

Identifying Methane Surface Emissions – A Comparison of Field Method Approaches

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Presentation Overview



- Funding Program/Purpose of Study
- Methods - data collected
- Results – figures and explanation
- Conclusions/Recommendations



Environment Canada Funding Program



Purpose – To support emerging and innovative technologies for optimizing methane mitigation at landfills

- drone-based methane measurement systems that can readily identify methane hotspots and leaks, and/or quantify total site emissions
- continuous methane monitoring systems that generate real-time continuous methane emissions data and identify leaks
- automated wellfield tuning systems that can be added to existing landfill gas (LFG) collection systems to maximize collection efficiency
- other monitoring technologies that will assist in measuring methane emissions from landfills, identifying emissions sources or leaks, or improving LFG collection efficiency

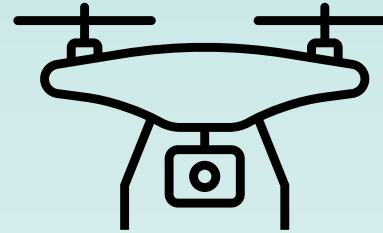


Comcor's project was one of five selected for funding

Purpose of Study



VS



- Determine if drone surveys are as dependable as walking surveys in identifying hotspots
- Only technical effectiveness considered (not economics!)
- Are results replicable at multiple sites
 - City of London Landfill (W12A), Ontario
 - Oxford County Landfill, Ontario
 - Brady Road Landfill, Winnipeg, Manitoba

- Drone (height of 40 to 50 metres)
 - Integrated methane concentration using TDLAS (tunable diode laser absorption spectroscopy) – Pergam Falcon
 - Thermal imaging
 - RGB aerial image of site
- Walking Sweep
 - Point methane concentrations (small scale TDLAS)
 - Instrument – Landec SEM5000

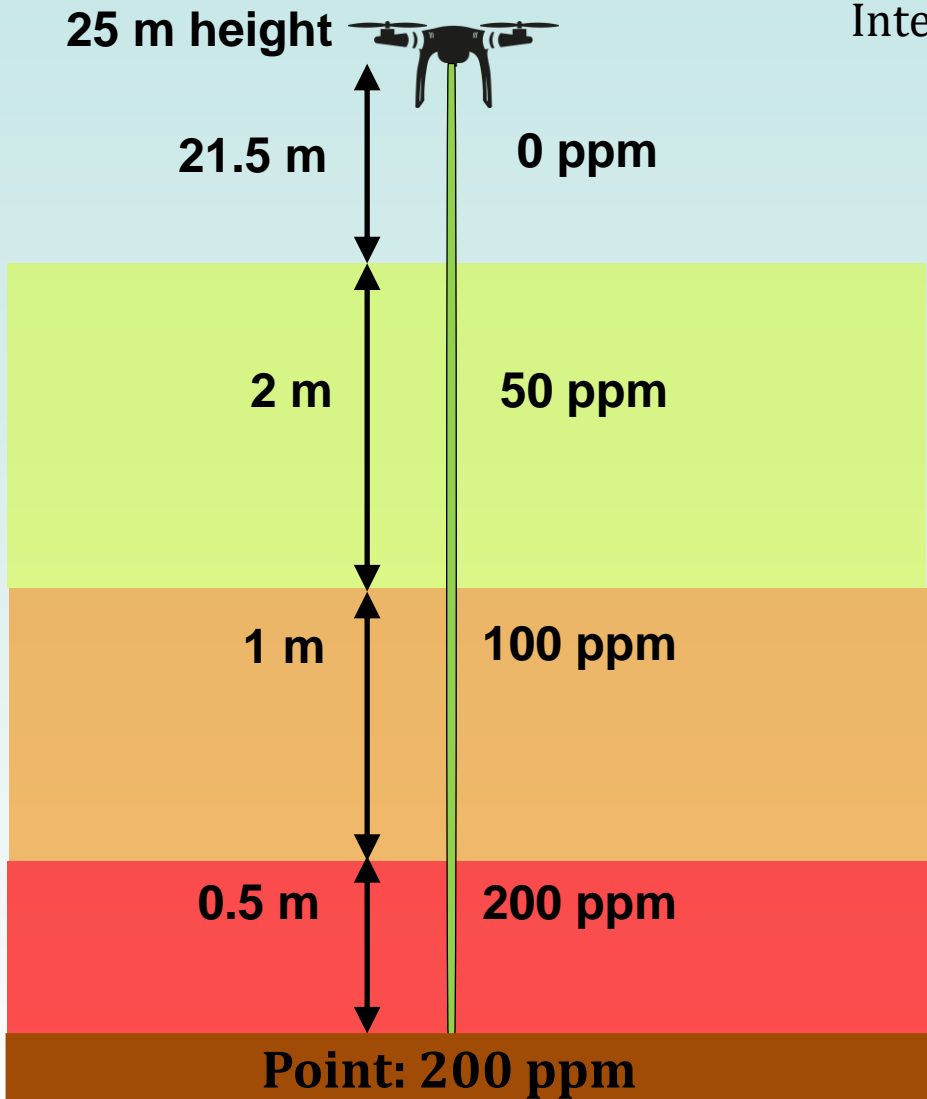


TDLAS

- **Emits laser only absorbed by methane**
- **Measures difference in outgoing and incoming signals**
- **In drone vs SEM5000**



Integrated vs Point Measurement



Integrated ppm·m measurement calculated as:
Concentration × Distance

$$0\text{ppm} \times 21.5\text{m}$$

+

$$50\text{ppm} \times 2\text{m}$$

+

$$100\text{ppm} \times 1\text{m}$$

+

$$200\text{ppm} \times 0.5\text{m}$$

=

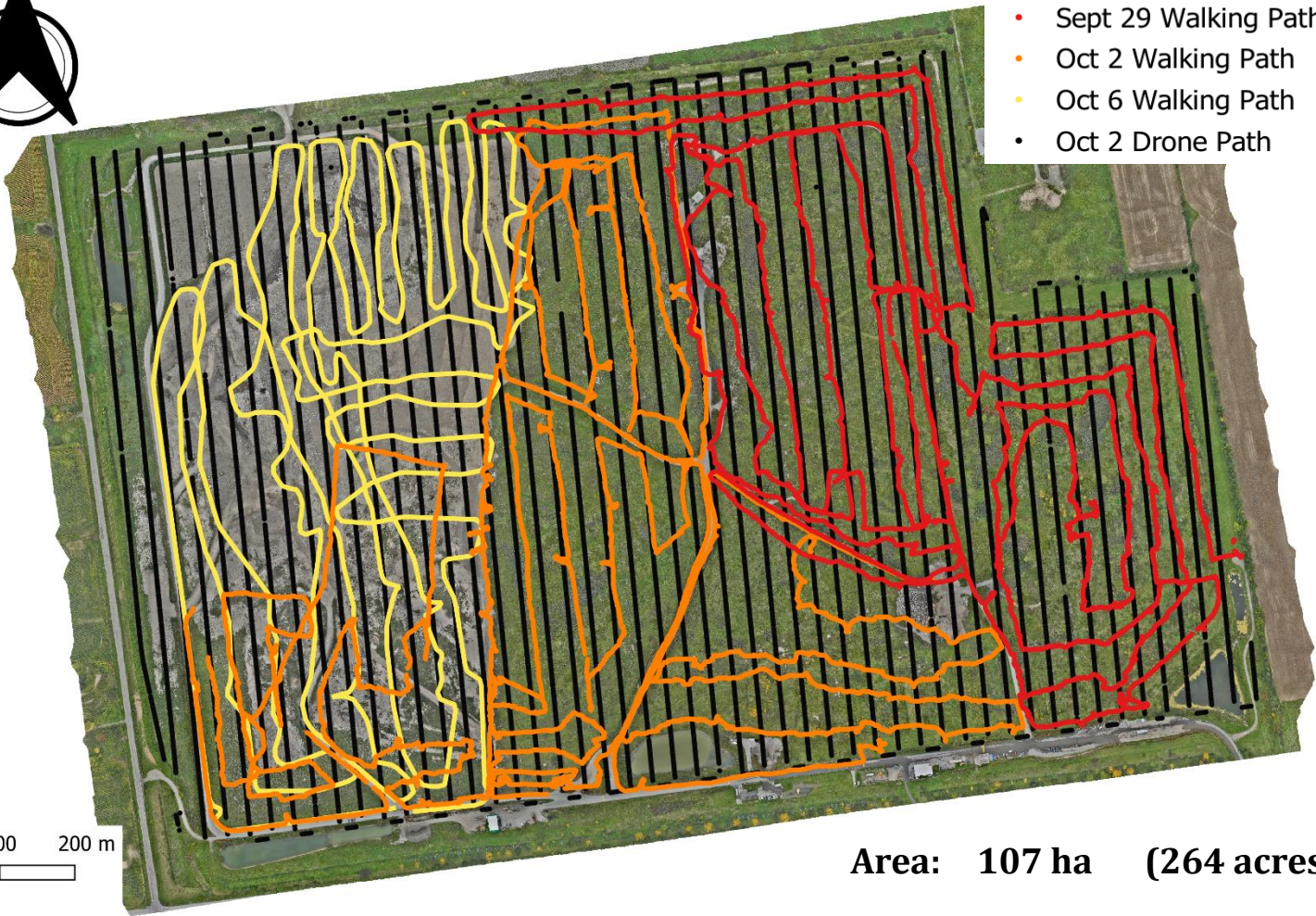
Integrated: 300 ppm·m

Coverage Results - London



Legend

- Sept 29 Walking Path
- Oct 2 Walking Path
- Oct 6 Walking Path
- Oct 2 Drone Path



Area: 107 ha (264 acres)

Oxford



Legend

- Oct 3 Walking Path
- Oct 3 Drone Path

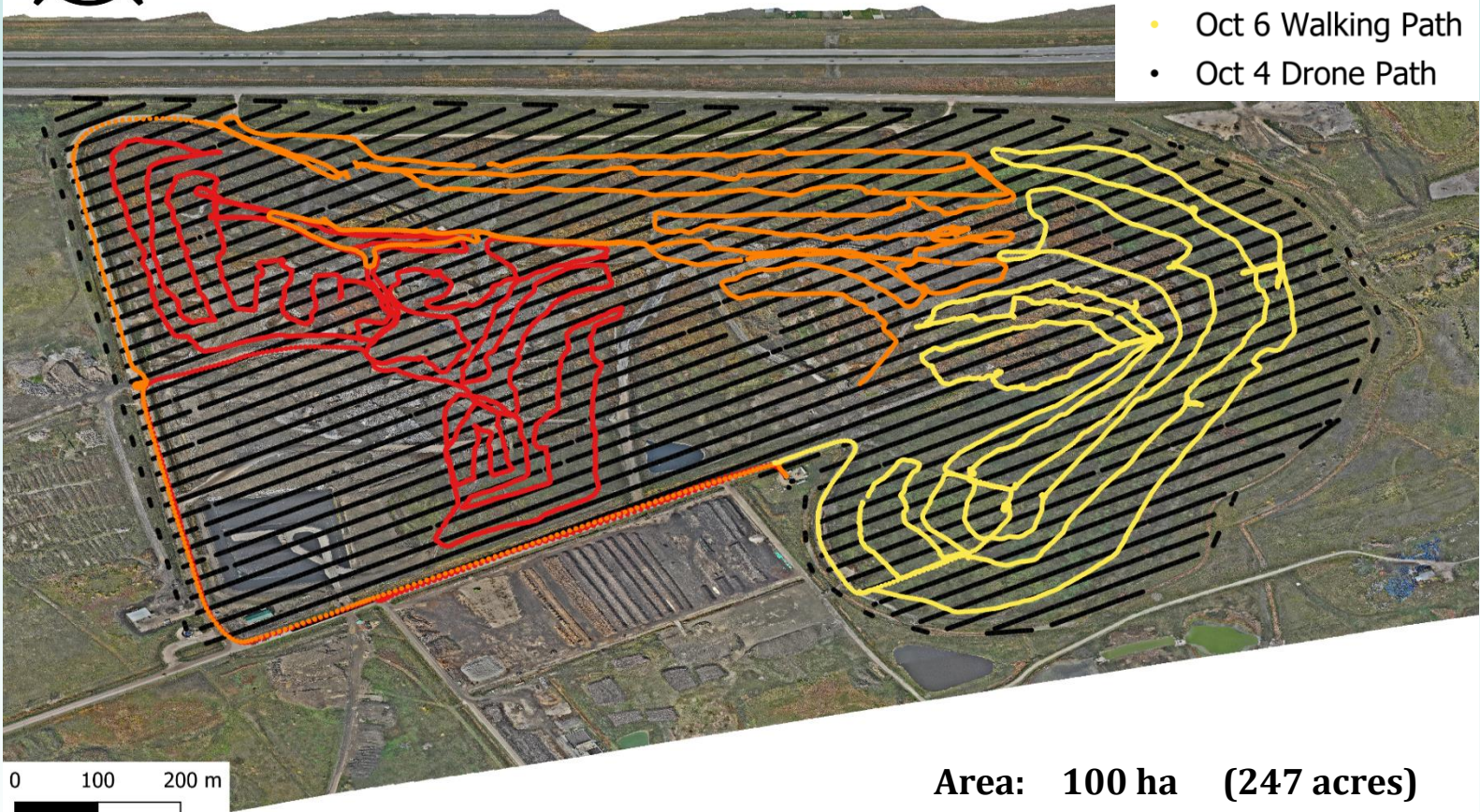
Area: 31 ha (77 acres)

Brady Road



Legend

- Oct 4 Walking Path
- Oct 5 Walking Path
- Oct 6 Walking Path
- Oct 4 Drone Path



Area: 100 ha (247 acres)

Coverage results

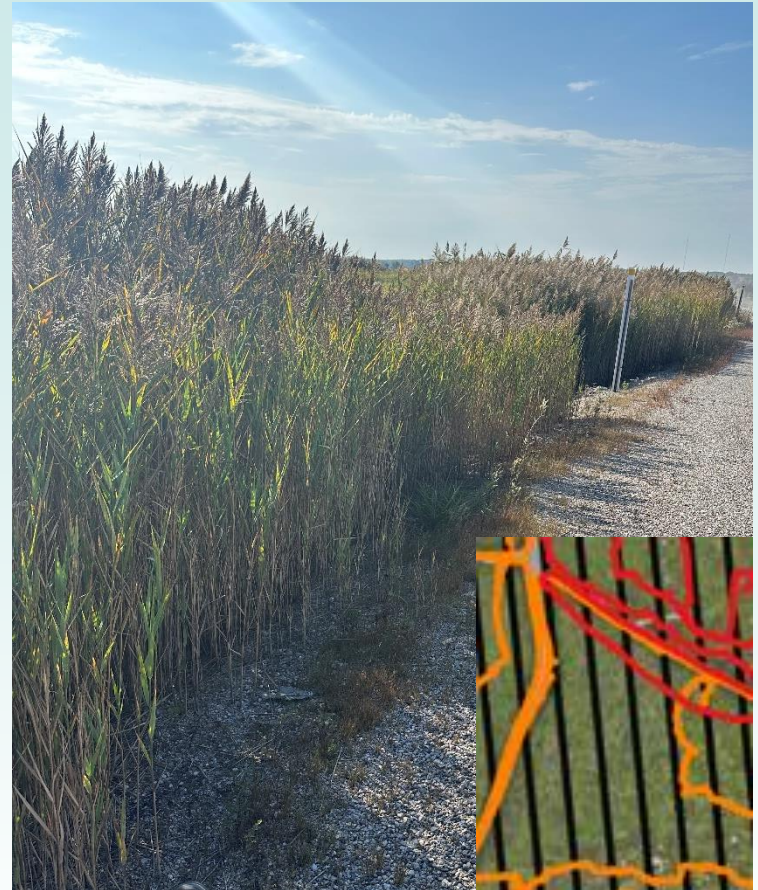


- Drone can cover areas that cannot be traversed by foot

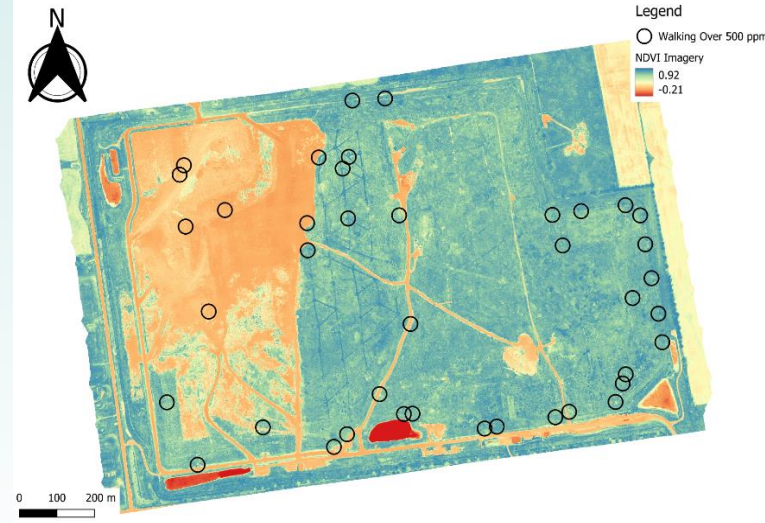
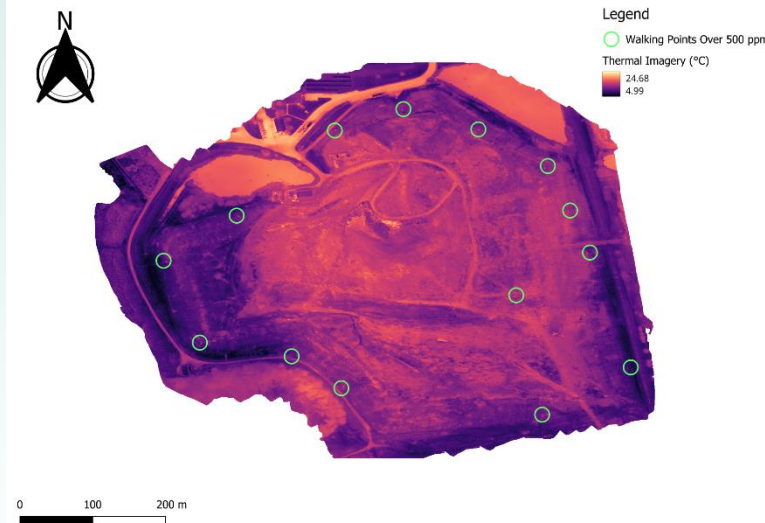
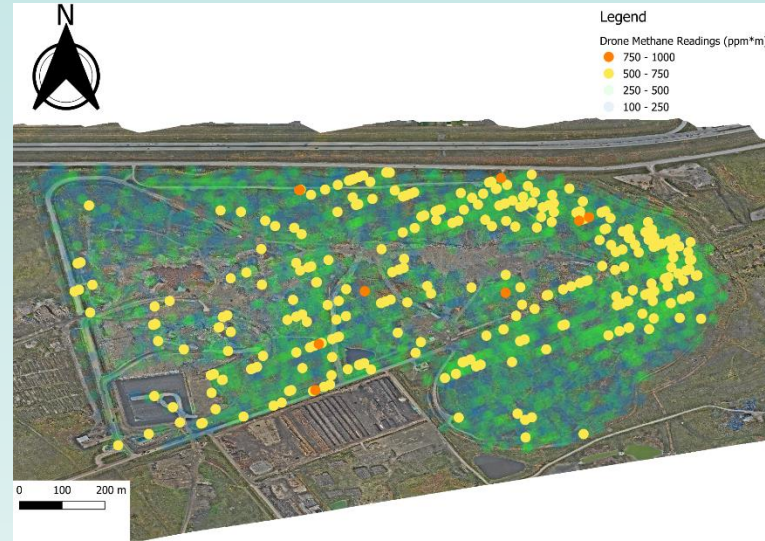
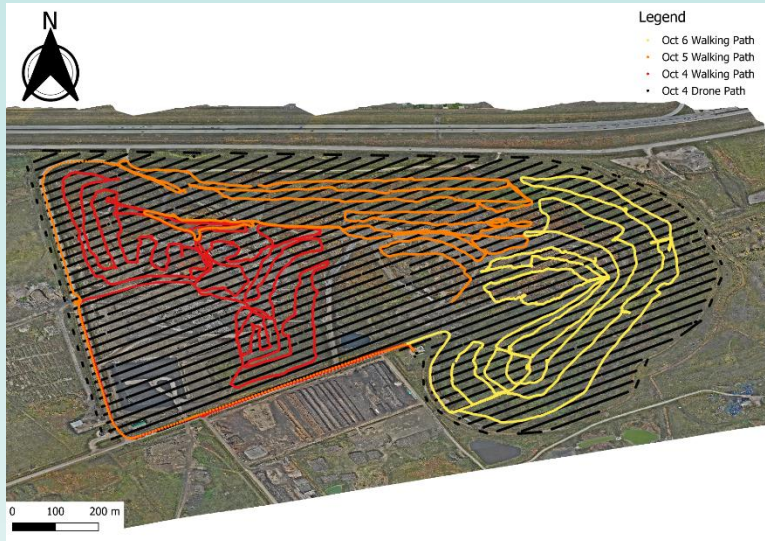
Active fill areas



Dense vegetation



Methane Concentration Results



London Drone



Drone Sweep Performed Oct 2, 2023

Legend

Drone Methane Readings (ppm*m)

● >2500

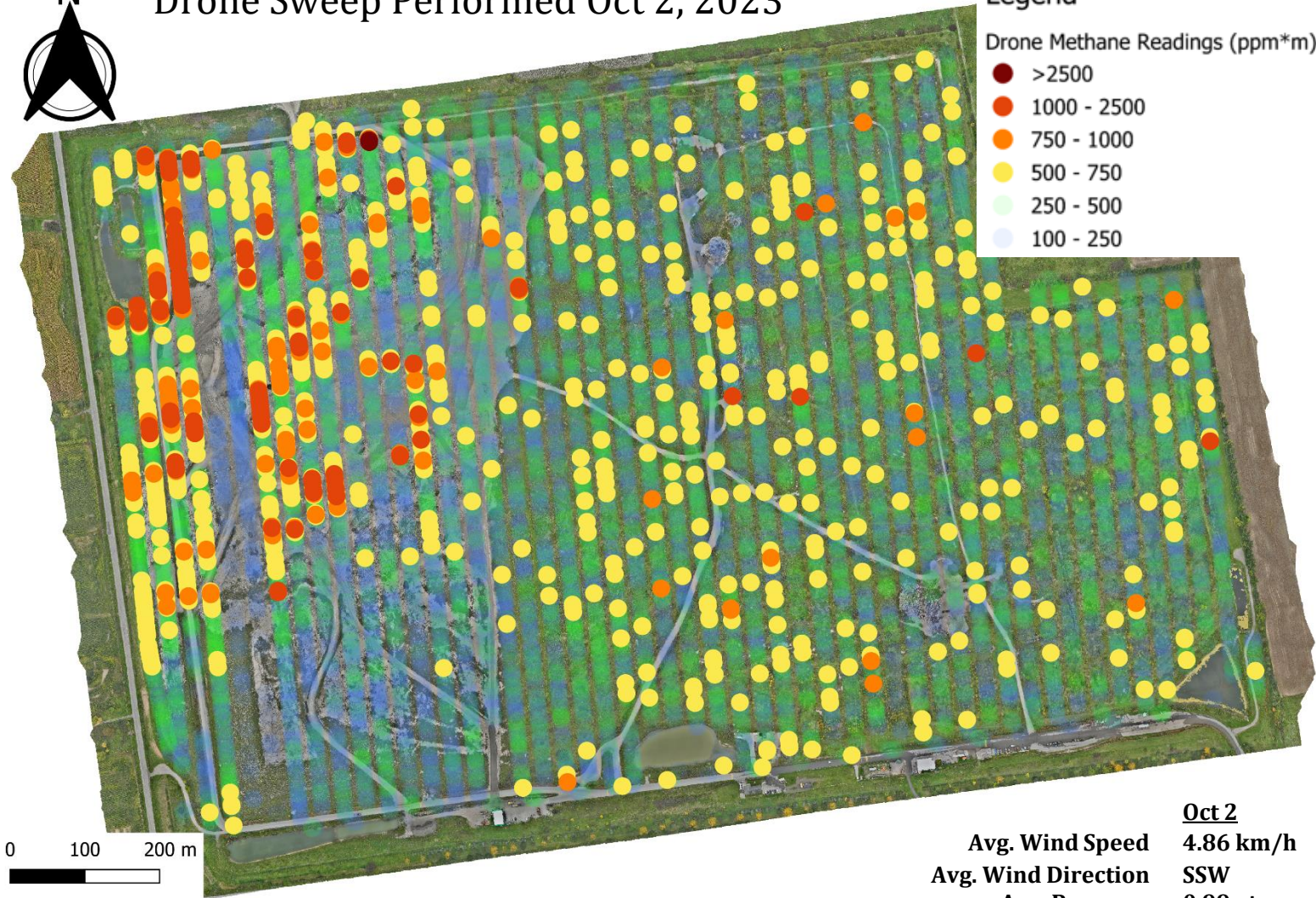
● 1000 - 2500

● 750 - 1000

● 500 - 750

● 250 - 500

● 100 - 250

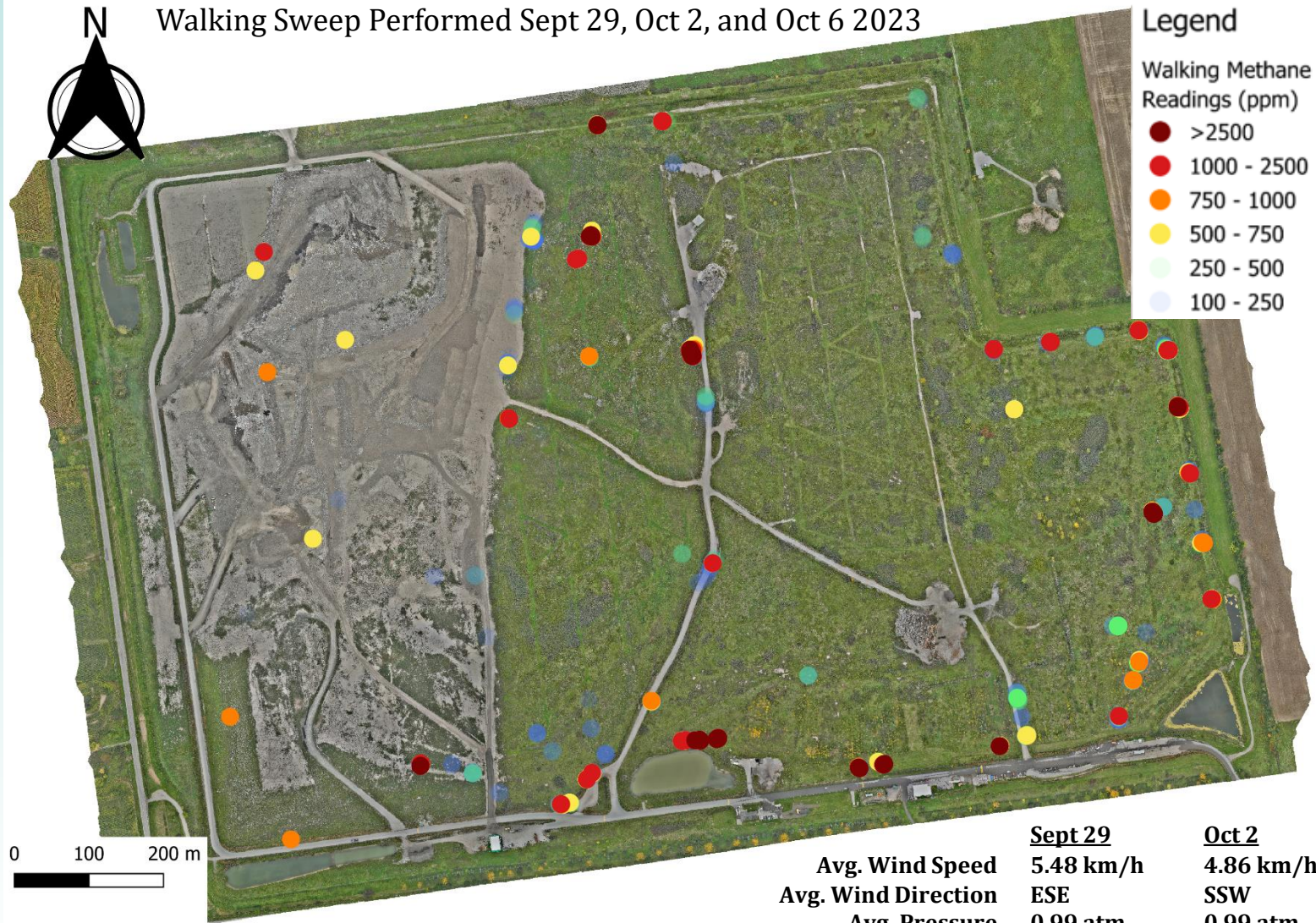
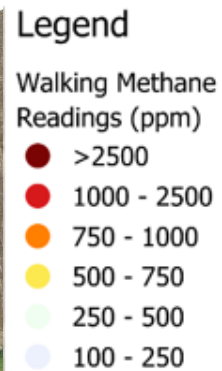


	<u>Oct 2</u>
Avg. Wind Speed	4.86 km/h
Avg. Wind Direction	SSW
Avg. Pressure	0.99 atm

London Walking

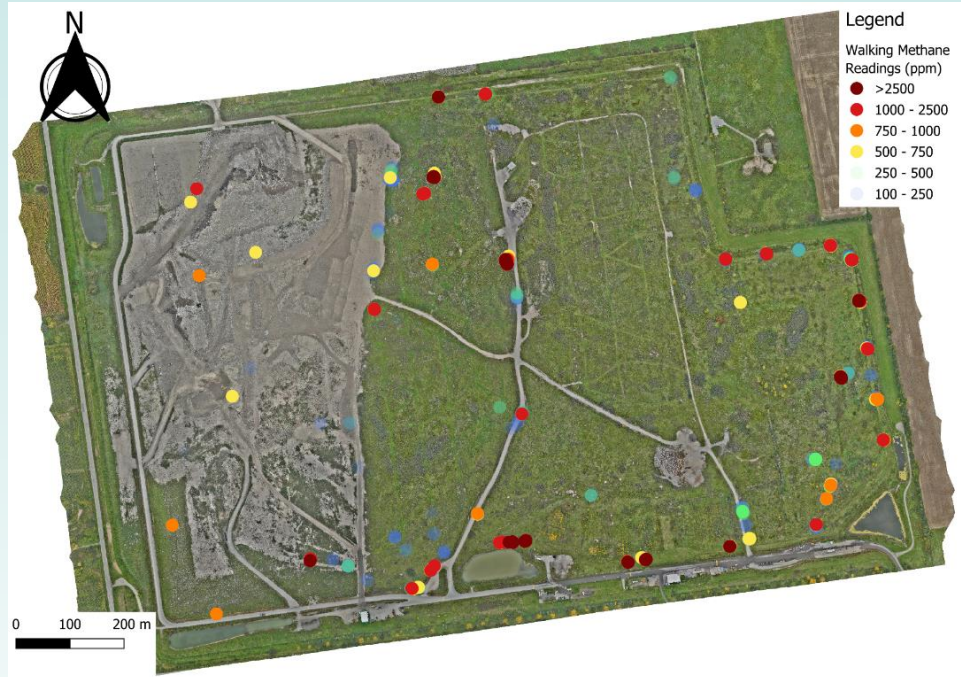
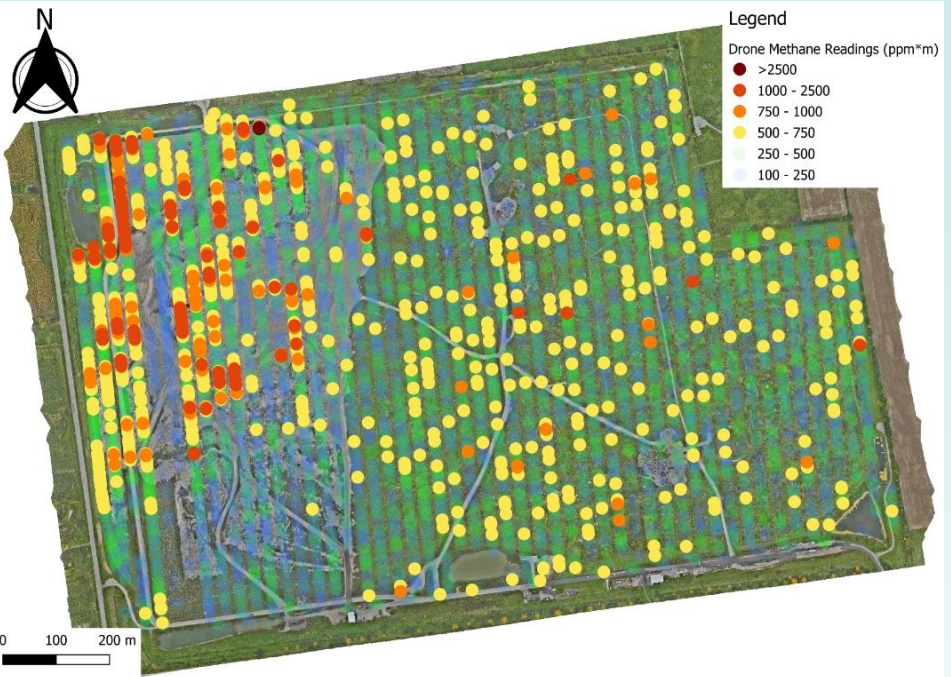


N Walking Sweep Performed Sept 29, Oct 2, and Oct 6 2023



	<u>Sept 29</u>	<u>Oct 2</u>	<u>Oct 6</u>
Avg. Wind Speed	5.48 km/h	4.86 km/h	9.93 km/h
Avg. Wind Direction	ESE	SSW	WSW
Avg. Pressure	0.99 atm	0.99 atm	0.98 atm

Hot Spot Identification - London



Oxford Drone

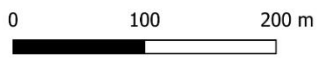
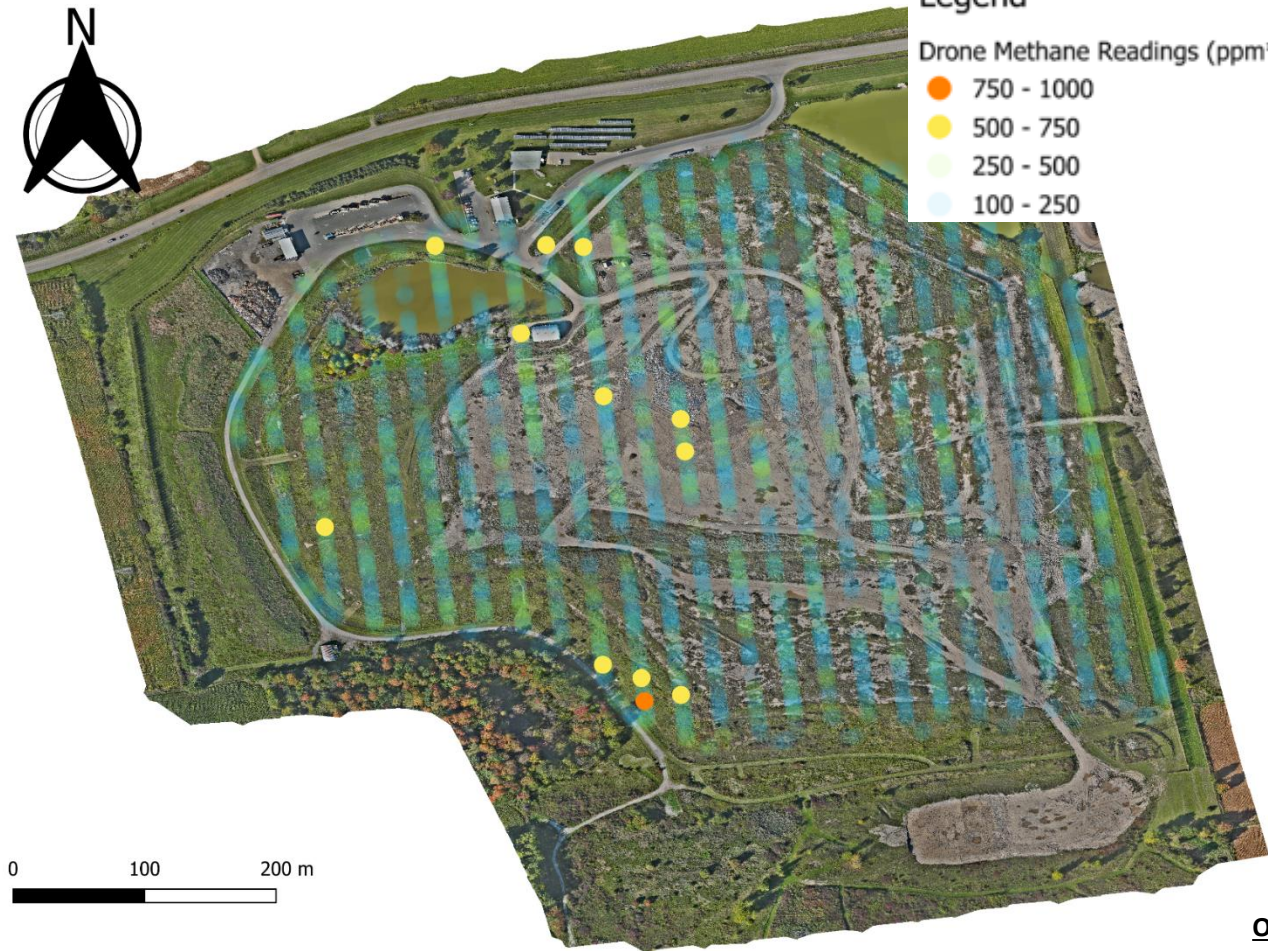


Drone Sweep Performed Oct 3, 2023



Legend

- Drone Methane Readings (ppm*m)
- 750 - 1000
 - 500 - 750
 - 250 - 500
 - 100 - 250



	Oct 3
Avg. Wind Speed	10.4 km/h
Avg. Wind Direction	SSW
Avg. Pressure	0.99 atm

Oxford Walking

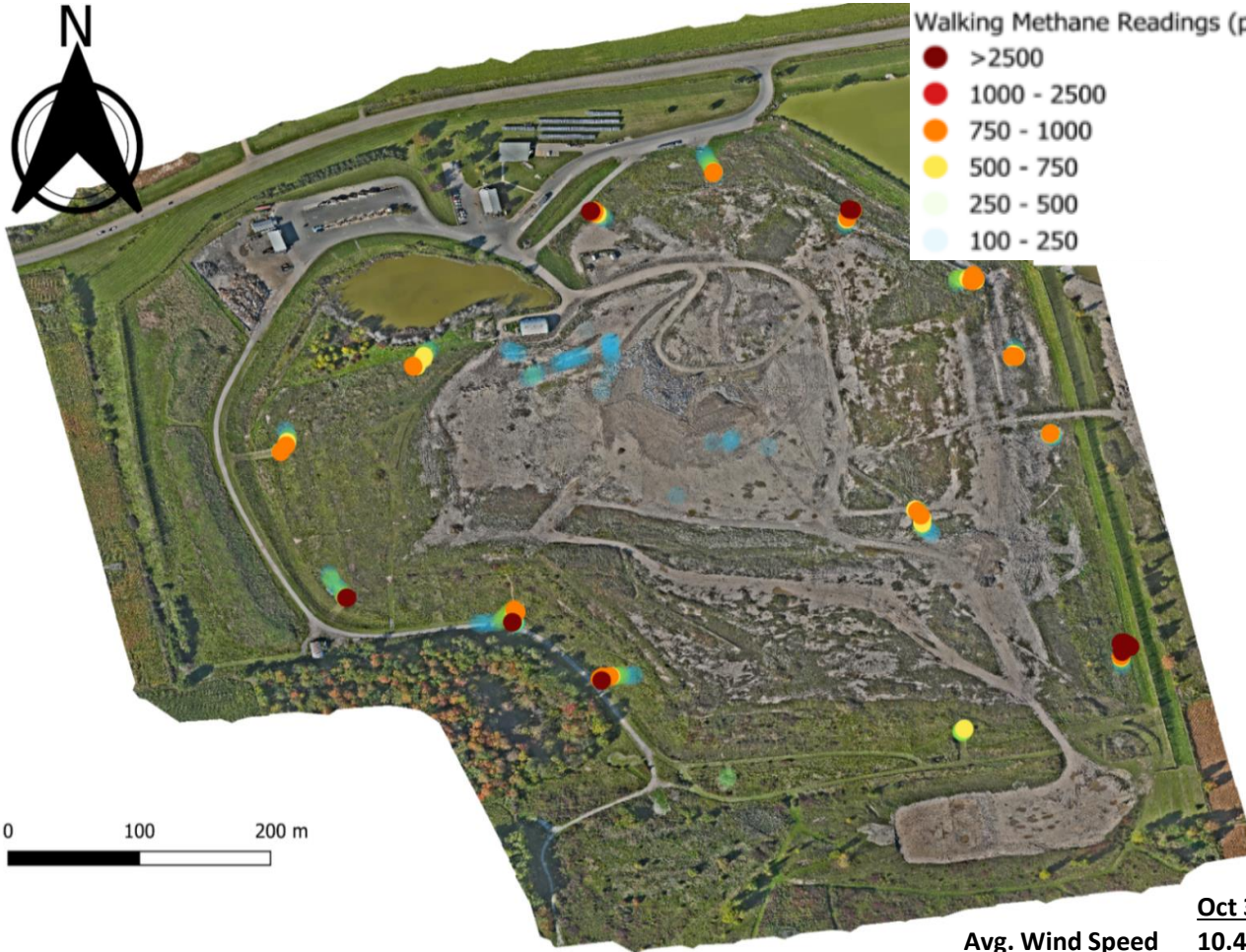


Walking Sweep Performed Oct 3, 2023

Legend

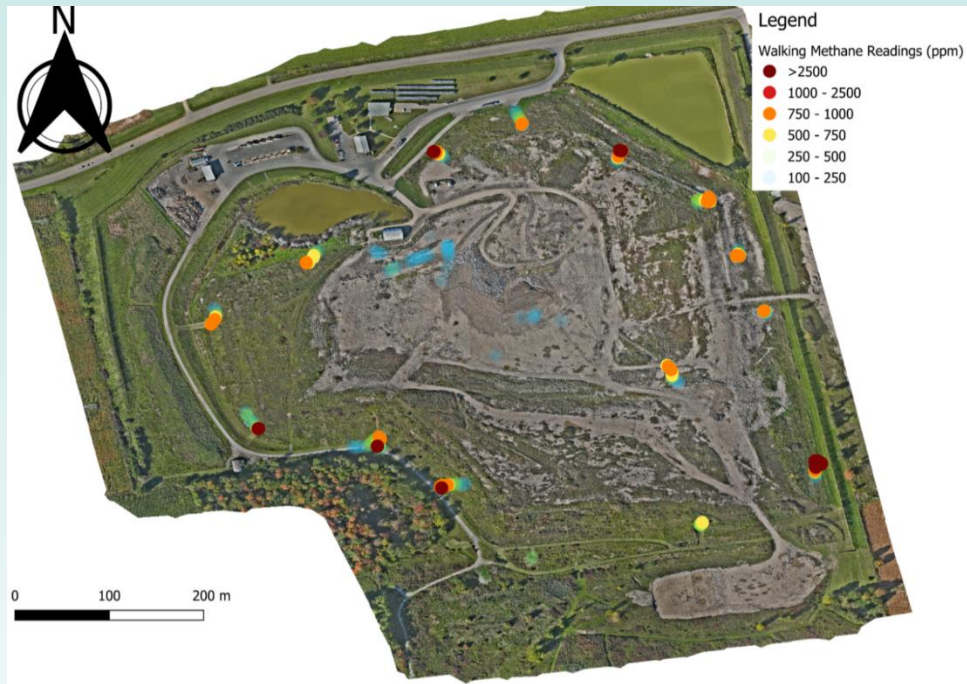
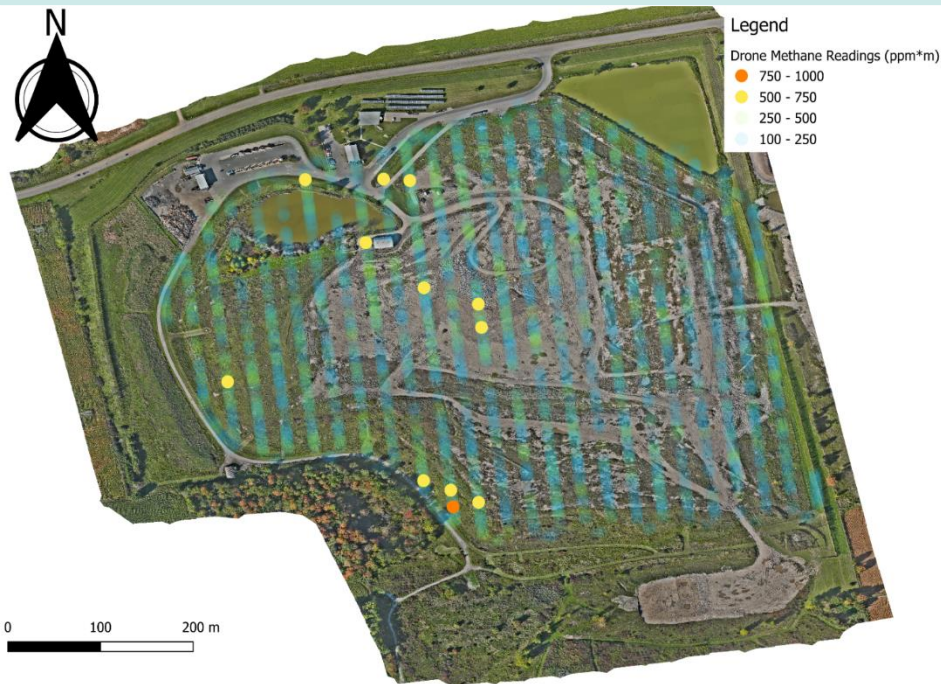
Walking Methane Readings (ppm)

- >2500
- 1000 - 2500
- 750 - 1000
- 500 - 750
- 250 - 500
- 100 - 250



	Oct 3
Avg. Wind Speed	10.4 km/h
Avg. Wind Direction	SSW
Avg. Pressure	0.99 atm

Hot Spot Identification - Oxford



Brady Road Drone

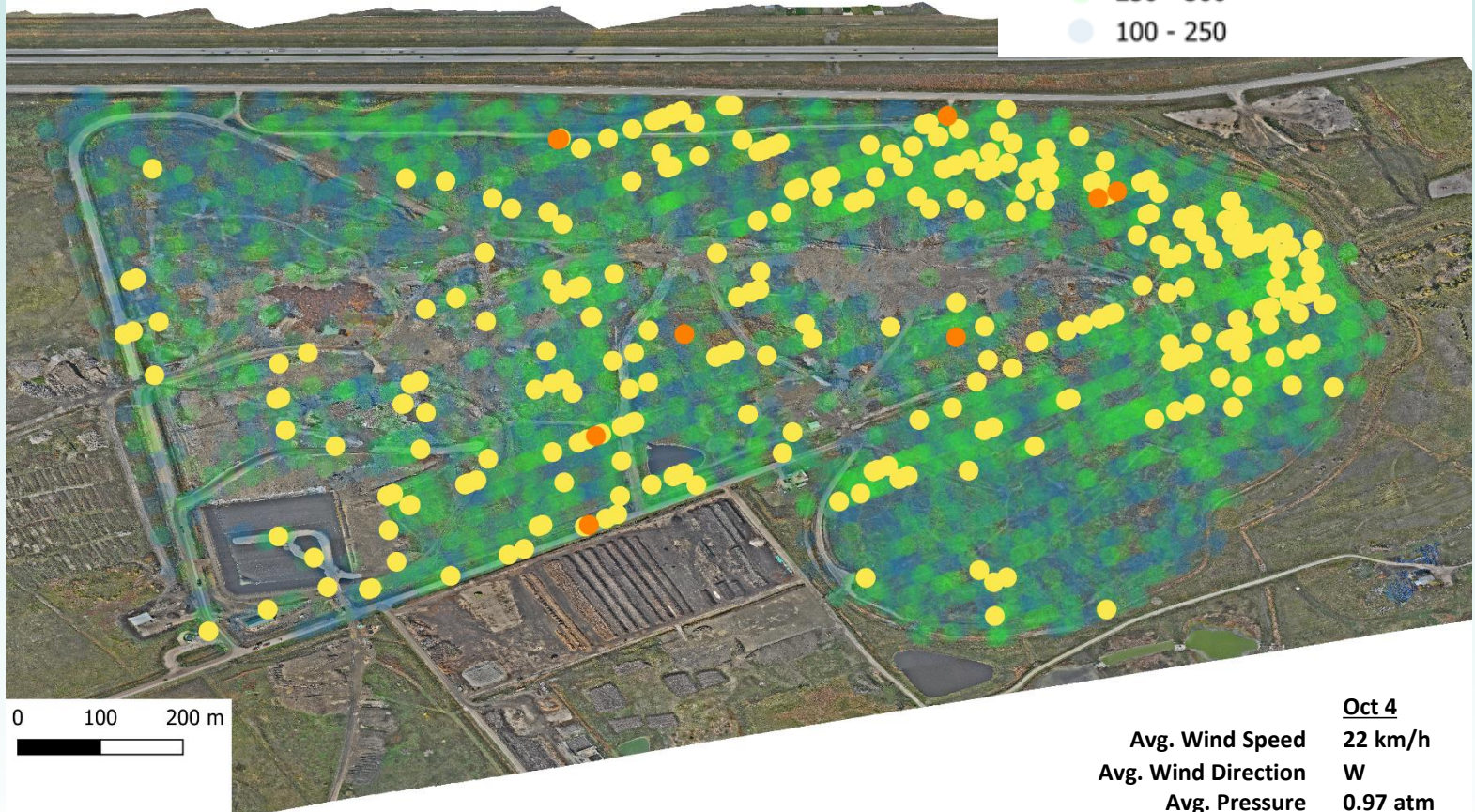


Drone Sweep Performed Oct 4, 2023

Legend

Drone Methane Readings (ppm*m)

- 750 - 1000
- 500 - 750
- 250 - 500
- 100 - 250



0 100 200 m

Oct 4
Avg. Wind Speed 22 km/h
Avg. Wind Direction W
Avg. Pressure 0.97 atm

Brady Road Walking

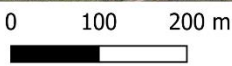
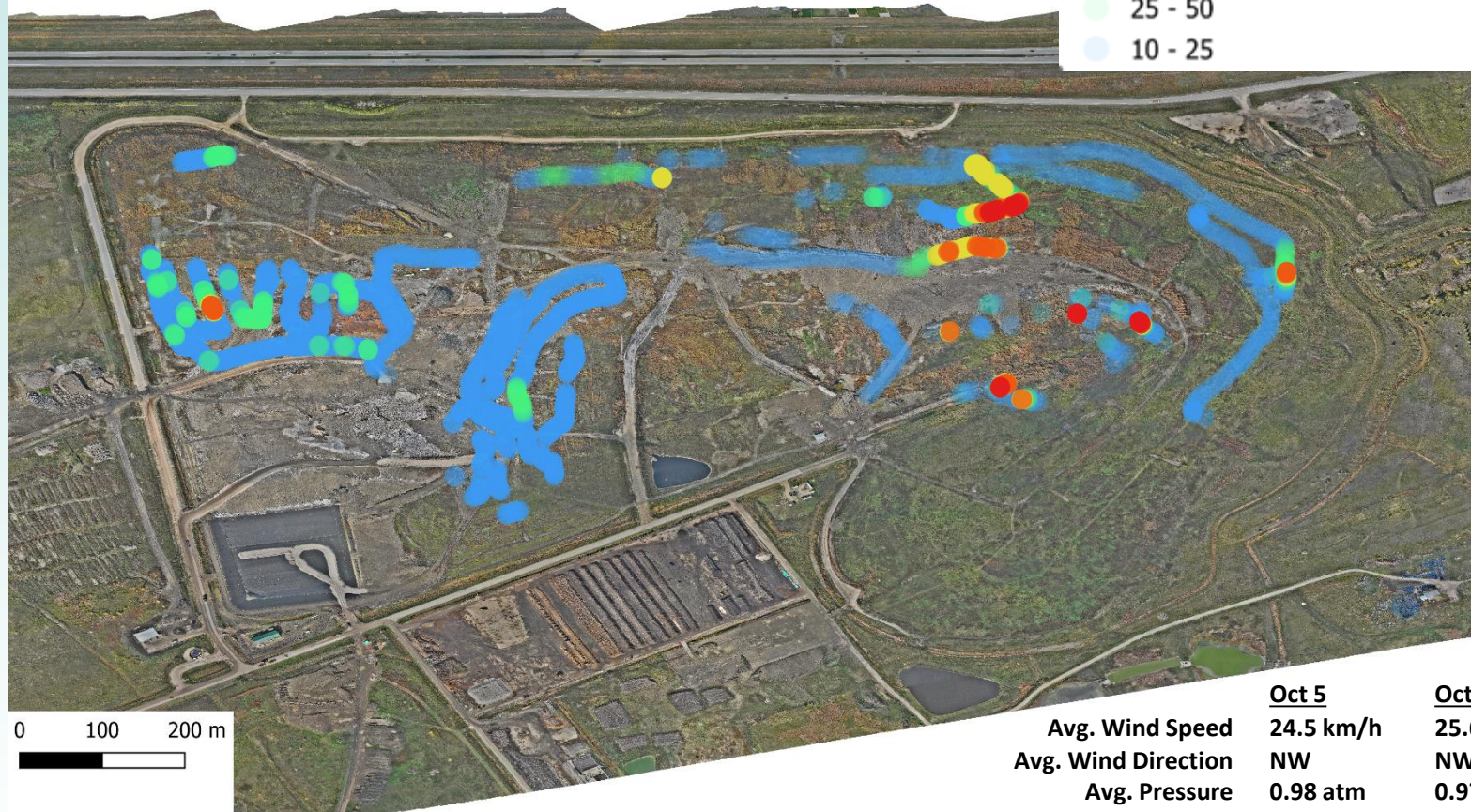


Walking Sweep Performed Oct 5 - Oct 6 2023

Legend

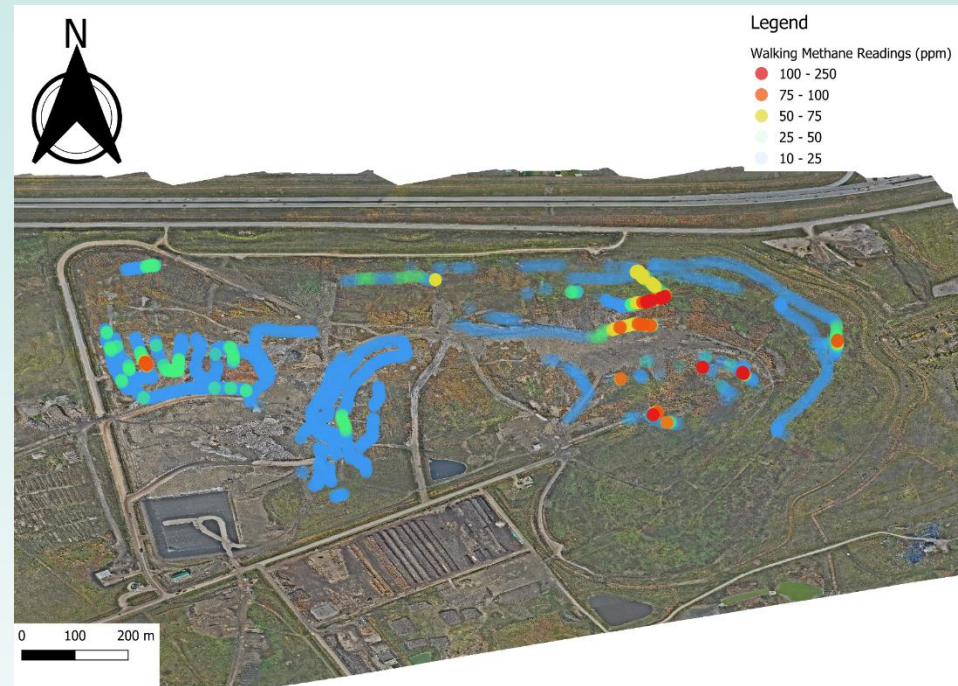
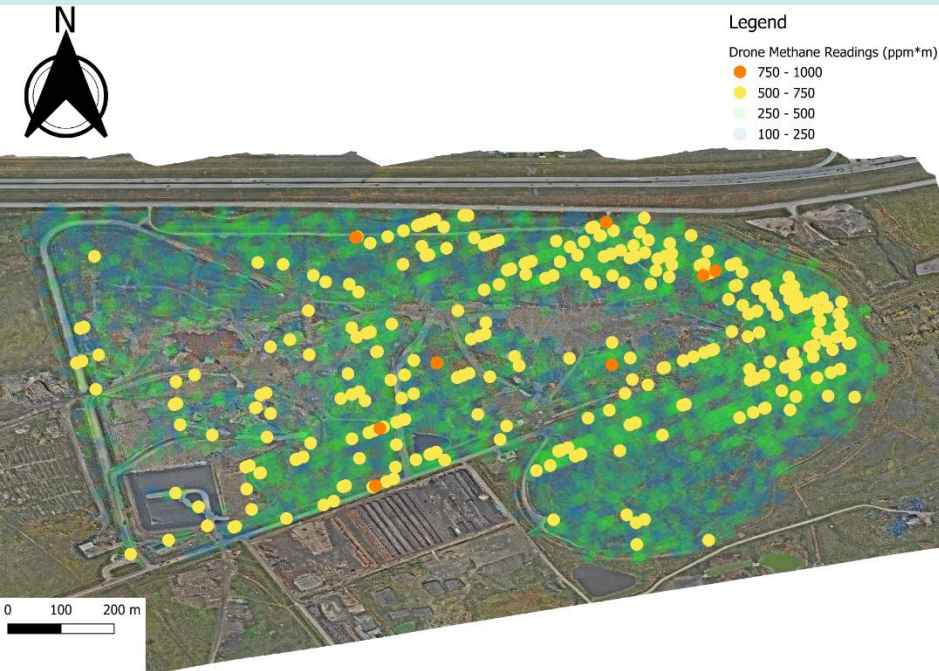
Walking Methane Readings (ppm)

- 100 - 250
- 75 - 100
- 50 - 75
- 25 - 50
- 10 - 25



	<u>Oct 5</u>	<u>Oct 6</u>
Avg. Wind Speed	24.5 km/h	25.6 km/h
Avg. Wind Direction	NW	NW
Avg. Pressure	0.98 atm	0.97 atm

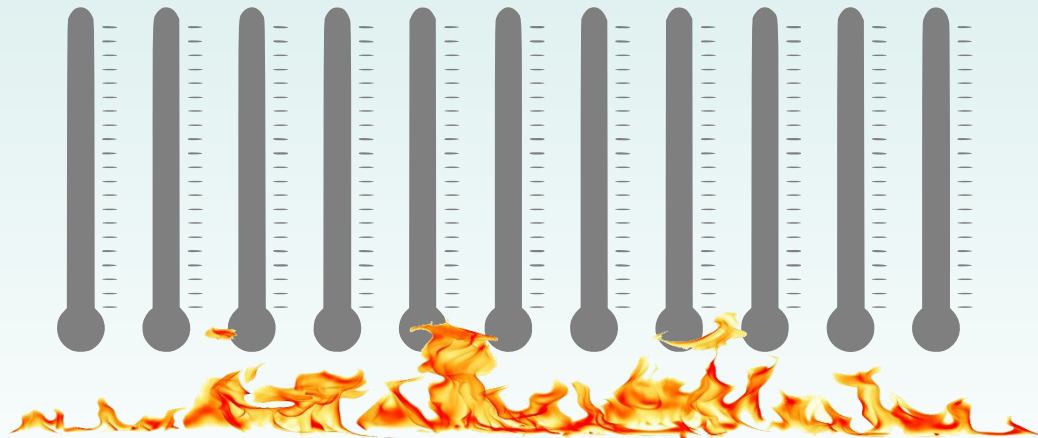
Hot Spot Identification – Brady Road



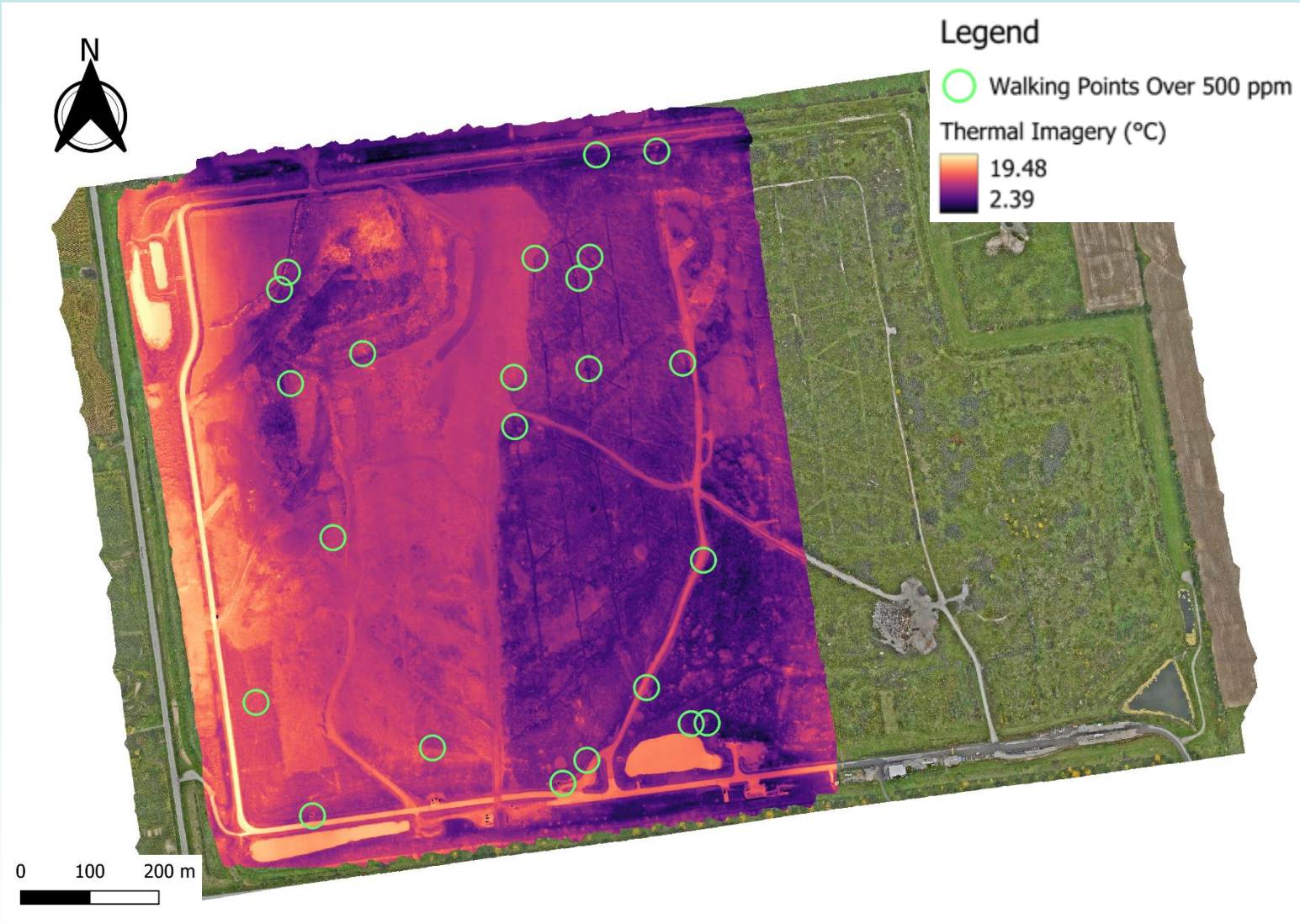
Thermal Imagery



- Temperature at ground surface
- LFG hotter than ambient air
- Compare with high walking sweep readings
- If whole site could not be completed, active areas were prioritized



London



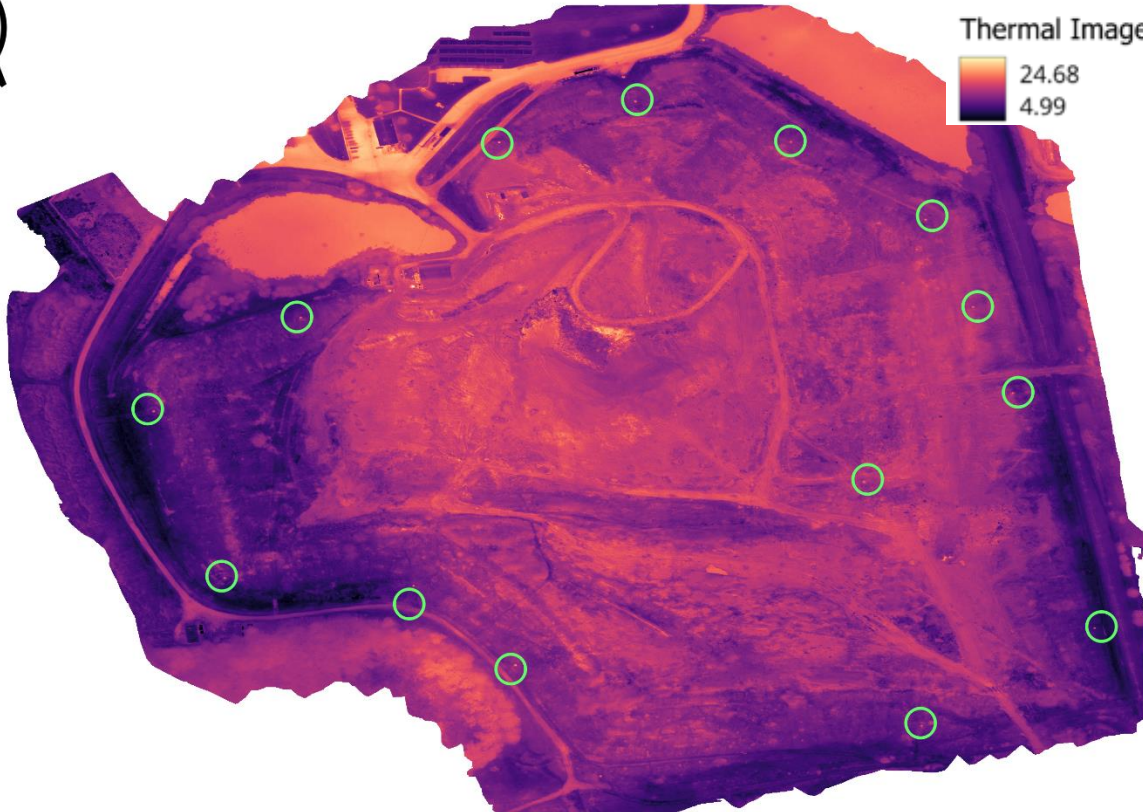
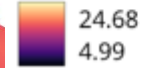
Oxford



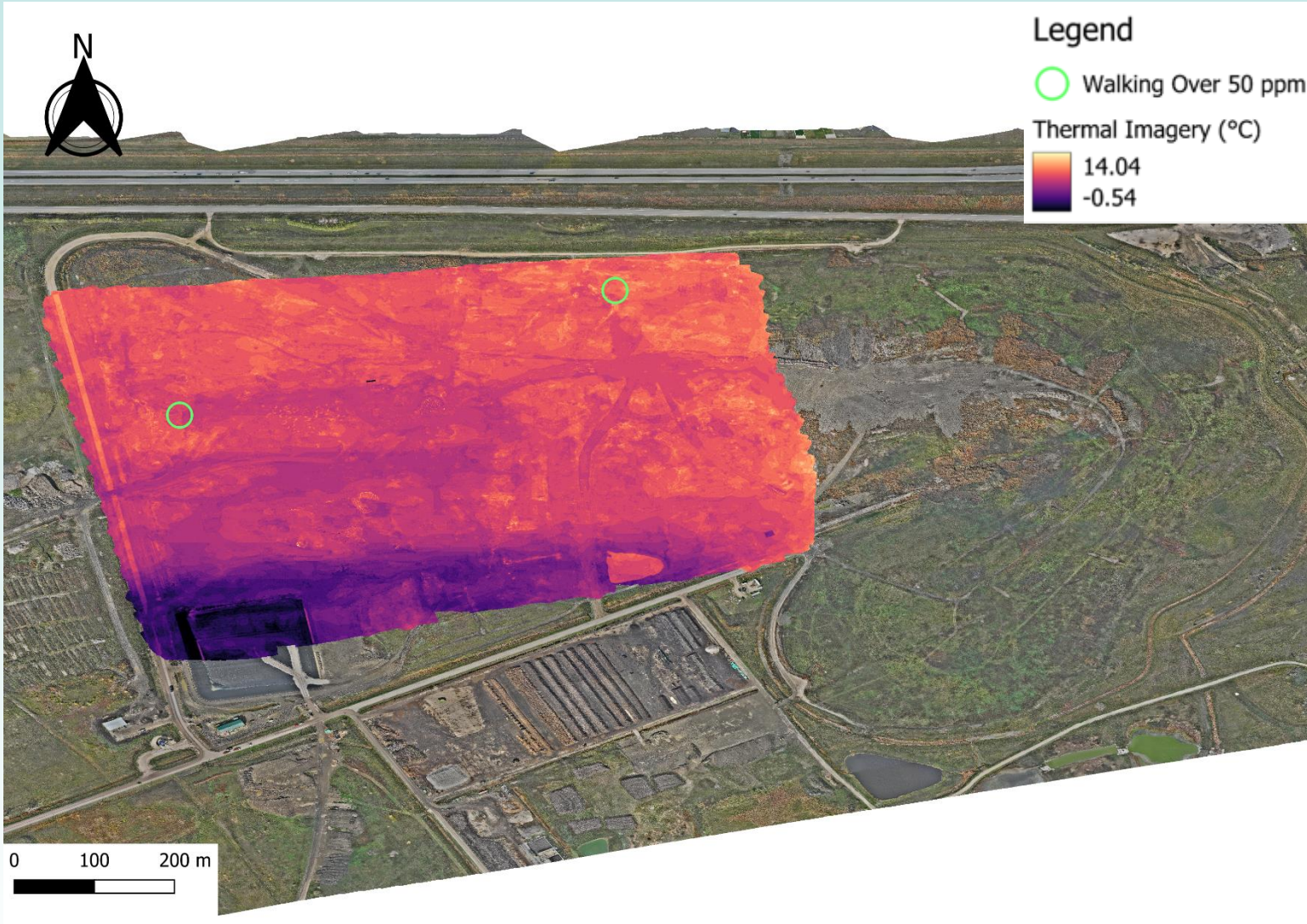
Legend

 Walking Points Over 500 ppm

Thermal Imagery (°C)

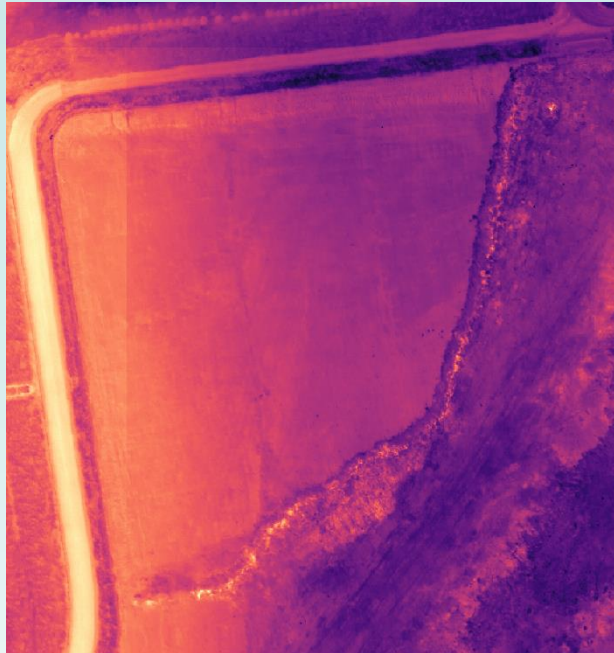


Brady Road

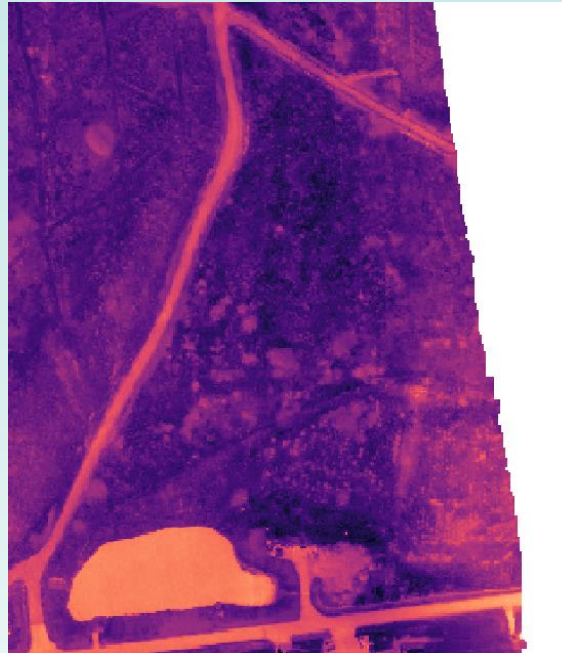


Other factors causing temperature difference at surface

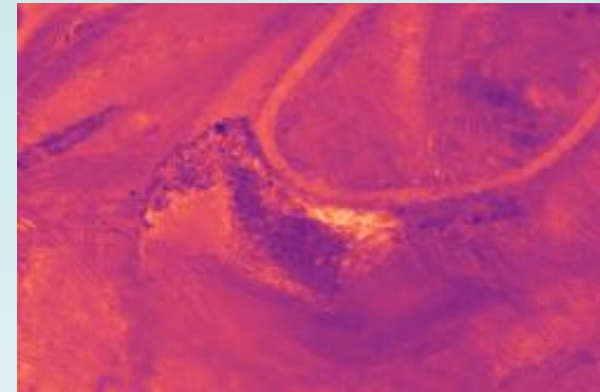
Divots or channels



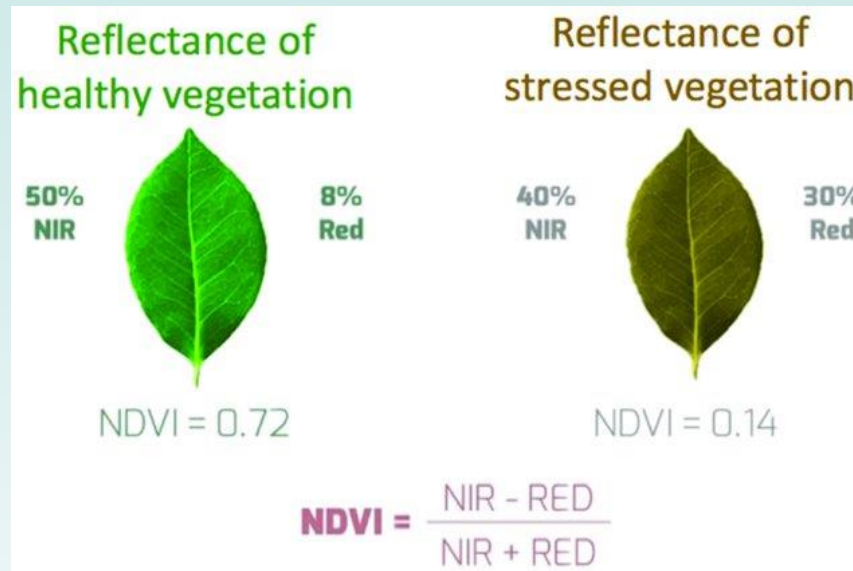
Vegetation



Freshly laid soil/garbage



- **Plant health indicator**
 - **Healthy plants absorb red light and reflect near infrared light (NIR)**
 - **NDVI is determined using the reflectance of these wavelengths**



- **Methane harms vegetation – dead spots can indicate leaks**

Dead Vegetation at Leaks

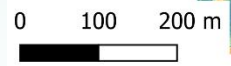
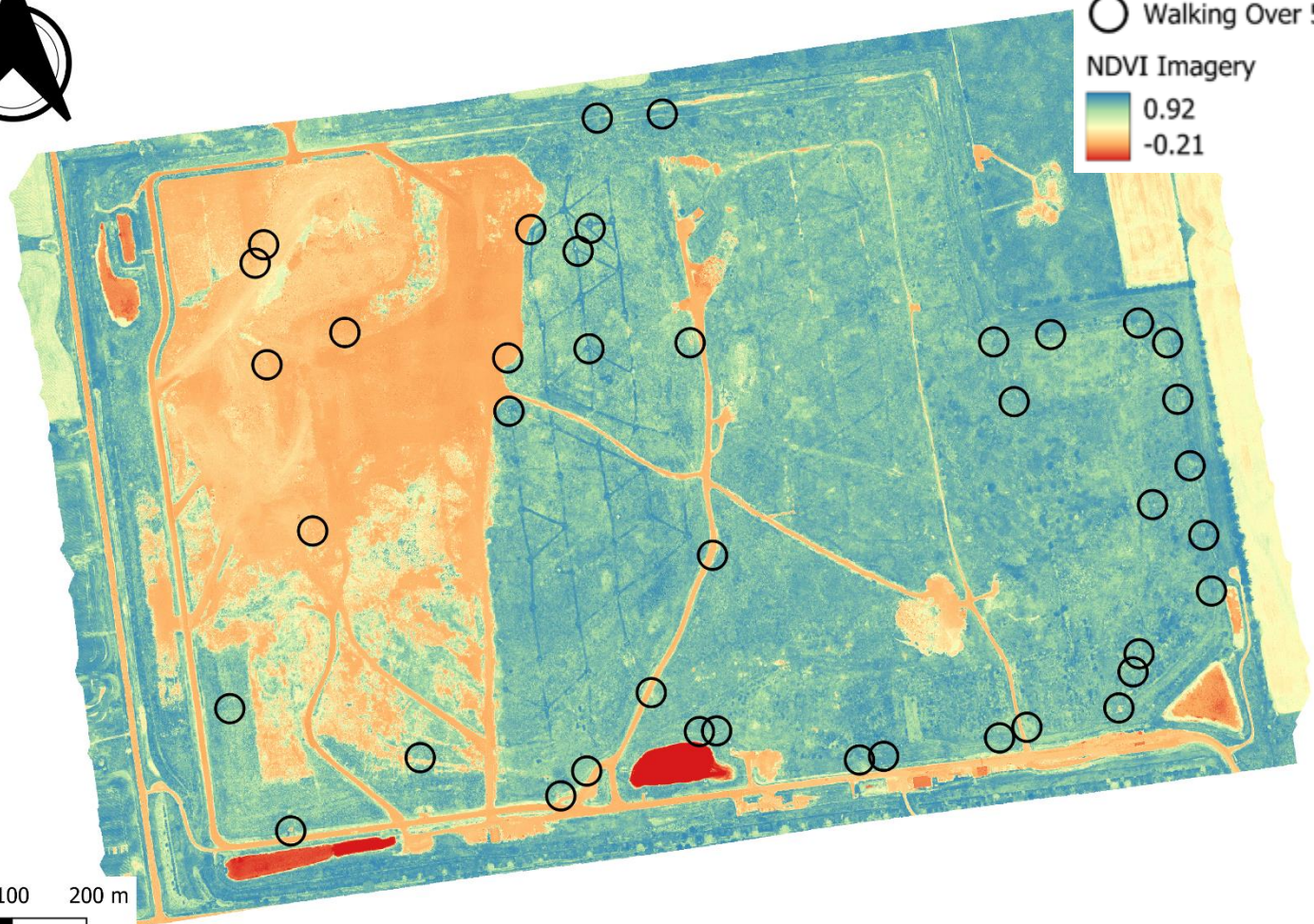


London

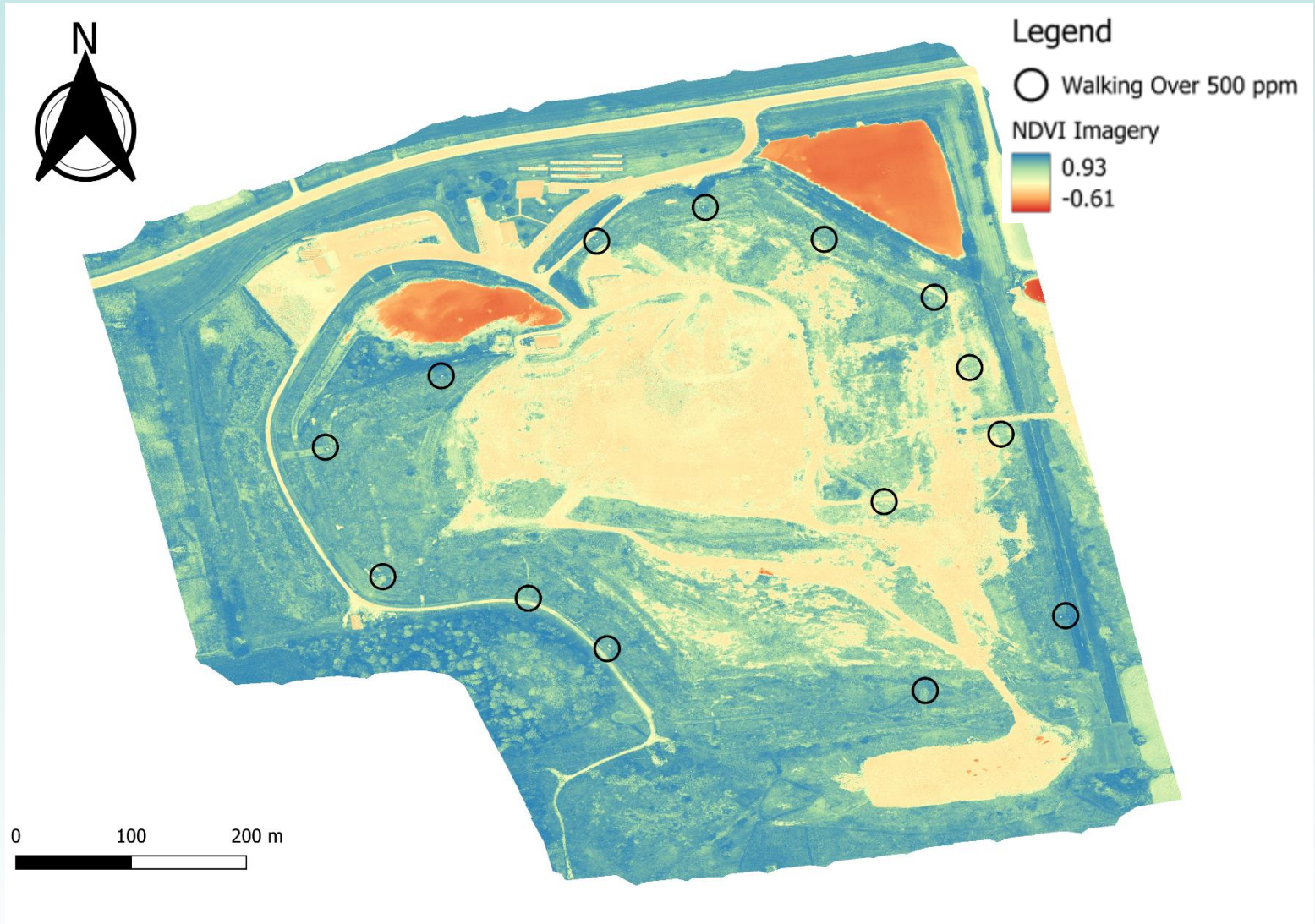


Legend

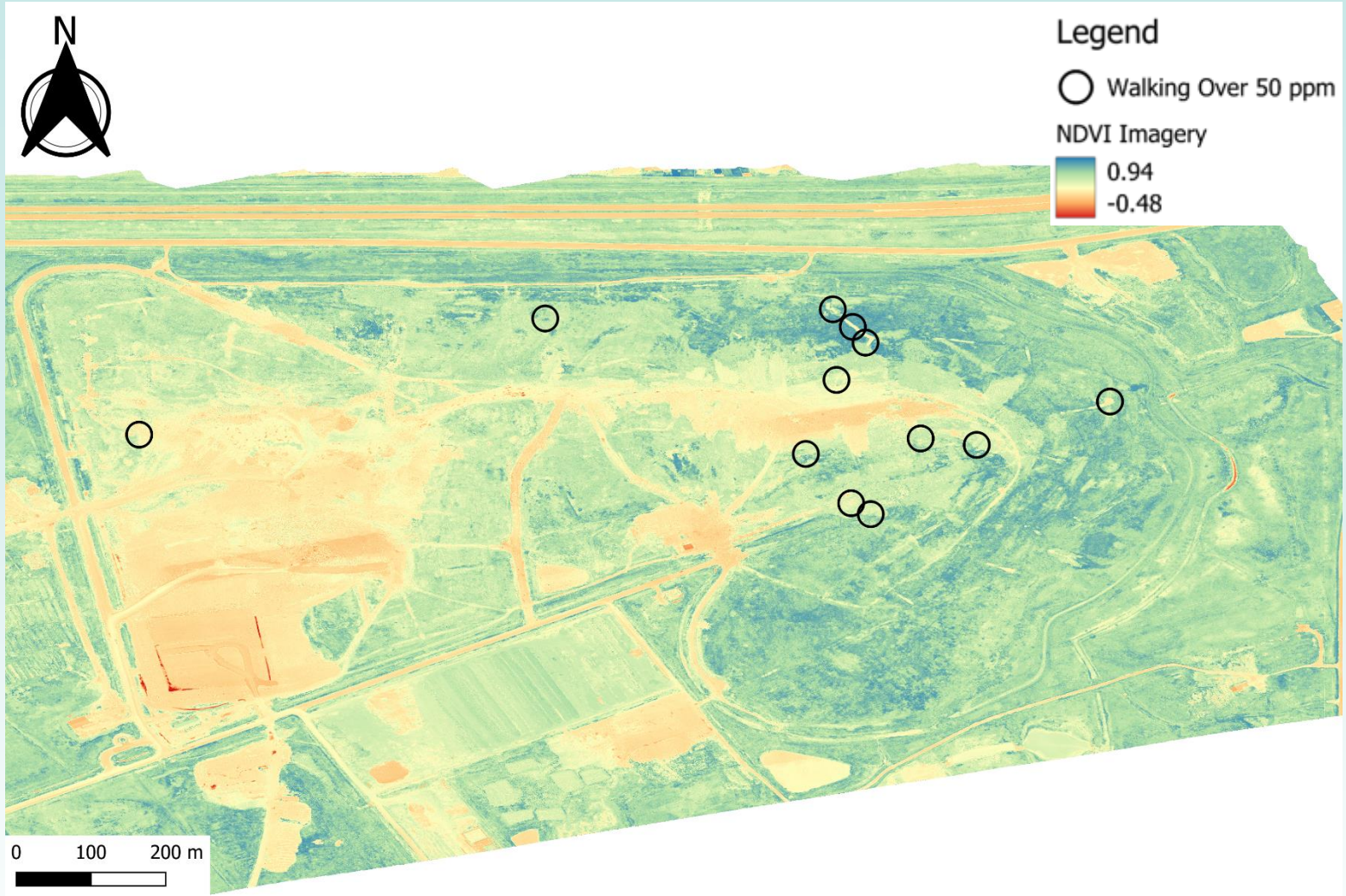
- Walking Over 500 ppm
- NDVI Imagery
- 0.92
- 0.21



Oxford



Brady Road



Conclusions



- **TDLAS – no observed correlation between walking and drone hot spots**
- **Thermal – cannot determine if the warmer surfaces are caused by LFG or other causes**
- **NDVI – like thermal, cannot determine if LFG is the cause for low NDVI values**



Recommendations



- **Flying drones lower than 40 metres could correlate better with walking sweeps**
- **Consideration needs to be given for determining threshold values**
- **Continue consulting with landfill and drone industry for feedback**



Thank you!



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