

Field-based Learning in Surface and Groundwater Processes: preparing water literate citizens and water resource professionals



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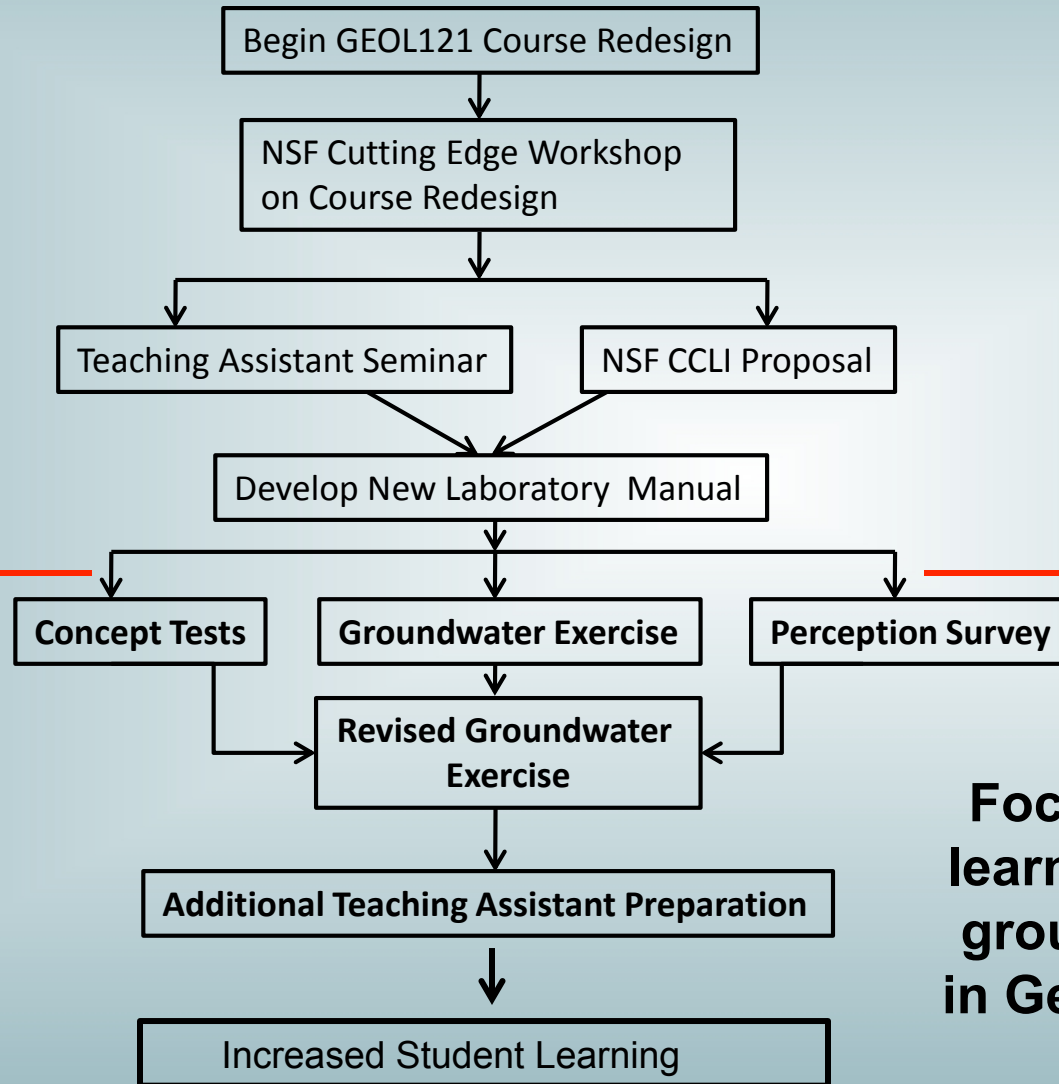
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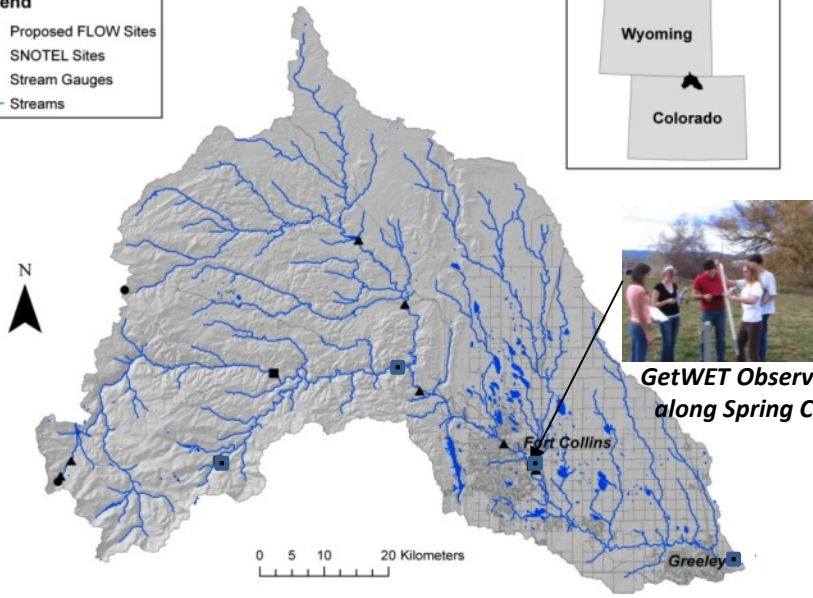
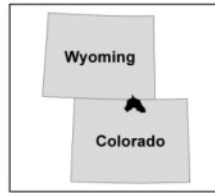
Previous Research



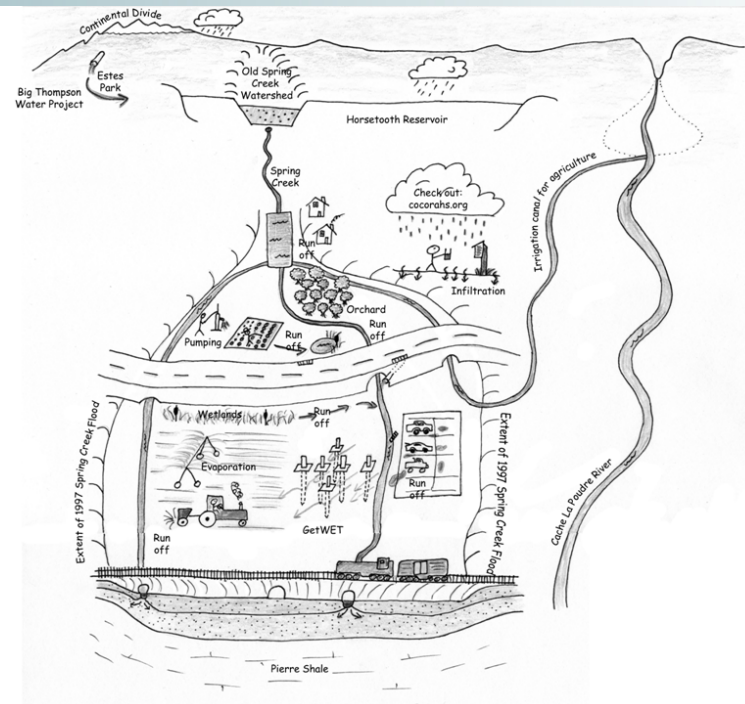
Focus on undergraduate learning of surface water - groundwater interactions in Geosciences at GetWET

Previous Research

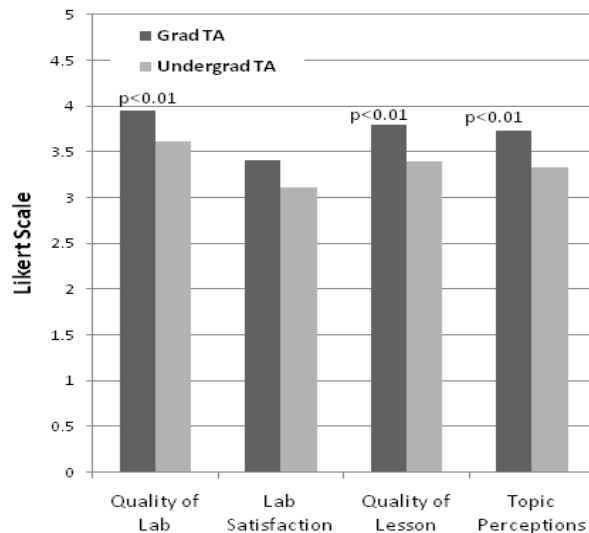
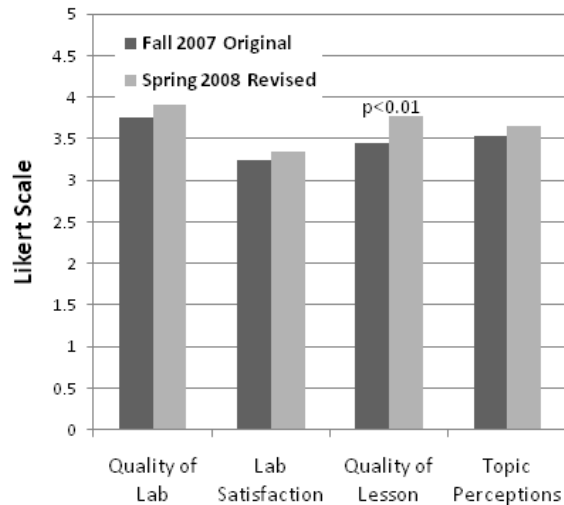
- Legend**
- Proposed FLOW Sites
 - SNOTEL Sites
 - ▲ Stream Gauges
 - Streams



GetWET Observatory along Spring Creek



Previous Research



GEOL121 Introductory Geology Lab

-Quality of the lesson increased due to a revision of the exercise

-Quality of the lab, lesson, and student's understanding of their interaction with surface and groundwater increased with graduate student teaching assistants

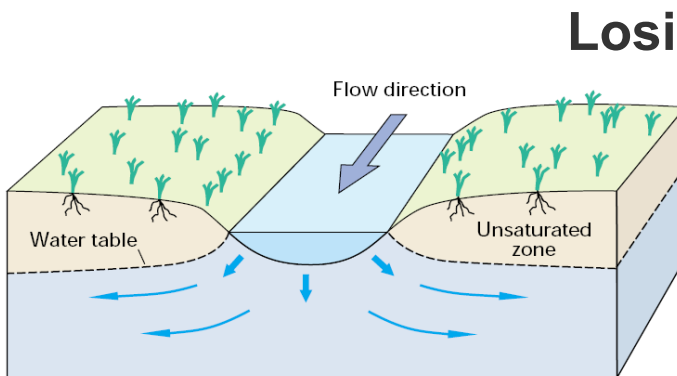
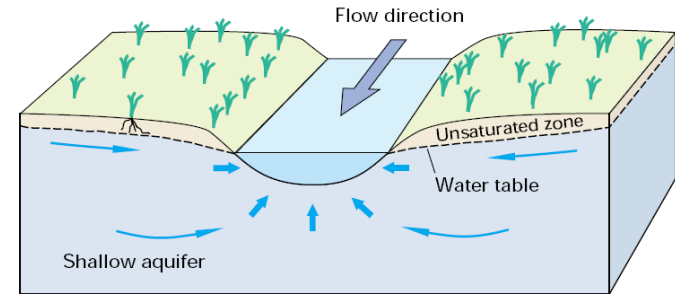
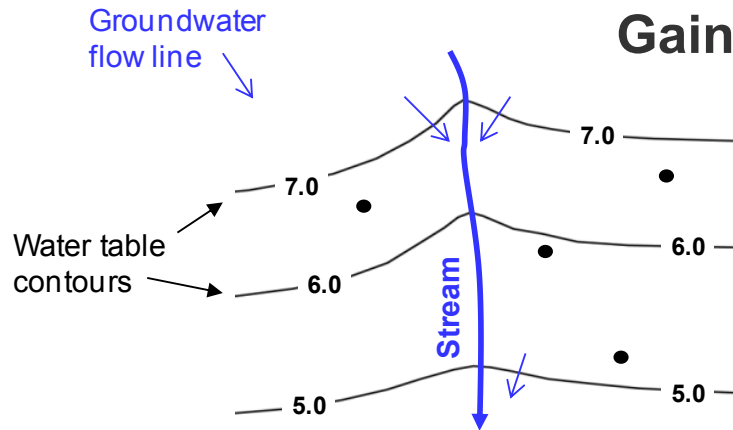
-Pre- and post-test gains in basic content knowledge increased with additional TA training

- questions addressed fundamental surface and groundwater concepts, Bloom's taxonomy

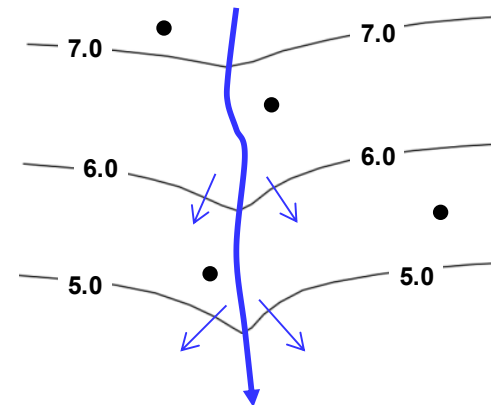
Key Learning Concepts

Integrated groundwater-surface water analysis

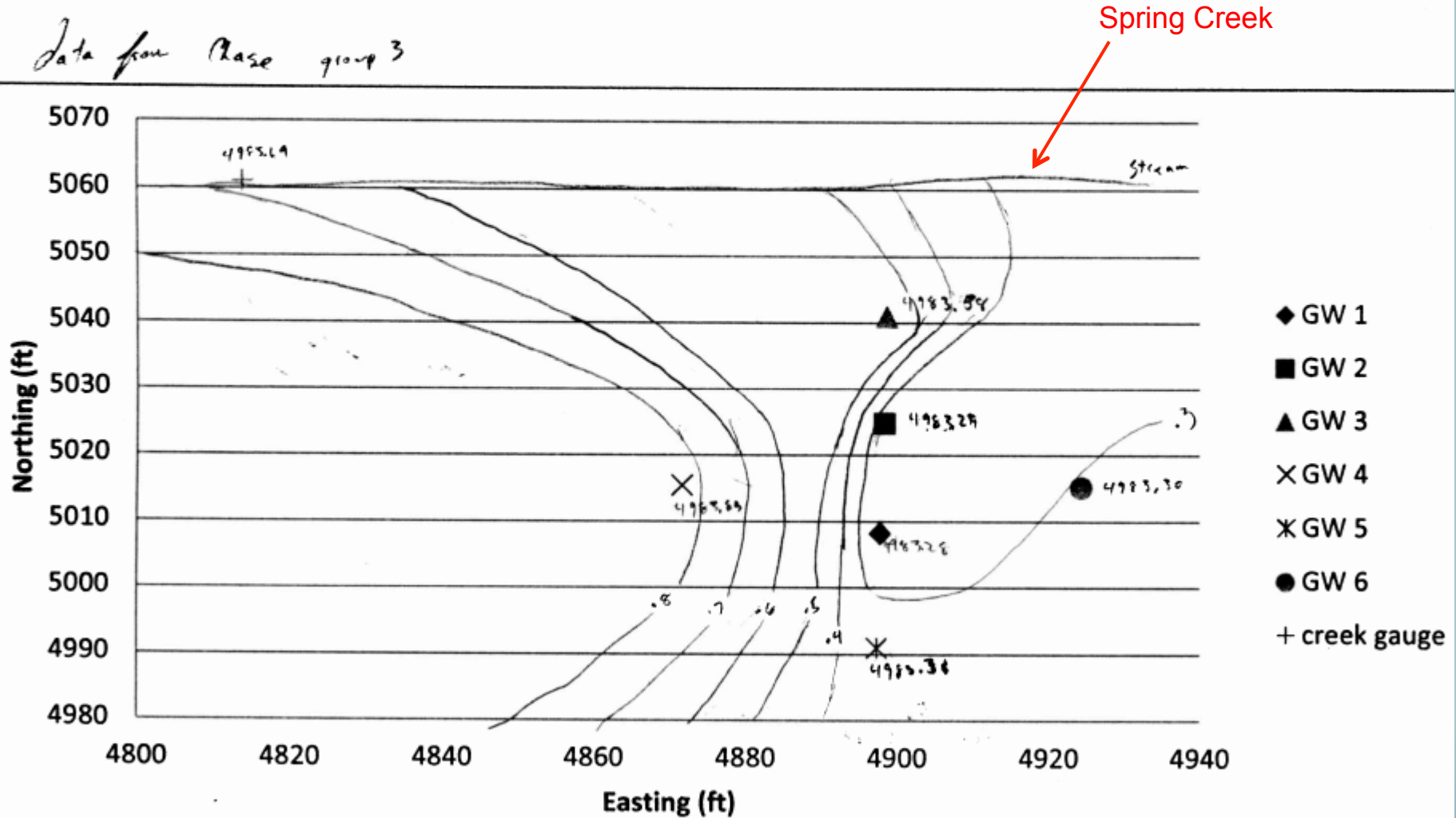
- Measurement of groundwater levels and river stage.
- Assessment of groundwater-surface water interaction.



Losing stream



Data from Base group 3



Current Research

Interest in the GetWET beyond Geosciences

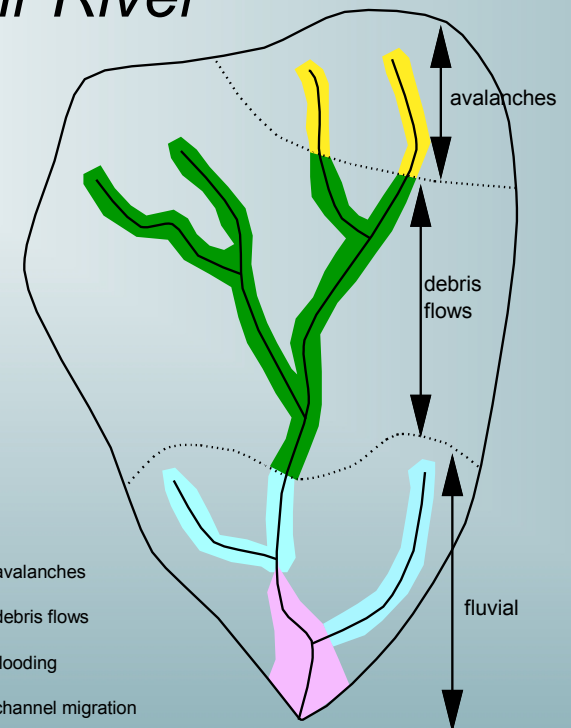
- Stephanie Kampf, Jeff Niemann, Steven Fassnacht

Led to development of 2nd NSF proposal

-Fostering Learning of our Watershed (FLOW): Building a Community of Learners Linked to their River

Myriad learning opportunities due to:

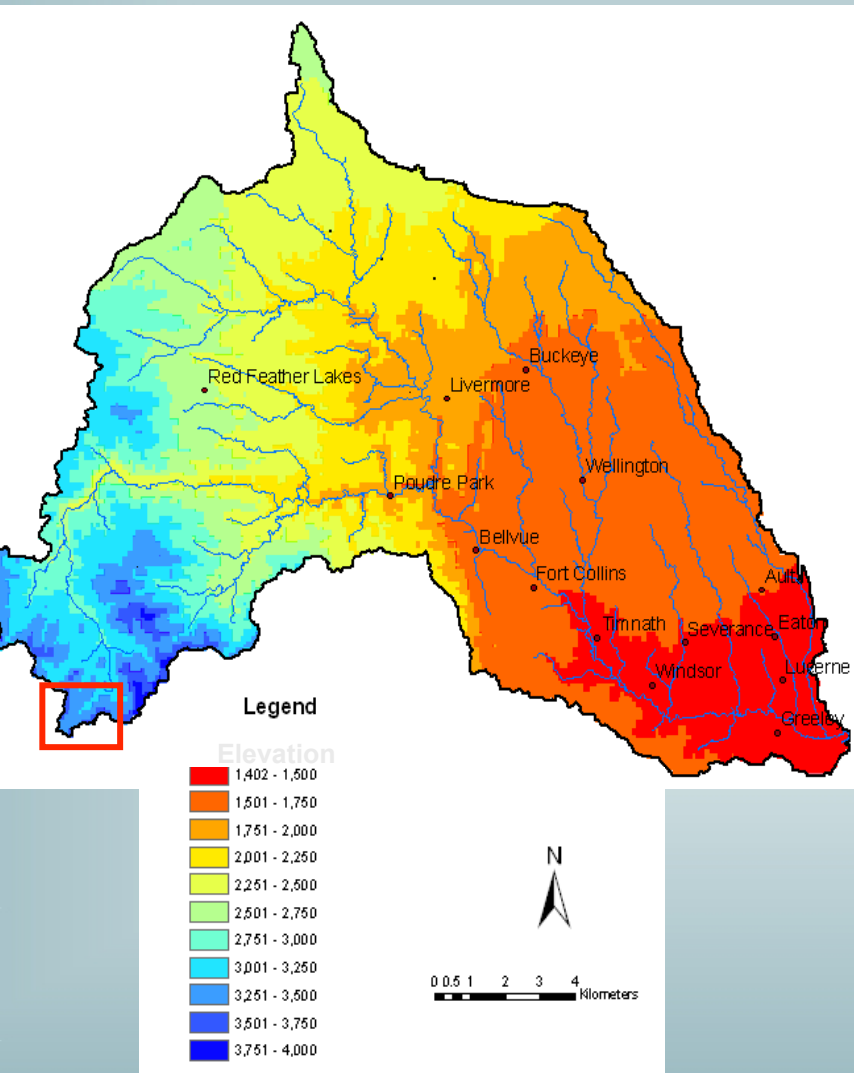
- spatial variability of surface water and groundwater processes related to diverse geologic, climatic, biologic, and land use characteristics
- relevance of local water issues
- clear need for increased water literacy



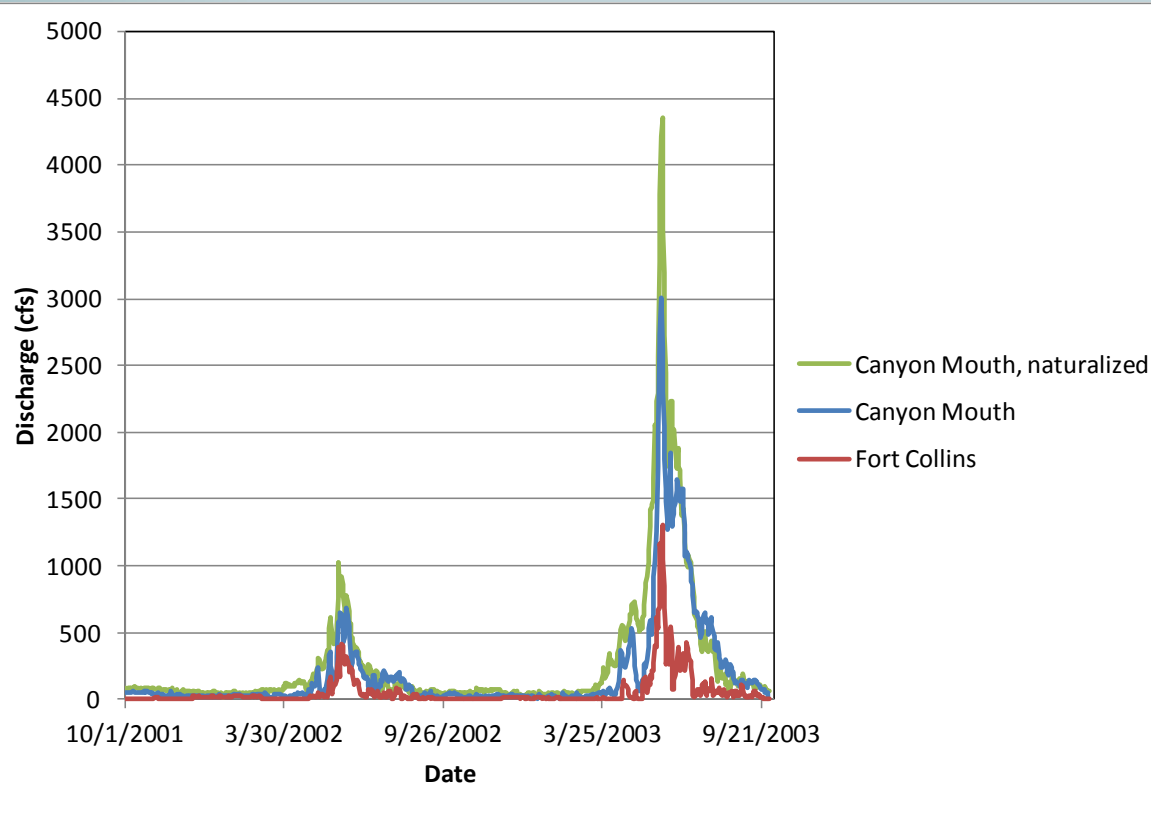
Educational Innovations

WR304 Watershed Management

- Students write a watershed description using maps and online resources
- Calculate watershed elevation, range, and river gradient, and delineate watershed boundaries in the headwaters



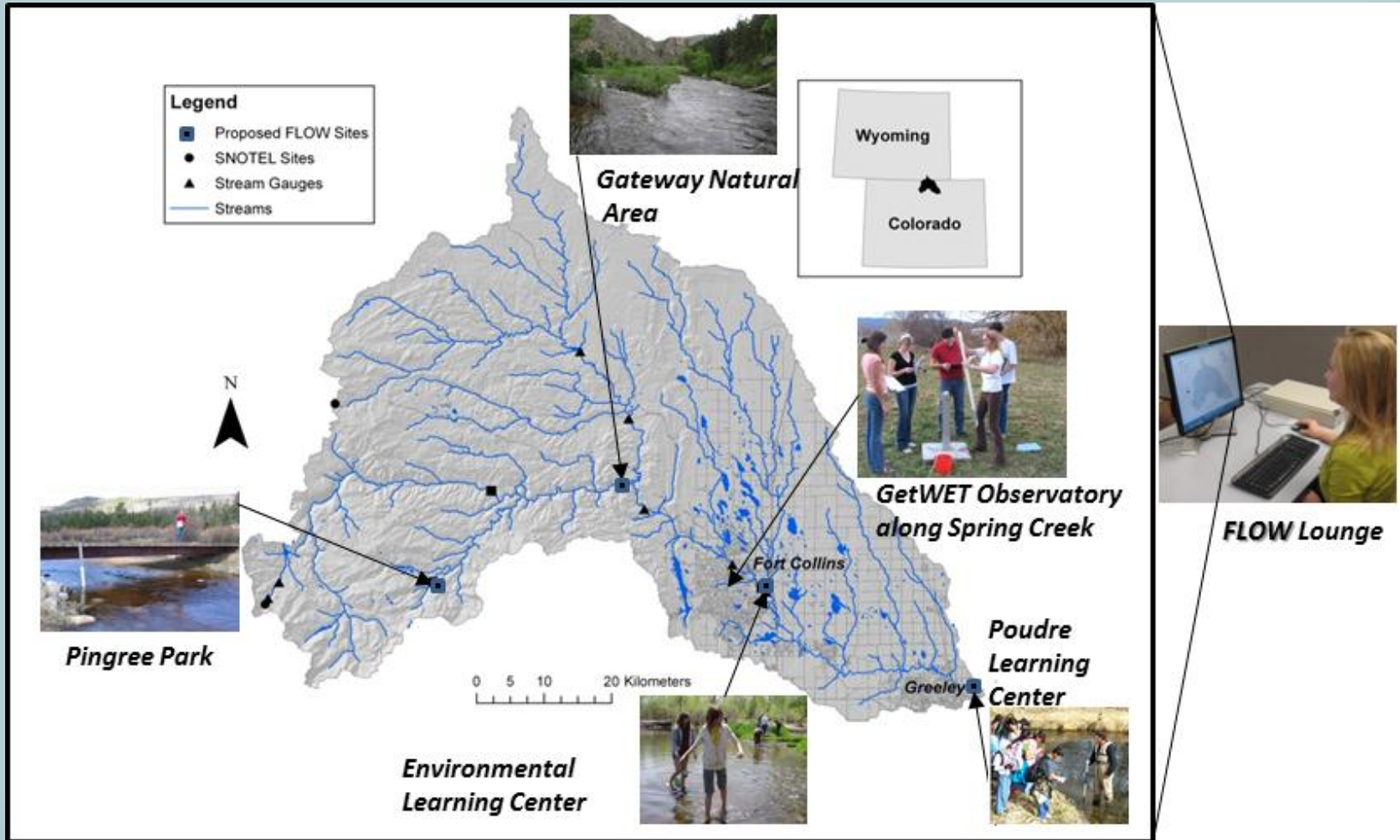
Educational Innovations



WR304

- Students collect, plot and analyze discharge data for the Poudre River at two gaging stations
- Evaluate how and why discharge changes over time and space

Current Research



Four hydrologic field stations comprising the Poudre FLOW Network

Current Research

Objectives:

➡ Improve undergraduate teaching and learning of water concepts at CSU, Front Range Community College, and University of Northern Colorado

- Easy access to sound, reliable water quantity and quality data for authentic field, laboratory, and web-based learning opportunities

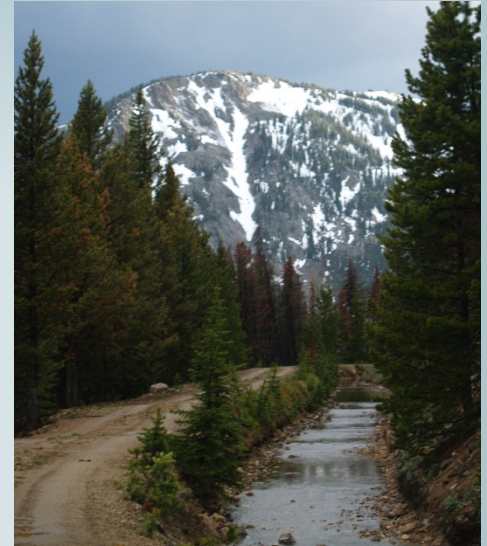
➡ FLOW Website

- Digital database for storage and dissemination
- Including image archives

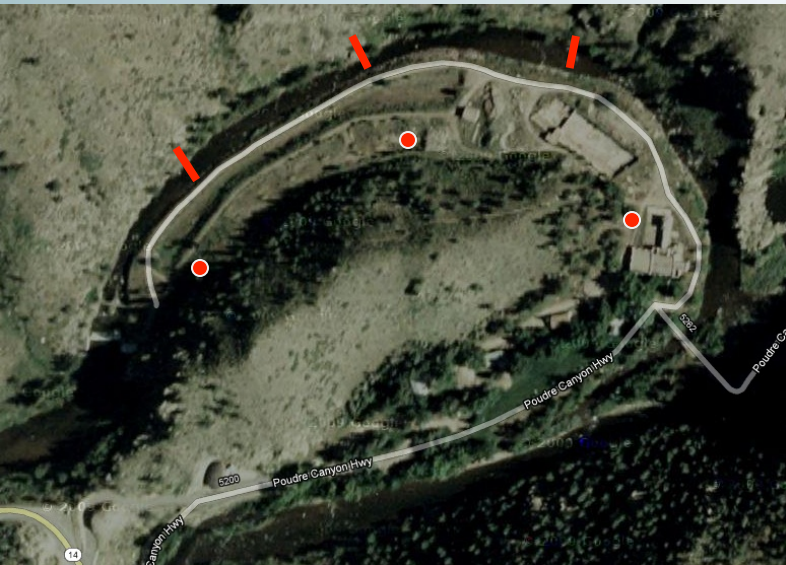


Current Research

- ◆ Will add critical information about water quantity and quality for use in 12 courses for improved student learning (1,300 students annually in WCNR).
 - Importance of high elevation snowmelt (Richer, 2009), South Fork ungauged.
 - Water conveyance system, transbasin diversions.
- ◆ Consolidation of data will augment and enhance efforts by Cities of Fort Collins and Greeley.
- ◆ Water Center for students.
- ◆ Important water-related issues confront citizens, many of whom are CSU, FRCC, or UNC students.



Current Research



Gateway Natural Area

- Well installation and development
- Piezometers and surface water gauges
- Students involved during all phases
- Assessments via Geoscience Concept Inventory (GCI) with Steve Anderson (UNC)
- Based on 240 student surveys in GEOL120 and 122
 - 50% know source of drinking water for Ft. Collins
 - ~15% could illustrate where groundwater occurs

Key Learning Concepts

- ◆ Surface and groundwater flow measurement
- ◆ Flow calculation and interpretation
- ◆ Hydrologic and geomorphic mapping and spatial analysis
- ◆ Assessing physical-biotic interactions along riparian corridors
- ◆ Evaluating human impacts to river networks
- ◆ Assessing alluvial aquifer properties
- ◆ Computer modeling

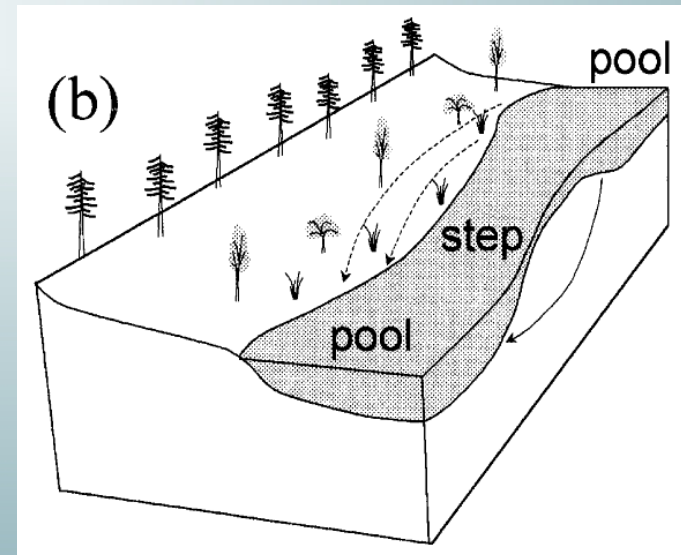
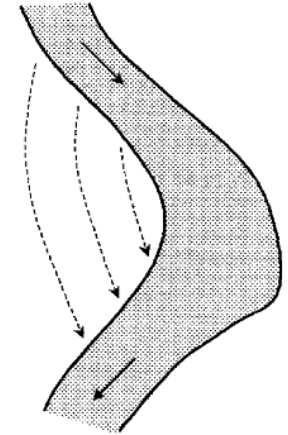


Educational Innovations

New field site at Gateway Natural Area



Channel sinuosity enhances the groundwater-surface water exchange



(Hayashi and Rosenberry, 2002)

Wrap Up

- ◆ Interdisciplinary, field-based, watershed approach to education at CSU, FRCC, and UNC
- ◆ A community of learners built around our watershed
- ◆ Ultimately impact 2200 students in 25 courses
- ◆ Multi-institutional faculty collaboration developing authentic, innovative educational materials
- ◆ Strong assessment of student learning
- ◆ Process of proposal writing is building collaborations
 - ◆ Other CSU, UNC faculty
 - ◆ Poudre River Natural Heritage Area



Hayashi, m., and Rosenberry, D., 2002, Effects of Groundwater Exchange on the Hydrology and Ecology of Surface Water, *Groundwater* 40:309-316.

Rathburn, S., and Weinberg, A., 2011, Undergraduate Student Satisfaction and Achievement at the GetWET Observatory: A fluid learning experience at Colorado State University, *Journal of Geoscience Education* 59:47-55.

Richer, E., 2009, Snowmelt runoff analysis and modeling for the Upper Cache la Poudre River Basin, Colorado, unpublished Master's Thesis, Department of Forest, Rangeland and Watershed Stewardship, Warner College of Natural Resources, Colorado State University, 117 p.