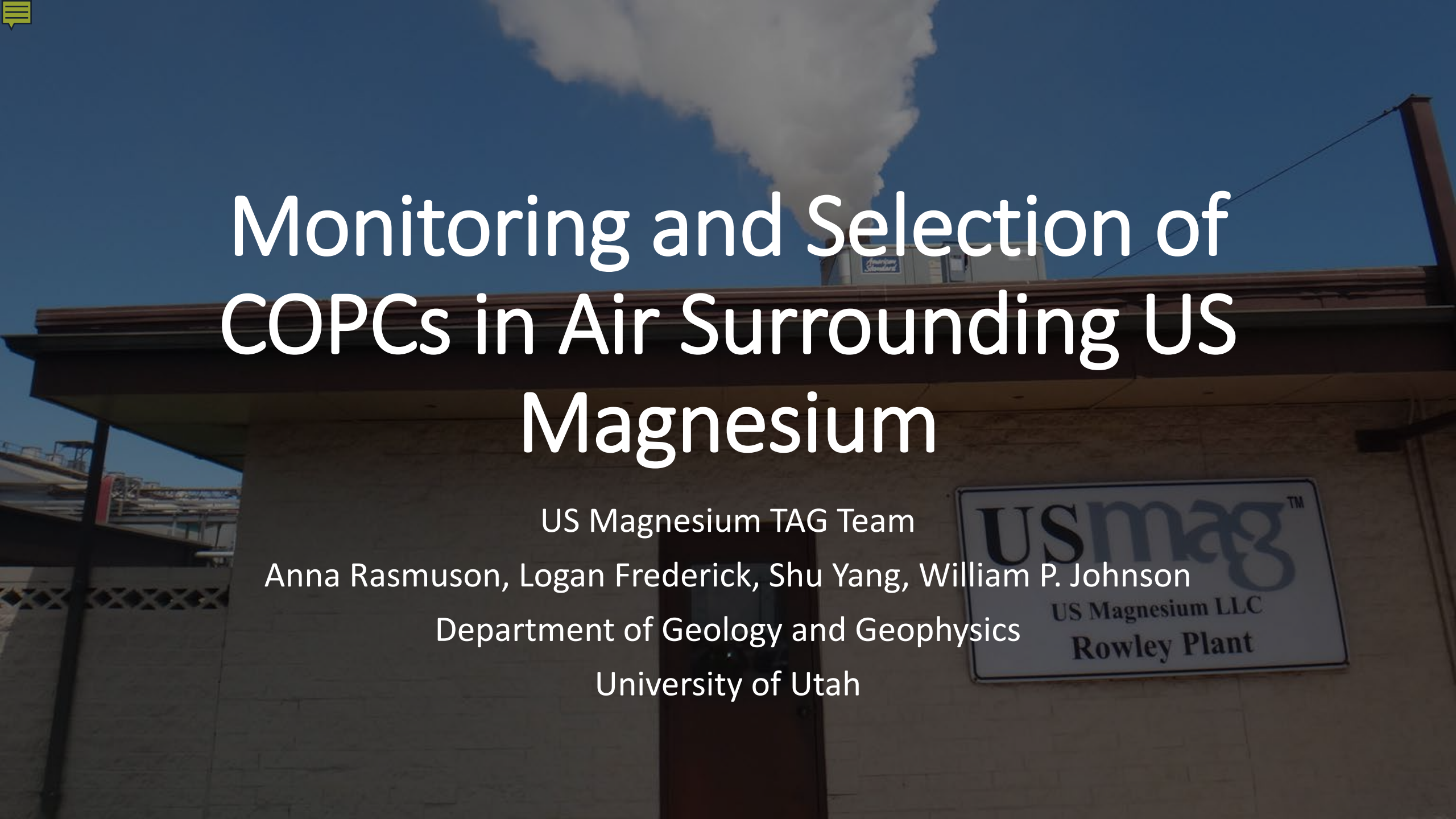

Monitoring and Selection of COPCs in Air Surrounding US Magnesium

US Magnesium TAG Team

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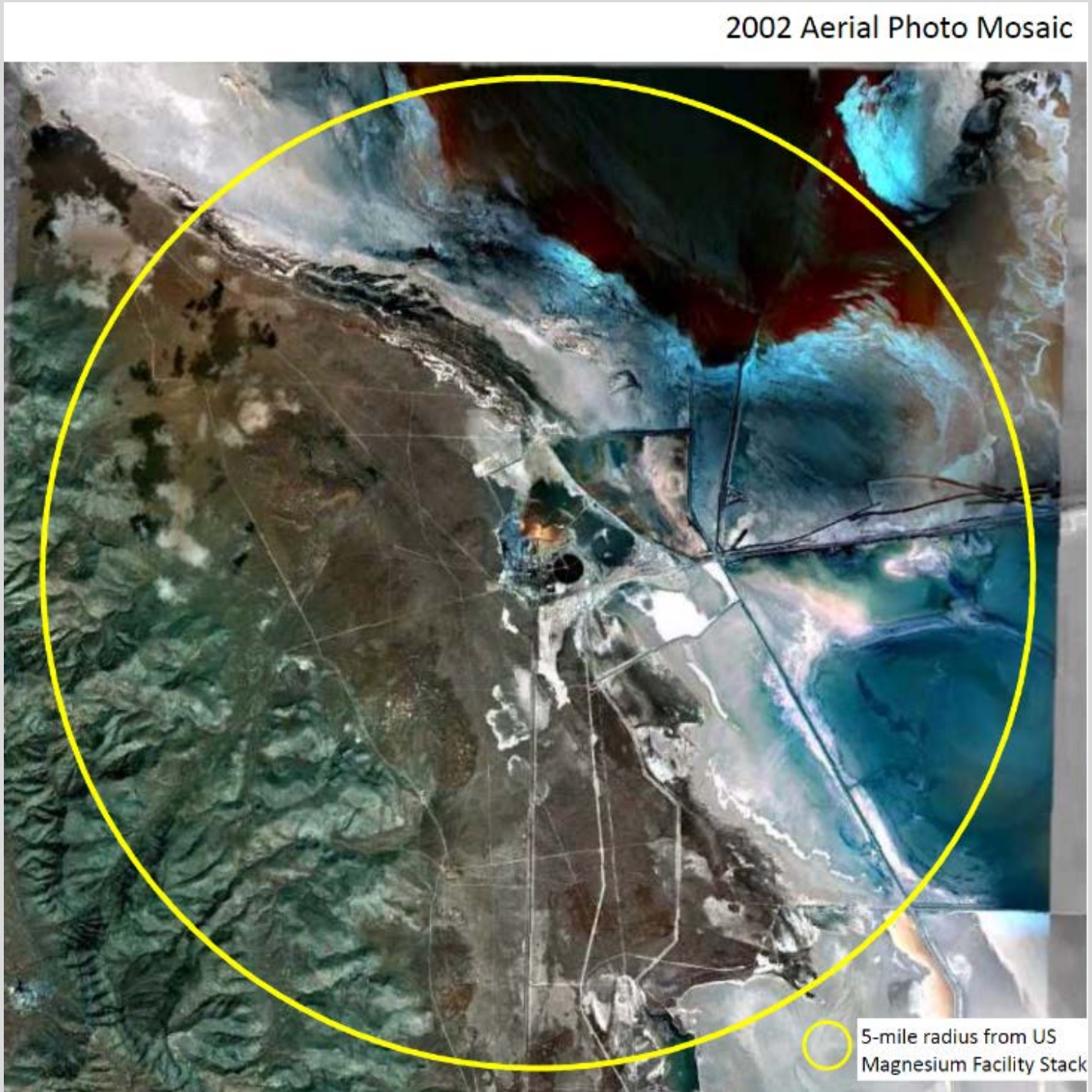
Department of Geology and Geophysics

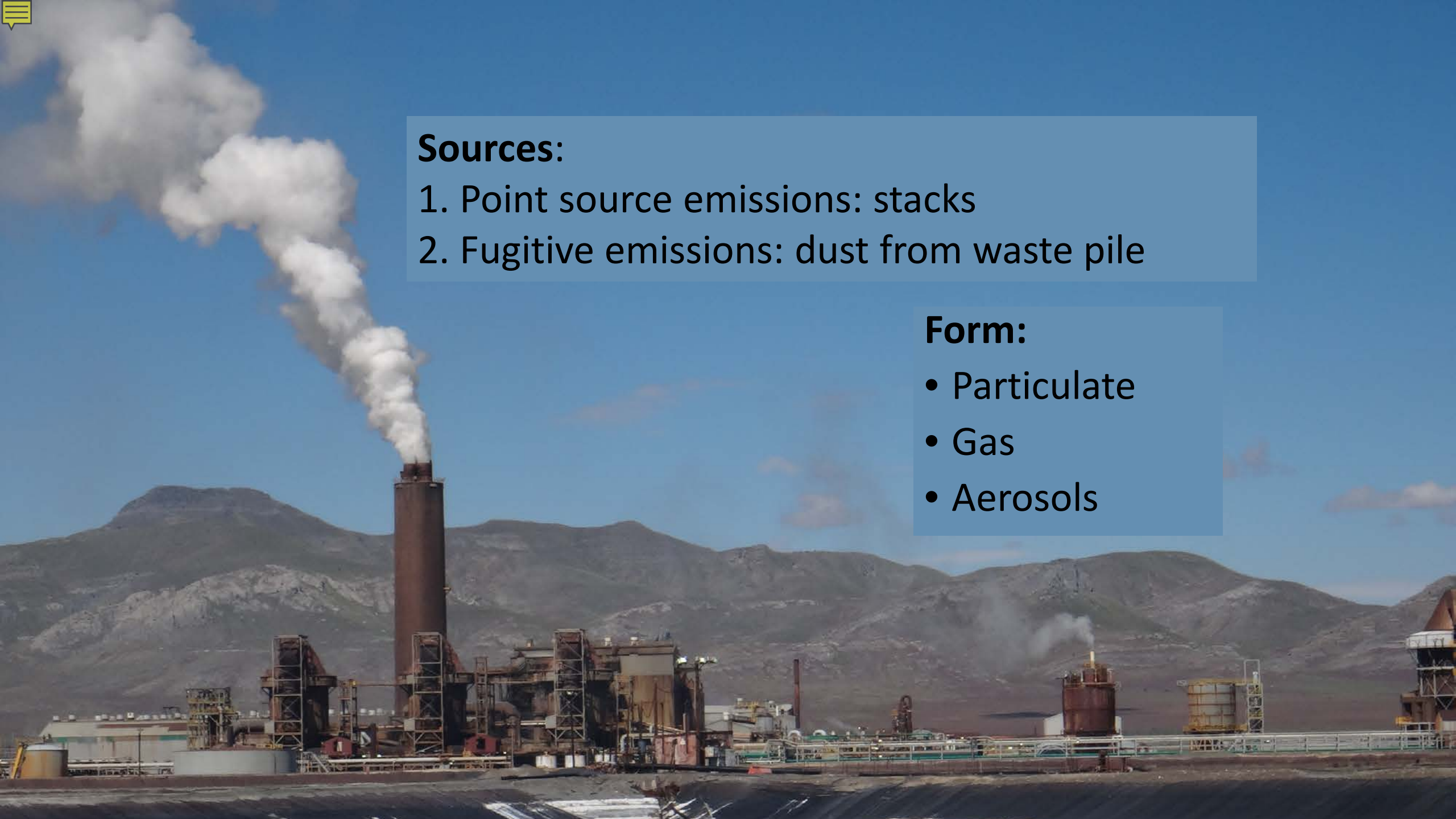
University of Utah

Outline

- Sources
  - Stacks
  - Fugitive
- COPCs
  - Chronic
  - Acute
- Title V Operating Permit
  - Violations
- Monitoring Strategies
  - Chronic Acute
- Selection of COPCs
  - AERMOD
- Ecological and Human Risk Assessment



- Located in Tooele County
- Site encompasses 75 mi^2 with an additional 5 mile boundary radius
- Opened in 1972
- Produces 50,000 tons Mg/year
- Listed on NPL in 2009



Sources:

1. Point source emissions: stacks
2. Fugitive emissions: dust from waste pile

Form:

- Particulate
- Gas
- Aerosols

Source: Stack Emissions

There are 6 stacks:

- 3 Spray Dryer Systems
  - PM_{10}, $PM_{2.5}$, HCl, natural gas combustion products, and steam
- 1 melt reactor
  - PM_{10}, $PM_{2.5}$, Cl_2, and dioxins/furans
- 1 chlorine bypass scrubber
  - Cl_2, PCBs, and HCB
- 1 Emergency off gas scrubber

Ancillary Worker Area (PRI 12)

Source: Fugitive Emissions

Extent of Landfill (PRI 2)

Radius of Gypsum Pile (PRI 4)

Landfill, gypsum pile, smut pile, barium sulfate area

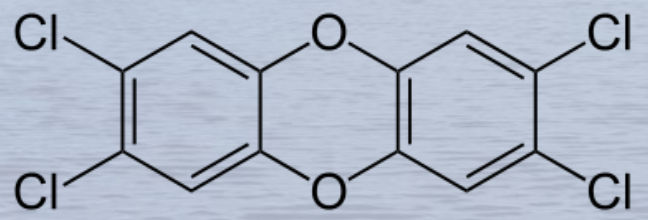
Chemicals of Potential Concern (COPCs)

- Potential COPCs on the Site include:
  - Cl_2
  - HCl
  - VOCs
  - SVOCs
  - PCBs
  - PCDDs/PCFs
  - Trace elements
  - Non-volatile Organic Compounds
  - Other PM_{10}
- Chronic toxins = dioxins/furans, HCB
- Acute toxins = Cl_2 and HCl (already COPCs)

Chronic COPCs:

Dioxins:

- Toxic dioxins among most potent human carcinogens
- Non-cancer risks:
  - Strong correlation with diabetes
  - Immunotoxicity



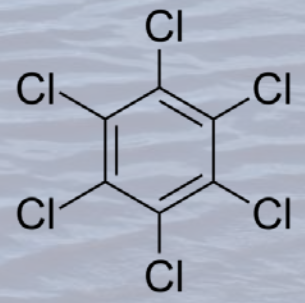
TCDD

Hexachlorobenzene (HCB):

- Bioaccumulates in fatty tissue (takes 15 years to rid HCB from the body)
- Probable human carcinogen

Non-cancer risks:

- Linked to diabetes
- Immunotoxicity (can lead to cancer)
- Liver damage
- Miscarriage/infant death



COPCs: Trace Elements

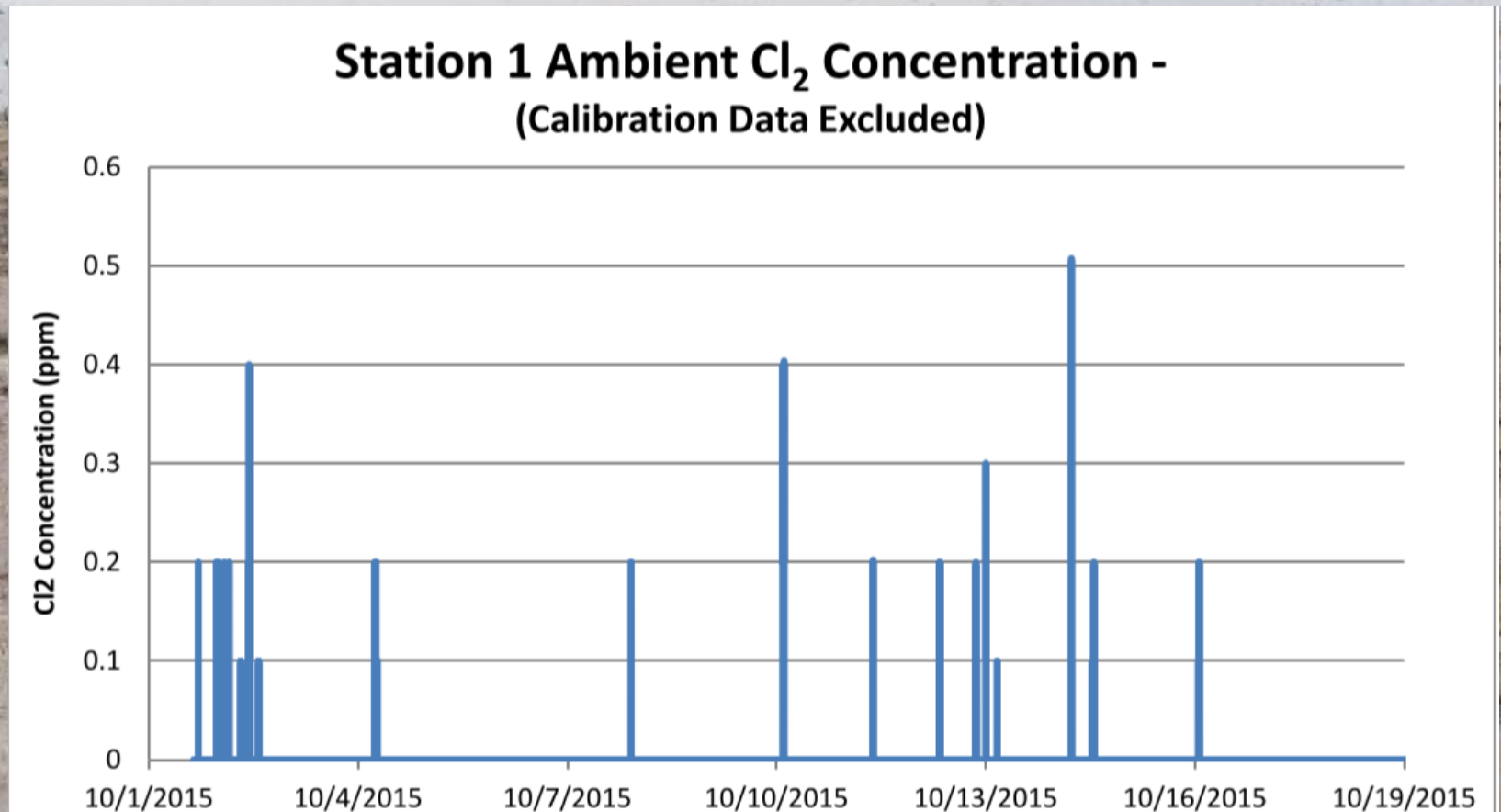
- Sourced from the anode dust box designed to collect off-gasses and dust by-products on site
  - All have high values of arsenic, chromium and mercury
  - Concern for gas and particulate release to air
- Dust is removed by workers with shovels with no dust collection or control procedure in place
- Within the facility → permitted and regulated by RCRA

Acute COPCs: Chlorine gas Cl_2 and HCl

- Cl_2 was used as a weapon in WWI
- Effects are usually reversible
- Exposure is easily detected
- Cl_2 generated in the electrolytic refining process are captured and then recycled or sold
- Opportunity for fugitive emissions as well as emissions from the stack are present

Chlorine Reduction Burner (CRB)

- Converts Cl_2 to HCl
- Stack testing indicates 98-99% efficiency when working properly
- Annual shutdown/maintenance/malfunctions → untreated Cl gas → reported to UDEQ-AQD



Title V Operating Permit:

Cl_2

- 3,300 ton/year source-wide
- 7,500 tons/60 months for maintenance
- 75 tons/year fugitive emission

VOCs

- 0.81 tons/year
- With 0.61 tons/year classified as hazardous air pollutants

HCl and Particulate

- 200 lbs/hr of HCl and 100 lbs/hr of particulate emission
- Discharge of fugitive HCl is NOT permitted

- Division of Air Quality: Monthly reports tracking daily emissions and annual Cl_2

Title V Violations

State of Utah
GARY R. HERBERT
Governor
SPENCER J. COX
Lieutenant Governor

Department of
Environmental Quality
Alan Matheson
Executive Director
DIVISION OF AIR QUALITY
Bryce C. Bird
Director

Violated permit:

- August 27, 2015- uncertified monthly chlorine emission report, inaccurate 6 month monitoring report, incomplete record of stack testing…
- January 19th, 2016- lack of calibration of Chlorine Reduction Burner and Emergency off Gas Stack thermocouples quarterly, flow meters semi-annually, pressure transducers monthly
- February 10th, 2016- failing to observe the packing height, volume, and mist eliminators of the 03 Spray Dryer Scrubber during the 6 month period July 1, 2015 to December 31, 2015

Monitoring Strategies

- Acute: Continuous monitoring for 1 year beginning August 2016
- Chronic: Used modeling to select time of year/location where maximum concentrations are probable
- Concentrations of COPCs vary as a function of:
  - Distance and direction from the Site
  - Time: short-term (daily) and long-term (seasonal)
  - Meteorological conditions
  - Release rates from plant operations
  - Maintenance activities

COPC Selection:

1. State the Problem

- Contaminants are released as gases aerosols, and/ or particulates
- Expected to vary spatially and temporally
- Historical data insufficient

2. Identify the Goal of the Study

- Reliably select COPCs that require further quantitative evaluation in Human and Ecological Risk Assessment (RA)

3. Identify Information Inputs

- Need to characterize both chronic and acute toxins

4. Define the boundary of the study

- Spatial: 5 miles around the site
  - Will be expand if data indicates receptor risk at larger distance
- Temporal: dispersion modelling to 4 years to select optimum sampling locations/times

5. Develop Analytical Approach

- Capture C_{max} for each COPC
- Compare C_{max} to appropriate Risk Based Concentration (RBC)
  - cancer risk >1 in 1 million or HQ > 1
- If measured C_{max} > RBC the contaminant is COPC for Site

6. Specify Performance of Acceptance Criteria

- Want to ensure correct COPCs are selected by collecting high number of samples with reliable collection method

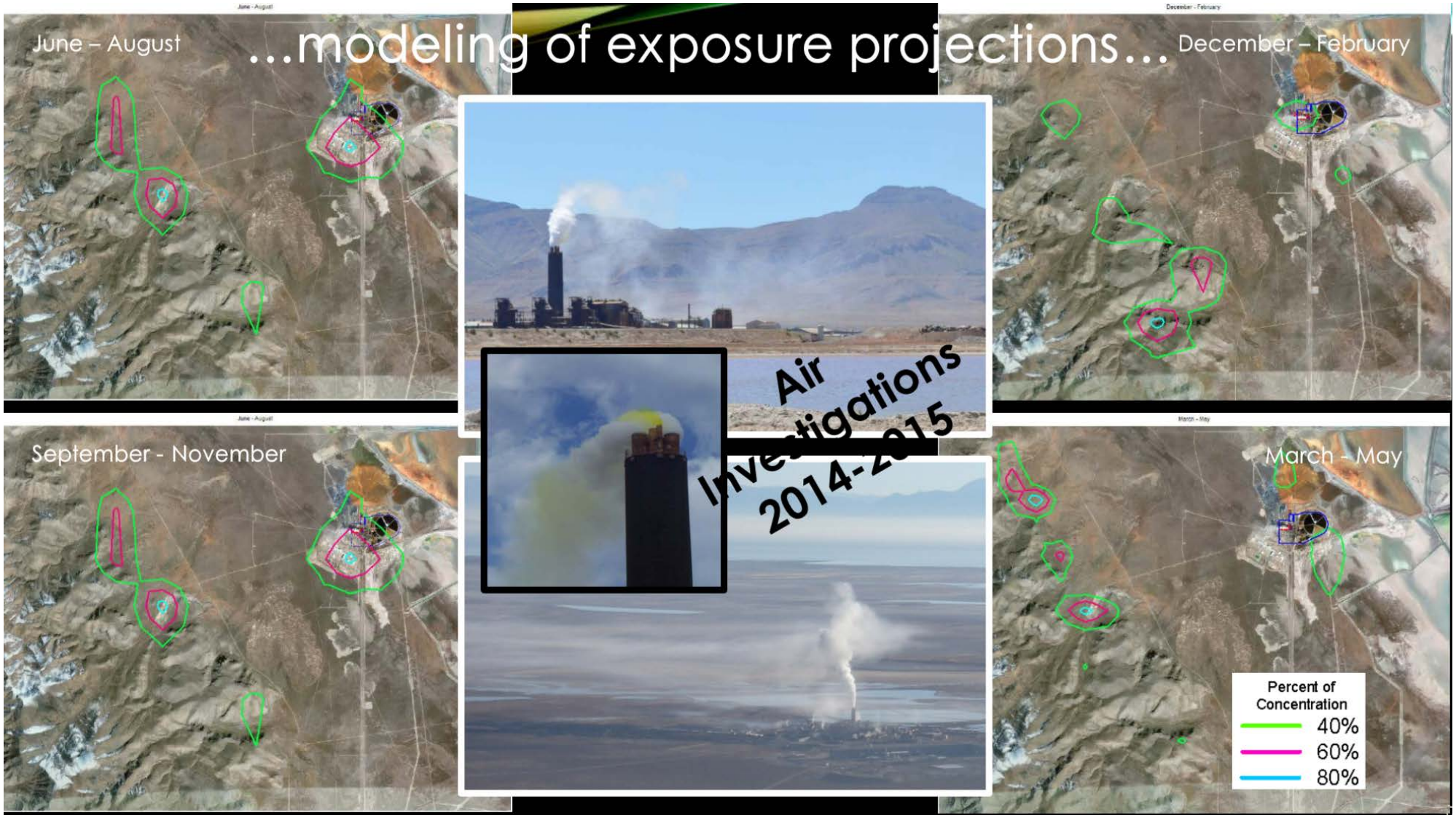
7. Develop Plan for Obtaining Data

- Use AERMOD (dispersion model) and meteorological data to select optimum locations for sampling

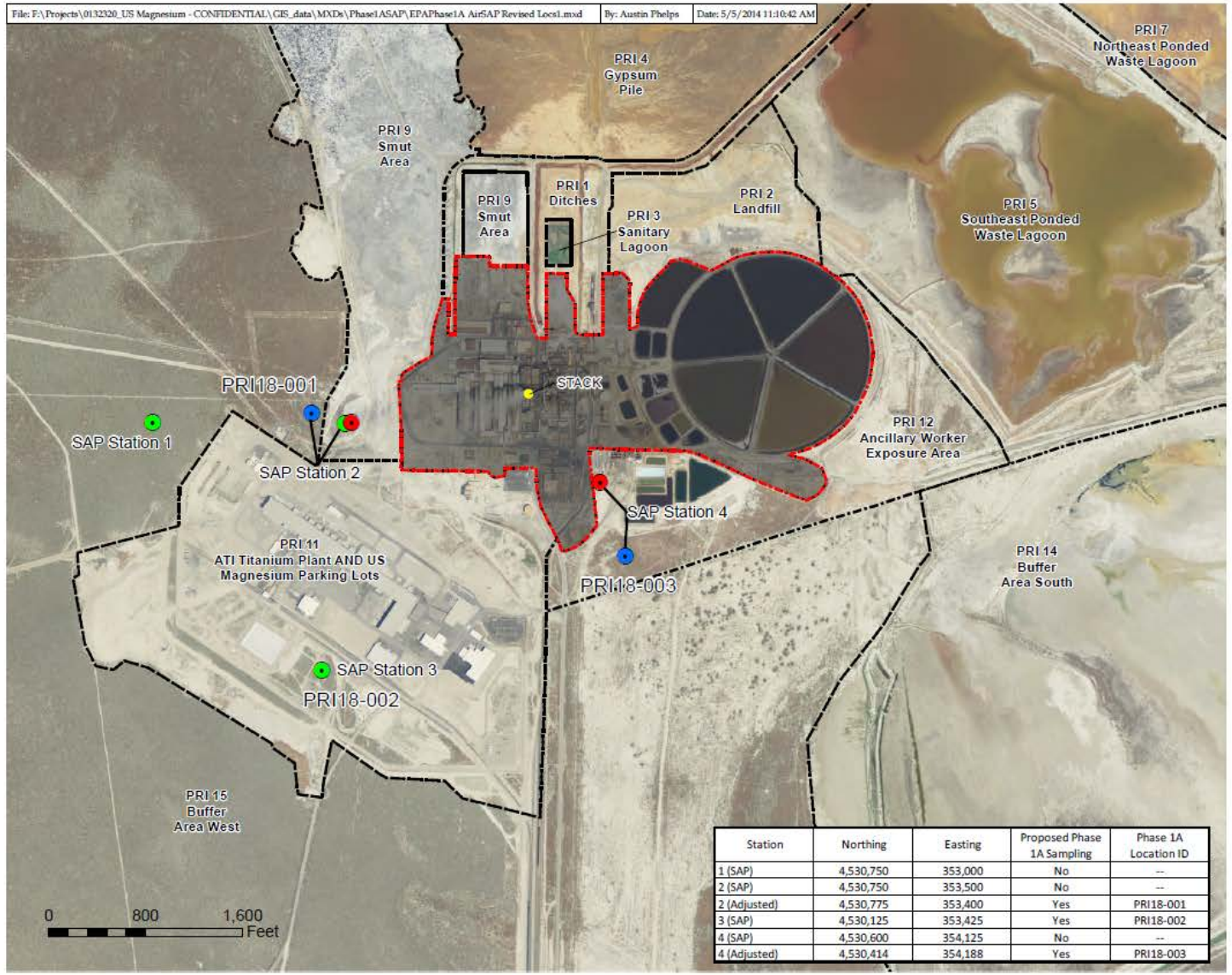
AERMOD

- Grid pattern on 250-meter spacing
- Used to determine sampling locations for both acute and chronic COPC selection
- Average daily concentration
  - Relative daily concentration was calculated for 3 years
- Average long-term concentration
  - Highest long-term average value = modeled average C_{max}
  - Data grouped into consecutive 3-day and rolling 3 month sets
  - Grids were ranked on the probability of exceeding C_{max}
  - Method identifies locations and times where/when the probability of exceeding the average C_{max} is the highest

AERMOD Results



AERMOD: Chronic COPCs



Adjusted Location - 24 September 2013

SAP Target Location

- Optimum for Stack
- Optimum for Fugitive

Operating Facility

Preliminary Remedial Investigation Areas

Notes:
Parcel Boundaries and Land Ownership from Utah GIS Portal.
All boundaries approximate, originally provided by EPA.
Adapted from September 2013 USEPA Final Phase 1A SAP Figure 14-15.
Aerial Photo: NAIP (USDA) July 3, 2011.

Station	Northing	Easting	Proposed Phase 1A Sampling	Phase 1A Location ID
1 (SAP)	4,530,750	353,000	No	--
2 (SAP)	4,530,750	353,500	No	--
2 (Adjusted)	4,530,775	353,400	Yes	PRI18-001
3 (SAP)	4,530,125	353,425	Yes	PRI18-002
4 (SAP)	4,530,600	354,125	No	--
4 (Adjusted)	4,530,414	354,188	Yes	PRI18-003

DRAFT

N

Figure 1
Proposed Air PRI Phase 1A Sampling Locations
U.S. Magnesium, LLC
Rowley, Utah

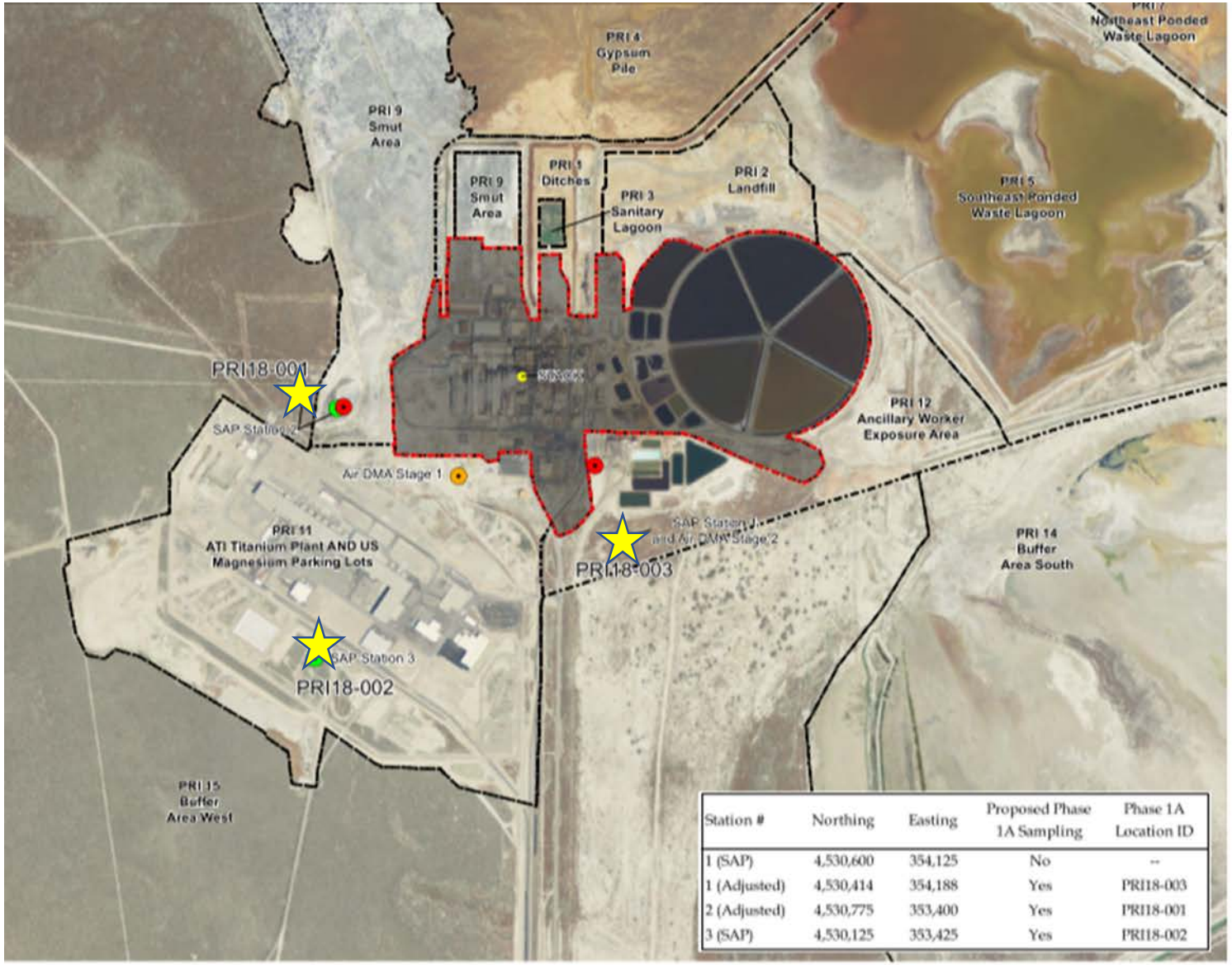
USmag

Environmental Resources Management
101 SW Main St, Suite 804
Portland, Oregon 97204
ERM

AERMOD: Chronic COPCs

- Modelling completed separately for stacks and for fugitive emissions
  - If only stack emissions probability of exceeding the average C_{max} was highest in the **summer.**
  - If only fugitive emissions probability of exceeding the average C_{max} was highest in **winter.**
- Stack is assumed to be the greatest source (mass) of air releases at the Site
  - Summer was selected for sampling
  - Does not capture the maximum fugitive emissions
    - Probability of exceeding the average C_{max} was 20% for fugitive emissions
    - Sampling period is expected to represent both emission sources.

AERMOD: Chronic Sampling Locations



Station #	Northing	Easting	Proposed Phase 1A Sampling	Phase 1A Location ID
1 (SAP)	4,530,600	354,125	No	--
1 (Adjusted)	4,530,414	354,188	Yes	PRI18-003
2 (Adjusted)	4,530,775	353,400	Yes	PRI18-001
3 (SAP)	4,530,125	353,425	Yes	PRI18-002

- Adjusted Location - 24 September 2013
- Optimum for Stack
- Optimum for Fugitive
- Air DMA Sample Location
- Preliminary Remedial Investigation Areas
- Operating Facility

Notes:
All boundaries approximate, originally provided by EPA.
Adapted from September 2013 USEPA Final Phase 1A SAP Figure [illegible]
Aerial Photo NAIP (USDA) July 3, 2011.

0 800 1,600 Feet

N

Figure 3
Air DMA and Phase1A
Air Sampling Locations
Phase 1A Air SAP
U.S. Magnesium, LLC
Rowley, Utah

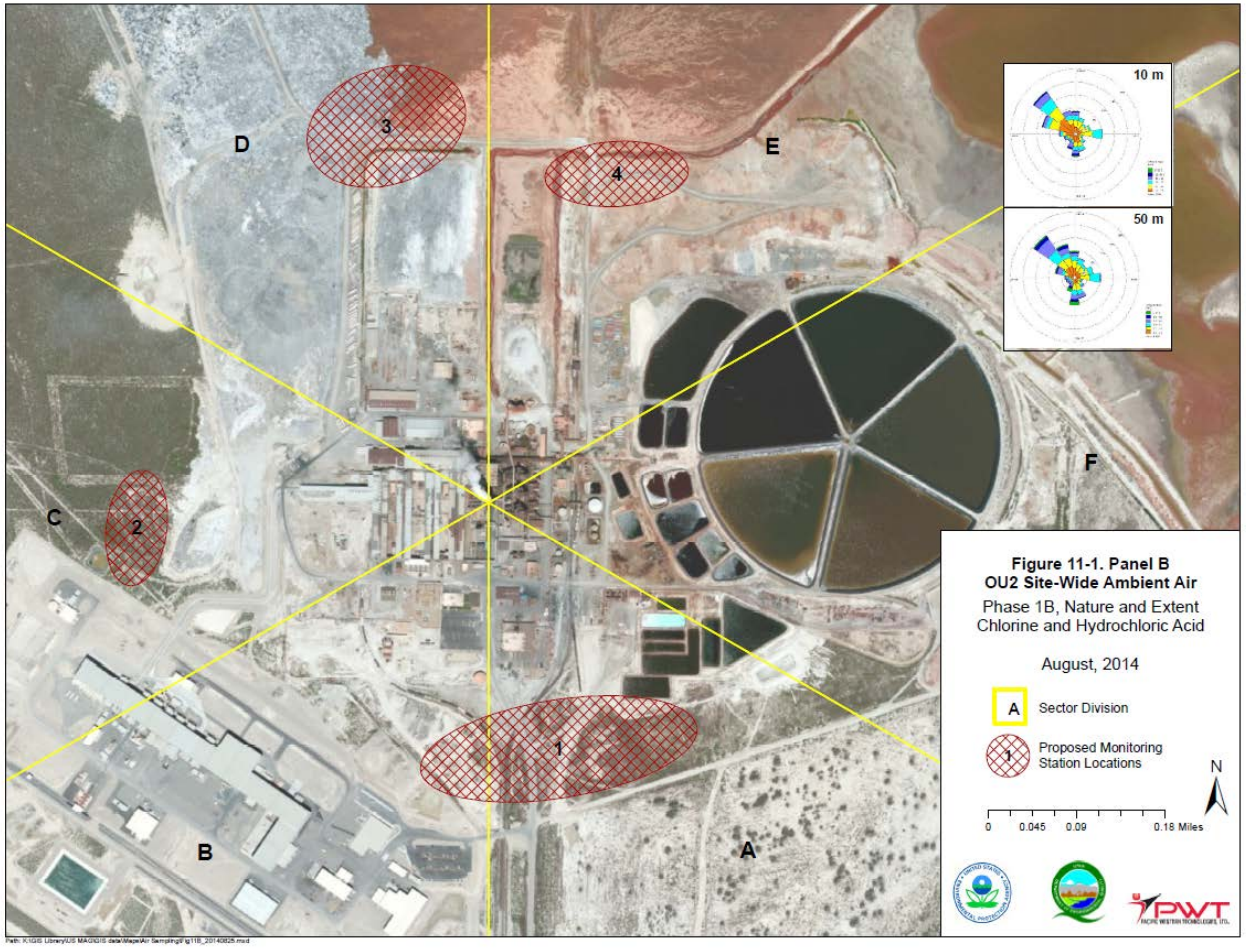
USmag

Environmental Resources Management
101 SW Main St, Suite 804
Portland, Oregon 97204

ERM

AERMOD: Acute COPCs

- Site divided into 6 wedge shaped sectors radiating out from plant
  - Locations grouped:
    - Lakeshore
    - Central
    - Upland/Foothill
- AERMOD used to predict the relative likelihood of high concentration
  - Long term: four-year average
  - Seasonal: by month



Map of inner candidate locations for AERMOD

AERMOD: Acute COPCs

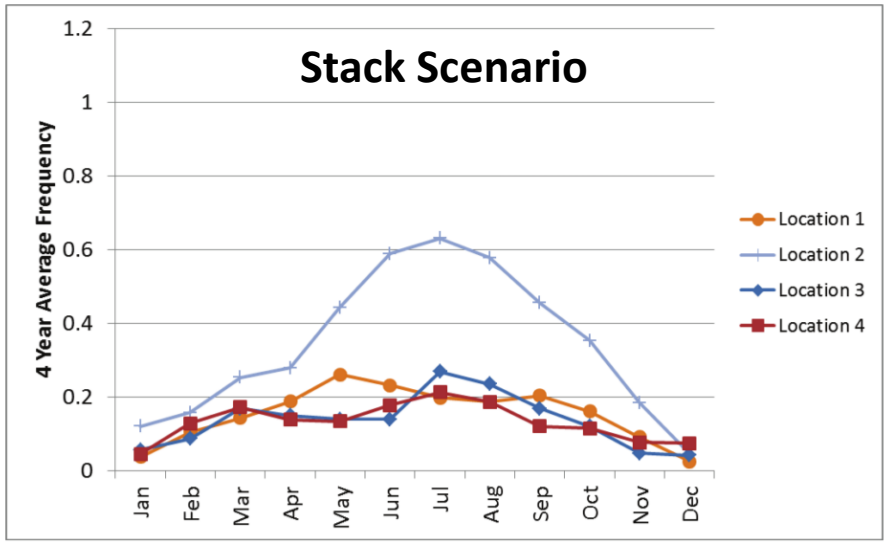


Figure 4. Monthly Event Frequency Results – Inner Candidate Locations, Stack Scenario

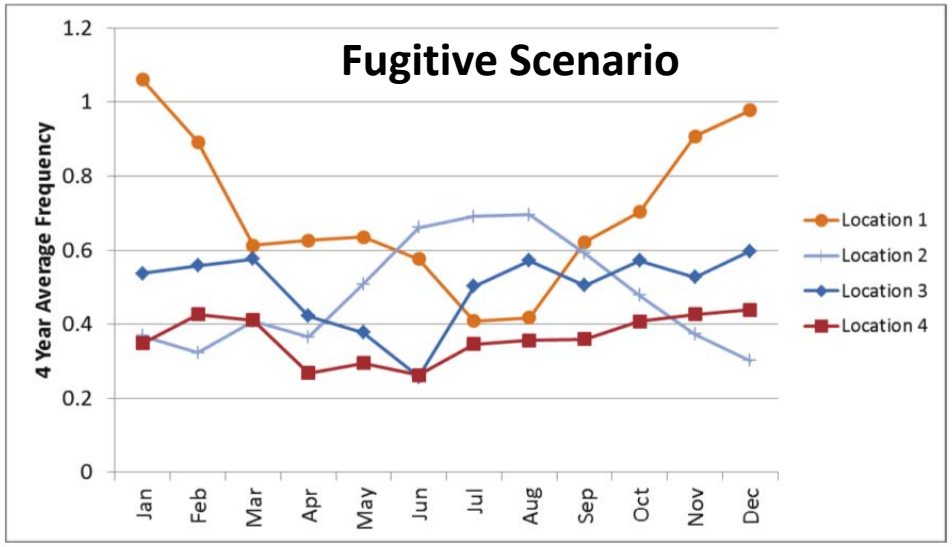


Figure 5. Monthly Event Frequency Results – Inner Candidate Locations, Fugitive Scenario

Table 5. Overview of Phase 1B Monitoring Site Recommendations

Selected Station	Monitoring Months	Modeled Event Frequency Range	Stakeholders/Receptors at or Near this Station
1	Oct. – March	Stack = Moderate/Low Fugitive = High	ATI workers, Hill Bros. workers, delivery persons
2	April – Sept.	Stack = High Fugitive = Moderate	US Magnesium workers
7	Feb. – Sept.	Moderate	Ranchers, recreational visitors, land managers
9	Full Year	Summer = High Winter = Moderate/Low	BLM workers
11	Oct. – Jan.	Moderate/Low	Brine shrimp harvesters, land managers

Monitoring Locations

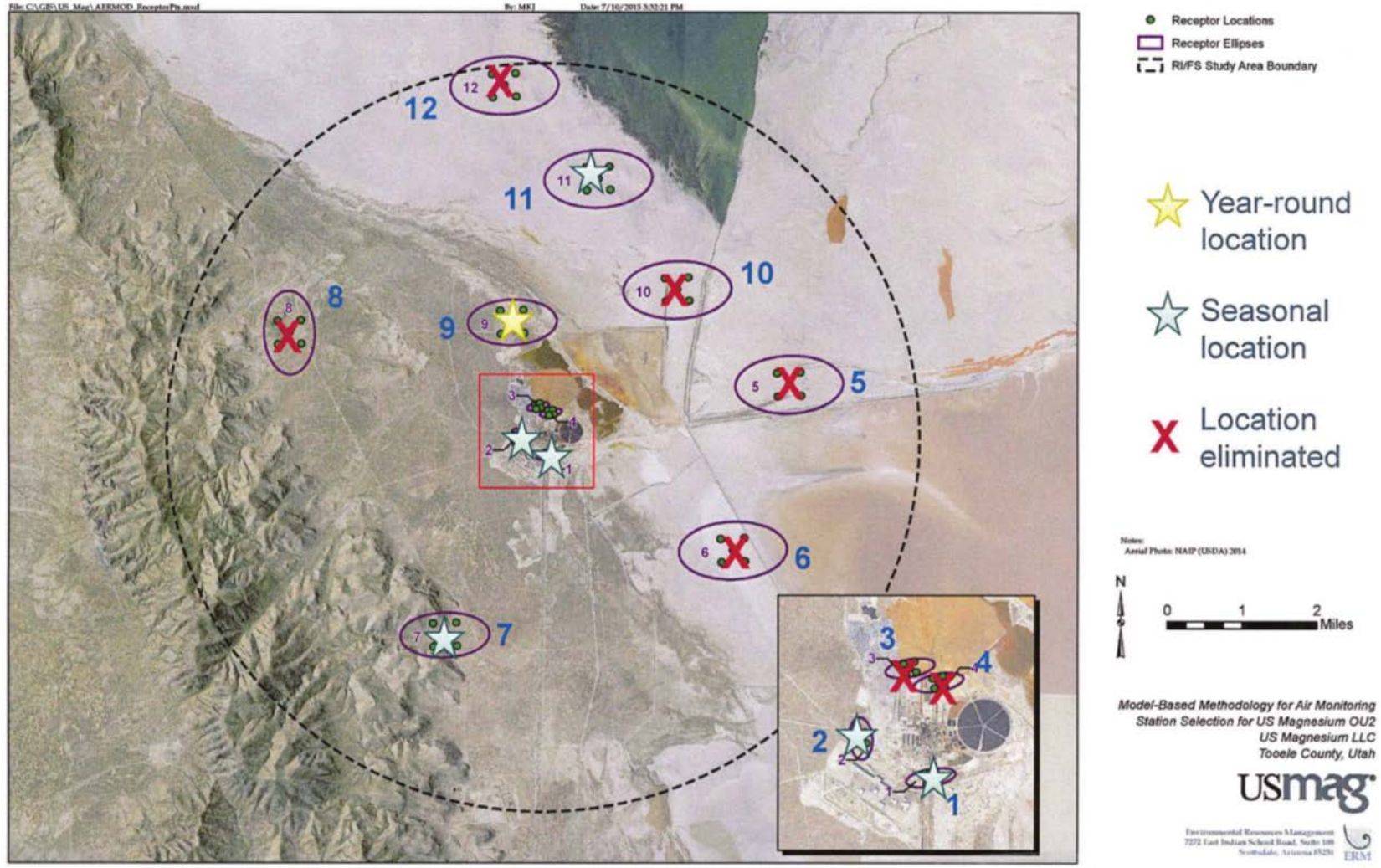


Figure 8. Map of Recommended Phase 1B Monitoring Locations and Zones

Ecological and Human Risk Assessment

- Baseline risk assessment (BRA) for human and ecological receptors completed after screening-level risk assessment on COPCS

- Ecological Risk
  - Birds
  - Mammals
  - Terrestrial and aquatic plants
  - Terrestrial invertebrates
  - Aquatic invertebrates
  - Amphibians and Reptiles

Higher Exposure Risk

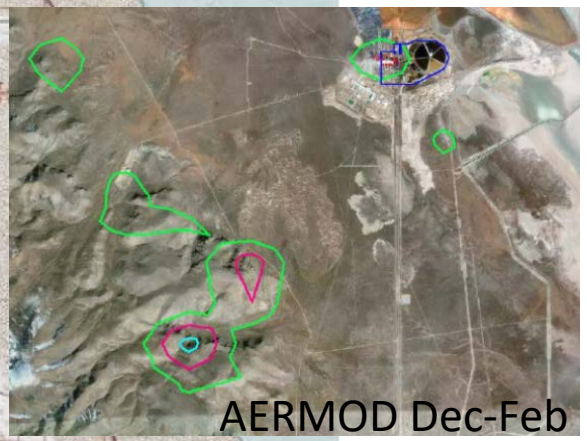
Lower Exposure Risk

- Human Risk
  - Full-time workers at US Magnesium
  - Workers at nearby facilities
  - Episodic workers
  - State and Federal land managers
  - Off-site recreational visitors
  - Hunters
  - Ranchers
  - Seasonal workers

Eagle Nest Locations

Protected by:

- Bald and Golden Eagle Protection Act (16 U.S.C. 668-668c)
- Migratory Bird Treaty Act (16 U.S.C. 703–712).



Map: Phase 1B RI SAP Air
Photo: dailygalaxy.com

Questions for EPA:

1. Measurement of chronic COPCs:

- Sampling of chronic COPCs in air on the Site will occur only in summer because stack emissions (dominant in chlorine and HCl mass) are highest in summer

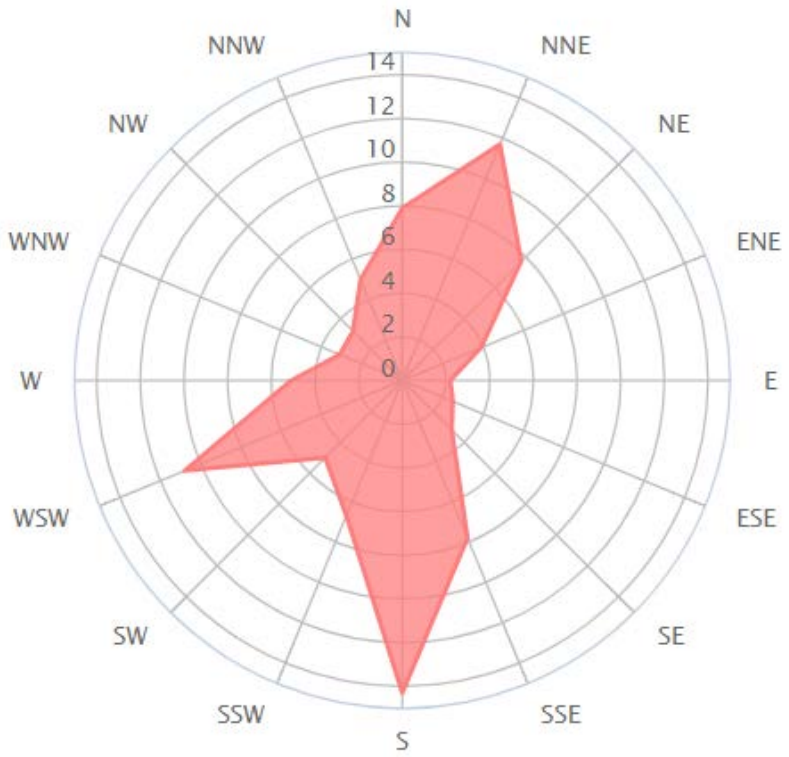
- However, in winter AERMOD predicts higher fugitive emissions (potentially includes a range of COPCs)

- Will summer only sampling miss COPCs in fugitive emissions?

Questions for EPA:

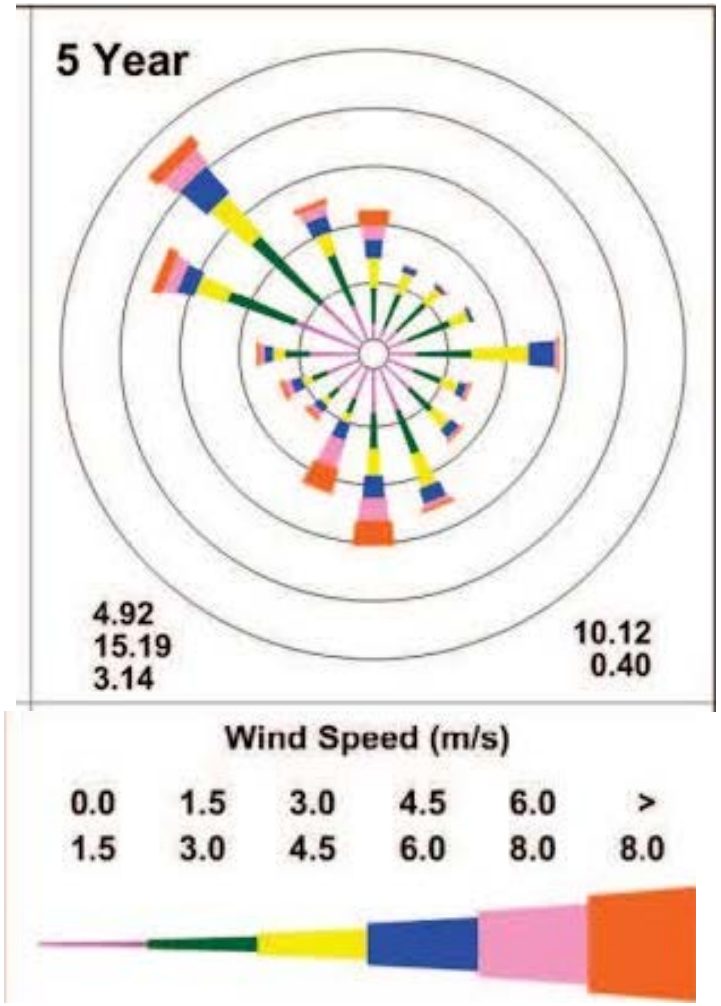
2. Is a circle appropriate? (Predominant N-S winds)

Grantsville Annual Wind Averages



Source: windfinder.com

US Magnesium wind rose

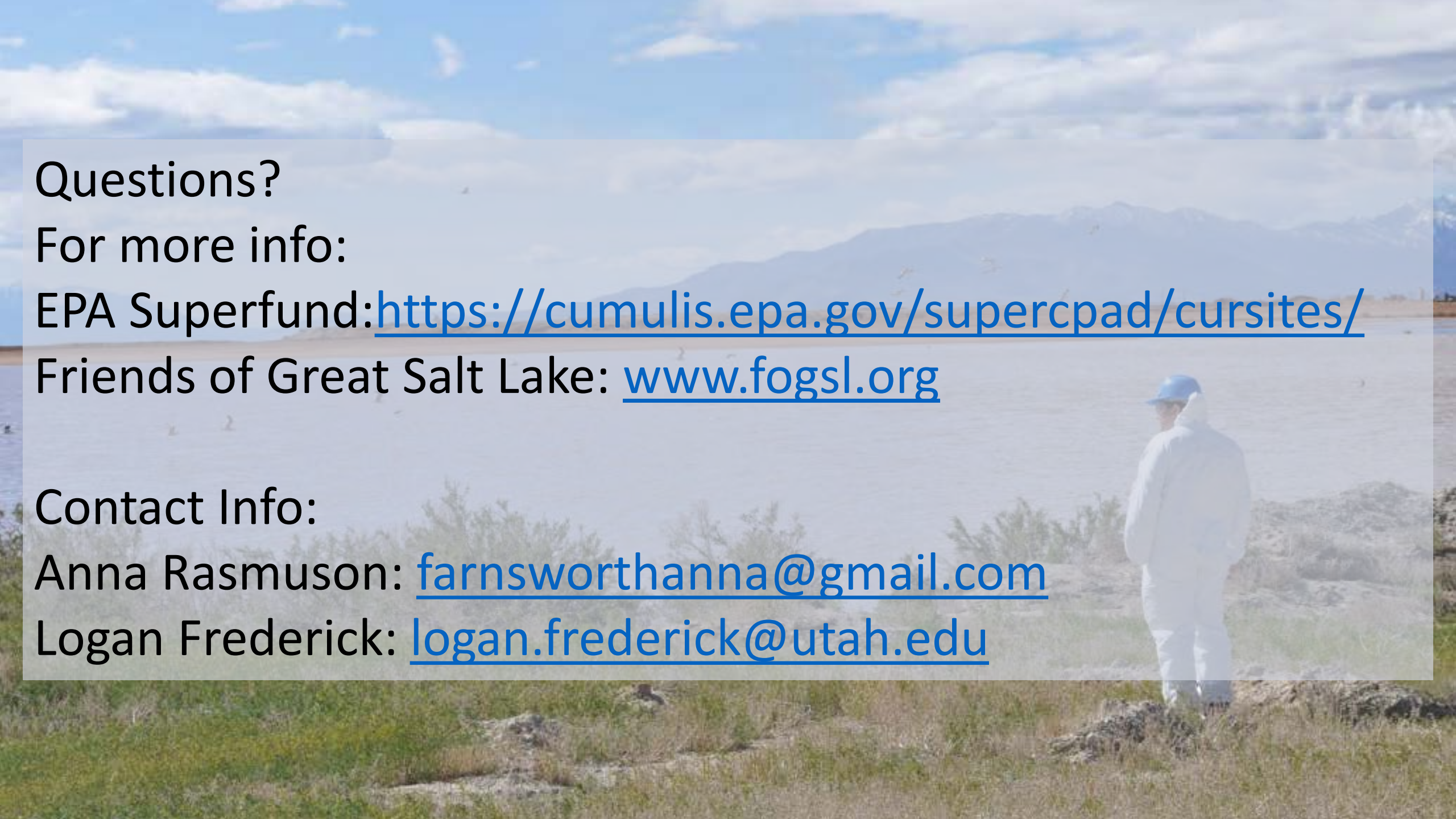


Questions for EPA:

2. Is a circle appropriate? (Predominant N-S winds)

Anecdotal

- A “considerable” distance north of the site: DNR/GSLEP workers experienced “*severe and painful burning of throat, eyes, and nasal cavities.*” –Phase 1B RI SAP
- 18 miles south of the Site: PWT3 personnel experienced “*on two occasions during the Phase 1A activities, with a strong north wind, chlorine gas could be noted (smelled) as far south as the Muskrat Fire Station.*” –Phase 1A RI SAP
- Leonard Herr, air quality expert at BLM noted that continuous monitoring at multiple locations at the Site is necessary in order to monitor emissions during upset/breakdown conditions. A previous breakdown event exposed BLM staff in the field near the site. Toxicity risk for such exposure events need to be evaluated.



Questions?

For more info:

EPA Superfund:https://cumulis.epa.gov/supercpad/cursites/

Friends of Great Salt Lake: www.fogsl.org

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