

**CHaMP Monitoring:
Pool Tail Fines and Particle Size Distribution
Site & Watershed Level Standard Errors Vs.
Measurement Protocol Changes**

Matt Nahorniak
South Fork Research
November 2012

Site & Watershed Level Standard Errors Vs. Measurement Protocol Changes: Motivation

- Pool Tail Fines and Particle Size Distribution consume a high portion of overall field effort (30% ?)
- How can within site effort and total number of sites surveyed be optimized, with respect to user requirements?
 - At the site and the watershed (or other multi-site) spatial levels, what would the effect on the precision of metric estimates be for various protocol changes aimed at reducing required site level effort?
 - If within site protocol changes (reductions in sampling effort) allow for increases in total number of sites sampled in a watershed, what are the effects on precision of watershed level estimates?

Metrics and Measurement Protocol Summary

- **Pool Tail Fines**

- **Metrics:**

- Pool Tail Fines < 2 mm
- Pool Tail Fines < 6 mm

- **Measurement Protocol**

- **10 Pools per Site**
 - or all pools if site has fewer than 10 pools)
- **3 Locations per pool**
- 50 Grid points per Location

- **Particle Size Distribution (fast water)**

- **Metrics:**

- D₁₆, D₅₀, D₈₄
- Particle Embeddedness

- **Measurement Protocol**

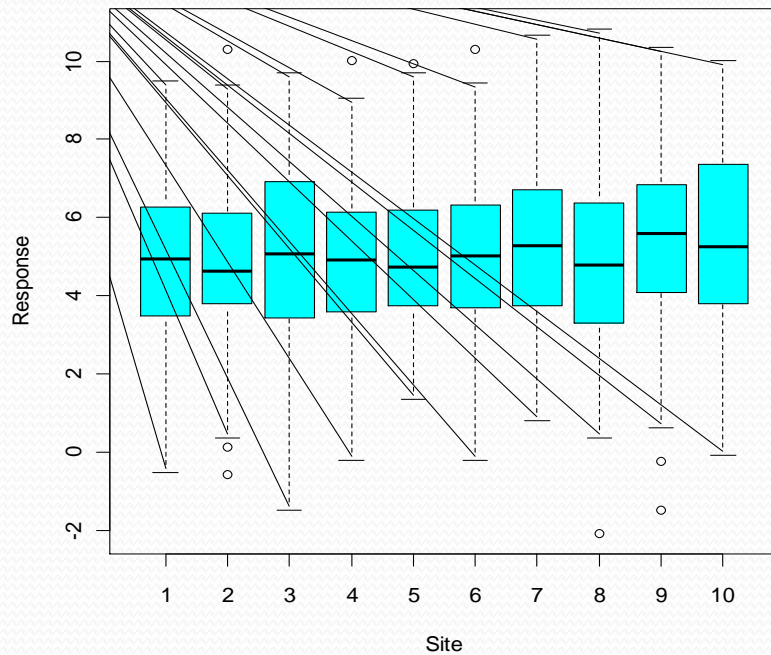
- **10 Cross Sections per Site**
- **21 Locations per Cross Section**

Background

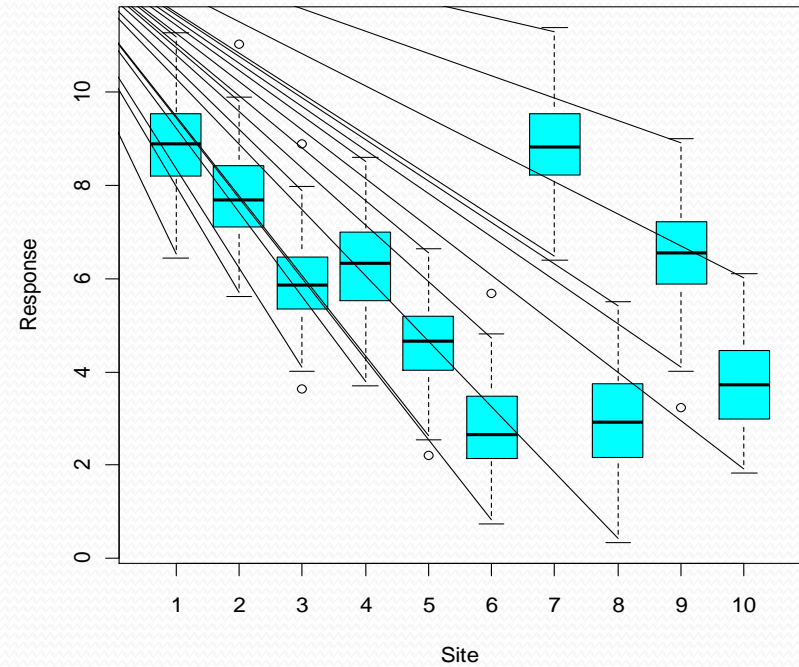
Site & Watershed Level Standard Errors Vs. Measurement Protocol Changes

Site to Site Vs. Within Site Variability Example

Hypothetical Response by Site:
Low Site-Site Variance

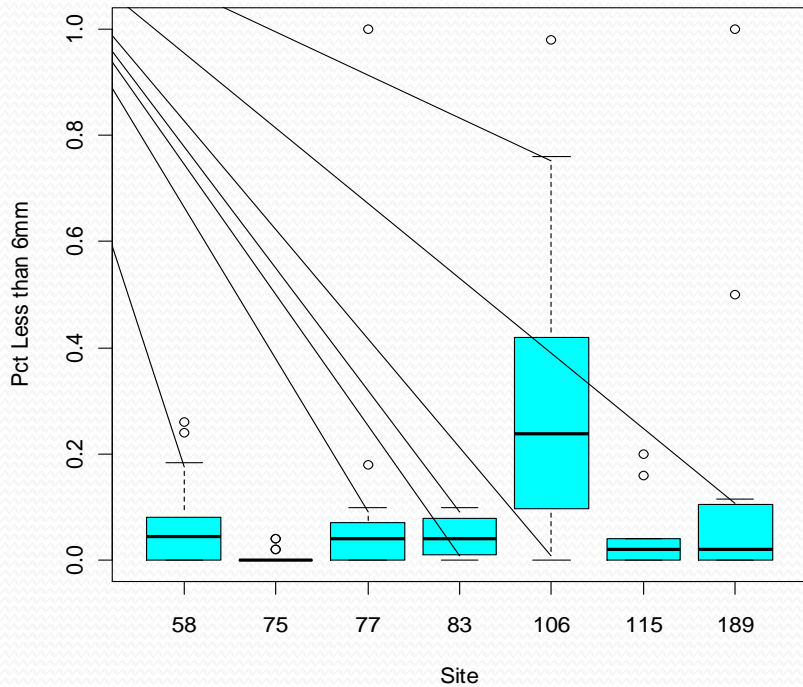


Hypothetical Response by Site:
High Site-Site Variance

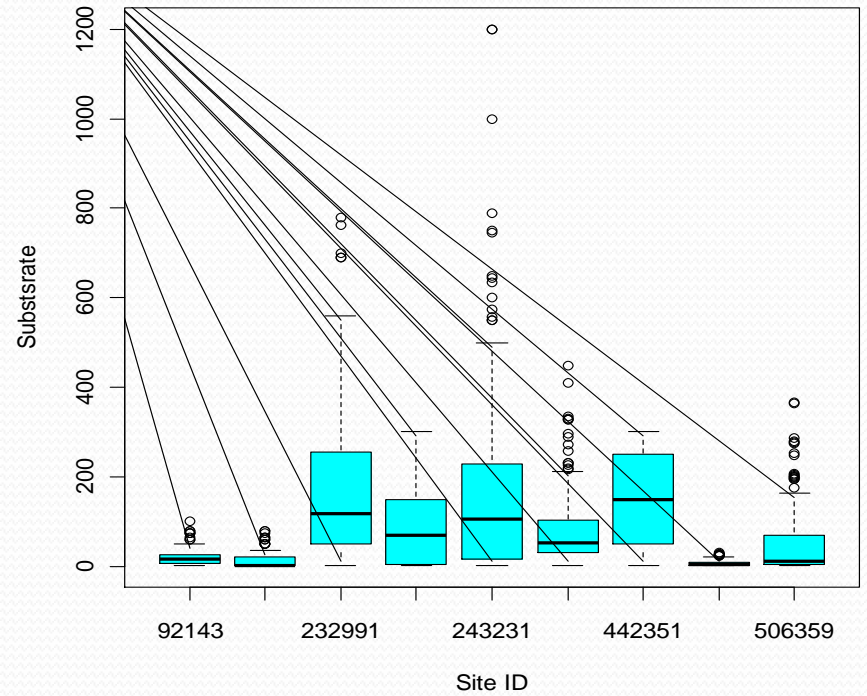


South Fork Salmon 2011 Data:

Southfork Salmon: Pct Pool Tail Fines Less than 2mm by Site



South Fork Salmon: Substrate Sizes by Site



Protocol / Sample Size Change Simulation Methodology

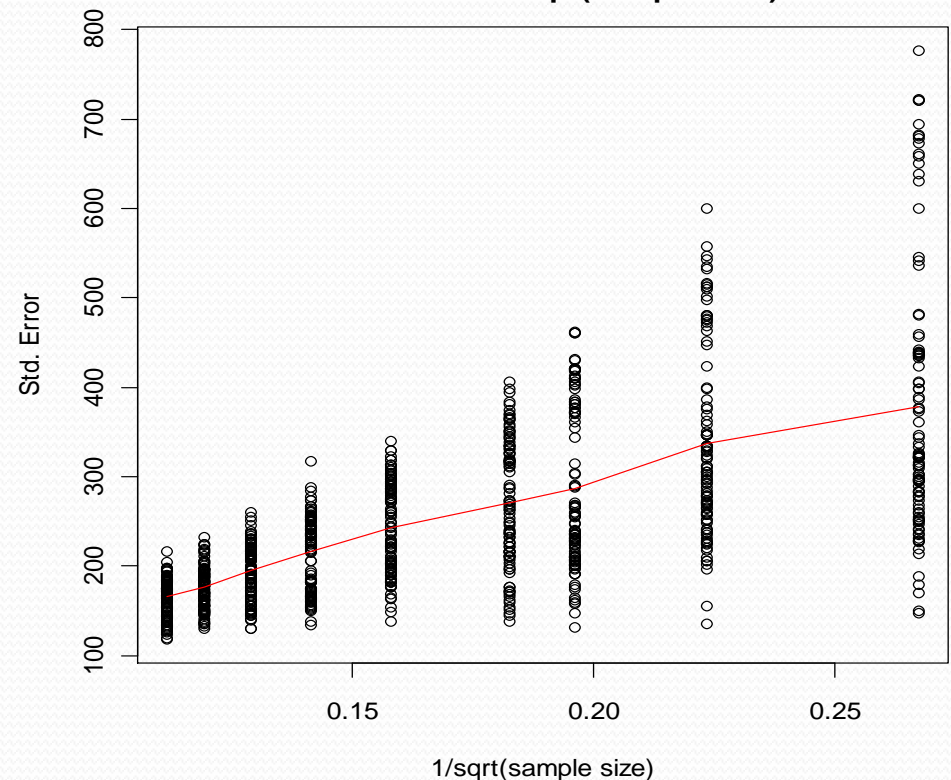
Within Sites:

Bootstrap Sampling to generate repeated simulations of site-level measurements at various protocols

Site:Site (GRTS Sample):

Use Relationship: $SE \propto 1/\sqrt{N}$

Stratified GRTS Sampling Simulation:
Std Error vs. $1/\sqrt{\text{Sample Size}}$

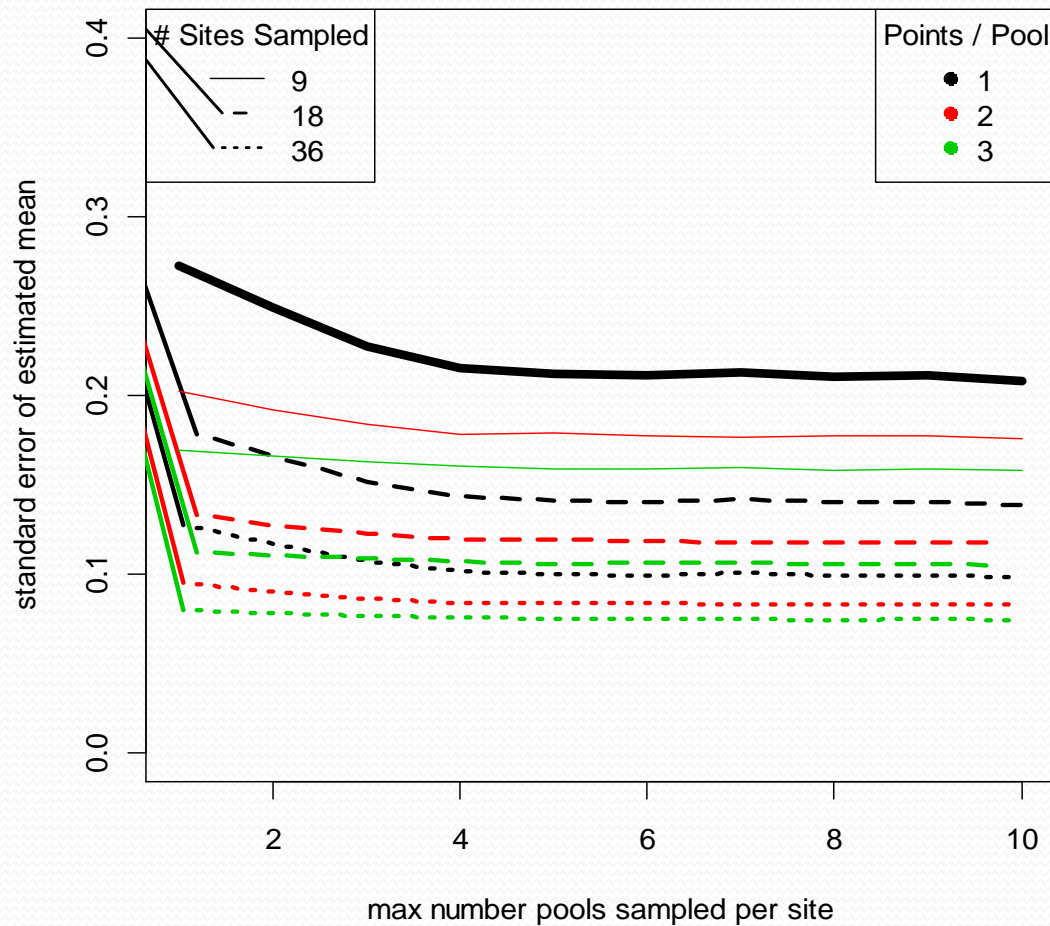


Results

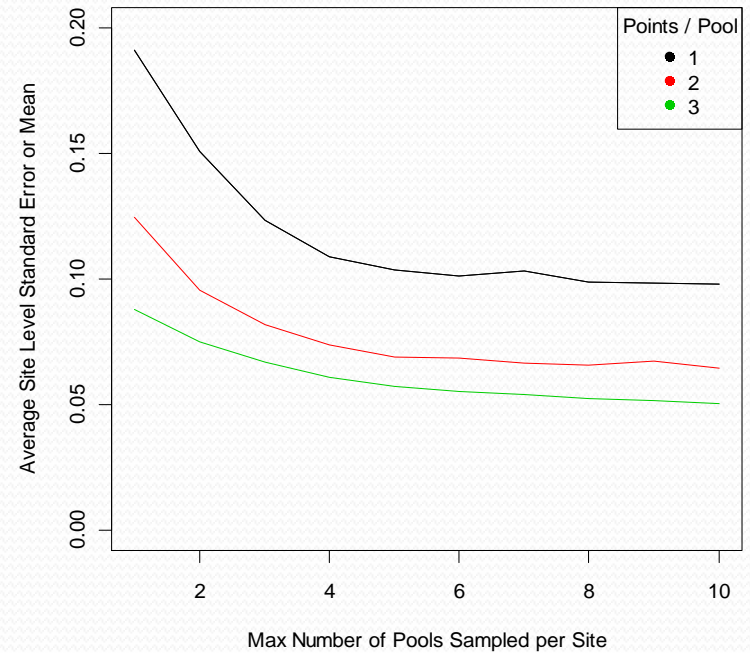
Site & Watershed Level Standard Errors Vs. Measurement Protocol Changes

Standard Errors by Protocol Changes: Pool Tail Fines < 6mm

**Watershed Level Estimate of Pool Tail Fines < 6 mm:
Standard Error vs. Max Number of Pools Sampled / Site**

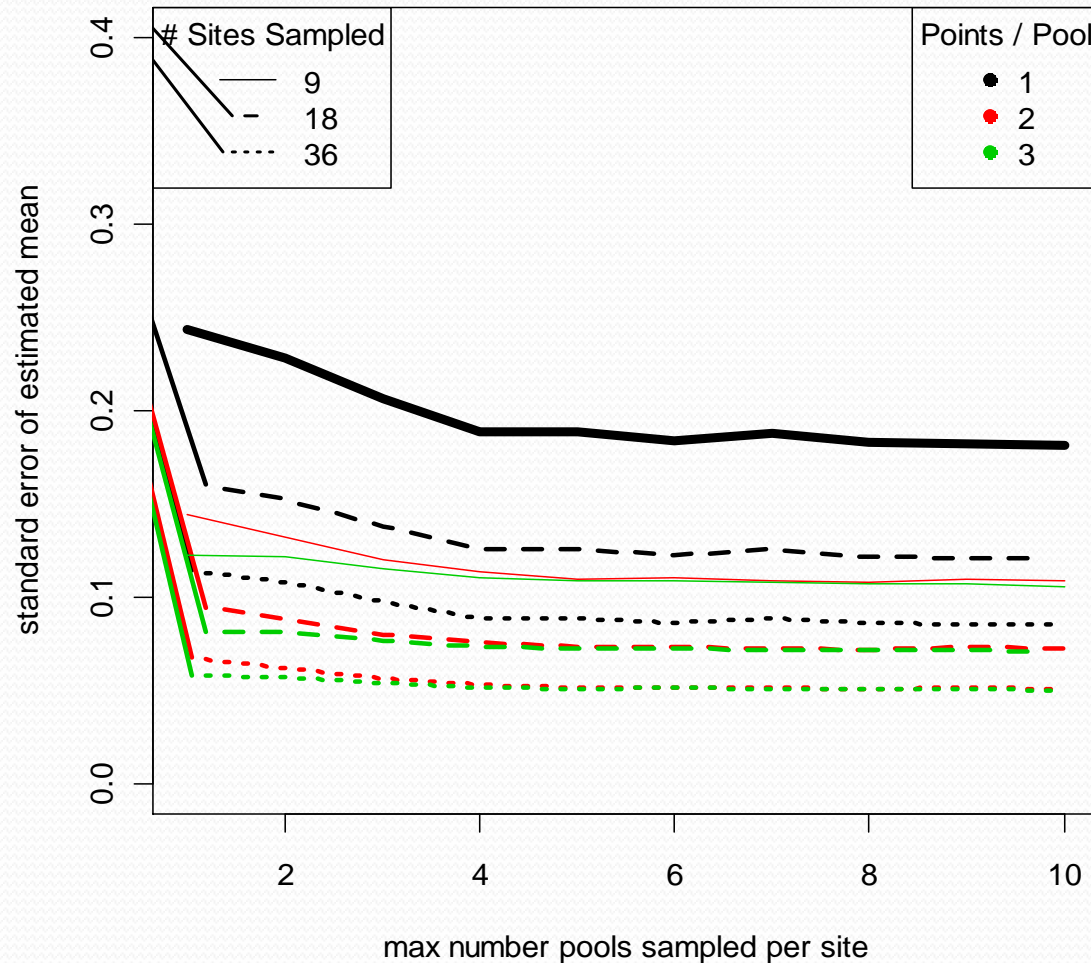


**Pool Tail Fines < 6 mm:
Average Site Level Standard Error of Mean Estimate**

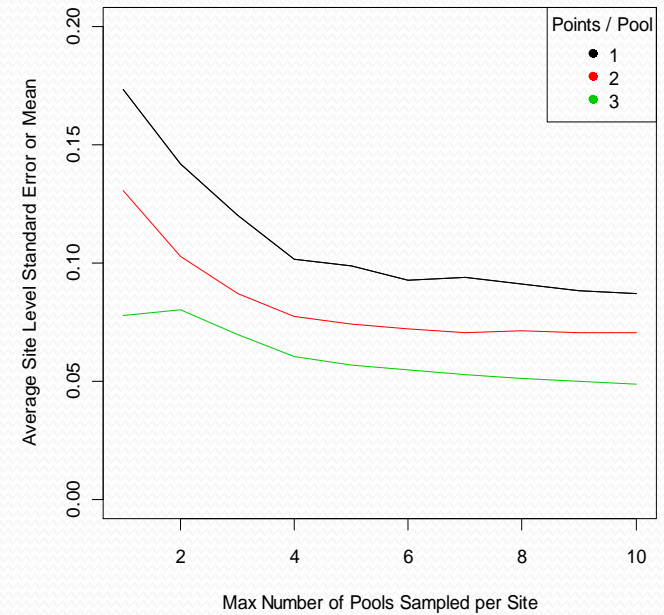


Standard Errors by Protocol Changes: Pool Tail Fines < 2mm

**Watershed Level Estimate of Pool Tail Fines < 2 mm:
Standard Error vs. Max Number of Pools Sampled / Site**

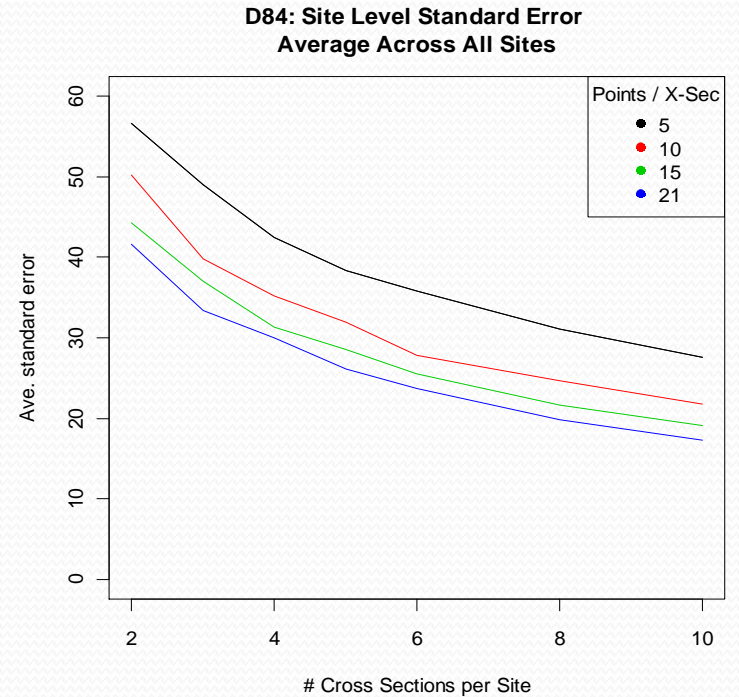
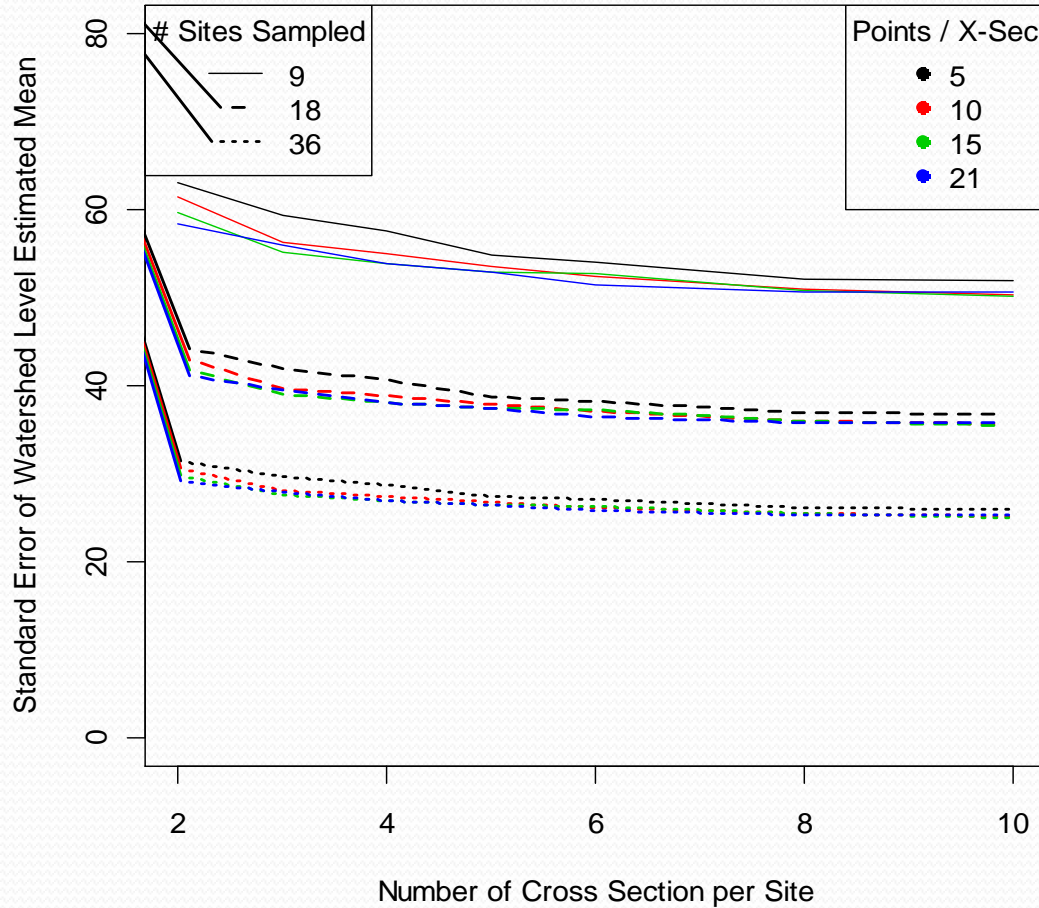


**Pool Tail Fines < 2 mm:
Average Site Level Standard Error of Mean Estimate**



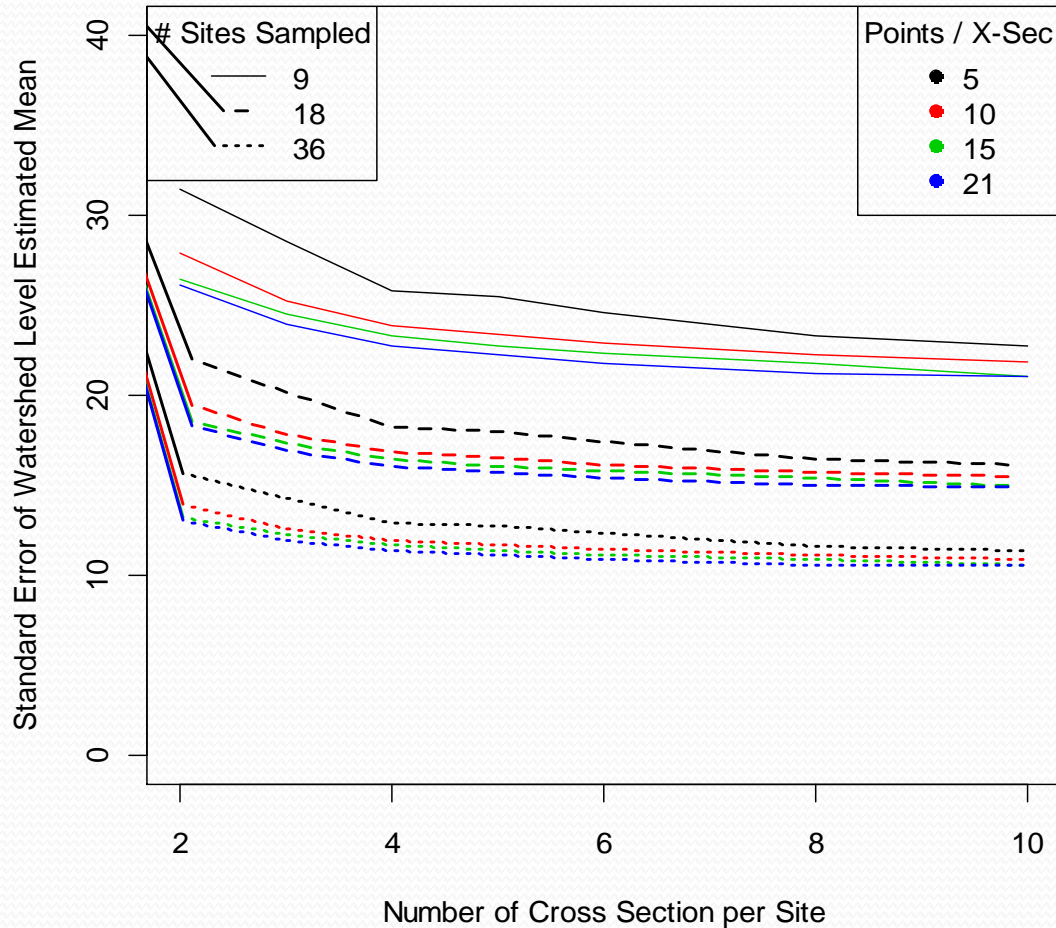
Standard Errors by Protocol Changes: D84

**Watershed Level D84 Estimate:
Standard Error of Mean by # Sites, Cross Sections per Site, and Points Measured per Cross Section**

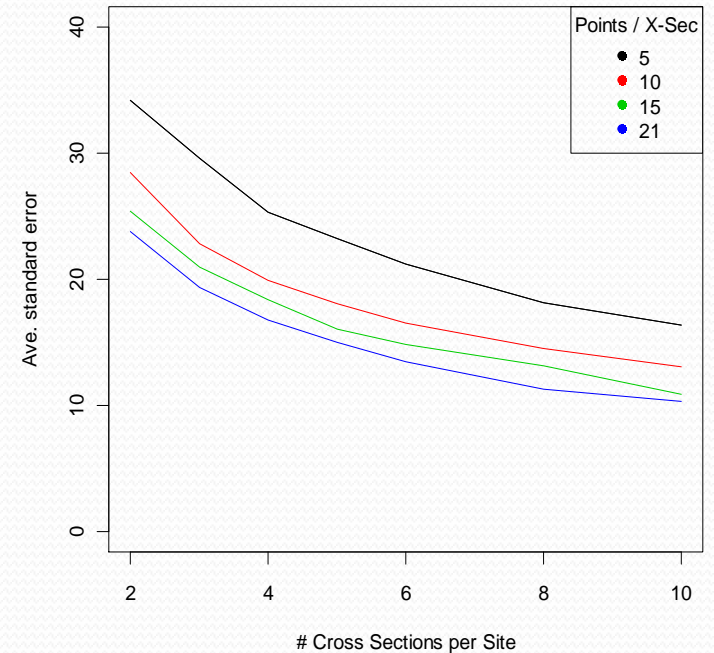


Standard Errors by Protocol Changes: D50

**Watershed Level D50 Estimate:
Standard Error of Mean by at # Sites, Cross Sections per Site, and Points Measured per Cross Section**

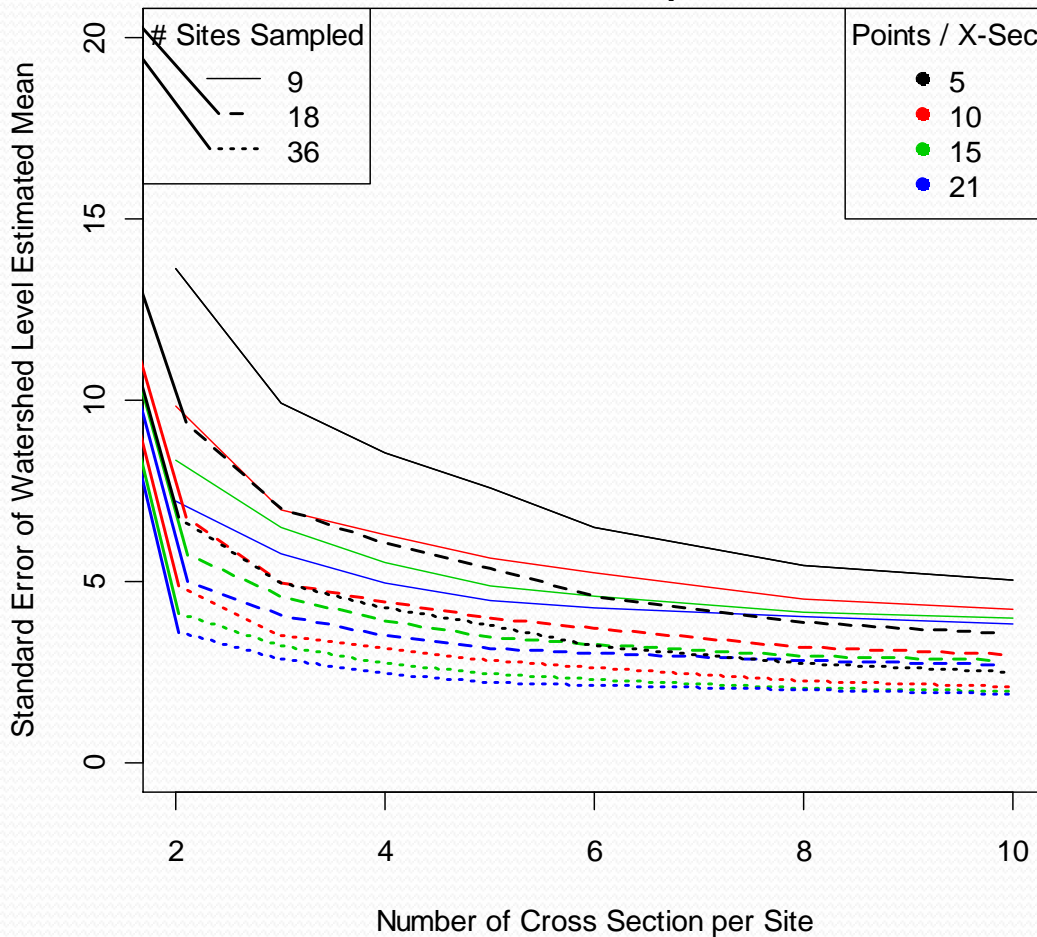


**D50: Site Level Standard Error
Average Across All Sites**

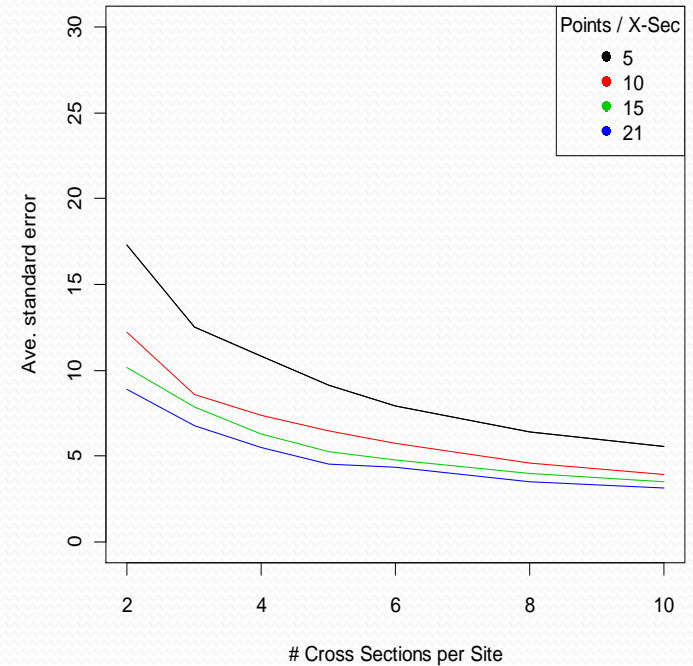


Standard Errors by Protocol Changes: D16

**Watershed Level D16 Estimate:
Standard Error of Mean by at # Sites, Cross Sections per Site, and Points Measured per Cross Section**

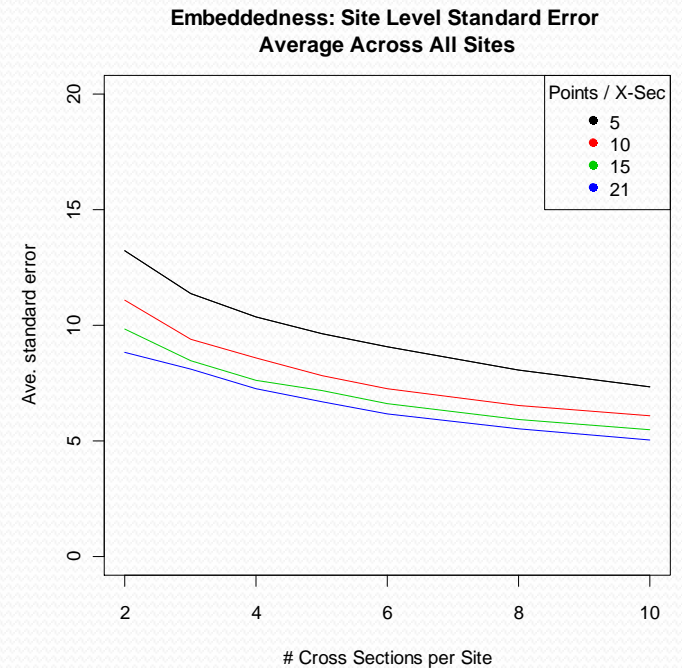
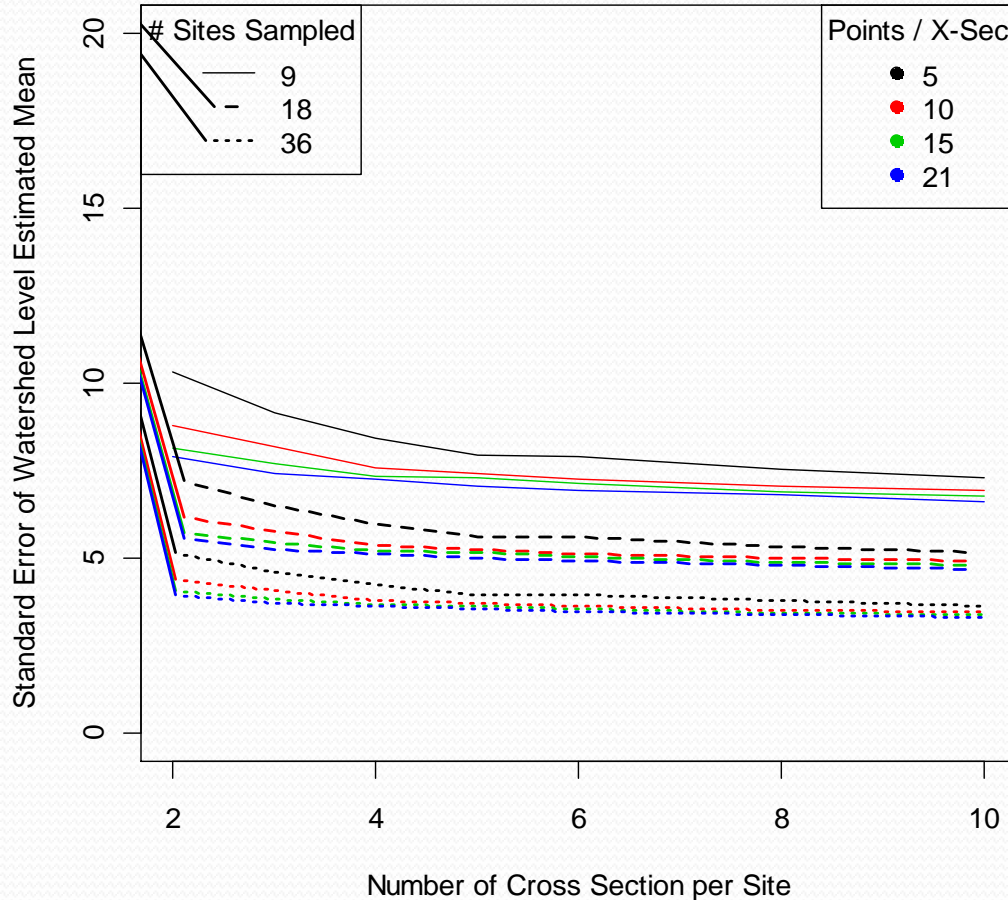


**D16: Site Level Standard Error
Average Across All Sites**



Standard Errors by Protocol Changes: Particle Embeddedness

**Watershed Level Embeddedness Estimate:
Standard Error of Mean by at # Sites, Cross Sections per
Site, and Points Measured per Cross Section**



Conclusions

Site & Watershed Level Standard Errors Vs. Measurement Protocol Changes

Summary

- In general, maximizing the total number of sites sampled results in the best watershed level precision
- For watershed level estimates, there is little precision to be gained by sampling more than 4 or 5 cross sections or pools within each site

Additional Discussion

- “Total Effort” is not a liquid asset;
 - CHaMP sampling managers will need to determine if, and to what extent, reductions in site-level measurement intensity enable increases in total number of sites sampled
- Site-site travel and other logistics may suggest that an optimal protocol allows for flexibility by site such that site level effort is limited to measurements that can be completed in a single day (for example)
- Other habitat and abundance metrics likely follow similar trends

References

- **CHaMP Survey Protocol Sample Size Tradeoffs**, Matt Nahorniak, South Fork Research, Inc., November 2012
- Pool Tail Fines: Salmonid Habitat Protocol for CHaMP 2012, section 7.5, <http://www.champmonitoring.org>
- Particle Size Distribution and Particle Embeddedness: Salmonid Habitat Protocol for CHaMP 2012, section 7.4, <http://www.champmonitoring.org>
- Details on Metric Calculations for Pool Tail Fines < 2 mm, Pool Tail Fines < 6mm, D16, D50, D84, and Particle Embeddedness: <http://www.champmonitoring.org/Program/Details/1#documents>

Questions?

Site & Watershed Level Standard Errors Vs. Measurement Protocol Changes