[illegible] -Post-remedial Concentration

[illegible] = [illegible] ([illegible] + [illegible])

[illegible] = [illegible]

[illegible] = ([illegible] × [illegible] + [illegible] × [illegible]) / ([illegible] + [illegible])



Algebra

$$\frac{\Delta\,[\text{illegible}]}{[\text{illegible}]} = \left[\frac{1 - \frac{[\text{illegible}]}{[\text{illegible}]}}{[\text{illegible}] + (1 - [\text{illegible}])\left(\frac{[\text{illegible}]}{[\text{illegible}]}\right)}\right]$$

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Robust Planning

$$\frac{\Delta \square\square\square\square\square\square\square\square}{\square\square\square\square} = \square\left[\frac{1 - \frac{\square\square}{\square\square}}{\square\square + (1 - \square)\left(\frac{\square}{\square}\right)}\right]$$

$\square\square$ (Proportion Remediated)	$\frac{\Delta \square\square\square\square\square\square\square\square}{\square\square\square\square\square\square\square\square}$
0	0
0.5	$\frac{1 - \frac{\square\square}{\square\square}}{1 + \frac{\square\square}{\square\square}}$
1.0	$1 - \frac{\square\square}{\square\square}$

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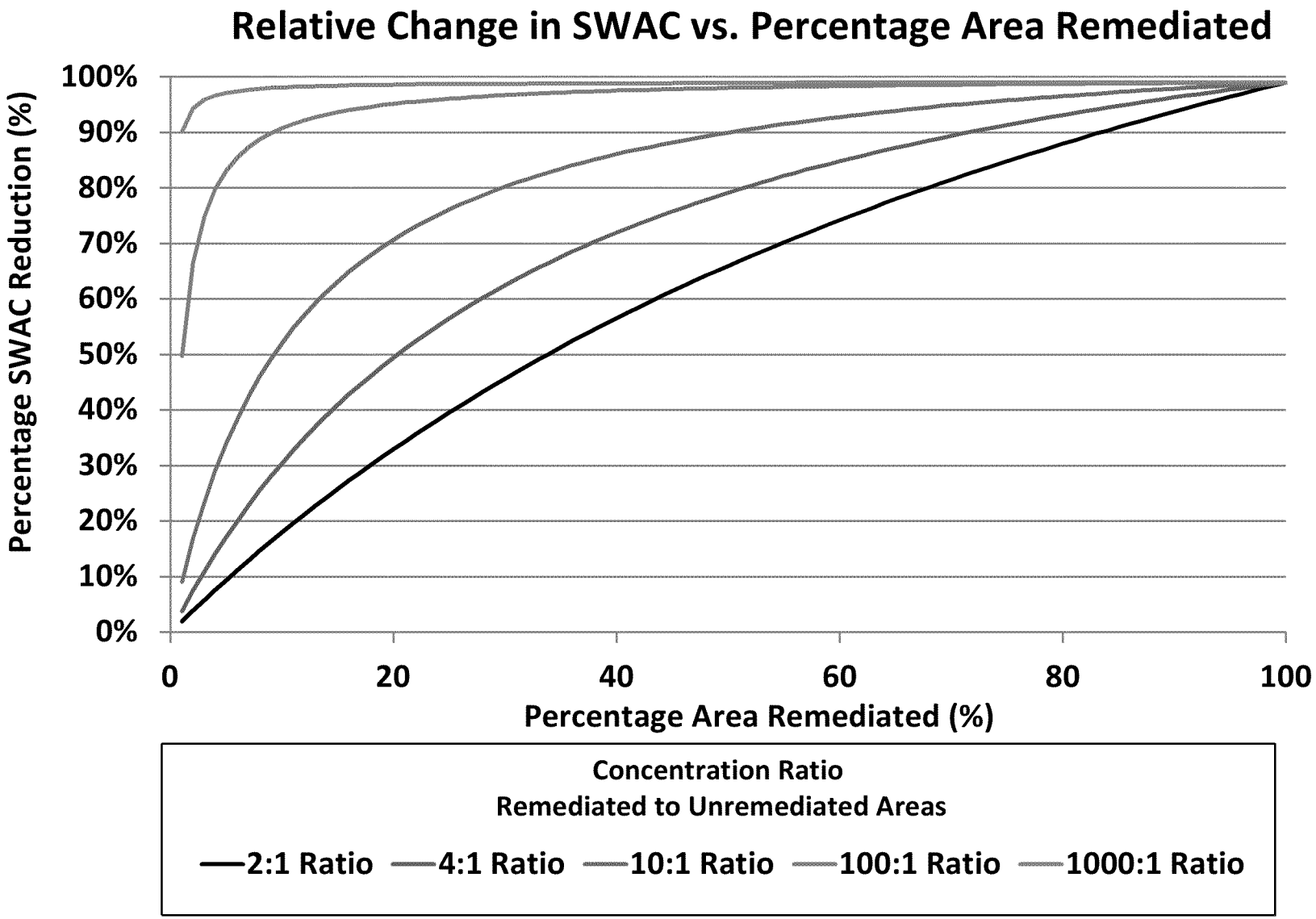

Note: Assumes 99% reduction within footprint area.

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Discussion Topics

- Uncertainties in predicted values are large for proposed method based on Thiessen Polygons, and not much better for other standard approaches.
- Geomorphic hypothesis based on bathymetric change is weak and should be fully tested prior to using it as the basis for a remedial strategy.
- Maps will be uncertain, so measures of the influence of this uncertainty on remedy testing and selection are necessary.
- Constraints on SWAC reduction need to be considered in context of uncertain mapping efforts.
- Failure to integrate these uncertainties into remedial alternatives analysis (Feasibility Study) may lead to inaccurate cost and schedule estimates.

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