Measuring flow rates on the Perrine Coulee using photogrammetry and UAS

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BACKGROUND

Water flow measurement is crucial for managing water resources, irrigation, and environmental monitoring. In dry, semi-arid, steppe climates, such as those found in Southern Idaho, management of water flow is critical for providing reliable information to water managers. Traditional methods like weirs and current meters offer reliable, direct measurements but can be Infrastructure-intensive, time-consuming, cause in-stream disturbance, and be limited in scope.

METHODS

1. Collected water depths and velocity measurements from Perrine Coulee in Twin Falls, Idaho using a top-setting wading staff and velocity meter.

2. Gathered GPS waypoints on localized elevations and created semi-permanent landmarks across a controlled section of the streambed. Utilizing real-time kinematics (RTK)P GPS at sub-centimeter accuracy.

3. Created multiple ground-control points (GCP) using RTK-GPS in the area of the controlled section for use with remotely-sensed imagery.

4. Used SUAS to collect visible (RGB) imagery at the same time flow data was taken, ensuring 70% overlap for photogrammetric purposes.

5. Processed the imagery using open-source software to generate 3D models and extract data of the water surface at the controlled section.

6. Correlated the flow data with the elevation to attempt to create a regression to determine suitability of suing sUAS for a flow measurement.

Image 1– Brigham flying drone at Perrine Coulee

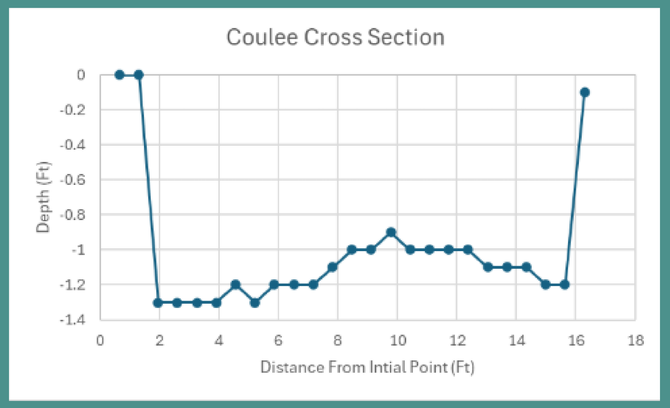

Figure 1– Cross Section of controlled section of the Perrine Coulee

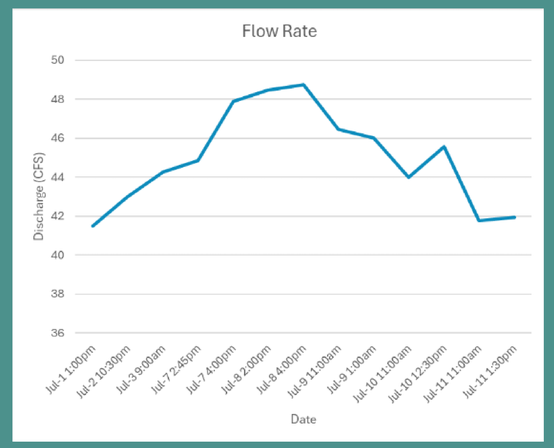

Figure 2-Perrine Coulee Flow Rates

Image 2– 3D image on Perrine Coulee created from pictures from drone

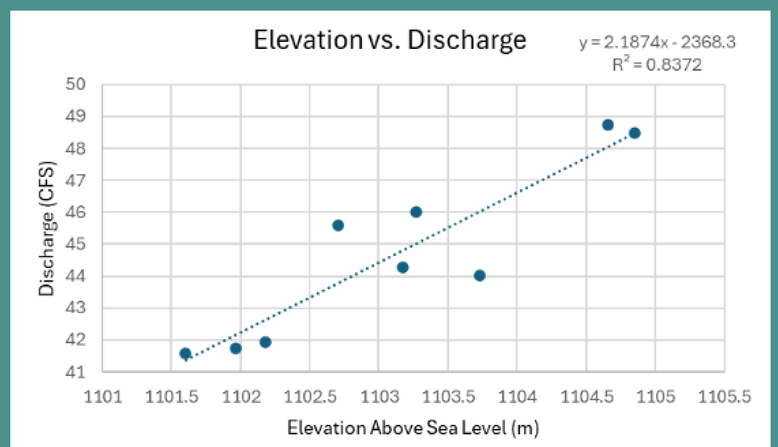

Figure 3-Elevation vs Discharge

Image 3– Brigham and Caleb collecting metered data on Perrine Coulee.

RESULTS

Flow rates on the Perrine Coulee ranged from 41.49 CFS to 48.75 cubic feet per second (CFS). Water elevations ranged from 1101 to 1105 m as extracted from the imagery. Flow rates relative to elevations were charted in figure 2. The R2 value on a linear regression was 0.837 with a line equation of y=2.1874x -2368.3, with as flow rate (CFS) as the y value and x as the elevation (m) of the stream at the controlled section.

CONCLUSIONS

With only nine points of elevation data that could be compared to flow data, the results are promising, indicating an acceptable predictability. Given the results on such a small data set is encouraging, suggesting water managers could potentially utilize sUAS (drones) as a tool to monitor flow rates at a time and labor savings. However, more data is required to safely conclude the utility and overall reliability of the method.

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