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

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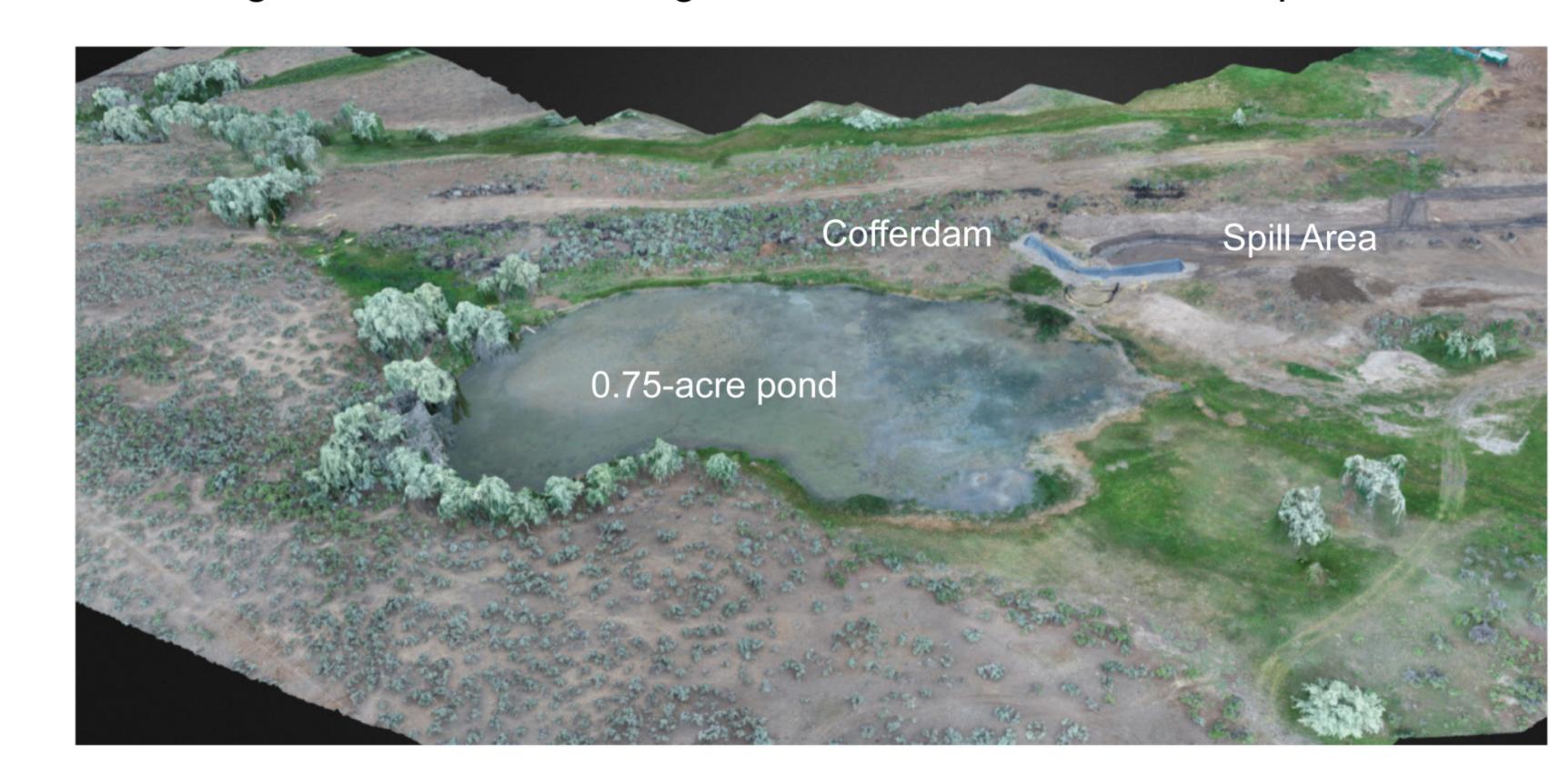
#### Introduction

An April 2018 pipeline breach in south-central Idaho resulted in the overland release of mixed diesel and aviation fuel to a privatelyowned 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.

Response activities included use of low-altitude drone flight to document site conditions, including topography, vegetative mapping, visual extent to surficial petroleum impact, and response activities.

Drone imagery and field reconnaissance were used in concert to assess feasibility of using plant-assisted bioremediation (rhizodegradation) as a supportive site remedy.

Drone flight aerial-mosaic image of Site. After fuel release. April 11, 2018.



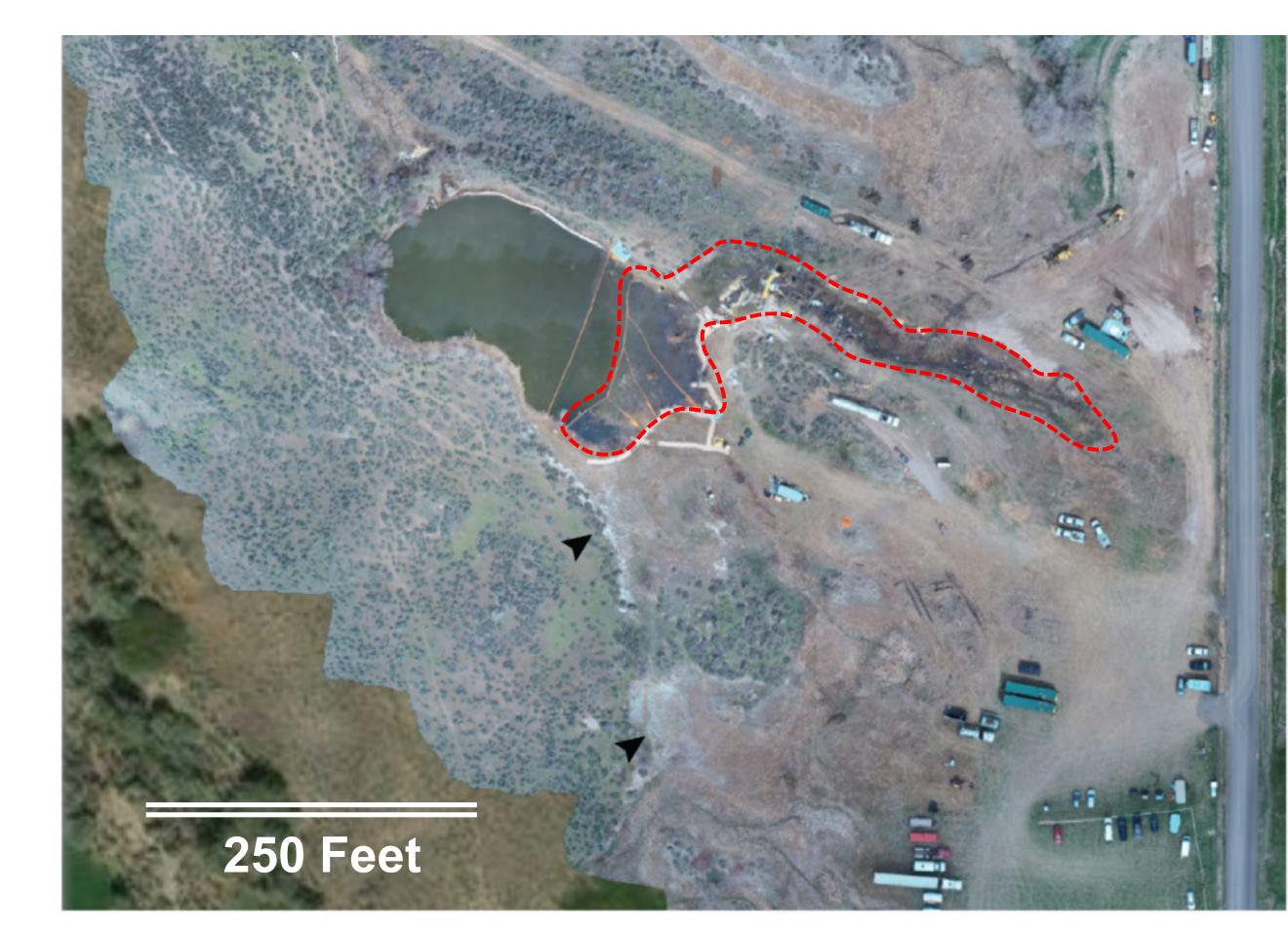
Drone flight aerial-mosaic image of Site. Post-response. May 30, 2018.

## Goals

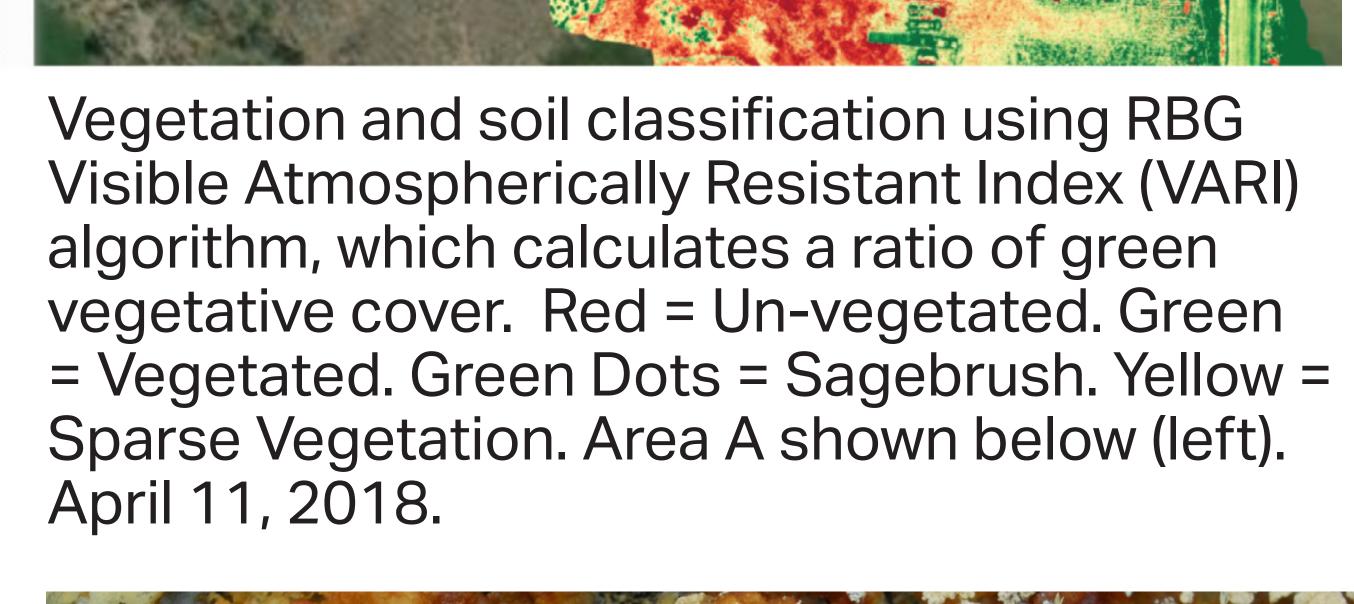
- Project goals included the immediate protection of the environment, facilitated through pipeline repair and emergency response activities, including bulk fuel removal, deployment of sorbent booms, and limited impacted soil removal,
- A longer-term goal was to assess feasibility of phytoremediation as a plausible technology for residual petroleum hydrocarbon impact along the spill area and a drainage swale,
- Site restoration using native plants, along natural topographic features, and basalt bedrock outcrops existing on site,
- Property owner requested minimal disruption of grazing cattle, while maintaining a rural natural setting,
- Client preferred use of passive remediation approach.

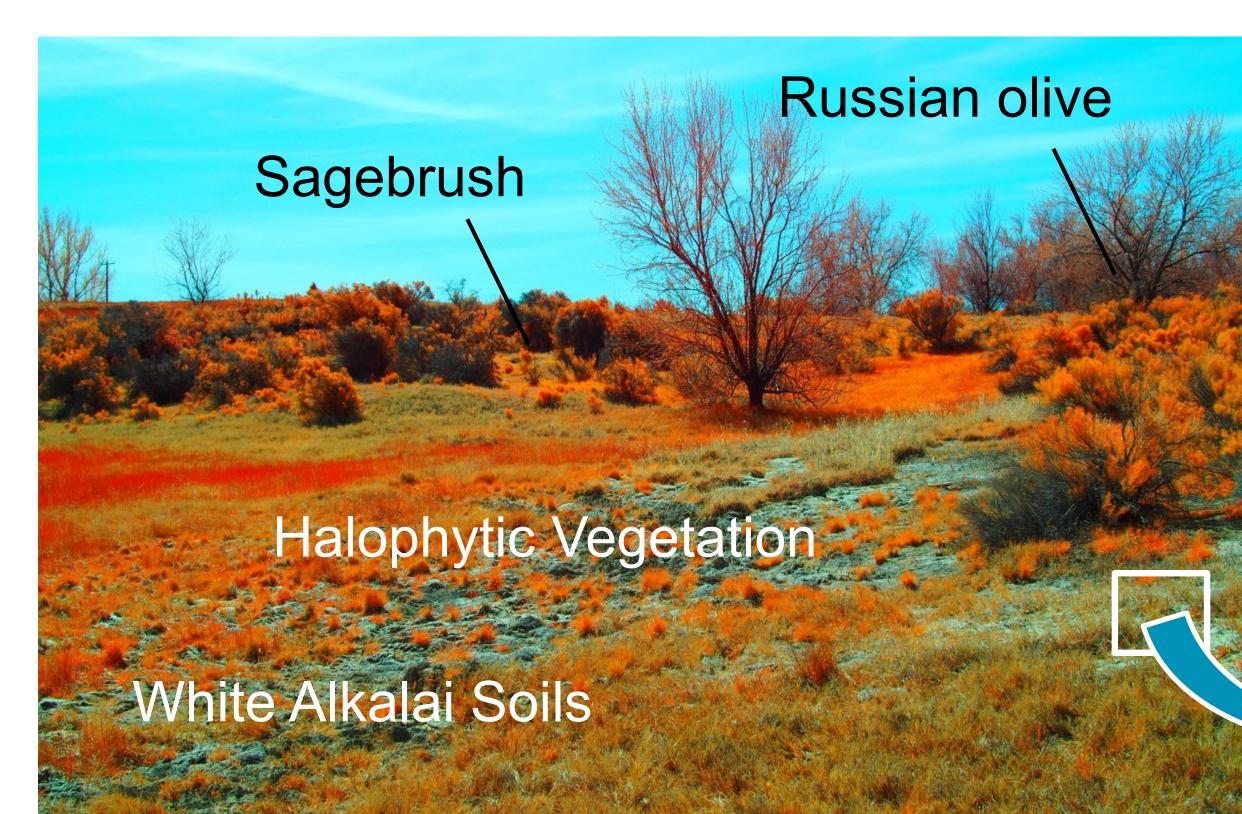
# **Approach and Methods**

Simplified and expedited approach for screening site suitability for plant-assisted bioremediation.

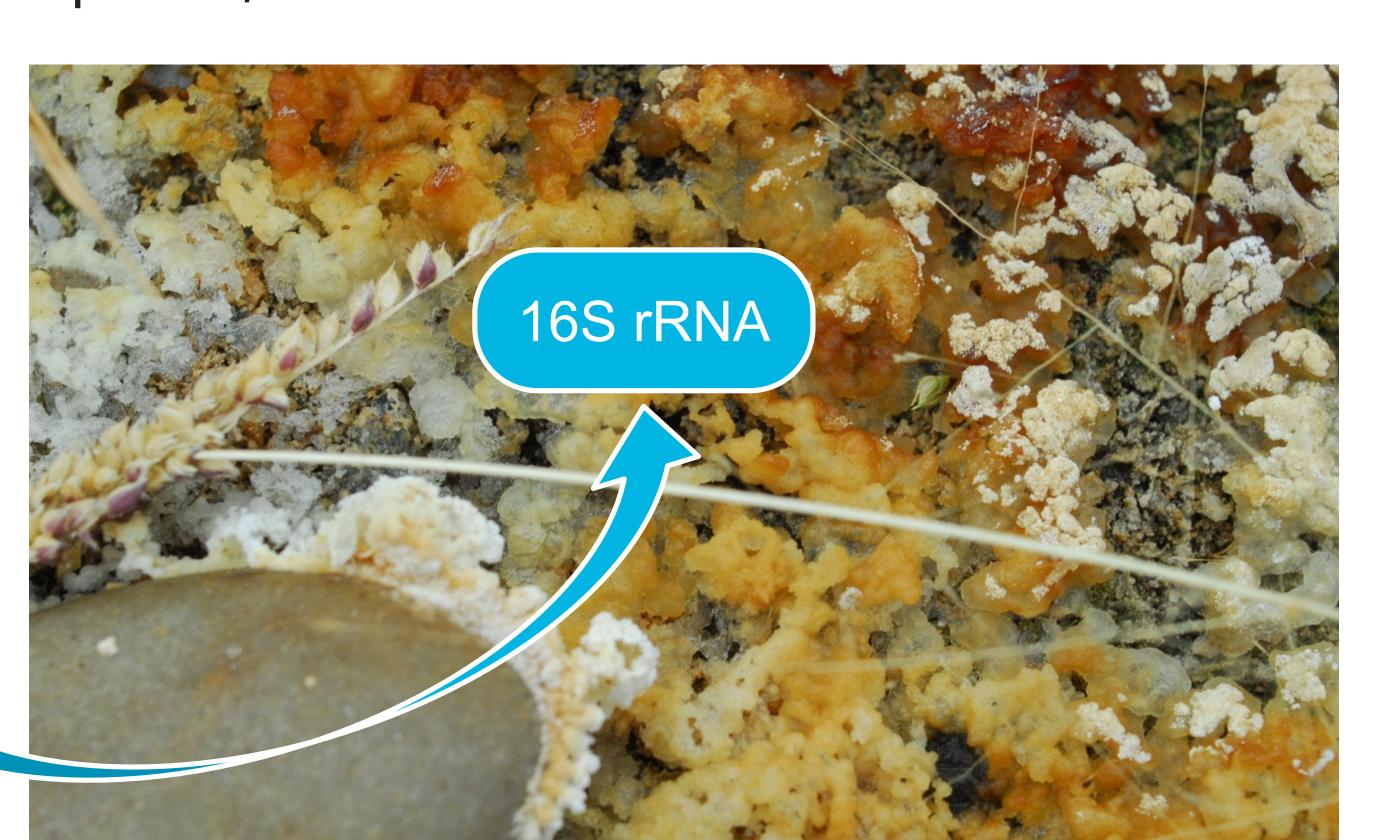


Low-altitude photo-mosaic aerial image of spill area and 0.75-acre pond derived from DJ Phantom 4 drone, with 1-inch 20 mp CMOS sensor. Salt-rich white alkalai soils denoted. Petroleum spill area within red dashed demarcation. April 11, 2018.



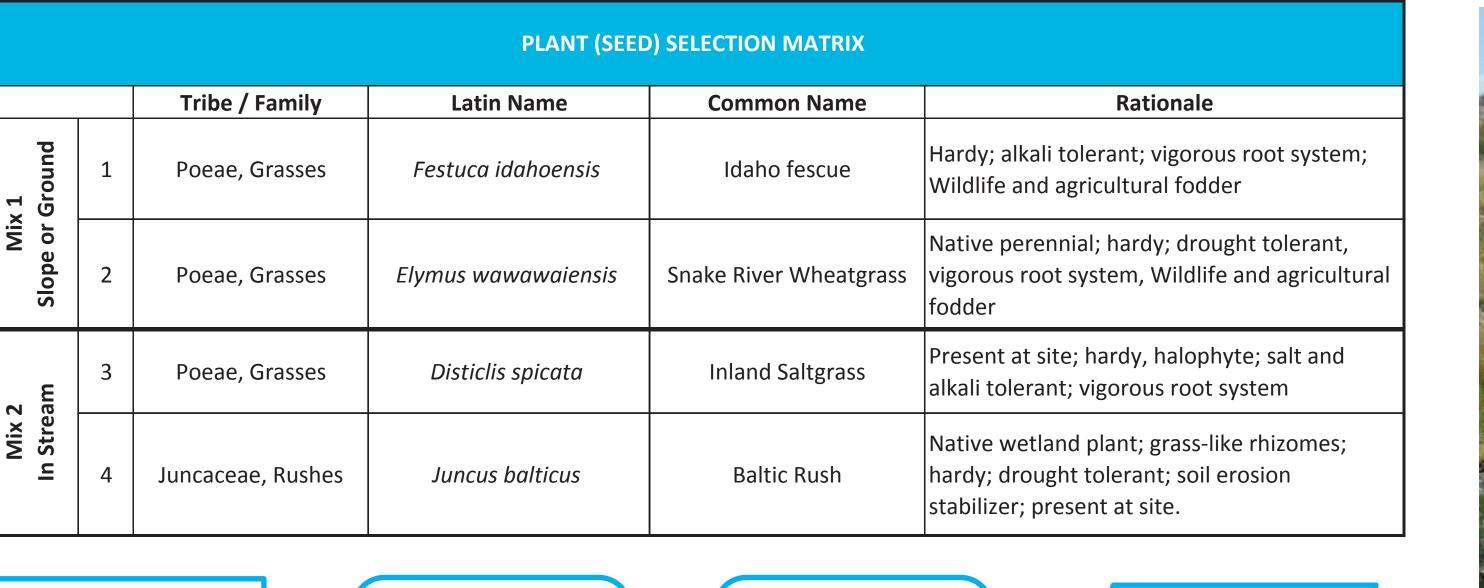


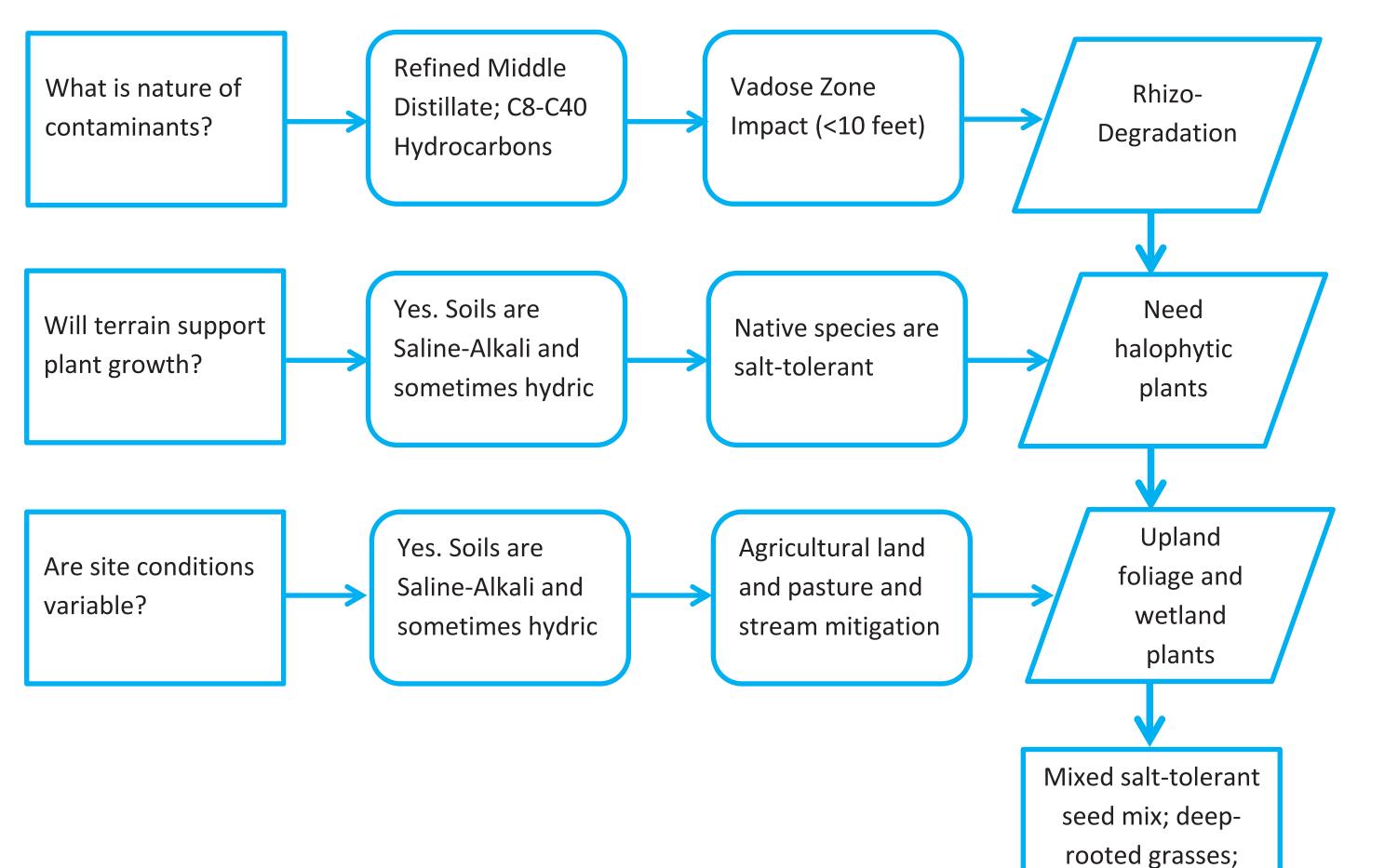
Ground-based image of sagebrush steppe habitat (Area A) using digital near infrared Normalized Difference Vegetative Index



Salt-rich soil supports halophytic vegetation. 16s rRNA profiling of soil indicated presence of haloalkaline bacteria, including Cytophagia (yellow-(NVDI). The red tufts are salt-grass (*Distichlis*). brown-red colonies) and *Halomonadaceae*.

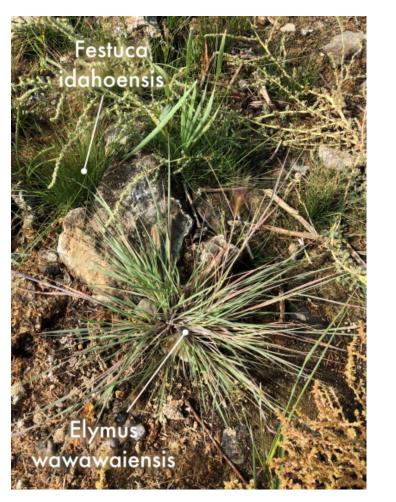
### Phytoremediation Screening



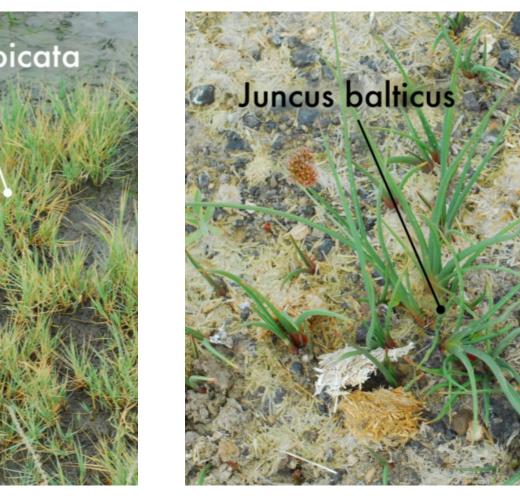




Petroleum spill area along drainage swale. Looking east. Seeded with specified plant mix. October 2018.







In-stream and ground mix grasses and rushes post-germination. October 2018.

#### **Endnotes and Lessons Learned**

#### **Endnotes**

- Drone-based aerial reconnaissance using VARI and ground-based digital IR NVDI is an effective approach for mapping both soils and vegetation.
- Geobotanical surveying and observation of whitealkali soils suggested need for salt-tolerant rhizodegradation species.
- Native halophytes and future monitoring will include assessment of root-zone bacteria, plant health, and contaminant mass within former spill area.

#### **Lessons Learned**

- Proposed plants should match habitat.
- Watch where you step in cattle country.



