

UAV-Based Soil Erosion Monitoring for the Removal of Ward's Mill Dam, NC

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Site



Ward's Mill Dam

- Built in 1890
- Watauga River
- 40 m long 6 m high
- Provided electricity, jobs, firewood and building materials for surrounding area

Removal

Owners surrendered hydroelectric power generation license due to trouble with maintaining dam

Removed on May 16, 2021

Reconnects 35 miles of aquatic habitat in the Watauga river

Removal was a top priority for many environmental groups including US Fish and Wildlife



Goal

Monitor changes in topography after dam removal

Using UAV imagery and structure from motion

Replace In Situ surveys

- Accuracy
- Time
- Money
- Safety



Data Collection



DJI Phantom 4



Drone2Map

- Orthomosaics
- DSMs



GCPs

Data Collection

Flight Date	Elevation (m)	Time
4/4/2021	200	2 pm
5/14/2021	200 (230)	4 pm
6/21/2021	230	3 pm
7/16/2021	230	11 am
8/26/2021	230	3 pm
9/24/2021	230	3 pm
11/5/2021	200	11 am
2/11/2022	200	12 pm

Methods

Capture images

Create orthos and DSMs

Georeference orthos to May ortho

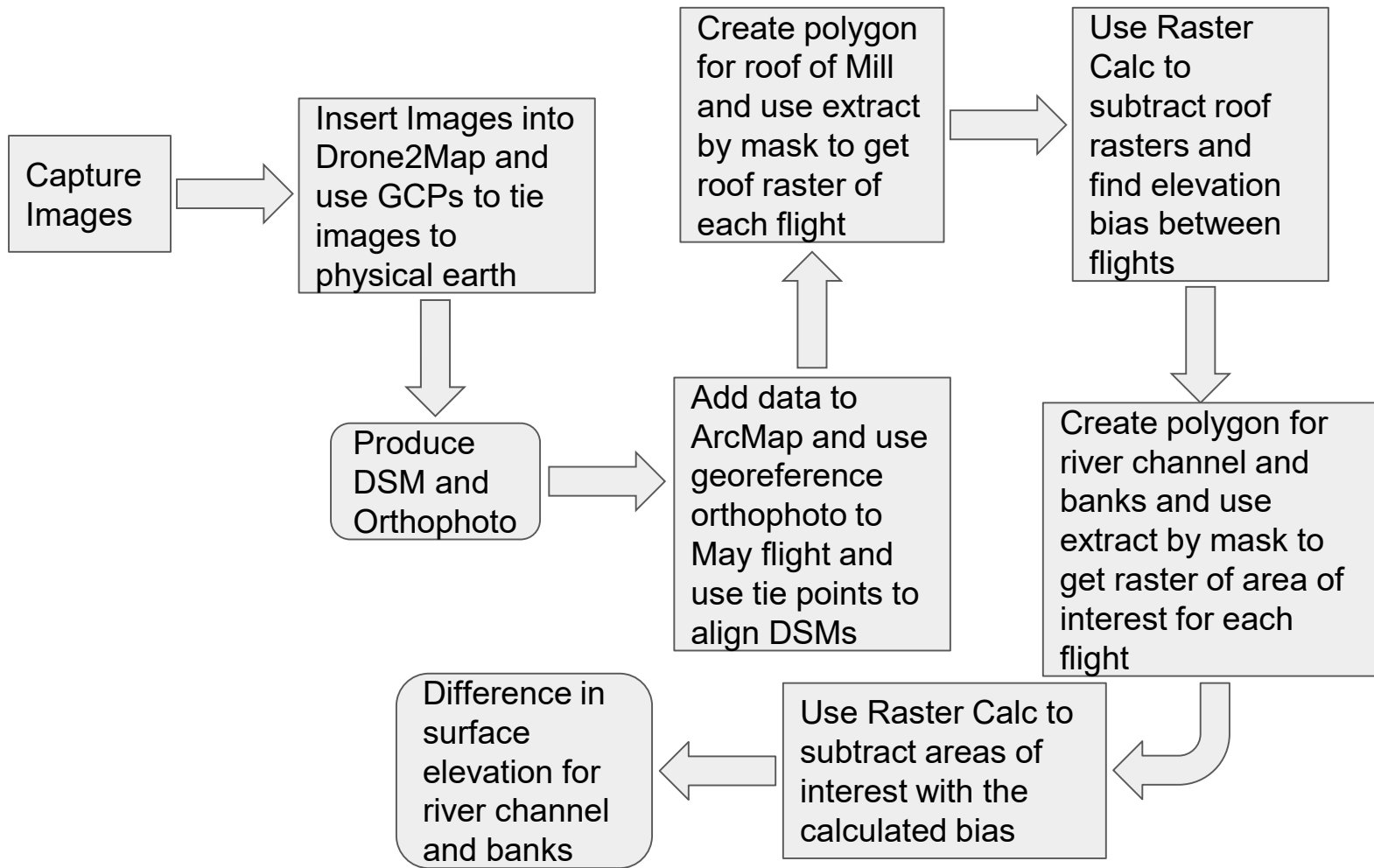
Extract DEM for roof of building

Calculate bias

Extract DEM for river including banks

Calculate change





Flights



Flight Lines



Image Points

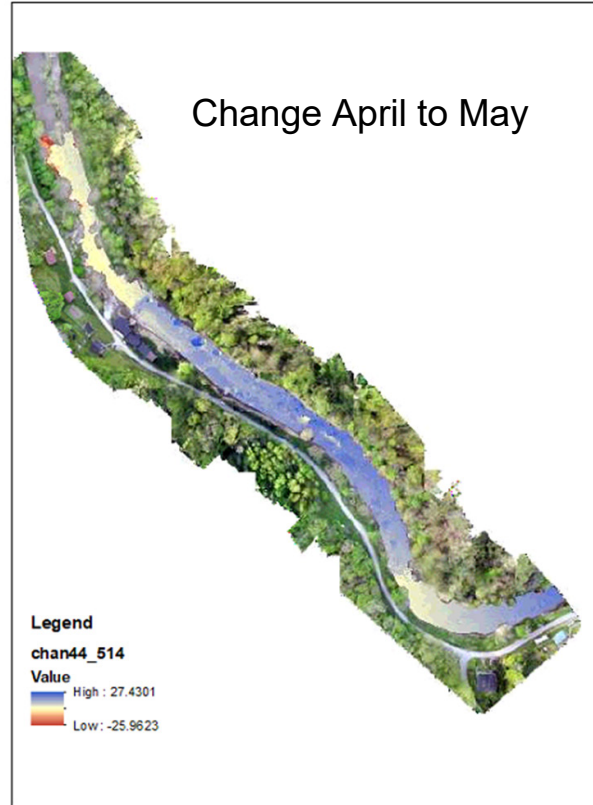


GCPs

April vs May (3 flights)



April 2021



May 2021

April vs May (Dam area)

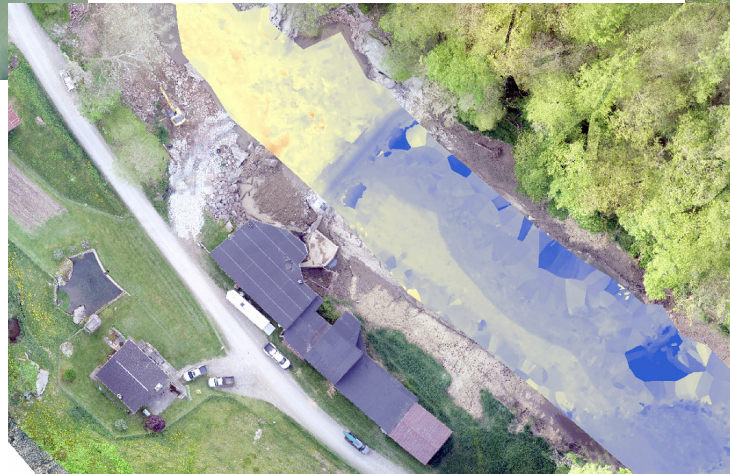


April 2021

Change April to May



May 2021



Legend
chan44_514
Value
High : 27.4301
Low : -25.9623

Middle Flight



Change April to August Month to Month



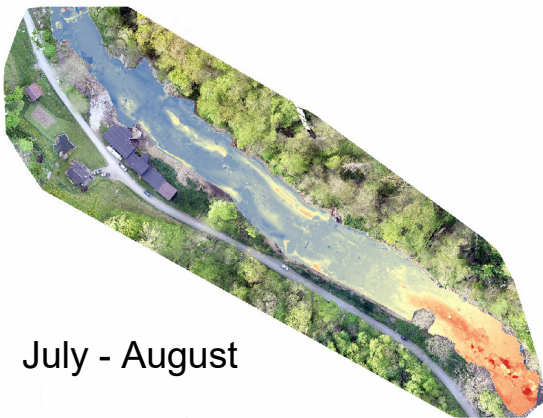
April - May



May - June



June - July



July - August

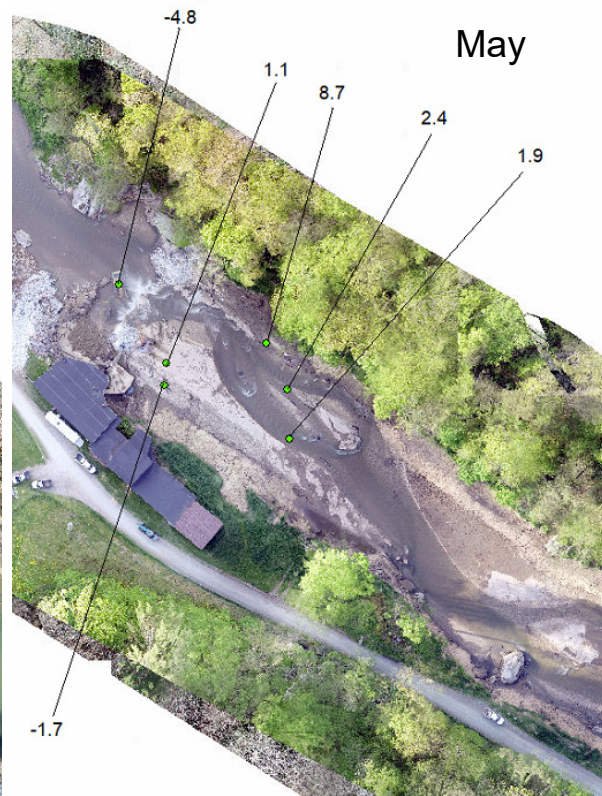
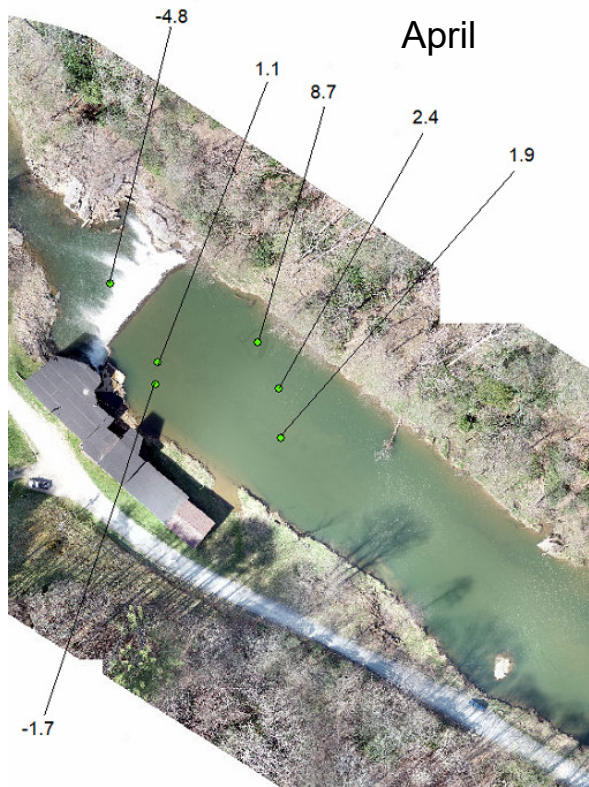
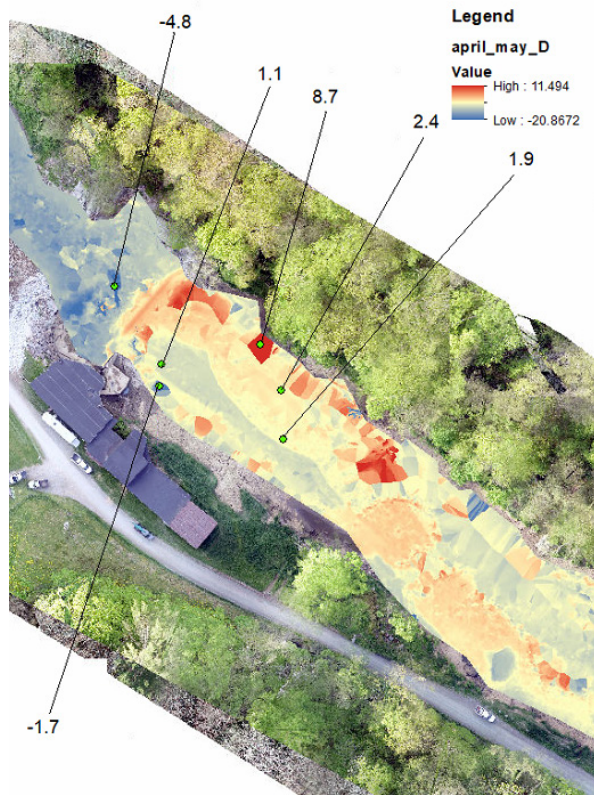


August - September

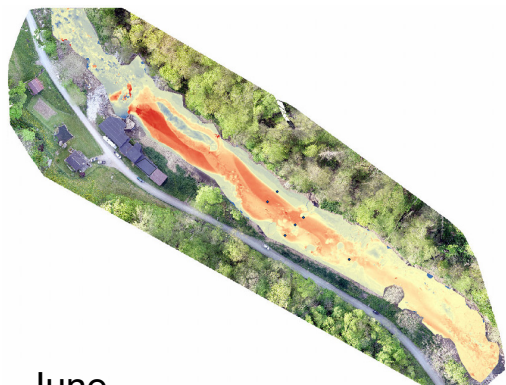


September - November

Analysis (April vs May)



Changes May to November



June



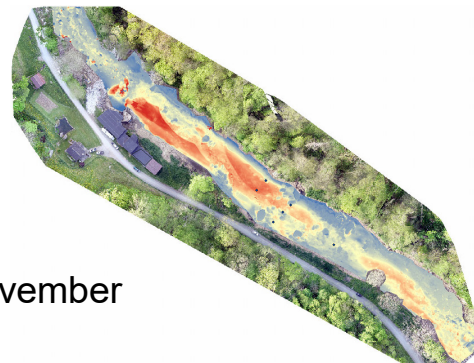
July



August



September

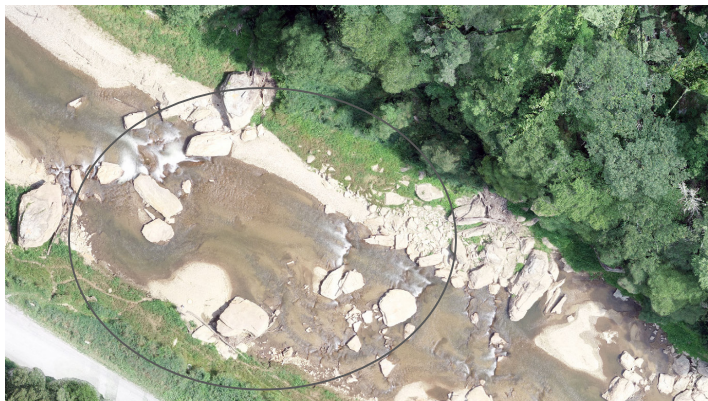
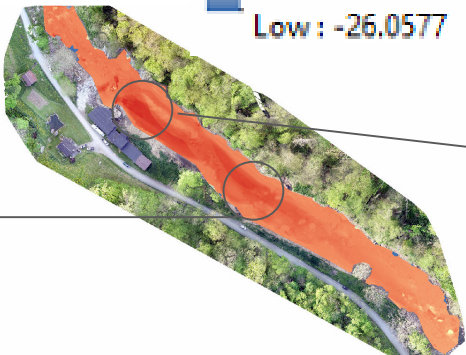
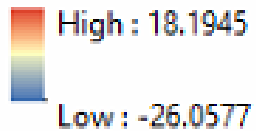


November

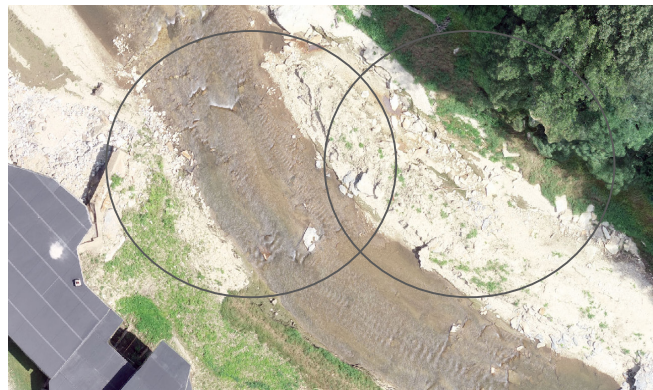
Analysis (May vs July)



May



July



Optical Images



April



May



June



July



August



September



November

Error Matrix

	April	May	June	July	August	September	November
April		-113.232	-113.246	-113.294	-113.188	-113.035	-113.113
May			-0.014	-0.061	0.044	0.197	0.12
June				-0.047	0.058	0.212	0.134
July					0.105	0.259	0.181
August						0.154	0.076
September							-0.077
November							



September

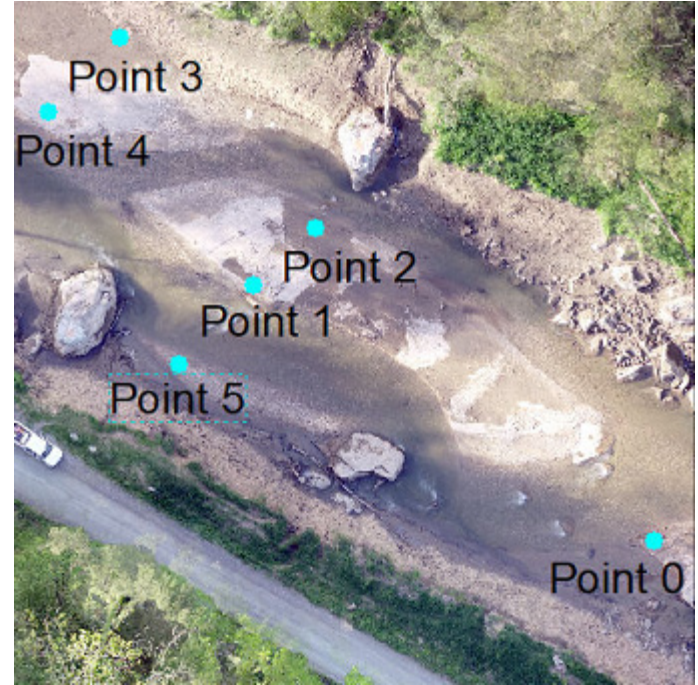


August



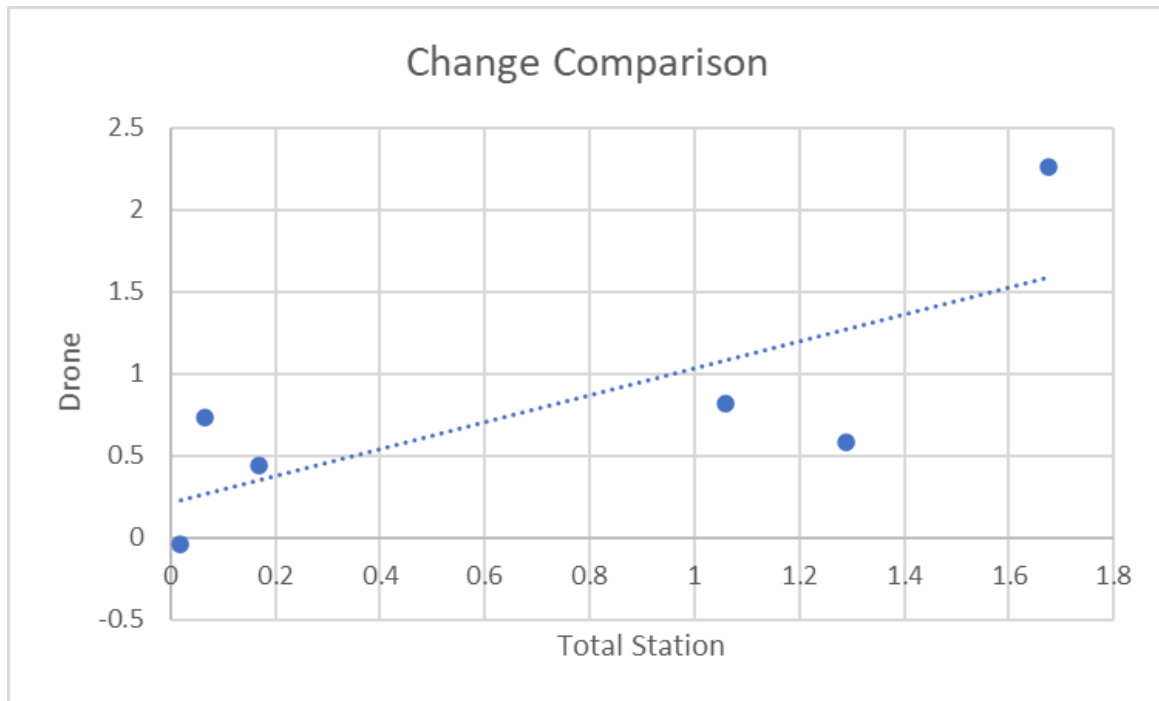
November

Total Station Verification

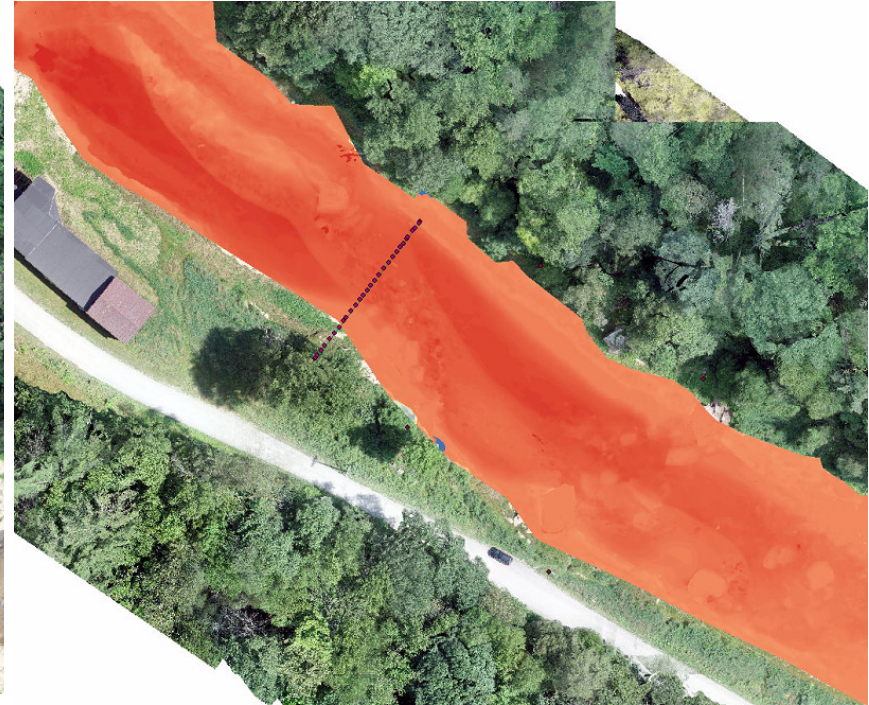


Total Station Verification

Point	TS Difference (m)	Drone Difference (m)
0	0.170	0.439
1	1.289	0.578
2	0.066	0.736
3	0.019	-0.043
4	1.675	2.257
5	1.058	0.821



Cross Section Verification



Verification

Point	Difference in ch	Drone Change	Field Measurement	Distance Difference	May Field	May Distance	July Field	July Distance
8	1.059724	0.029724	-1.03	-0.6	2.84	8.6	3.87	9.2
9	1.576602	0.016602	-1.56	0.4	2.74	10.4	4.3	10
10	2.255492	0.005492	-2.25	0.7	2.86	12.2	5.11	11.5
11	3.461643	0.871643	-2.59	-0.8	2.86	12.2	5.45	13
25	2.036411	1.446411	-0.59	-0.1	4.07	29.4	4.66	29.5 ☆
26	2.498049	1.438049	-1.06	0.6	3.26	31.8	4.32	31.2
27	1.830332	1.340332	-0.49	-0.1	3.26	31.8	3.75	31.9 ☆
28	1.476685	0.976685	-0.5	0.3	3.21	33.2	3.71	32.9

Continuing

Continuing to monitor every month

Going to try to create more accurate gcps with Trimble Catalyst V2.0

River profiling data from another research group

Automate processing