

Monitoring Ecological Change and Project Effectiveness: Examples from San Antonio Creek, Jemez Mountains, NM

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Tribal Clean Water Act Training
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March 4-7, 2024



San Antonio Creek Beaver Habitat and Water Quality Project



Using low tech process-based restoration to:

- Restore beaver habitat
- Improve fish habitat
- Increase water storage
- Improve water quality
- Create NM Meadow Jumping Mouse habitat
- Promote fire resiliency
- Monitoring applicable to CWA 319h, CWA 104b3, CWA 404/401 permit

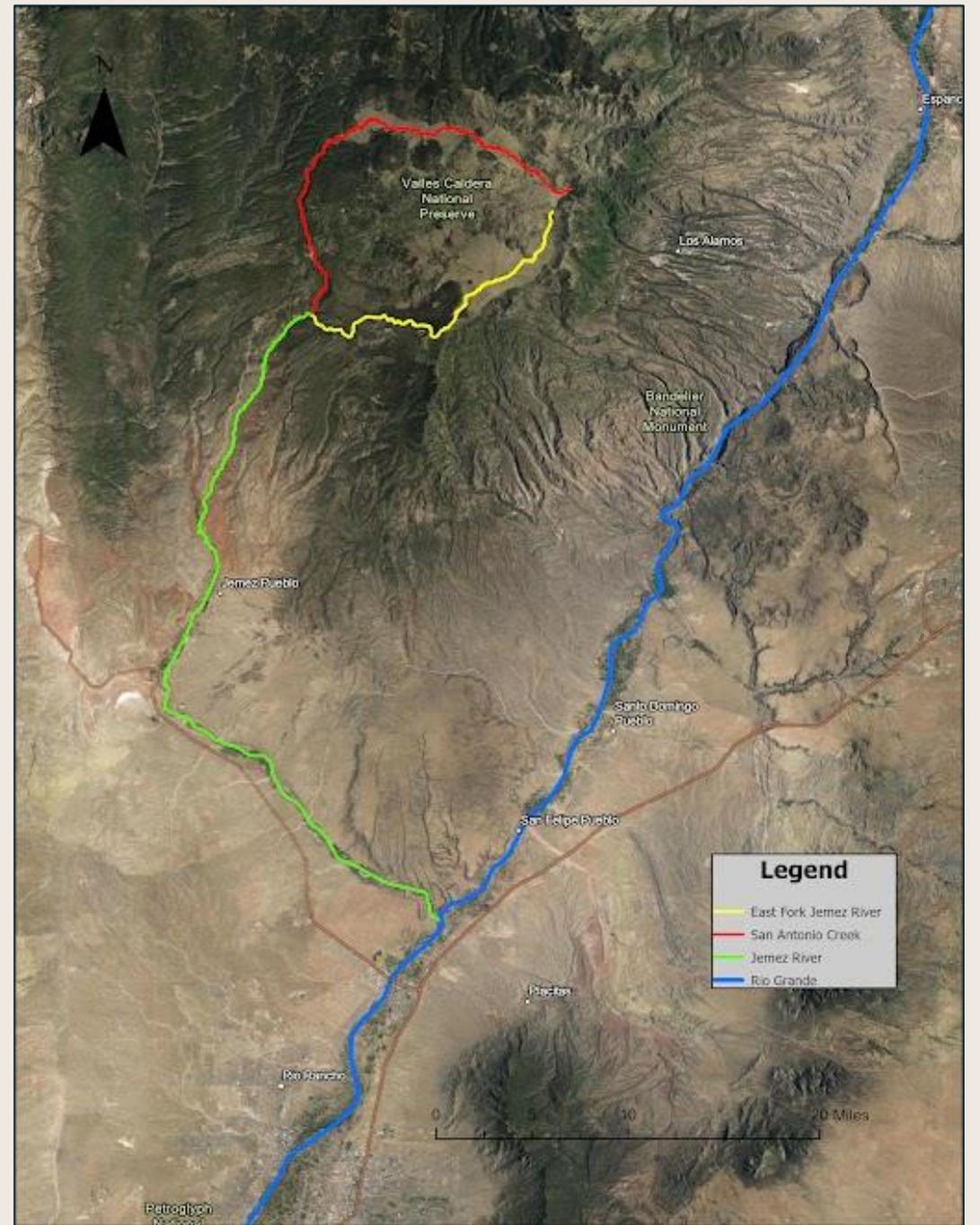
San Antonio Creek Before/After Project Characteristics



July 2012



August 2021



San Antonio Creek, Jemez River Watershed

Exclosures/Willows



Beaver Dam Analogs

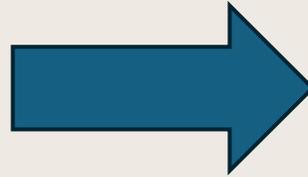


Post-Assisted Log Structures and Large Woody Debris



Reasons for Monitoring

- Demonstrate project effectiveness to funders (CWA 319h)
- Demonstrate functional uplift to regulatory agency (CWA 404)
- Meet water quality standards (CWA 303d)
- Show that LTPBR restoration methods have desired outcomes
- Provide basis for adaptive management



Monitoring Question: Has LTPBR treatment improved water quality, water storage and beaver habitat?

Monitoring Considerations

- Parameters- What should we measure?
 - Identified problems (CWA 303d impairments) – temperature, turbidity, nutrients, total Al
 - Ecosystem changes that we can affect (increase wetland acreage, increased woody vegetation and shade)
- Equipment, supplies and long-term equipment maintenance
- Budget (effectiveness versus research)
- Frequency
- Duration
- Sampling Locations

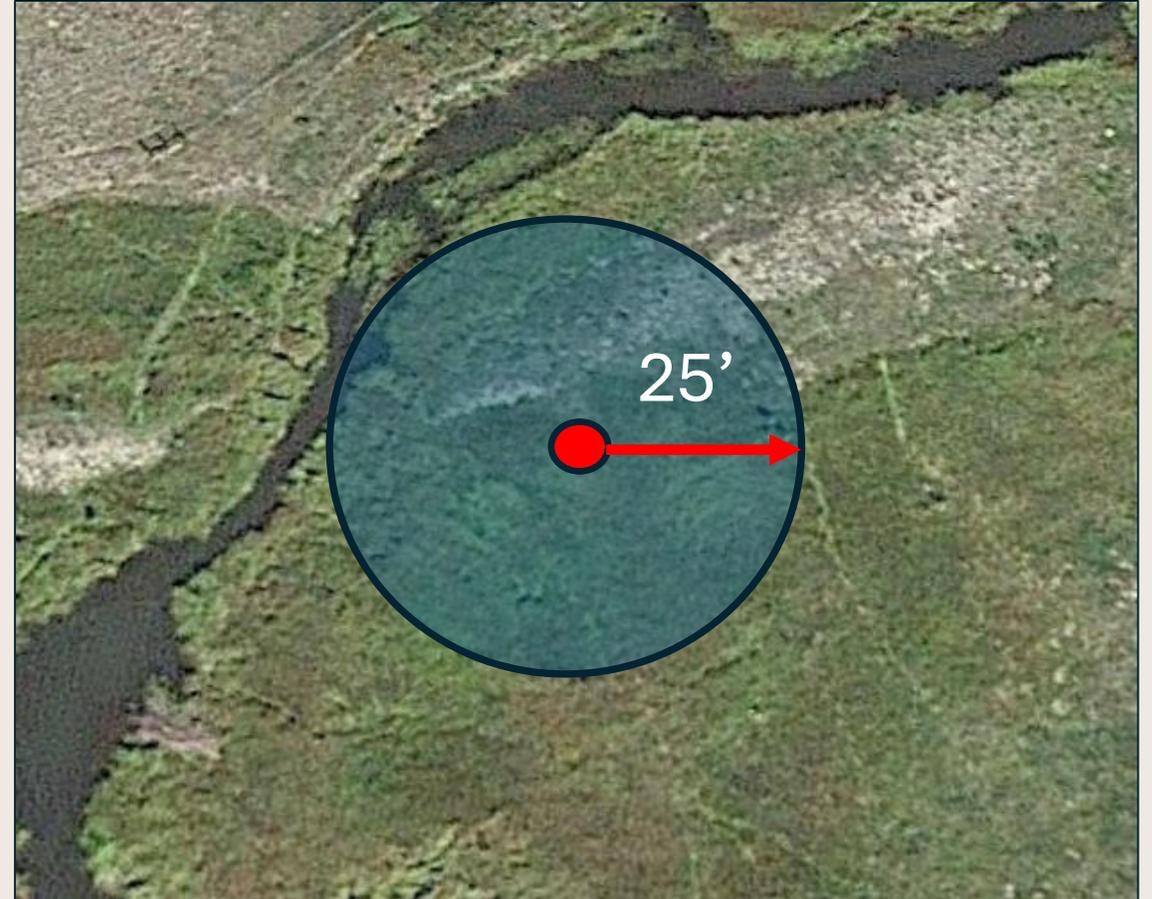
San Antonio Creek- Current Monitoring Plan

- Vegetation
 - Woody vegetation stem counts
 - Line-point intercepts
 - Stream shade
- Geomorphology
 - Longitudinal profiles
 - Cross sections
- Ground water levels
- Imagery
 - Annual photopoints
 - Drone video and photos
- Surface water temperature
- New Mexico Meadow Jumping Mouse



Woody Vegetation Stem Count

- Measures how many planted riparian shrubs and trees are alive
- Pin and stretch a 25' measuring tape
- Plot centers are monumented
- Count all stems within the circular plot
- Identify live vegetation species if possible
- Describe general plot characteristics (height, density)



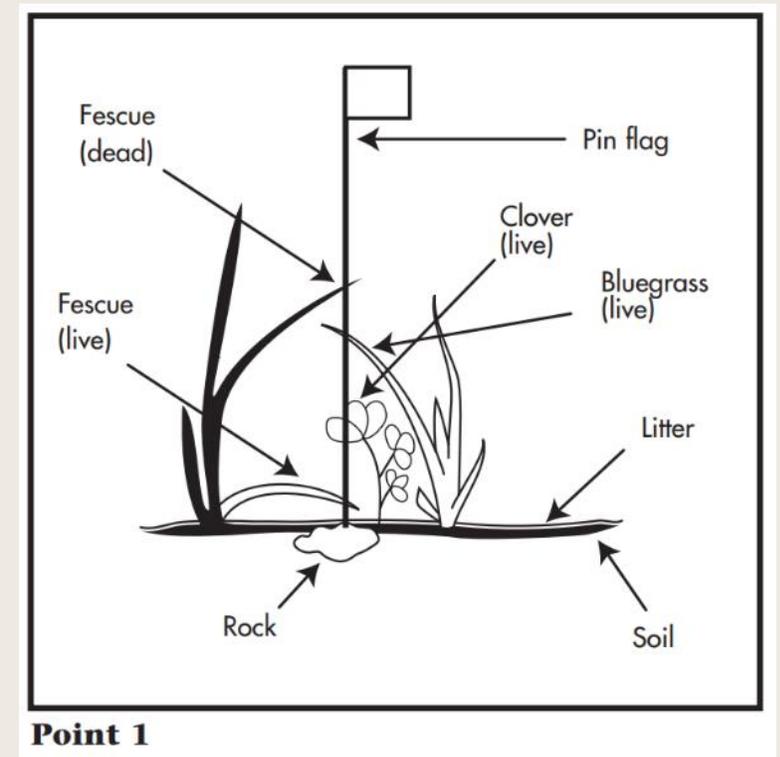
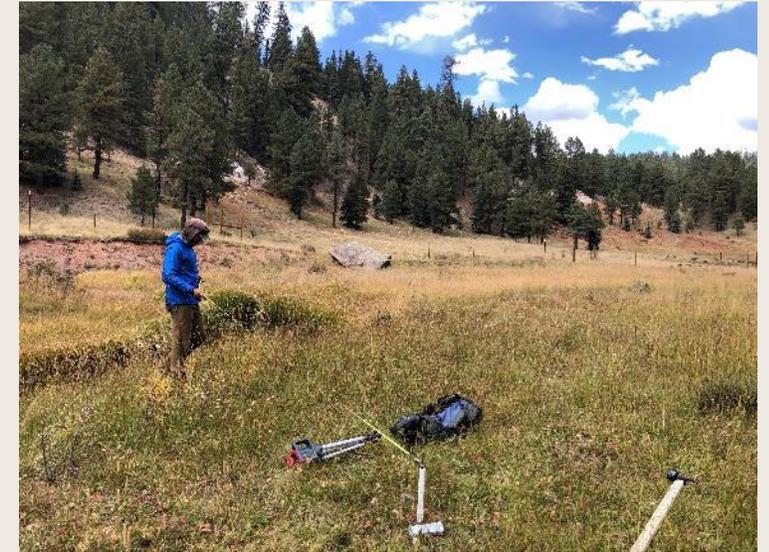
Woody Vegetation Data Example

Date: 8/8/23	Observers: KM & PW	Location: 35°52'04.5", -106°36'55.6"	Notes
Species	Live	Dead	Bebb's willows are 4'6" tall; Coyote willows are 4' tall. Abundant carex and a small pond with cattails. Willows are abundant and healthy. No sign of elk browse or beaver chew.
<i>S. bebbiana</i>	283	30	
<i>S. ligulifolia</i>	105	5	
<i>S. exigua</i>	190	46	
<i>S. spp</i>			
<i>P. ponderosa</i>			
<i>A. incana</i>			
<i>P. angustifolia</i>			
<i>P. virginiana</i>			
<i>P. tremuloides</i>			
Total	578	81	



Line Point Intercept Vegetation Monitoring

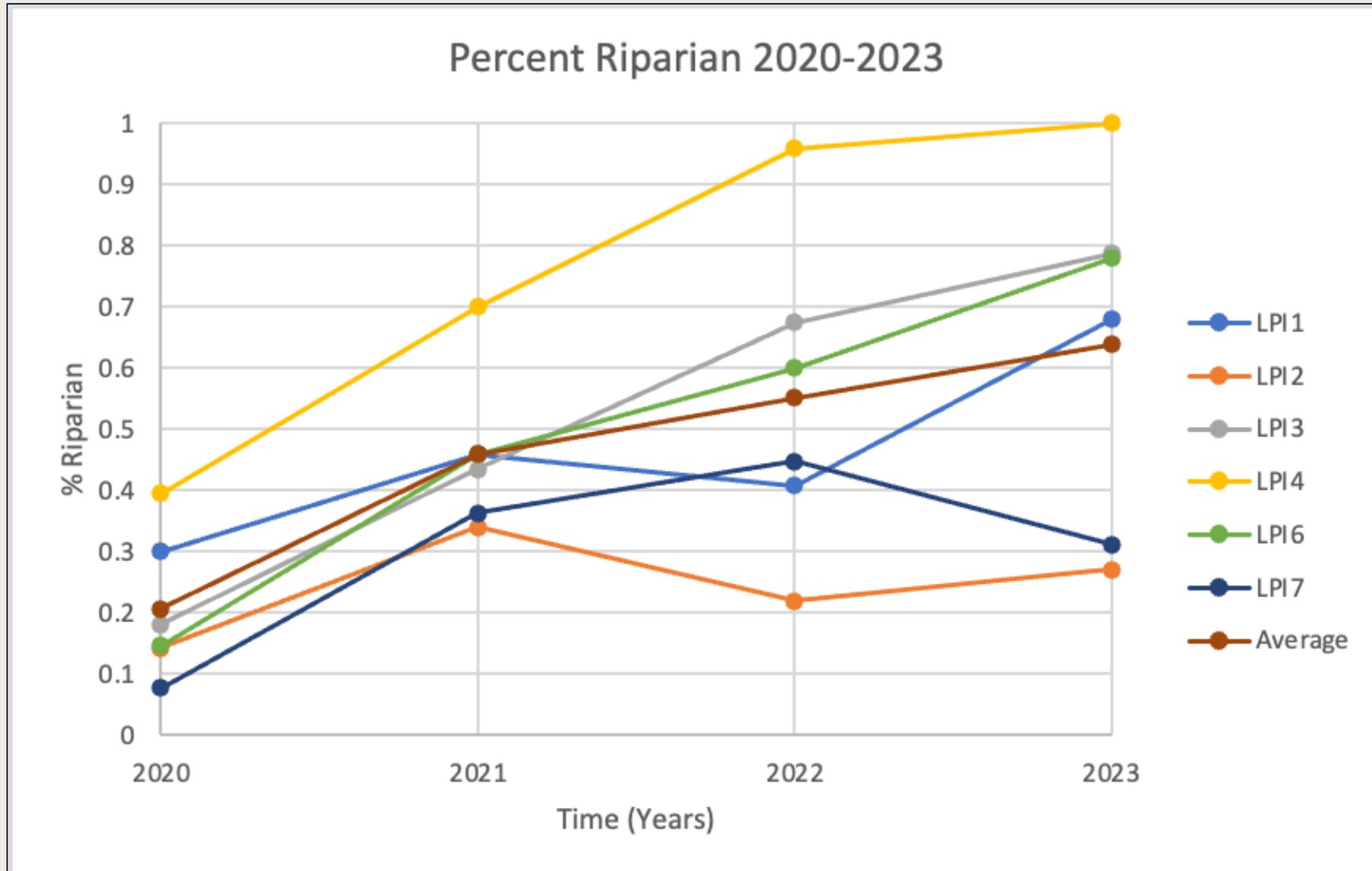
- Rapid, accurate method for quantifying soil cover, including vegetation, litter, rocks and biotic crusts
- Pin and stretch a 50 meter (150 ft) measuring tape
- Locations are monumented
- 50 points per line
- Drop a pin flag every meter, record every plant species it intercepts and plant height
- Record ground surface type (e.g. bare, leaf litter)
- *Monitoring Manual for Grassland, Shrubland and Savannah Ecosystems*, Herrick et al., 2017



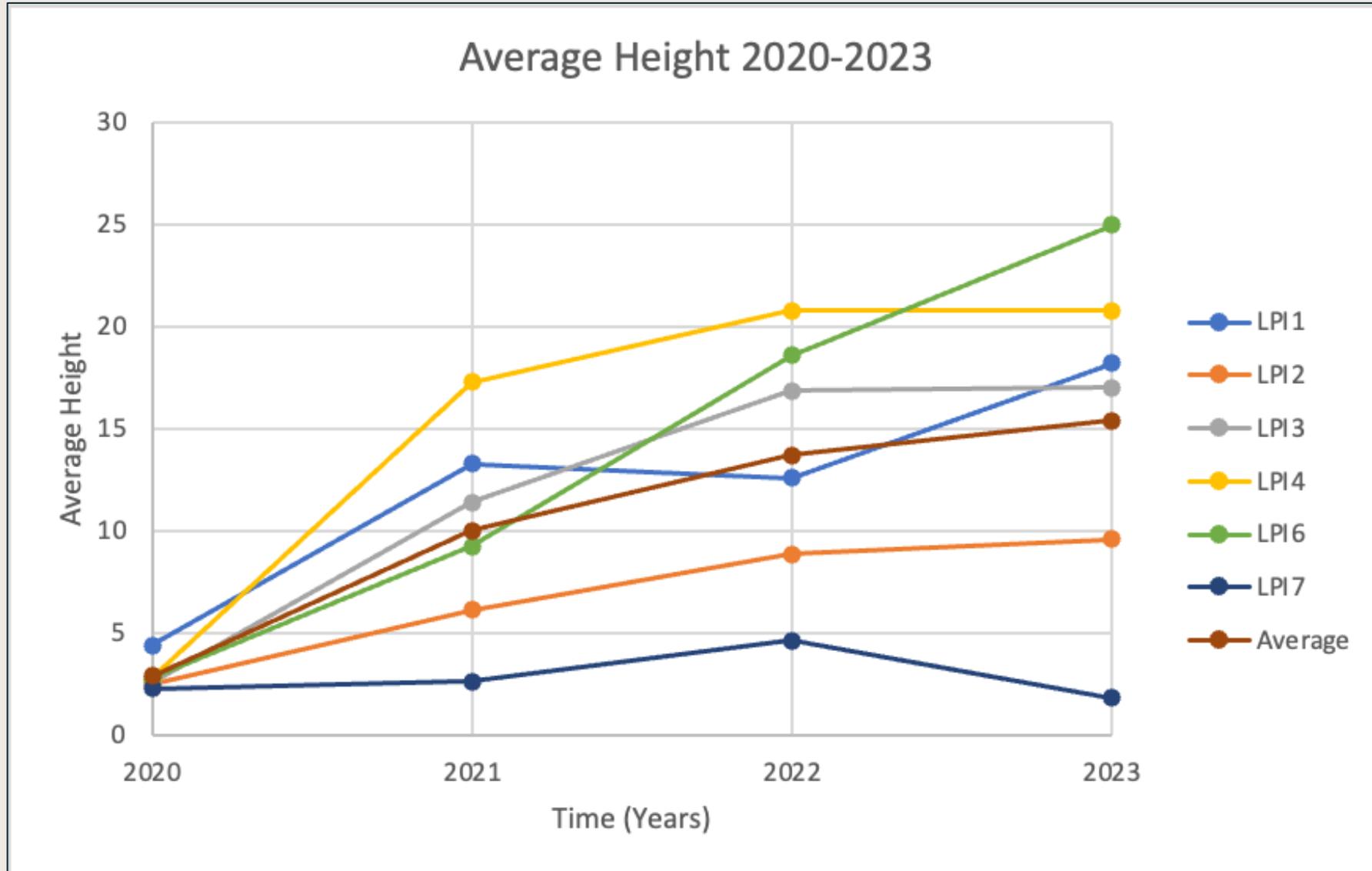
Vegetation – Line Point Intercept Data Example

Line Point Intercept #2						
STA 0		STA 50				
35.95877		35.95869				
-106.63105		-106.63086				
Genus	species	Frequency (2020) (Pre-construction)	Frequency -2021	Frequency 2022	Frequency 2023	Notes
Achillea	millefolium	2	3	1	5	Western Yarrow
Agrostis	scabra	-	4	4	3	Bentgrass
Antennaria	spp	2	-	-	-	Antennaria species
Bare		11	3	-	2	Bare ground
Blepharoneuron	trichopsis				5	Pine Dropseed
Bouteloua	gracilis	-	-	3	-	Blue Grama
Bromus	inermis	2	-	2	7	Smooth Brome
Bromus	ciliatus	-	-	-	1	Fringed Brome
Carex	spp	-	3	-	1	Unknown Carex
Dasiphora	fruticosa	-	-	1	-	Shrubby Cinquefoil
Elymus	trachycaulus	-	3	2	-	Slender Wheatgrass
Eriogonum	spp	-	2	1	-	Unknown Buckwheat
Equisetum	laevigatum	-	-	1	3	Scouring Rush
Festuca	Arizonica	-	1	2	4	Arizona Fescue
Festuca	ovina	1	-	-	-	Sheep Fescue
Juncus	balticus	4	9	6	4	Mountain Rush
Litter		10	-	-	-	Litter
Lycurus	setosus	-	-	1	-	Bristly Wolfstail
Medicago	lupulinum	-	-	2	-	Black medic
Muhlenbergia	richadsonis	-	-	4	-	Mat Muhly
Muhlenbergia	torreyi	-	1	4	-	Ring Muhly
Phleum	pratense	-	7	3	3	Timothy
Phleum	alpinum	-	-	1	2	Alpine Timothy
Poa	pratense	6	1	2	4	Kentucky Bluegrass
Poa	spp	-	-	2	-	unknown Poa
Potentilla	hippiana	1	-		2	Wooly Cinquefoil
Potentilla	spp	-	2		-	Unknown Potentilla
Rudbeckia	hirta	-	-	2	-	Black-eyed Susan
Rudbeckia	laciniata	-	-	-	1	Cut-leafed Coneflower
Salix	exigua	-	-	-	1	Coyote Willow
Stipa	viridula	-	6	-	-	Green Needlegrass
Taraxacum	officinale	10	5	6	2	Common Dandelion
Forb	spp	1	-	-	-	Unknown Forb
Height		2.53	6.12	8.87	9.6	Inches
		28	47	50	48	

Vegetation – Line Point Intercepts



Vegetation – Line Point Intercepts

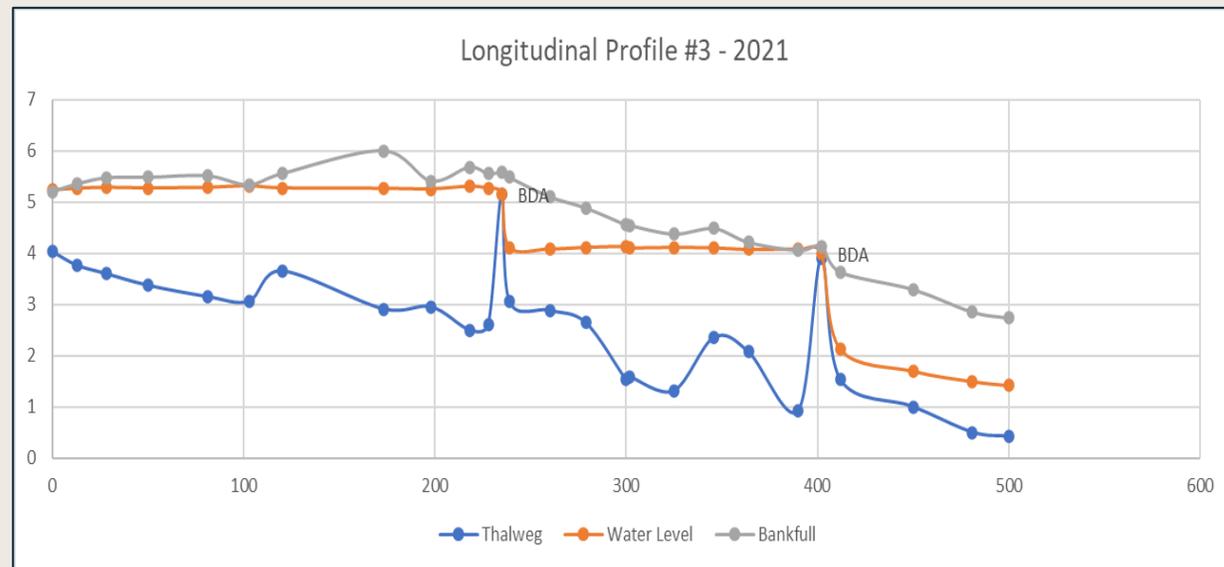
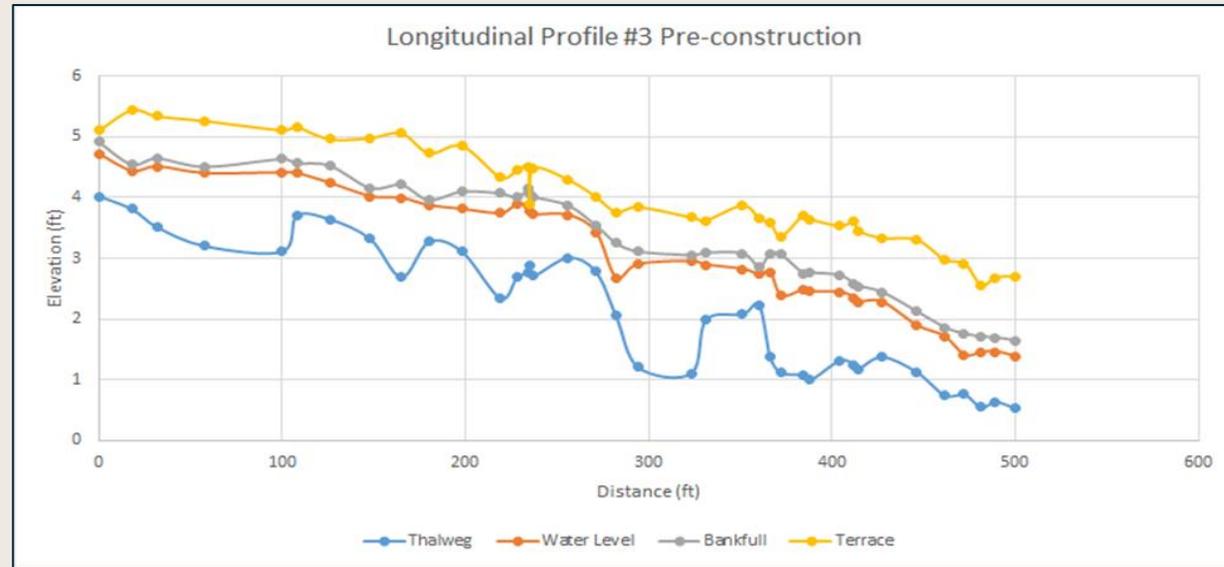


Geomorphic Monitoring

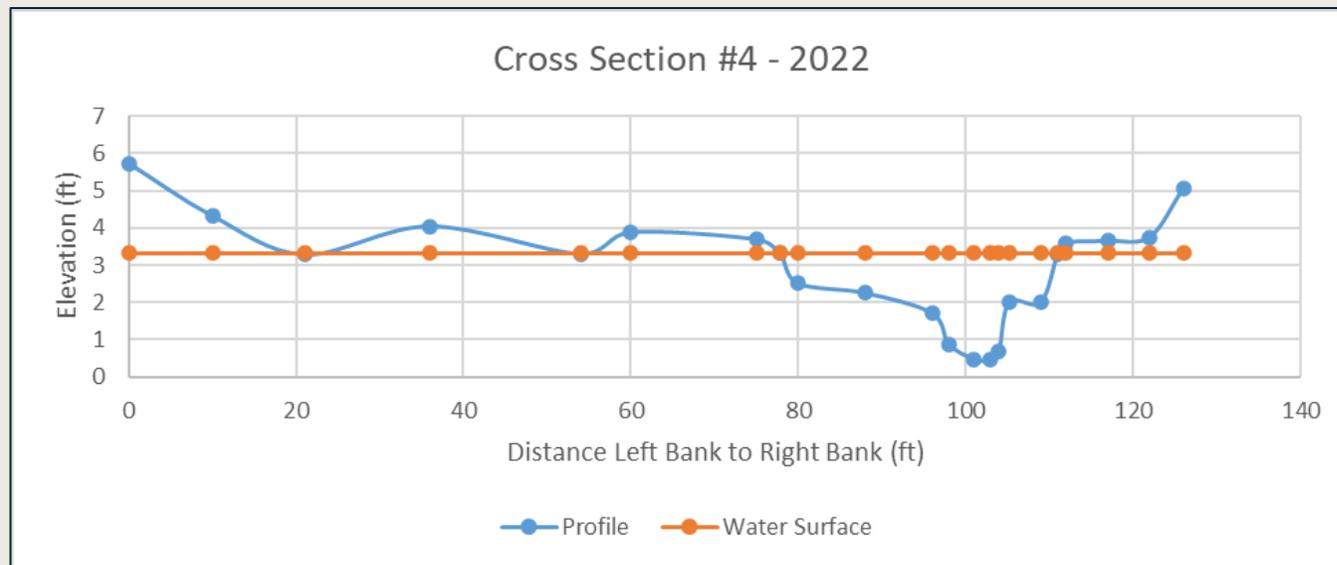
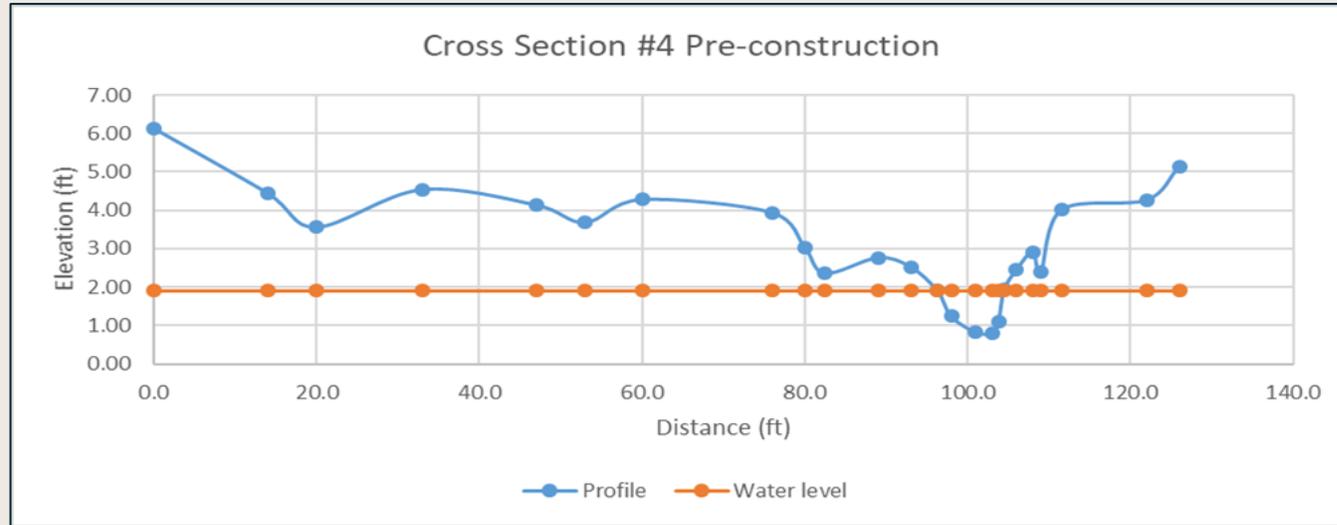
- 5 cross sections established and monumented perpendicular to the stream
- One longitudinal profile parallel to the stream
- Elevations of pertinent stream features are measured with survey equipment
- Rosgen Level 2 or Natural Channel Design monitoring



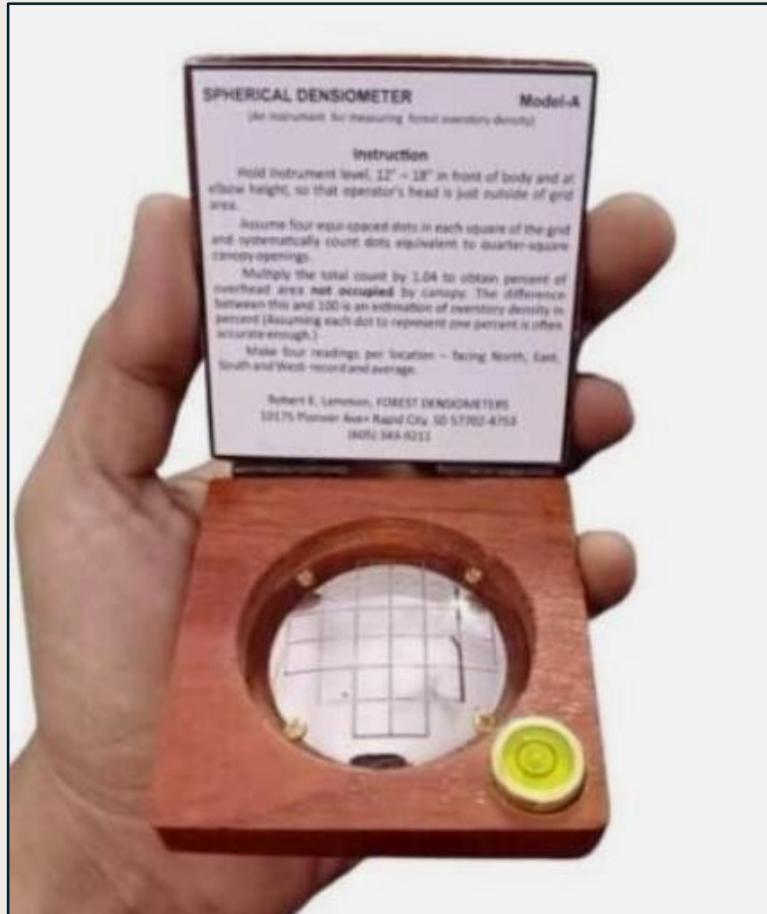
Geomorphic Monitoring – Longitudinal Profile



Geomorphic Monitoring – Cross Section



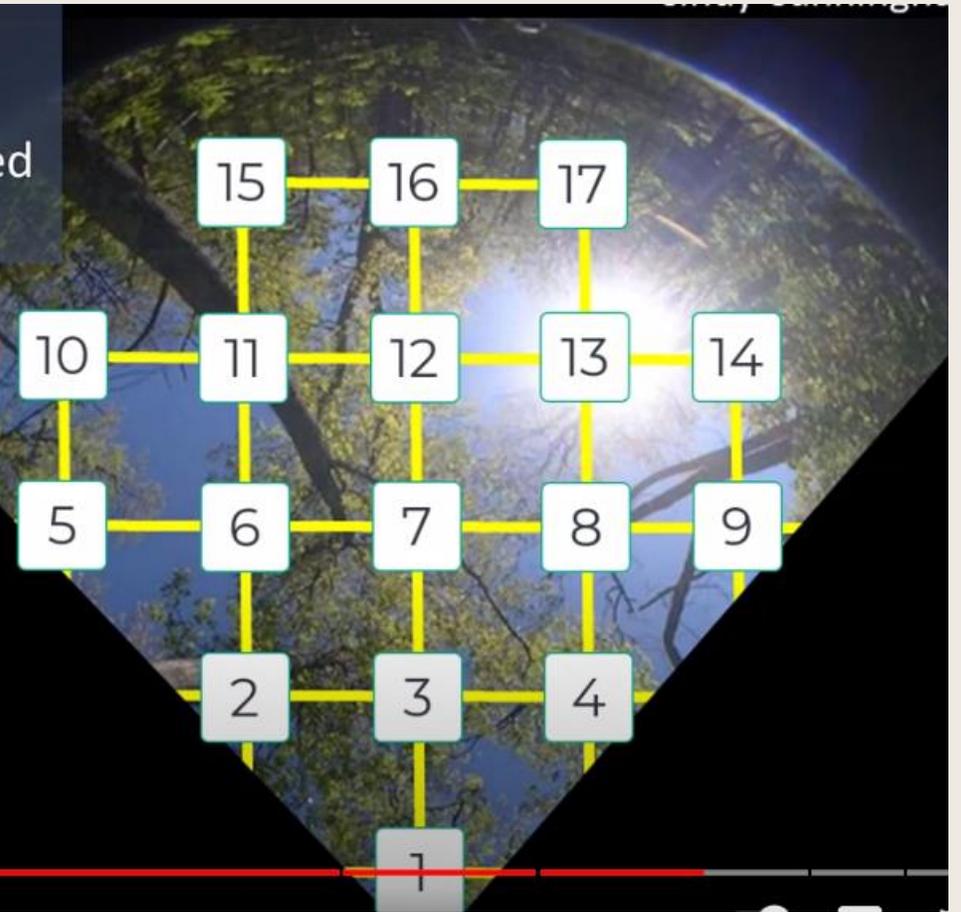
Stream Shade – Spherical Densimeter



17 line Intersections

If intersection covered by canopy = "hit".

Step #4



Water Level Measurements

- 6 piezometers distributed along a 2-mile reach
- Ground water levels have risen up to 36 inches adjacent to San Antonio Creek.
- Estimated 100 acre-feet increase in subsurface water storage



Water Temperature – Data Loggers



PART NUMBER - U22-001



HOBO Water Temperature Pro v2 Data Logger
Water Temperature (400 ft.)
\$175.00

A durable water temperature data logger with 12-bit resolution; for depths up to 400 feet.

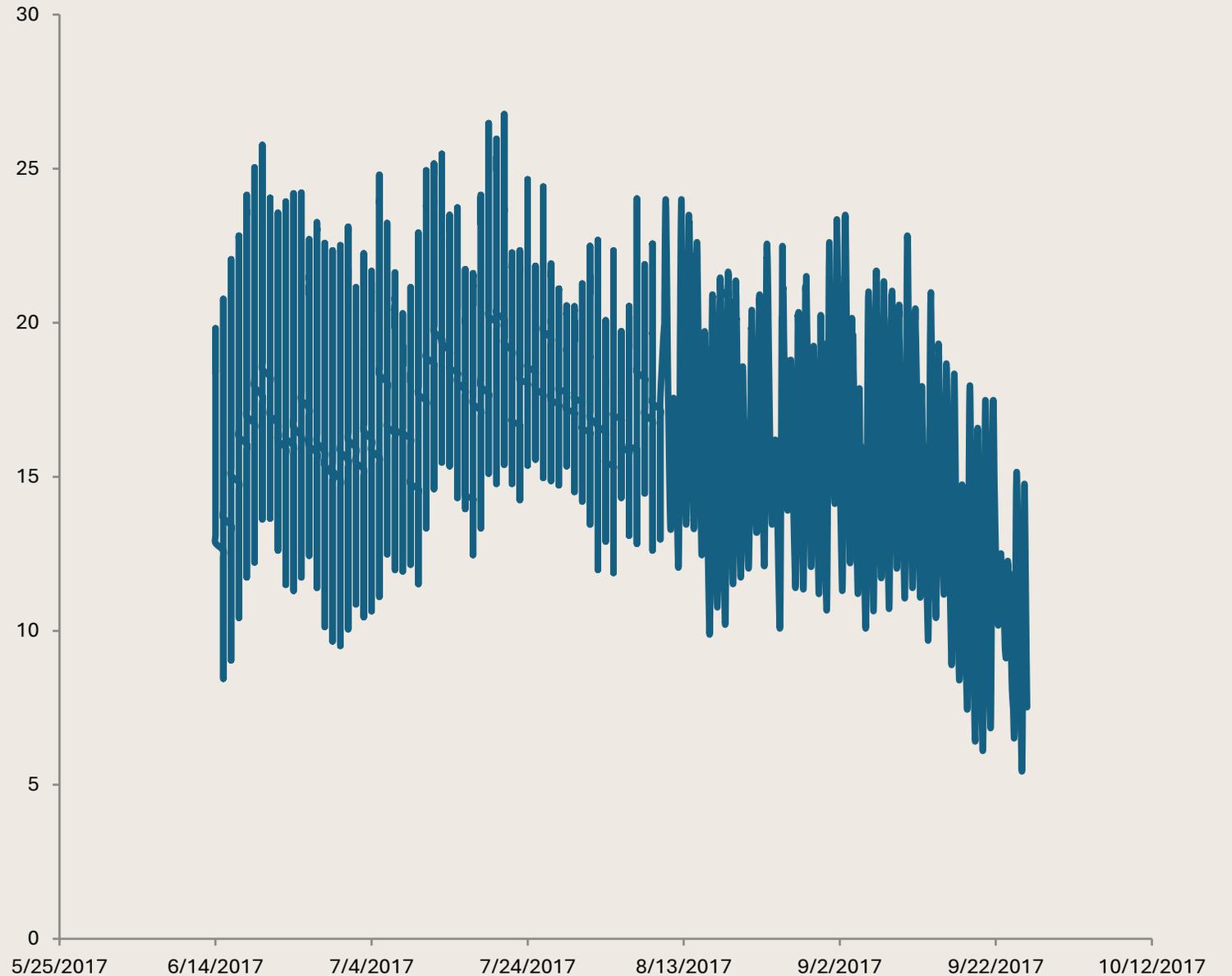
IMPORTANT INFORMATION
Requires [HOBOWare software](#) and either an [Optic USB Base Station](#) or [HOBO Waterproof Shuttle \(U-DTW-1\)](#). HOBOWare Pro is required when using the HOBO Waterproof Shuttle. See compatible items below.

Compatible with
HOBOWare Software

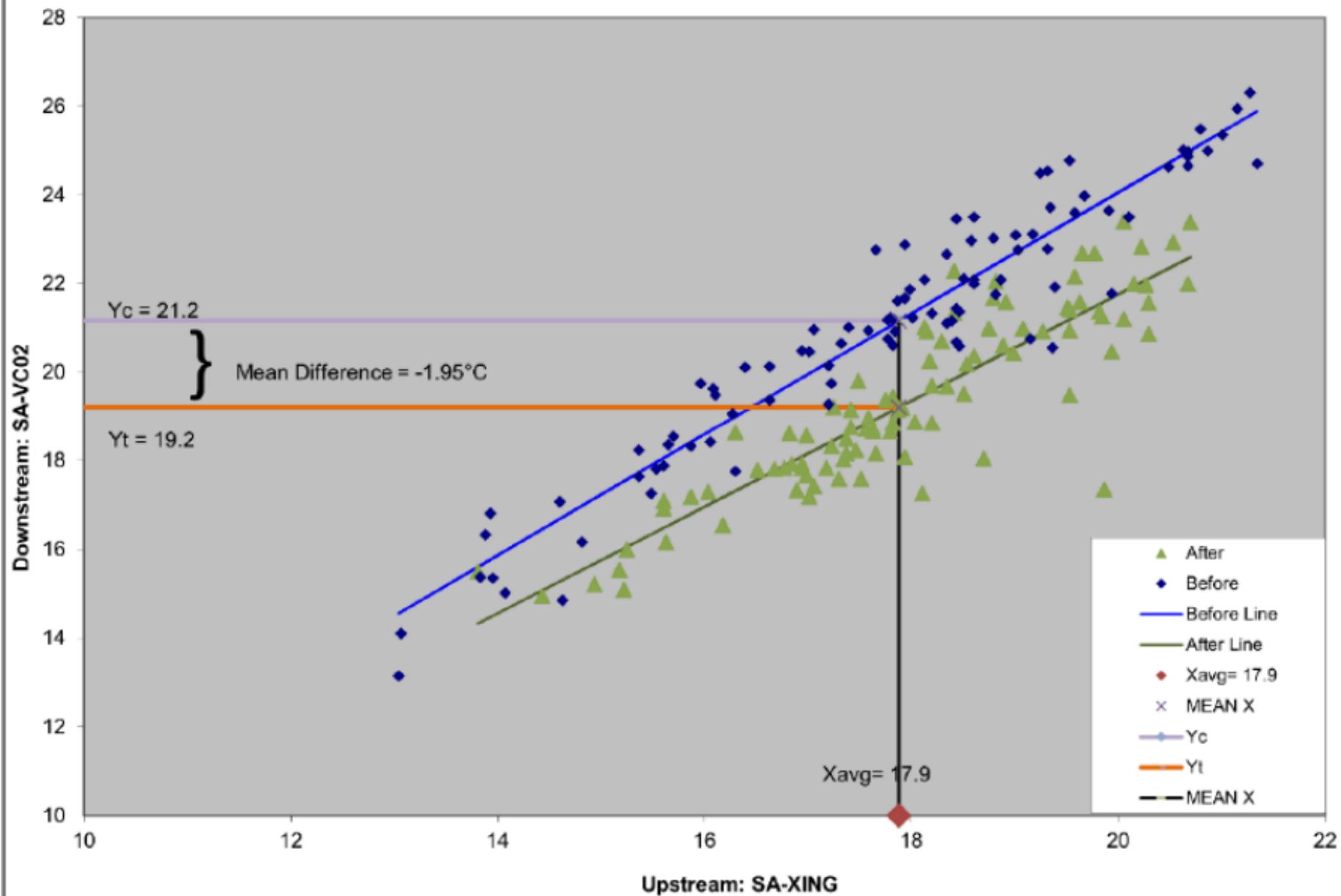


Water Temperature Data Example – Single Point

6/14/2017 18:00	19.341
6/14/2017 18:15	19.127
6/14/2017 18:30	18.866
6/14/2017 18:45	18.58
6/14/2017 19:00	18.319
6/14/2017 19:15	18.033
6/14/2017 19:30	17.748
6/14/2017 19:45	17.463
6/14/2017 20:00	17.153
6/14/2017 20:15	16.796
6/14/2017 20:30	16.439
6/14/2017 20:45	16.106
6/14/2017 21:00	15.796
6/14/2017 21:15	15.485
6/14/2017 21:30	15.199
6/14/2017 21:45	14.912
6/14/2017 22:00	14.625
6/14/2017 22:15	14.361
6/14/2017 22:30	14.098
6/14/2017 22:45	13.834



San Antonio Creek ANCOVA: Daily Max Temp (°C) 2009 vs 2014



Annual Photopoint Monitoring



May 2020



September 2022

Annual Photopoint Monitoring



October 2020



September 2022

Drone Imagery

- DJI AIR 2S Fly More Combo Drone- \$970.00
- FAA Part 107 Small UAS Certificate (certified commercial drone operator). Unmanned Aircraft System



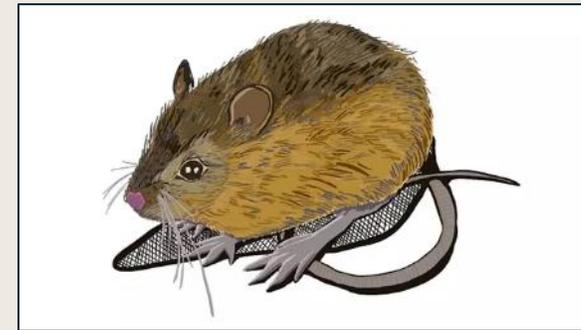


August 2023



August 2023

New Mexico Meadow Jumping Mouse - Track Plate Monitoring



Zapus hudsonius luteus
National Park Service, 2022



*Real beaver dam on San Antonio Creek.
Beaver occupation is the goal!*

Questions?

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Ecological Opportunities

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