RECLAMATION
*Managing Water in the West*

U.S. Department of the Interior
Bureau of Reclamation

# Research Update

**S&T Program Project ID 7738-02**
**Bulletin 2017-06**

## Bottom Line

**This research project demonstrated that a UAS can be used to collect quality data for decisionmaking.**

## Better, Faster, Cheaper

**Using a UAS to collect inspection imagery significantly reduces data collection time and reduces risks to safety.**

## Principal Investigator

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# UAS Data Collection and Photogrammetry From Elephant Butte Dam

*Using unmanned aerial systems data to build a photogrammetric three-dimensional dam model*

## Problem

Many of Reclamation's facilities consist of large-scale structures that are time-consuming to inspect and require special safety equipment and procedures to physically access. Currently, manned rope access teams have to perform inspections and measuring by hand, which take time, are costly, and increase risks for inspectors. In addition, facility condition assessments require complex planning and take time to execute as well.

Unmanned aerial systems (UAS) technology could be used rather than humans for large-scale structures and/or inaccessible features inspections. UAS have the potential of collecting high-quality data cheaper and safer than other alternatives.

Photogrammetry as a condition assessment tool is a relatively new idea at Reclamation. The process of photogrammetry involves stitching a series of images together to create a digital three-dimensional (3D) model. The 3D model is overlaid with a photorealistic texture with the same resolution as the original images. Thus, the model can be inspected in lieu of an actual inspection. By inspecting digital models, the inspector is not encumbered by weather, safety, gravity, or other physical limitations. This reduces the time to perform the inspection and makes the inspection safer.

Technological advancements in UAS, cameras, and computing should be leveraged to reduce inspection time, increase safety, and provide quality results.

*Leptron Avenger E Model UAS at Elephant Butte Dam, New Mexico. Note sensor gimbal at the front of the airframe.*

## Solution

The purpose of this Reclamation Science and Technology Program research project was to determine if a UAS could be used to collect quality inspection data, including data to be used for photogrammetry.

Elephant Butte Dam was identified for the aerial inspection due to its age and challenging configuration requiring specialized procedures for detailed manual inspections. This structure, now over 100 years old, was completed in 1916 and is located on the Rio Grande River about 5 miles northeast of Truth or Consequences, New Mexico. The 301-foot-high, 1,174-foot-long concrete structure impounds approximately 2 million acre feet of water that is used for irrigation and power generation at its 28-kilowatt powerplant, which was constructed in 1940.

The structure is an ideal test for UAS inspection given its simple plan layout and tall, inaccessible downstream dam face. In addition, the structure is showing signs of deterioration that would provide a real world test of UAS inspection capabilities.

*A 3D print of the photogrammetric model of Elephant Butte Dam, New Mexico.*

## Application and Results

UAS data collection was performed in several autonomous flights over a 2-day period in June 2016. The imagery collected was used to build a 3D model that was processed overnight. Both optical and infrared data were collected. The optical data were used to provide a photorealistic high-resolution texture over the model and the infrared data were used to help identify subsurface defects.

## Future Plans

This research project showed that UAS data collection can be reliably conducted to provide high-quality data for inspections and also underscores Reclamation's need for an internal UAS program.

***"UAS and 3D modeling technology will change the way we look at our structures."***

**Matthew Klein**
**Civil Engineer**
**Reclamation's Technical Service Center**

## Collaborators

- **Reclamation:**
  - ◊ **Commissioner's Office**
  - ◊ **Research and Development Office**
  - ◊ **Technical Service Center**
  - ◊ **Public Affairs**
  - ◊ **Management Service Office**
  - ◊ **Security, Safety, and Law Enforcement**
  - ◊ **Pacific Northwest Region**
  - ◊ **Upper Colorado Region**
  - ◊ **Albuquerque Area Office**
  - ◊ **Elephant Butte Field Division**
  - ◊ **El Paso Field Division**
- **U.S. Department of the Interior's Office of Aviation Services**
- **U.S. Geological Survey**
- **New Mexico State University**

## More Information

**www.usbr.gov/research/projects/detail.cfm?id=7738**

**www.usbr.gov/research/projects/researcher.cfm?id=2676**