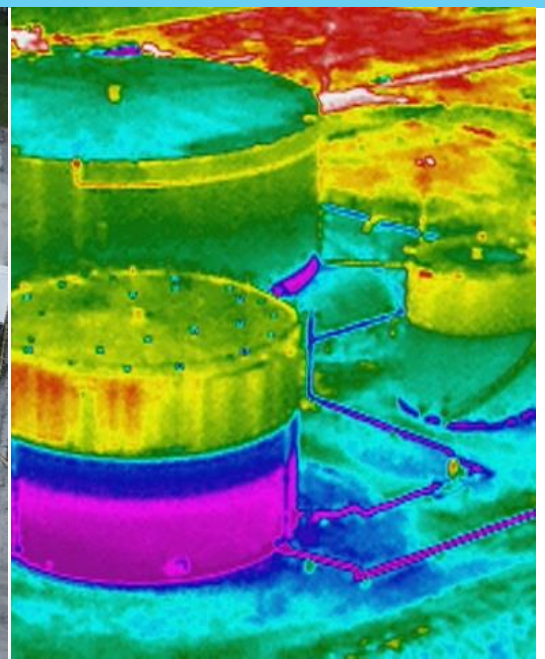
ENVIRONMENTAL
EXPERTISE
FROM THE
GROUND UP

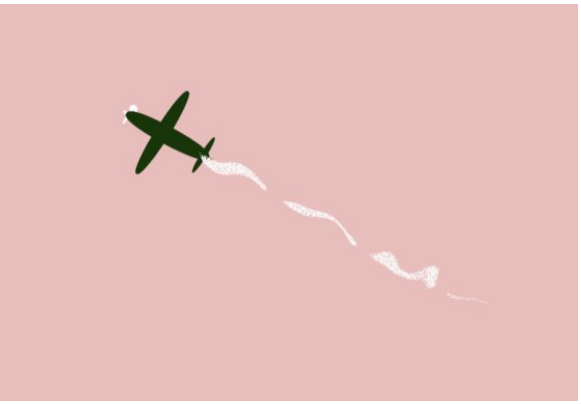


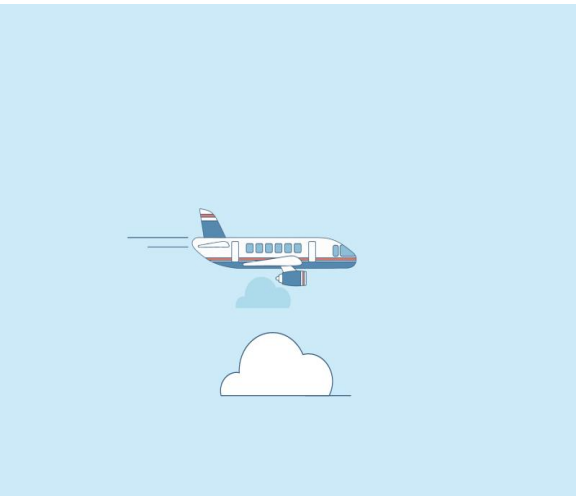
Drones:

Insights on the Evolving Environmental Data Collection Platform

– a pathway paved by innovation

IPEC, October 2019





400 ft

10,000 ft

30,000 ft

Agenda

Objective: Share knowledge on the breadth of utility granted from the adoption of innovative technology, such as UAV.

01 Overview

02 **WHAT** is a drone / UAV?

03 **HOW** are they being used?

04 **WHY** should we be using them?

05 Questions

What is a “Drone”?

- FAA: “small Unmanned Aircraft System”, sUAS
- Unoccupied Aerial Vehicle, UAV
- May Be Autonomous
  (Still Requires a Pilot in Command)
- Platforms Include:
  - Multirotor
  - Helicopter
  - Fixed wing
  - VTOL

  (with many hybrids of power units)
- Commercial Remote Pilot License
  Part 107 Available: Oct, 2016

Recreational

$35
Gyro, IMU
Camera

“Prosumer”

$1,878.00 ✓prime
Redundant Gryo, IMU, GPS, Object Avoidance, 4K Camera

Industrial

$50,000
Redundant navigation, multiple high-res cameras and sensors

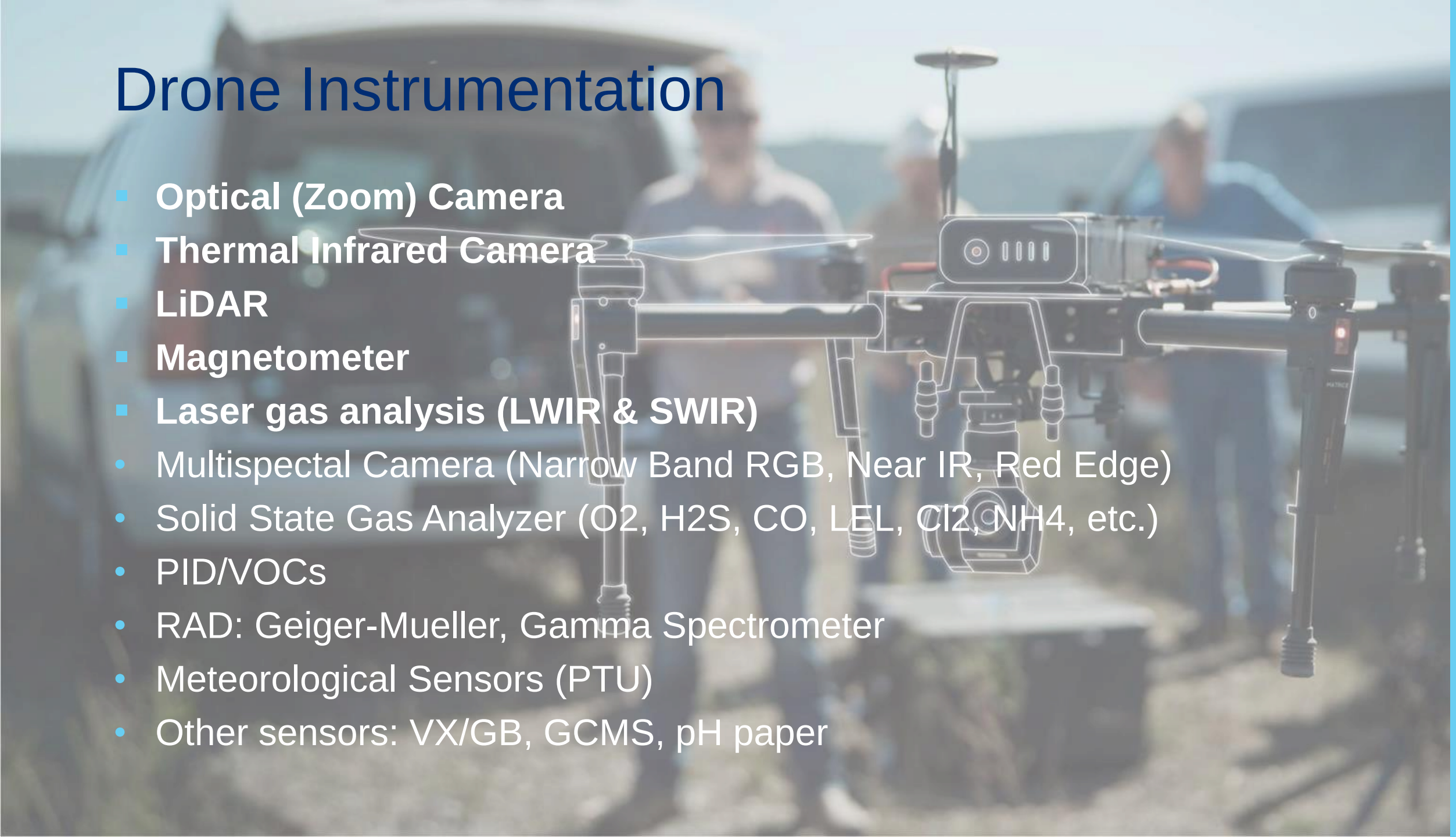
Regulatory Framework

Safety - Best Practice - Compliance

- 14 CFR Part 107 - Commercial use of small unmanned aircraft systems into the national airspace.
- Restrictions on commercial flights including, without limitation:
  - Class G airspace only w/o authorization/waiver
  - Aircraft registration
  - Remote pilot certification
  - < 55lbs
  - VLOS
  - Daytime
  - Over people
  - From moving vehicles
  - Hazardous material
  - Recordkeeping

FAQ

Drone Instrumentation



- **Optical (Zoom) Camera**
- **Thermal Infrared Camera**
- **LiDAR**
- **Magnetometer**
- **Laser gas analysis (LWIR & SWIR)**
- Multispectal Camera (Narrow Band RGB, Near IR, Red Edge)
- Solid State Gas Analyzer (O2, H2S, CO, LEL, Cl2, NH4, etc.)
- PID/VOCs
- RAD: Geiger-Mueller, Gamma Spectrometer
- Meteorological Sensors (PTU)
- Other sensors: VX/GB, GCMS, pH paper

HOW Drones are being applied

Drone Derived Data (3-D)

- Mapping
- Photogrammetry
- Area and volume measurements
- Environmental compliance
- Project management
- Inspection and monitoring

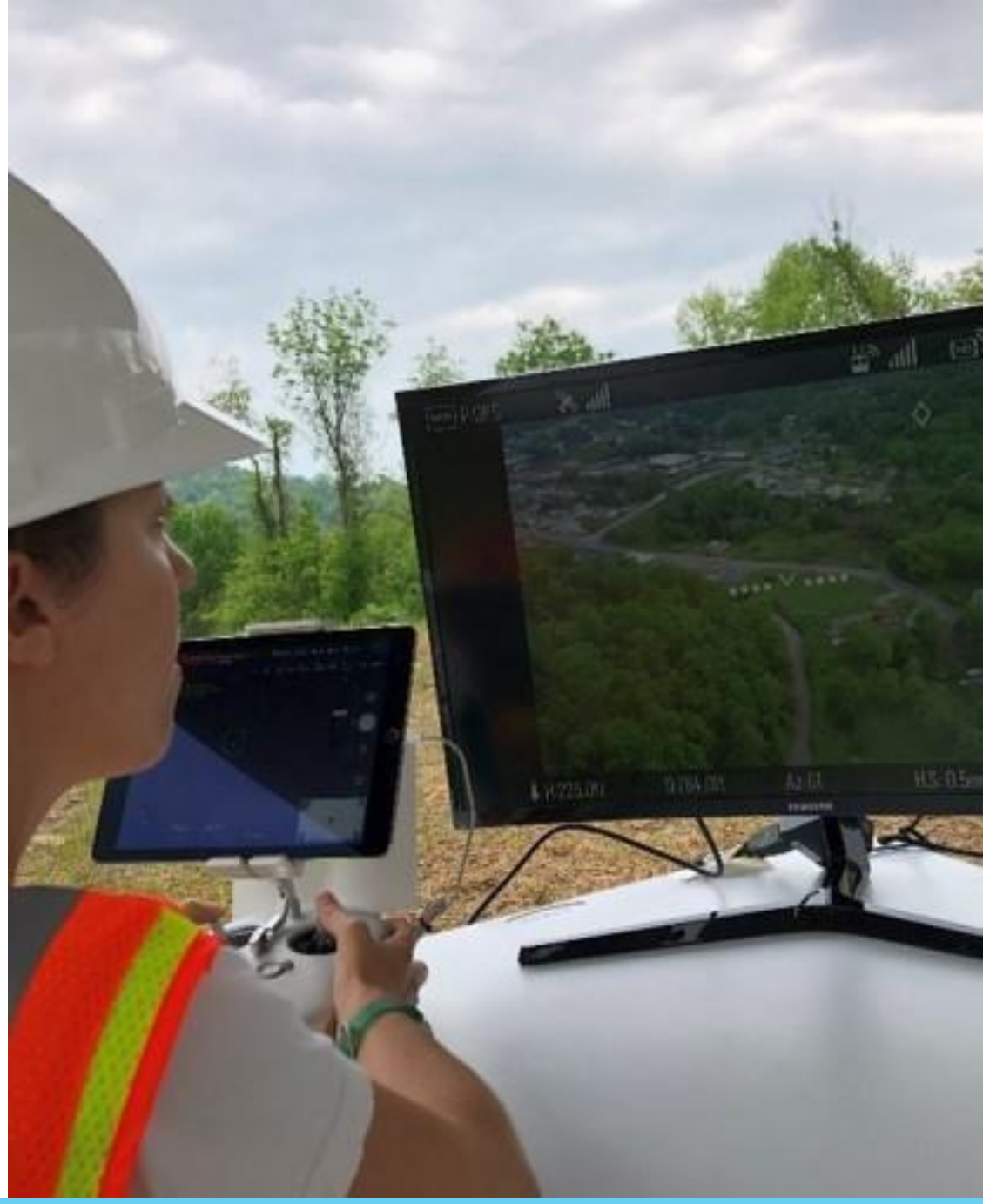
Maturity Model

Data

Info

Knowledge

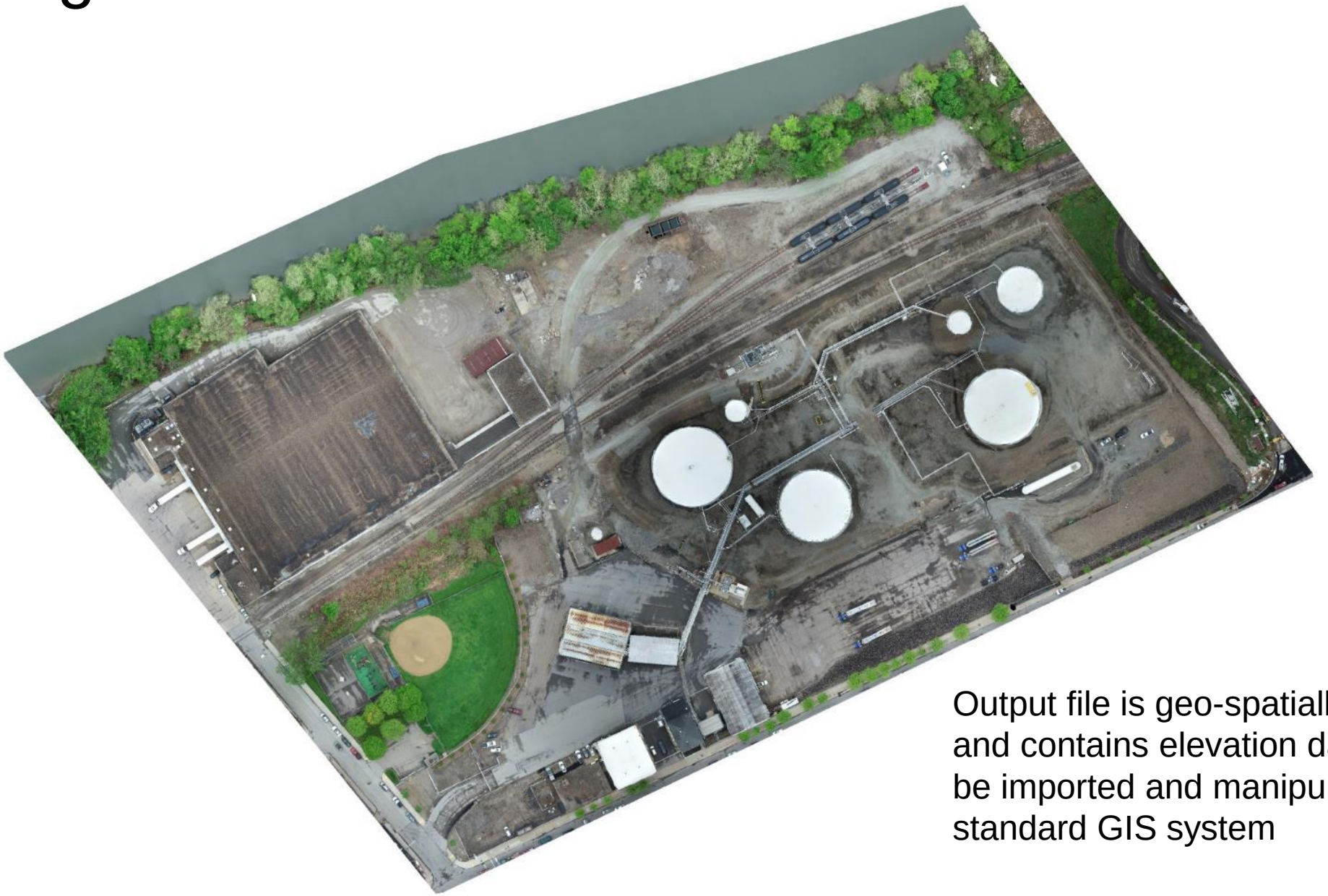
(Notice: It’s not about the drone. It’s about the data that you collect in order to provide accurate Info and continue with practical knowledge.)



Terminals, Pipelines, and Refineries

Beating Heart of Petroleum Transport Infrastructure

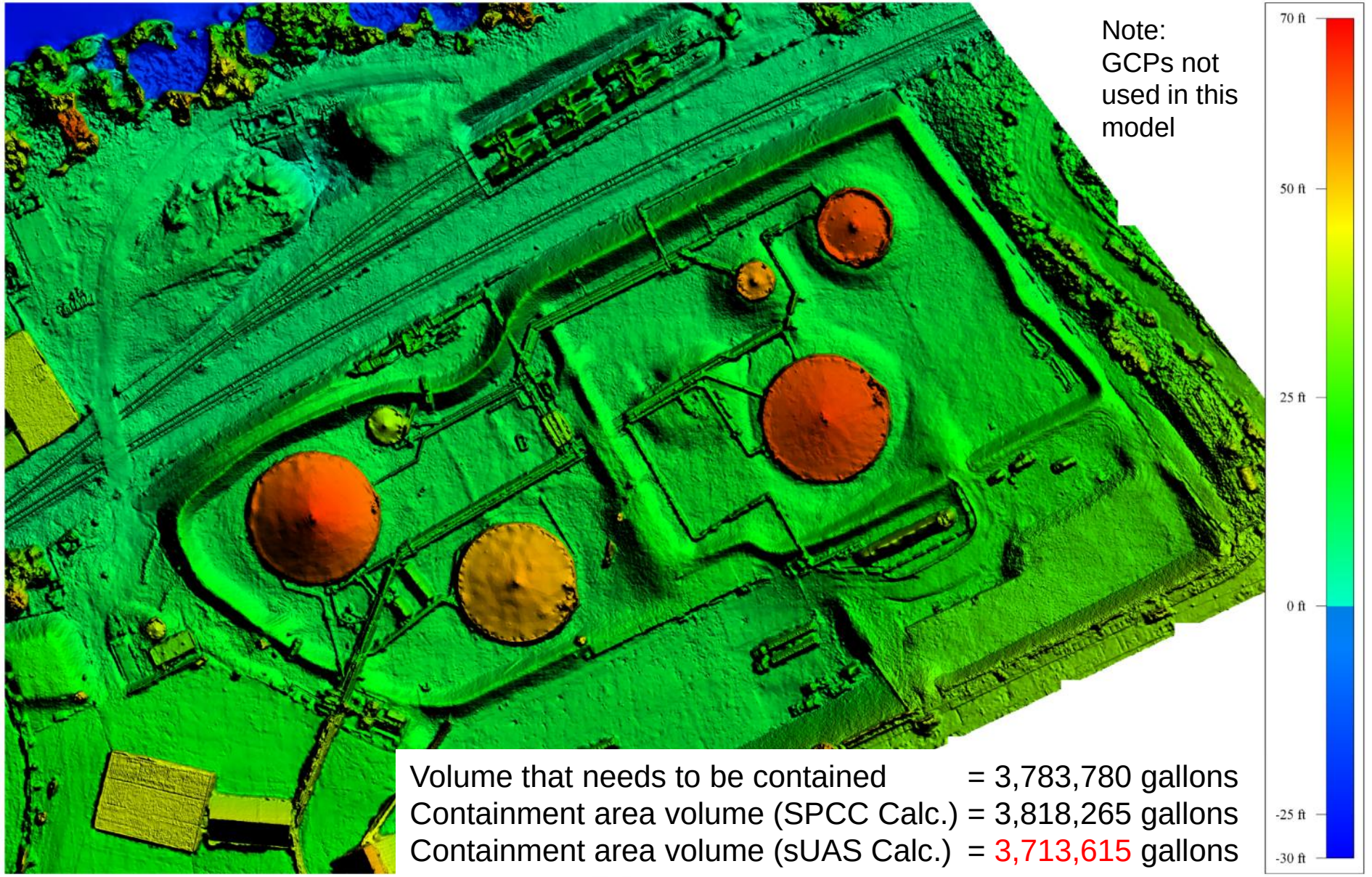
High-Resolution Orthomosaic from Aerial Imagery



Output file is geo-spatially referenced and contains elevation data which can be imported and manipulated in any standard GIS system

High-Resolution Orthomosaic from Aerial Imagery

Digital Elevation Model (DEM) of Diked Area



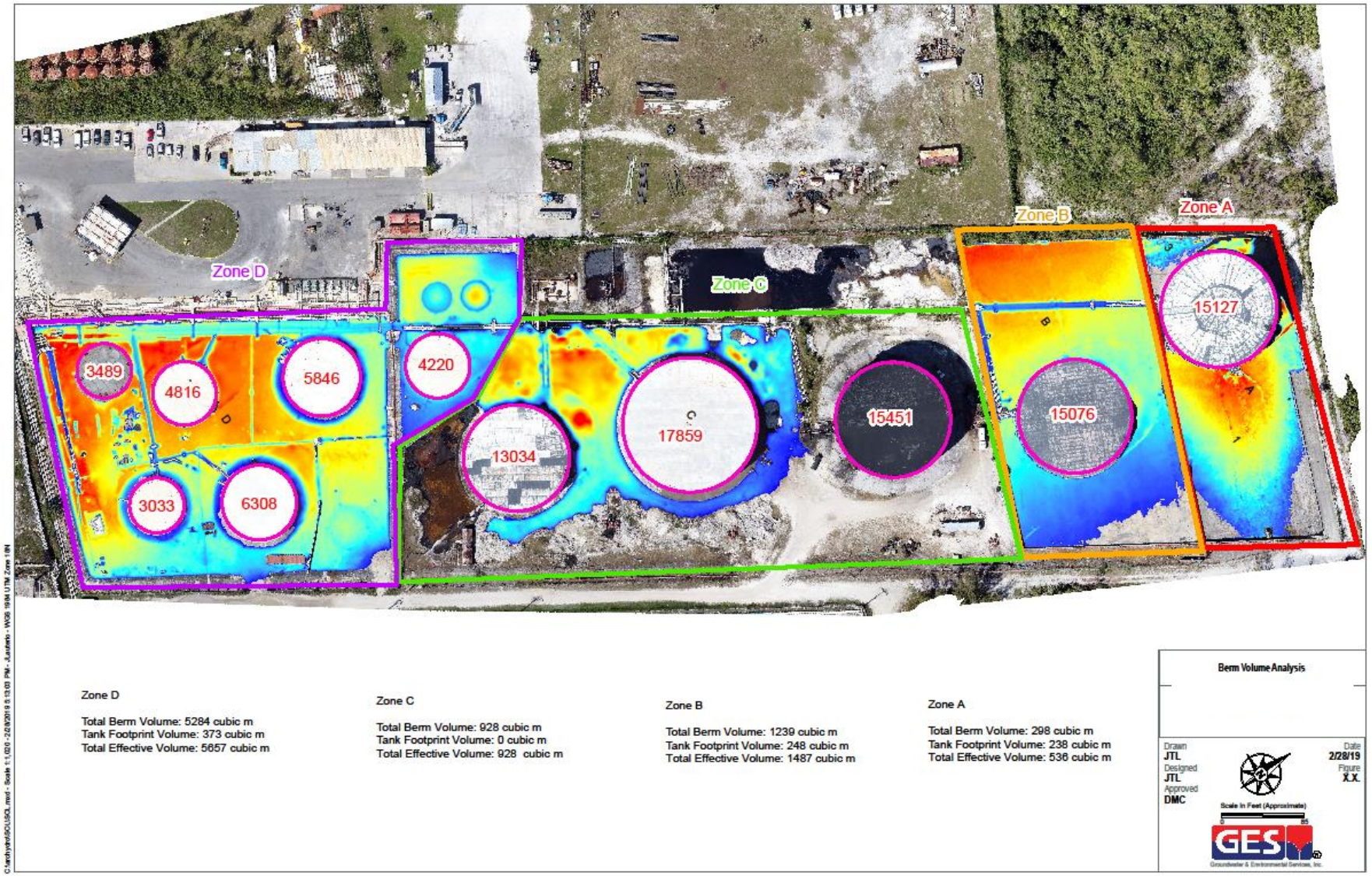
Note:
GCPs not used in this model

Volume that needs to be contained = 3,783,780 gallons
Containment area volume (SPCC Calc.) = 3,818,265 gallons
Containment area volume (sUAS Calc.) = 3,713,615 gallons

Facility Site Map Recreated from sUAS Photographs

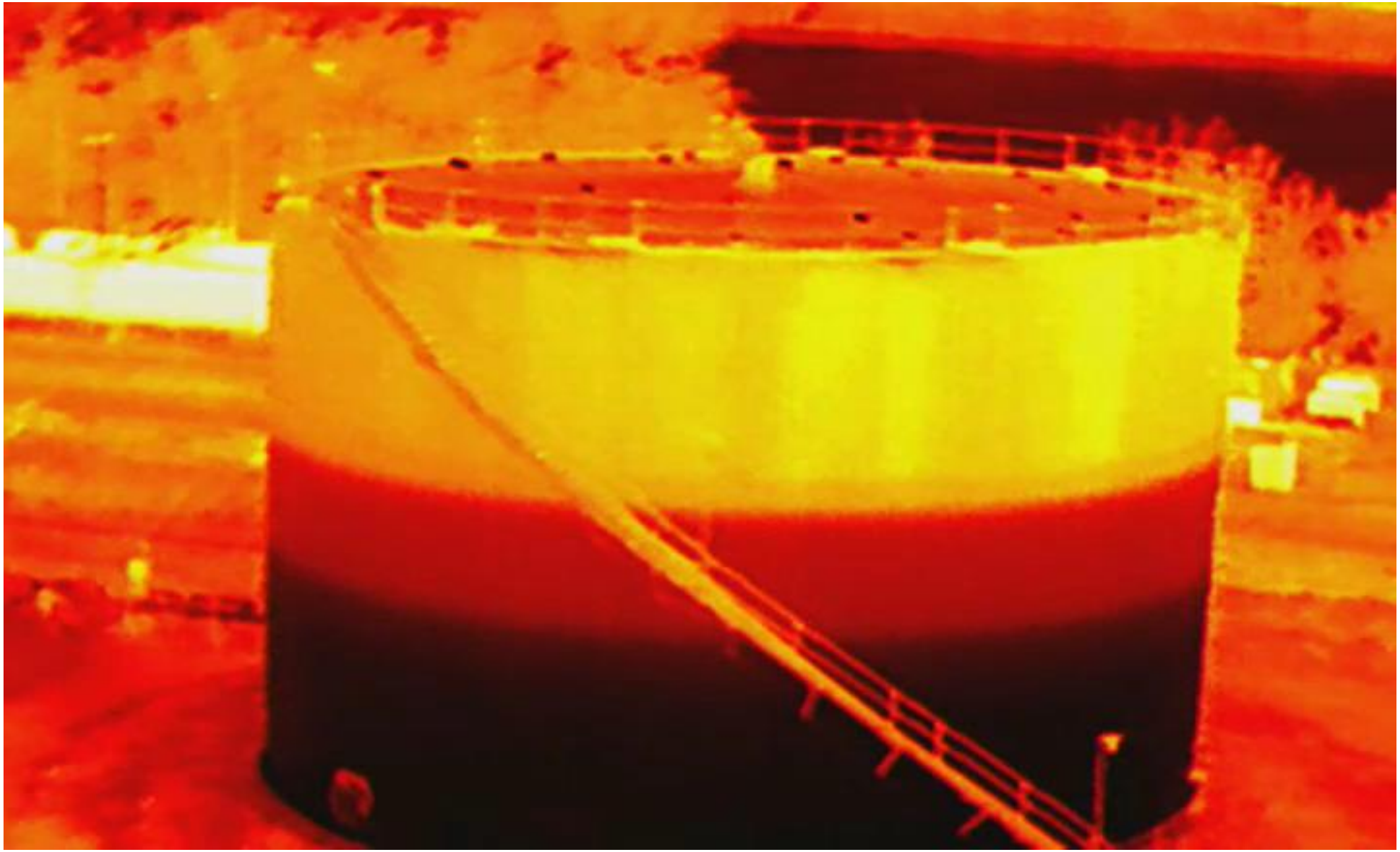
Mapping - Digital Elevation Model (DEM) of Diked Area

Spill capacity and flow modeling



- **Efficient Field Time**
  - 23 acres
  - 246’ AGL
  - 217 images
  - 1 battery
  - **12:16 min:sec**
- **Deliverable**
  - Tank and berm volume calc map
  - Orthomasiac JPEG/PDF
  - AutoCAD DXF file
  - Annotation and accuracy report

Inspection – Thermal, Tank Fill Monitoring

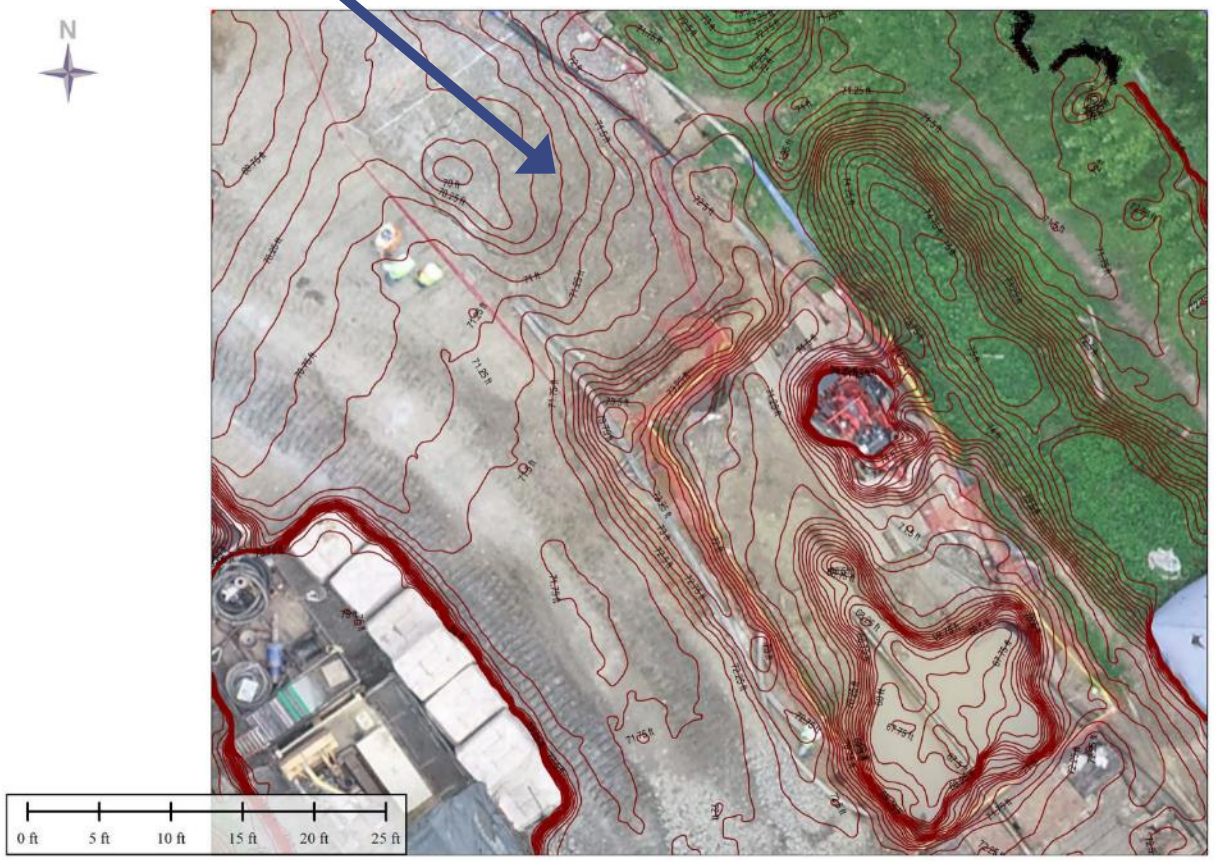


Inspection - Tower Weld

Inspection - Subsidence at a Pipeline Construction Site

Day 0

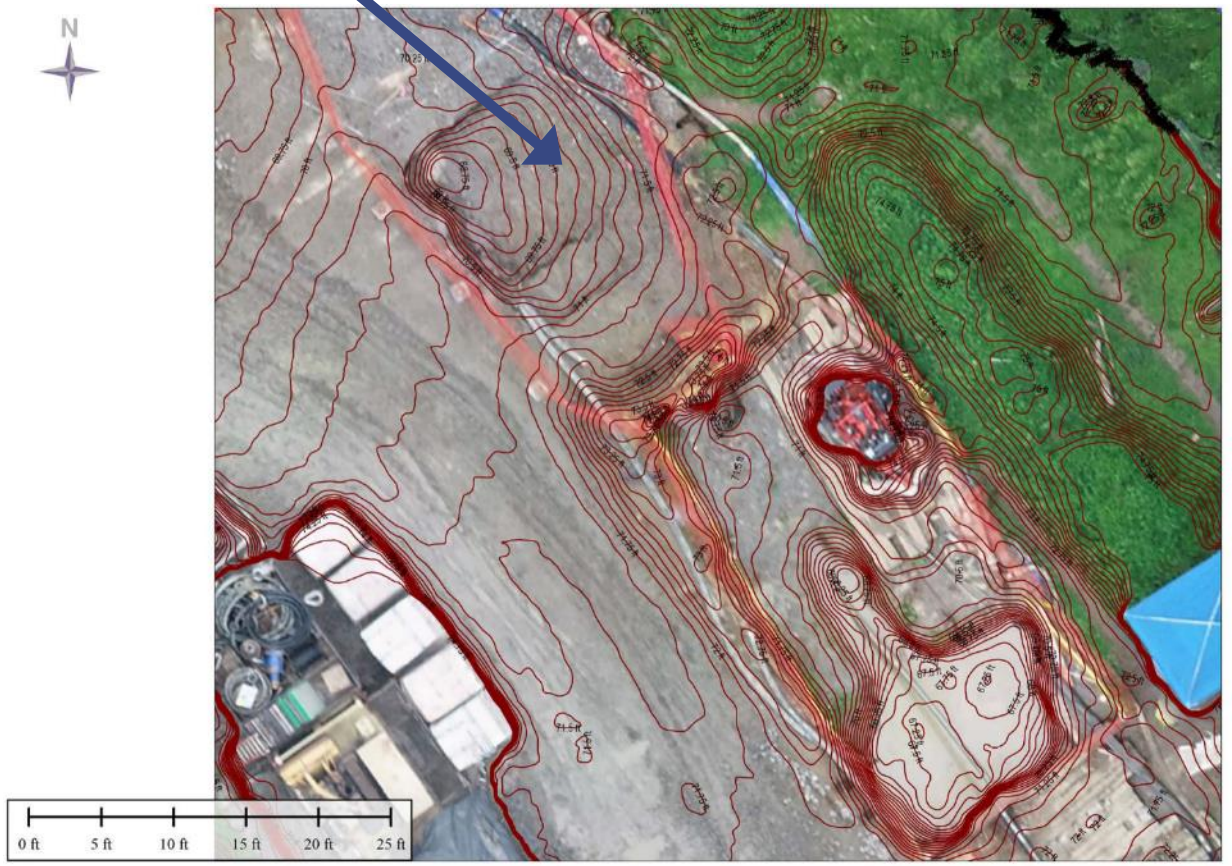
Depression Area



Inspection - Subsidence at a Pipeline Construction Site

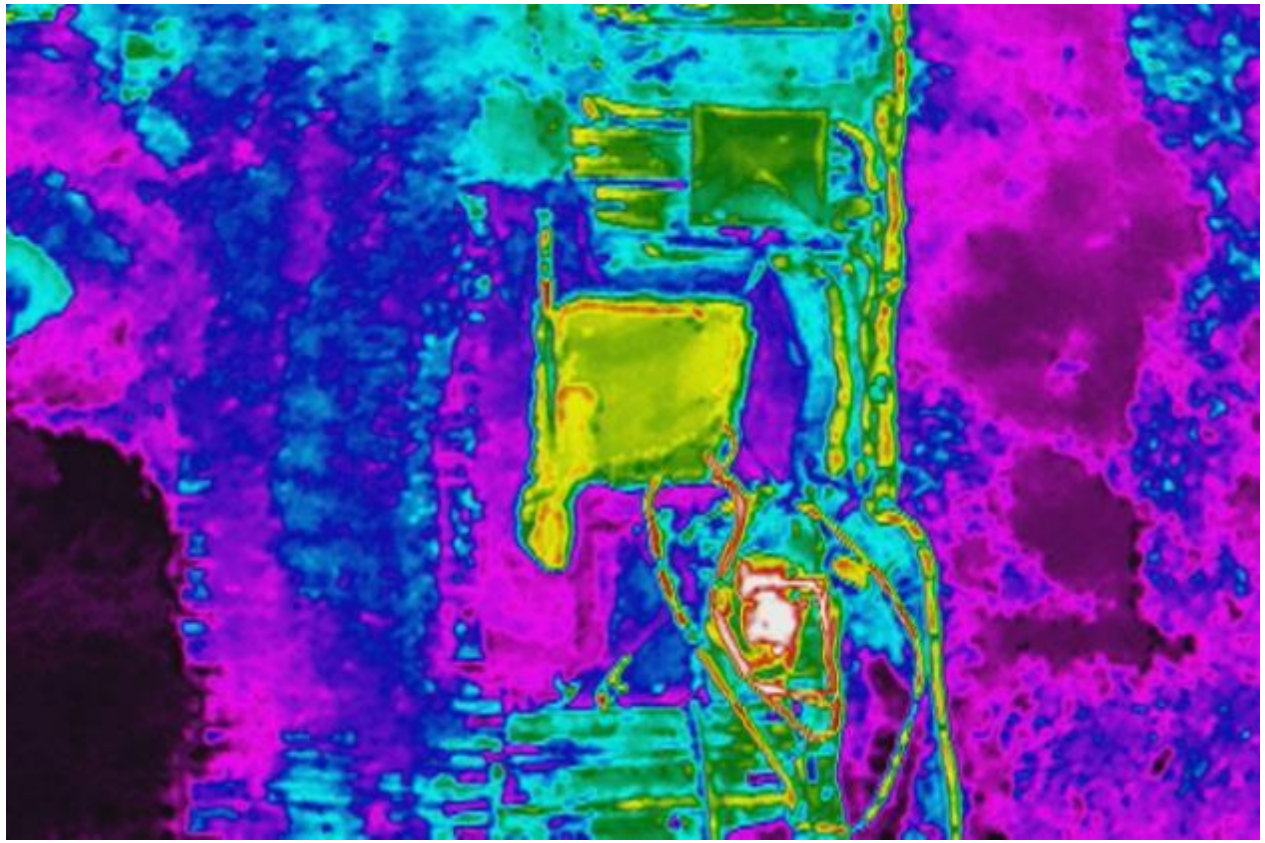
Day 4

Depression Area

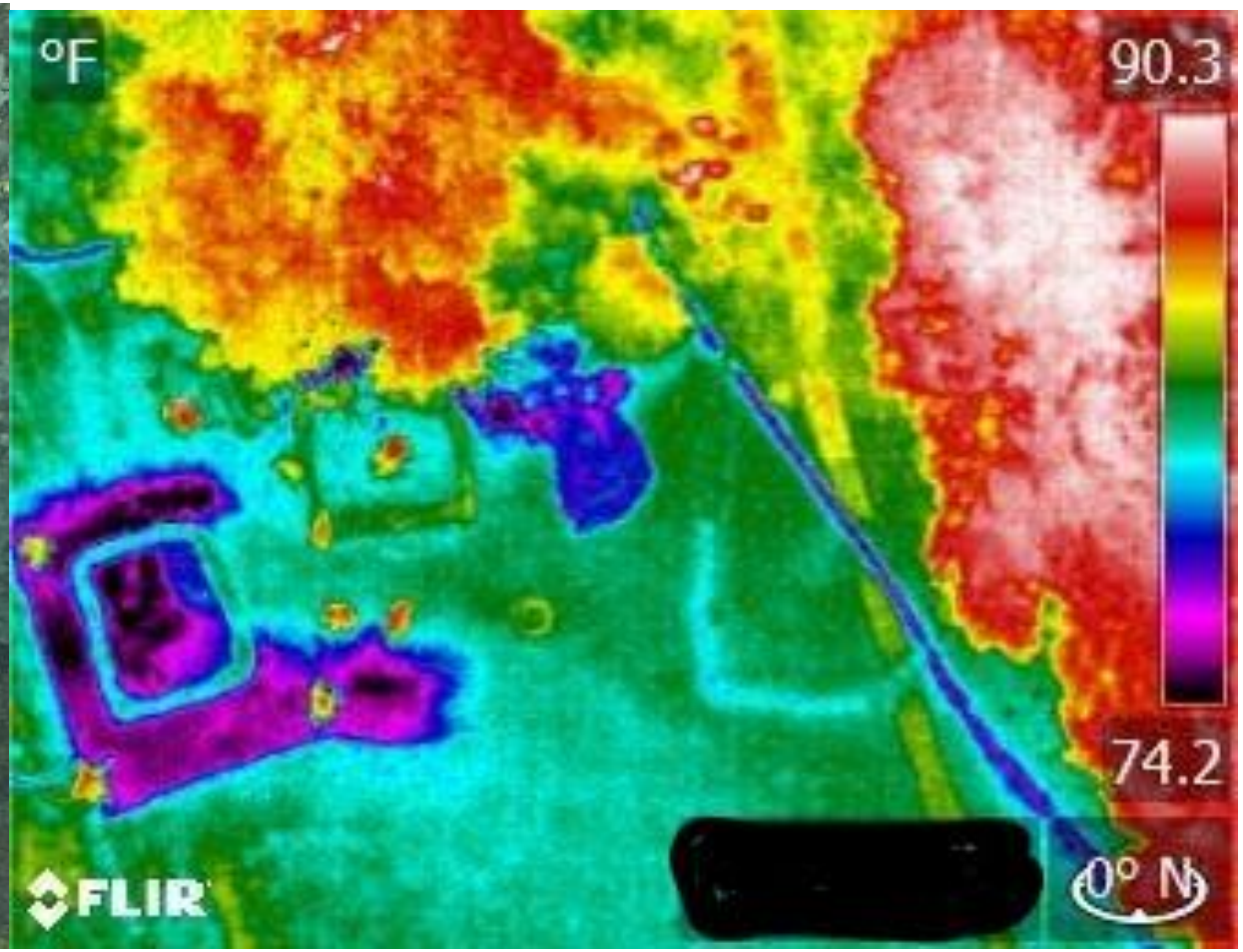


Inspection - HDD Mud Pit Thermal Imaging / IR Monitoring Implications

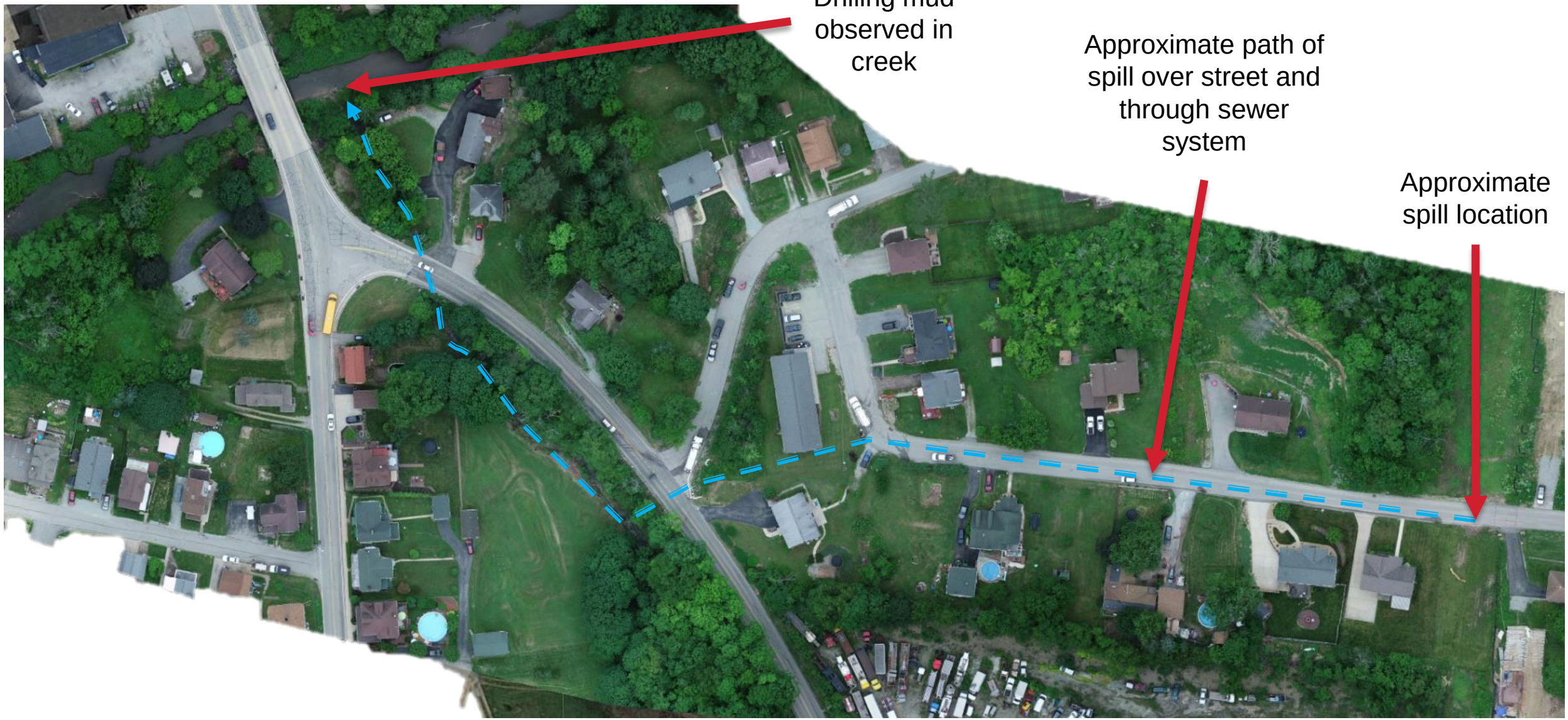
Stacking Multiple Data Layers Simultaneously



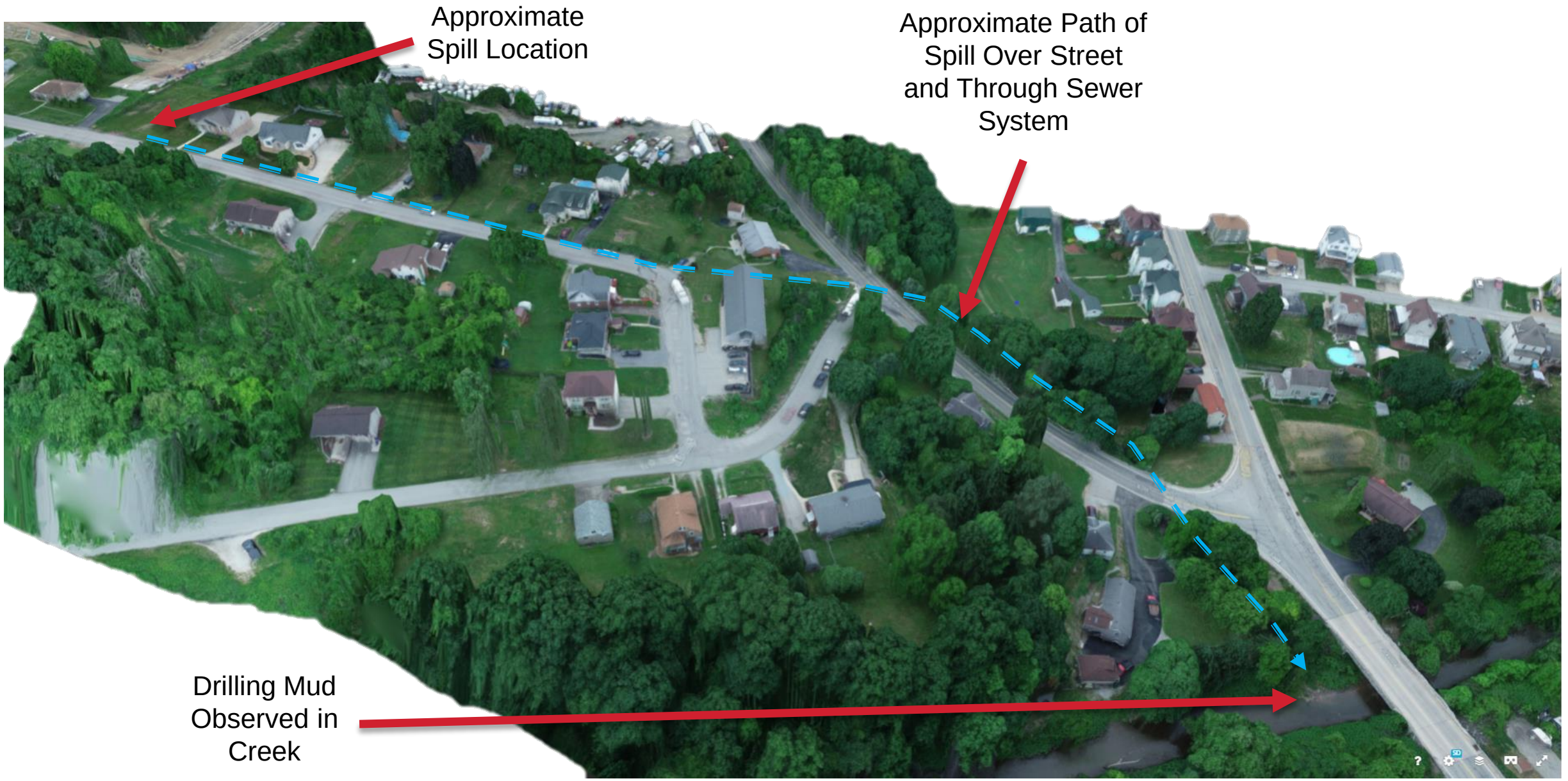
IR Detection



High-Res Aerial of Mud Spill from Pump Truck



3D Model of Mud Spill from Pump Truck



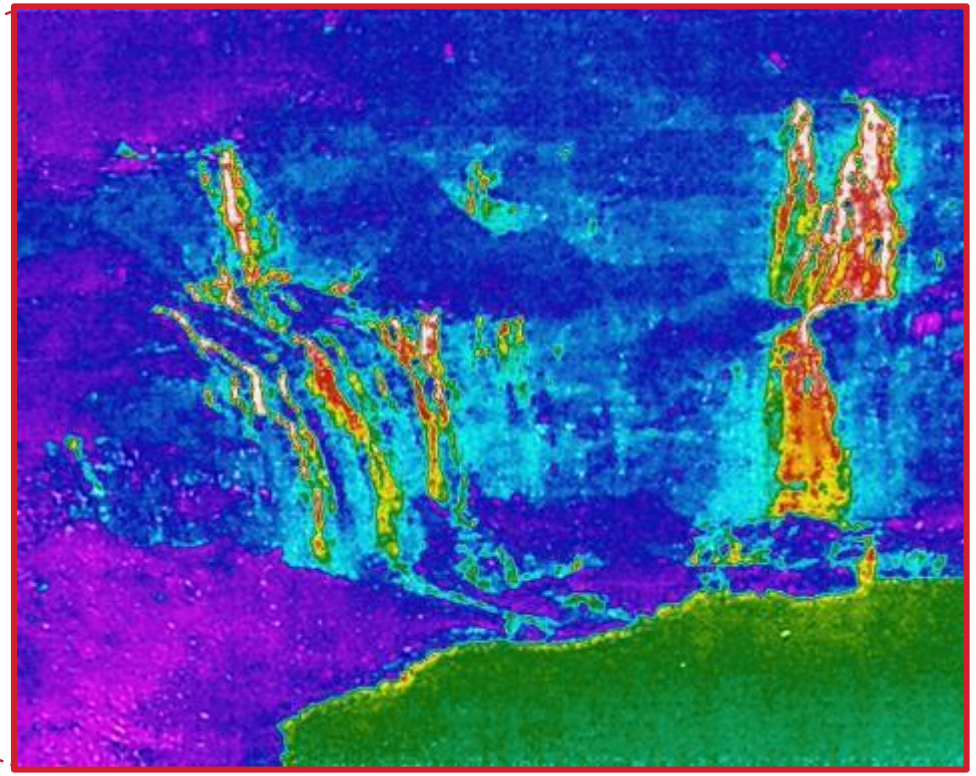
Seep Identification – Visual Light

Field Conditions

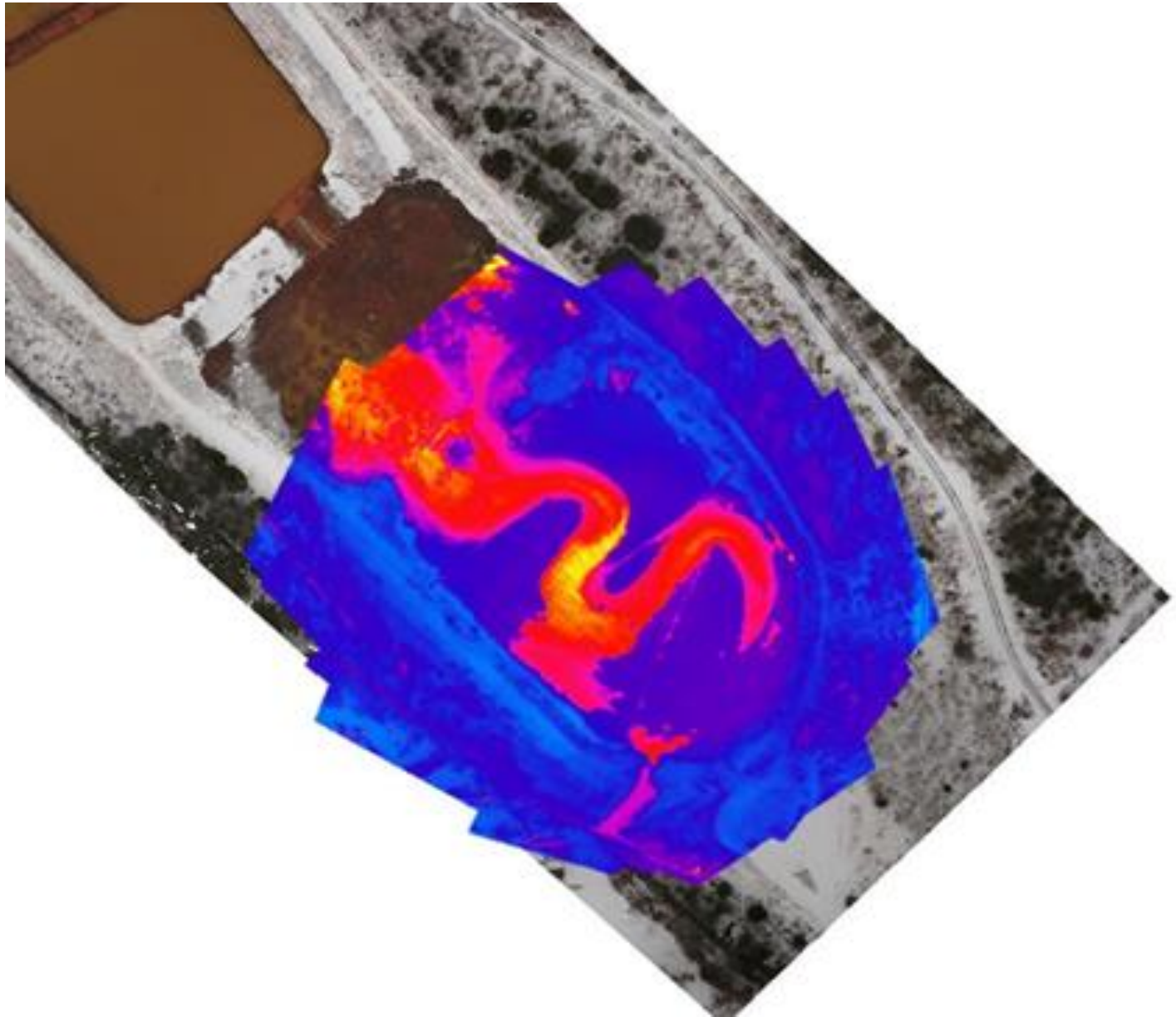
- Early AM lighting
- Low lighting in lower elevations
- Homogeneous colored terrain
- Steep, gravel banks
- Hard to access
- Low temps near body of water

Seep Identification – Thermal (Infrared)

Radiometric Camera
Temperature Sensitivity
0.1 ºC



Remediation System Monitoring



55 °F

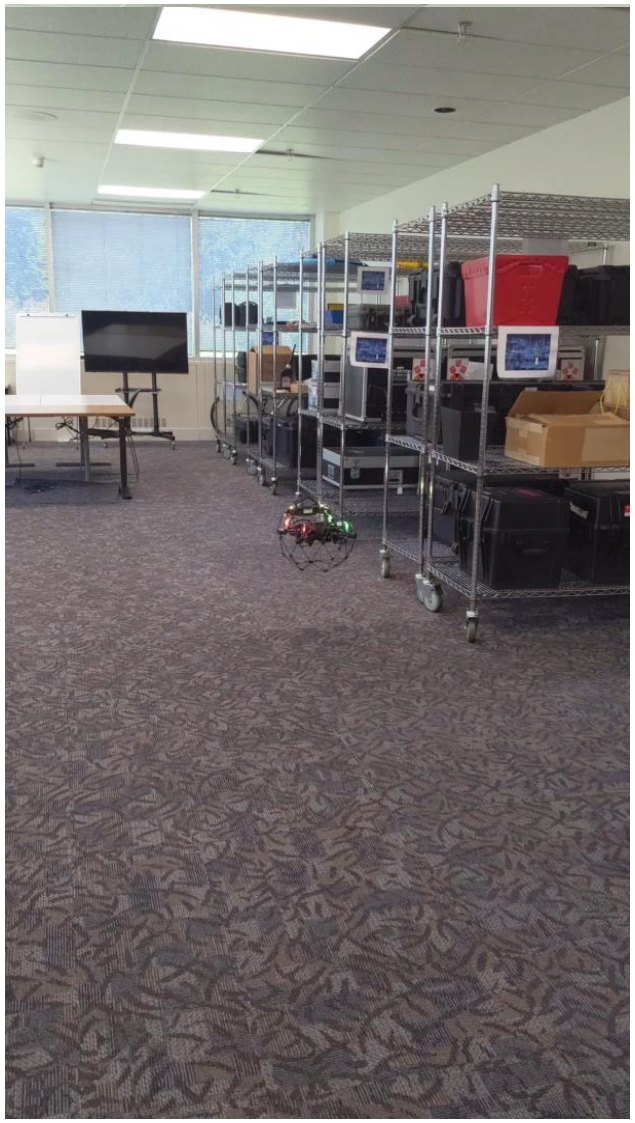
29 °F

N

100 ft

Scale Approximate

Inspection – Indoor flights

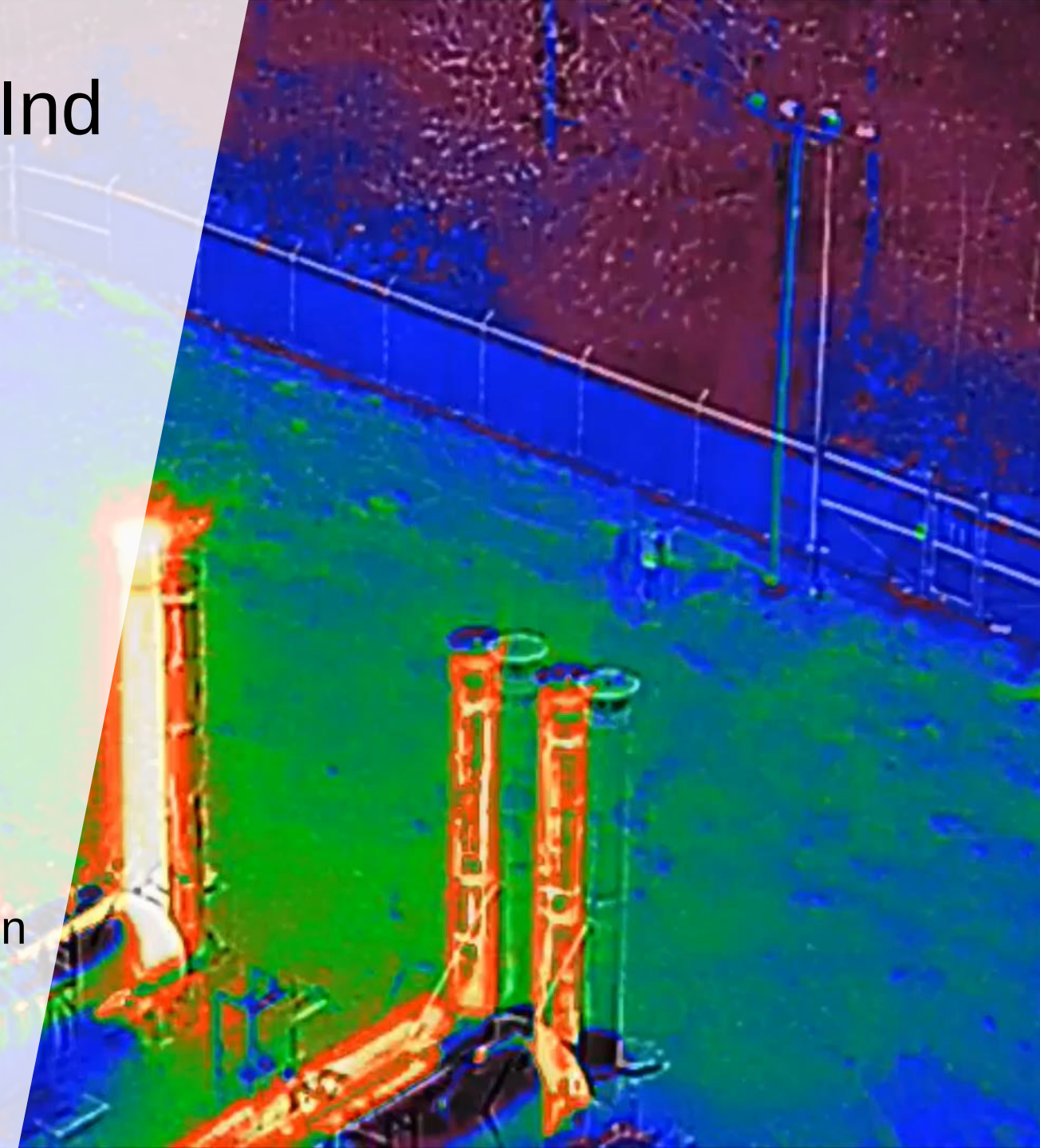


Inspection – Methane detection (FLIR)

KML Output

Benefits of Drones to Petro Ind

- **Mapping** – Terminal facilities
  - Site model updates
  - Construction monitoring
  - Asset tracking
- **Inspection** – Tanks and Pipes
  - Safety
  - Access
  - Efficiency
- **Documenting Site Activities and Conditions** – EAP
  - Regulatory requirements
- **Security**
  - Threat identification and communication



Why use a Drone?

3 Reasons:

Safer.

Cheaper.

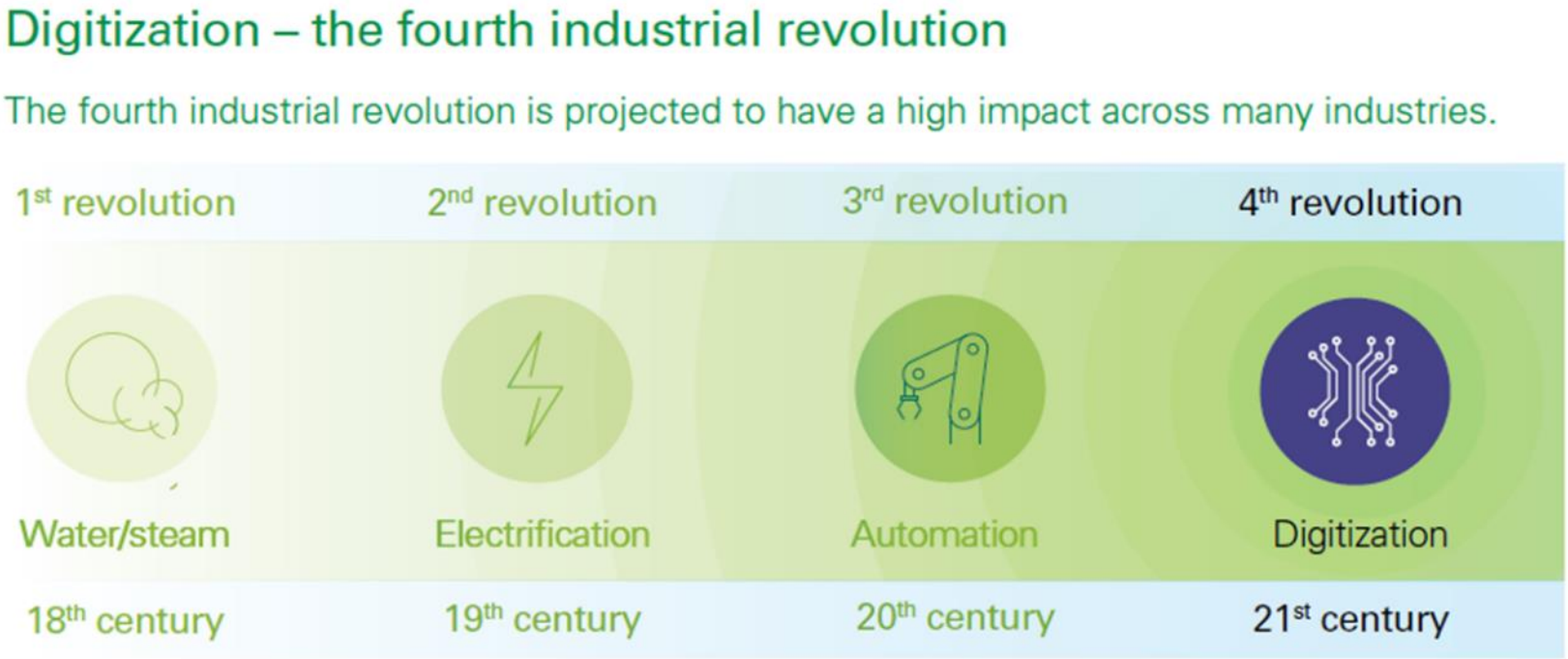
Better.

Fortune, 2016

Reason 1: Best Available Technology

- Reduced exposure to site hazards:
  - Biologicals
  - Temperature extremes
  - Slips/trips/falls
  - Fatigue
  - Security risks
- Access to locations that would otherwise be too hazardous or impossible

Reason 2: Digital Transformation



By 2022, **60% of global GDP will be digitized**.

Yet today, only 45% of people trust that **technology will improve their lives**.

Every sector is beginning to face deep questions about what the implications of this transformation will be.

https://www.weforum.org/whitepapers/our-shared-digital-future-responsible-digital-transformation-board-briefing-9ddf729993

Take Away - Digital Transformation

"The future is already here – it's just not very evenly distributed." – *William Gibson*

- **BP announces industry-first, continuous methane measurement programme**

  Release date: 10 September 2019

- *With all these new technologies, inspections that used to take **seven days** will now only take **30 minutes**, BP said.*

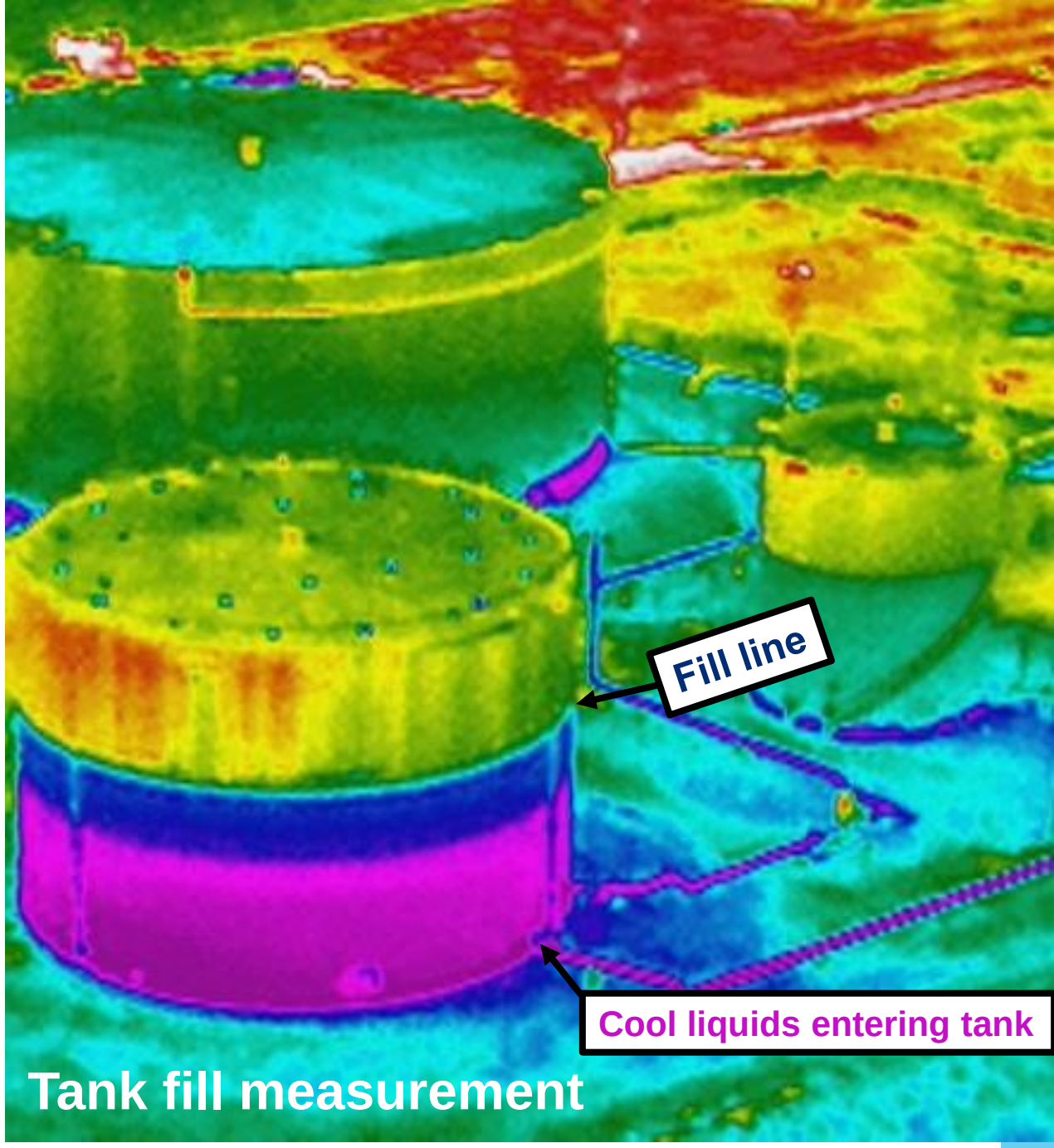
https://www.bp.com/en/global/corporate/news-and-insights/bp-magazine/bp-deploys-continuous-methane-emissions-measurement.html

Reason 3: Readiness

Greatest advantages and benefits of using sUAS are attained by those who need it most in Petro Ind.

- Health and safety (societal)
- Environmental management
- Operations management (economical)

The limit of use-cases **has not been defined** *but* general drone use practices are being **firmly established by leaders in the industry.**



THANK YOU

Questions?

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GES
Groundwater & Environmental Services, Inc.