

**Pre-harvest Calibration of a Paired and Nested
Watershed Study to Evaluate Event-Based
Suspended Sediment Export**

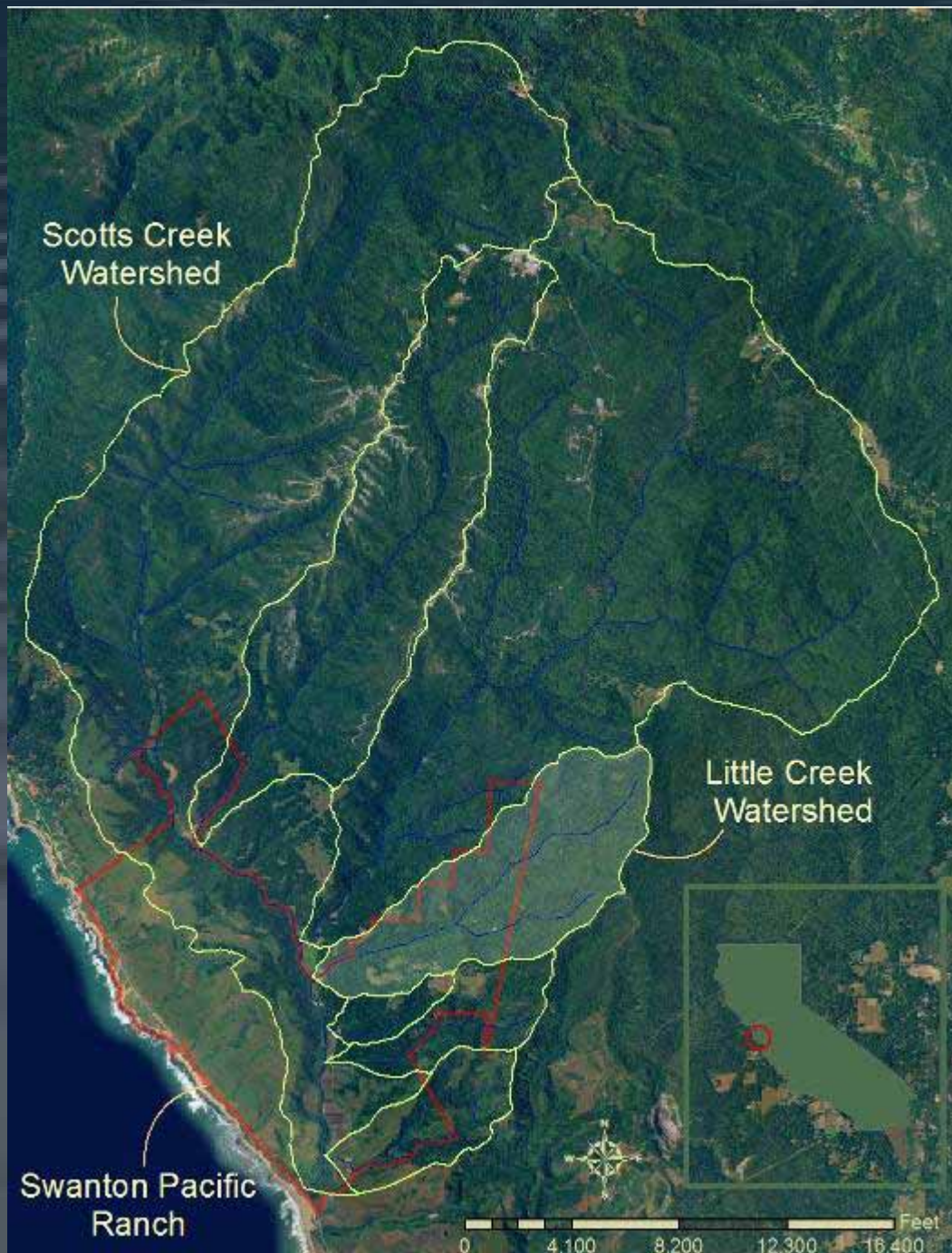
The Little Creek Study
Swanton Pacific Ranch
Davenport, CA

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August, 2007

Project Director
Brian Dietterick

Presentation Outline

- Location overview
- Management history
- Little creek monitoring project
 - Goals
 - Study design
 - General timeline
 - Water quality data collected and stat analysis



Little Creek Watershed

Water Quality Monitoring

Physical attributes

526 hectare (1,300 acre) total area

North Fork subwatershed 279 ha (690 acres)

South Fork subwatershed 109 ha (270 acres)

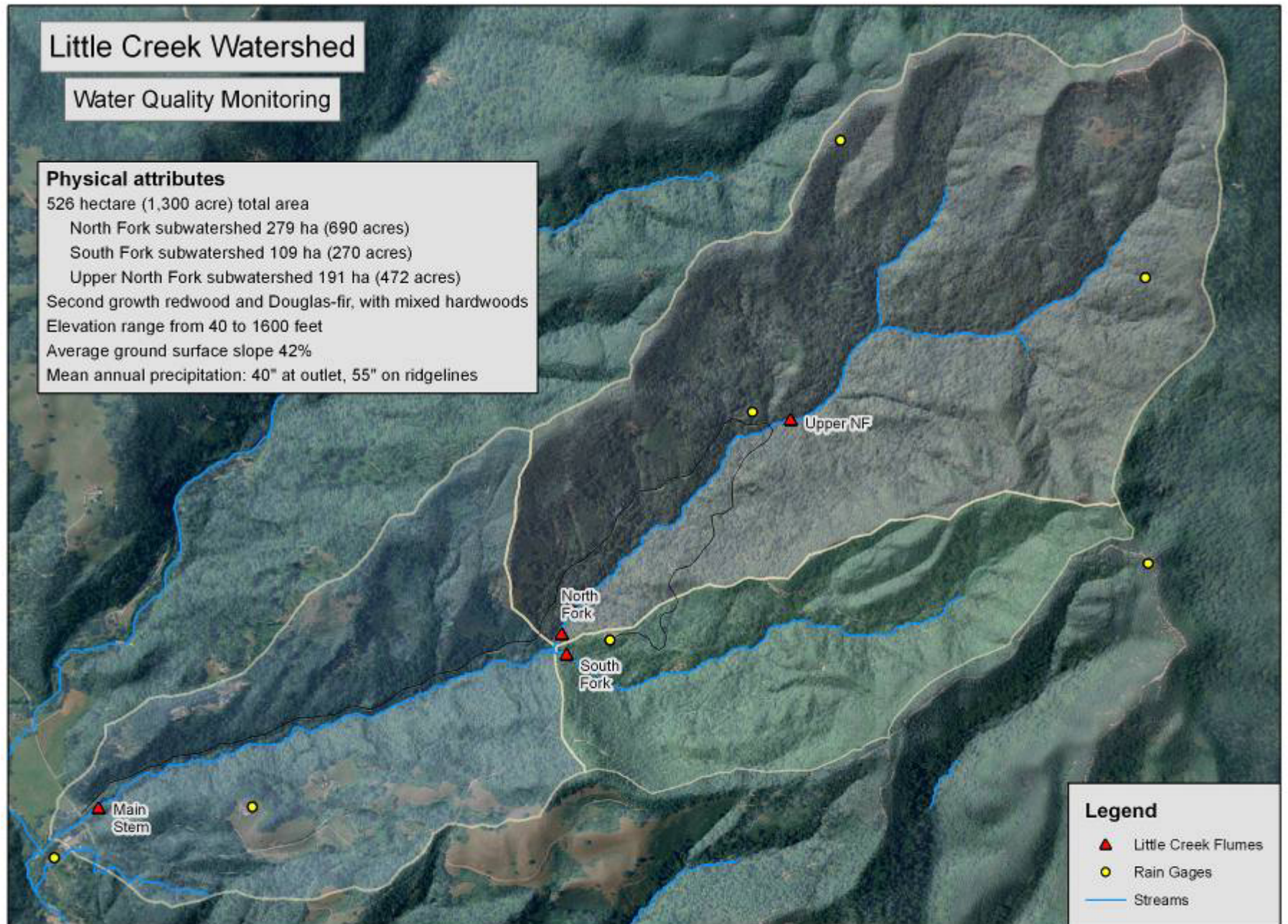
Upper North Fork subwatershed 191 ha (472 acres)

Second growth redwood and Douglas-fir, with mixed hardwoods

Elevation range from 40 to 1600 feet

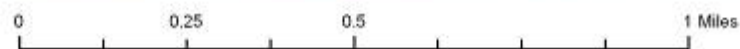
Average ground surface slope 42%

Mean annual precipitation: 40" at outlet, 55" on ridgelines



Legend

- ▲ Little Creek Flumes
- Rain Gages
- Streams



Management history



Looking Downstream in
North Fork ~1910

Looking Upstream in
North Fork ~2000



Little Creek study goals and current analysis

- Scientifically document water quality and channel conditions before, during, and after single-tree and small group selection harvests
- Evaluate the effectiveness of current forest practice rules and best management practices for timber harvesting activities in maintaining existing water quality and channel conditions
- Current analysis
 - Analyze the storm event water quality data from the Little Creek watershed to assess the calibration (pre-treatment phase) of the Little Creek Study.
 - Describe the existing variability
 - Determine the magnitude of change capable of being detected in the post-treatment period

Timeline and study design

Calibration period 2001-2008

- Measure existing water quality

Treatment in 2008

- Harvest portion of watershed between the North Fork and Upper North Fork stations

Post-treatment 2008-2011+

- Measure for potential change in water quality

Paired Watershed Design

- Control watershed: South Fork
- Treatment watershed: North Fork

Nested Watershed Design

- Control Watershed: Upper North Fork
- Treatment watershed: North Fork



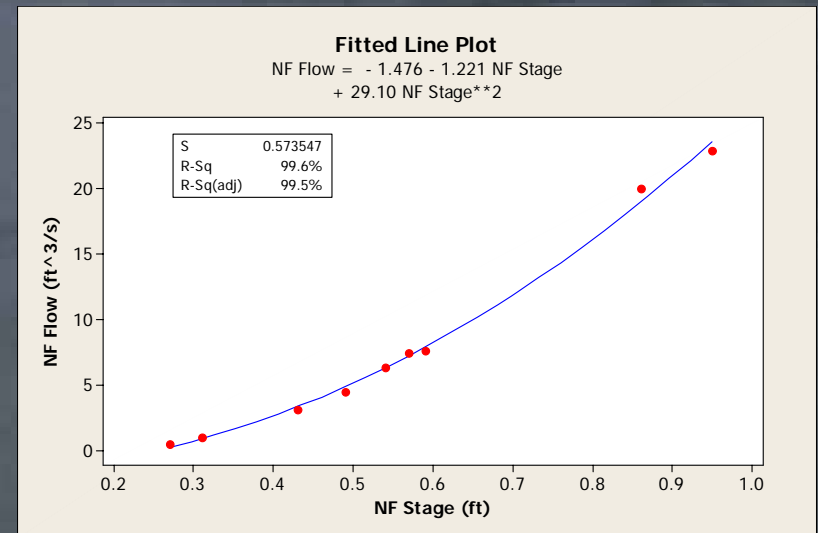
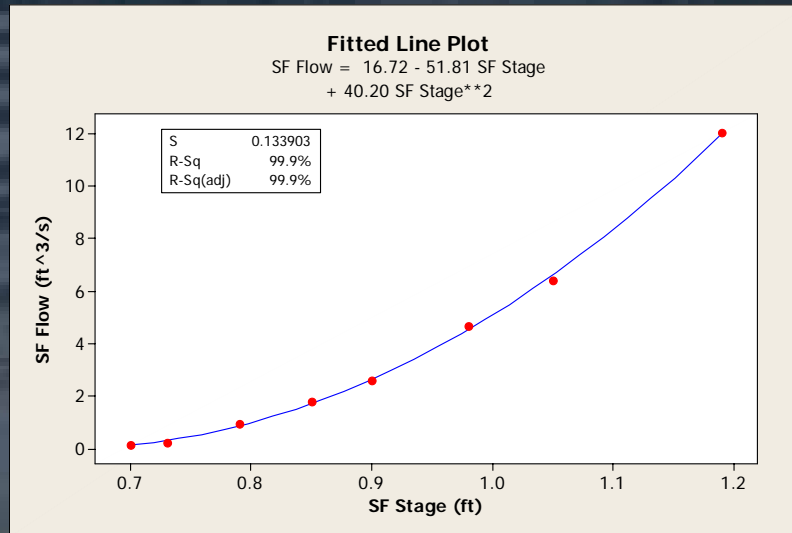


Field data collection – stage and streamflow

Stage



- A. Flow Meter
- B. Pressure Transducer
- C. FW-1 Stage Recorder
- D. Staff Gage



Field data collection – water quality samples

- 1-hour interval samples
- Collection of 24 bottles before swap



Lab Water Quality Testing

- Lab analysis of 1 hour samples
 - Turbidity
 - Units: nephelometric turbidity units (NTUs)
 - Suspended Sediment Concentration (SSC)
 - Units: mg/L



A. Turbidimeter



B. Scale

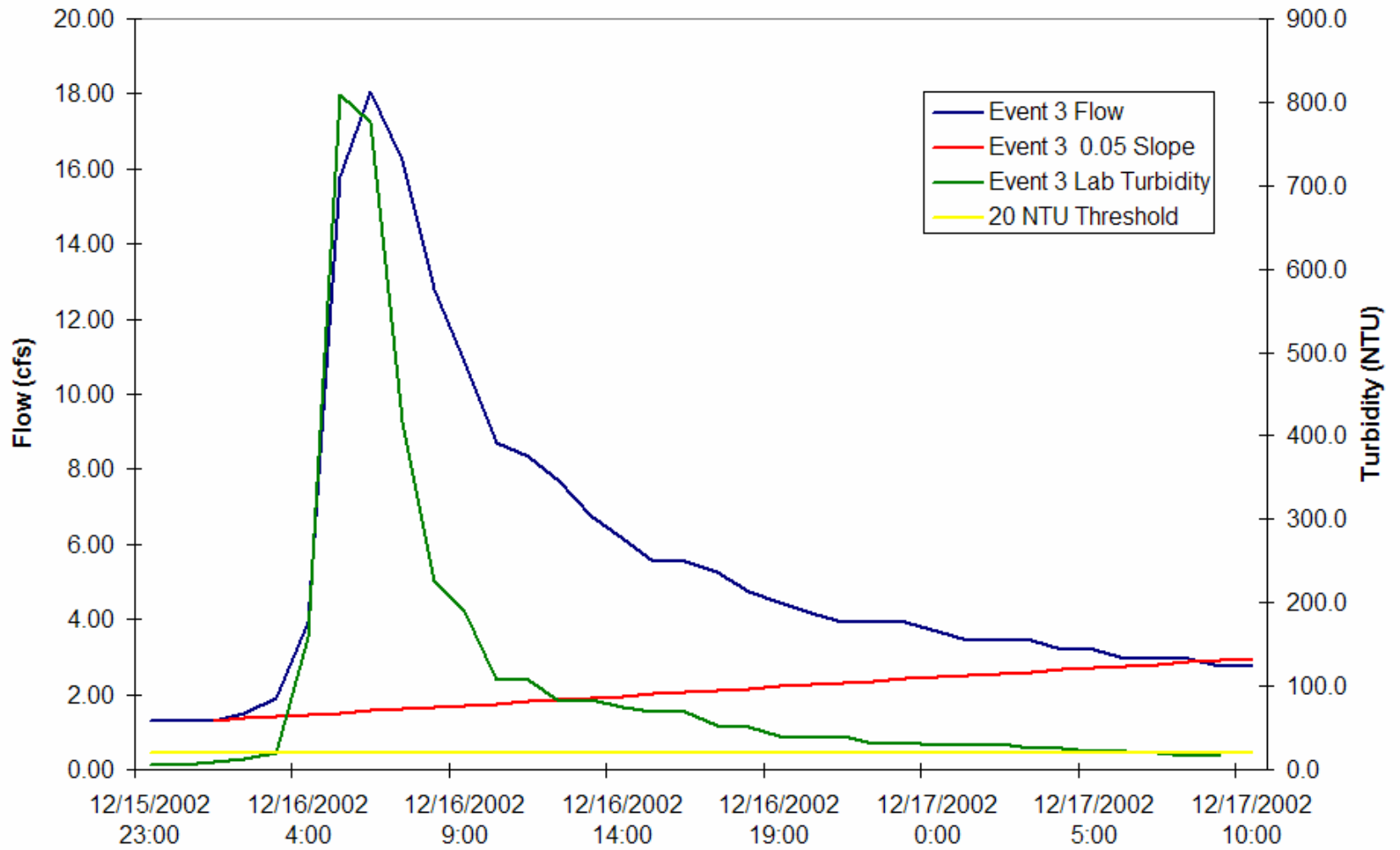
Defining the dataset – Predicting SSC from turbidity

- Need for SSC to be predicted from turbidity
 - Turbidity shown to be a better predictor than flow
- Previous research has indicated SSC versus turbidity is a variable relationship that is best defined on an event basis
- Regression analysis used to establish relationship.
 - Regressions assessed based on r^2 , p-value, residual plots, and fits
 - Data transformations when necessary

Defining the dataset – storm events

- Minimum storm event size based on turbidity
 - Peak must be greater than 20 NTUs
 - Only samples >20 NTUs analyzed for SSC
- Define storm events based on the hydrograph using Hewlett and Hibbard (1967) 0.05 slope method
 - Separates storm flow from base flow
- Storm event ends when turbidity drops below 20 NTUs or the 0.05 slope line intersects the hydrograph

North Fork 2002-2003 Event #3

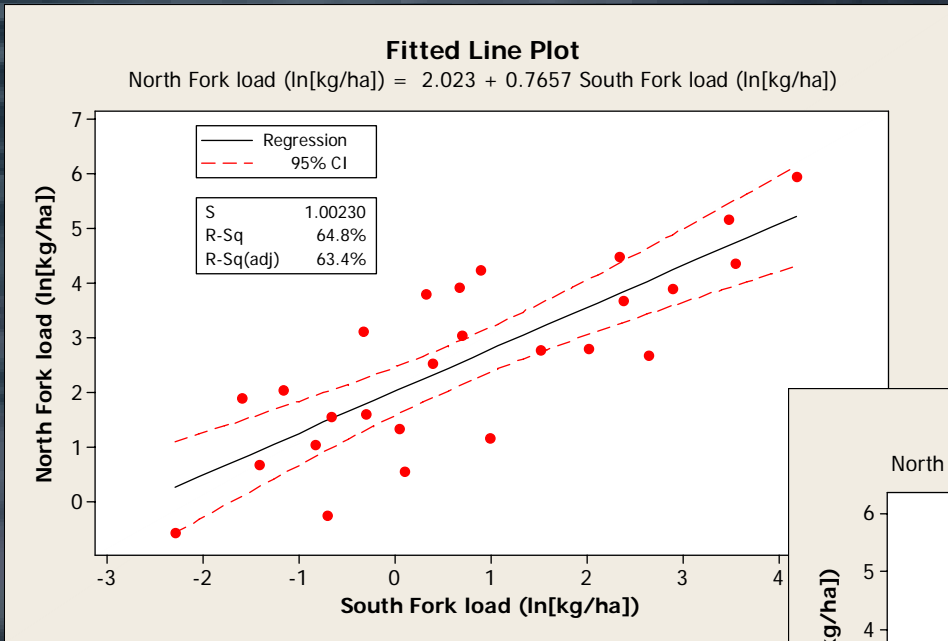


Event load calculation

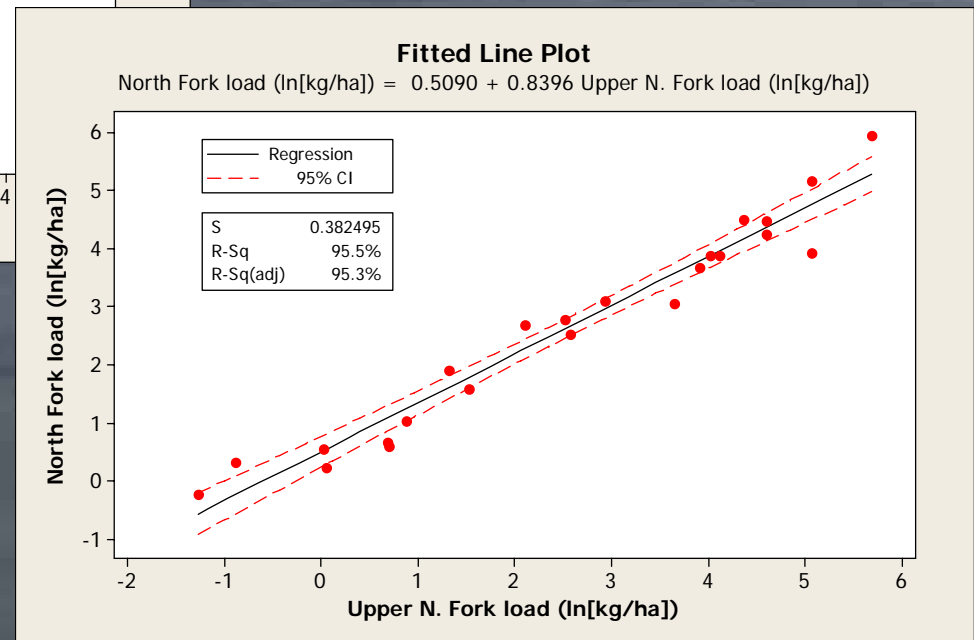
- Events with complete SSC and flow datasets used for analysis
 - Must have both datasets to calculate loads
- Calculate individual hourly loads to determine event loads
 - High temporal variability requires hourly sums
- Event loads establish the calibration dataset
 - Changes in the relationship used to detect change

Paired and nested analysis after transformations

Paired



Nested

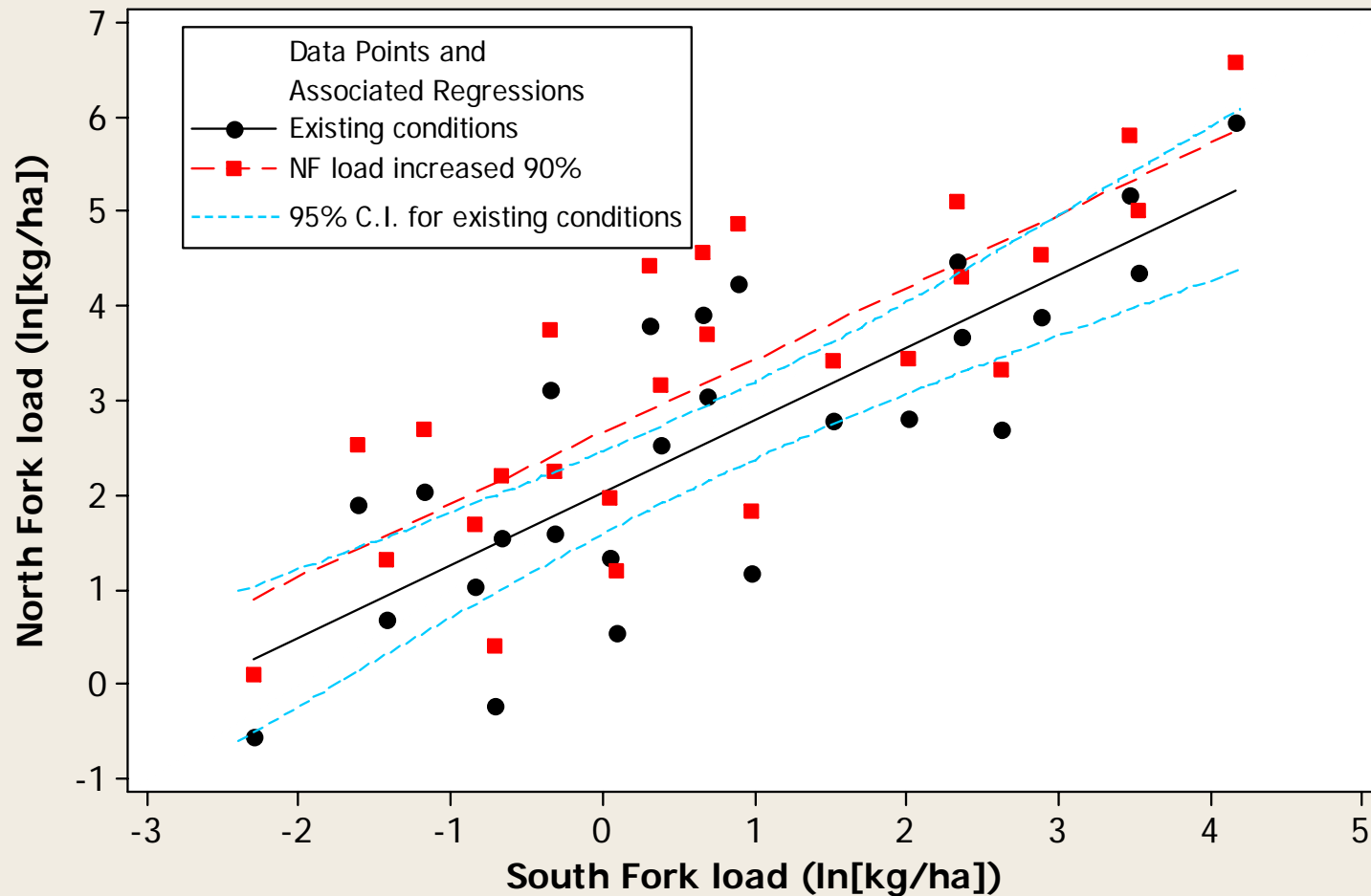


Assessing detectable magnitude of change using confidence intervals

- Back-transformation of confidence interval into non-logarithmic numbers not valid
- Generate a synthetic dataset representing percentage increases over the original dataset
- Transform the new dataset, perform regression, and compare new regression line to original confidence interval

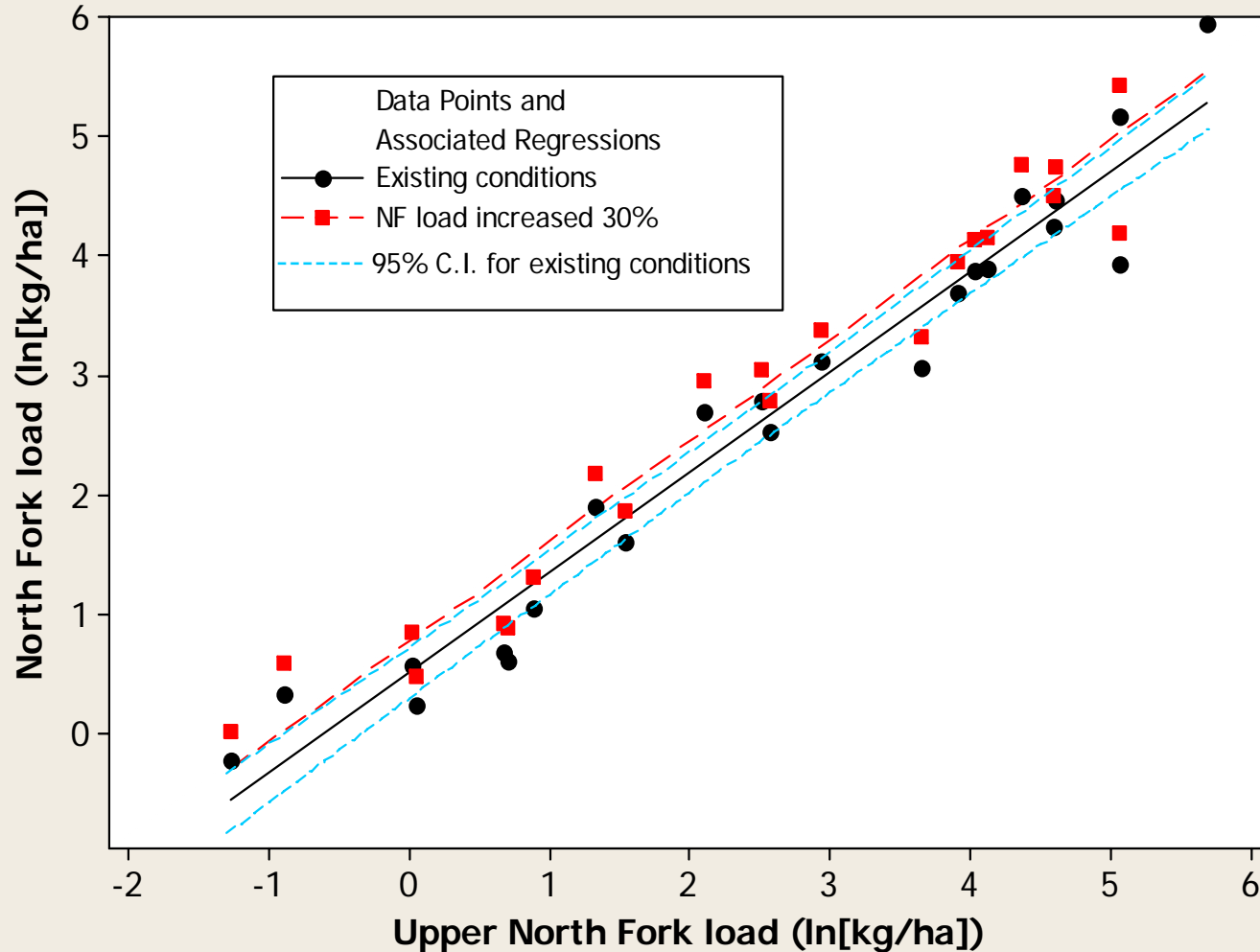
New regression line comparison to existing confidence intervals for NF versus SF

90% Increase in Existing NF Conditions, NF v SF



New regression line comparison to existing confidence intervals for NF versus UNF

30% Increase in Existing NF Conditions, NF v UNF



Conclusions

- Suspended sediment versus turbidity relationship has allowed for prediction of suspended sediment data
 - Established on an event basis
- Data thus far has yielded a sufficient number of event-specific suspended sediment loads to enable simple linear regression analysis
 - Nested (NF versus UNF) relationship indicates less variability than paired (NF versus SF) relationship
 - Narrower confidence intervals for magnitude of change detection for nested relationship

Other Little Creek Study Components

- Annual geomorphic surveys
 - Longitudinal profiles and cross sections to detect potential sediment source/sink areas
- LIDAR mapping analysis (Russ White)
 - Stream channel and road features under forest canopy
 - Comparison with conventional surveys

Questions?

