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Advanced Leak Detection and Emissions Quantification

Northeast Gas Association Advancements in Leak Detection Technologies

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Director Product and Strategy
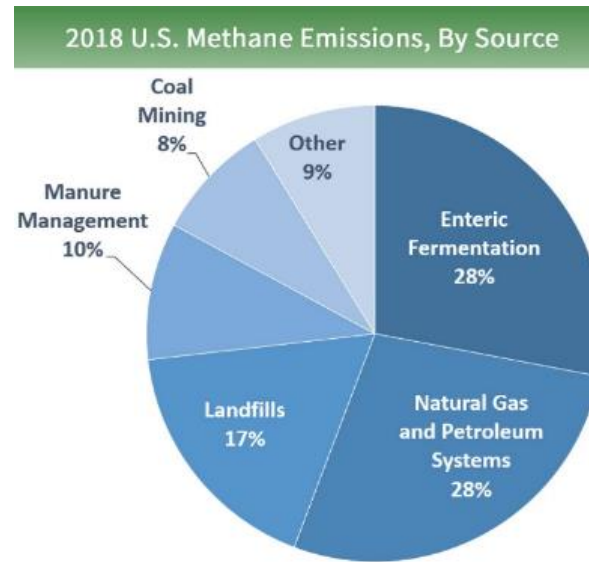
April 2022

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Agenda

- Current Environment - Methane Reduction
  - Available Technologies - Recent
  - Evolving Technologies
- Cost Effective Advanced Platform
- Overview - Leak Detection and EQ
  - Survey Methodology
 - Field Work Process
  - Benefits and Applications

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Why Worry about Methane?

- Methane is a major component of natural gas -- about 95%.

- Methane (CH_4) is a potent greenhouse gas (GHG) and represents about 10% percent of all anthropogenic GHG emissions.

- Methane has the capability to trap about 86 times more heat in the atmosphere more immediately over the first 20 years than carbon dioxide (CO_2).

2018 U.S. Methane Emissions, By Source

- Coal Mining 8%
- Other 9%
- Manure Management 10%
- Enteric Fermentation 28%
- Landfills 17%
- Natural Gas and Petroleum Systems 28%

U.S. Environmental Protection Agency (2020). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2018

Overview of Greenhouse Gas Emissions in 2018

- Nitrous Oxide 7%
- Fluorinated Gases 3%
- Methane 10%
- Carbon Dioxide 81%
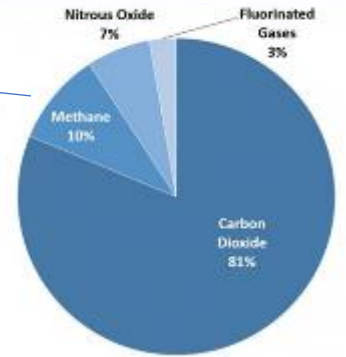
Reducing methane emissions and preventing accidents:
- Easiest and fastest way to reducing overall GHG emissions in the short term
- Provides pipeline and gas infrastructure safety
- Protects people and property
- Enables environmental stewardship reach you ESG goals faster
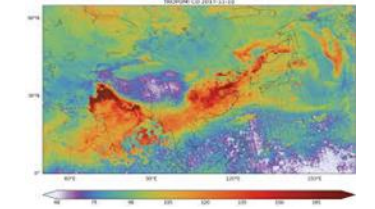
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Fast Moving Environment

- Much has changed in the last four years

    - From FID to Laser based handhelds with GPS and Bluetooth

    - From Trucks / ATV with FID to AMLD type technologies with ppb sensors

    - From Airborne to cost effective Drone based surveys – Lasers to LiDAR

    - Paper based to Digital Records and Cloud based Storage

- And now……. Satellite surveys

- Data Analytics and Visualization have begun to play an even bigger role. ML is becoming a buzz word

- Much more will come in the next 1-2 years with continuous and fixed monitoring using all kinds of technologies with analytics and ML

- Tiered surveys - Airborne/Spaceborne combined with ground-based technologies all coming together in one package.

- Revisit OGI with new ML analytics and AI-based Convolutional Neural Networks ?

- Hyperspectral Imaging and Analytics –multi-gas analytics ?

> Using these technologies and new digital tools can help accelerate, scale, and optimize methane reduction programs and meet emissions targets more quickly and efficiently

References: (White Papers from Southern Cross)
1. Methane Emission Reduction Technologies and Mitigation Strategies in Natural Gas Supply Networks; A Ebrahim
2. Emission Quantification (EQ) Surveys in Natural Gas Networks; A Ebrahim
3. Going-Green-starts-with-Reliable-Data; A Ebrahim
4. AI for the Gas Utilities; A Ebrahim

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Leak Detection and EQ Solution Set – Southern Cross Approach

SC Preferred Equipment

- Irwin laser based handheld leak survey unit
- Multi-Gas and personal safety handheld units
- Partner solutions
- Mobile survey unit fitted with preferred equipment
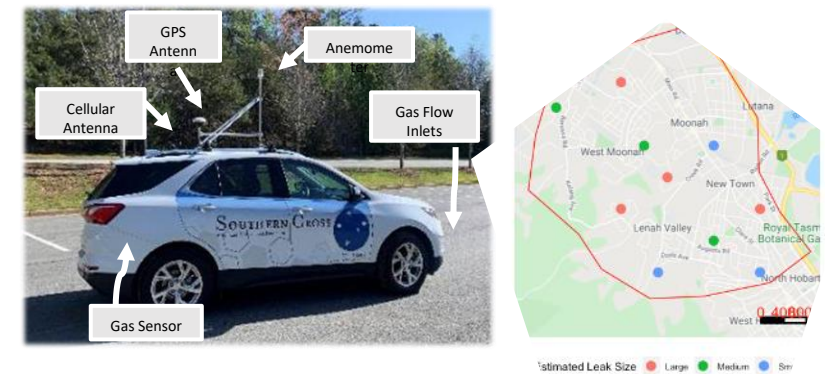
Client-Required Equipment

- Remote laser solutions
- Other approved survey equipment (Airborne platforms)
- Client Software

AMLD Solutions (Advanced Mobile Leak Detection and EQ Platform)

- Extended range high sensitivity sensors combined with data analytics
- Additional investigation for pinpointing
- Emissions Quantification
- Quality assurance

SC Software

- Tracking of workforce
- Validated performance against GIS data
- Leak tracking and quantification

IRwin Methane Detector

GPS Antenn

Anemome

Cellular Antenna

Gas Flow Inlets

Gas Sensor

Estimated Leak Size   Large   Medium   Sm

AMLD Platform

Gas Sensor Hardware
- Ethane/Methane detection
- Parts-per-billion (ppb) sensitivity from Aeris Technologies

Wind Sensor
- Sonic Anemometer
- Vehicle-corrected wind direction

GPS Sensor
- High-precision location information embedded to all data

Auxiliary Systems
- Wireless modem for prompt data upload to the cloud
- Auxiliary power system for independent operation from vehicle systems
- In-car Driver tablet

GPS Antenna

Anemometer

Cellular Antenna

Gas Flow Inlets

Gas Sensor (ppb)

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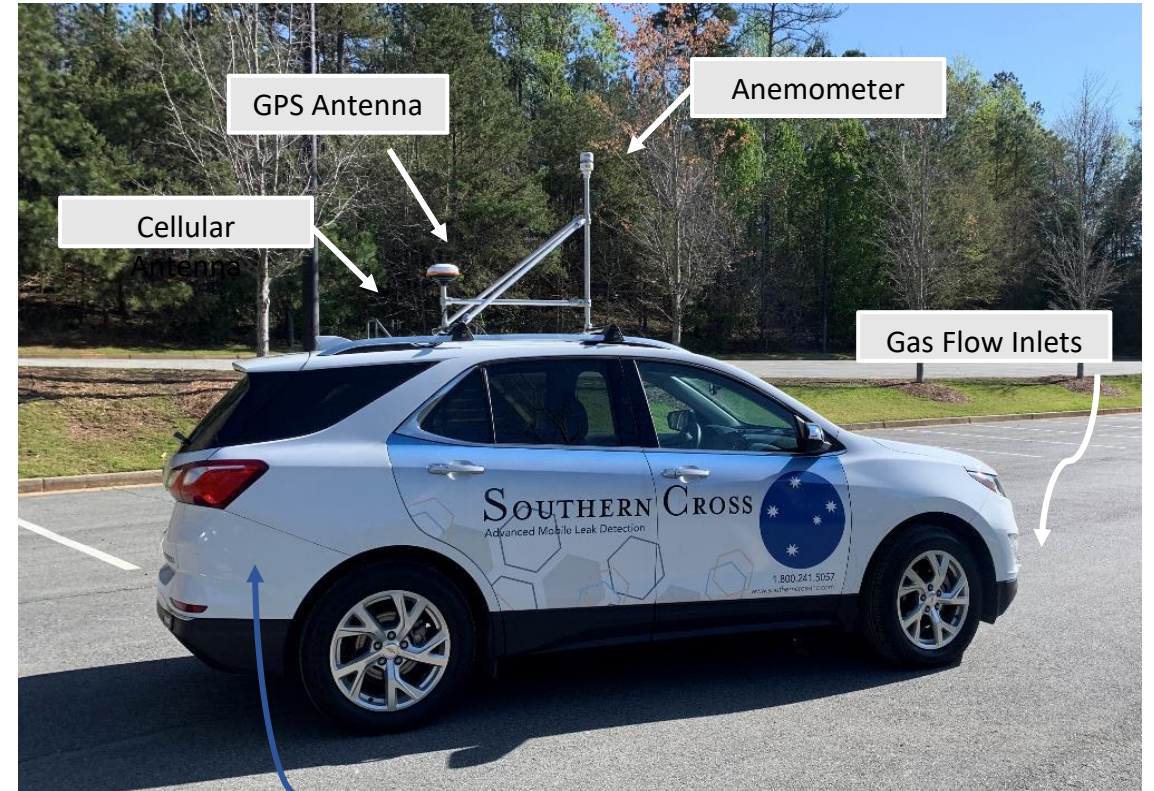
AMLD Analytics

- Ability to combine data from multiple drives
- Generate Leak Indications from Individual clusters of gas
- Technician dispatching system for further investigation and confirm presence of leak
- Indications can be prioritized by magnitude of gas, frequency of detection, etc.
- Probability of Natural Gas (source discrimination)
- Indication location GPS coordinates
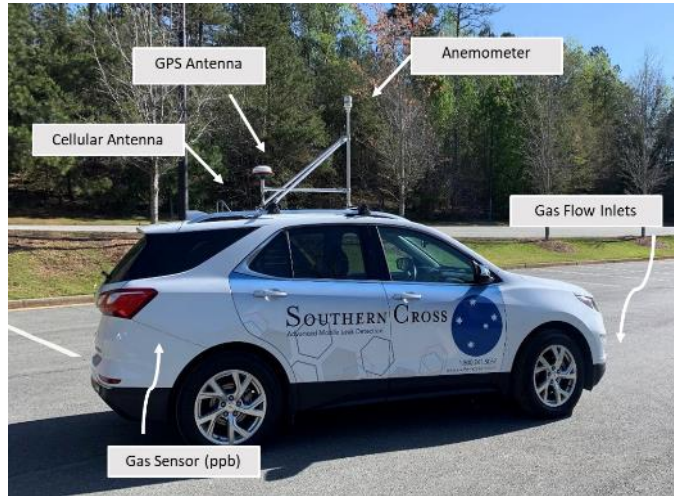- Confidence score
- Emissions Quantification
- Ranking
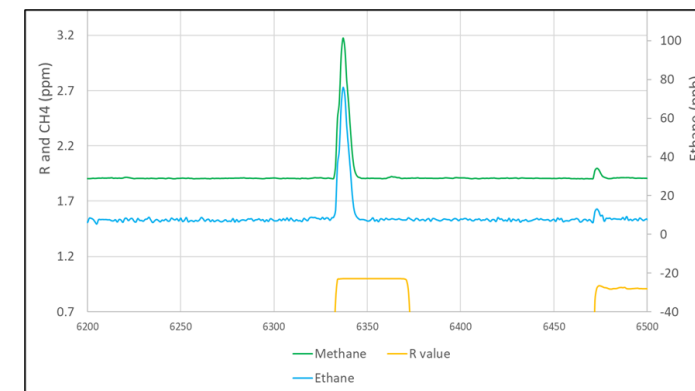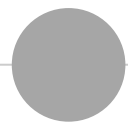
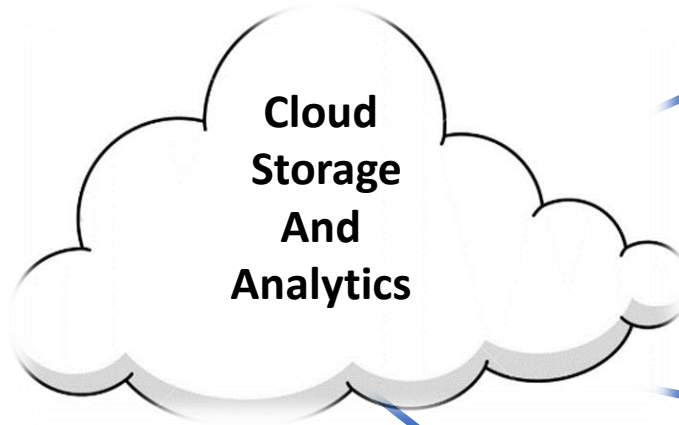# Implications - High Sensitivity Analyzer + Advanced Analytics?

- **Systematic Approach**

- **Highest Probability of finding Leaks**:
  - Using sensors that are 1000 times more sensitive than traditional handheld sensors
  - Confirming the **presence** or an **absence** of a methane leak up to distance of several hundred feet.

- **Paradigm Shift in Leak Survey**:
  - Traditional approach - walk all services from meter to meter. 90% of the time there are no leaks,
  - AMLD platform can survey large swaths of the natural gas infrastructure and confirm presence or absence of methane
  - Dispatch technicians only to areas where presence of leak is found

- **Digital Records and Reporting**:
  - Digital representation of the potential emissions in terms of spatial data (Latitude/Longitude)
  - Risk ranking and aids in pipeline replacement programs.

- **Single Survey – Multiple Applications**
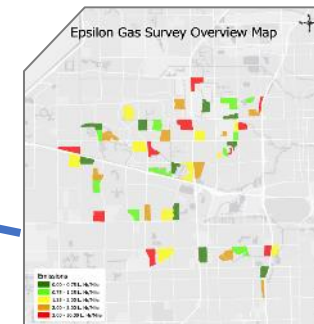
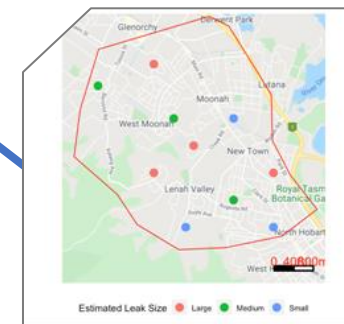# One Survey – Multiple Use Cases

Data Collection

Labels: GPS Antenna, Anemometer, Cellular Antenna, Gas Flow Inlets, Gas Sensor (ppb)

Cloud Storage And Analytics

Methane / Ethane
GPS / GIS
Wind
Atmosphere Condition
Speed/Direction
Vehicle Speed
Technician Profile

Compliance Survey

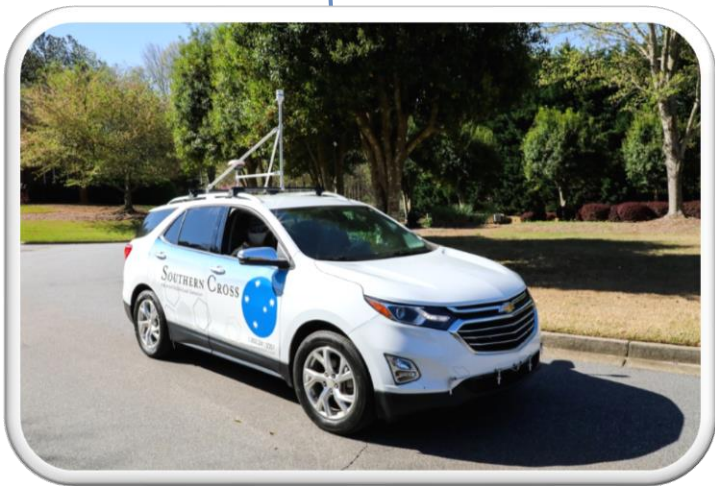**Emissions Quantification**

"Super" Emitters Program
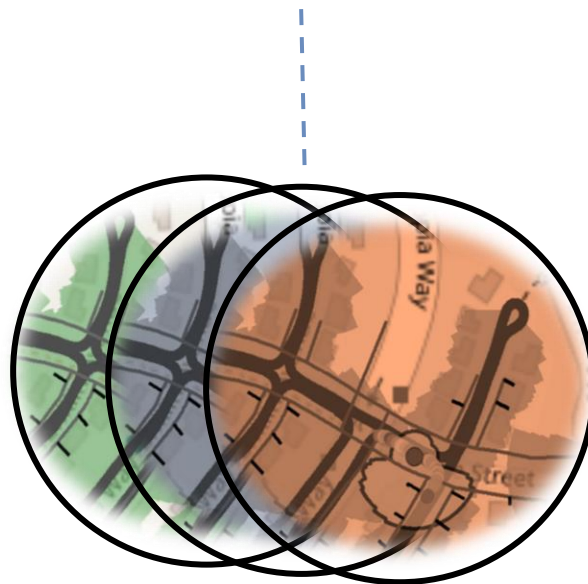
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AMLD Methodology

DATA CAPTURE

First, driving survey data is collected.
Driving is the most efficient means of
data collection
(CH_4 levels, GPS, Wind Speed/Direction)

DATA ANALYTICS

Raw data from multiple drives are
analyzed and consolidated using
algorithms and data analytics.
Source identification is derived
Actionable Insights generated

DECISION & EXECUTION

Work Orders are then generated
embedded with information such as
location of the detected emission,
gas amplitude, gaps in coverage, etc
Data and insights used for multiple
purposes

Driving and Data Collection

- Vehicle drives all roads in the area
- Via the wind, the vehicle is able to detect leaks some distance off the road
- Detection limited only by access to leak and wind behavior
- Vehicle makes **Multiple passes** over many days
- *Strength:* via multiple passes, the survey increases the likelihood of detection

Driving Path

Coverage

Pipeline

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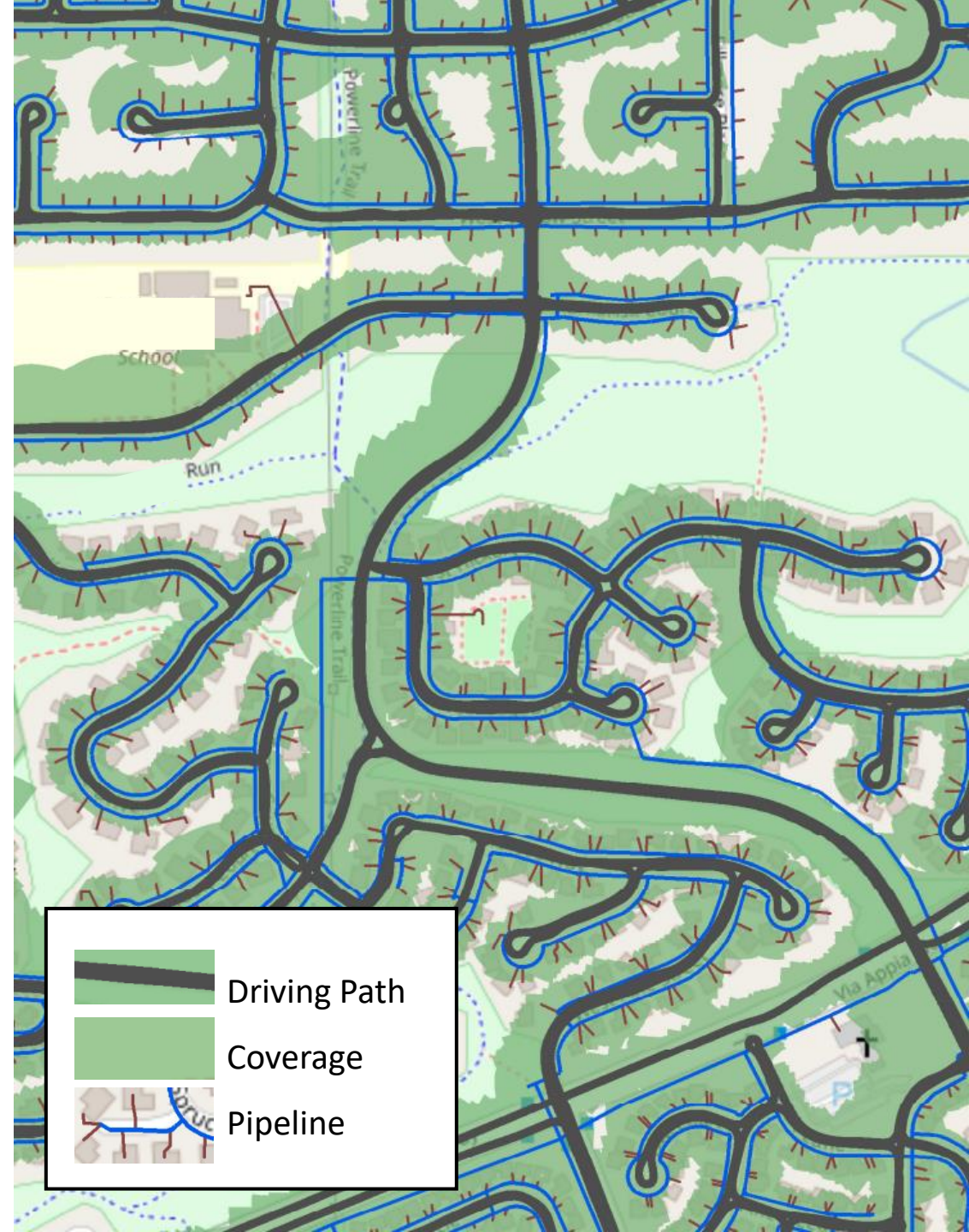
Data Analytics

- Gas sensor data is analyzed for elevations in Natural Gas against background methane.
- Analysis considers environmental data
- Natural Gas versus 'Swamp Gas'
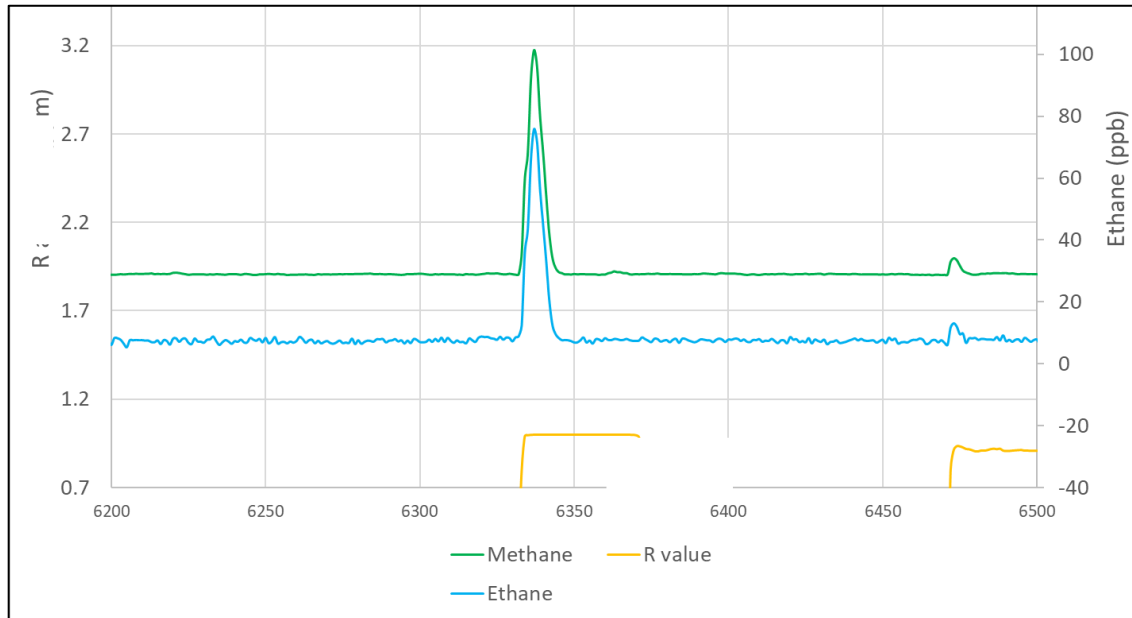
AMLD Analytics Output – Leak Survey

THREE Basic Outputs:

1. **Coverage – No Gas found**
   - No further activities in this area
   - Typically, 85% to 90% of area is covered

2. **Coverage with Leak Indications – Gas found**
   - Technician dispatched to investigate and confirm the leaks
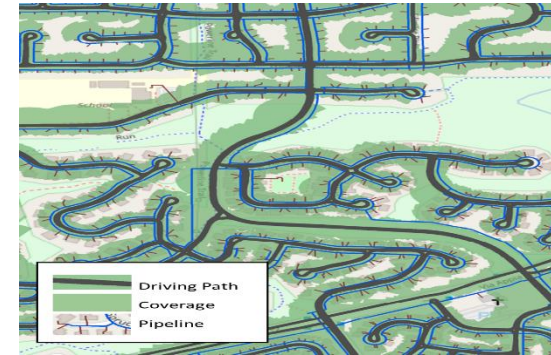
3. **Not Covered – Gaps**
   - Technician dispatched to survey the area
   - Typically, 10% to 15% of the area depends

Field work then consist of dispatching technician for:

1. Investigating the Leak Indications, confirming presence of leaks and grading the leaks
2. Surveying the Gaps for any leaks

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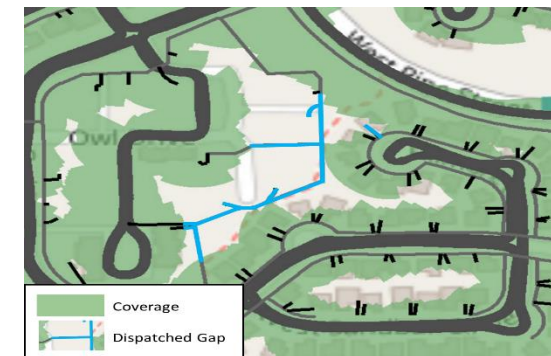
③

> **Entire area is now surveyed**
> **(100% Complete)**

Coverage with No Gas Found

- Analytics confirms the **absence** of gas
- These areas do not need any further investigation activities
- Assets can be marked – No Gas Found
- Typically, 85% to 90% of area is covered

| Town	Coverage %
Polygon 1	66%
Polygon 2	87%
Polygon 3	96%
Polygon 4	88%
Polygon 5	90%
Polygon 6	69%

Recent Survey

Coverage with Leak Indications – Gas found

- Individual clusters of gas are dispatched as Indications
- Technician dispatched for further investigation and confirm presence of leak
- Indications can be prioritized by magnitude of gas, frequency of detection, etc.

- Probability of Natural Gas
- Indication location GPS coordinates
- Confidence score
- Emissions Quantification

Indication Search Area

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- The vehicle aims to cover all assets in the survey area.

- Gaps
  - poor quality data-
  - not able to drive in the area-private road/construction
  - unfavorable environmental conditions

- Any assets or portions or the target area not covered by the vehicle are dispatched for traditional investigation as a Gaps

- Gap can be outputted as shapefile

Coverage
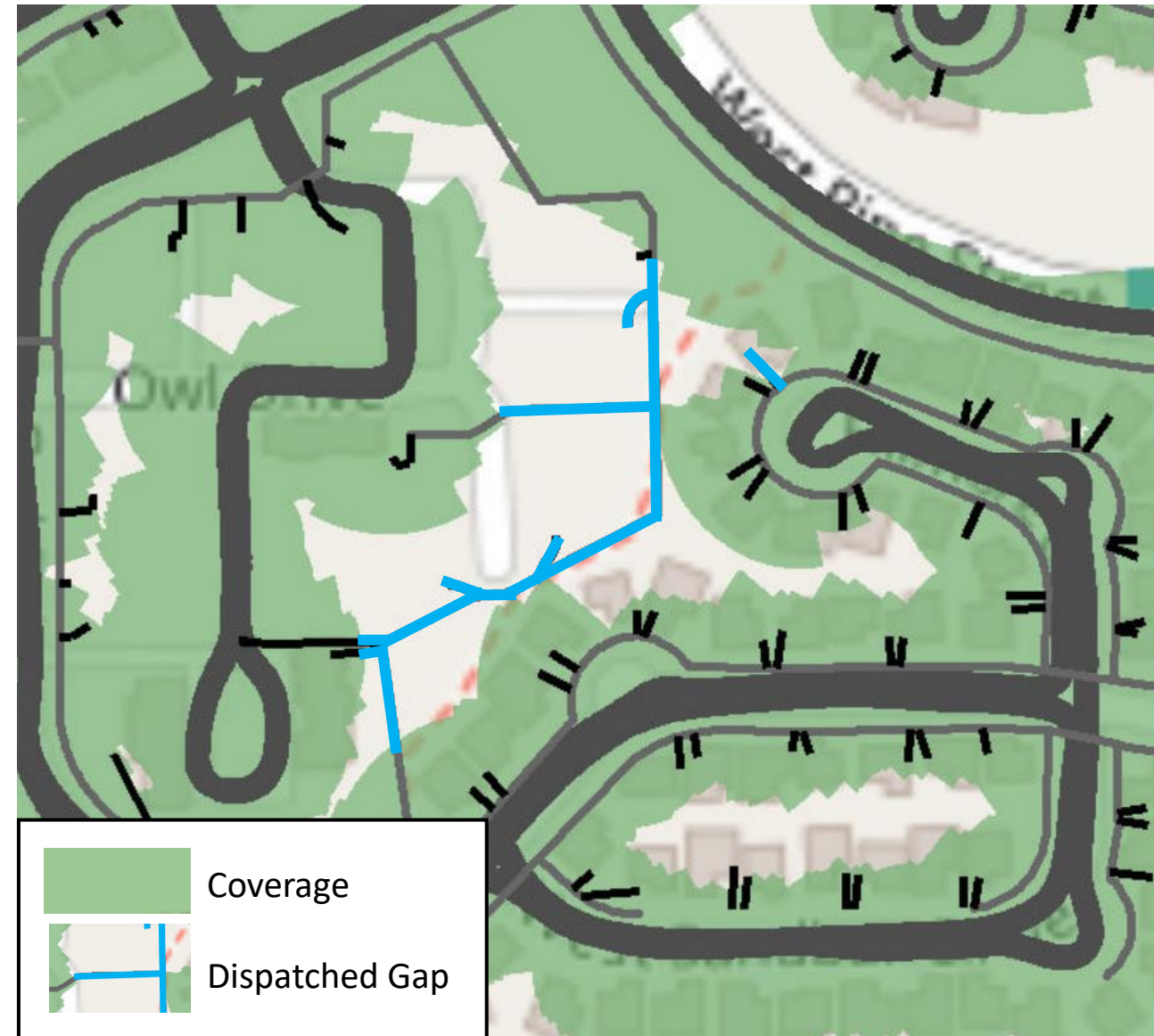
Dispatched Gap

Summary – Leak Survey

To Summarize the THREE Basic Outputs:
1. **Coverage – No Gas found**
    - No further activities in this area
    - Typically, 85% to 90% of area is covered

2. **Coverage with Leak Indications – Gas found**
    - Technician dispatched to investigate and confirm the leaks

3. **Not Covered – Gaps**
    - Technician dispatched to survey the area
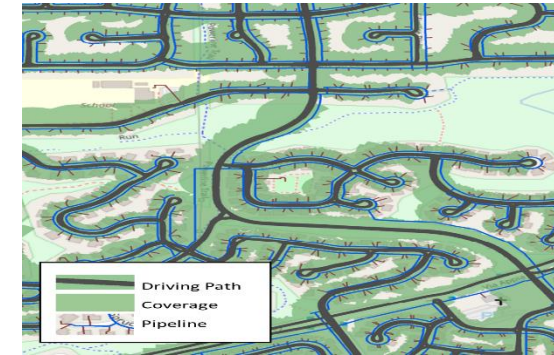   - Typically, 10% to 15% of the area depends

Field work then consist of:
1. Dispatching technician to investigating the Leak Indications, confirming presence of leaks and grading the leaks
2. Dispatch technician to surveying the Gaps for any leaks
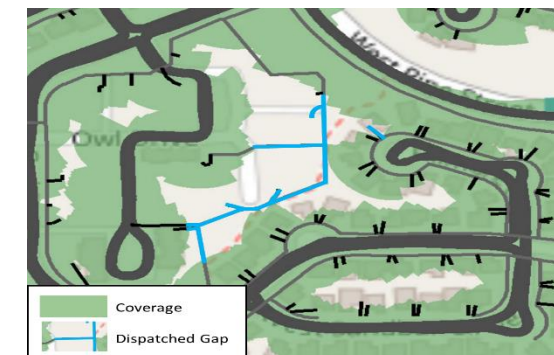
Entire area is now surveyed
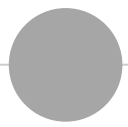- (100% complete)

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Benefits

AMLD gives the utility the highest probability of finding all potential leaks in the defined area.

- Quality and on-time completion matters in every leak survey. BUT - also important it be done at the level of quality needed to be confident in a quality leak survey.
- Using a methane detection capability that is 1,000 times more sensitive than traditional survey equipment can give utilities an increased comfort in the quality of their leak survey.

Increases in efficiency

- AMLD provides indications for technicians to start their traditional leak pinpointing process, prioritizing their time at the places that are most likely to result in leaks.
- Change in the way leak survey is conducted. In the traditional survey the technician walks or drives slowly from meter to meter and completes the survey whilst spending majority of time on areas with no leaks.

Records and Reporting

- Spatial representation of data- lat/long, methane size in digital format
- Risk Ranking process (actionable data driven decision making)
- EQ programs aids in pipeline replacement programs

Many Applications and Uses of AMLD Technology

Regulatory Compliance Survey

Pre-Event & Public Safety Audits

DIMP Assessment Management

Disaster Recover Surveys

Environmental & Emissions Reduction programs

Frost Patrol

Pre & Post Quality Construction Audits

Auditing Traditional Leak Survey

Southern Cross offers:

Full Compliance Leak Survey

- Use all appropriate technology platforms including AMLD to complete leak survey on time and budget using our own qualified technicians

## Indication (Pinpointing) Survey

- Use AMLD Technology to survey the entire network
- Provide actionable data - GIS leak indications locations and gaps areas
- Utility conducts their own investigations from supplied data

Emission Quantification Survey

- Use AMLD Technology platform to survey entire network
- Provide estimated emissions flow rates and rankings (optional –leak locations)
- Utility takes appropriate risk mitigation actions from supplied data

Supply Qualified and Experienced Technicians

- Qualified and experienced drivers to operate other AMLD type platforms
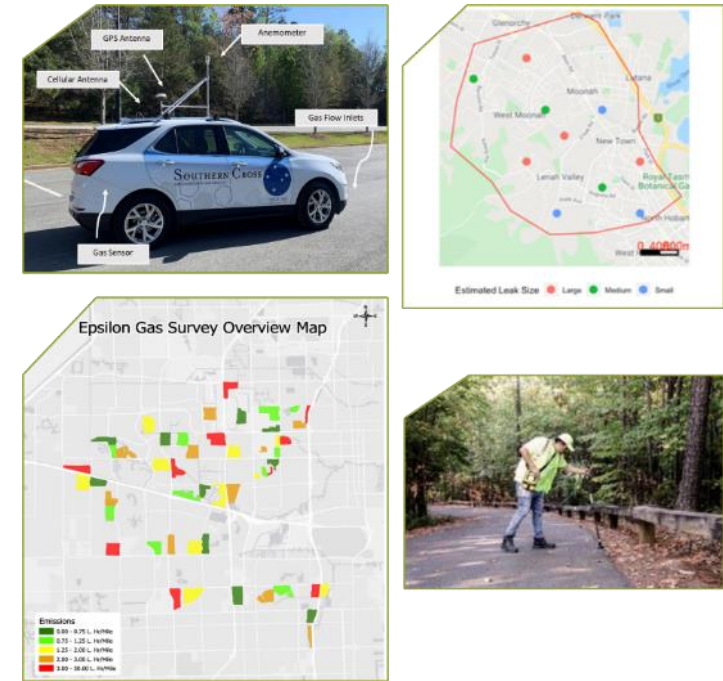- Qualified technicians for follow-up leak indications investigations
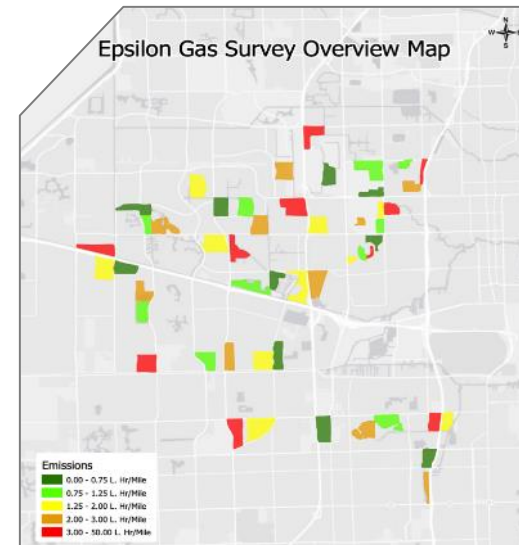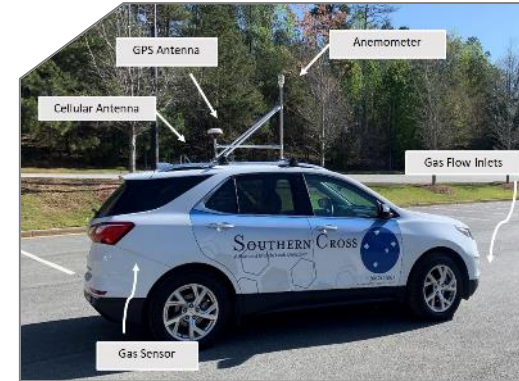
Conclusions

- New digital tools like AMLD with advanced software analytics can be used TODAY and provides opportunities to reduce emissions quickly and cost-effectively:
  - Leak Detection Surveys
  - Identify "Super Emitters"
  - Supplementary data for pipe replacement and repair program
  - Identify and Rank pipe segments for Risk Mitigation

- **Using outsourced emission quantification services is cost effective.**
  - Southern Cross UNIQUELY offers Advanced Mobile Leak Detection (AMLD) and other technology as part of an outsourced solution - to utilities of all sizes (small, medium, and large).

  - The key advantage to utilities is the avoidance of large capital investments in this advanced technology. This allows utilities to use this emerging advanced technology and analytics to identify and quantify methane emissions while also improving the pipeline repair decision making process.

Epsilon Gas Survey Overview Map

Thank You

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