Determine the Relative Contribution from Three Facilities for the Development of Real-Time Odour Monitoring

Jay Witherspoon[1], Jerry Bovee[2], Scott Cowden[3], Mel Suffet[4], **Bart Kraakman[5]**

[1]**Jacobs Engineering**, San Francisco, USA
[2]**BAAQMD**, San Francisco, USA
[3]**Jacobs Engineering**, Corvallis, USA
[4]**University of California Los Angeles**, Los Angeles, USA
[5]**Jacobs Engineering**, Bristol, UK

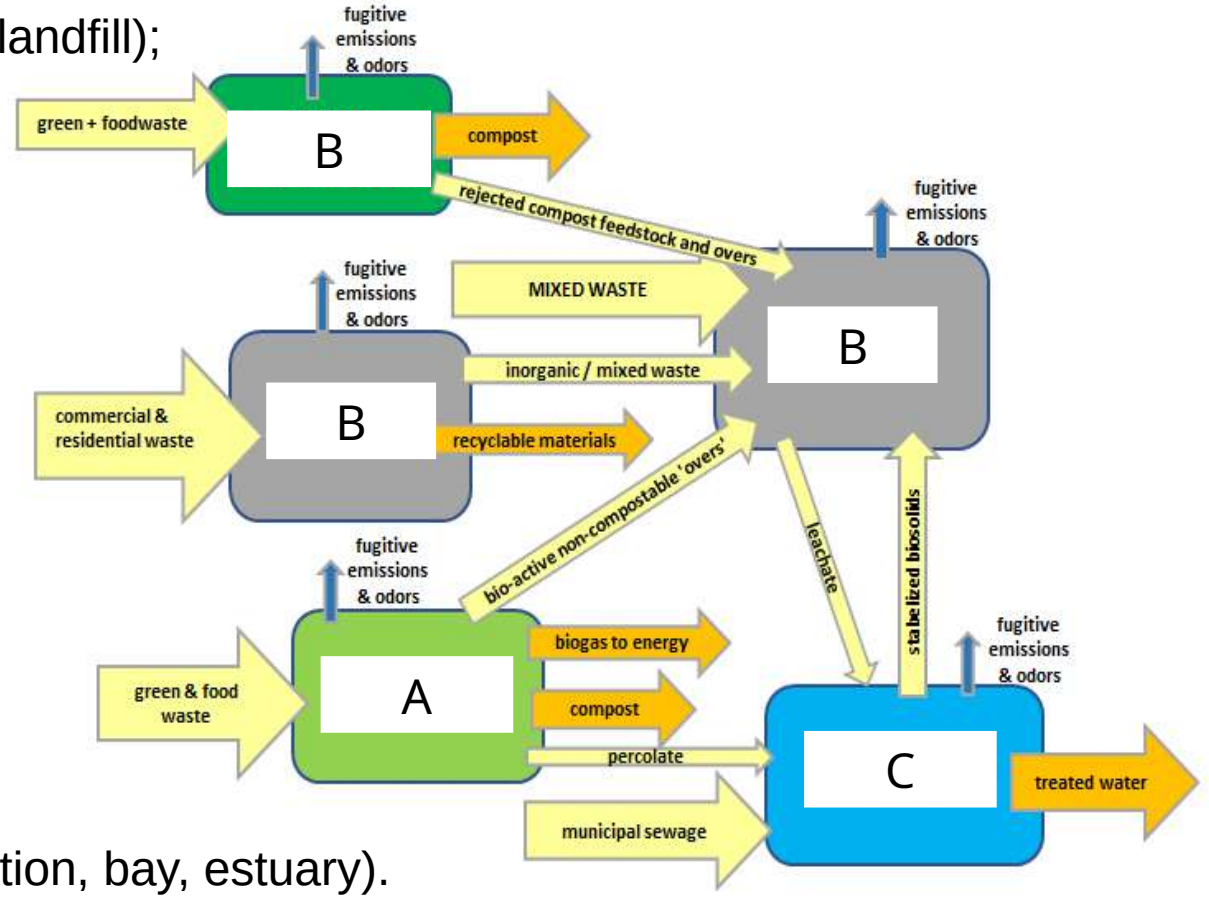
*Supported by Bay Area Air Quality Management District of California, USA

Introduction

The odours in the area originate primarily from three closely located facilities including:

Facility A: An Anaerobic Organic Material Dry Digestion Facility;
Facility B: A Waste Recycling Facility
(waste recycling facility, composting facility, and a landfill);
Facility C: A Wastewater Treatment Facility,

<u>main goal</u>
determine the contribution of odour causing compounds from these sources.



while other natural sources were also considered (lift station, bay, estuary).

Objectives

The objectives of the project were to:

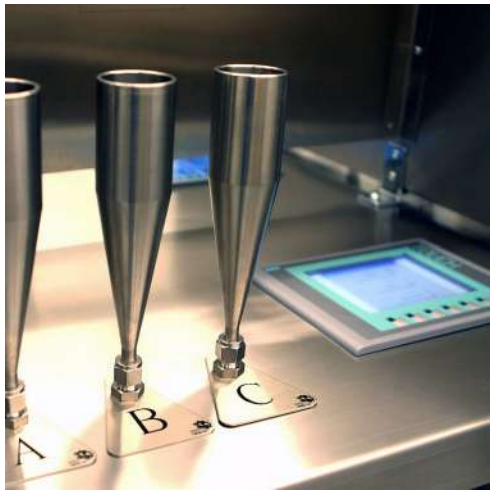
- **determine the contribution** and variability of odour causing compounds from these sources.
- **develop a strategy for measuring** how often and at what concentration these potential odour causing compounds may be passing into the local community.

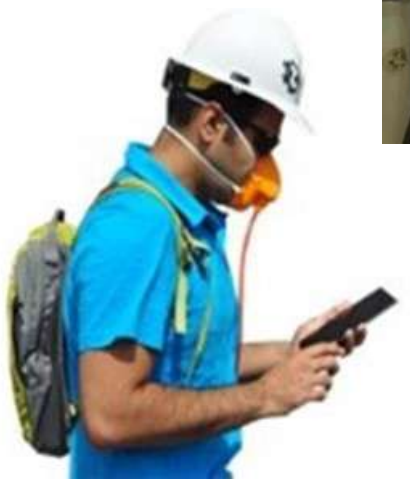
Methodology

Table: Summary of the odour sample collection and analysis methods used.

Odor Constituents	Sample Collection Method	Sample Analyses Method
Olfactometry Laboratory (OU/m^3)	Teflon Bag	ASTM E679-04 Standard of Practice with a presentation rate of 20 liters per minute (per EN 13725)
Reduced Sulfur Compounds	Teflon Bag	ASTM D5504 Method by Modified GC/SCD with sulfur chemiluminescence
VOCs[1]	Sorption Tubes	TO -17 (EPA 1999)
Aldehydes	Sorption Tubes	TO -11A (EPA 1999)
Carboxylic Acids	Sorption Tubes	ALS (sorbent tube) Method 102
Spot H_2S	In-field	Jerome Meter
Continuous H_2S	In-field	OdaLog
Odor Profile Method (OPM)	Teflon Bag	Modified Standard Method 2170: Flavor Profile Analysis Method (applied to air)
Chemical compound analysis (Proton Transfer Reaction)	Teflon Bag	PTR-TOP-MS
Field Olfactometer (D/T)	In-field	SM-100 & In-field Odor Characterization

Methodology

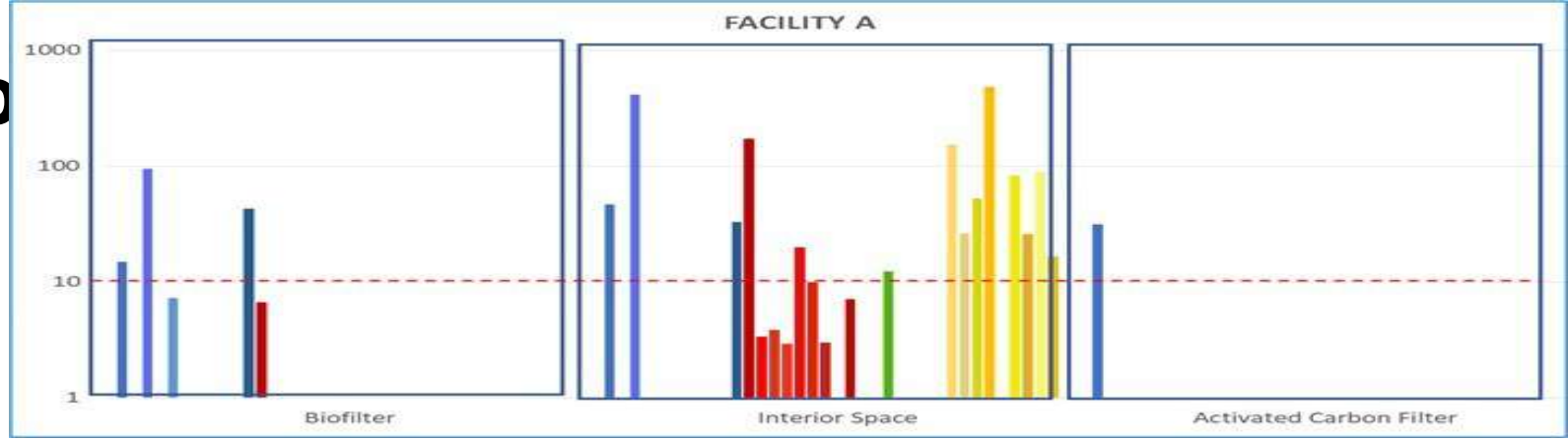


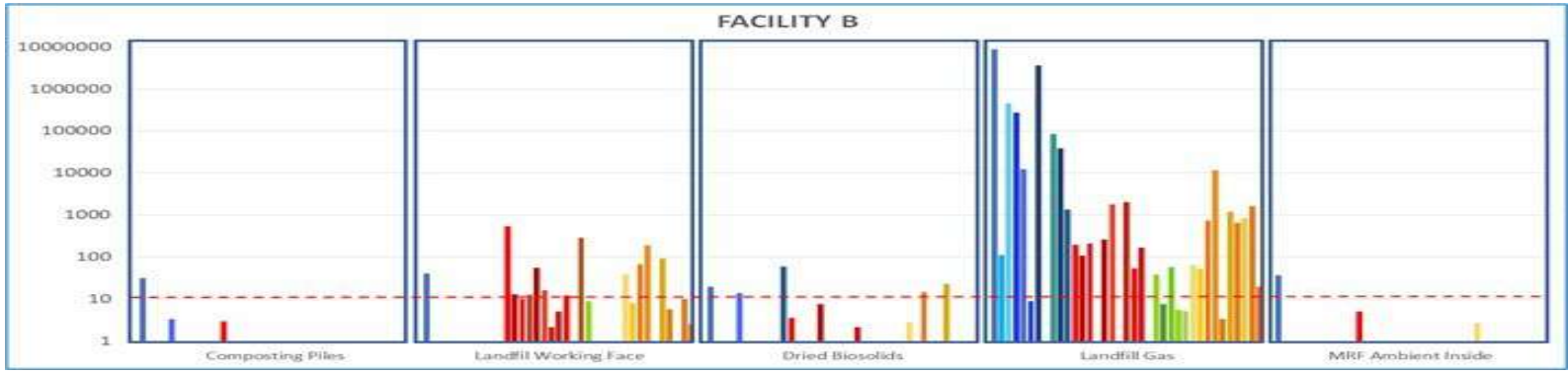


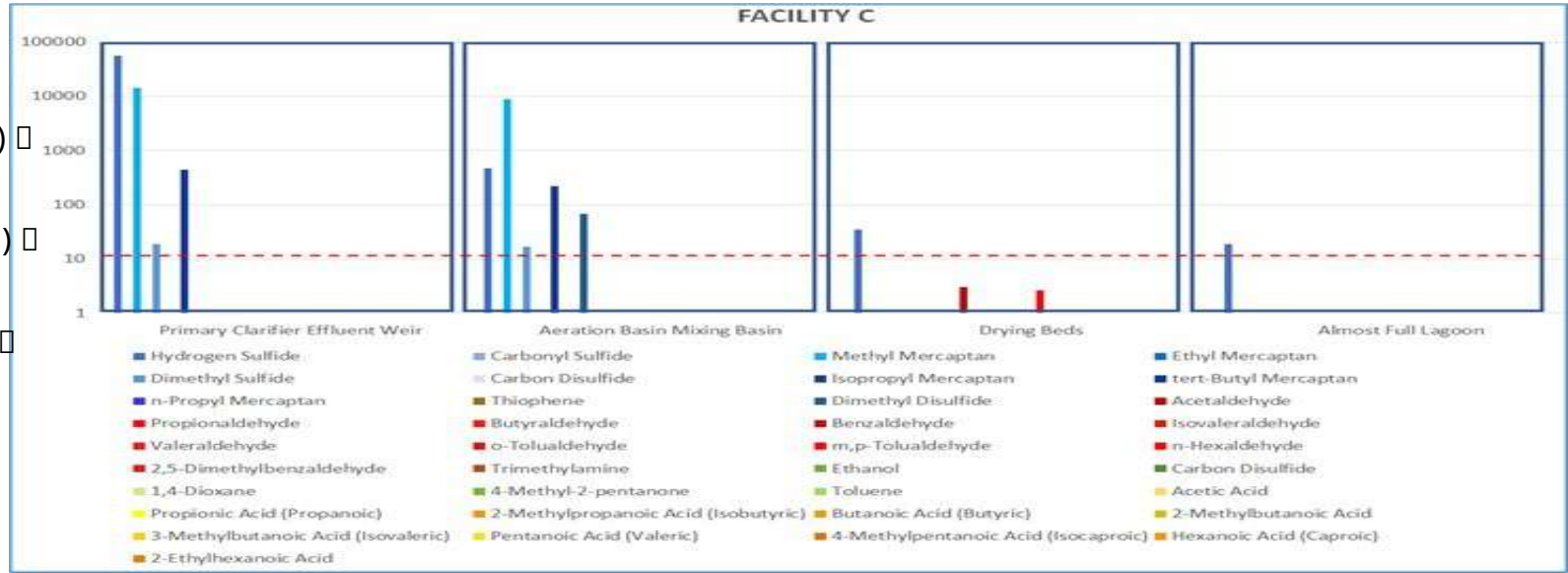
Results - lab odo

Odour Activity Values (OAVs) quantify odour potency/importance

OAV is defined as the ratio of measured mass concentration of an odorant to its odour threshold concentration (OTC).







Sulfur-compounds (characterized as rotten eggs, rotting vegetables) → **blue**;

Aldehydes (characterized as sweet) → **red**;

Carboxylic Acids (characterized as rancid) → **yellow**;

Amine (characterized as fishy) → **brown;**

VOCs (characterization varies) → **green**;

Results – Field Odour Assessments (downstream facilities)

Table: Summary of the key odour sources at each facility.

Facility	Key Odour Sources	Odour Intensity[1] (average/max)	Hedonic Tone[2] (average/max)	Odour Descriptions
A (Organic Material Digestion Facility)	Processing Building Biofilters Activated carbon filters Pressure Release Valves leachate tanks	5.7 / 6 (very strong /extremely strong)	-2.6 / -3 (revolting /nauseating)	putrid, rancid, rotten vegetables, manure
B (Waste Recycling Facility)	Landfill working face Composting Facility Biogas collection system Dried Biosolids Stockpile	4.0 / 6 (strong /extremely strong)	-1.6 / -3 (revolting /nauseating)	garbage, rotten vegetables, sweet
C (Wastewater Treatment Facility)	Primary Settling Tanks Bioreactors Biosolids Facility Sludge Drying Beds	4.1 / 6 (strong /extremely strong)	-1.7 / -3 (revolting /nauseating)	sewage, septic, faecal, urine

[1] Odour Intensity scale as measured just outside the fence-line:
Not Detectable (0), Very Weak (1), Weak (2), Distinct (3), Strong (4), Very Strong (5), Extremely Strong (6)

[2] Hedonic Tone scale as measured just outside the fence-line:
Pleasant (1), Neutral (0), unpleasant (-1), revolting (-2), nauseating (-3)

Results – Field Odour Assessments (downstream facilities)

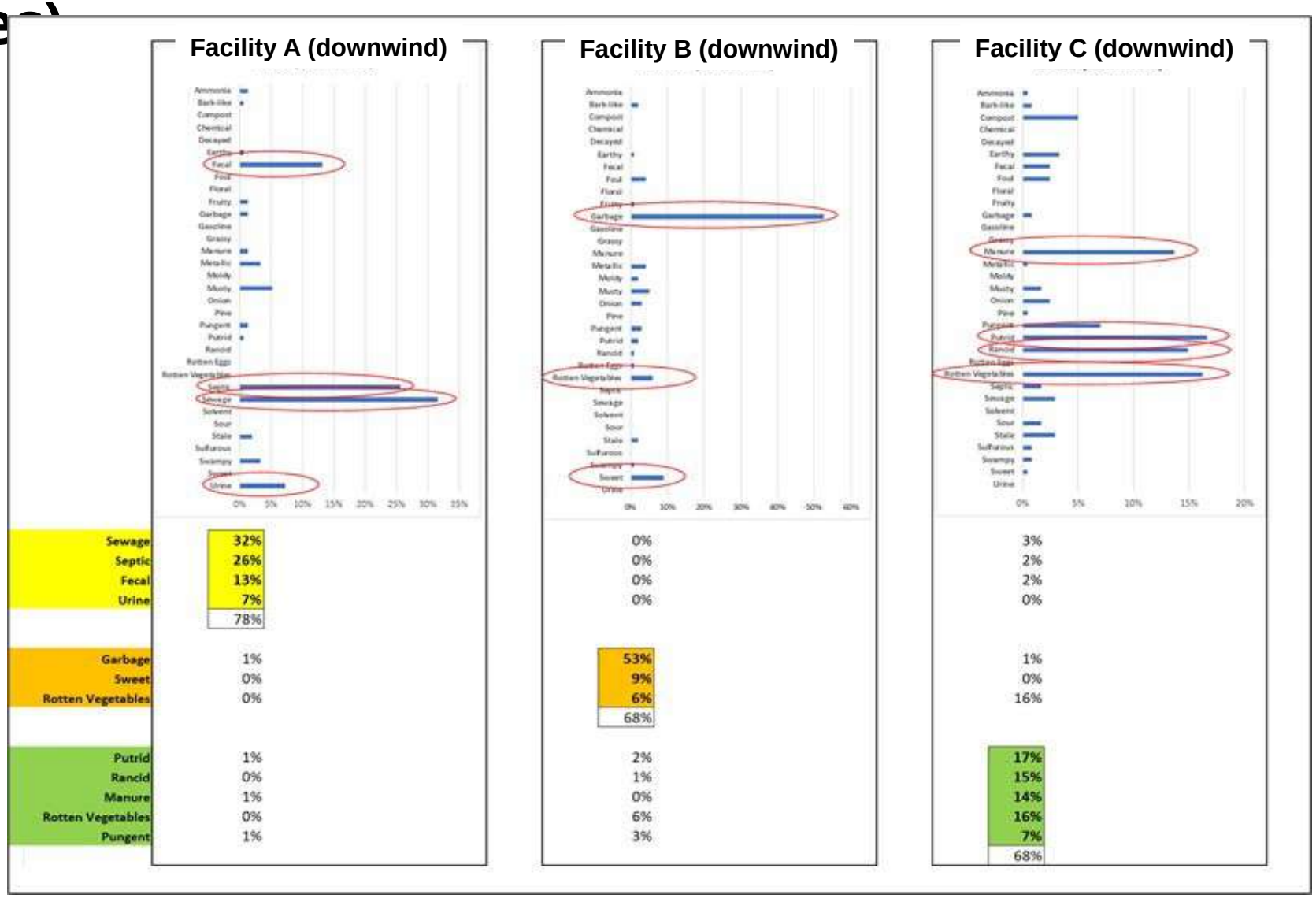
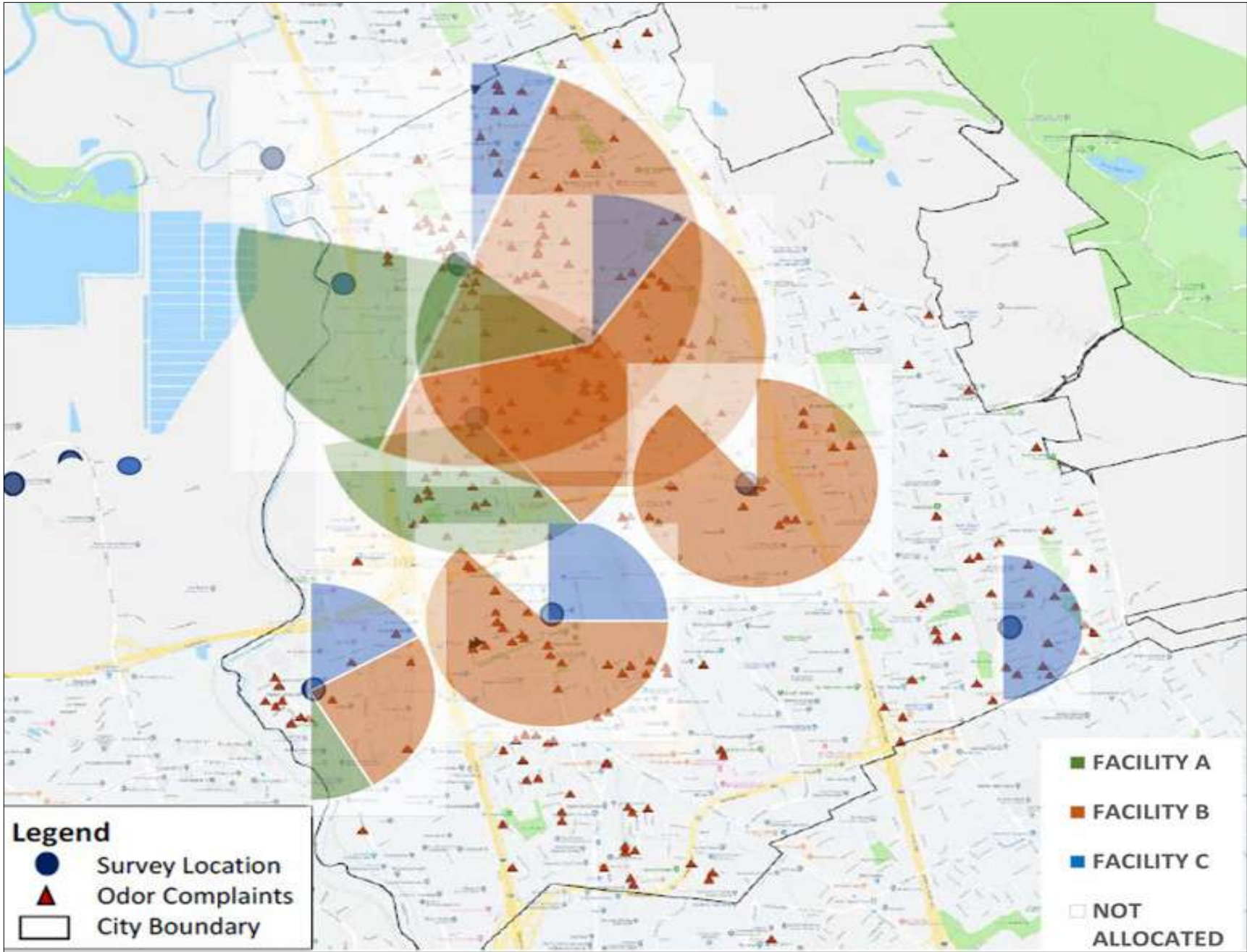


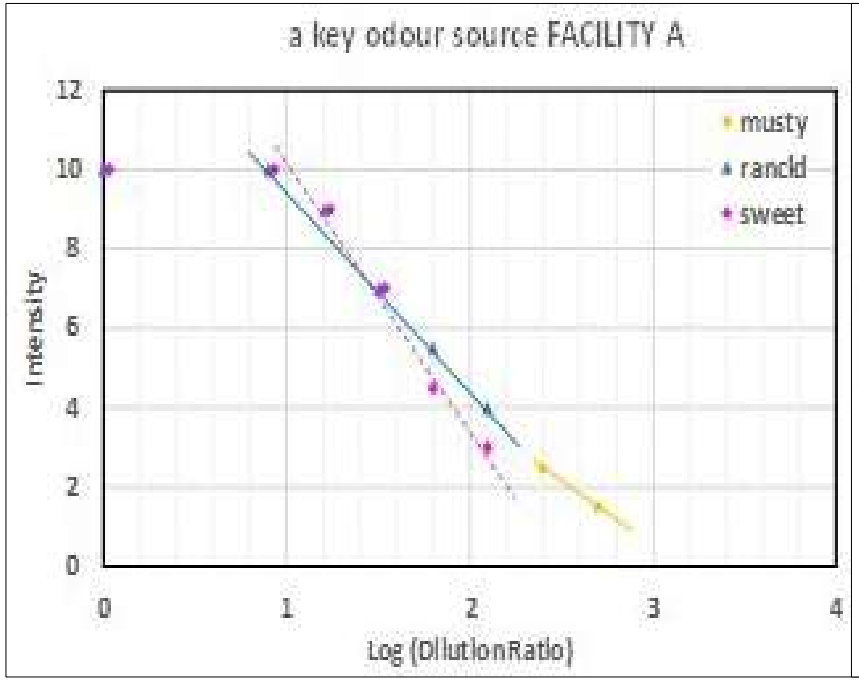
Figure: Frequency an Odor Descriptor is used to Describe Odor Character of Odor Observed Directly Downwind of the Three Main Odor-Emitting Facilities.

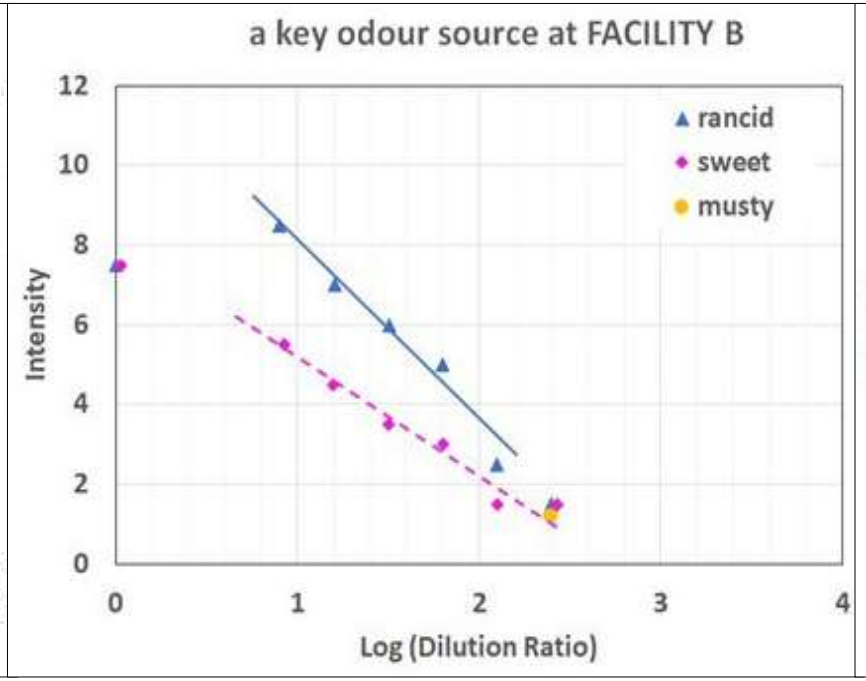
Results – Field Odour Assessments (in the community)

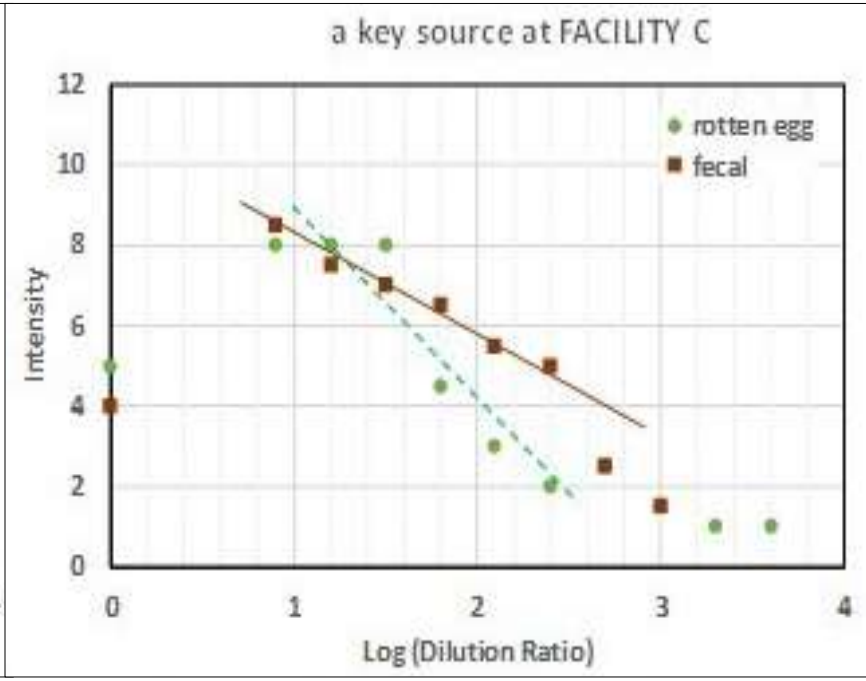


A high-level visual representation (BLOB map) that Illustrates most likely origination of odors observed in the community.

Results

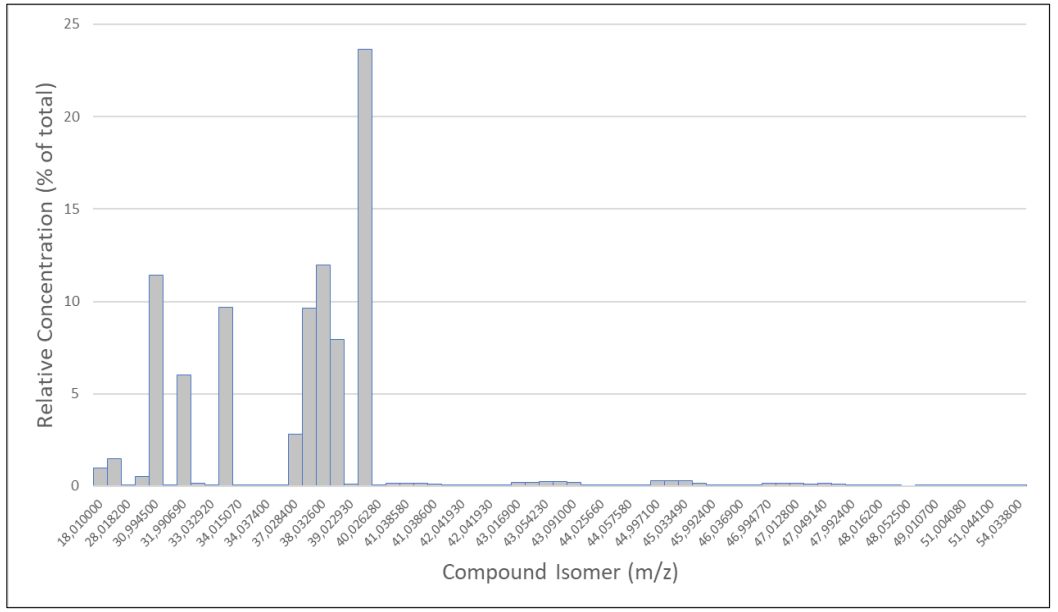


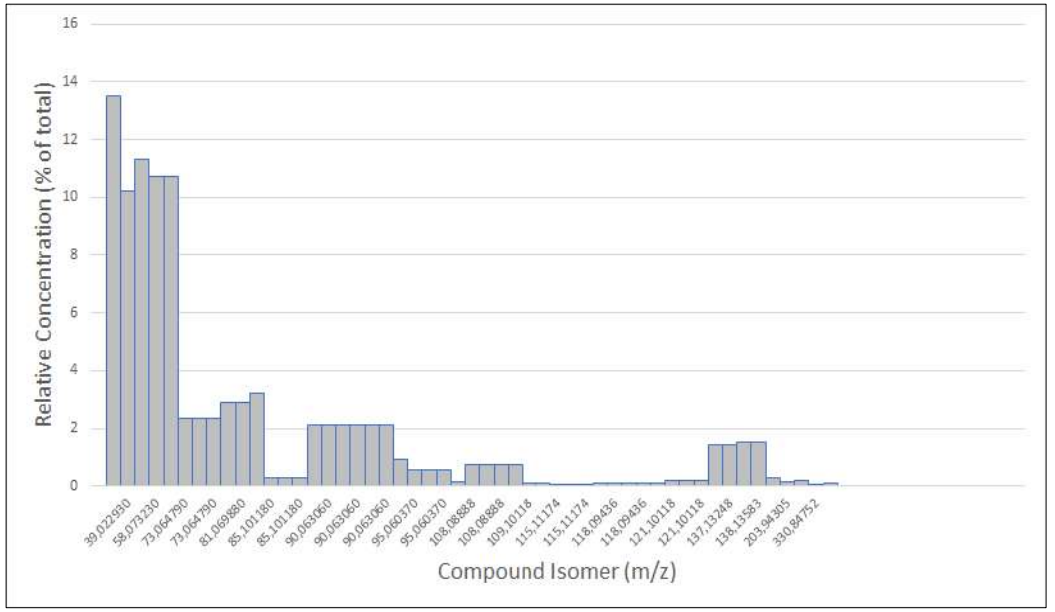


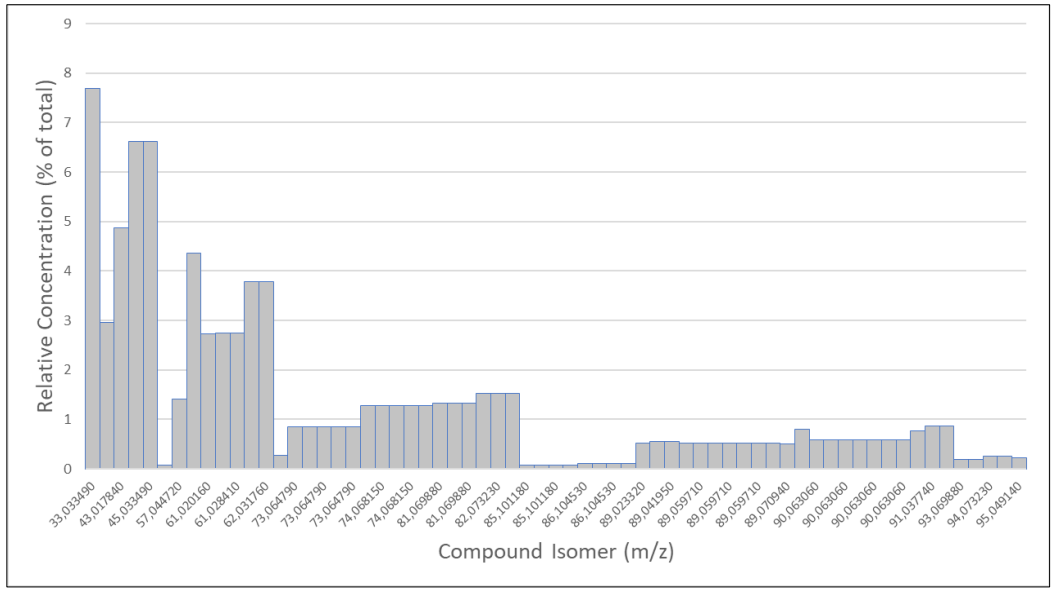


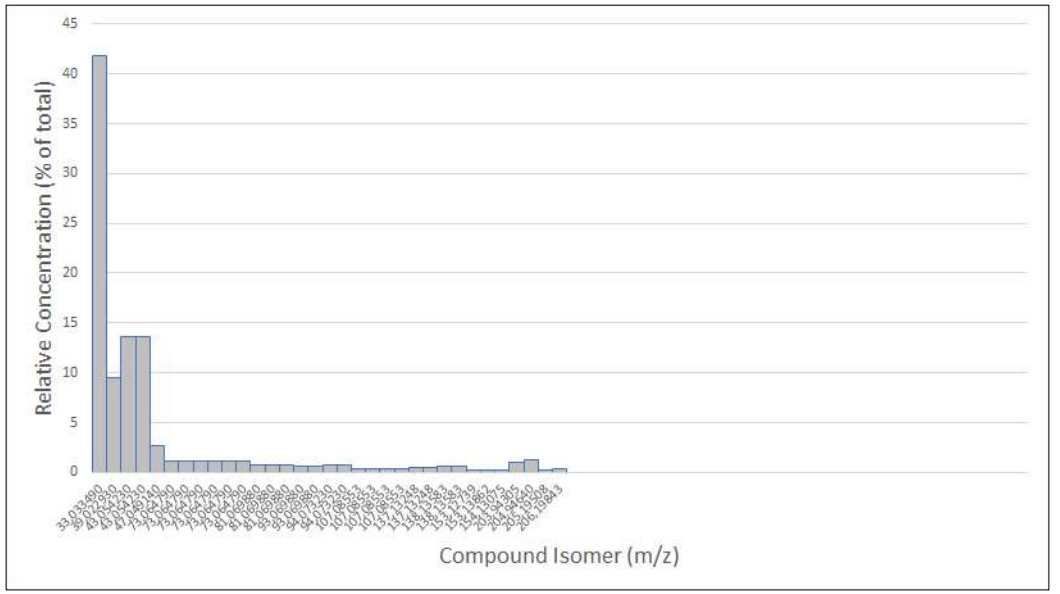
Examples of the Odor Profile Method (OPM) results that illustrate the odour intensity reduction with dilution (persistency curves) as well as the character of the dominate type of odours at each dilution.

Results – PTR-TOF-MS









Conclusions & Next Steps

An improved understanding of the relative contribution of odour causing compounds from closely located odour sources is obtained and how they impact the local community.

The combination of lab olfactometric analyses, lab & field odour compound analyses, PTR-TOF-MS surveys and field odour assessments all helped to get a better understanding.

The next steps are to develop and propose a method (or combination of methods) to employ ongoing monitoring. This would help the stakeholders to:

- inform future actions to reduce odours - best practices, enforcement, rules
- establish methods to measure progress on facilities' future odour reduction actions
- educate community - teach the community how to characterize the different odours to understand better where they are coming from and how they impact the community (make optimal use of the community in ongoing effort to reduce odour impacts)

THANK YOU

Bart.Kraakman@jacobs.com

- Jay Witherspoon[1], Jerry Bovee[2], Scott Cowden[3], Mel Suffet[4], **Bart Kraakman[5]**

[1]**Jacobs Engineering**, San Francisco, USA
[2]**BAAQMD**, San Francisco, USA
[3]**Jacobs Engineering**, Corvallis, USA
[4]**University of California Los Angeles**, Los Angeles, USA
[5]**Jacobs Engineering**, Bristol, UK