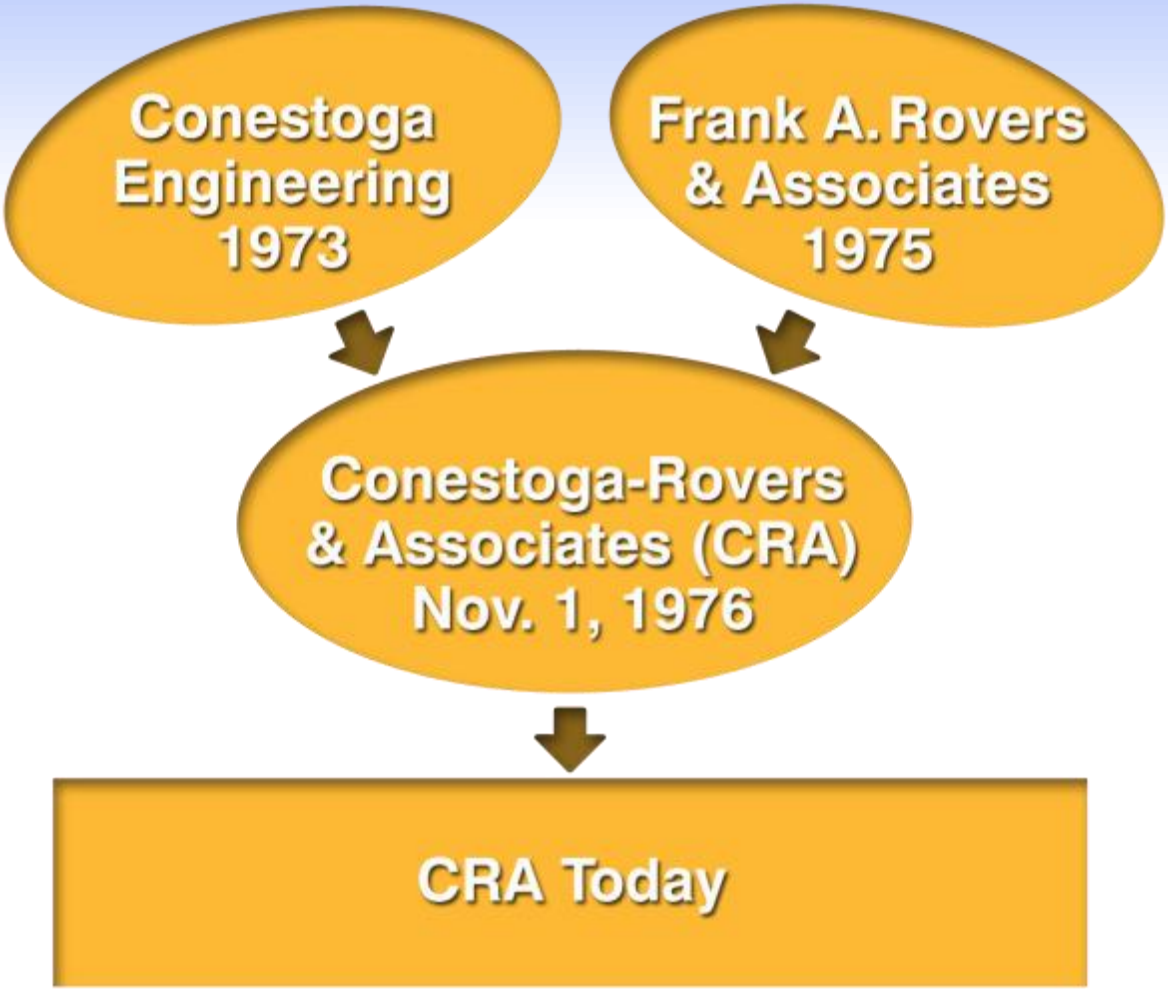
CONESTOGA-ROVERS & ASSOCIATES

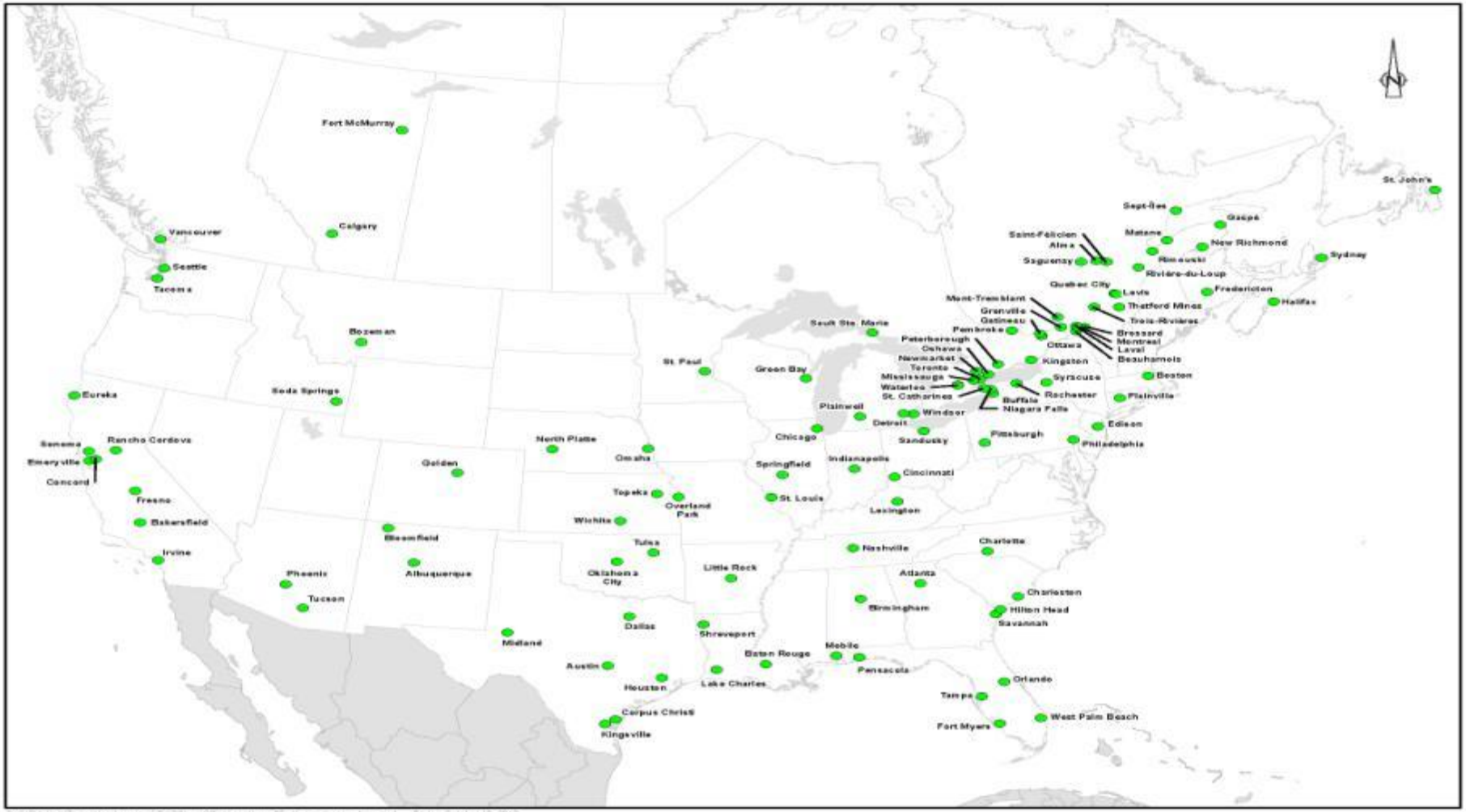
Mobile Mapping of Greenhouse Gas Emissions

Presented by John Monell, GISP

CRA Corporate Organization



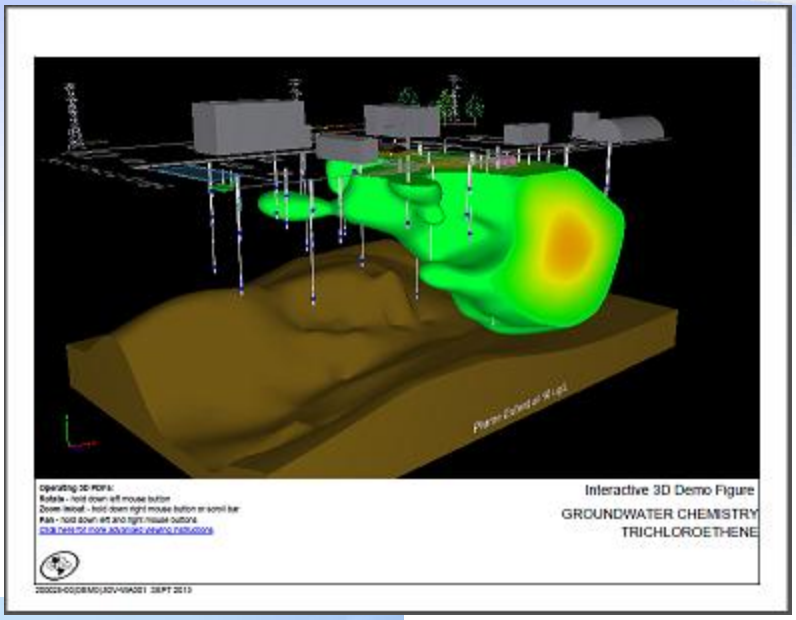
CRA North American Office Locations



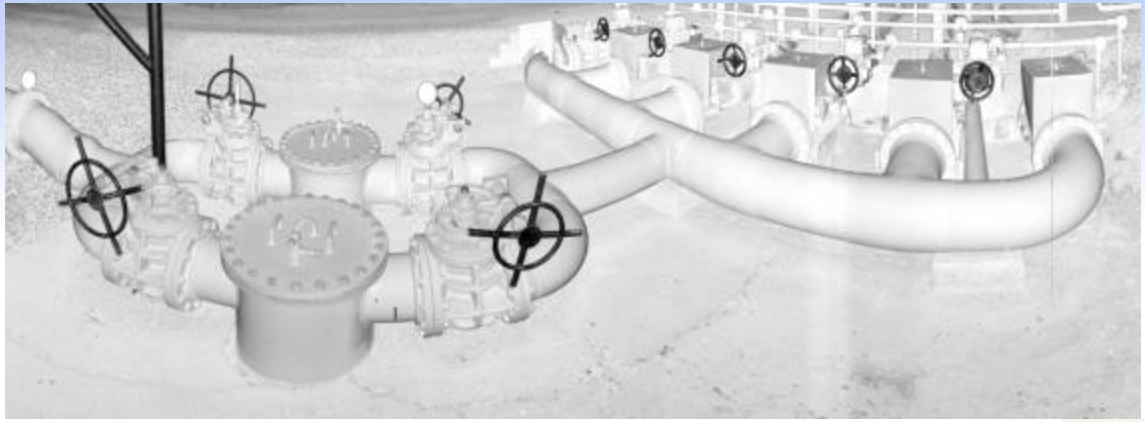
CRA Niagara Falls Office

- *Opened in 1976 – Occidental Chemical*
- *4 employees*
- *Love Canal Cap Design*
- *210 WNY employees*

GIS and Data Collection



3D Laser Scanning



Black and White Laser Scan
Pipe Manifold
Rural Montana

Scanner in Action
Point of Diversion
Logan, Utah

Color Laser Scan
Williamsville Mill Restoration
Williamsville, New York

CONESTOGA-ROVERS & ASSOCIATES

Mobile Mapping of Greenhouse Gas Emissions

Presented by John Monell, GISP

The Team


EDF
ENVIRONMENTAL
DEFENSE FUND
Finding the ways that work


American Gas Association


CRA
CONESTOGA-ROVERS
& ASSOCIATES

Two Approaches to the Same Problem

Mobile Methane Mapping

- Instrument a mobile platform with a high-speed methane instrument
- Collect
  - Methane Concentration
  - GPS data
  - Road Speed
  - Direction of Travel
  - Actual Wind Direction
- Best for leaks with unknown locations

Tracer Ratio Experiments

- Setup an experiment near an area of interest, releasing a known amount a surrogate compound
- Collect at the area of interest
  - Surrogate Release Rate
  - Wind Speed and Direction
- Collect Downwind
  - Methane Concentration
  - Surrogate Concentration
- Best for a specific location of interest

Instrumentation

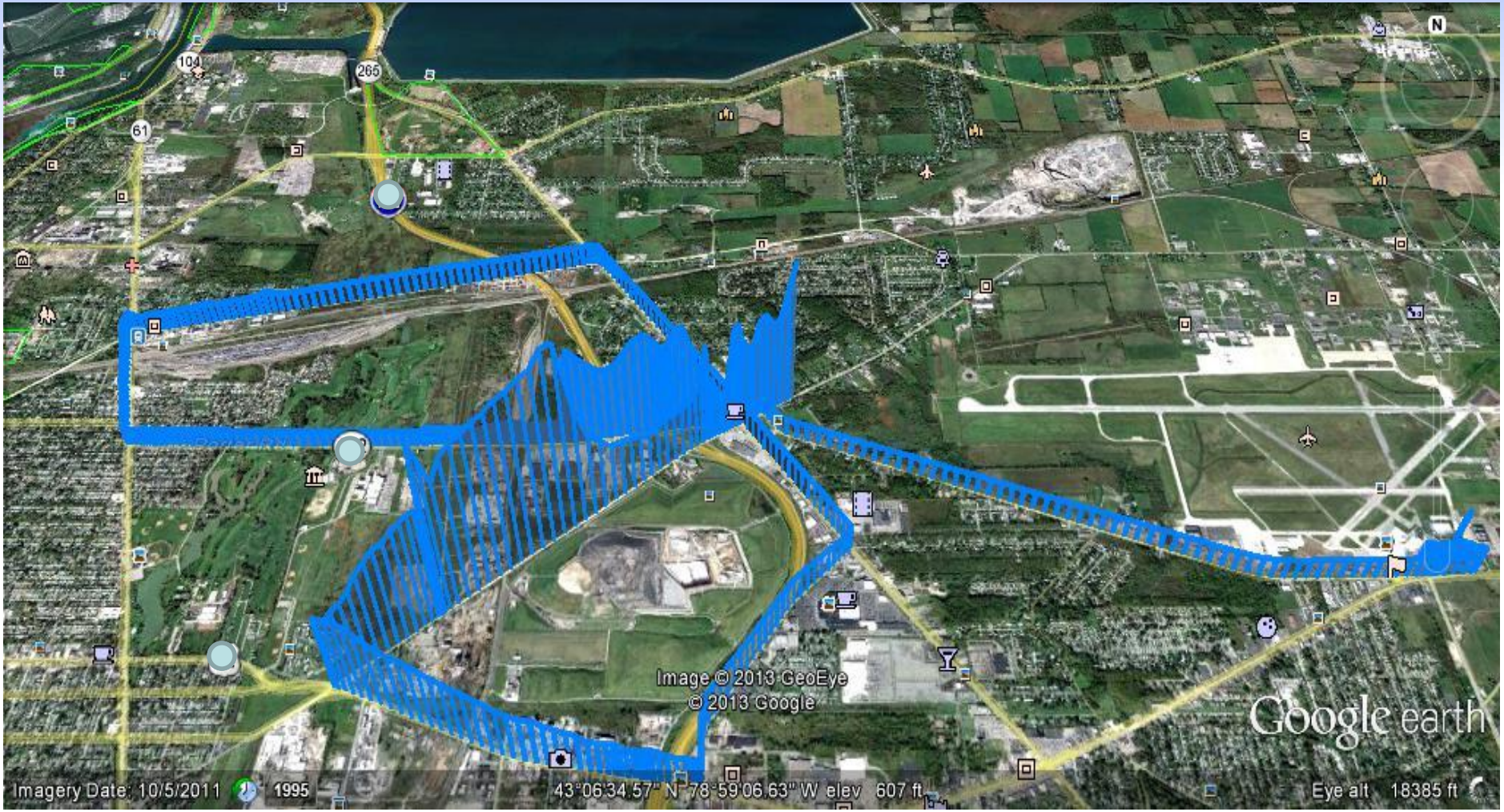
- Mapping Methane Plumes
  - Vehicle equipped with CH_4 (methane) analyzer, GPS, and meteorological package
  - CH_4 stable isotope sampling equipment

- Tracer Ratio Method
  - CH_4 analyzer
  - CRA continuous SF_6 (sulfur hexafluoride) analyzer
  - Tracer release flow control and measurement instruments

Instrumentation

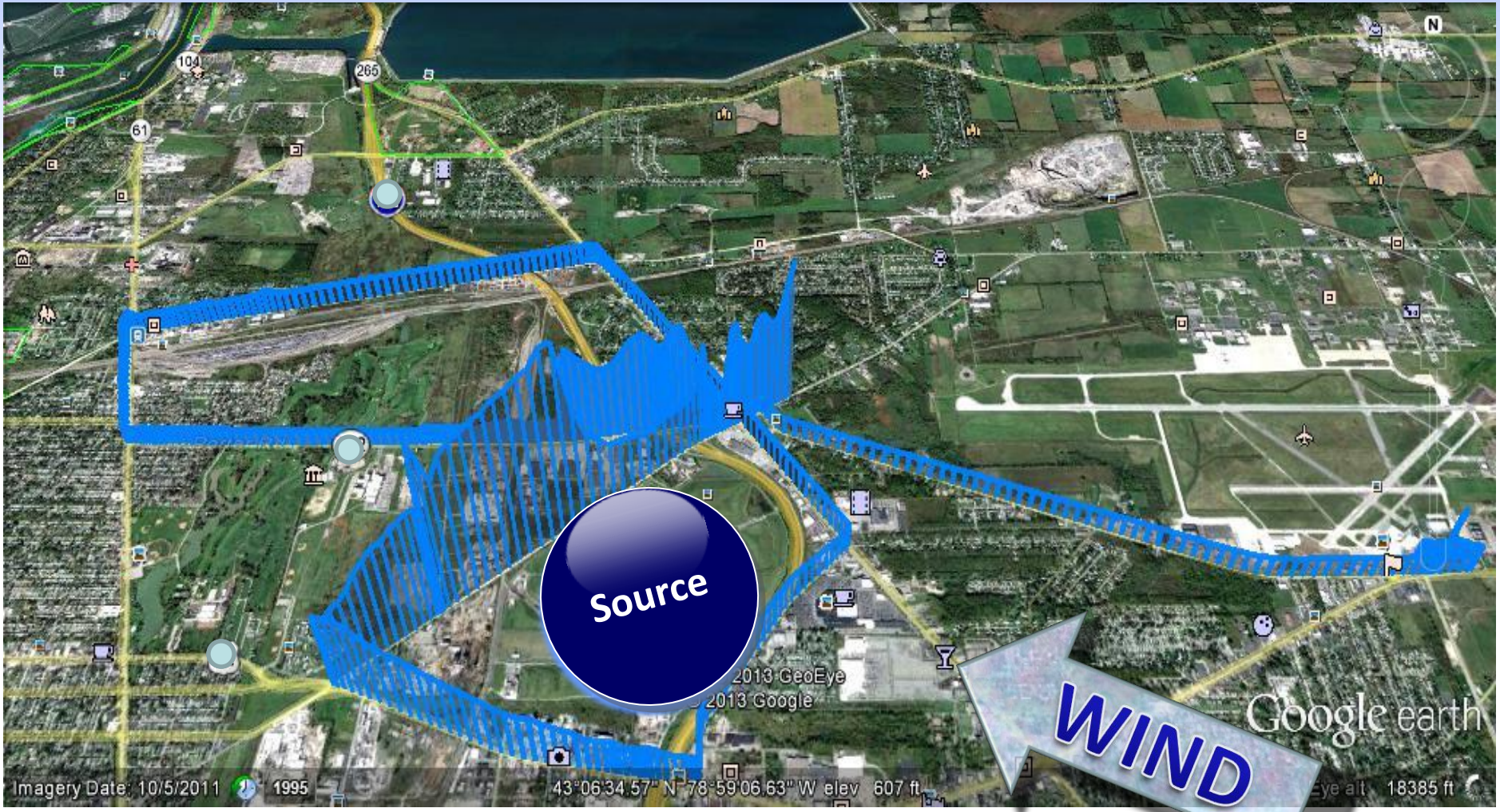
- Wind speed & direction
- Solid-state compass
- 10 Hz GPS 3-axis accelerometer 3-axis rate gyro
- Barometric pressure
- Ultrasonic wind readings Optional relative humidity
- Air temperature

Mapping Methane Plumes

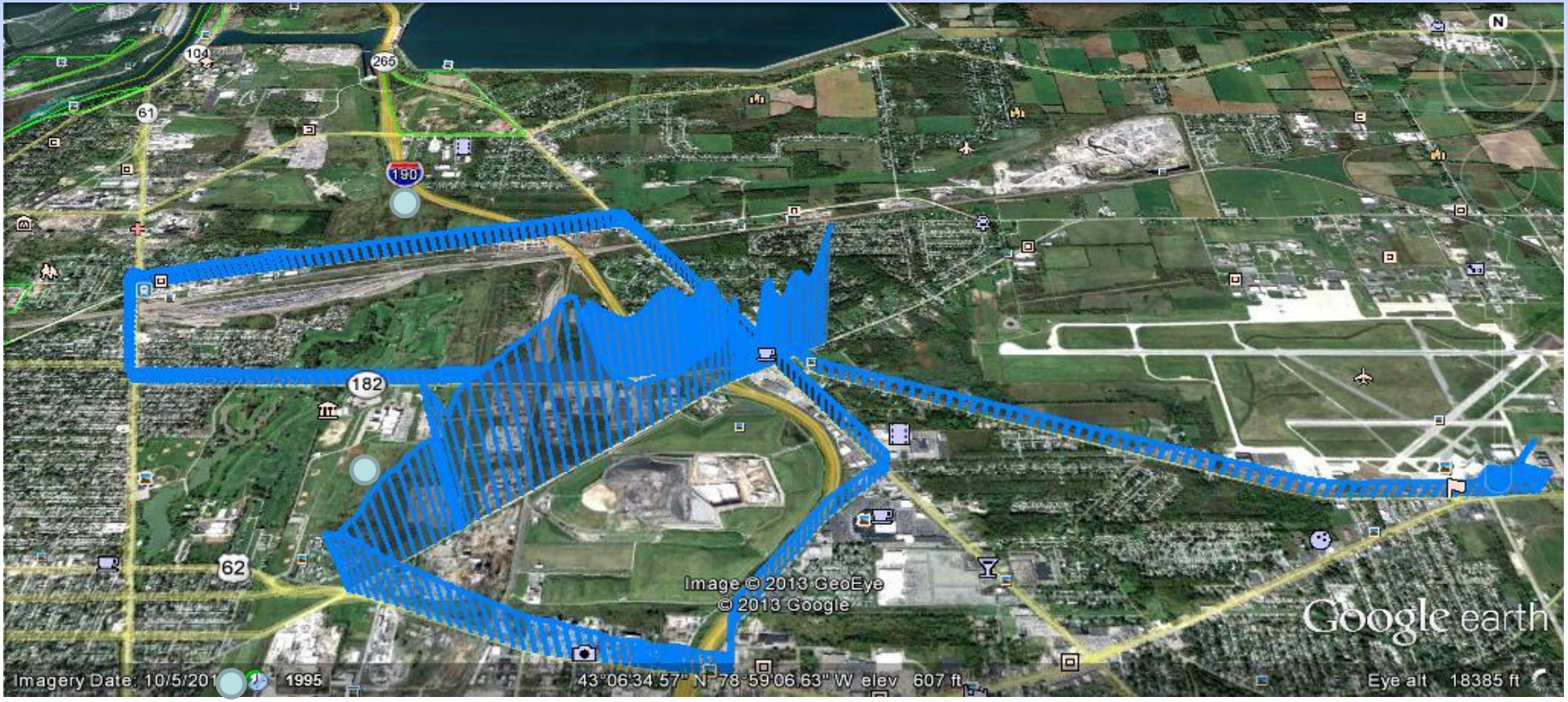


Mapping Methane Plumes

Mapping Methane Plumes



Mapping Methane Plumes



Using proprietary software, concentrations are plotted in real time. Areas of increased concentration are indicated by the line height.

Methane Source

Source ?

Not a source, but…

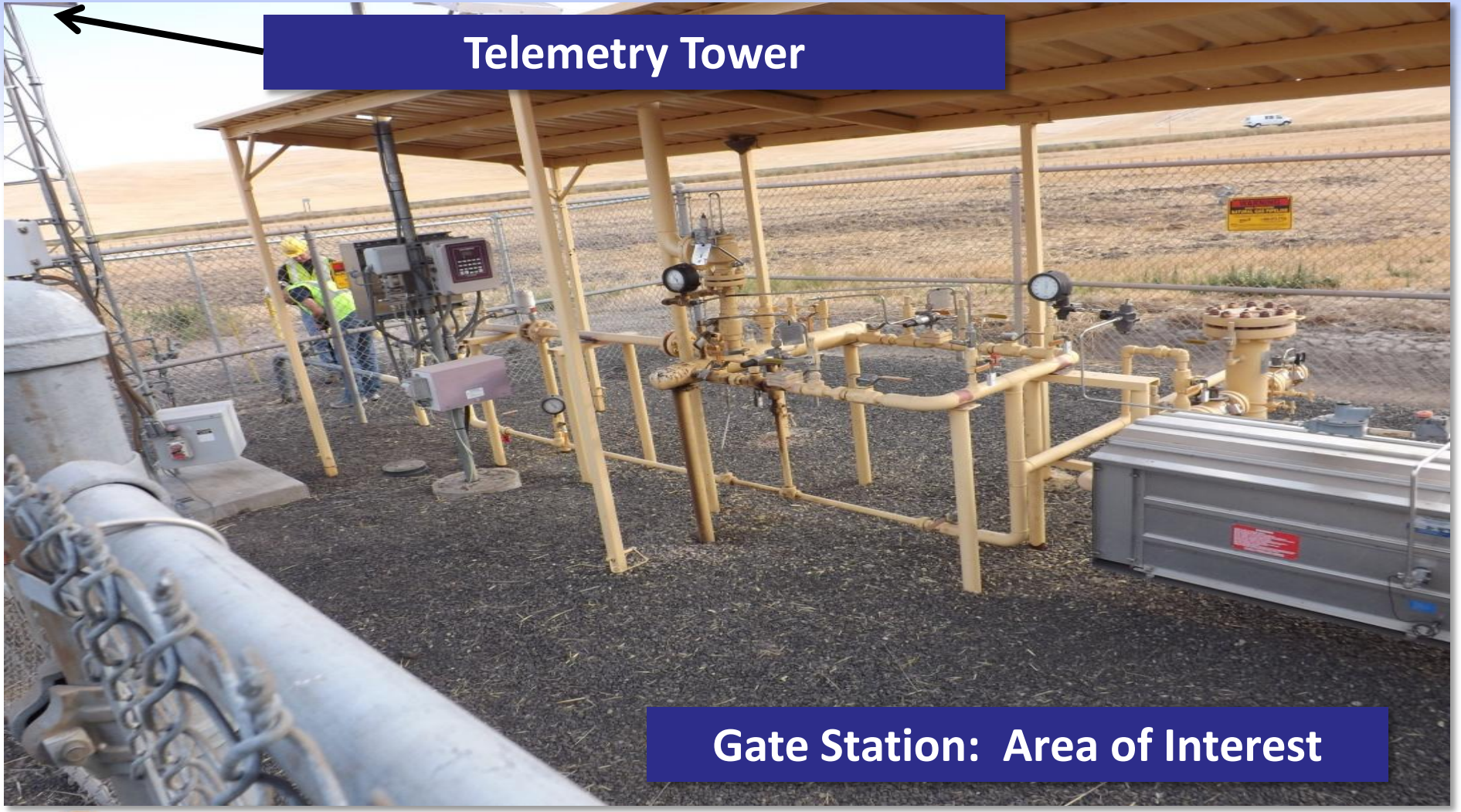
Tracer Ratio Methodology

Tracer Ratio

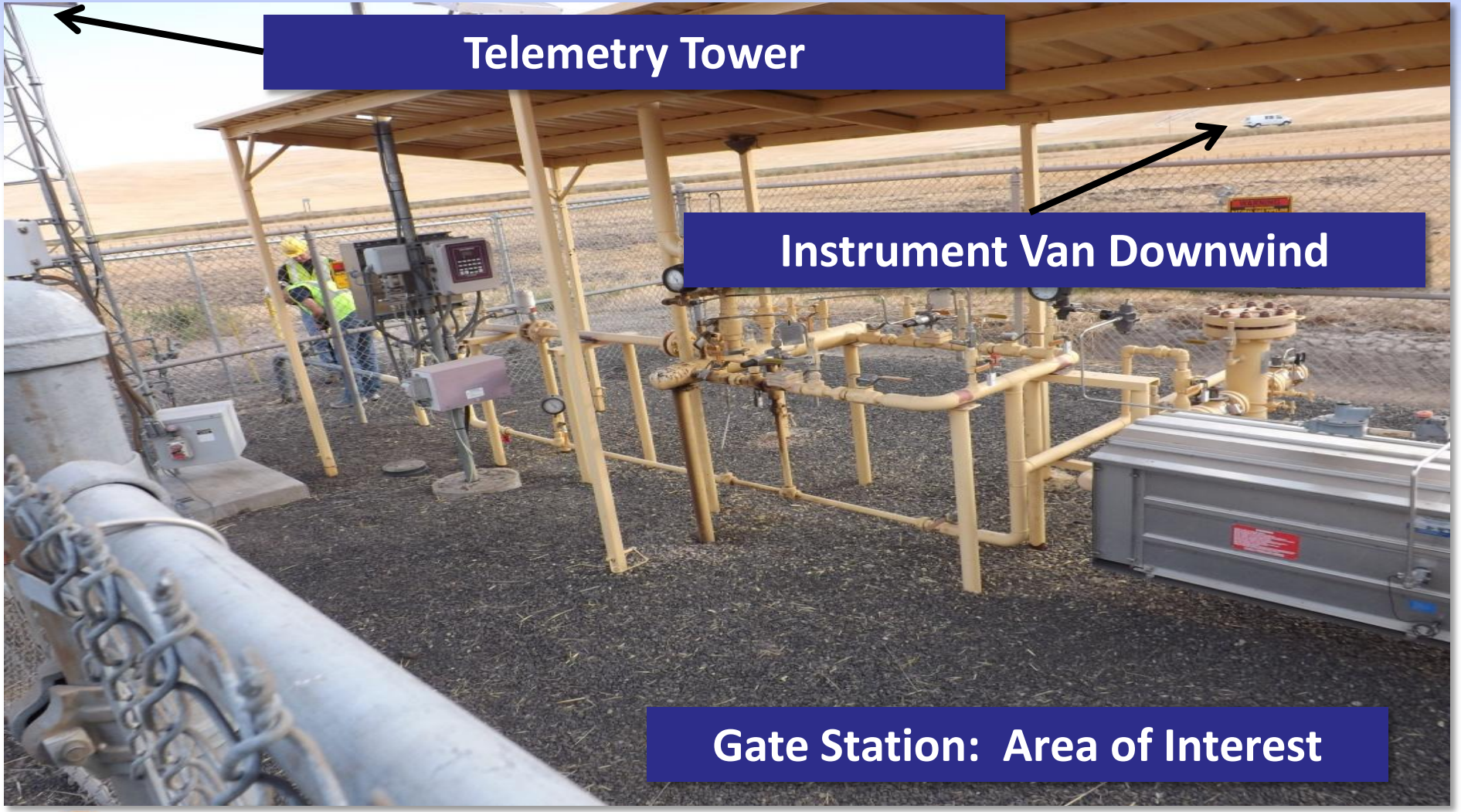
- Sulfur Hexafluoride (SF_6) is used as a “tracer”
- SF_6 has a negligible natural occurance in the atmosphere
- SF_6 can be measured in extremely low concentrations, 50 ppt
- Collocating SF_6 released of known quantites next to unknown emissions allow for calculating of a “Tracer Ratio”

Tracer Ratio Methodology

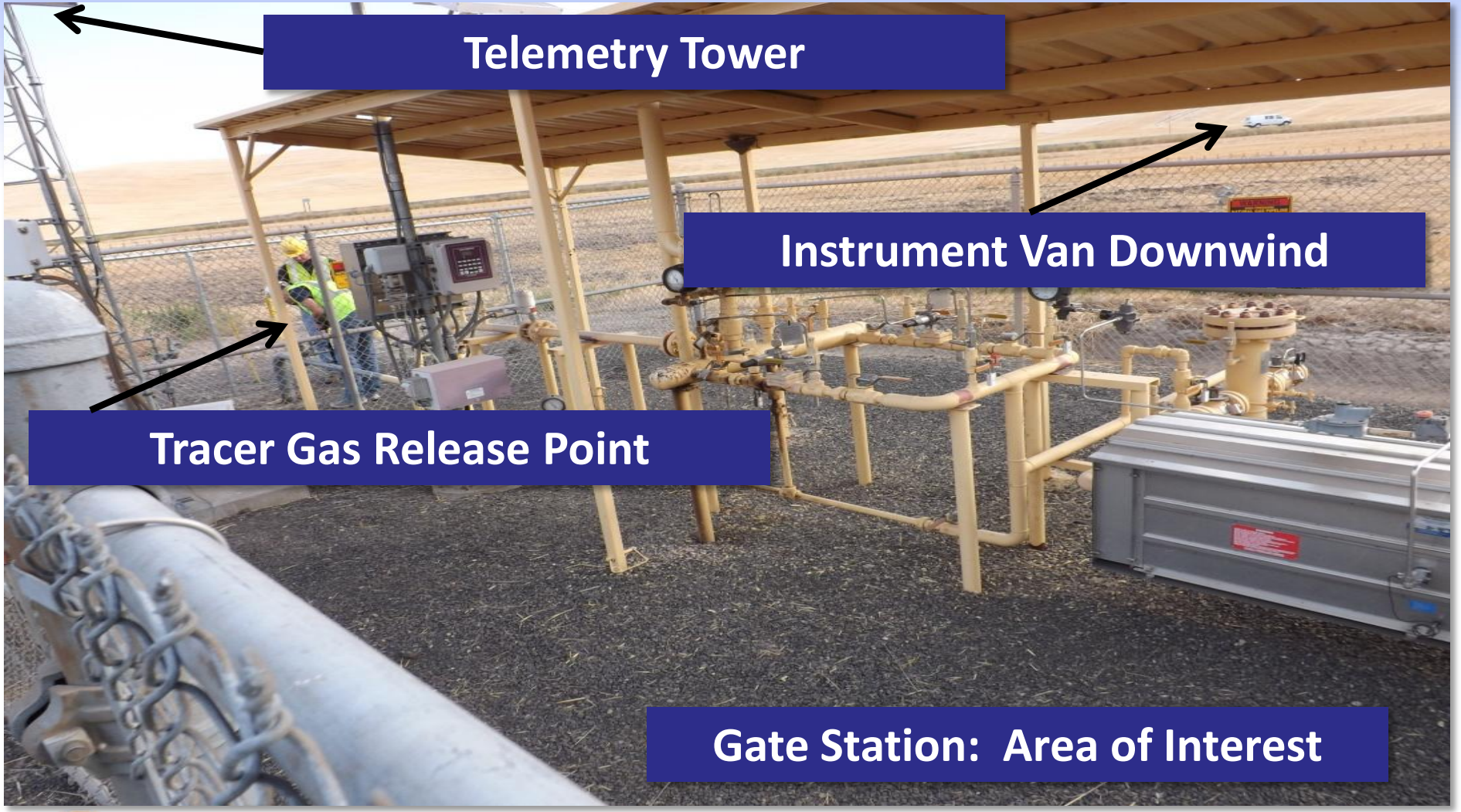
Tracer Ratio Methodology



Tracer Ratio Methodology



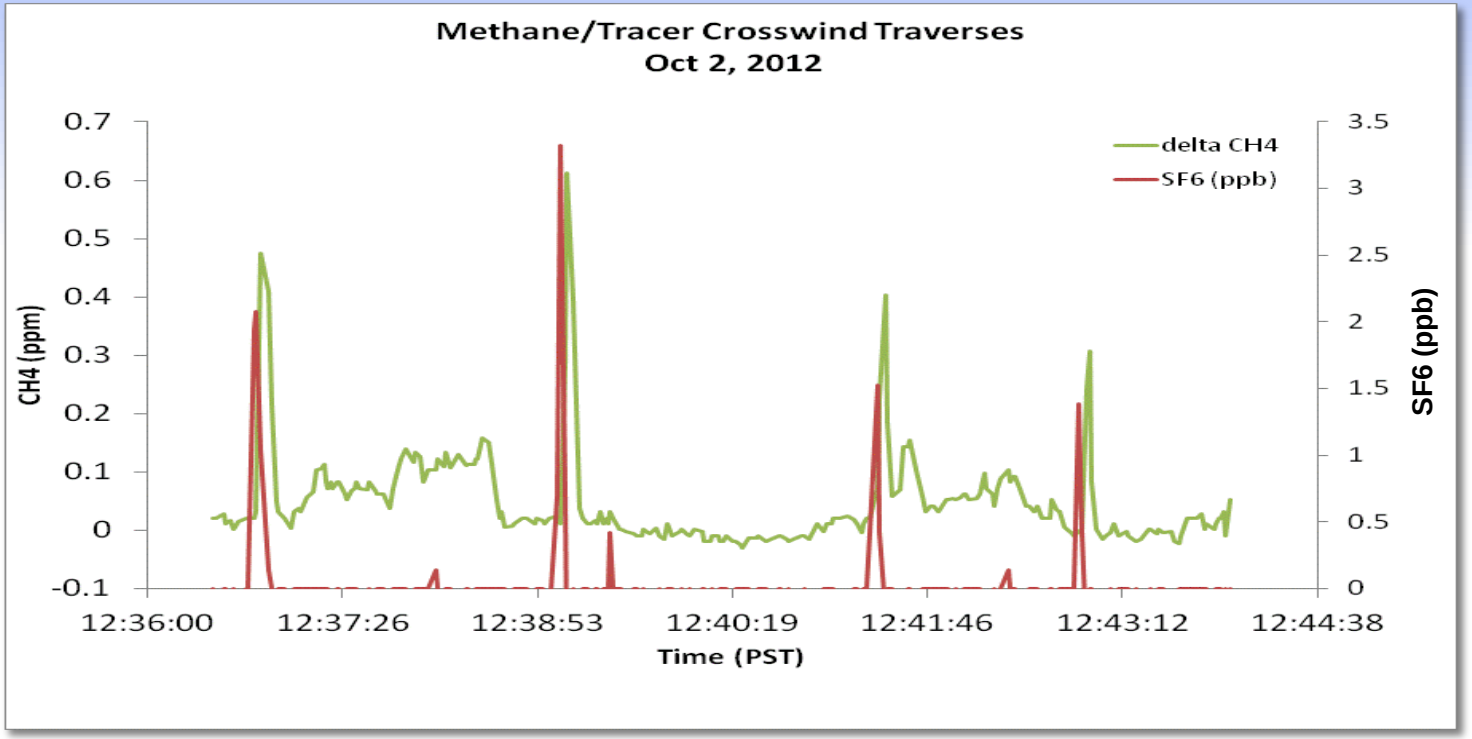
Tracer Ratio Methodology



Tracer Ratio Methodology

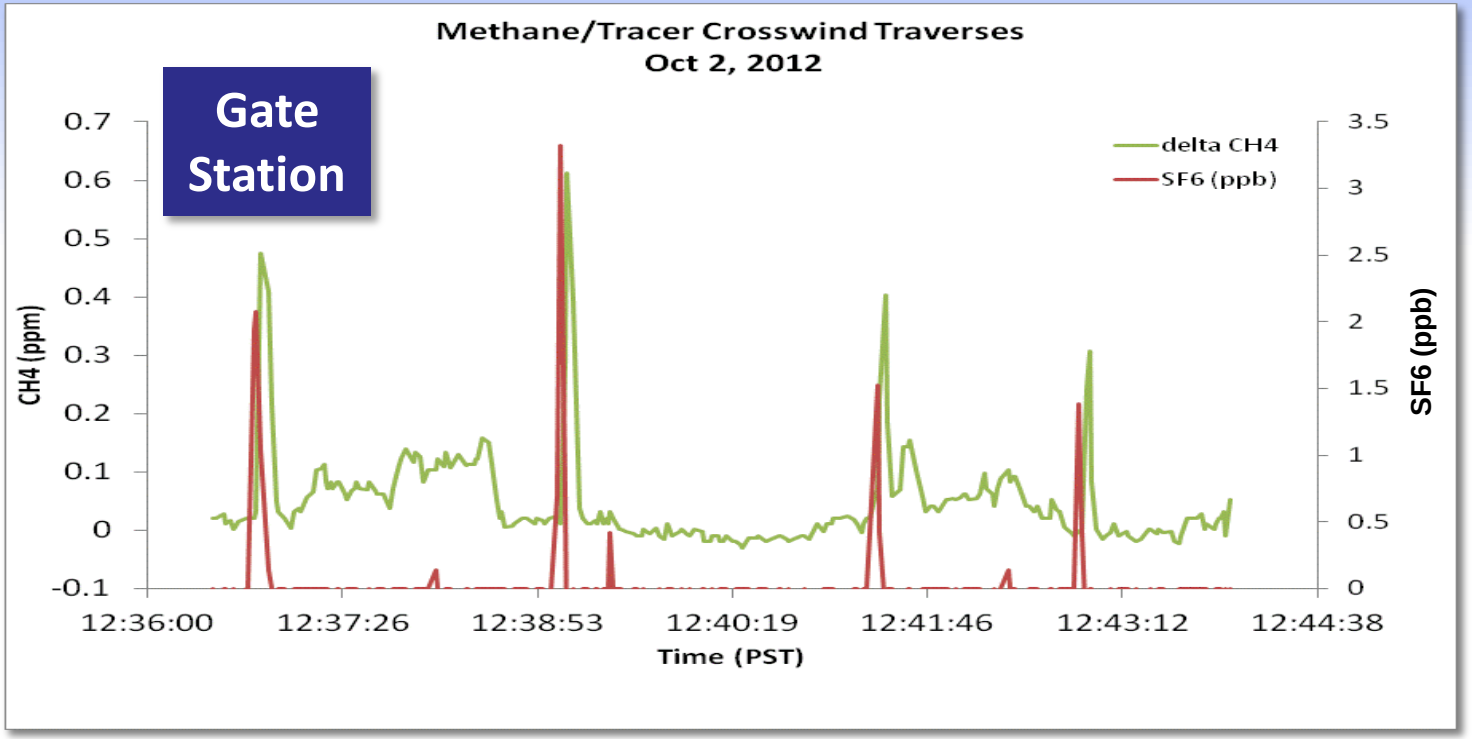
Tracer Ratio Methodology

Tracer Ratio Methodology



The ratio between the known (SF_6) and unknown (CH_4) allows you to calculate the emission rate of the methane leak

Tracer Ratio Methodology



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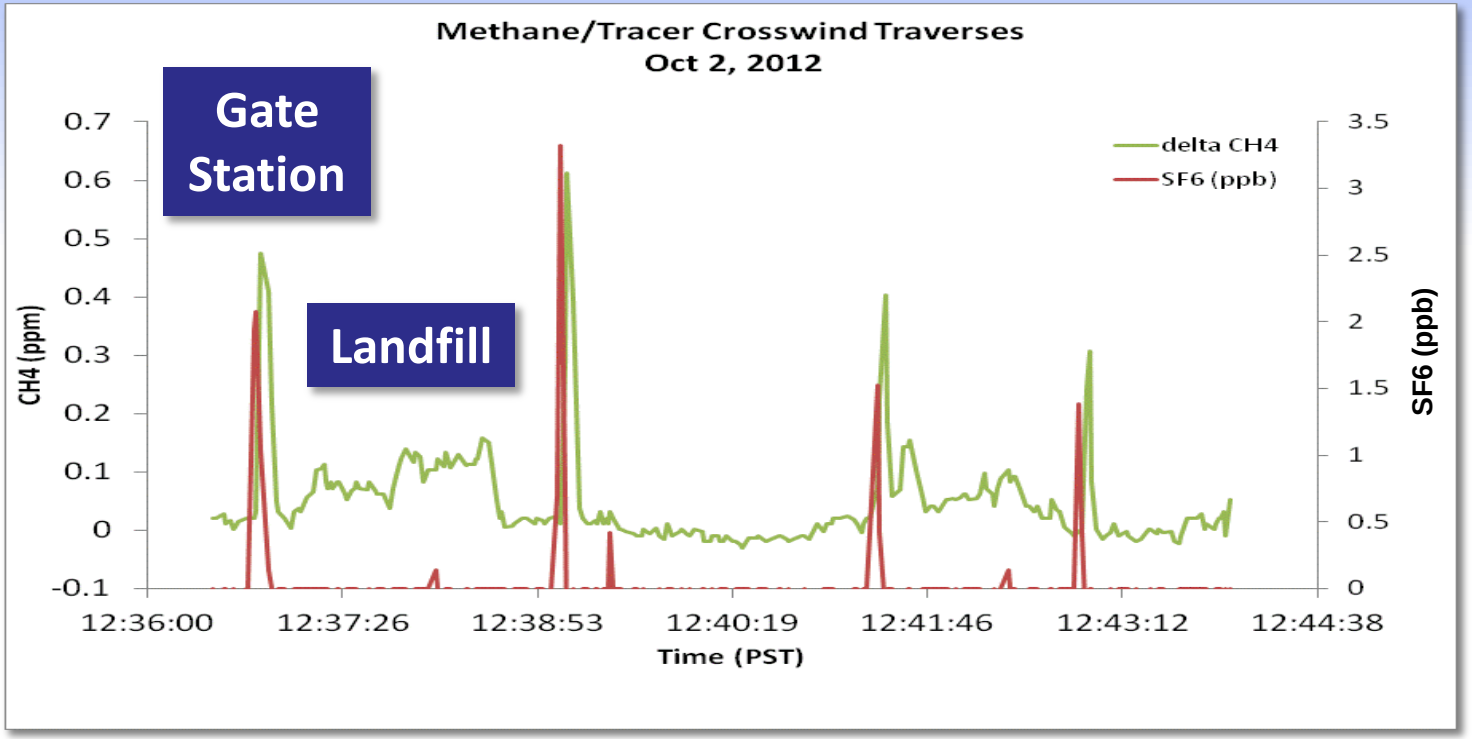
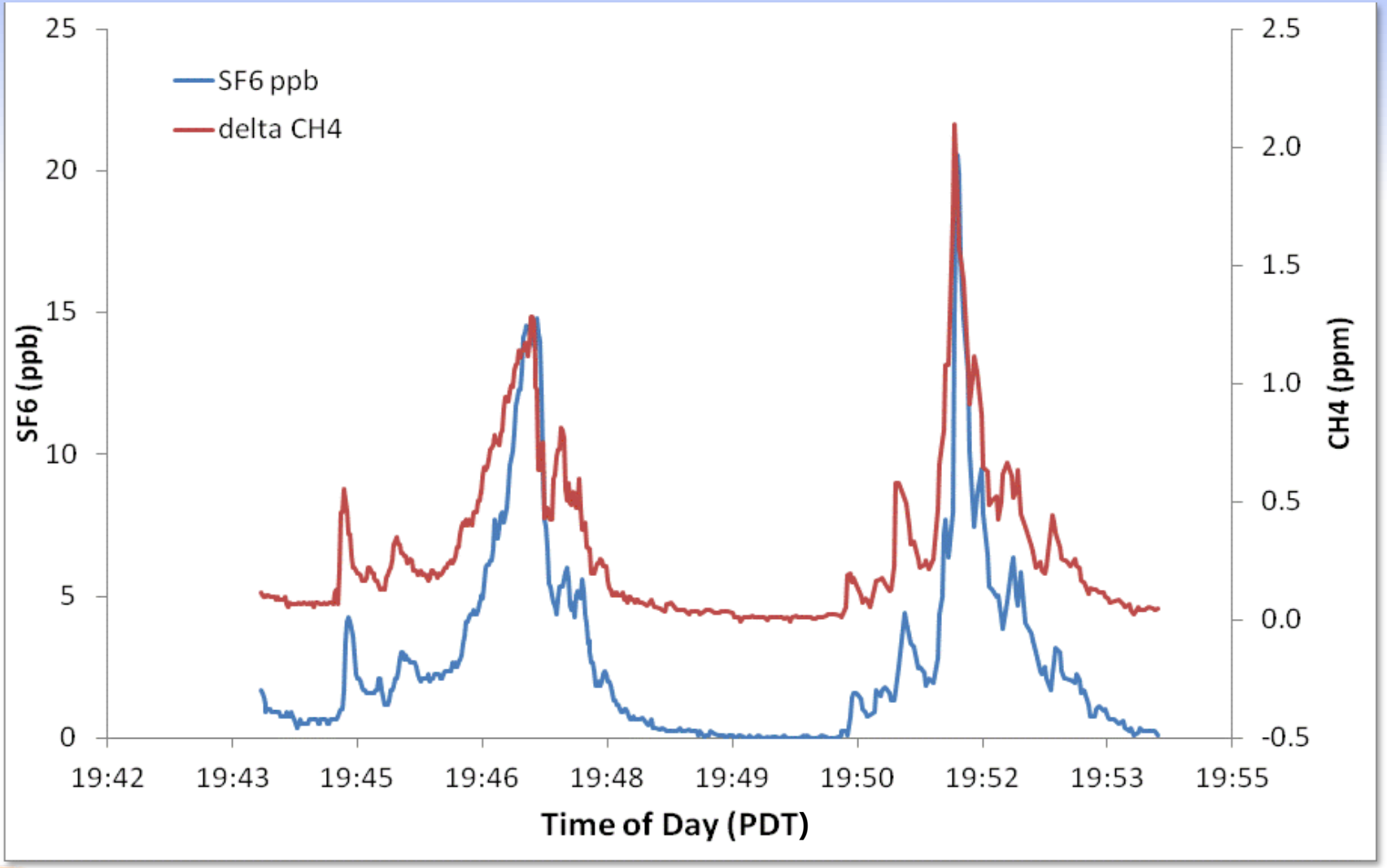
Tracer Ratio Methodology



$$\frac{SF_6 \text{ Release}}{SF_6 \text{ Concentration}} = \frac{CH_4 \text{ Release}}{CH_4 \text{ Concentration}}$$

Co-Located CH_4/SF_6 Plumes



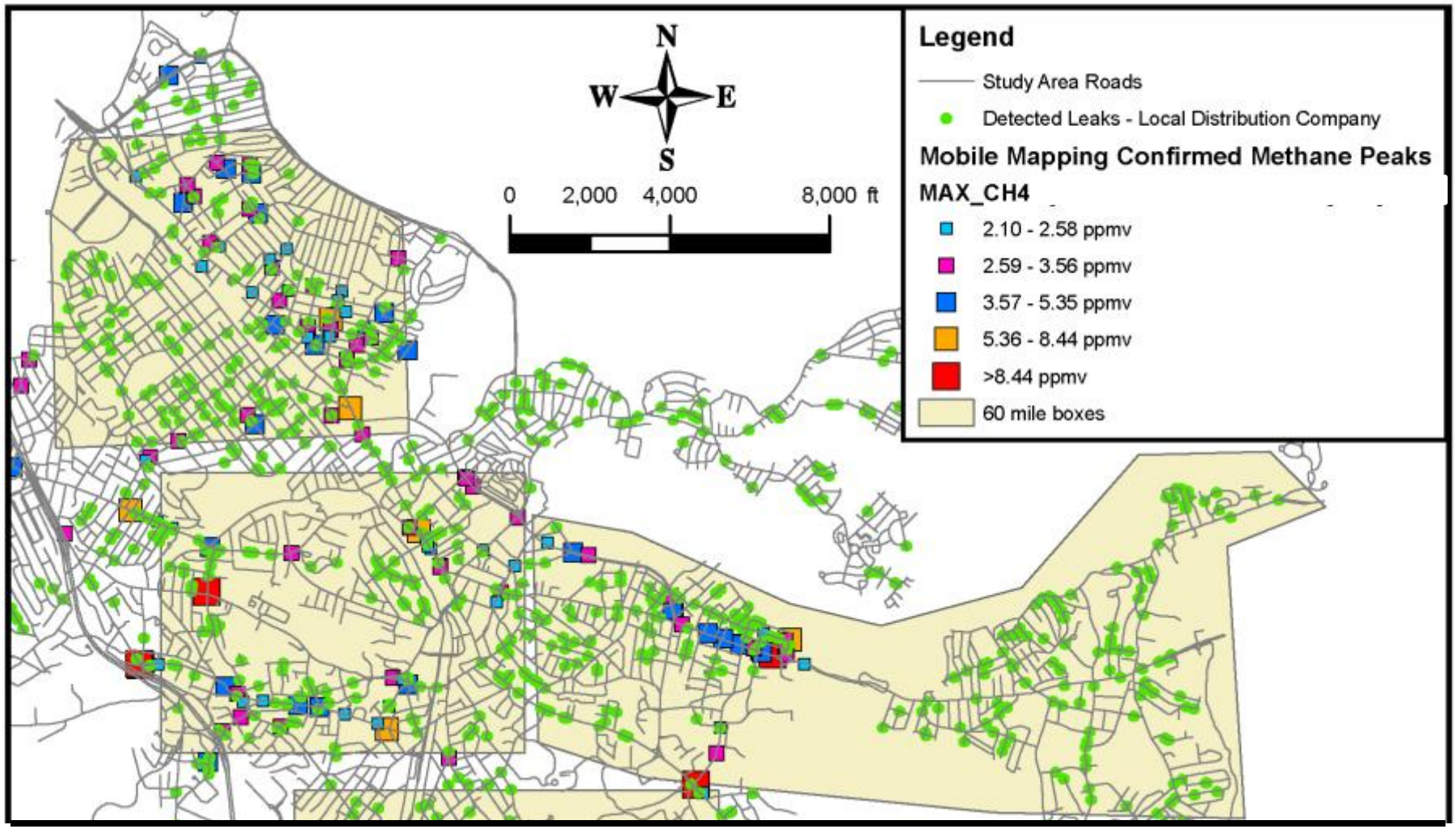
Additional Data

- Facility Type
- Geographic Location
- Component counts by type
- Pipe information (age, material, pressure)
- Distribution Company
- Weather conditions during leak measurements
- Collected with iPad

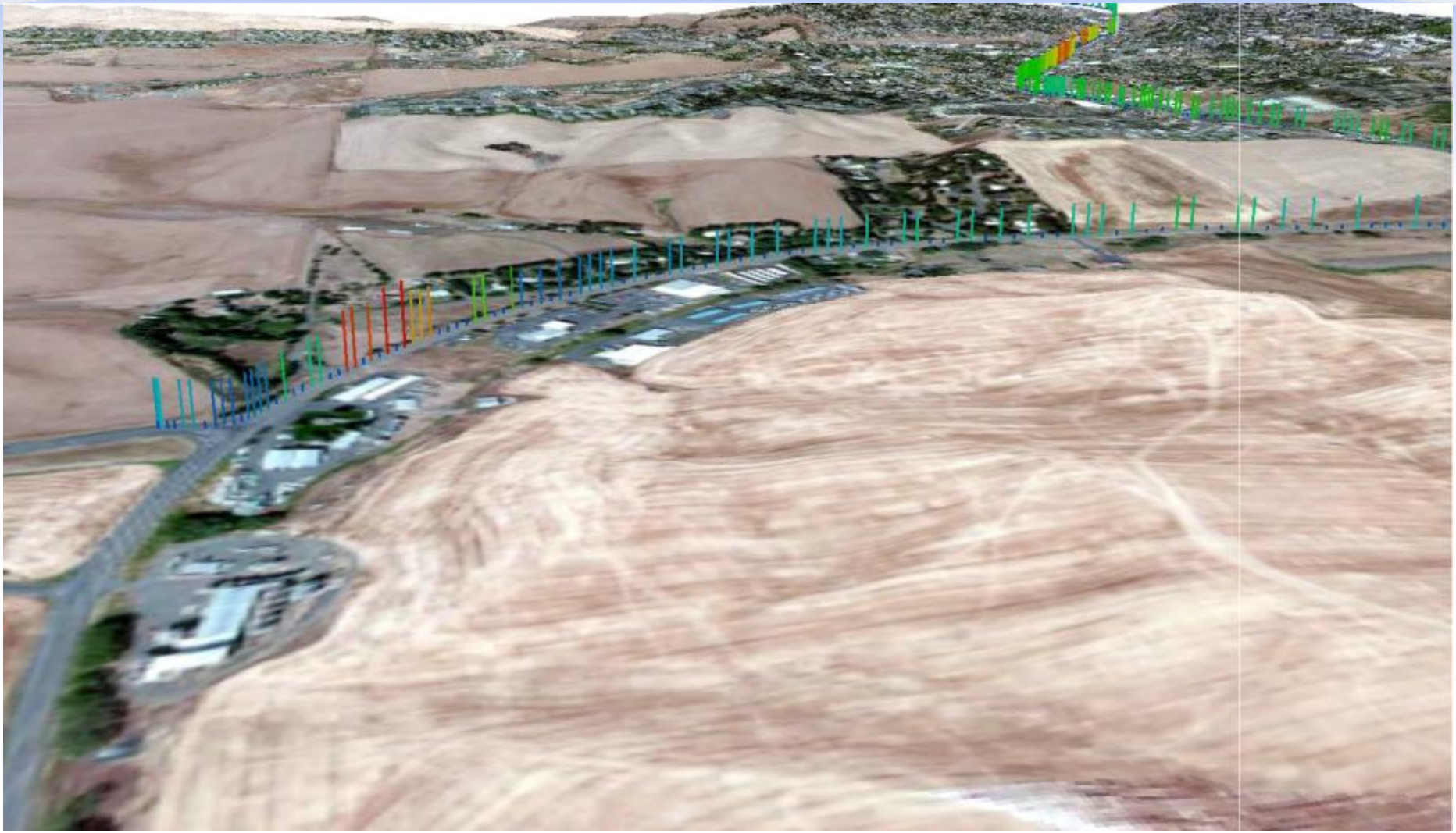
Appropriate Approach

- Mobile Mapping
  - Hot spots
  - Unknown or unfound leaks
    - Best for covering largest amount of area
- Tracer Ratio Measurements
  - Underground Leaks
  - Customer Meters
    - Highest degree of accuracy
- Comparison of both approaches results in high level quality assurance check

Presentation of Data



Presentation of Data



Presentation of Data

Large Gate Station

SF_6 Release Method

Data Collection Van

Infrared Leak Detection Camera

Obvious Leak

Leak Detection - Underground Pipes

The Van

Thank You!


SO YOU LIVE IN WEST SENECA, AND YOU WANT TO WIN A STATE CHAMPIONSHIP ON A FOOTBALL FIELD?
JOIN THE MARCHING BAND.