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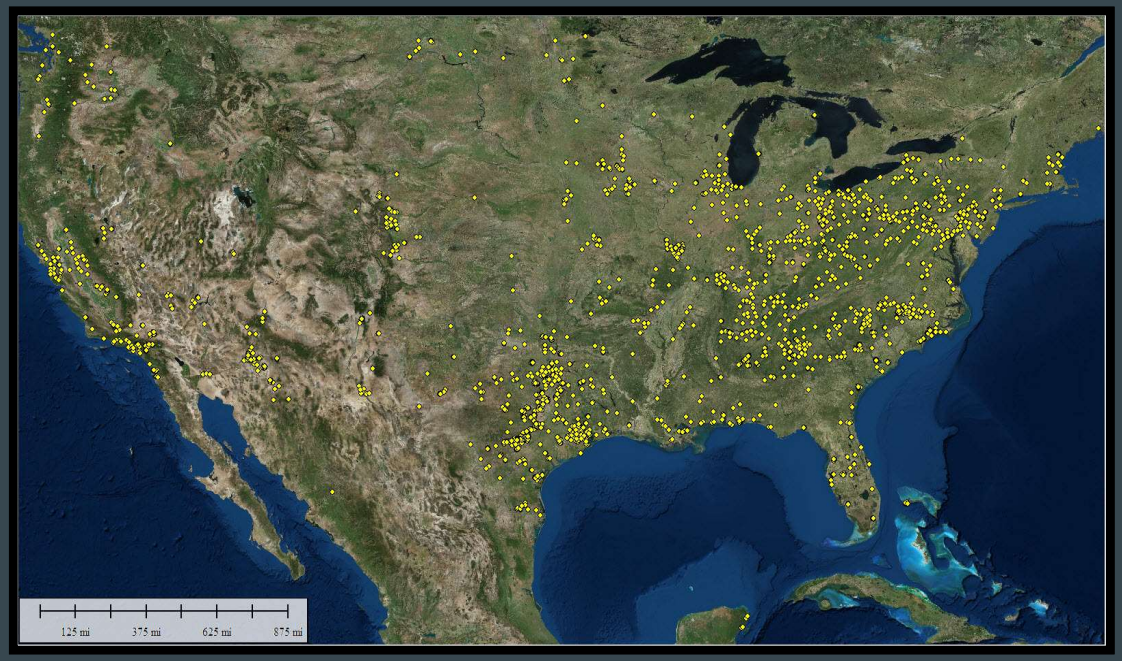
Drone Based Methane Detection

Company History & Experience

- Providing mapping & measurement services since 1989 in the U.S., Canada, Mexico & The Caribbean
- Team of Professional Engineers, geologists, drone pilots & data processors
- Laser scanning & flying drones for solid waste sites since 2009
- Projects for more than 30 solid waste companies at over 300 individual solid waste sites
- Performing quarterly fill, density & airspace surveys nationwide
- Dominant national stockpile inventory company
- Over 3,000 jobs completed every year



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Company History & Experience cont

Mobile laser scanning:

- Truck-mounted Lidar
- Up to 36,000 points per second
- Real time GPS corrections

Company History & Experience cont

Drones

- Calibrated Camera
- RTK & PPK enabled drones
- Not dependent on Ground Control Targets for accuracy

Benefits:

- ✓ Accurate date
- ✓ Data capture is fast & safe
- ✓ Aerial orthophoto is generated every survey

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Company History & Experience cont.

UAV-based LiDAR

- Drone-mounted laser scanner
- Penetrate tree canopy & vegetation
- RGB colorized point cloud

Company History & Experience cont.

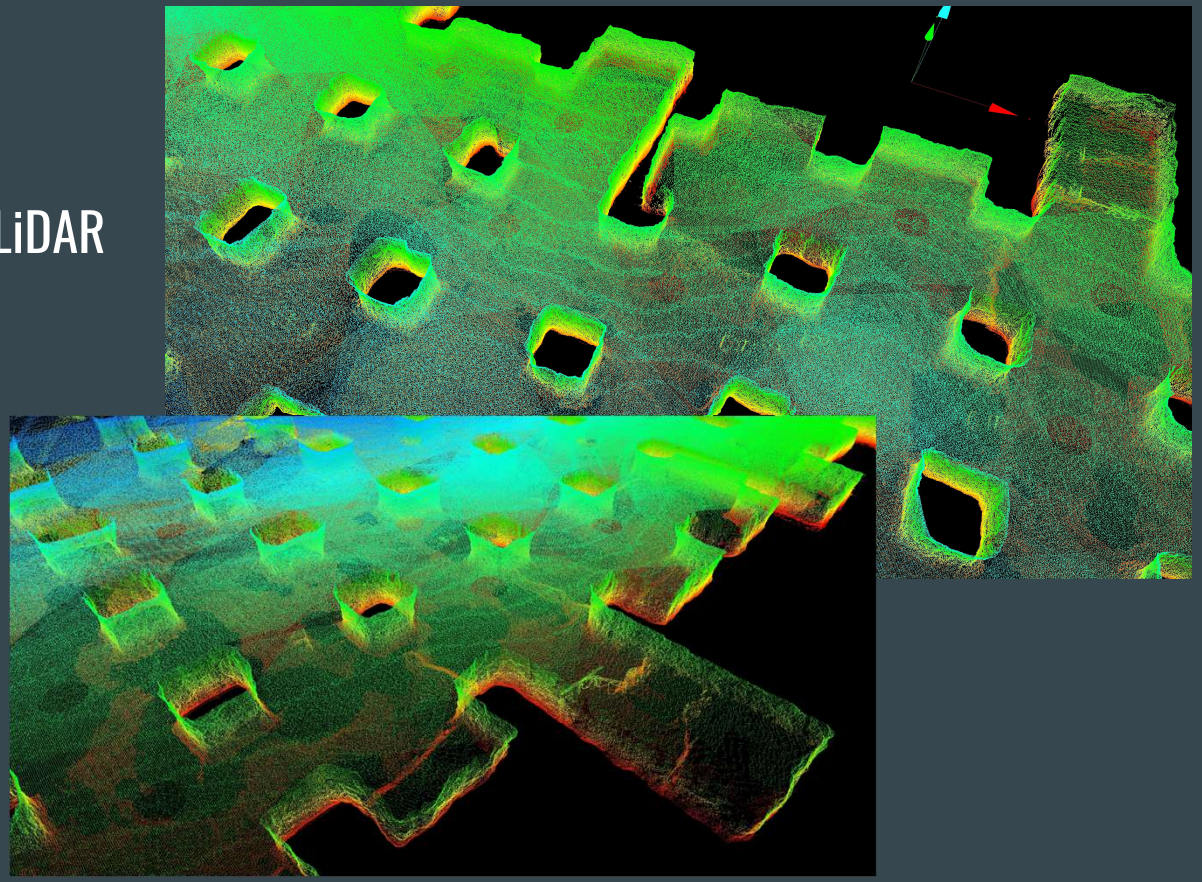
3D facade reconstruction

- Series of pictures stitched together to create a 3D model
- Digital twin applications

Company History & Experience cont.

Underground LiDAR scans

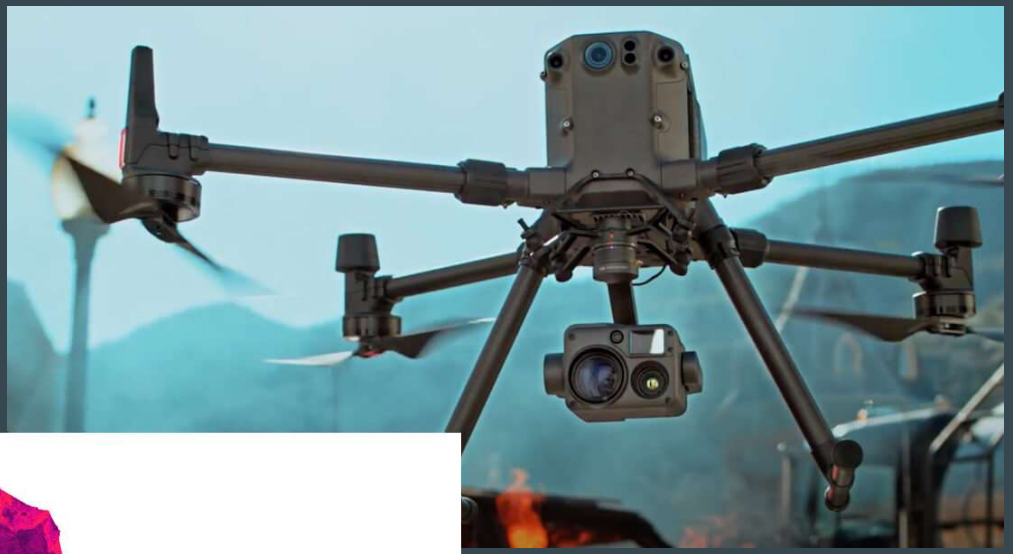
- Collected using tripod-mounted LiDAR scanners
- Generate a digital twin point cloud for engineering design

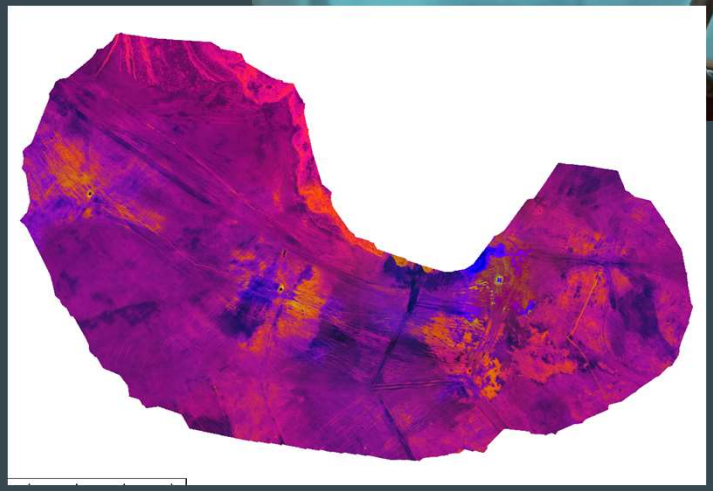


Company History & Experience cont.

UAV-based Thermal Imagery

- Safely collect data
- Generate radiometric thermal orthomosaics





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Methane sensing with a UAV?

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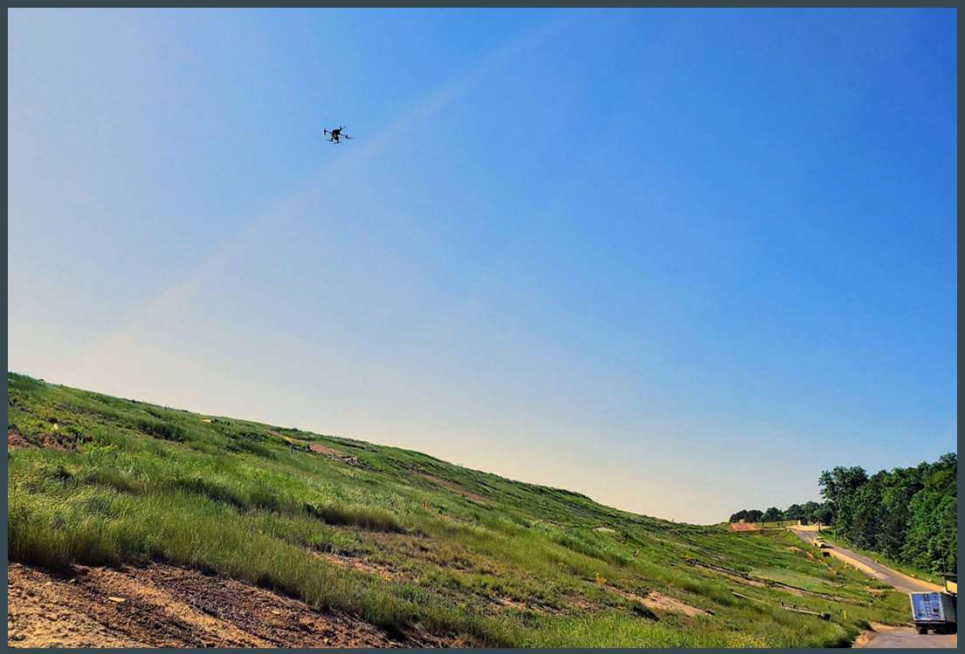
Laser sensor

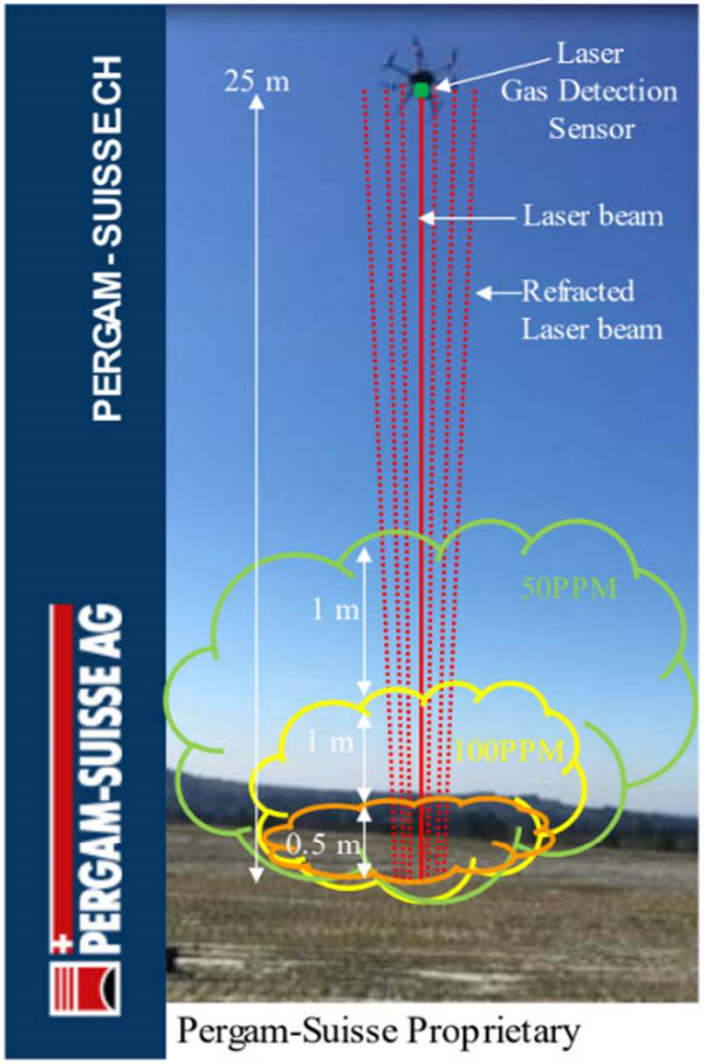


vs

Sniffer sensor

Pergam & UgCS

- Laser Falcon Methane Sensor
- Laser-type methane gas detector
- Methane & methane containing gases
- Detection limit: 1 to 50,000 ppm(x)m
- Calibration: Self-calibrated with integrated reference cell
- Mounted on DJI M300
- 30 meter max height



WHY PPM-METER?

Measures all Methane in Cloud

2 PPM x 22.5 m = 45 PPM -M

+

50 PPM x 1 m = 50 PPM -M

+

100 PPM x 1 m = 100 PPM -M

+

200 PPM x 0.5 m = 100 PPM-M

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295 PPM-M

PPM Reading Only at Ground = 200

PPM-M can be converted to Kilograms or PPM for the volume above an area

Figure 2: FALCON/LMC Detection Diagram

Flight Planning

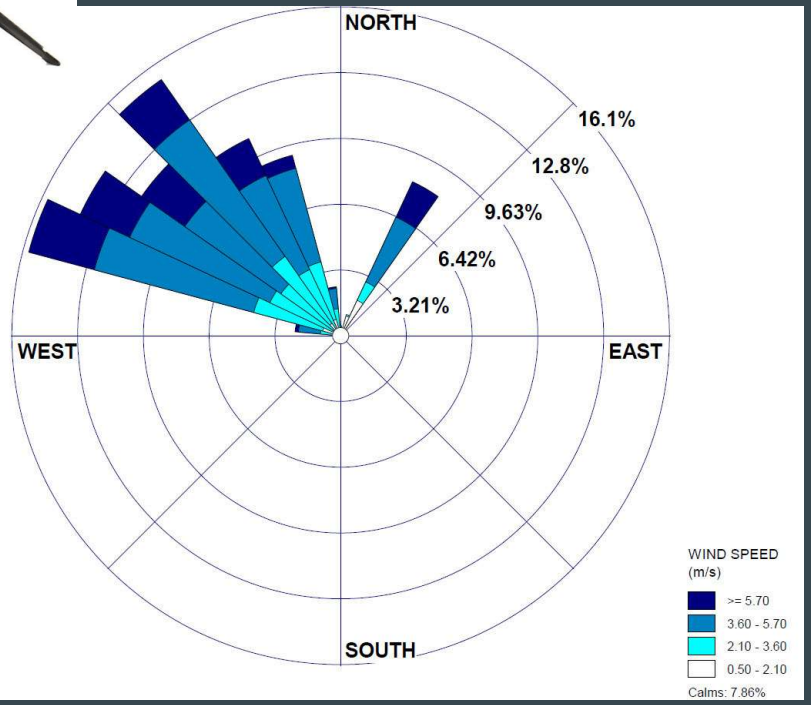
- UgCS Flight Control Software
  - UgCS Sky Hub
  - DJI M300
  - Pergam Falcon
  - Laser Altimeter
- 180 Acres
- Altitude: 20 m
- Flight line Spacing: 10 m
- Speed: 5 m/s
- 4.5 hour flight time

Data Collection

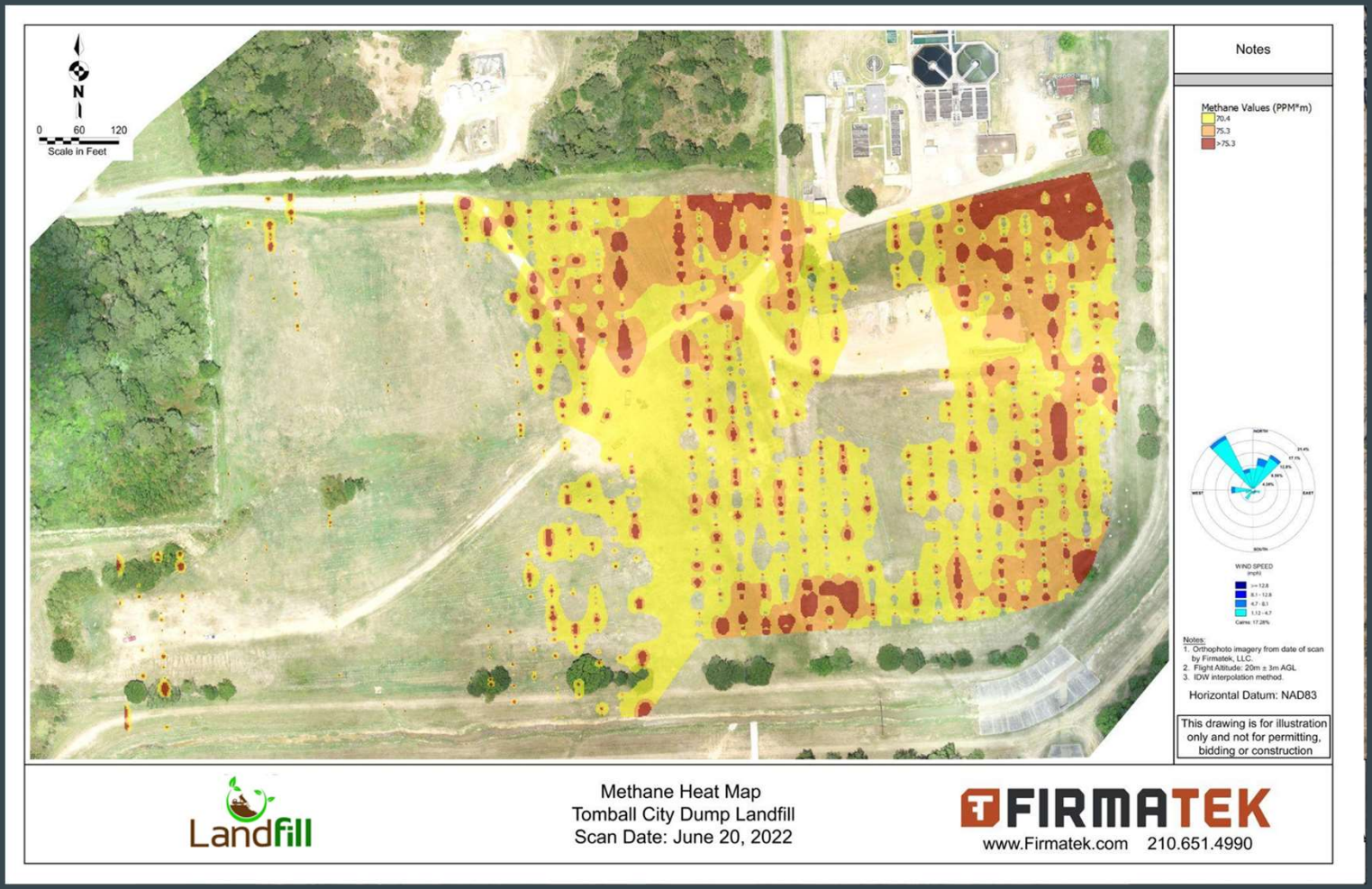
- 130 Acres
- 9 Flights
- 8 Hours on site
- On site weather station
- Wind
  - Avg: 6.5 mph
  - Max: 15 mph
- 32,500 Methane Readings

Wind Data

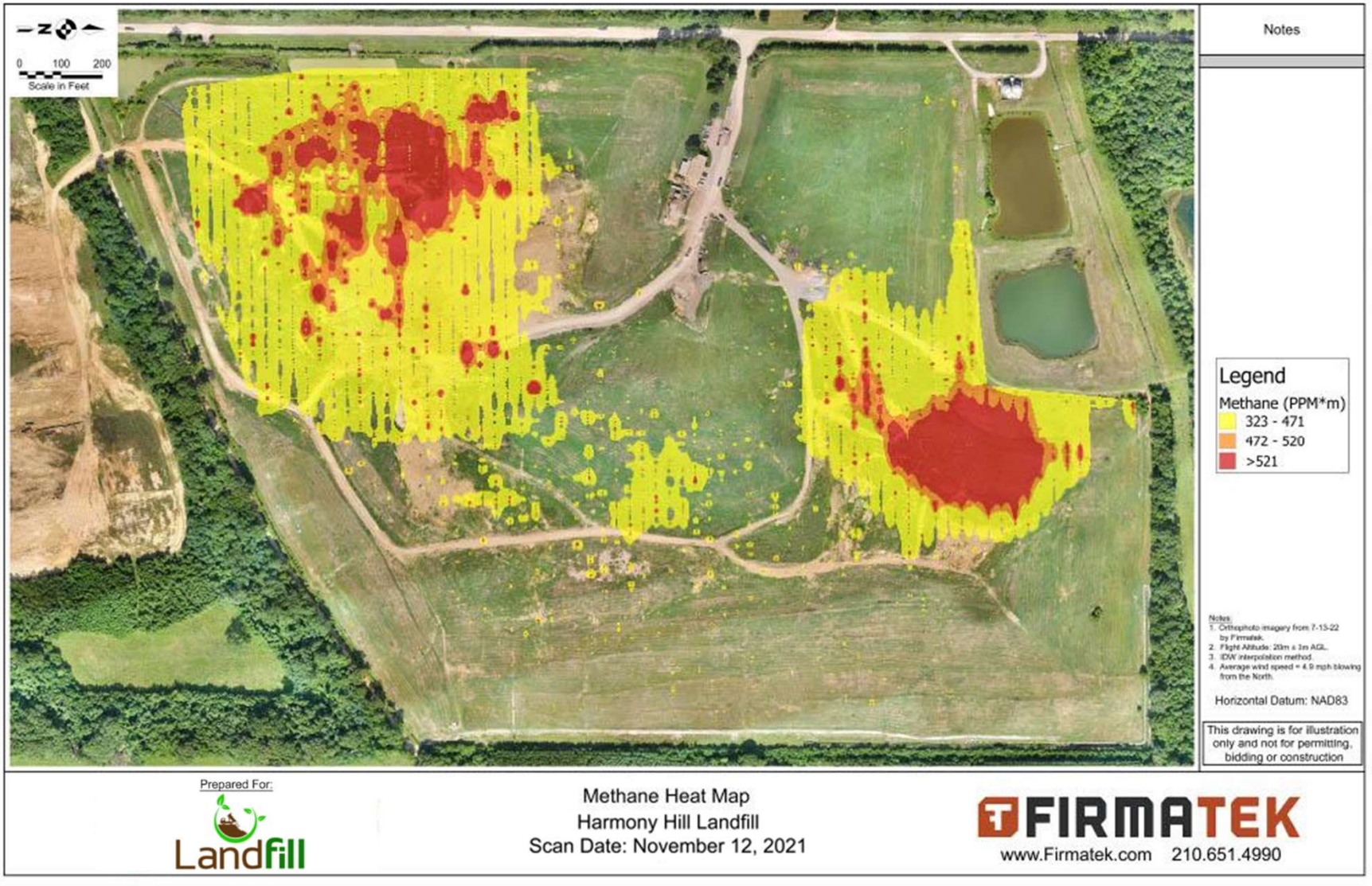
- Kestrel Weather station collects important wind & weather data



Hotspot Map



- Hotspot analysis to identify clusters
- Color by methane concentration
- Include wind, temp & other weather data
- Future: Use data for plume dispersion modeling?
- Future: Display interactive data on Kespry



Prepared For:

Landfill

Methane Heat Map
Harmony Hill Landfill
Scan Date: November 12, 2021

FIRMATEK
www.Firmatek.com 210.651.4990

What have we learned?

- Choosing the right equipment is extremely important
  - Laser sensor vs Sniffer sensor
- Many different way to display your methane data
  - Interpolation methods (IDW vs Getis-Ord Gi vs Nearest Neighbor Triangulation)
  - Are there outlier's in your data?
  - Weather data: Wind rose diagram vs flight path correlation
- Field work can be challenging!
  - 20m flight height restricts drone's radio signal
  - 3 different systems working together can cause trouble
  - Weather restrictions
- There's an industry need to identify and map methane emission sources
  - Landfills
  - Oil & Gas - Refinery, processing facilities pipelines, storage tanks
  - Livestock - Dairy, poultry, pig farm

Questions?

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