EPA
United States
Environmental Protection
Agency

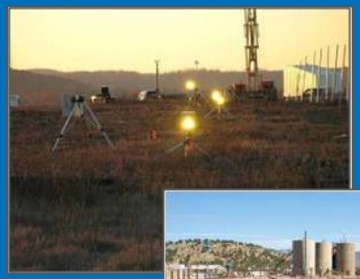
# Rubbertown NGEM Demonstration Project

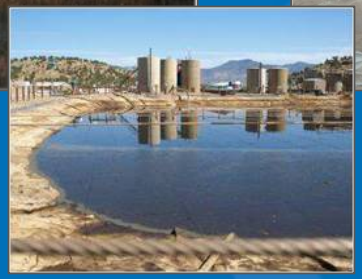
## Update Meeting #4, March 27-28, 2018

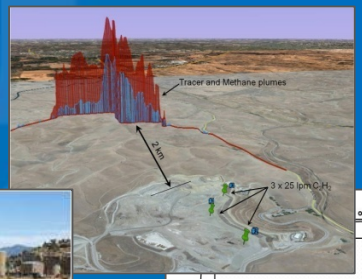

**Eben Thoma, Rachelle Duvall, and Ingrid George *(for the team)***

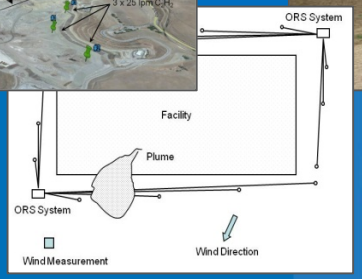
***EPA Office of Research and Development, Durham, NC 27711***

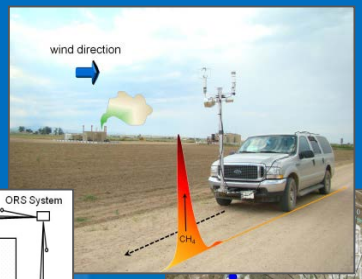


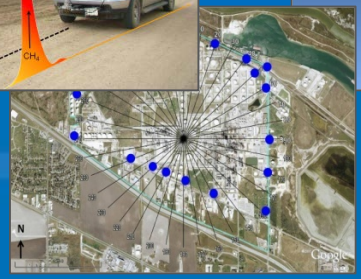



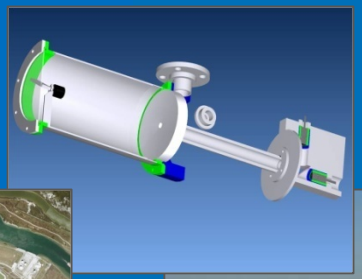





**Office of Research and Development**
National Risk Management Research Laboratory, Air and Energy Management Division

NRMRL Fugitive and Area Source Group
Source and Fenceline Measurements
Methods and Technology Development

# Rubbertown NGEM Demonstration Project

*Topics for Update Meeting #4:*

*(1) Status and next steps on NGEM project (Eben Thoma)*

*(2) Discussion of potential citizen science project (Rachelle Duvall)*

*(3) Questions and discussion*

# Rubbertown NGEM Demonstration Project

## *Quick Background Review for Meeting #4*

- *What is NGEM? …..Next Generation Emission Measurements*
  - Air quality sensors (mobile and fixed)
  - Lower cost gas chromatographs
  - Passive samplers and canisters
  - New source location modeling

- *What do we want to do?*
  - Work together to try new NGEM approaches and learn about air pollution sources in Louisville (research)

- *Who is involved in this project?*
  - EPA Office of Research and Development (ORD), EPA Region 4, Louisville Air Pollution Control District (APCD), and Jacobs Technology (EPA contractor)

# Rubbertown NGEM Demonstration Project

## *Quick Background Review for Meeting #4*

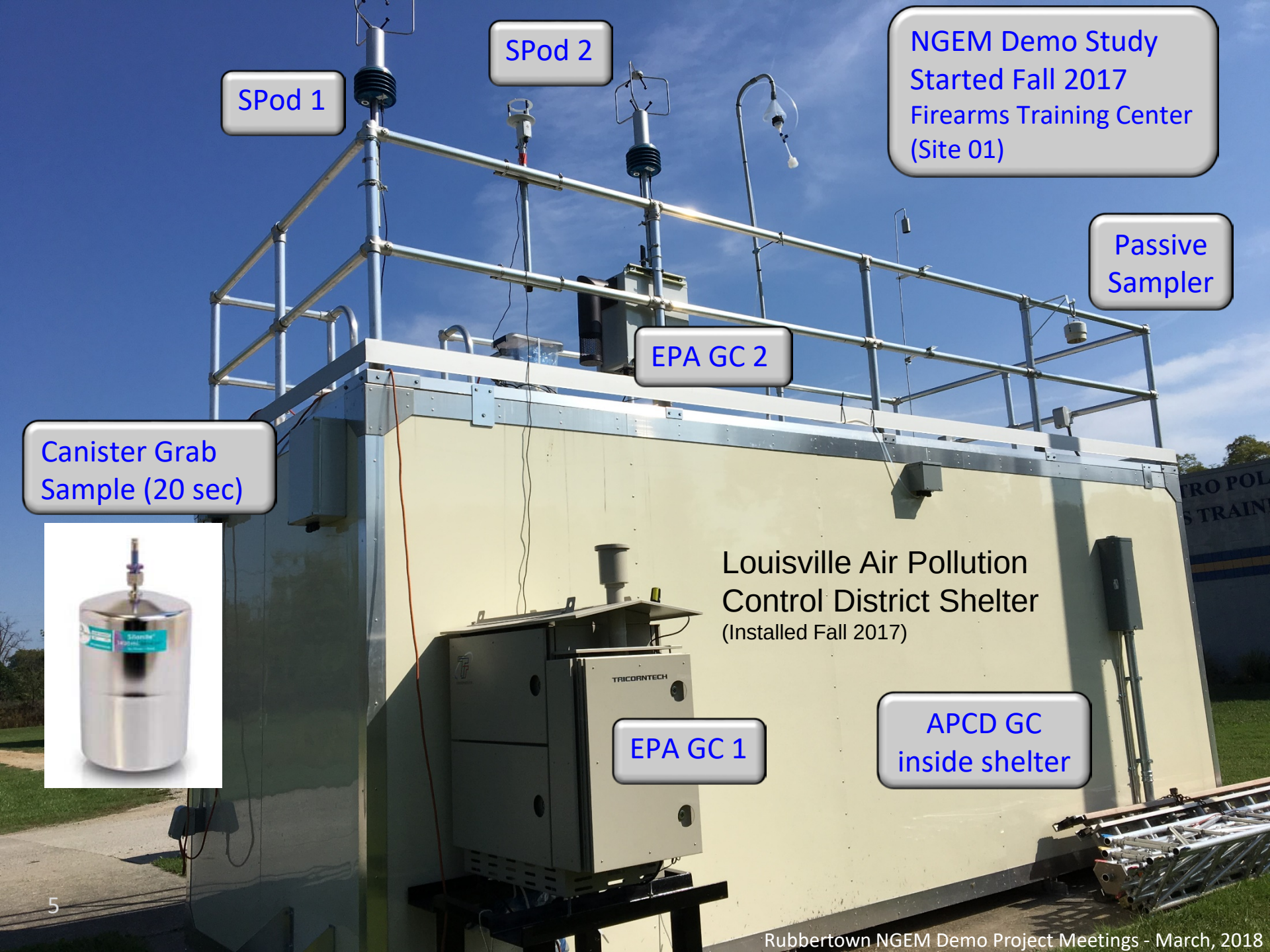
- *What is the project focus?*
  - Prototype NGEM system near Rubbertown facilities
  - Select gas-phase air pollutants
- *Is this a community health or exposure study?*
  - No, this is a NGEM technology demonstration project that may inform some aspects of emissions in Rubbertown
- *Is this an enforcement or compliance activity?*
  - No, this is a voluntary research effort
  - We will provide information to facilities, communities, and publish results

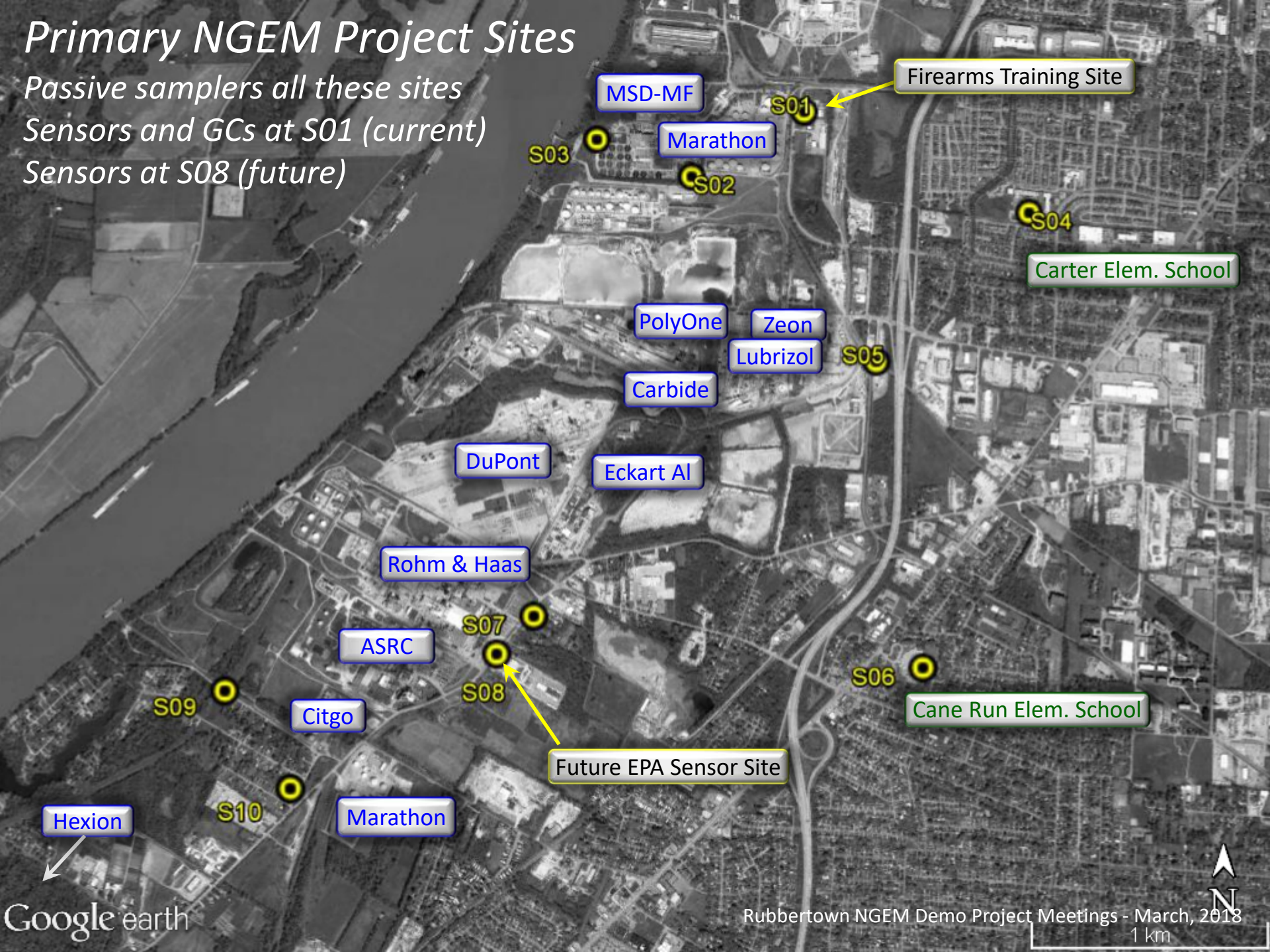
# Rubbertown NGEM Demonstration Project

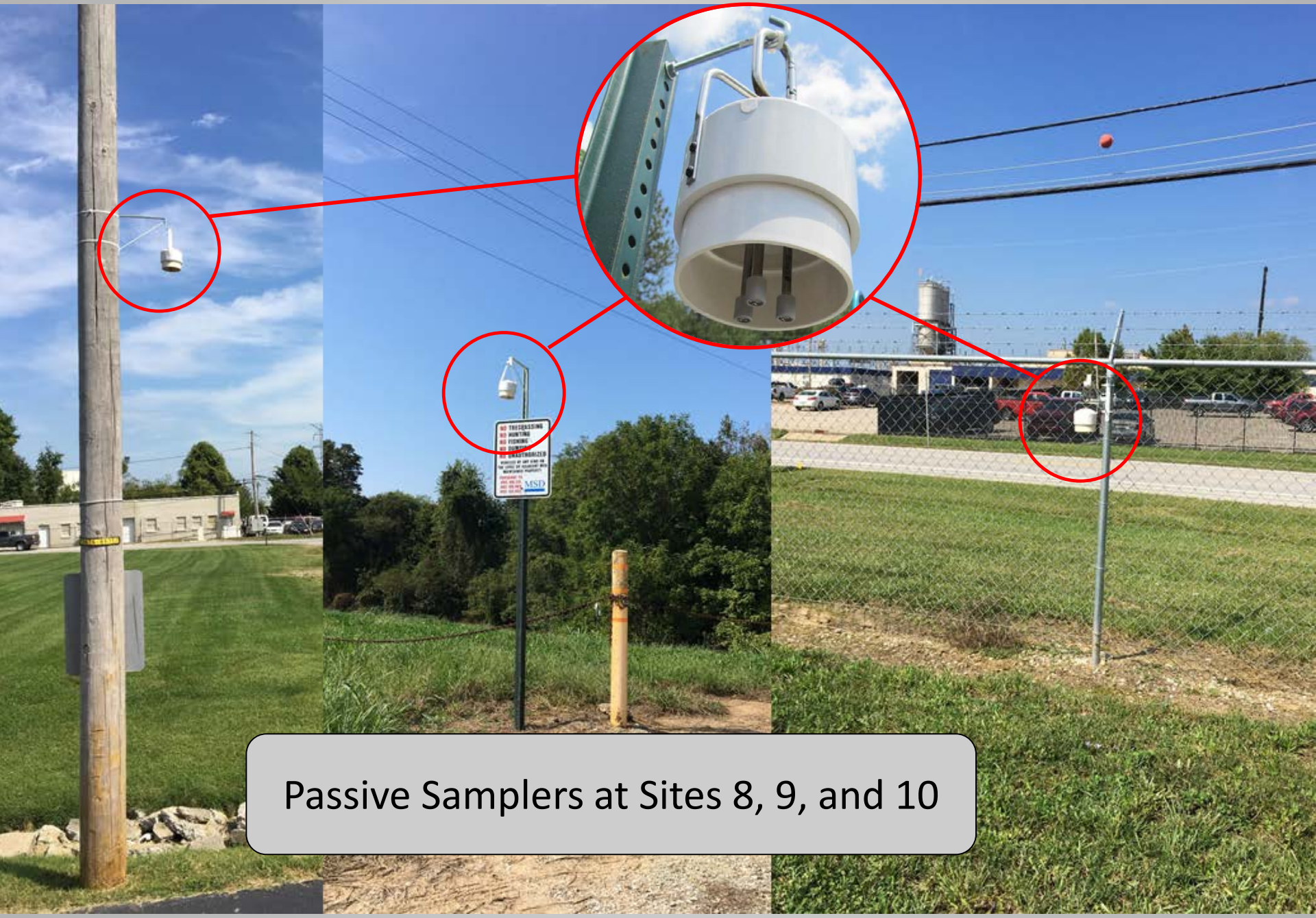
## *Status Update - March 2018:*

- Passive samplers deployed by APCD since Sept., 2017 (ongoing)
- 20 second canister grab samples acquired by EPA, Jacobs, and APCD
- Prototype SPod fenceline sensors deployed at Site 01
- Two prototype field gas chromatographs (GCs) deployed at Site 01 (only one is working)

*Today we will focus on the passive samplers and canisters*


SPod 1
SPod 2
NGEM Demo Study
Started Fall 2017
Firearms Training Center
(Site 01)
Passive
Sampler
EPA GC 2
Canister Grab
Sample (20 sec)
Louisville Air Pollution
Control District Shelter
(Installed Fall 2017)
TRICORNTECH
EPA GC 1
APCD GC
inside shelter


Primary NGEM Project Sites
Passive samplers all these sites
Sensors and GCs at S01 (current)
Sensors at S08 (future)
MSD-MF
Firearms Training Site
S01
Marathon
S03
S02
S04
Carter Elem. School
PolyOne
Zeon
Lubrizol
S05
Carbide
DuPont
Eckart Al
Rohm & Haas
S07
ASRC
S08
S09
Citgo
S06
Cane Run Elem. School
Future EPA Sensor Site
S10
Marathon
Hexion
Google earth
N
Rubbertown NGEM Demo Project Meetings - March, 2018
1 km


Passive Samplers at Sites 8, 9, and 10

# Rubbertown NGEM Demonstration Project

## *Geospatially Deployed Passive Samplers*

- *Two-week Passive Samplers are pretty good for:*
  - Helping us understand spatial differences in concentrations
  - Helping us understand chemical source signatures
- *Two-week Passive sampler **<u>are not</u>** good for:*
  - Informing short-term concentrations or “emission events”
  - Informing low absolute concentrations for some compounds

*(small uncertainties in tube background levels and variable uptake rates)*

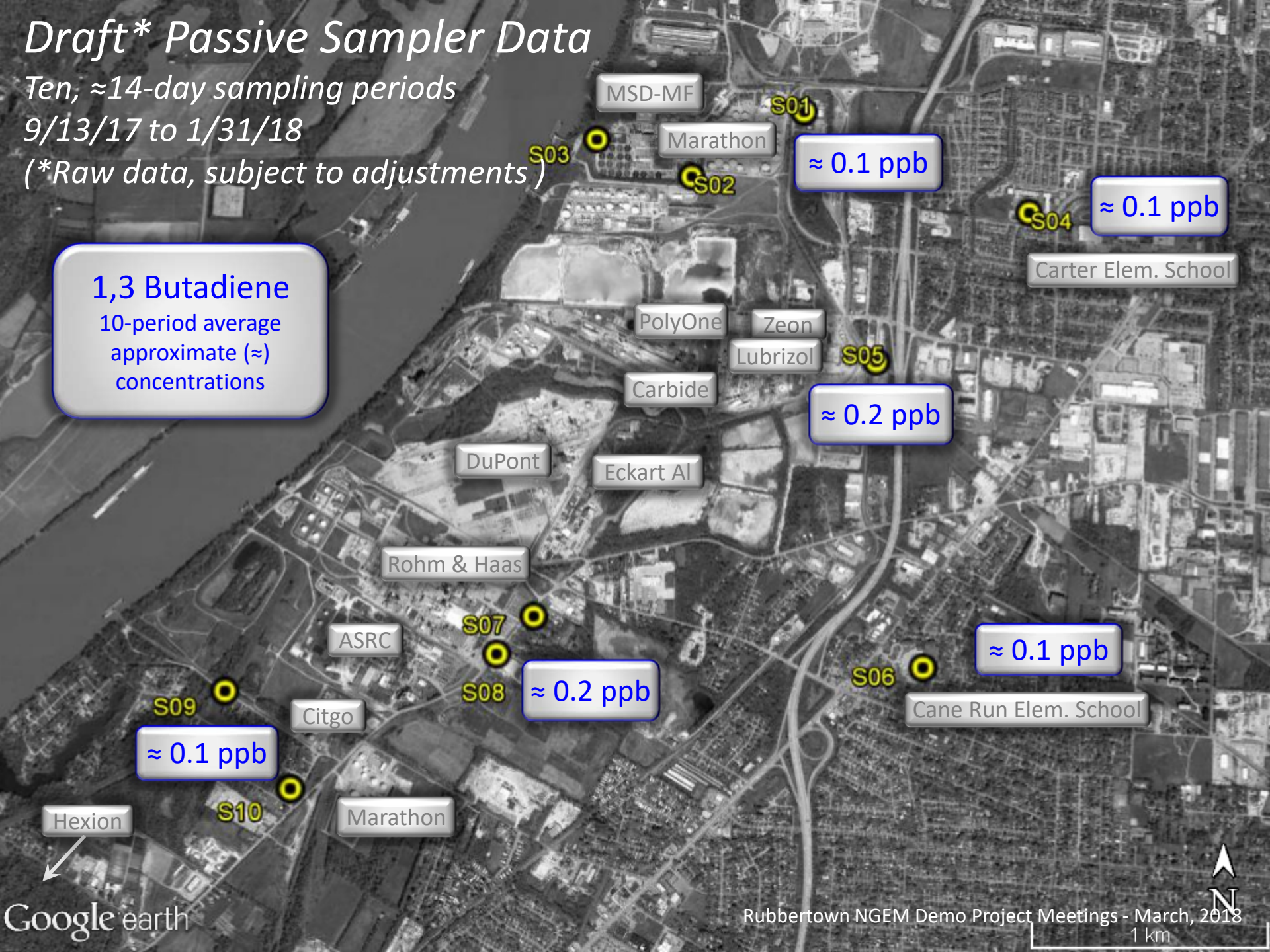
# Passive Sampler Primary Compound List

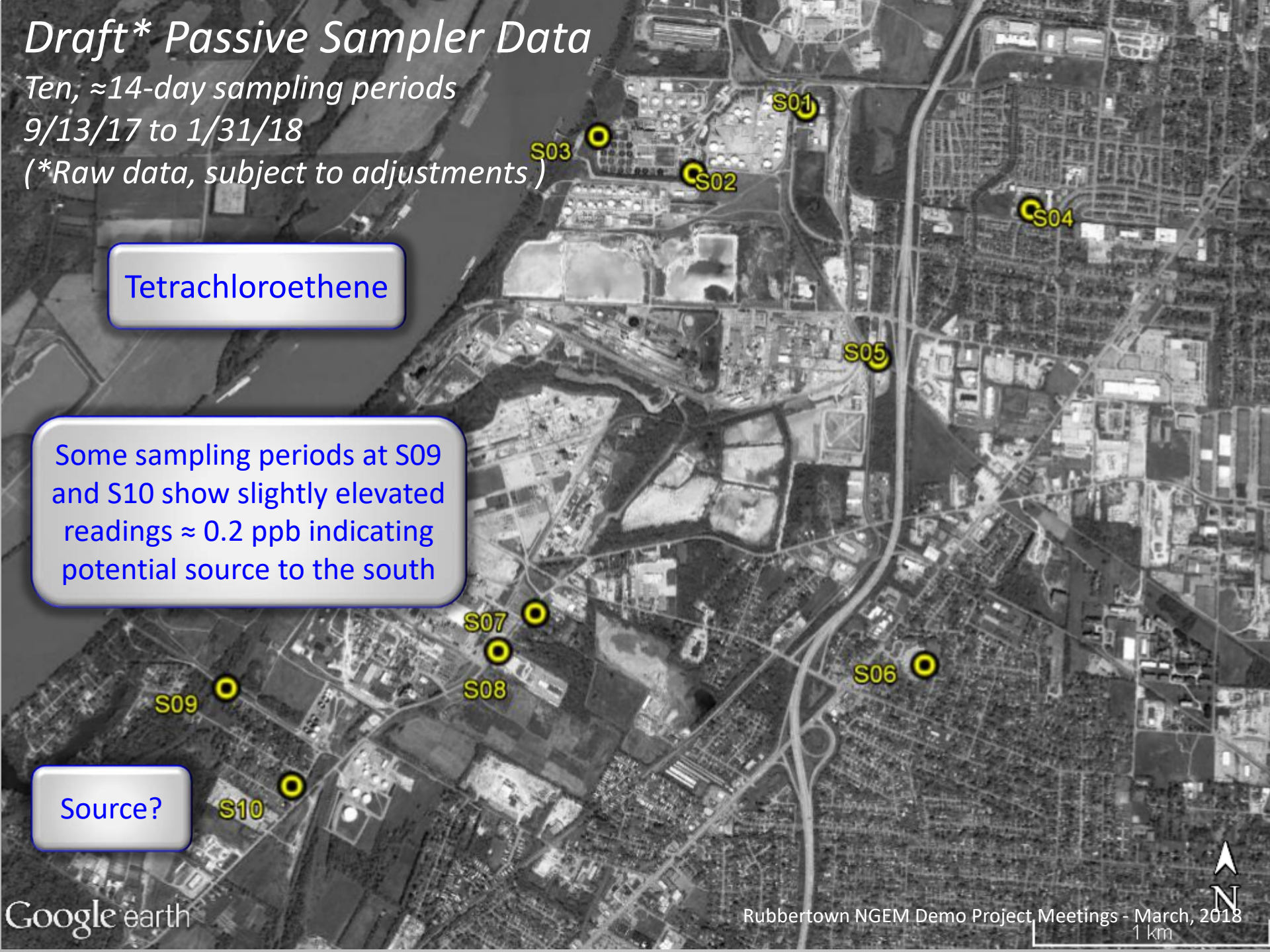
| | |
|---|---|
| ***Benzene** | ***Tetrachloroethene** |
| Freon 114 → Dichlorotetrafluoroethane | Chlorobenzene |
| Freon 11 → Trichlorofluoromethane | ***Ethylbenzene** |
| 1,1-Dichloroethene | m,p-Xylene |
| Freon 113 → Trichlorotrifluoroethane | ***Styrene** |
| 1,1-Dichloroethane | o-Xylene |
| cis-1,2-Dichloroethene | 4-Ethyltoluene |
| 1,2-Dichloroethane | 1,3,5-Trimethylbenzene |
| 1,1,1-Trichloroethane | m-Dichlorobenzene |
| ***Carbon Tetrachloride** | o-Dichlorobenzene |
| 1,2-Dichloropropane | p-Dichlorobenzene |
| ***Trichloroethene** | ***1,3-Butadiene** |
| ***Toluene** | |

Some preliminary results are presented for these two compounds

**Indicates APCD Target Compound*

Preliminary passive sampler results expressed in parts per billion by volume (ppbv or ppb)
Average method detection limit (MDL) for 1,3 butadiene ≈ 0.04 ppb, tetrachloroethene ≈ 0.02 ppb


Draft* Passive Sampler Data
Ten, ≈14-day sampling periods
9/13/17 to 1/31/18
(*Raw data, subject to adjustments)
1,3 Butadiene
10-period average
approximate (≈)
concentrations
MSD-MF
S01
Marathon
S03
S02
≈ 0.1 ppb
S04
≈ 0.1 ppb
Carter Elem. School
PolyOne
Zeon
Lubrizol
S05
Carbide
≈ 0.2 ppb
DuPont
Eckart Al
Rohm & Haas
S07
ASRC
S08
≈ 0.2 ppb
S06
≈ 0.1 ppb
Cane Run Elem. School
S09
Citgo
≈ 0.1 ppb
S10
Marathon
Hexion
Google earth
N
Rubbertown NGEM Demo Project Meetings - March, 2018
1 km


Draft* Passive Sampler Data
Ten, ≈14-day sampling periods
9/13/17 to 1/31/18
(*Raw data, subject to adjustments )
Tetrachloroethene
Some sampling periods at S09 and S10 show slightly elevated readings ≈ 0.2 ppb indicating potential source to the south
Source?
S01
S02
S03
S04
S05
S06
S07
S08
S09
S10
Google earth
Rubbertown NGEM Demo Project Meetings - March, 2018
1 km
N

# Rubbertown NGEM Demonstration Project

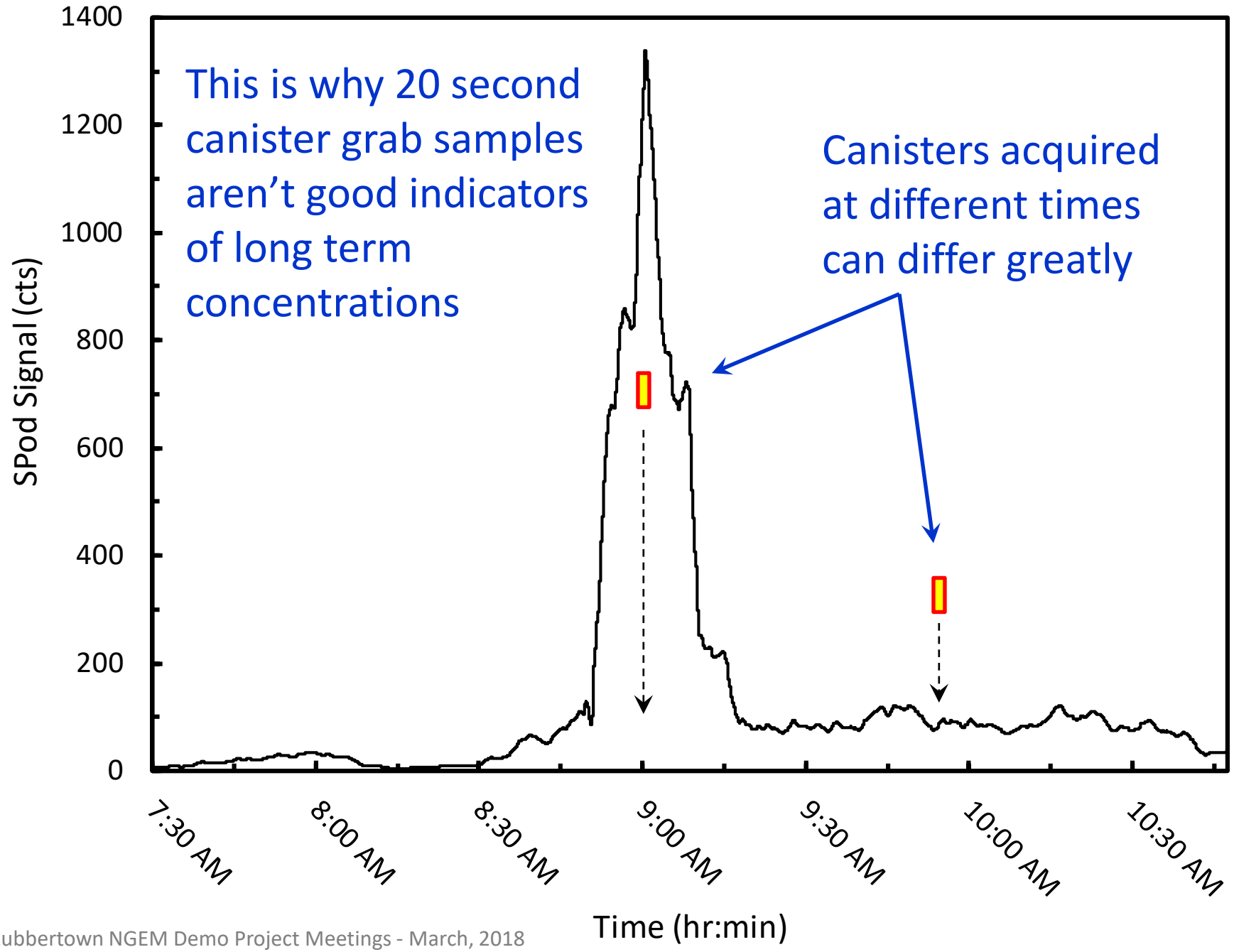
## *20 second Canister Grab Samples*

- *Canister Grab Samples are pretty good for:*
  - Understanding what is in the air at moment in time (snapshot)
  - Helping us study emission events (source signatures)

- *Canister Grab Samples **<u>are not</u>** good for:*
  - Informing long-term concentrations because there is a lot of variability in concentrations when close to a source (24-hour canisters are needed)

*We can't draw strong conclusions from 20 second grab sample data but we can learn a few things*

# SPod VOC Plume Detection on 10/31/17



# Canister Grab Sample Compound List

United States Environmental Protection Agency

***Observed in all canisters (N = 59 canisters)***

| | | | |
|---|---|---|---|
| Butane | Heptane | n-Decane | 1,2,3-Trimethylbenzene |
| Ethanol | ***1,3-Butadiene** | Carbon Disulfide | 1,2-Diethylbenzene |
| iso-Pentane | Isoprene | 1,2-Dichloropropane | 1,1,2,2-Tetrachloroethane |
| Propane | Methylcyclopentane | ***Vinyl Chloride** | Methyl-t-Butyl-Ether |
| n-Pentane | 2,4-Dimethylpentane | Vinyl Acetate | ***Bromoform** |
| Isobutane | 2,3-Dimethylpentane | Undecane | 1,1,1-Trichloroethane |
| Propylene | 1-Hexene | ***Trichloroethene** | cis-1,2-Dichloroethene |
| Chloromethane | Tert-Butanol | Ethyl Tert-Butyl Ether | trans-1,2-Dichloroethene |
| Dichlorodifluoromethane | trans-2-pentene | o-Ethyltoluene | o-Cymene |
| Trichlorofluoromethane | 2-Methylheptane | n-Propylbenzene | Vinyl Bromide |
| ***Methylene Chloride** | Isooctane | Cumene | 3-Chloro-1-Propene |
| CFC 113 | 2,3-Dimethylbutane | Hexachlorobutadiene | Tert Amyl Methyl Ether |
| Acetone | ***Ethylbenzene** | ***Ethyl Acetate** | 1,4-Dioxane |
| ***Carbon Tetrachloride** | Cyclopentane | Naphthalene | cis-1,3-Dichloropropene |
| 3-Methylpentane | cis-2-pentene | 1,1-Dichloroethene | trans-1,3-Dichloropropene |
| 2-Methylhexane | Octane | 1,2,4-Trimethylbenzene | 1,1,2-Trichloroethane |
| n-Hexane | ***Acrylonitrile** | Acetonitrile | 2-Hexanone |
| 3-methylhexane | p-Xylene | 2-Chloroprene | Dibromochloromethane |
| ***Benzene** | Tetrahydrofuran | Dodecane | 1,2-Dibromoethane |
| ***Chloroform** | Dichlorotetrafluoroethane | 1-Ethyl-4-Methyl Benzene | 1,1,1,2-Tetrachloroethane |
| 2-Butanone | 2,2-Dimethylbutane | 1,3,5-Trimethylbenzene | Chlorobenzene |
| ***Toluene** | m-Xylene | Bromomethane | Tert-Butyl Benzene |
| Methylcyclohexane | o-Xylene | Chloroethane | 1,3-Dichlorobenzene |
| 1-Butene | 2,3,4-Trimethylpentane | Bromodichloromethane | ***1,4-Dichlorobenzene** |
| 2-Methylpentane | 1-Pentene | 1,2-Dichloroethane | Sec-Butyl Benzene |
| Isopropyl Alcohol | 1,2,4-Trichlorobenzene | 1,1-Dichloroethane | 1,2-Dichlorobenzene |
| trans-2-butene | Nonane | ***Methyl Methacrylate** | 1,3-Diethylbenzene |
| Acrolein | m-Ethyltoluene | ***Styrene** | n-Butyl Benzene |
| Cyclohexane | ***Tetrachloroethene** | Diisopropyl ether | |
| cis-2-butene | 3-Methylheptane | ***4-Methy-2-Pentanone** | |

***Not present > MDL in any sample***

Method Detection Limit = MDL

Average MDL = 0.01 ppbv (except methylene chloride = 0.019 ppbv)

**Indicates APCD Target Compound*

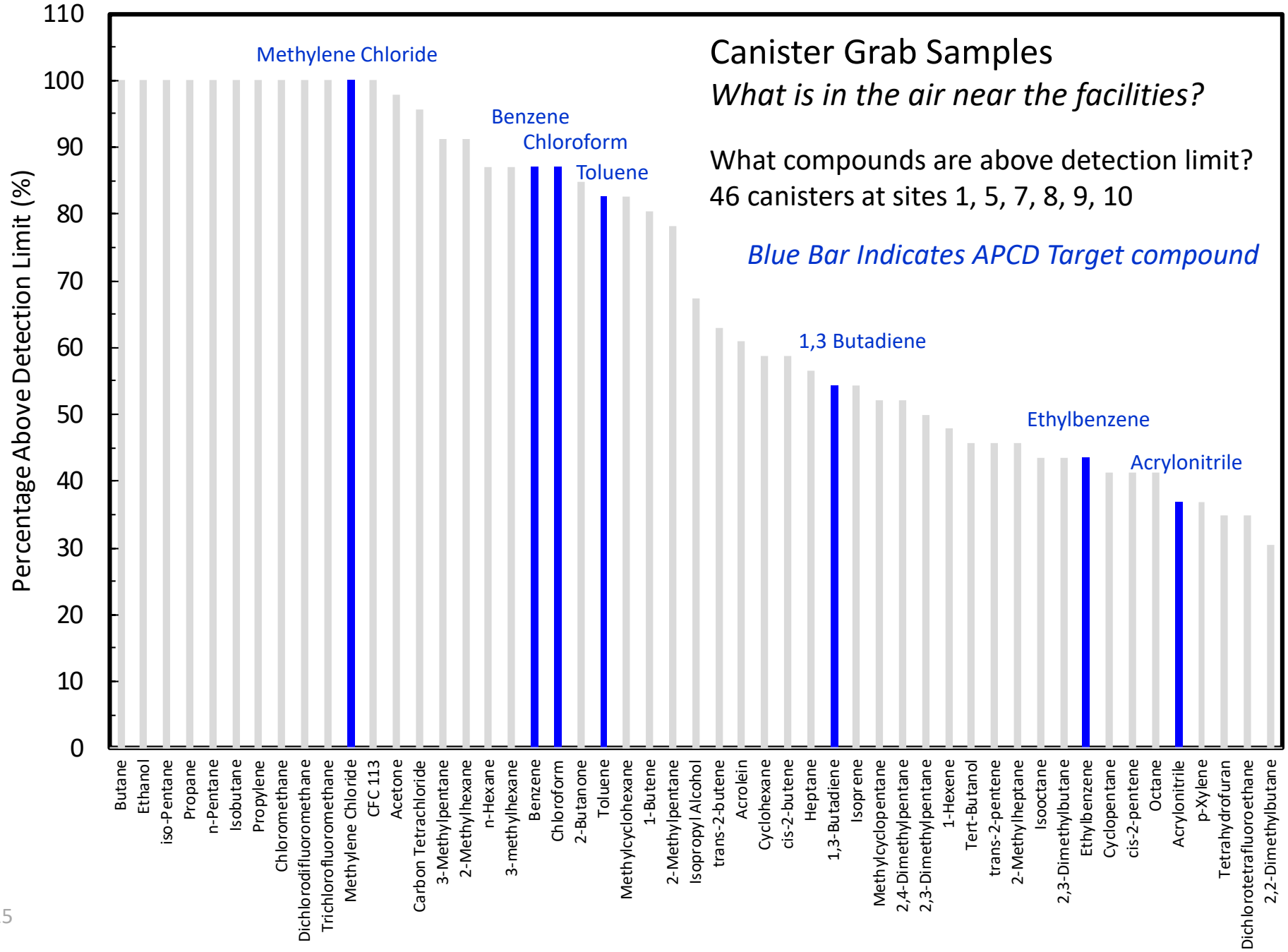
Listed in order of frequency of occurrence above MDL for sites 1, 5, 7, 8, 10

# Canister Grab Samples

*What is in the air near the facilities?*

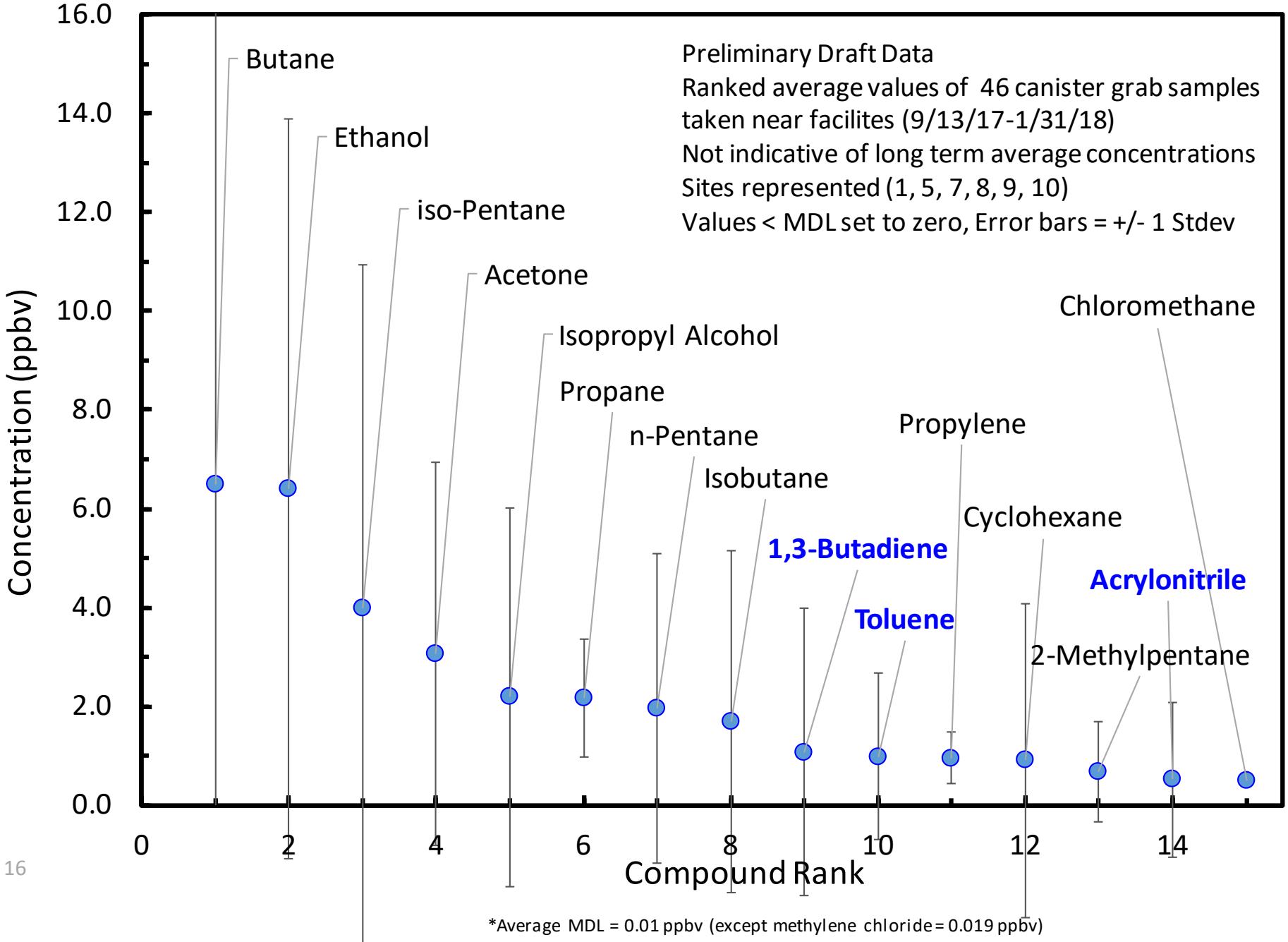
What compounds are above detection limit?
46 canisters at sites 1, 5, 7, 8, 9, 10

*Blue Bar Indicates APCD Target compound*

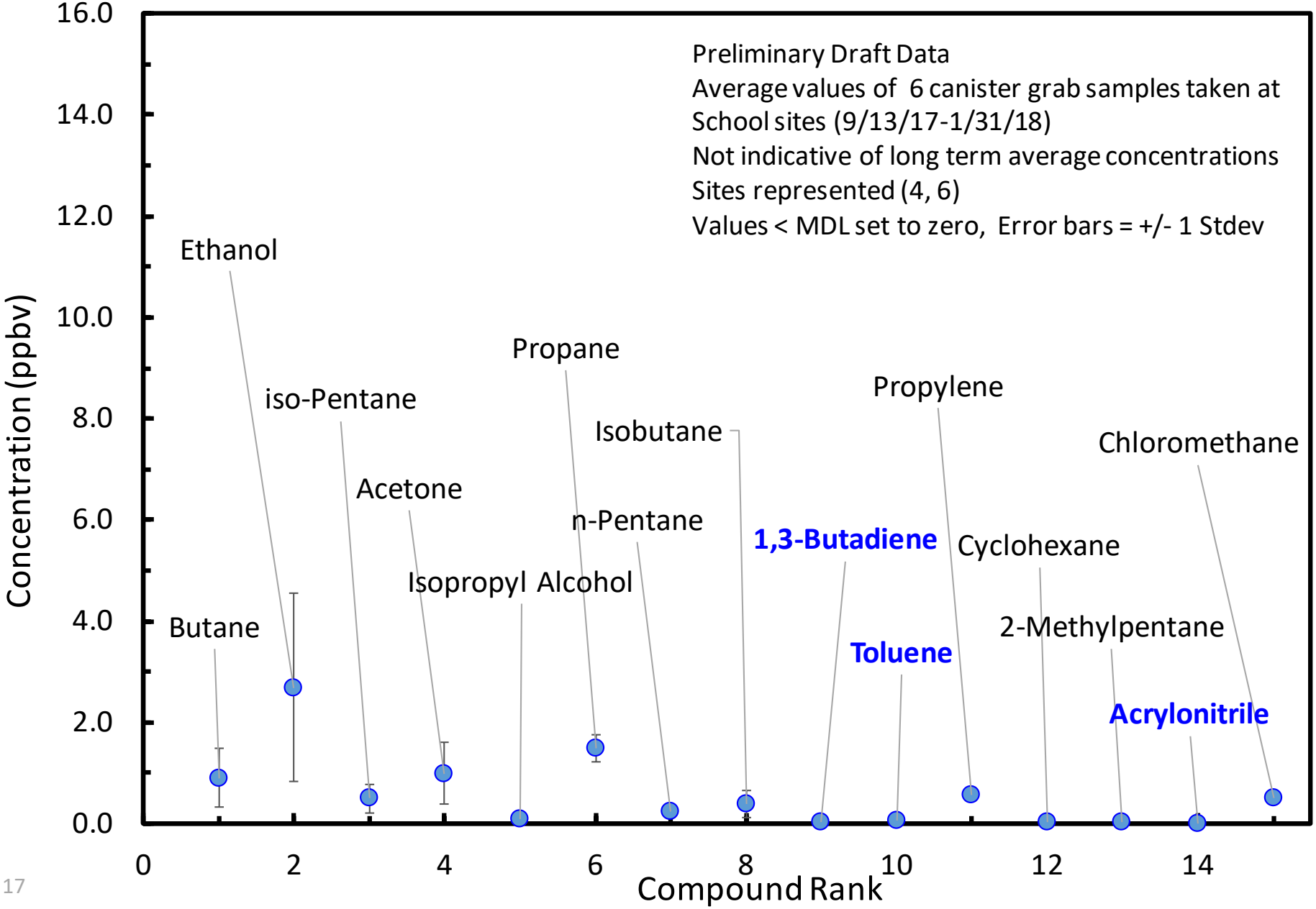



*Average MDL = 0.01 ppbv (except methylene chloride = 0.019 ppbv)

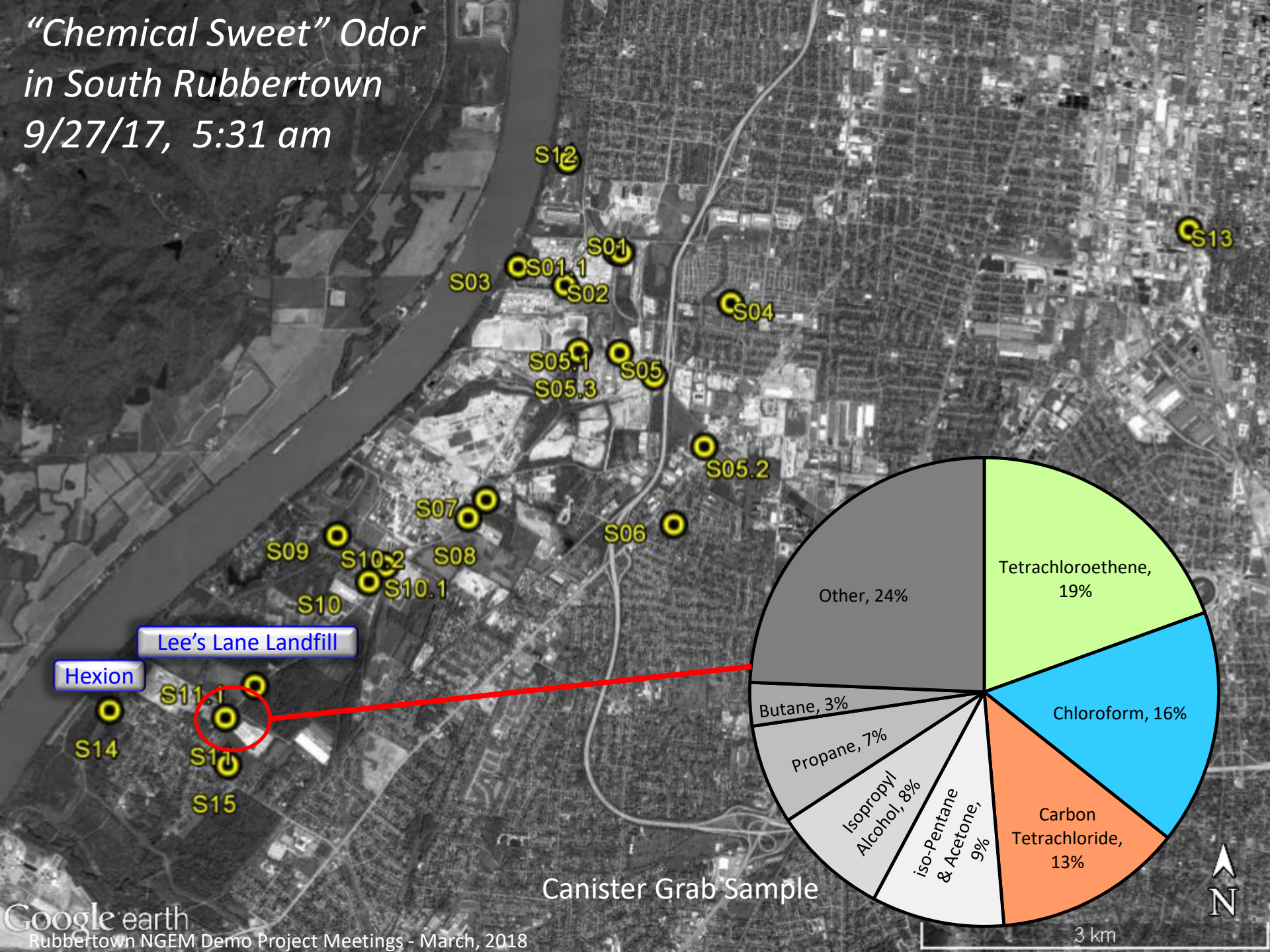
# Canister Grab Samples Near Facilities (N= 46)



# Canister Grab Samples at Carter and Cane Run Elementary Schools (N= 6)




*Average MDL = 0.01 ppbv (except methylene chloride = 0.019 ppbv)

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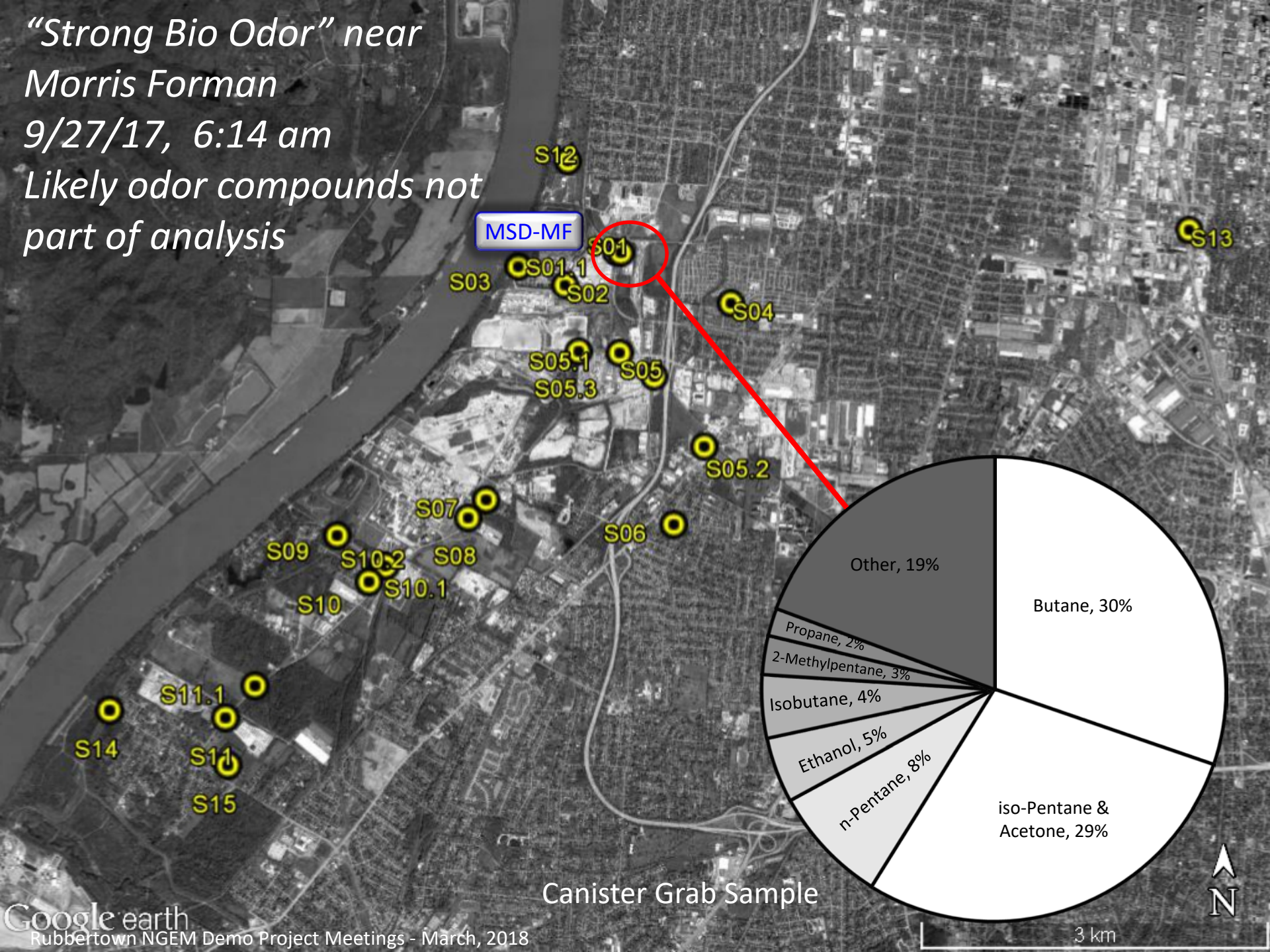
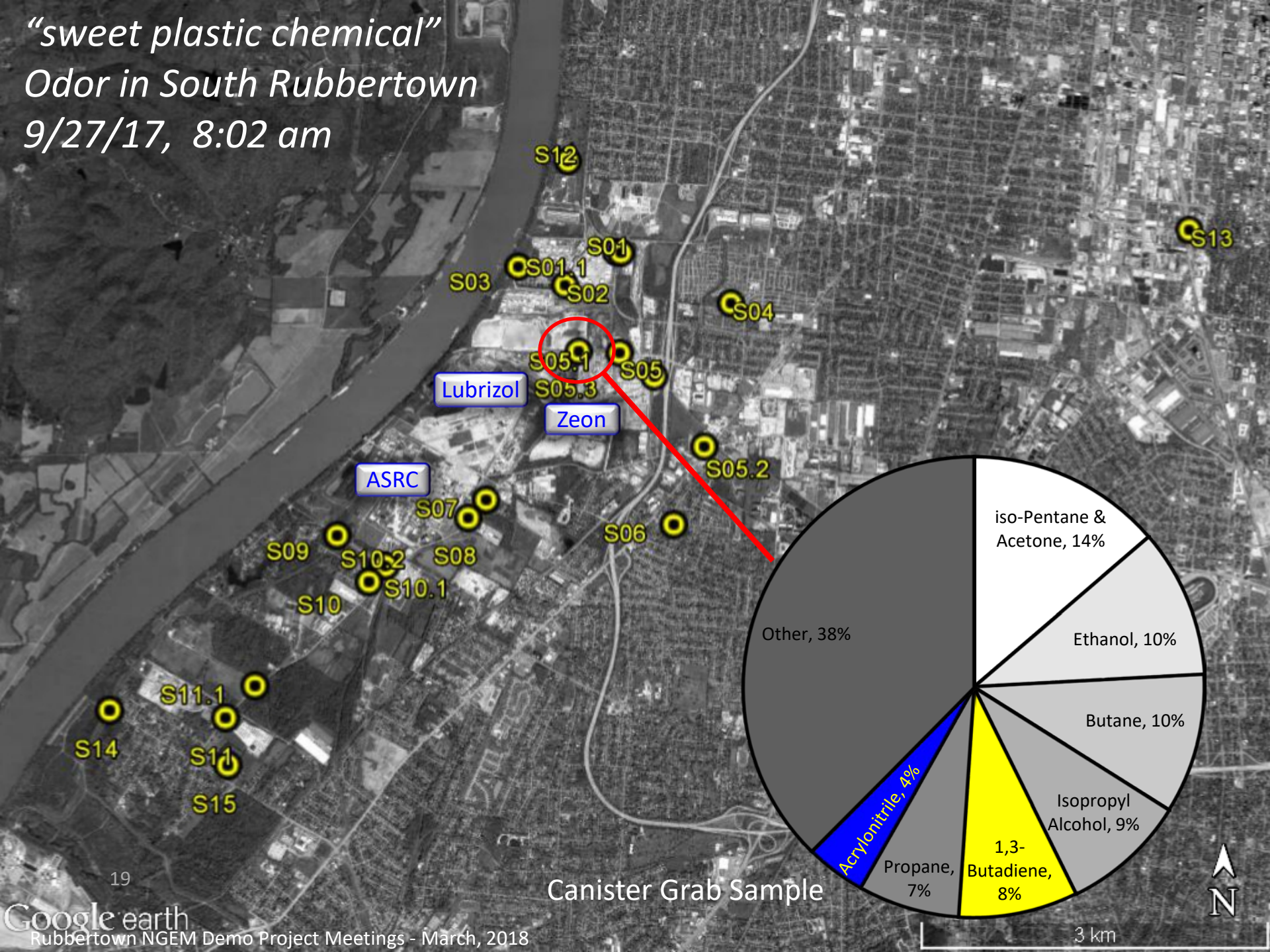
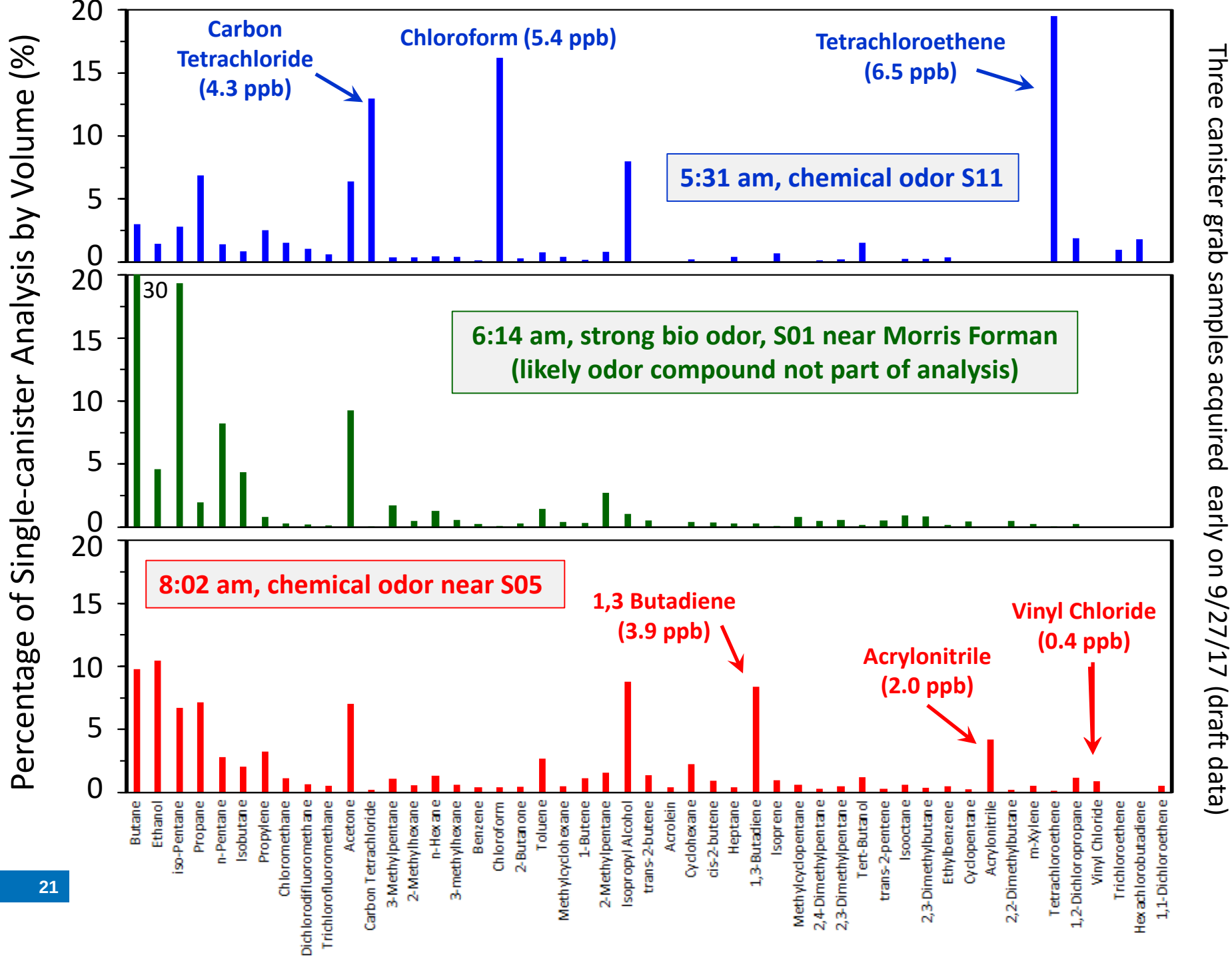

"Strong Bio Odor" near
Morris Forman
9/27/17, 6:14 am
Likely odor compounds not
part of analysis
MSD-MF
S12
S01
S01.1
S02
S03
S04
S05
S05.1
S05.3
S05.2
S06
S07
S08
S09
S10
S10.1
S10.2
S11
S11.1
S13
S14
S15
Other, 19%
Butane, 30%
Propane, 2%
2-Methylpentane, 3%
Isobutane, 4%
Ethanol, 5%
n-Pentane, 8%
iso-Pentane &
Acetone, 29%
Canister Grab Sample
N
3 km
Google earth

# *"sweet plastic chemical" Odor in South Rubbertown 9/27/17, 8:02 am*




Percentage of Single-canister Analysis by Volume (%)
Three canister grab samples acquired early on 9/27/17 (draft data)
Carbon Tetrachloride (4.3 ppb)
Chloroform (5.4 ppb)
Tetrachloroethene (6.5 ppb)
5:31 am, chemical odor S11
30
6:14 am, strong bio odor, S01 near Morris Forman
(likely odor compound not part of analysis)
8:02 am, chemical odor near S05
1,3 Butadiene (3.9 ppb)
Acrylonitrile (2.0 ppb)
Vinyl Chloride (0.4 ppb)
Butane
Ethanol
iso-Pentane
Propane
n-Pentane
Isobutane
Propylene
Chloromethane
Dichlorodifluoromethane
Trichlorofluoromethane
Acetone
Carbon Tetrachloride
3-Methylpentane
2-Methylhexane
n-Hexane
3-methylhexane
Benzene
Chloroform
2-Butanone
Toluene
Methylcyclohexane
1-Butene
2-Methylpentane
Isopropyl Alcohol
trans-2-butene
Acrolein
Cyclohexane
cis-2-butene
Heptane
1,3-Butadiene
Isoprene
Methylcyclopentane
2,4-Dimethylpentane
2,3-Dimethylpentane
Tert-Butanol
trans-2-pentene
Isooctane
2,3-Dimethylbutane
Ethylbenzene
Cyclopentane
Acrylonitrile
2,2-Dimethylbutane
m-Xylene
Tetrachloroethene
1,2-Dichloropropane
Vinyl Chloride
Trichloroethene
Hexachlorobutadiene
1,1-Dichloroethene

# VOC Emissions Tracker (VET)

*…… in development*


- SPod or other sensor
  - Fast, nonspecific concentrations
  - Wind field
  - Pressure, temp, R/H
- Field GC (low cost)
  - Compound specific (10 minute)
- Triggered canister grab sample
  - Optimal acquisition (in-plume)
  - Detailed Lab speciation


http://www.forestry-suppliers.com/product_pages/products.php?mi=21531

# Rubbertown NGEM Demonstration Project

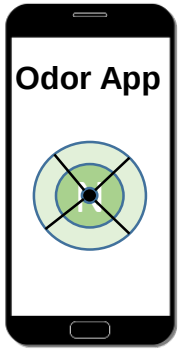
## *Next Steps - March 2018:*

- Keep deploying passive samplers (*Thanks APCD!*)
- Investigate addition of a passive sampler to the south to look at potential tetrachloroethene source
- Improve automated canister grab sample capability (SPod and VET)
- Help APCD with 24 hour canisters and FTC GC validation
- Stand-up EPA Sensor Site S08 across from ASRC
- Continue to test NGEM technologies
- Make linkages between odors and chemicals in the air

United States Environmental Protection Agency

# Potential Citizen Science Project

- EPA is looking into internal funding options for a citizen science add-on project
  - Unfortunately, EPA budget is not certain and we anticipate cuts!
- What would the project include?
  - Explore a phone/computer app that can be used by the local community to report odors
  - App would allow user to record information about the odor such as
    - Date/time
    - Type of odor (chemical, sewage, rotten eggs, etc.)
    - How long odor is present
    - Intensity of odor (mild, moderate, severe)
    - Location/address
    - Outdoor conditions (temperature, wind speed, wind direction)



# Rubbertown NGEM Demonstration Project

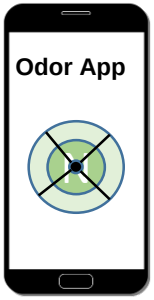
*collaboration on an odor wheel App*

United States Environmental Protection Agency

## How would an odor app be used?

**Step 1: Citizen smells odor**

**Step 2: Citizen enters information into an App**




- ***What is your location?***
- ***What is the intensity of the odor?***
- ***What odor do you smell?***
  ***(See 'Odor Wheel' to right)***
- ***How long did the odor last?***

**Step 3: Information collected**

**Step 4: Pair the odor observations with NGEM measurements**

### Odor Wheel Example

***(Draft idea for discussion)***


[1]Bio mixes contain various complex combinations of VOCs, organic and inorganic sulfur compounds, ammonia, mercaptans, amines, aldehydes, and volatile fatty acids.

[2] Chemical mixes contain various subsets of compounds and will relate to Rubbertown sources (compounds to be determined). Number of chemical categories may increase

EPA United States Environmental Protection Agency

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