



Lower Saluda River Instream Flow Study

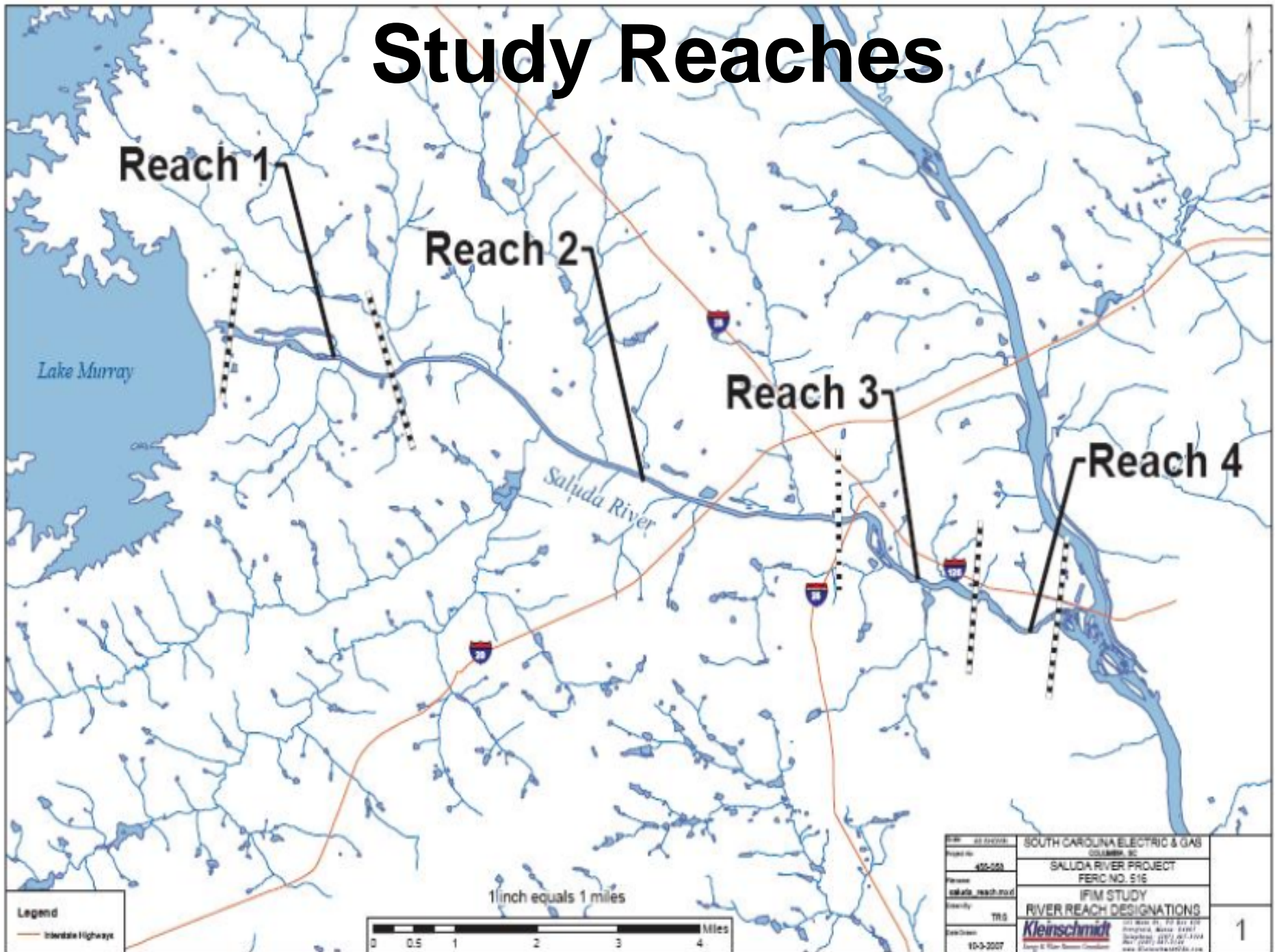
TWC Study Team Workshop
December 11, 2007

PHABSIM Study

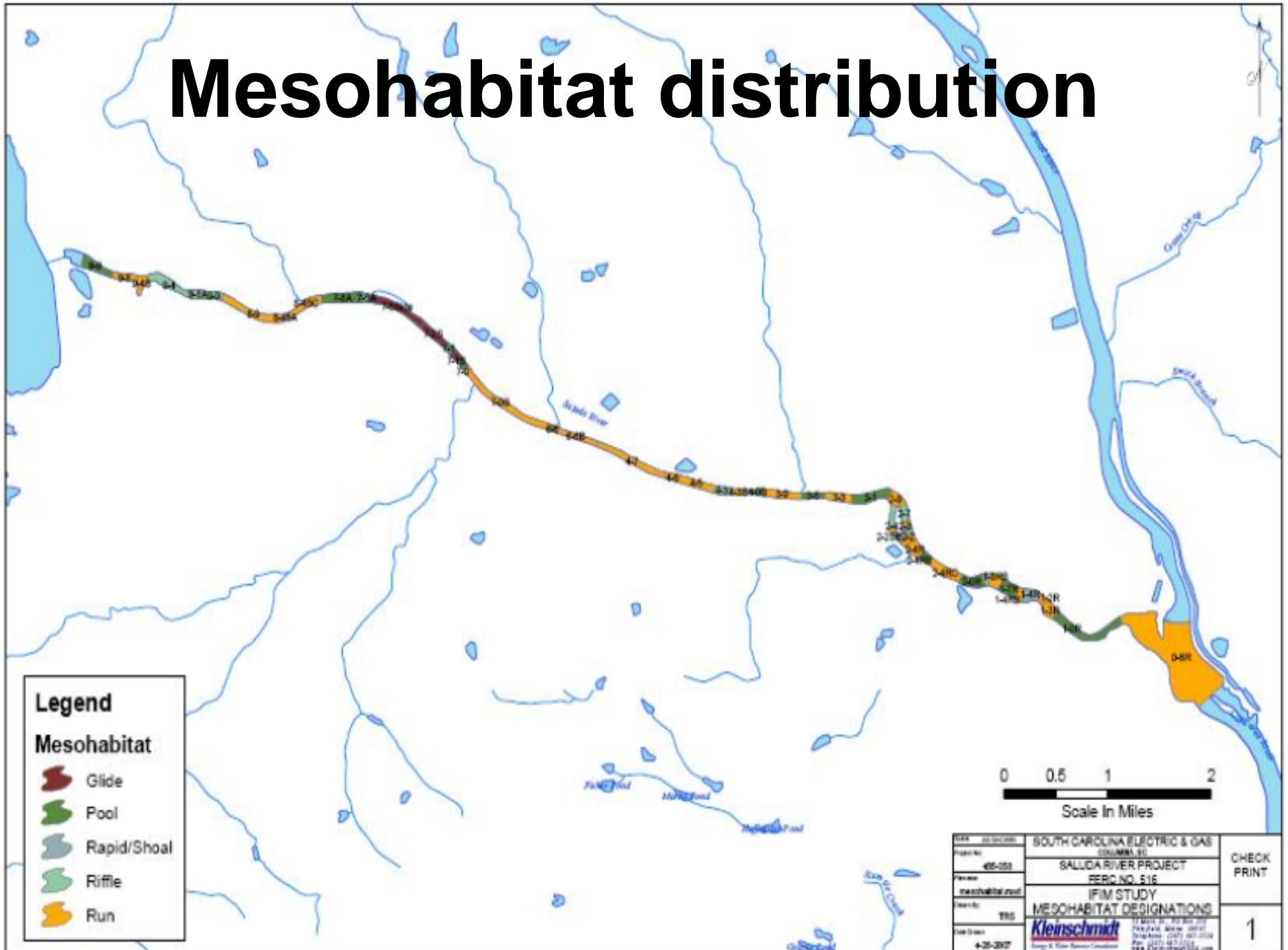
1. Study Planning
2. Locate reaches and transects
3. Obtain channel profile and microhabitat data
4. Develop hydraulic model
5. Input suitability rating criteria
6. Output suitability available at each flow increment of interest



Study Reaches



Mesohabitat distribution

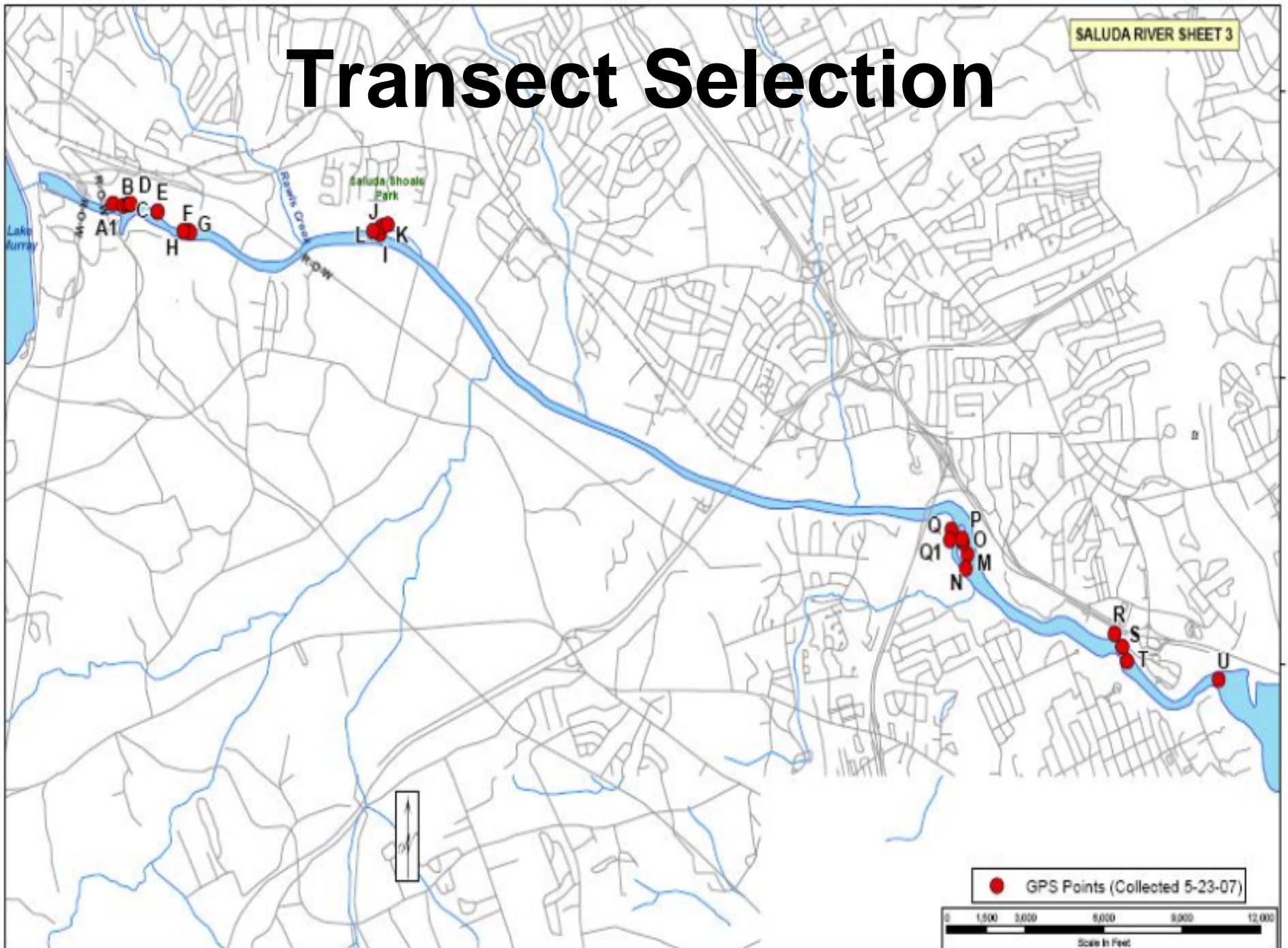


TWC Site Reconnaissance

- November 2006 orientation
- May 2007 transect selection at 500 cfs

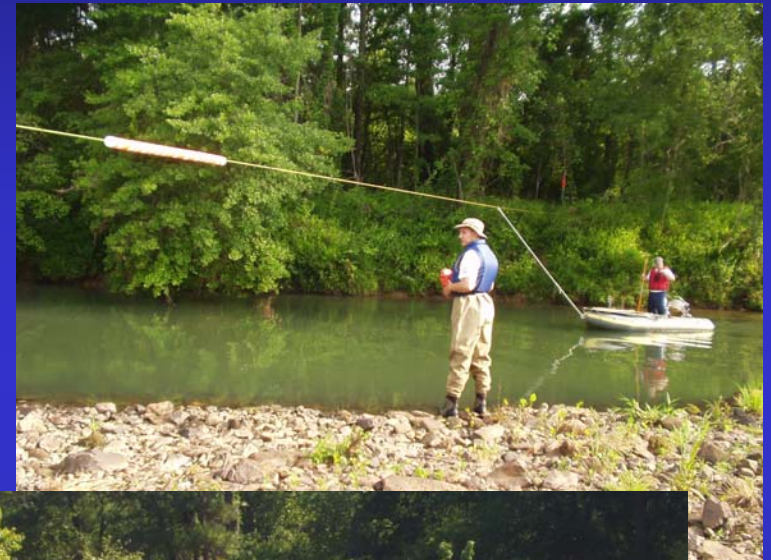


Transect Selection



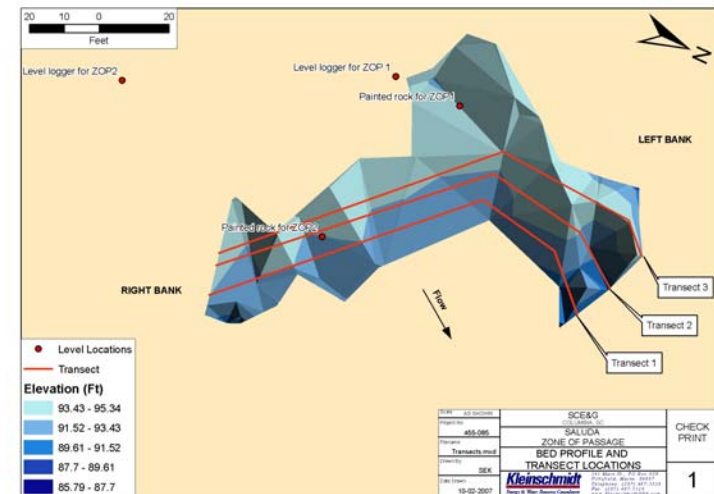
Data Collection

- Site surveying
- Bed elevation
- Substrate mapping
- Water surface elevation
- Velocities
- Stream gaging

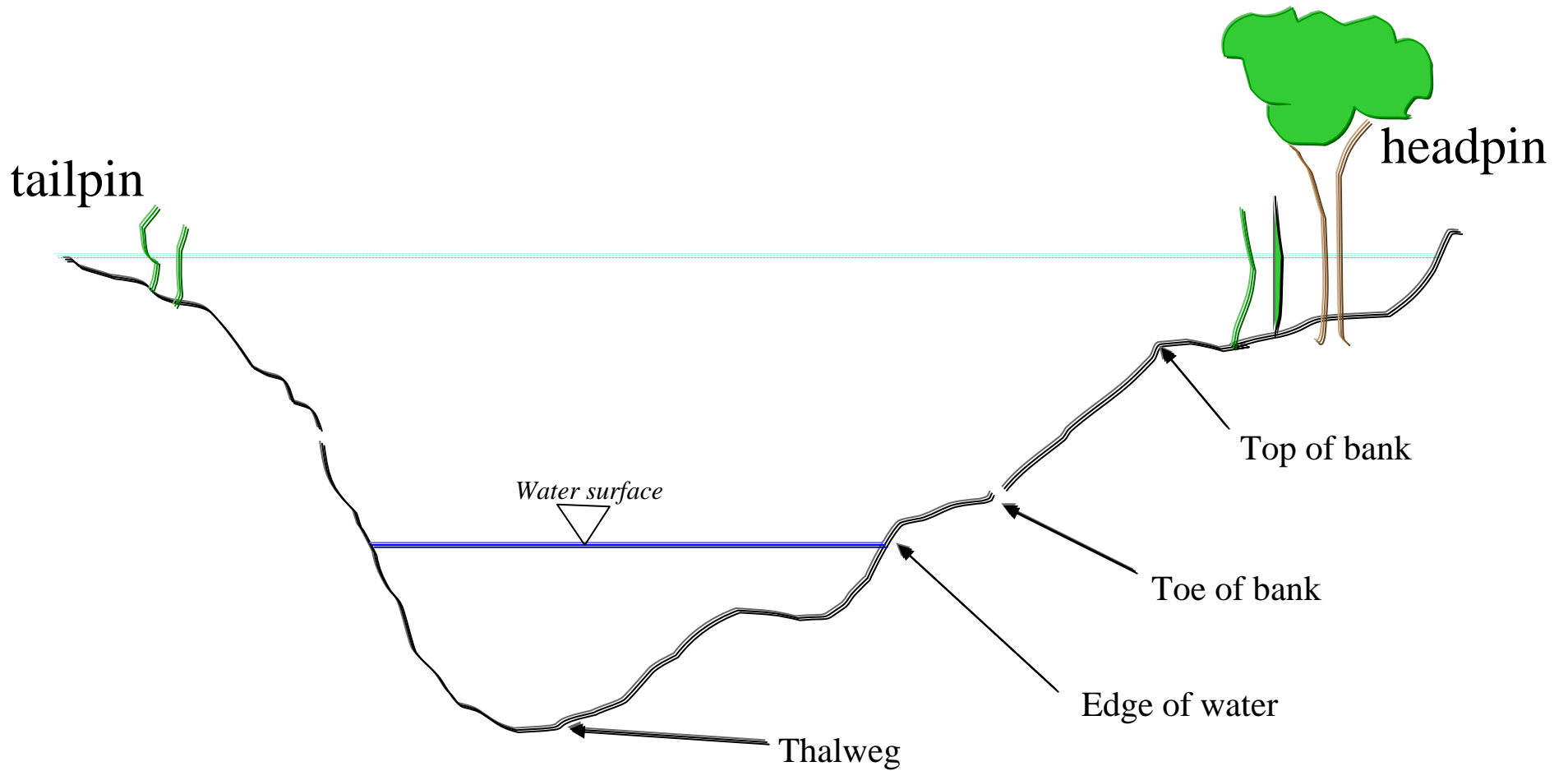


Velocity and elevation data

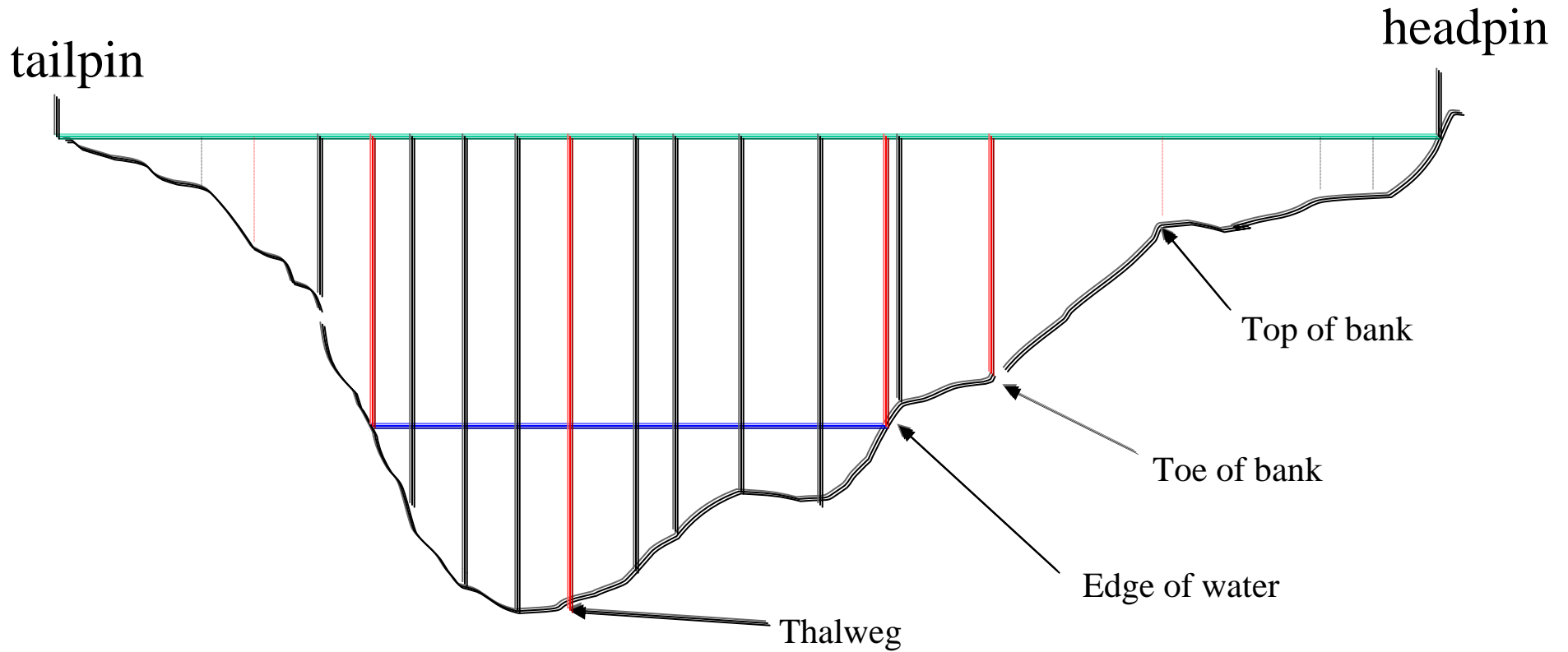
- Standard optical survey
- Electronic flow meter
- Acoustic Doppler Profiler
- Trimble GPS
- Level logger



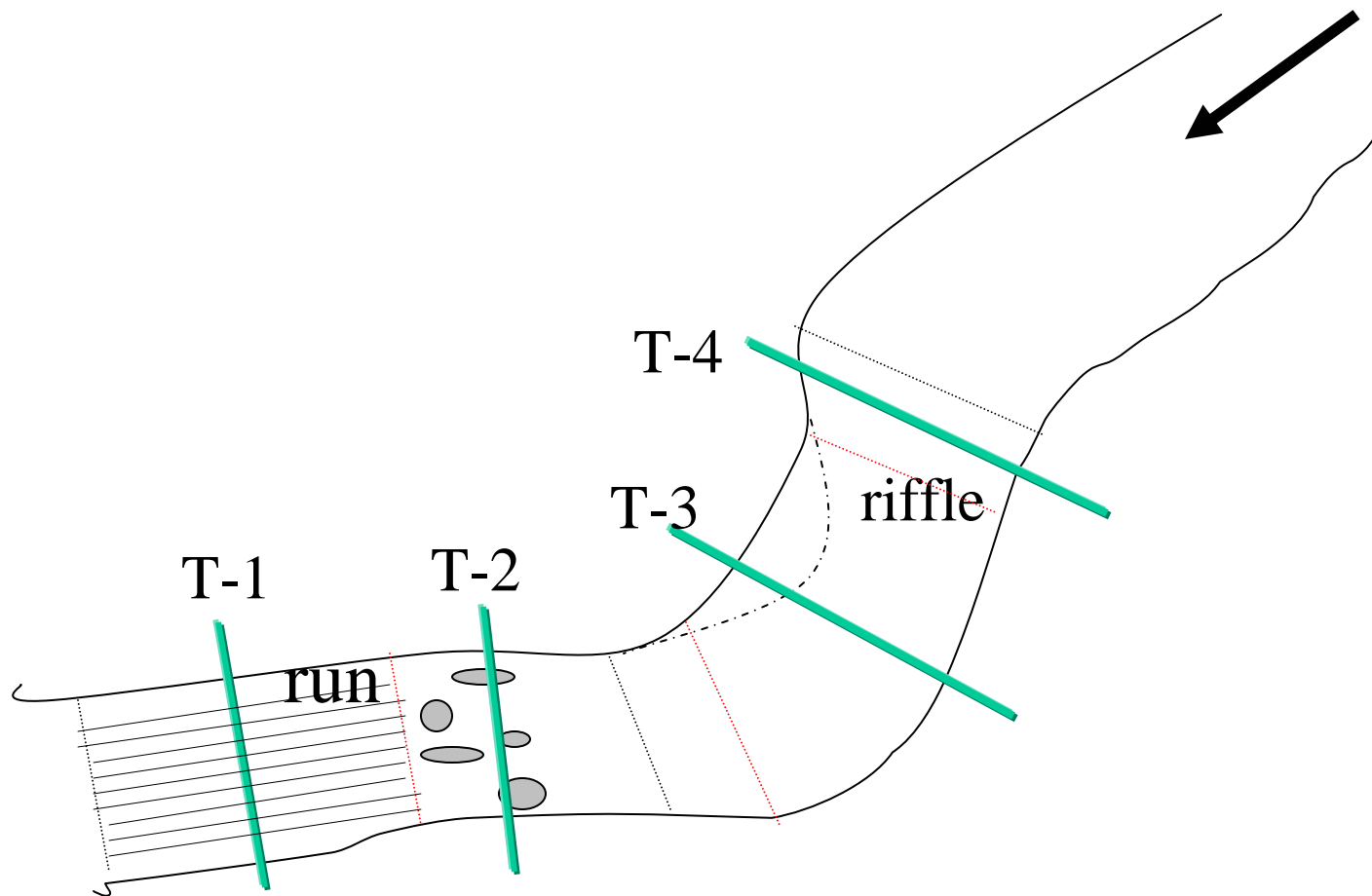
Typical transect (*looking downstream*)



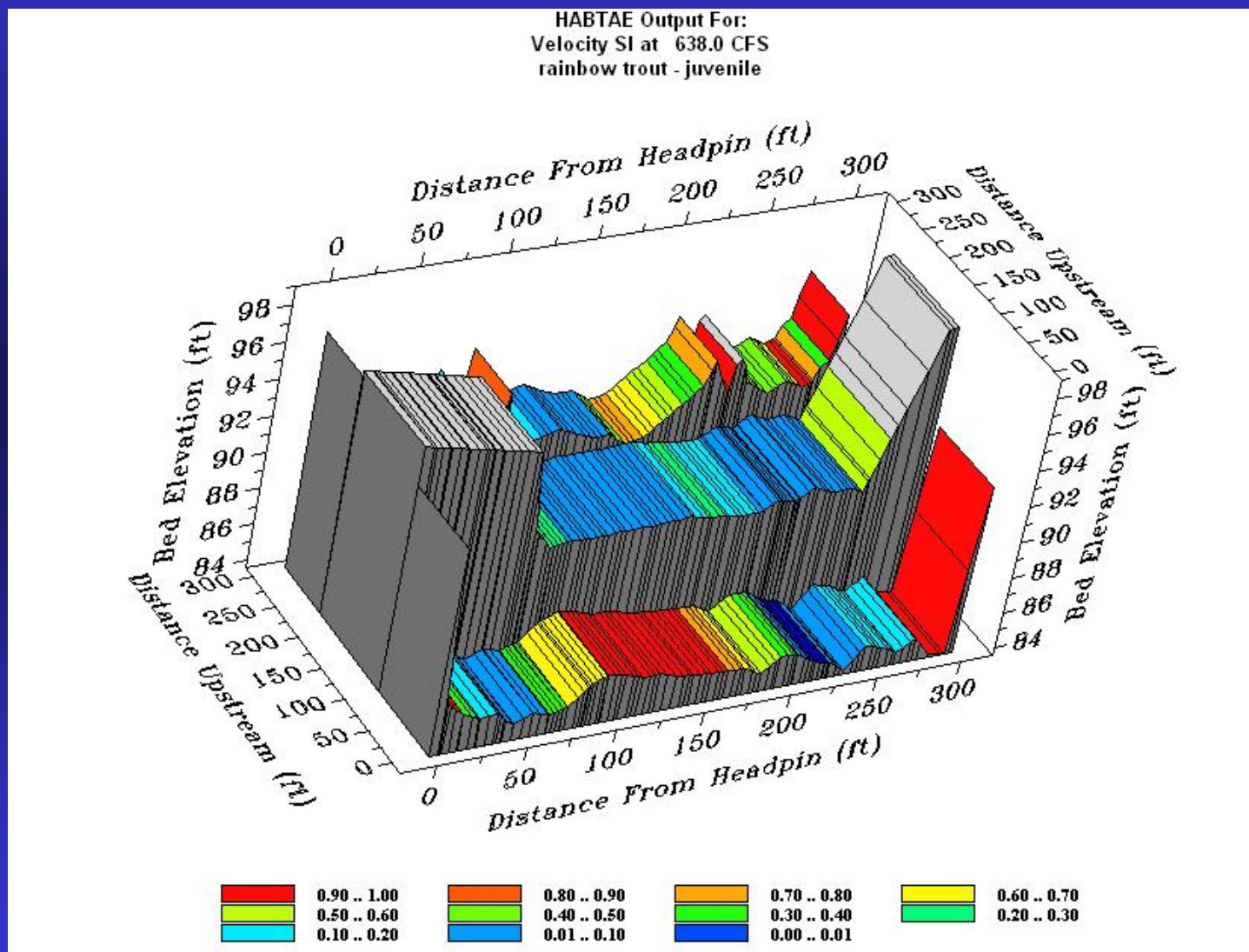
Verticals are located to capture key substrate and profile features



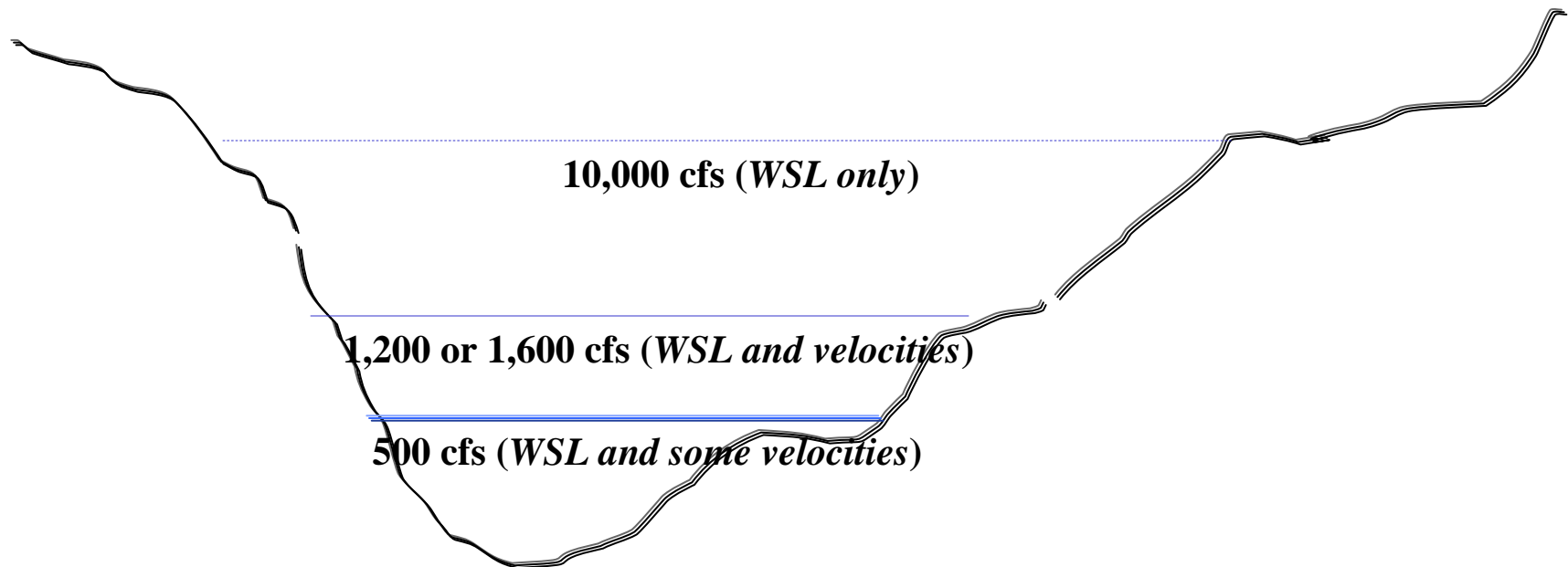
Verticals and cell boundaries act to divide each segment into a mosaic of known areas



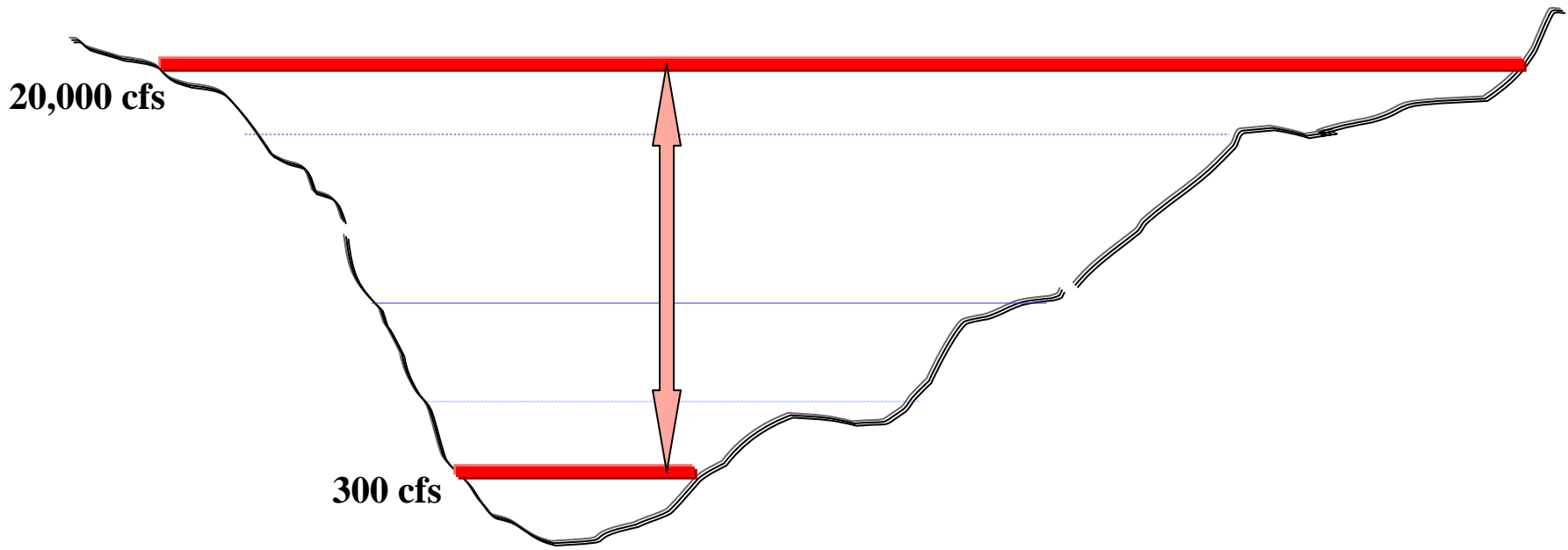
Habitat is “pixilated” into a mosaic of known dimensions



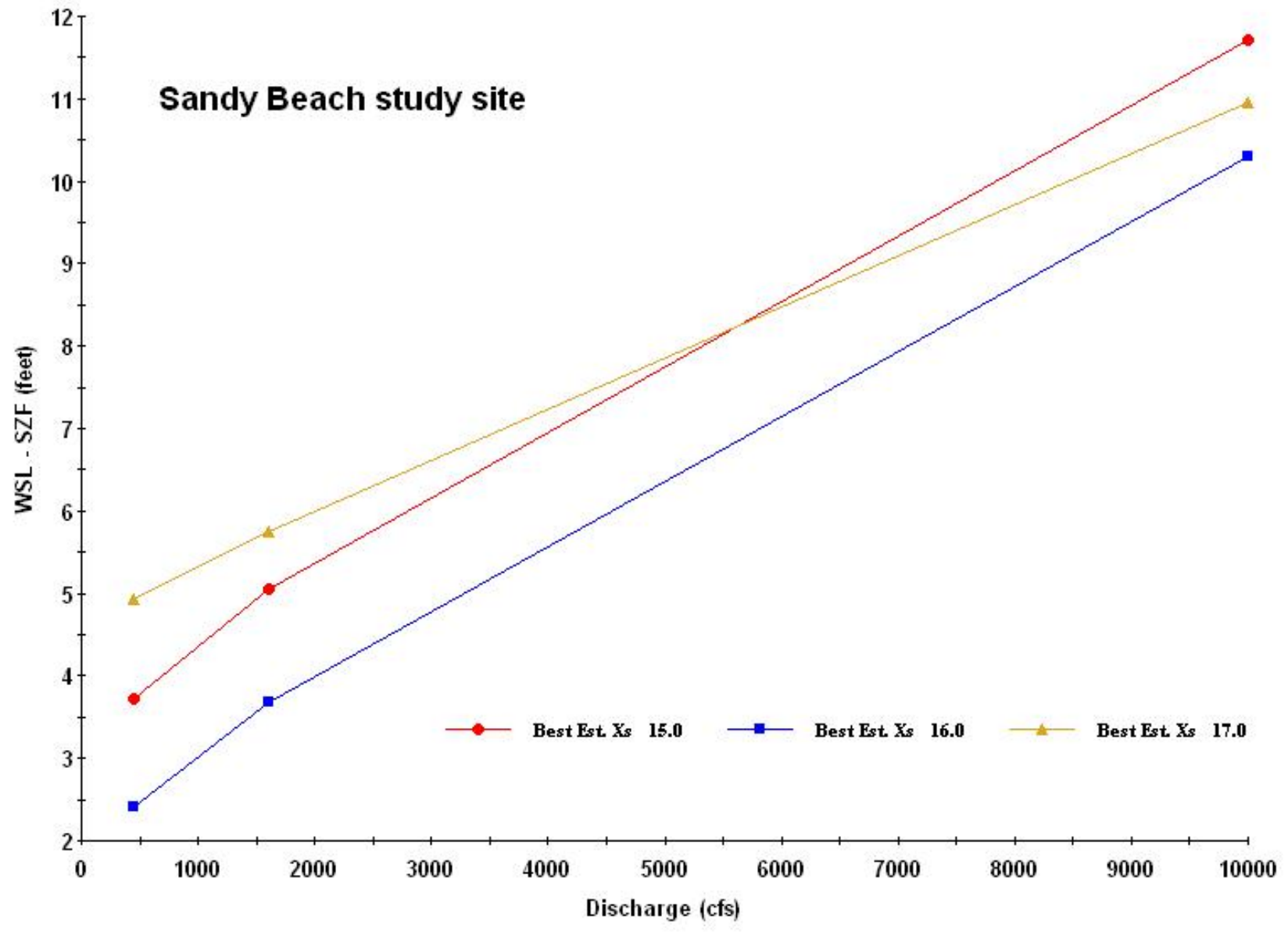
Calibration data gathered across a spectrum of flows



permits interpolation and extrapolation of hydraulics at other flows



Sandy Beach study site

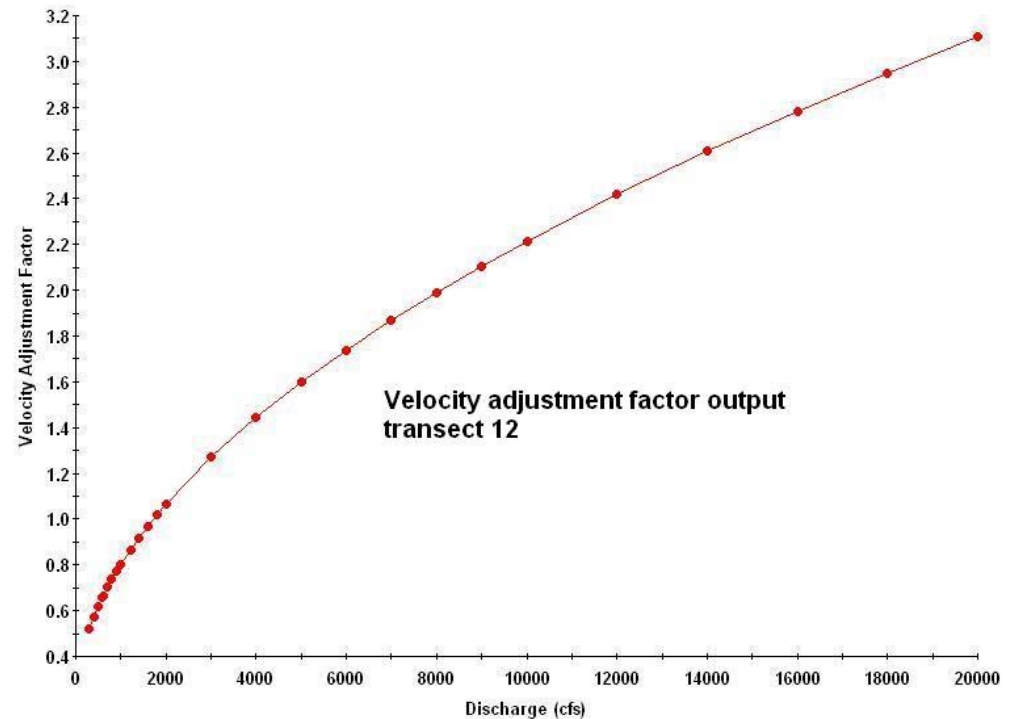


Transect 2 at three calibration flows

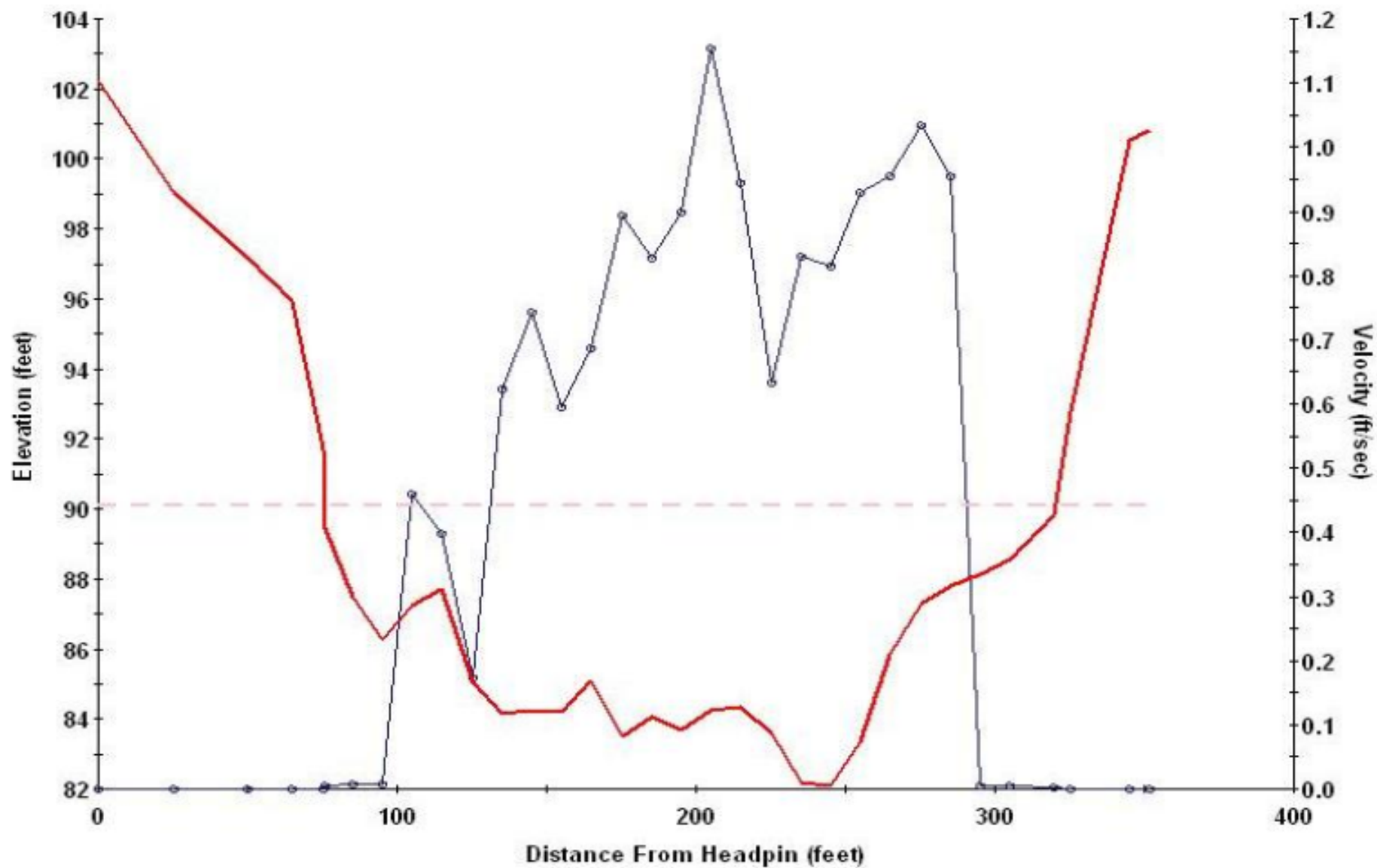


Model Calibration

- Establish stage-discharge relationship
- Calibrate velocities
- Simulate WSL's and velocities for other flows



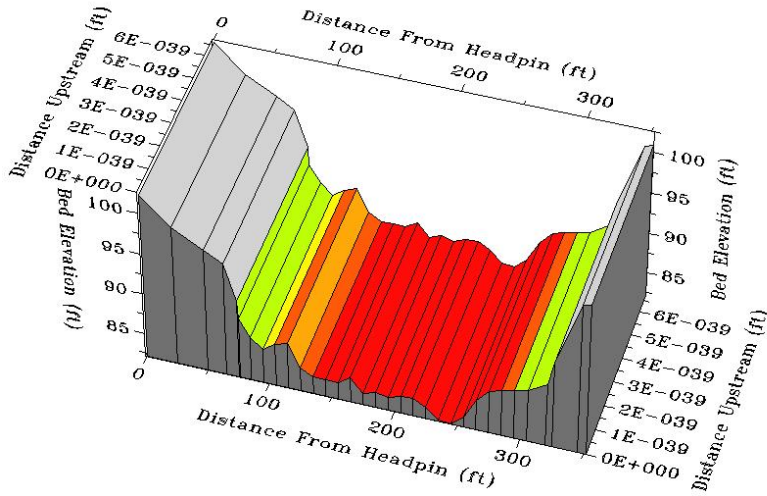
Bed Profile, WSL, Velocity
Cross Section 12.0



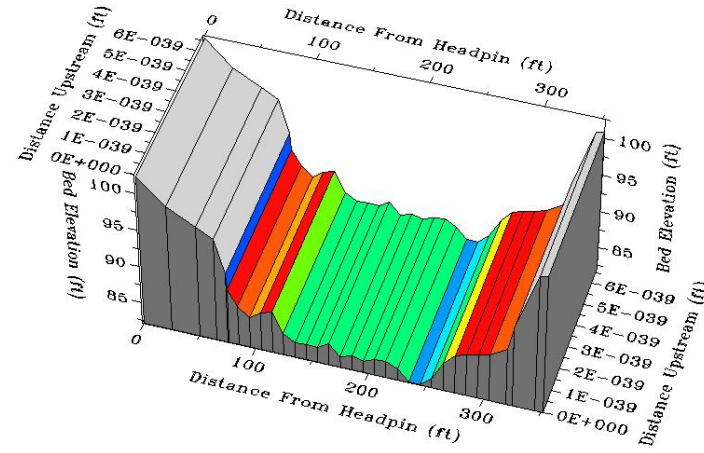
— Bed - - - WSLs(800.0) —○— VELs(800.0)

Depth, velocity and substrate are rated according to SI Criteria

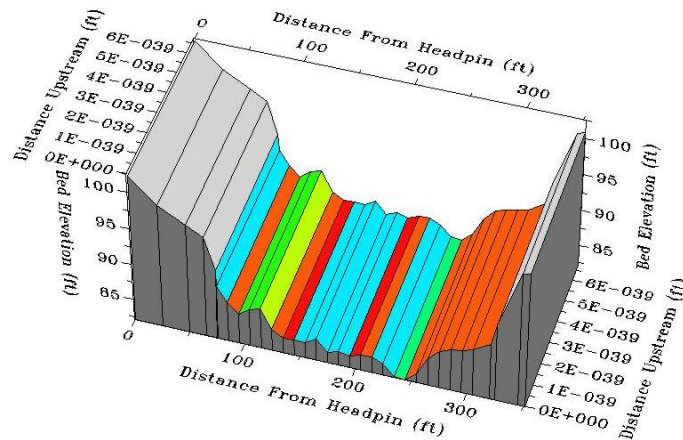
HABTAE Output For:
Velocity SI at 800.0 CFS
smallmouth bass - juvenile



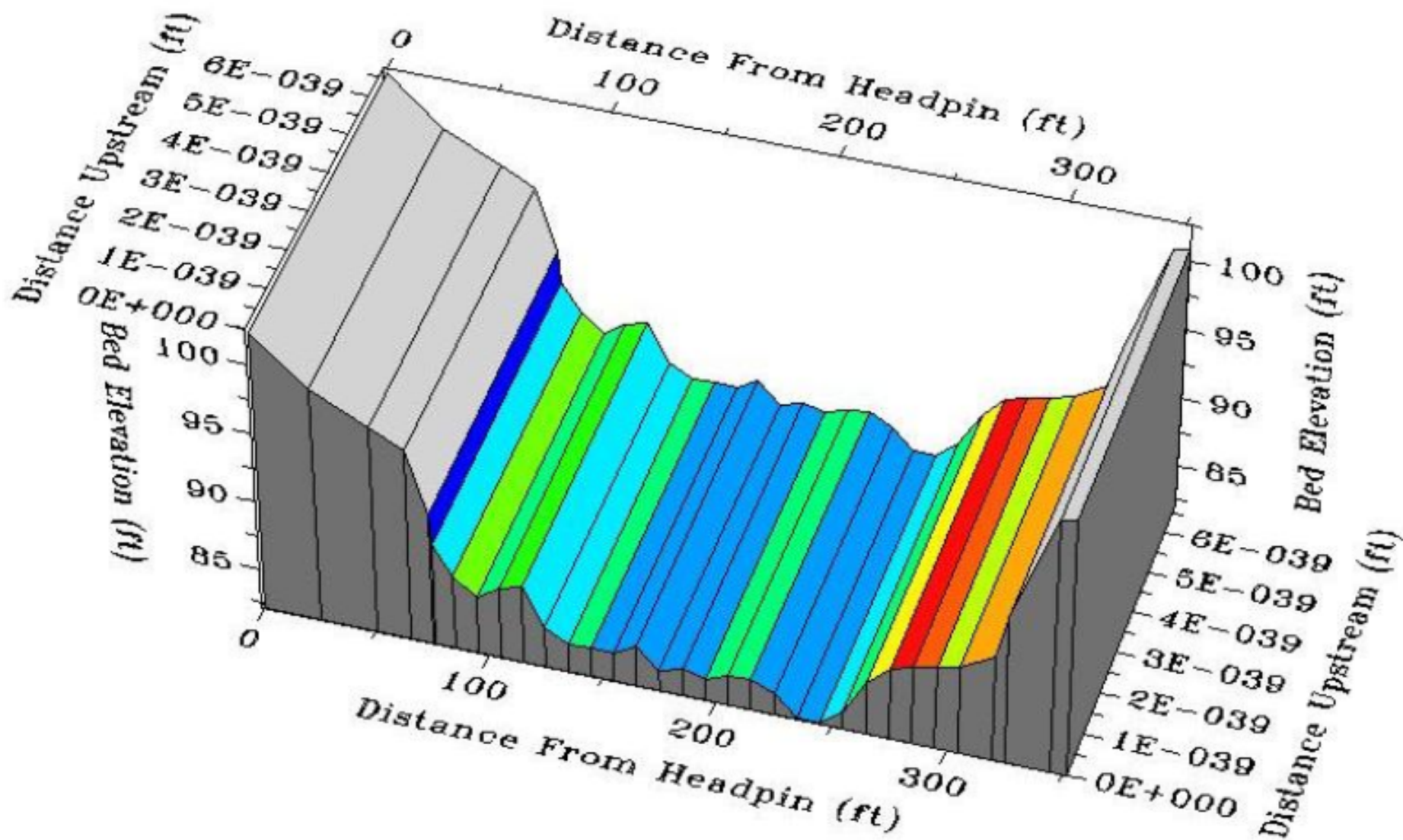
HABTAE Output For:
Depth SI at 800.0 CFS
smallmouth bass - juvenile



HABTAE Output For:
Channel Index SI at 800.0 C
smallmouth bass - juvenile

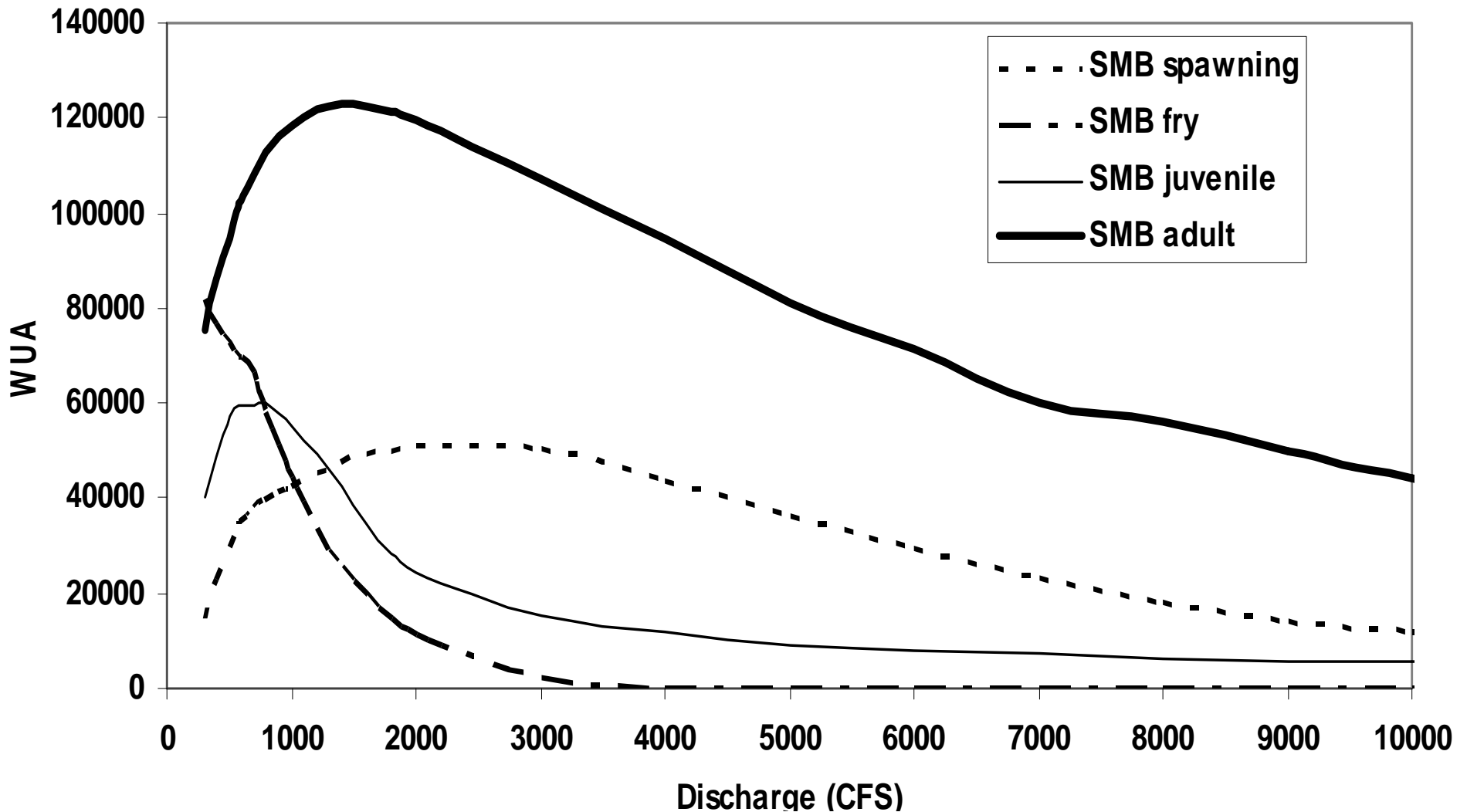


HABTAE Output For:
 WUA at 800.0 CFS
 smallouth bass - juvenile



Model output: Habitat-flow relationships for each river segment

Figure 16. Saluda River Instream Flow Study. Reach 2 Representative Run
Smallmouth bass habitat suitability



Traditional Problem-Solving Process

Compare habitat under existing flow scenarios

Assess extent to which all objectives are met

Evaluate trade-offs

Consider alternative flows as needed

Compare project operation under existing and alternate flow scenarios

Re-run alternative scenarios

TERMINOLOGY

A photograph of a river flowing through a dense forest. The river is the central focus, with water that appears slightly turbulent. The banks are lined with lush green trees and vegetation. The sky is visible in the distance, showing a mix of blue and white clouds.

Macrohabitat – water quality and hydrology

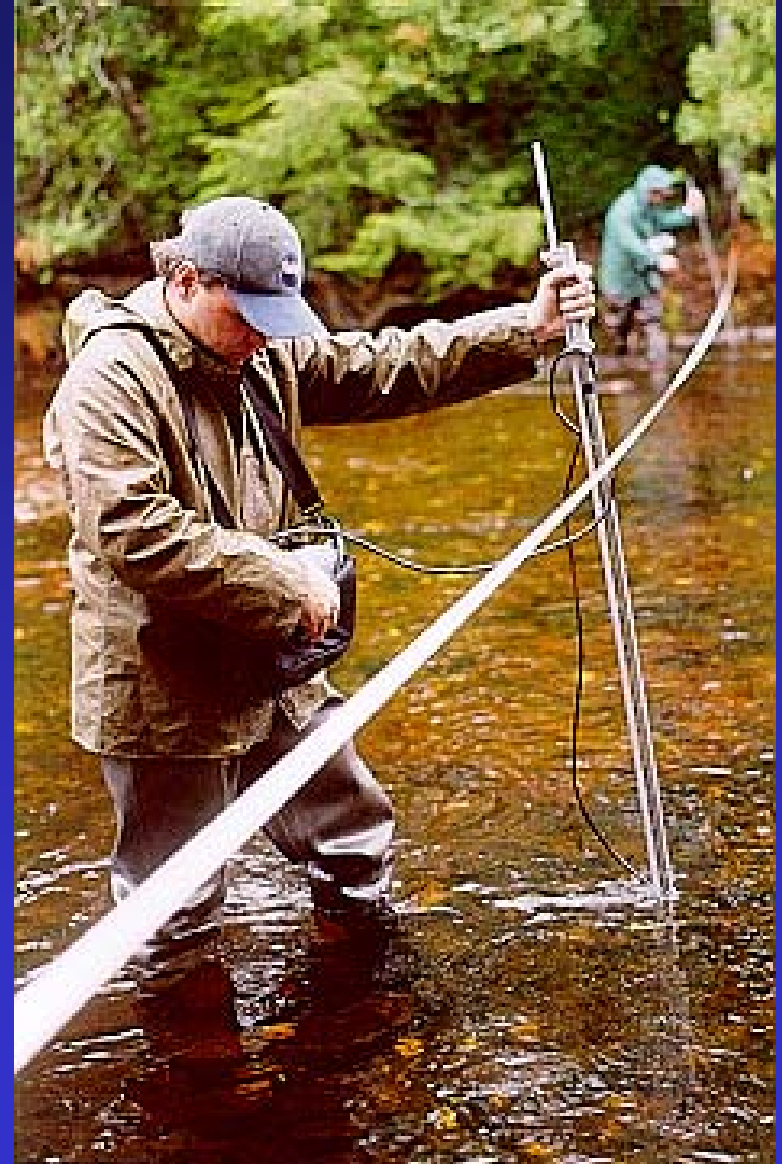
Mesohabitat – commonly occurring habitat types

Critical habitat – important to a species even if not common

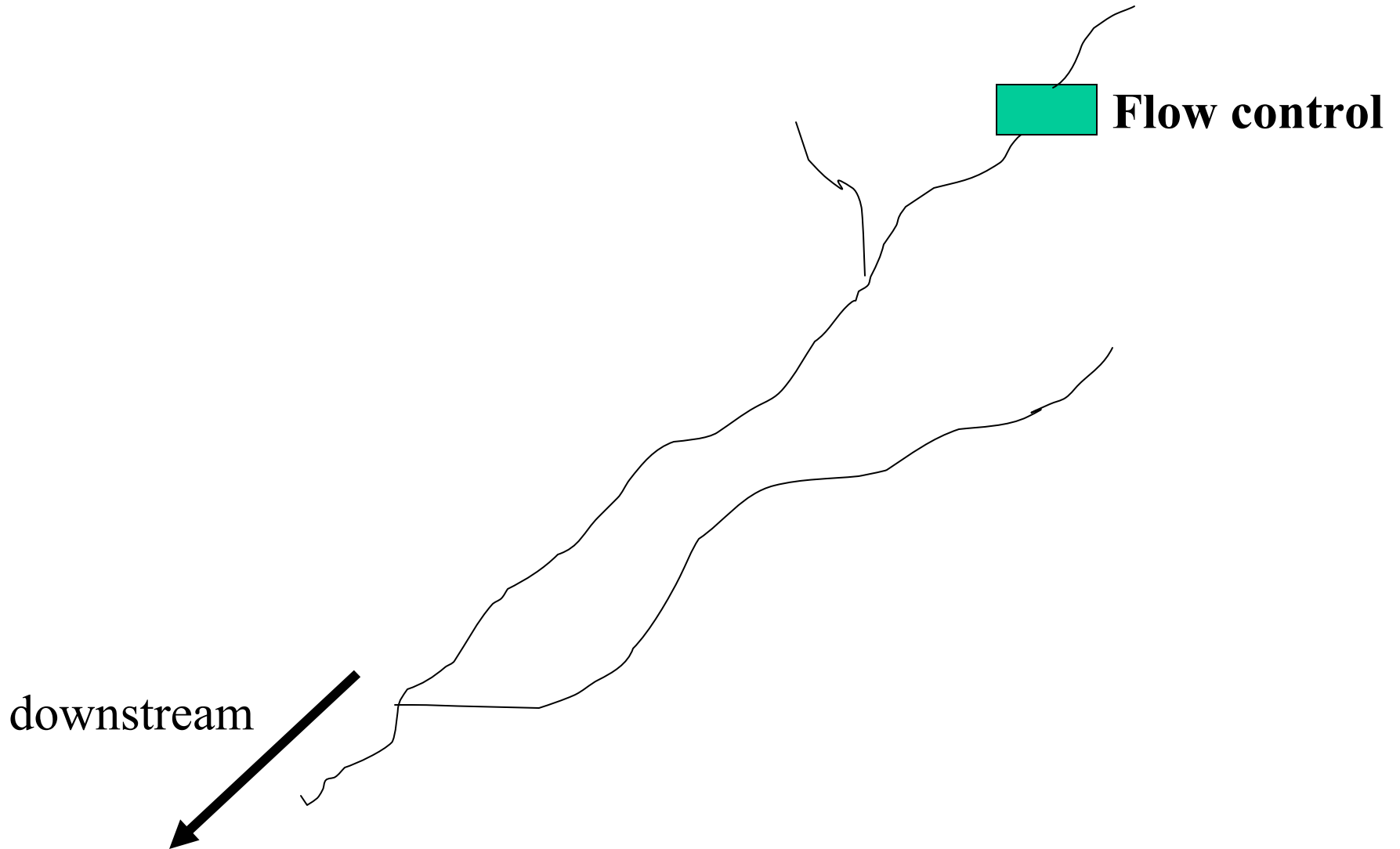
Microhabitat – depth, velocity and cover within each mesohabitat

PHABSIM Study

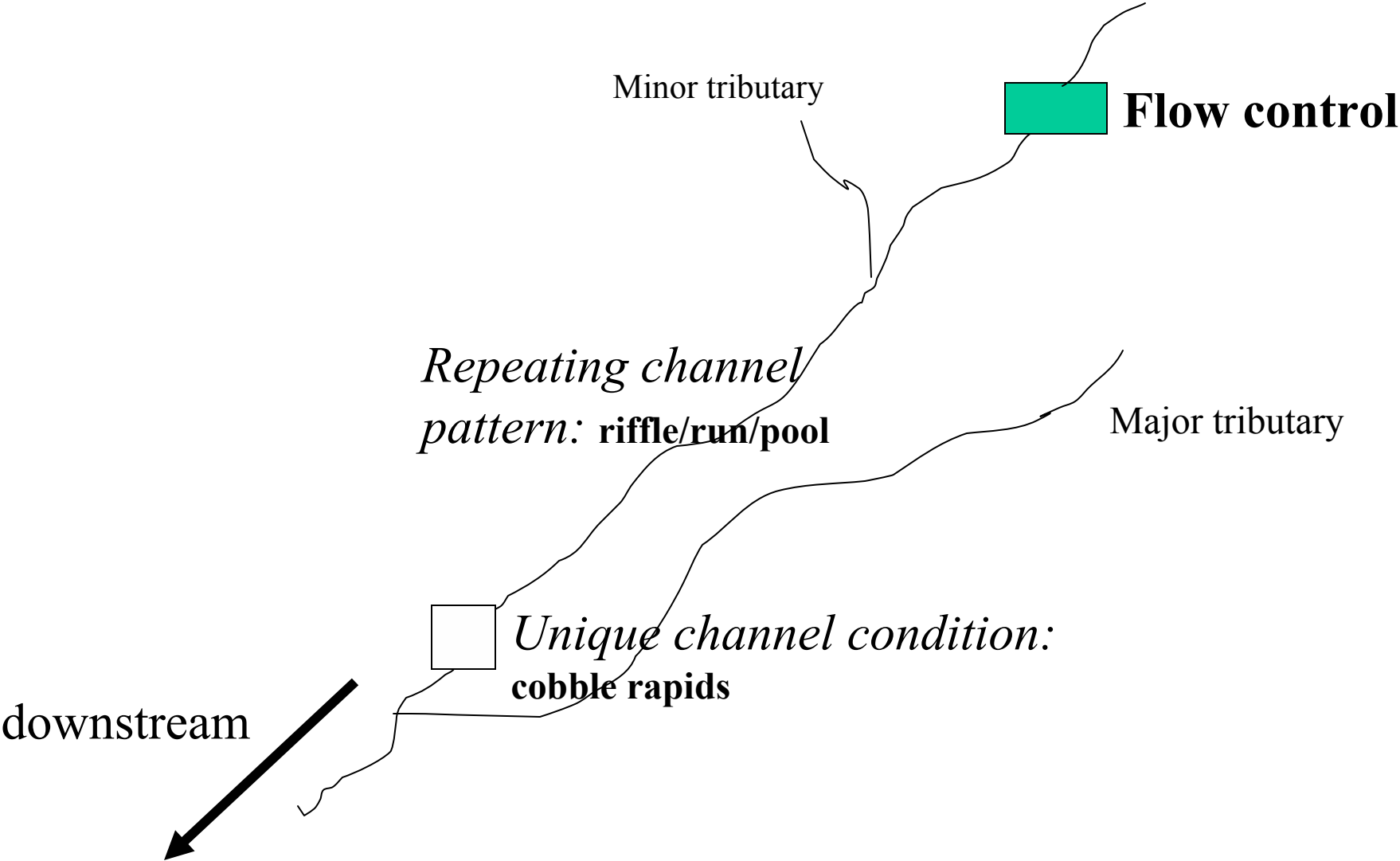
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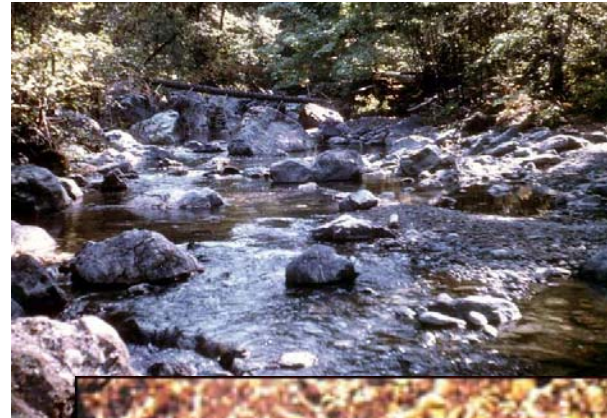
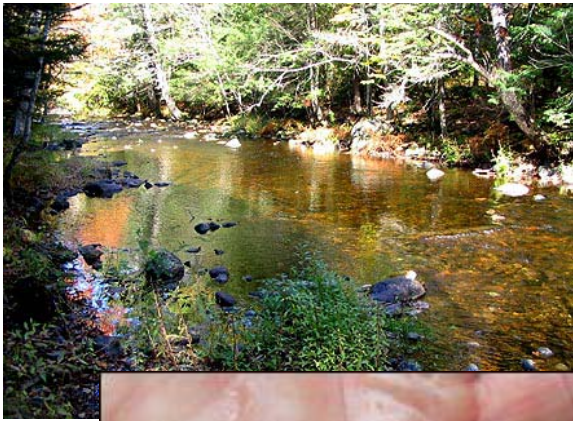
Hypothetical flow control issue



Review physical characteristics

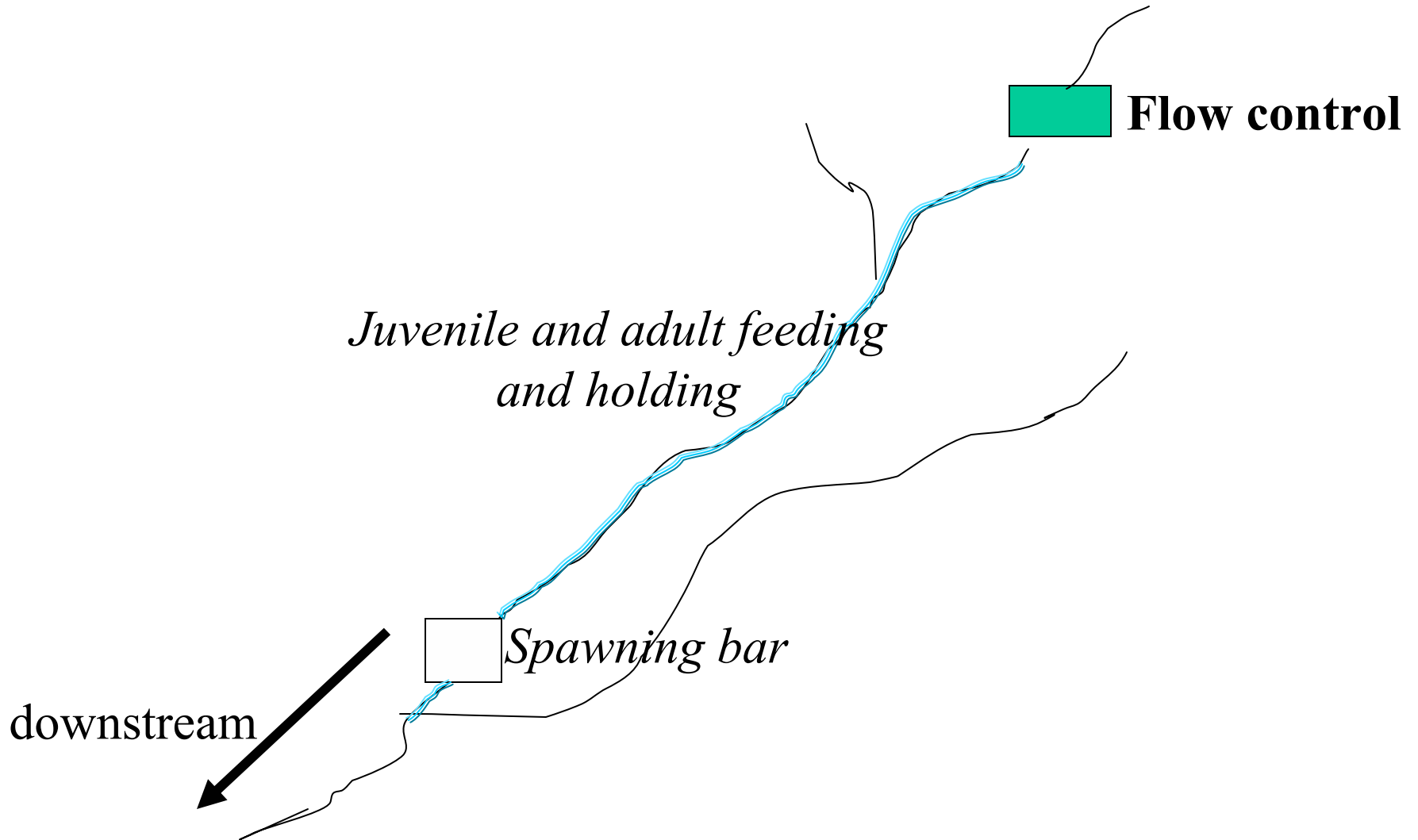


Link species/lifestages or guilds to specific mesohabitats

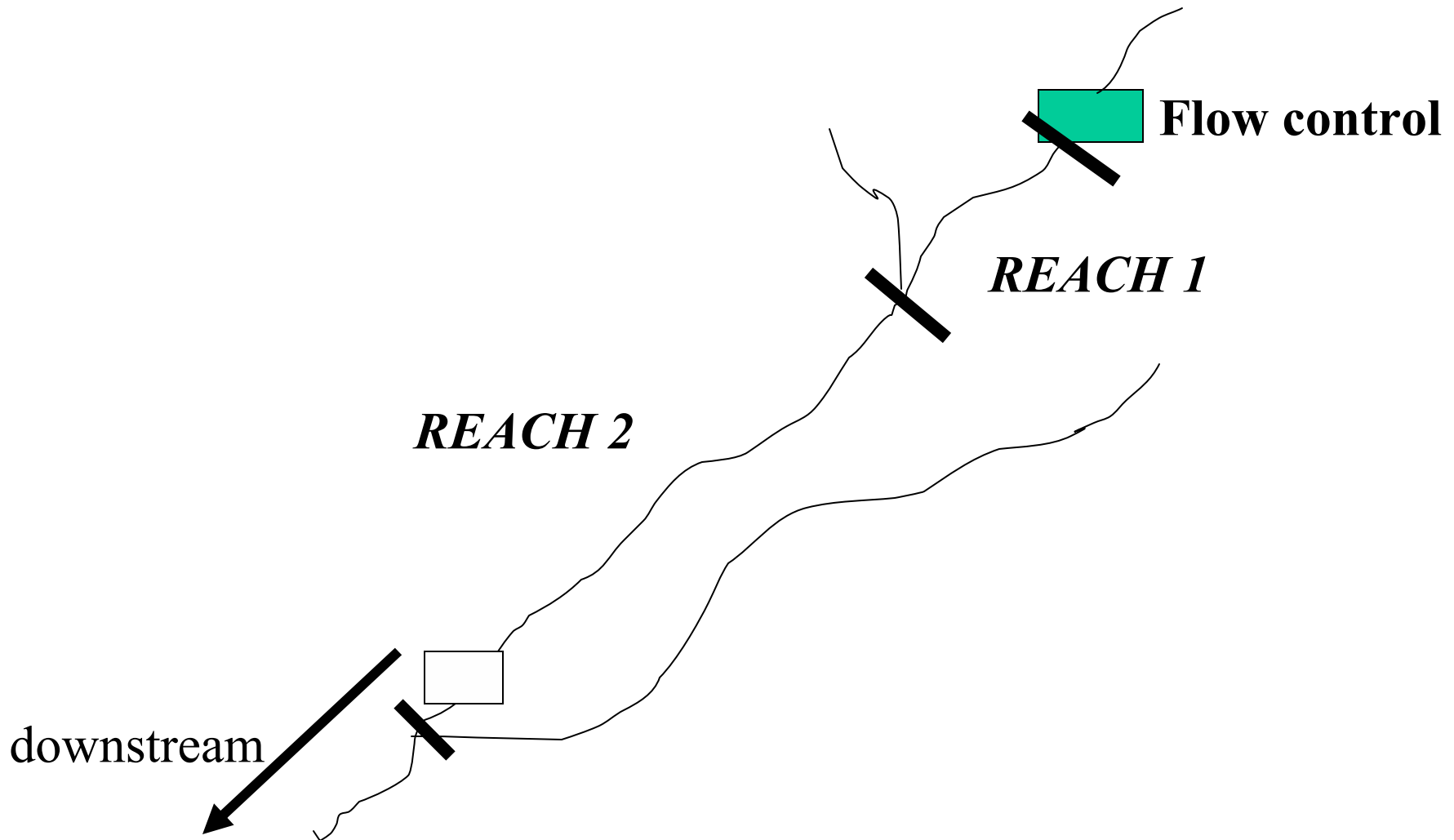


Stephen J. Brady

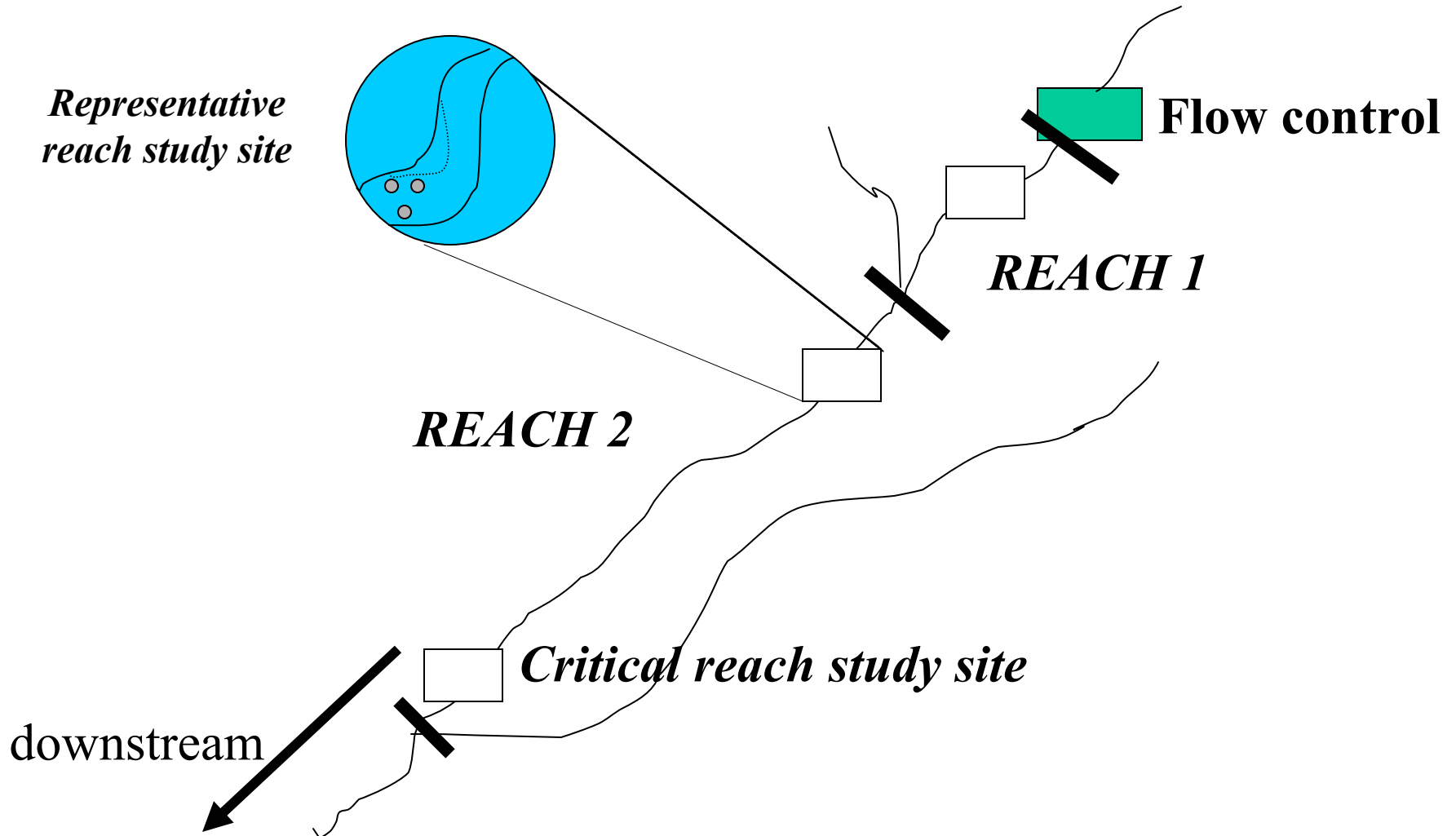
Define overall study area



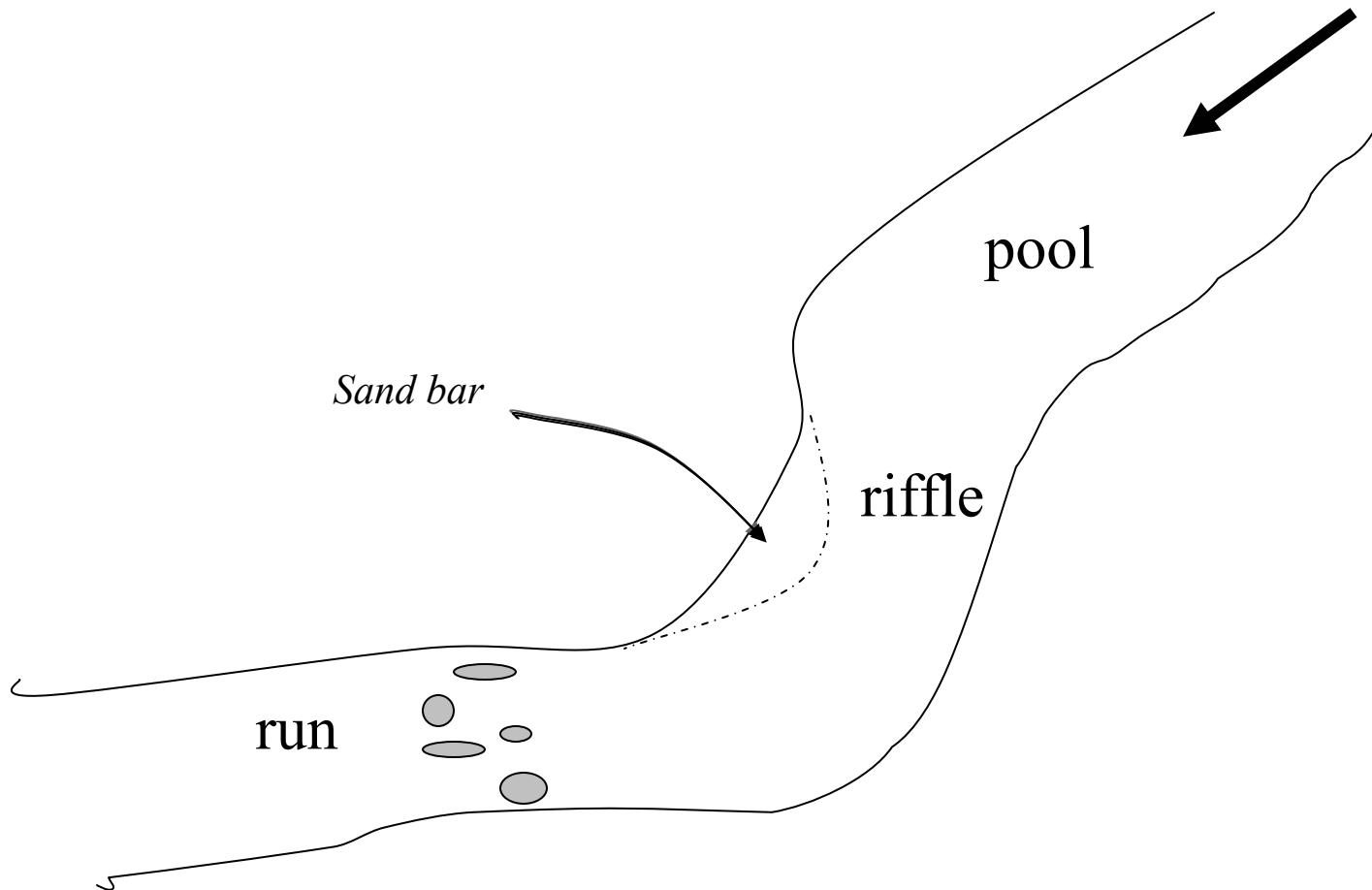
Stratify reaches according to physical, hydrologic and habitat use characteristics



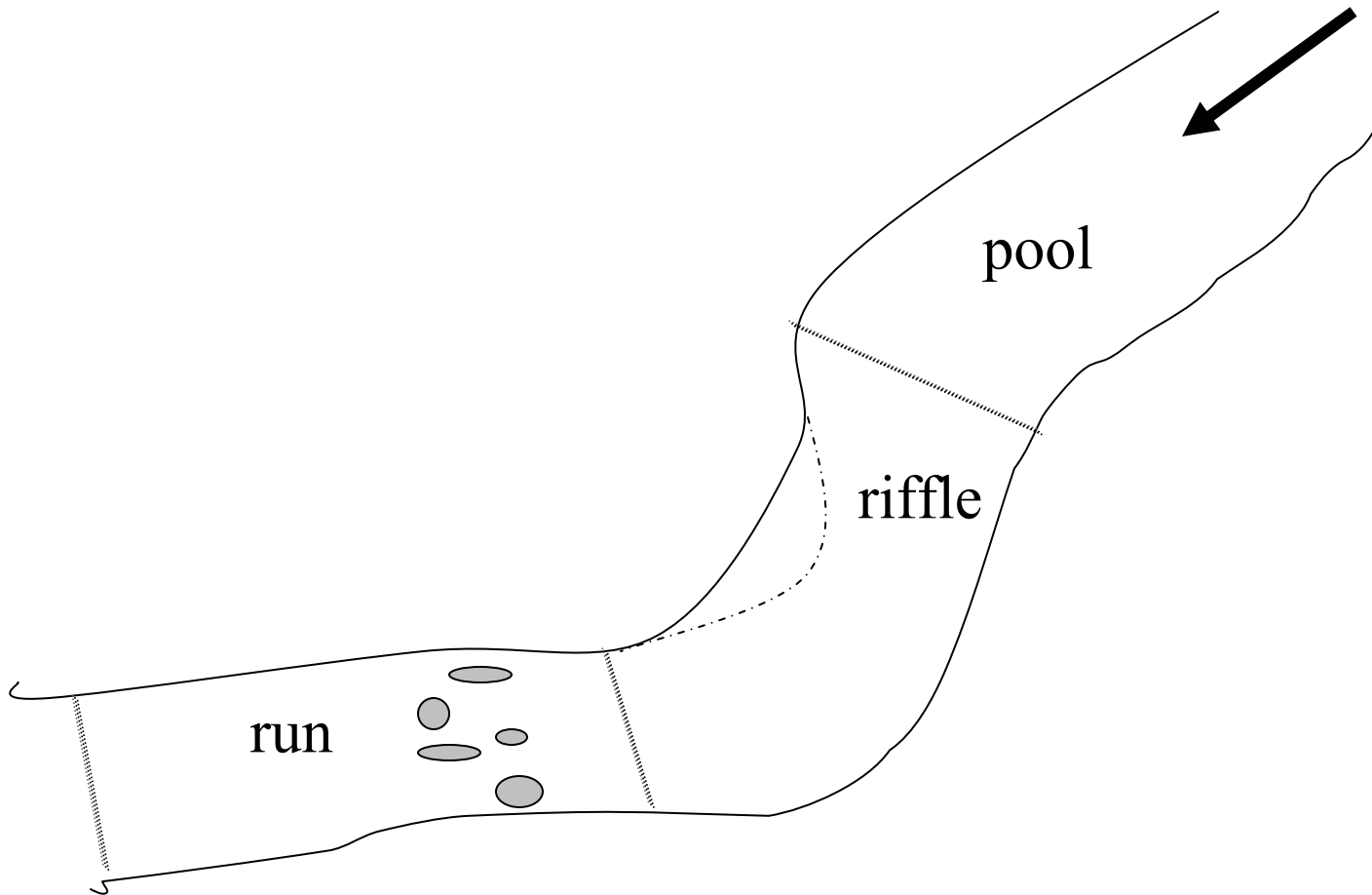
Select *study sites* representative of each reach



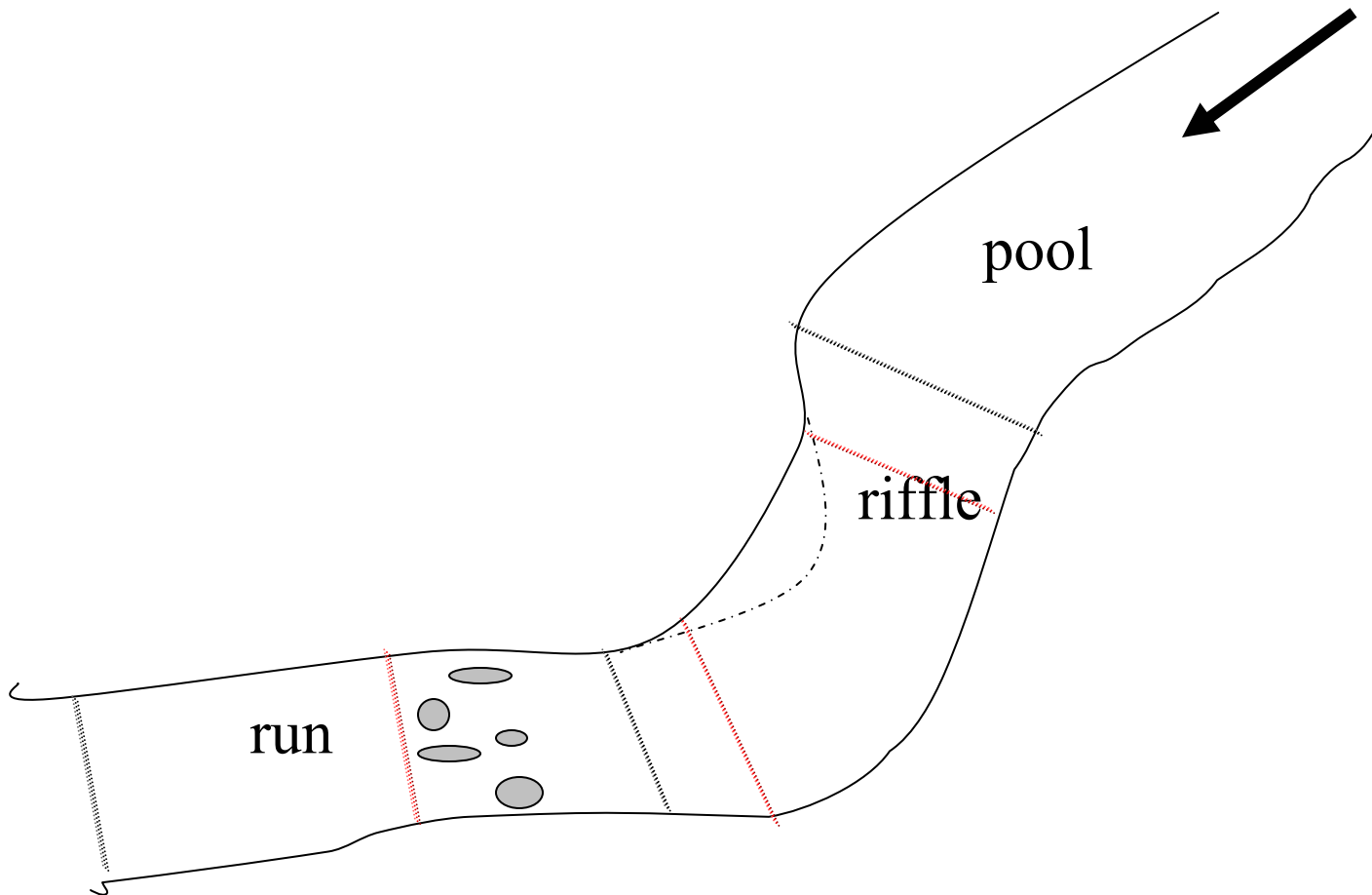
Representative Study Site



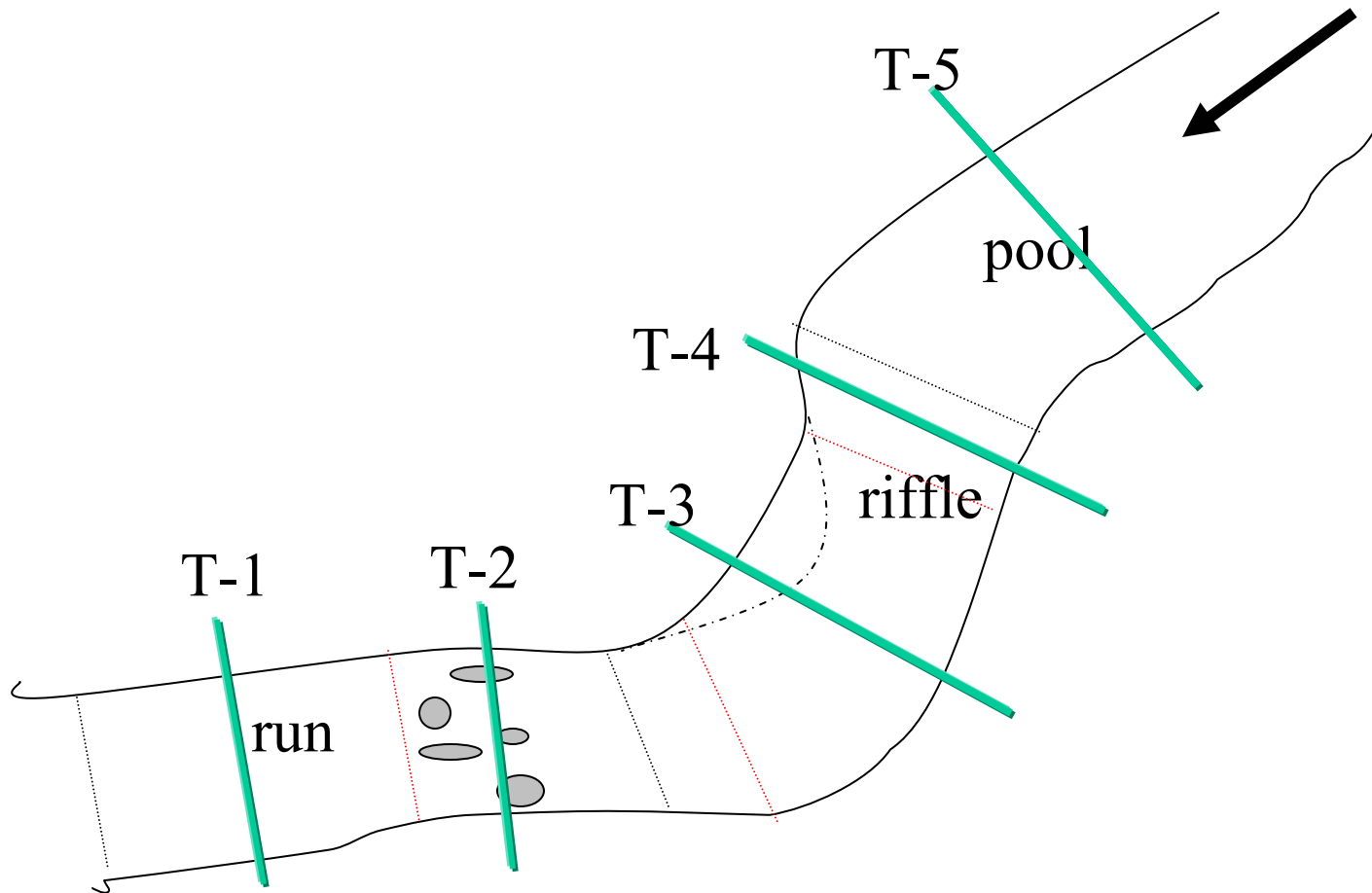
Cell Boundaries are located at breaks in habitat types



Cell Boundaries (*continued*)



One transect is located within each longitudinal cell



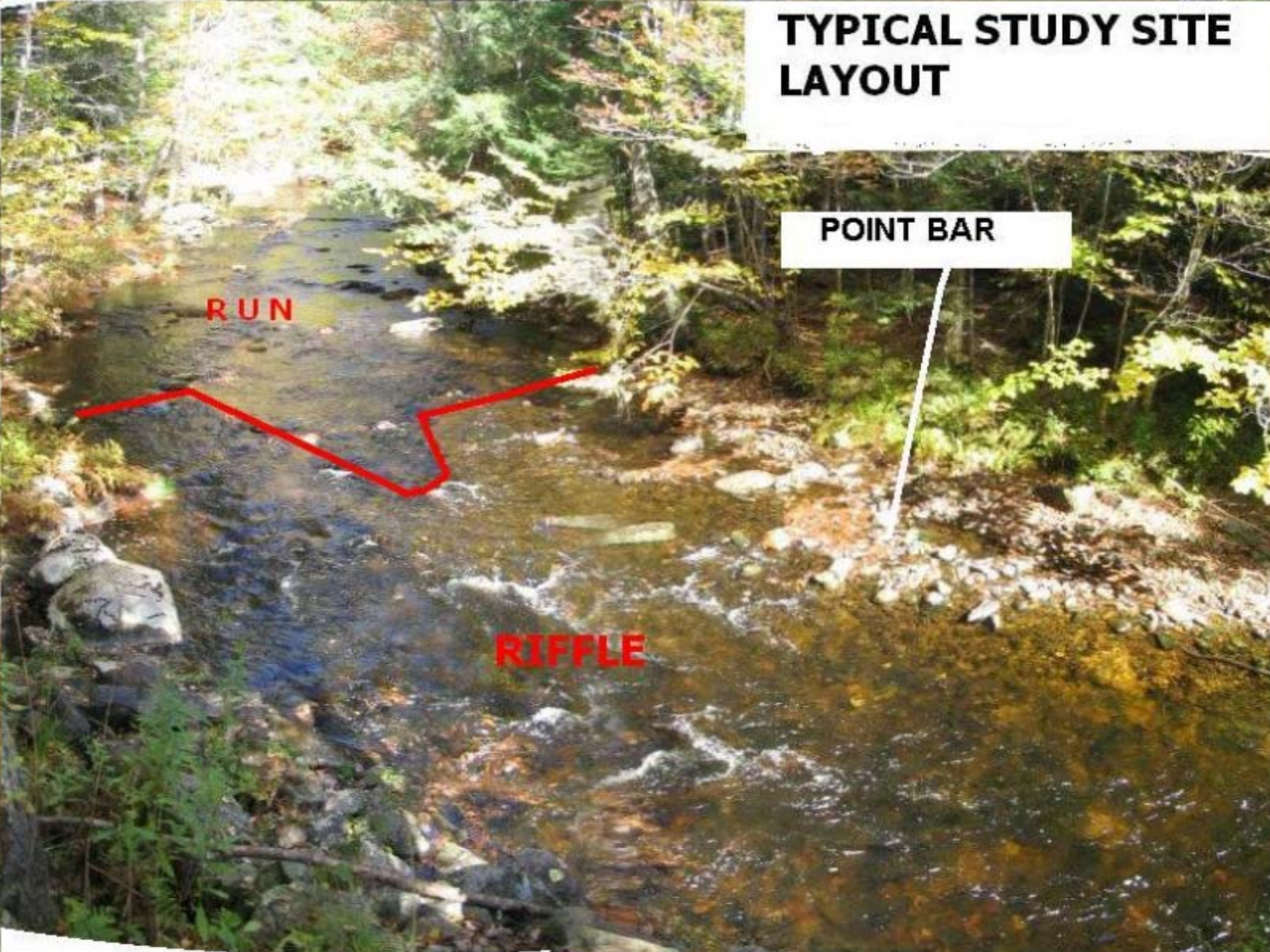


TYPICAL STUDY SITE LAYOUT

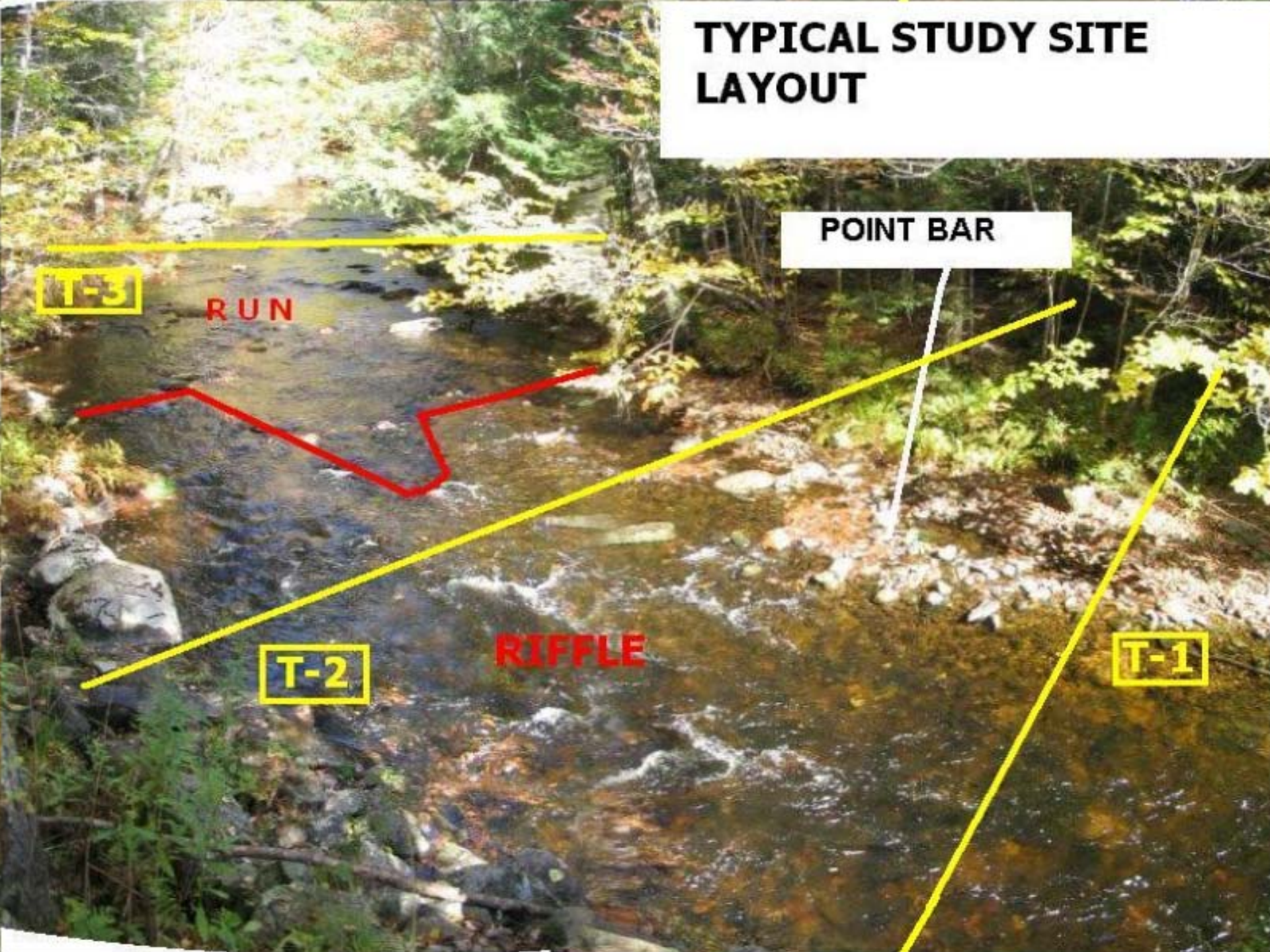
RUN

POINT BAR

RIFFLE



TYPICAL STUDY SITE LAYOUT



POINT BAR

T-3

RUN

T-2

RIFFLE

T-1

transect T-1 (*looking downstream*)

tailpin

headpin

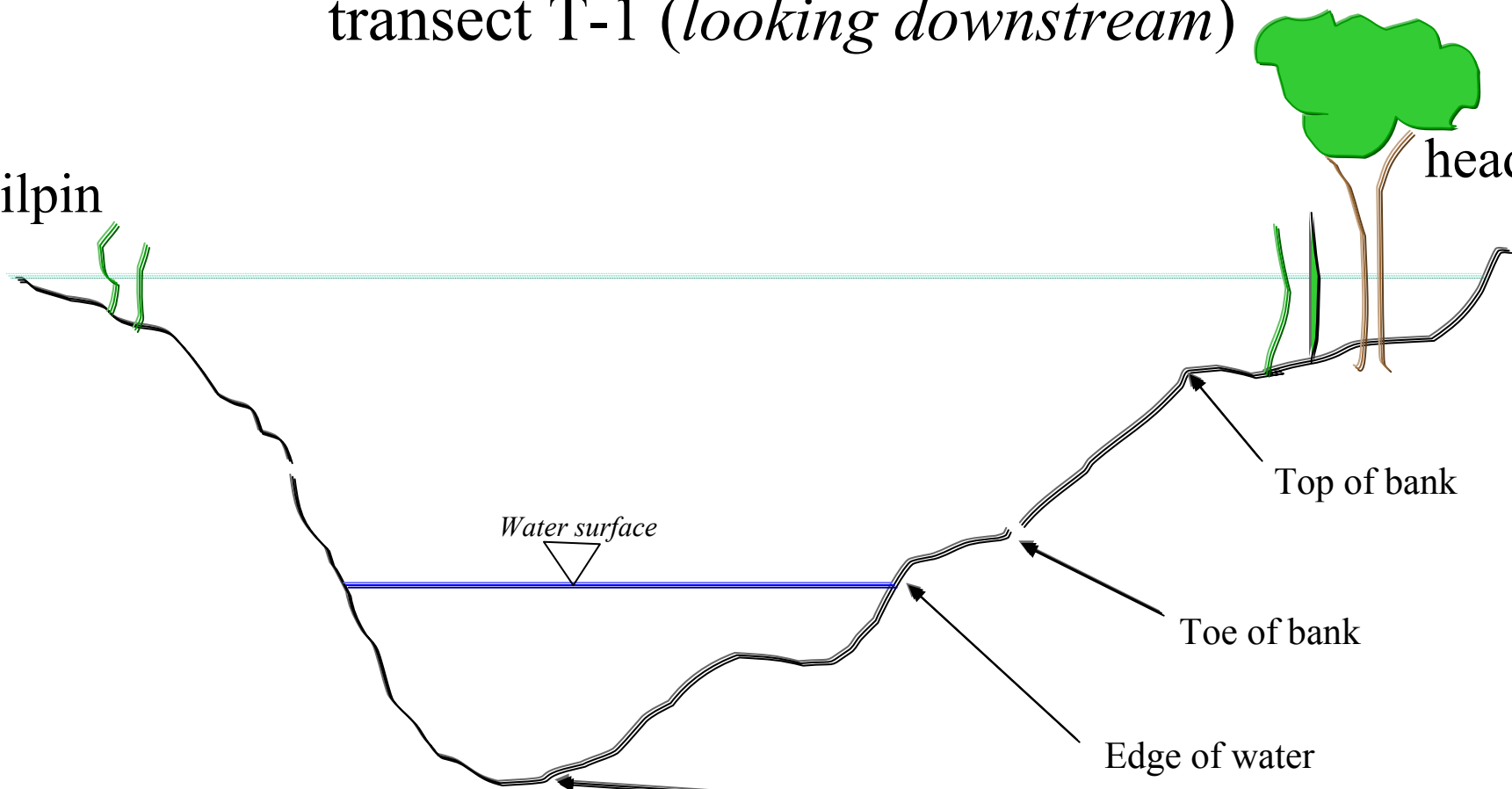
Water surface

Top of bank

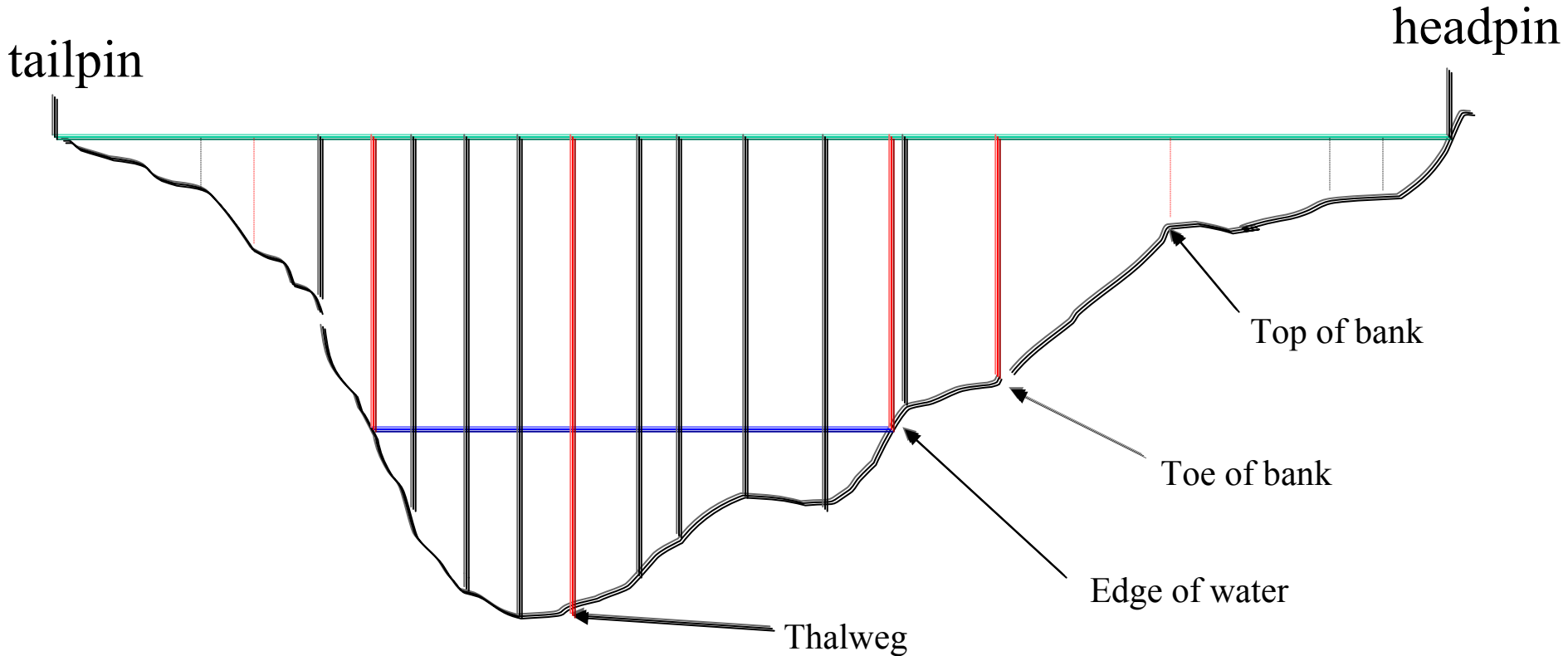
Toe of bank

Edge of water

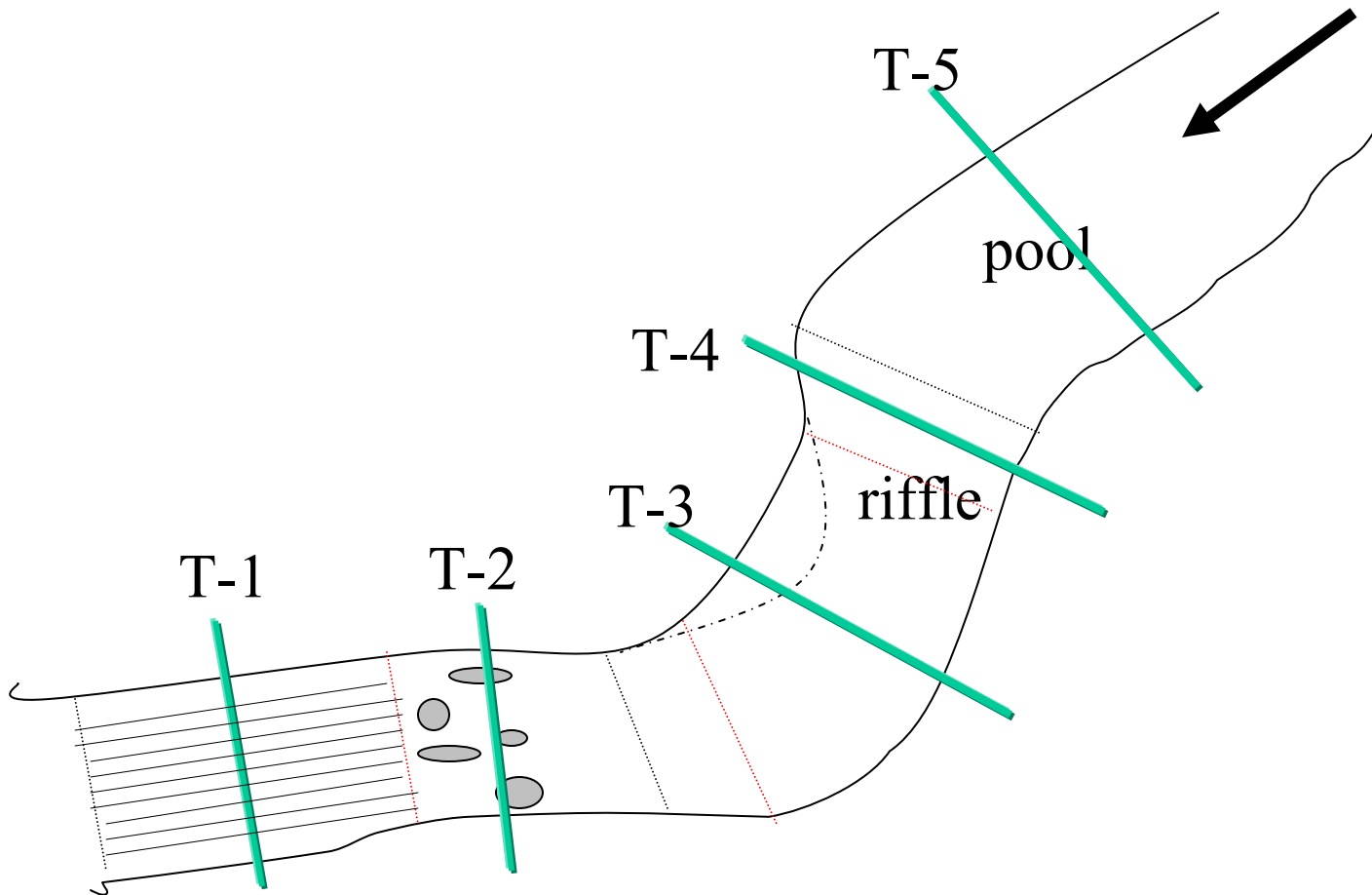
Thalweg



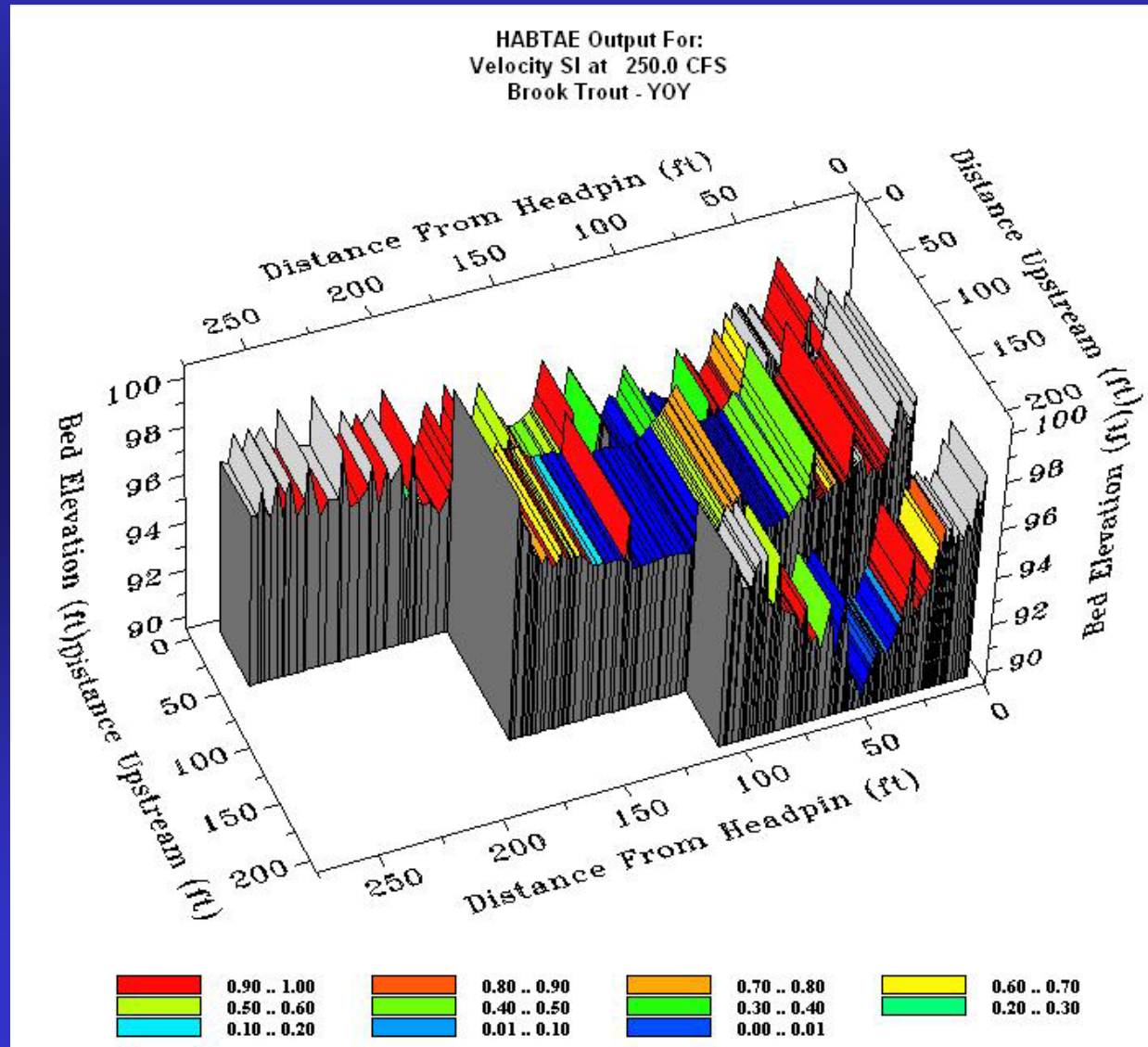
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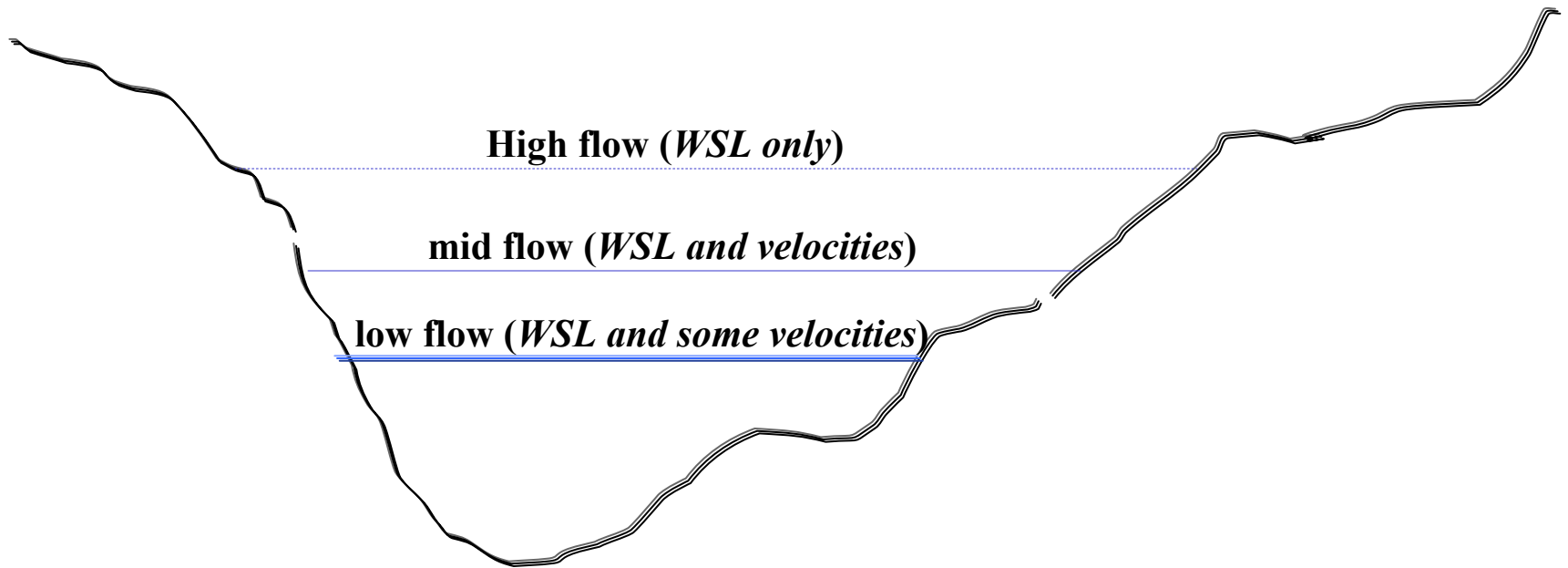
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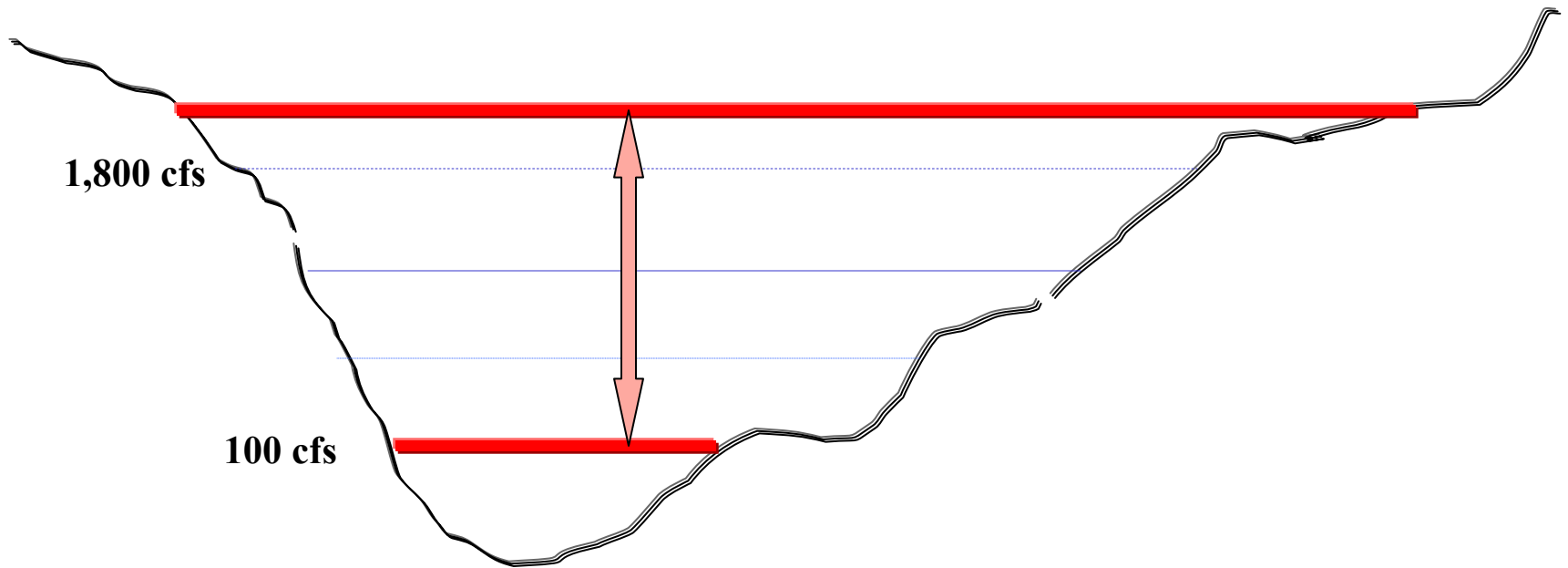
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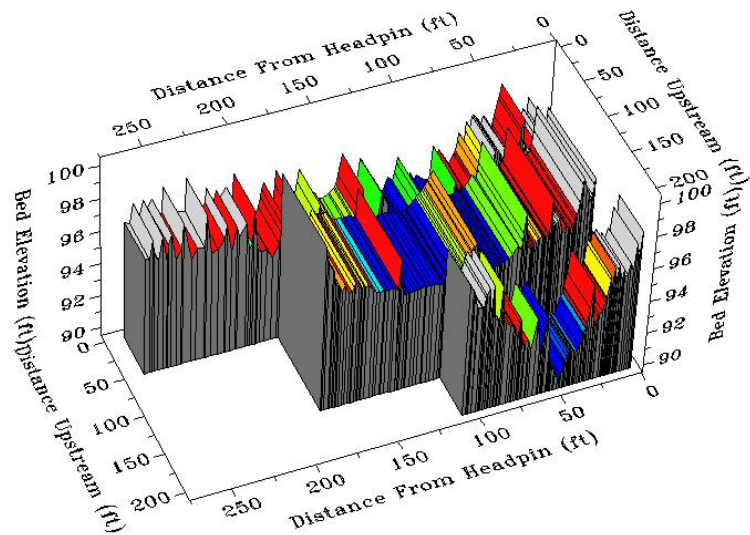
Calibration flows are gathered across the flow range of interest



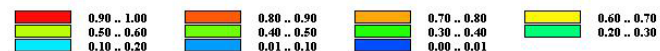
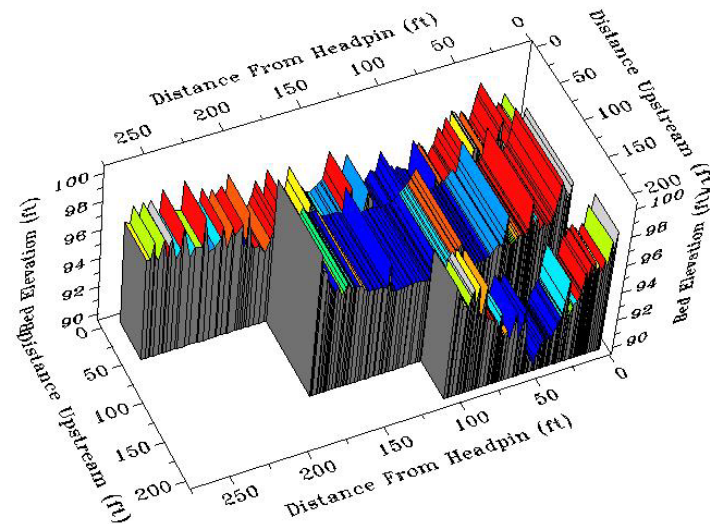
This permits interpolation and extrapolation of other flows



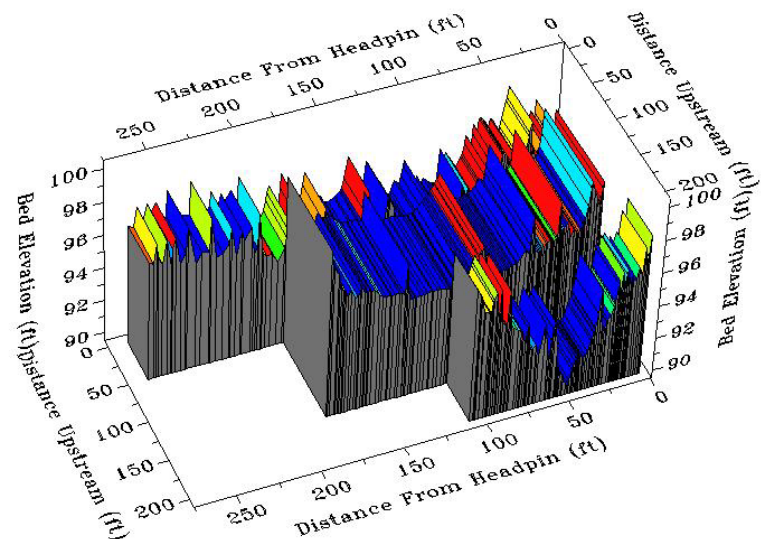
HABTAE Output For:
Velocity SI at 250.0 CFS
Brook Trout - YOY



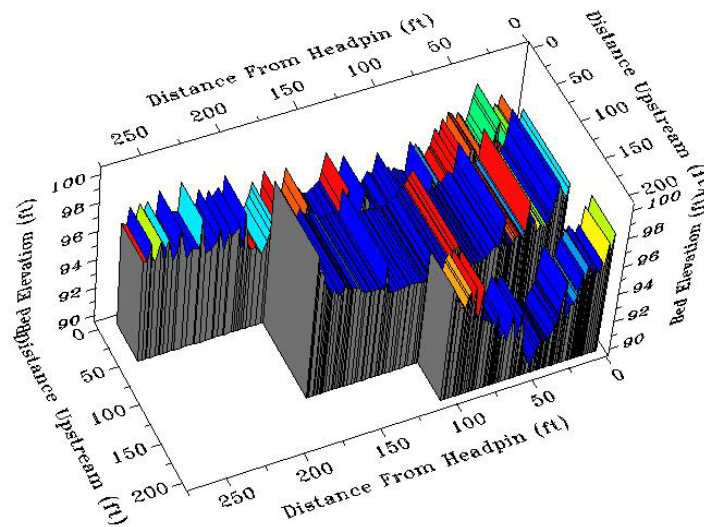
HABTAE Output For:
Combined SI at 500.0 CFS
Brook Trout - YOY



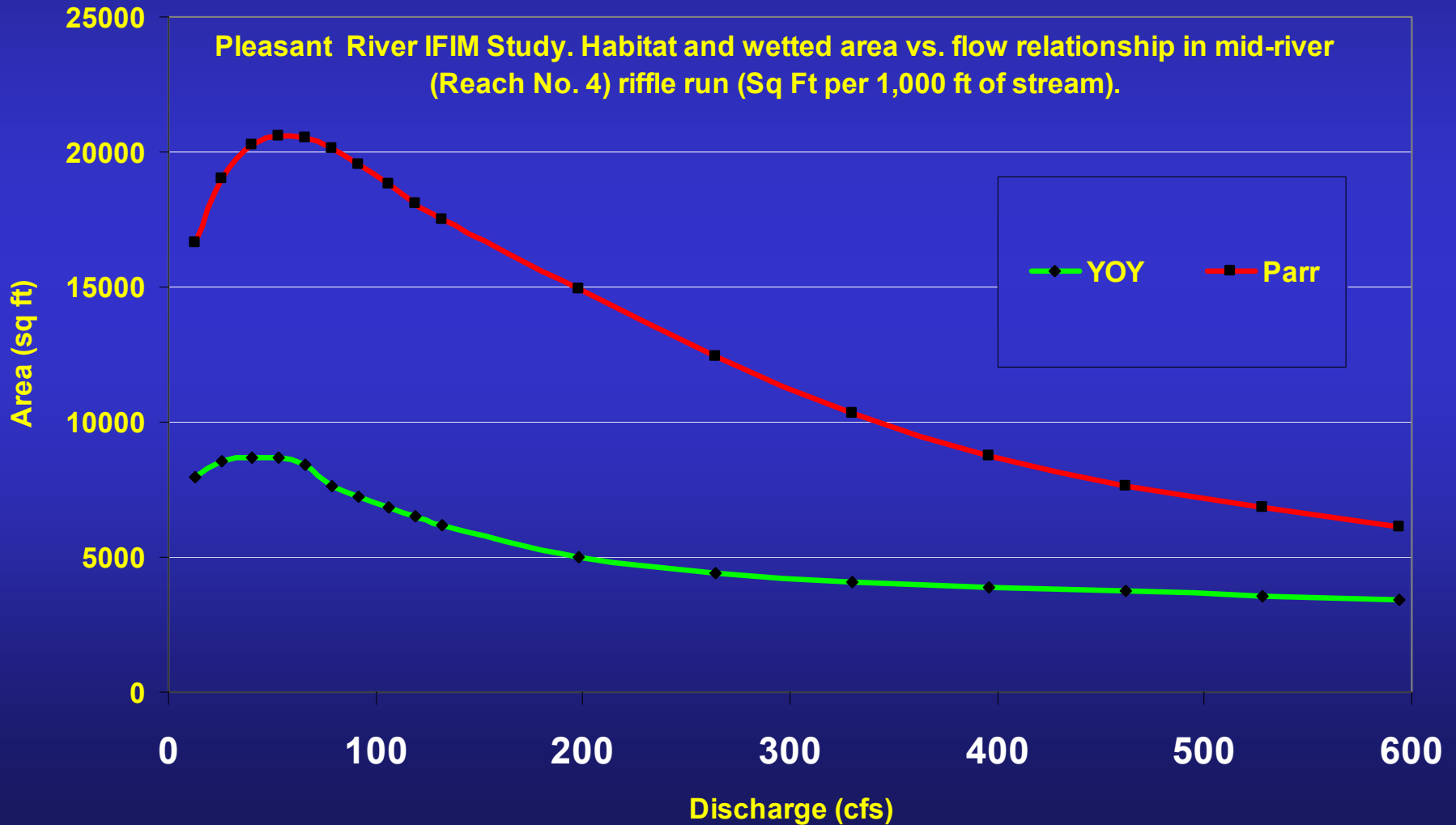
HABTAE Output For:
Velocity SI at 1000.0 CFS
Brook Trout - YOY



HABTAE Output For:
Combined SI at 1500.0 CFS
Brook Trout - YOY



Model output: Habitat-flow relationships for each river segment



Suggested Problem-Solving Process

Review hydrology time series

Compare habitat under existing and alternate flow scenarios

Compare project operation under existing and alternate flow scenarios

Assess extent to which all objectives are met under each flow scenario

Evaluate trade-offs

Re-run alternative scenarios



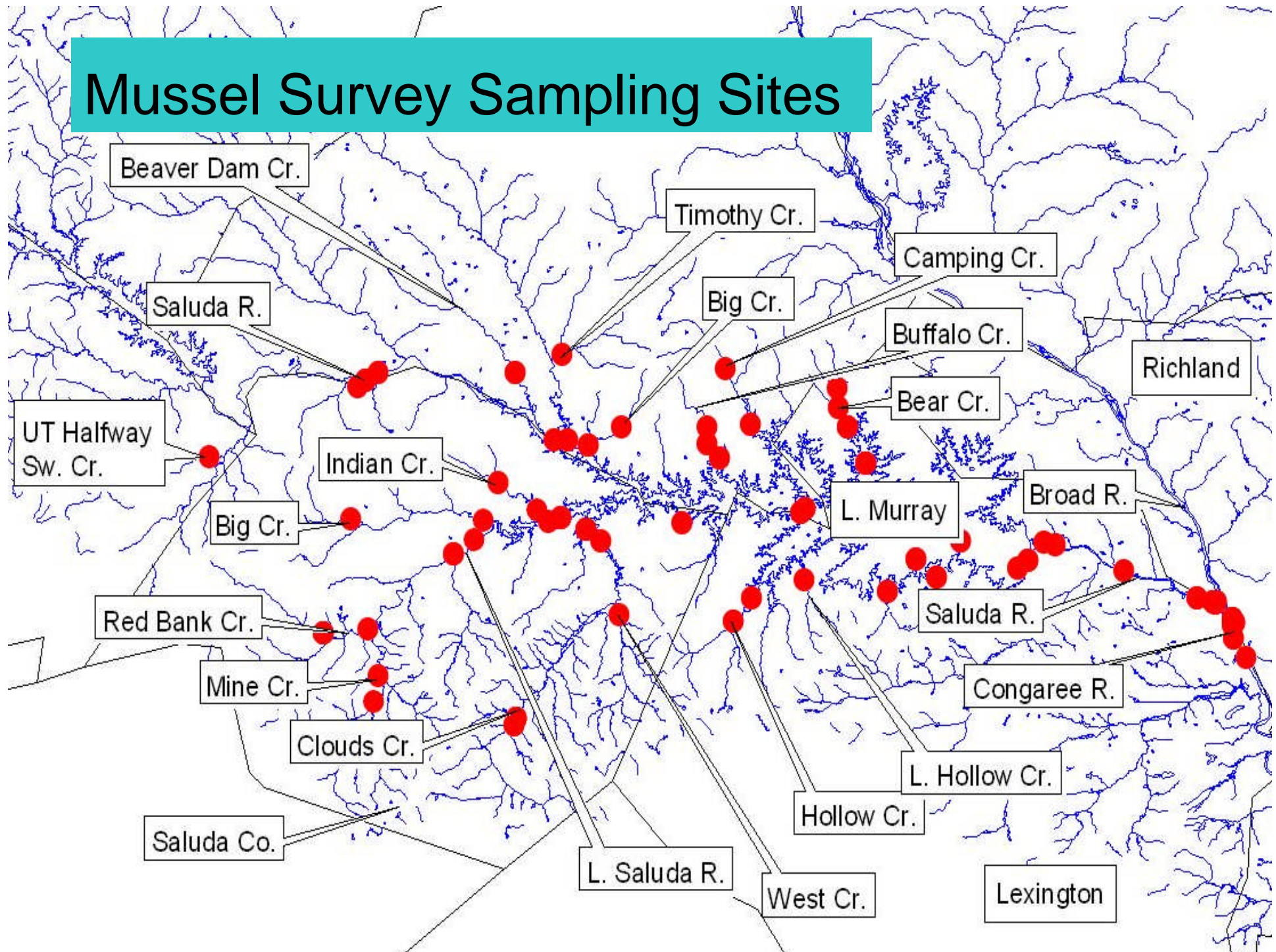
STATUS UPDATE: FRESHWATER MUSSEL RECONNAISSANCE SURVEY

Freshwater Mussel/Benthic
Macroinvertebrate TWC Meeting

July 26, 2006

Shane Boring, Kleinschmidt Associates

Mussel Survey Sampling Sites





Species Documented in Study Area

Common Name	Species	G Rank	Federal Status	Occurance ²
Roanoke Slabshell	<i>Elliptio roanokensis</i>	G2G3	SOC	BR, CO
yellow lampmussel	<i>Lampsilis cariosa</i>	G3G4	SOC	BR, CO
Carolina slabshell	<i>Elliptio congaraea</i>	G4	SOC	CO
Carolina Lance	<i>Elliptio angustata</i>	G4	SOC	LM, LMT, BR, CO
Common Elliptio	<i>Elliptio complanata</i>	G5		LM, LMT, BR, CO, S*
Variable Spike	<i>Elliptio icterina</i>	G4		LMT, CO
Atlantic Spike	<i>Elliptio producta</i>	G4		LM, LMT
Savannah Lilliput	<i>Toxolasma pullus</i>	G3	SOC	LM, LMT
Eastern floater	<i>Pyganodon cataracta</i>	G5		LM, LMT
paper pondshell	<i>Utterbackia imbecillis</i>	G5		LM, LMT
Rayed Pink Fatmucket	<i>Lampsilis splendida</i>	G3	SOC	LM, CO
Eastern Creekshell	<i>Villosa delumbis</i>	G4		LM, LMT, BR, CO, S*
Creeper	<i>Strophitus undulatus</i>	G5		S*, CO
Florida pondhorn	<i>Unio merus carolinianus</i>	G4		LM, LMT
northern lance	<i>Elliptio fisheriana</i>	G4		LM

¹ G1 - Critically Imperiled; G2 - Imperiled; G3 - Vulnerable; G4 - Apparently Secure; G5 - Secure

² BR = Broad; CO = Congaree; S = Saluda; LM = Lake Murray; LMT = Lake Murray Tributaries

* In Broad River washout area.



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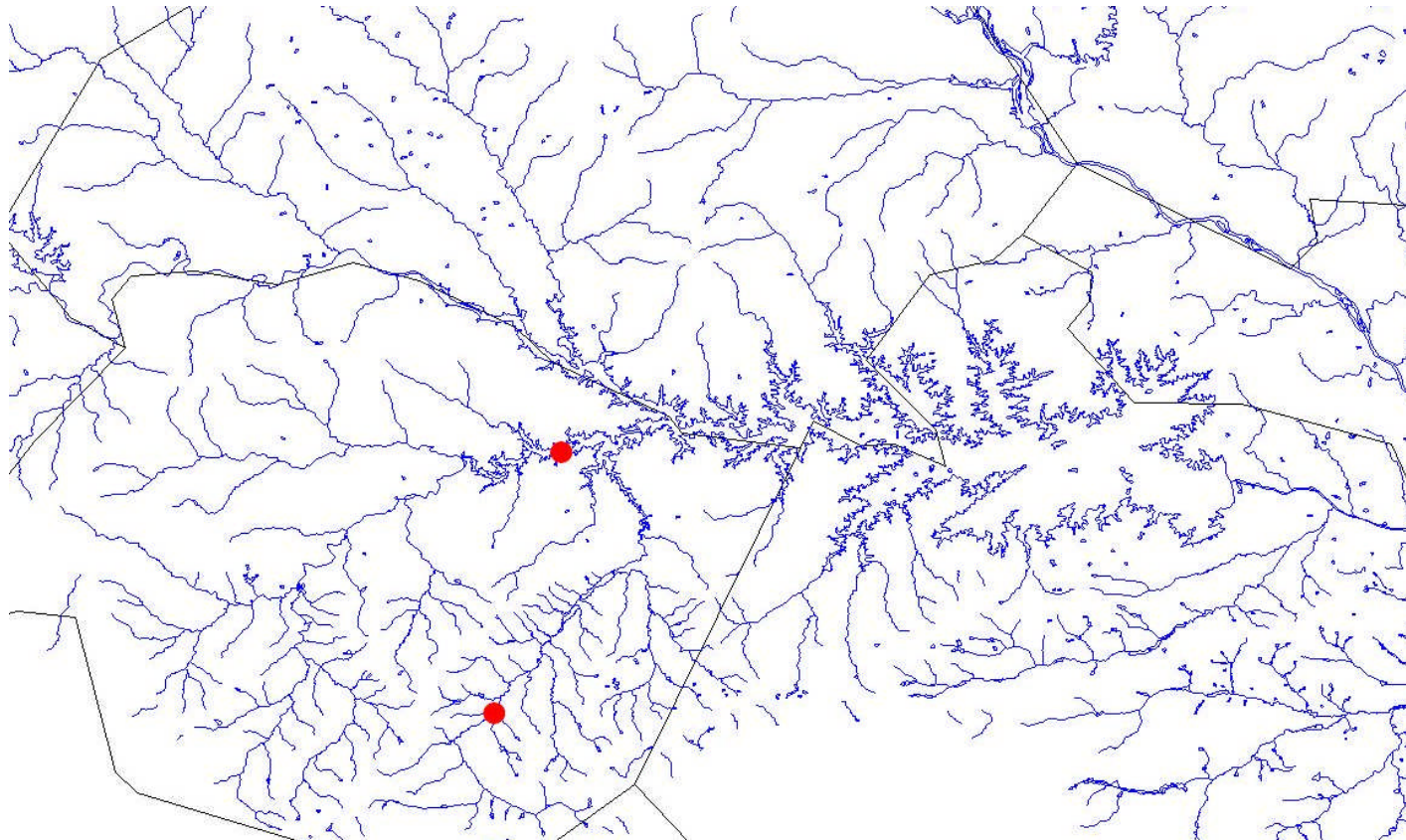
* In Broad River washout area.



Observations

- 6 Federal Species of Concern
- L. Murray dominated by species adapted to backwater habitat
(*Pyganodon*, *Utterbackia*, *Uniomerus*)
- *T. pullus* appears to occupy small area Little Saluda arm of upper lake
 - 4 shells at 2 sites

Survey stations with evidence of *Toxolasma pullus*





Observations

- *Elliptio roanokensis*, *E. congarea*, *Lampsilis cariosa* primarily limited to Broad and Congaree
- *Elliptio roanokensis* & *E. congarea* not found above dam or in LSR
 - Potential anadromous host
- Congaree River mussels
 - mostly distributed along Broad R. side
 - Diversity and abundance limited on Saluda side