

## ENGINEERING/TECHNOLOGY

### Estimation of Two-Stage Ditch Excavation Volume Using LiDAR Data

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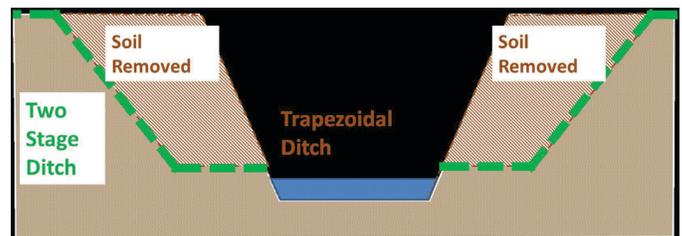
Agricultural drainage ditches are a major pathway for sediment, nutrients, and pesticides to enter stream systems. An innovative ditch geometry, called the two-stage ditch, includes a vegetated bench that acts as a floodplain, which helps to prevent erosion and increases the processing of nutrients which can improve water quality. Identifying potential sites for two-stage ditches would help conservation agencies focus their resources. One key factor in identifying suitable locations is the necessary soil excavation. This could be estimated through an expensive field survey of each potential site, or by an innovative analysis of Light Detection and Ranging (LiDAR) elevation data.

The excavation volumes for two ditches were estimated using two methods: a LiDAR digital elevation model (DEM), gridded to a 3 m resolution, and a ground survey using a highly accurate GPS unit. ArcGIS software was used to create profiles of the existing streams. Hypothetical two-stage cross-sections were created by calculating the bankfull depth, based on the drainage area, and the width, using an appropriate bank slope. The difference between the area under the two-stage cross-section and the original cross-section was multiplied by the length of the ditch to be converted to find the

excavation volume. The volumes estimated by the two methods were compared.

The difference in the estimated volumes varied by ditch, ranging from 16.9% to 46.5%. Possible explanations for this are that LiDAR does not survey below water and that the water levels were higher during the LiDAR survey than during the GPS survey, or that the DEM was not accurate enough. Since the sample size was very small, implementing the procedure on more ditches will provide a better idea of the accuracy of the method and its potential for more widespread use.

*Research advisor Jane Frankenberger writes, "Innovative solutions are needed to improve our drainage infrastructure. Paff's research explored a method for using a new geospatial data source, LiDAR, to streamline the process of identifying suitable sites for implementing two-stage ditches. Knowing the locations of potential sites will help agencies and landowners move this solution forward toward more widespread implementation."*



Two-stage ditch cross-section.