Environmental Applications for Unmanned Aerial Vehicles

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Background/Objectives. Unmanned aerial vehicles (UAVs) and systems (UASs) represent one of the most recent and visible digital innovations within the environmental field. Recent clarity regarding federal regulations regarding UAV usage has led to the proliferation of this technology in commercial applications. This proliferation has led to increased opportunities to utilize the UAV platform as a delivery mechanism for a variety of environmental data and information needs including: high-resolution topographic analysis, incident response support, as-built verification, and leak detection. This presentation provides an overview of three case studies illustrating the application of UAVs to environmental work and focuses on the advantages and limitations of this technology compared to conventional data acquisition methods.

Approach/Activities. Three field-scale projects are used to illustrate the implementation strategy and results of environmental data acquisition using UAVs including: 1) A high-resolution topographic analysis of a 300-acre impoundment to evaluate the containment capacity for the deposition of dredge spoils from a nearby berth expansion. 2) The use of UAV technology during derailment to provide near real-time images and video to response managers, as well as current orthorectified aerial mosaic images, and 3D model of derailment. 3) Use of UAV mounted thermal imaging to detect pipeline leakage in a marine environment by evaluating subtle temperature gradients within surface water body.

Results/Lessons Learned. 1) A series of aerial photographs were collected using a UAV and analyzed photogrammetrically to create a digital elevation model of the impoundment. The high resolution digital elevation model allowed for volumetric analysis of the impoundment with a high degree of confidence while increasing data collection efficiency compared to traditional elevation survey methods. 2) Use of UAV technology allowed for clear understanding of project challenges to off-site support staff. The use of up-to-date orthorectified aerial mosaic images, compared to historical aerial imagery, enhanced ability to communicate site conditions and remedial objectives to regulatory agency. Identified challenges associated with transmitting the large data sets generated by UAVs from remote locations with limited telecommunication services. 3) The use of UAV deployable thermal imaging reduced the risk to field investigation teams by eliminating the need to perform subsurface inspections within a marine environment. This technology allowed for the thermal investigation of a broad area of surface water with sufficient resolution to identify subtle temperature gradients associated with pipe leakage. Results indicate there may be feasibility limitations when utilizing this technology for marine leak detection due to site-specific conditions including depth of mixing zone and initial thermal gradient magnitude between released material and the receiving water body.