**Lidar Processing:**

LiDAR for this study was collected during the summer of 2017 with a Routescene LidarPod mounted on a Vulcan Raven X8 Heavy-lift unmanned aerial system (UAS). The system is designed around a Velodyne HDL-32e 3D LiDAR scanner with 32 lasers which operates in the infrared with a wavelength of 905 nm and can generate up to 1.4million 3D points per second. The system boasts high spatial accuracy using RTK from two extended arms mounted in the front and back of the UAS. In total, 37 flights were flown with single return to generate a point cloud for the Teller 27 watershed. In order to tie the data to the ground surface, a triangle of known points (measured with an R10 Trimble Rover and Base accurate to ~2cm) is flown over during every flight as well as calibration figure eights for the inertial units on board the UAS.

Post-processing for UAS LiDAR begins by narrowing down the point cloud from hundreds of millions of points to the most reliable points using filters for turns, using only the lasers with the least amount of error, and taking only returns within a certain range of the UAS. After the point cloud has been reduced, the next step is adjusting the roll, pitch, and yaw values to produce a continuous point cloud between overlapping flight lines. Once this has been done we can apply a cloth simulation filter in CloudCompare (Zhang et al. 2016) which separates ground and non-ground measurements to generate digital terrain models (DTMs) and digital surface models (DSMs). The method involves inverting the point cloud and simulating a cloth (Weil, 1986) over the surface with a parameter for the rigidness of the material. By tweaking parameters and looking at how they affect the vegetation, an appropriate DTM and DSM are created allowing for estimates of shrub heights throughout the watershed.