Drone-Based Vegetation Mapping Supporting Plant-Assisted Bioremediation at a Fuel Pipeline Spill in Sagebrush Steppe, South-Central Idaho

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Background/Objectives. A recent pipeline breach in south-central Idaho resulted in the overland release of mixed diesel and aviation fuel to a privately-owned rural agricultural property. The primary receptors were ecological, including a 0.75-acre pond, nearby irrigation swales and associated wetlands. The study area comprised approximately 14 acres of undeveloped terrain on native sagebrush steppe, *loess* soils and jointed columnar basalt bedrock.

Project objectives included immediate protection of the environment and development of a conceptual site model (CSM) to help support remedial decisions for the site. Plant-assisted bioremediation (rhizodegradation) was deemed a plausible long-term remedial approach due to the shallow-nature of the fuel impact, documented efficacy of rhizodegradation of middle distillates, and openness of the land.

Approach/Activities. During emergency and interim response activities performed over two months, three low-elevation (175 to 200 feet amsl) aerial drone surveys were completed using a DJ Phantom 4 drone equipped with a 1-inch CMOS 20 megapixel sensor and camera. Remotely collected data included terrain elevation, photo-documentation and plant health indexing using RGB Visible Atmospherically Resistant Index (VARI) algorithm. The combined aerial-photographic mosaic and elevation data were used to develop a three-dimensional terrain model for the site, which was used to develop a remedial CSM. Broad vegetative types and bare soil classes were identified using the VARI algorithm. Ground-based reconnaissance consisted of identifying vegetation and soil types and photo-documentation of vegetation using near-infrared Normalized Difference Vegetation Index (NDVI). Characterization of native plants and soil types allowed the team to select an appropriate phytoremediation plant mix for the site.

Results/Lessons Learned. Site soils were identified as sodic and “white alkali” supporting halophytic vegetation, primarily *Artemisia*, *Elaeagnus*, *Distichlis and Juncus.* Sagebrush and Russian olive were readily identified in the drone surveys using both false-color VARI indexing and visible light photography.

Selected rhizodegradation species included both alkali and salt-tolerant native plants, including *Festuca idahoensis, Elymus wawawaiensis, Distichlis spicata* and *Juncus balticus*.