UPPER GREEN RIVER BASIN AIR EMISSIONS STUDY

Commercial Oilfield Waste Disposal Ponds

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COWD POND EMISSIONS- *Upper Green River Basin, WY*

Background

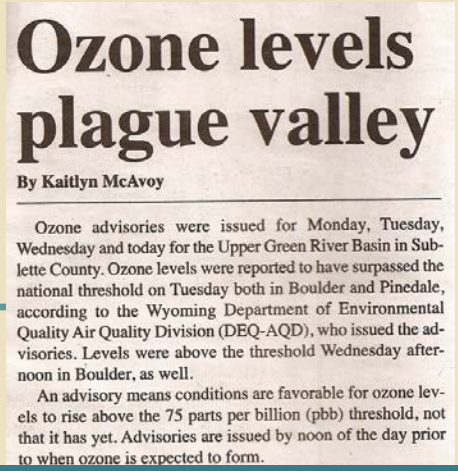
- Exceedances of the 8-hr NAAQS for ozone in the Upper Green River Basin
- Facilities perform crude emission estimates for emissions inventories

Need

- WDEQ desires technically sound emission estimation methodology for disposal ponds

Objective

- Establish correlation between pond VOC content and airborne concentrations to estimate future emissions

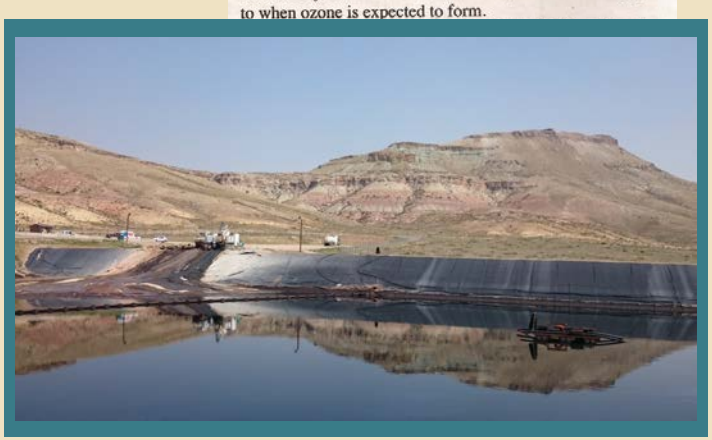


Ozone levels plague valley

By Kaitlyn McAvoy

Ozone advisories were issued for Monday, Tuesday, Wednesday and today for the Upper Green River Basin in Sublette County. Ozone levels were reported to have surpassed the national threshold on Tuesday both in Boulder and Pinedale, according to the Wyoming Department of Environmental Quality Air Quality Division (DEQ-AQD), who issued the advisories. Levels were above the threshold Wednesday afternoon in Boulder, as well.

An advisory means conditions are favorable for ozone levels to rise above the 75 parts per billion (pbb) threshold, not that it has yet. Advisories are issued by noon of the day prior to when ozone is expected to form.



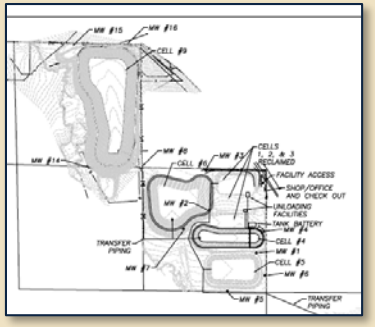
OUTCOME: **Develop easy-to-use software tool to predict air emissions from disposal pit water concentrations.**

WHAT ARE COMMERCIAL OILFIELD WASTE DISPOSAL PONDS?

- Large lined ponds for treatment and evaporation of produced water and other liquid waste from oilfield operations

UGRB PROJECT APPROACH

1 Data Collection: *Summer and Winter air/water sampling events at 2 Facilities.*



Flux Chambers (Utah State)

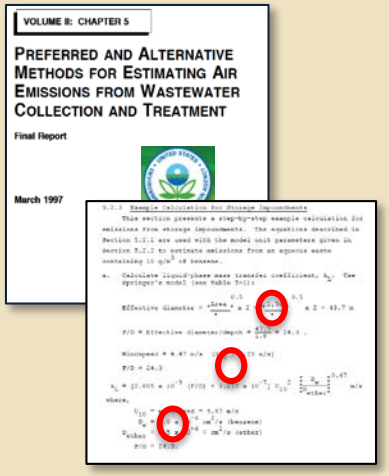
OP-FTIR (TAMU)

Air Sampling

Water Sampling

On-site Meteorology

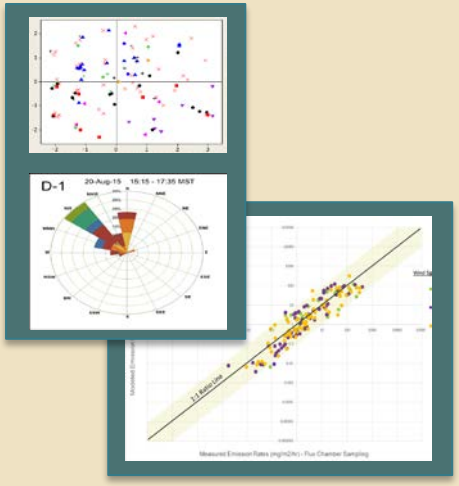
2 Predictive Model Development

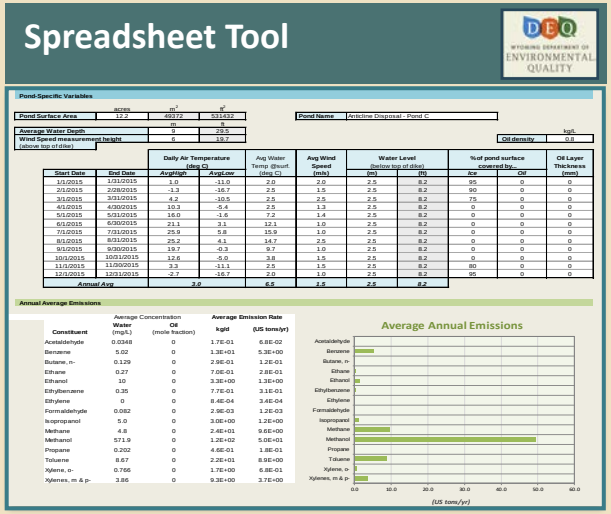

VOLUME II: CHAPTER 5

PREFERRED AND ALTERNATIVE METHODS FOR ESTIMATING AIR EMISSIONS FROM WASTEWATER COLLECTION AND TREATMENT

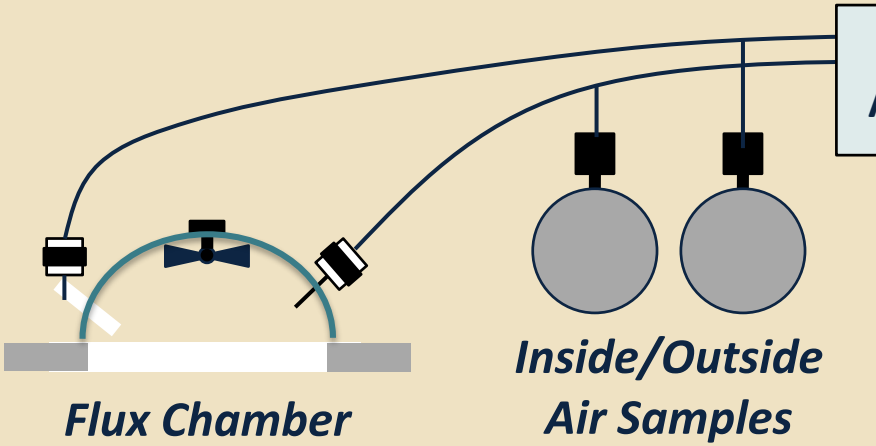
Final Report

March 1997





FLUX CHAMBER SAMPLING

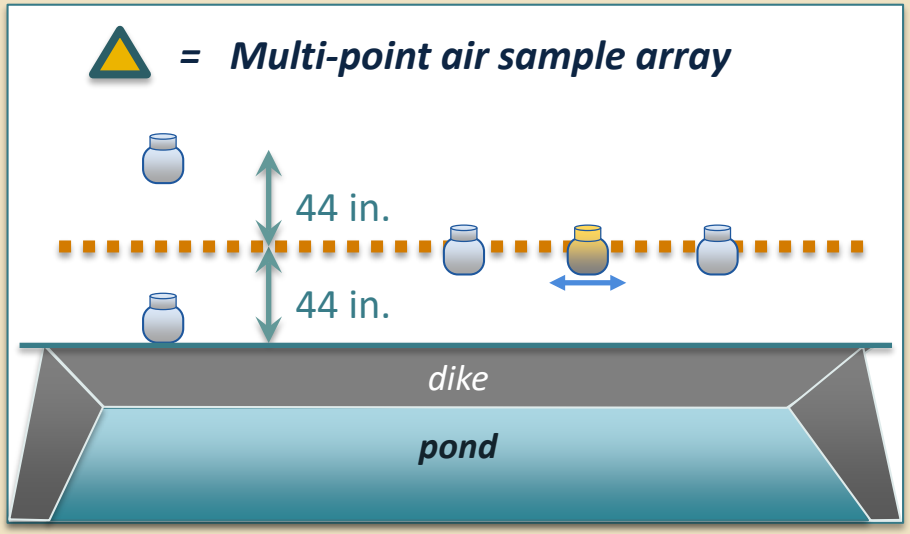


OPEN PATH FTIR SAMPLING

OP-FTIR Spectrometer and Met Station

"Walking" Air Samples (quantify FTIR NDs)

CANISTER ARRAY SAMPLING



LEGEND

- *OP-FTIR transect*
- *Walking air sample*
- *Stationary air sample point*

DEQ
WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY

WATER SAMPLING

Key Analytes:

- ***BTEX, Alcohols, Dissolved gases***
- ***Formaldehyde/ Acetaldehyde***
- ***Oil & Grease***

3D WIND SPEED MONITORING

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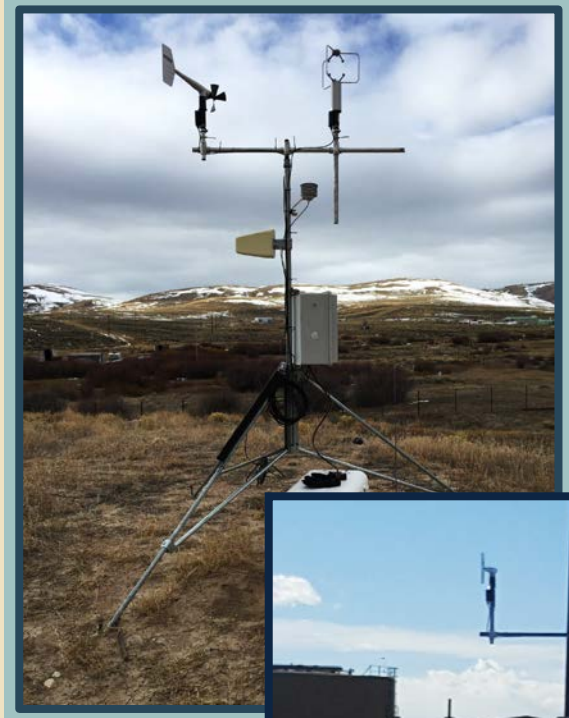
Sonic Float

Site Specific AQD Met Stations



FACILITY LAYOUT AND BACKGROUND

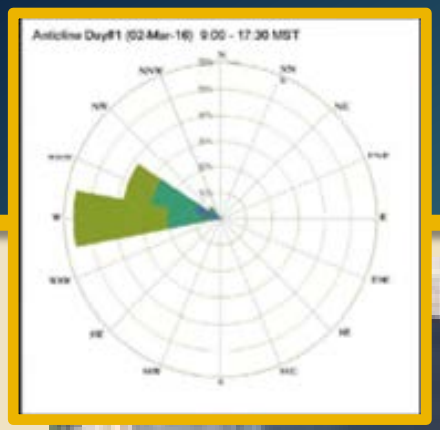
Facility 1

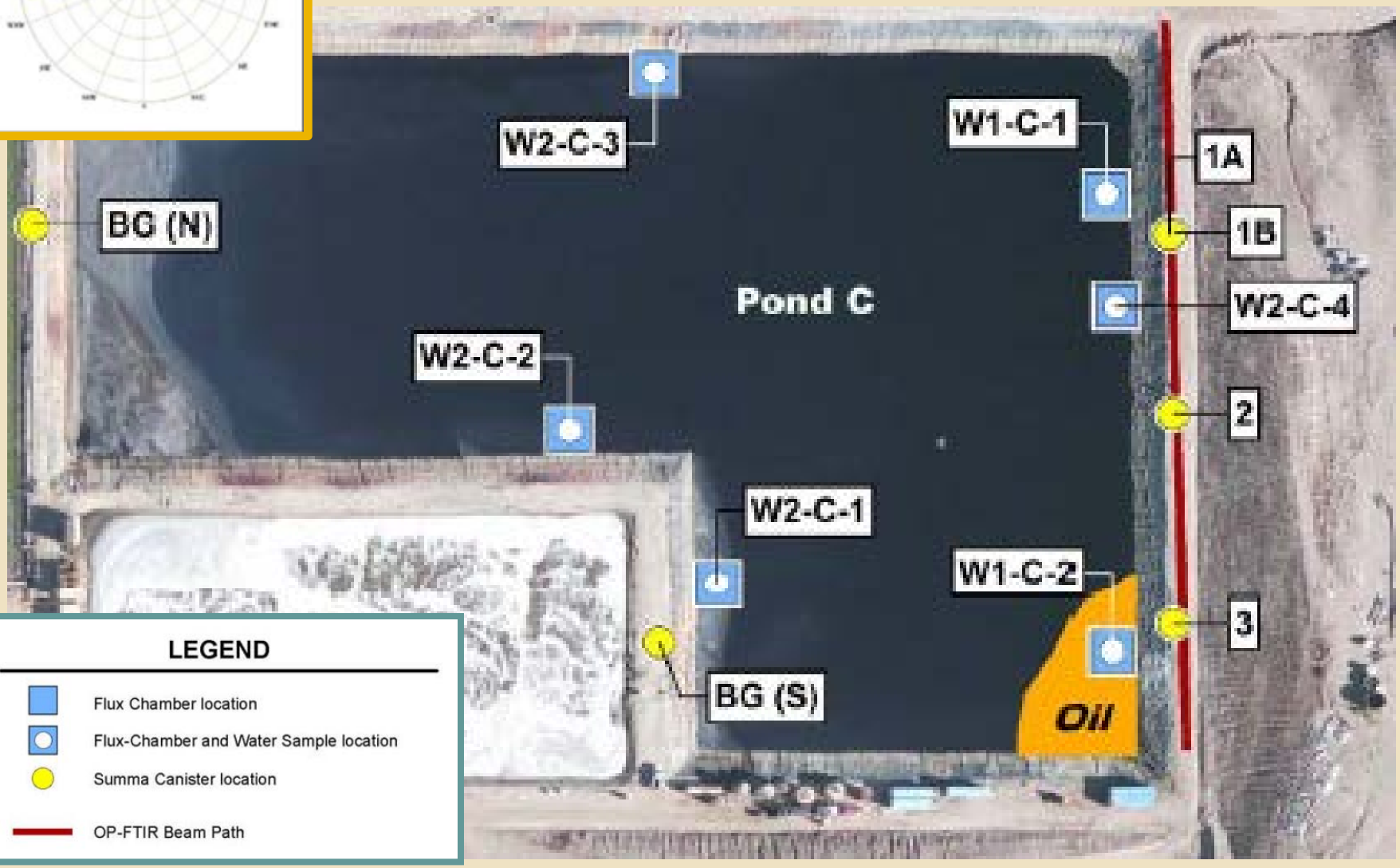
Facility 2

Site Specific OP-FTIR Meas. Background

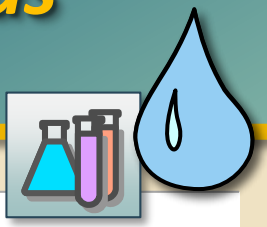
Methane:
1.2 ppm Facility 1
1.6 ppm Facility 2

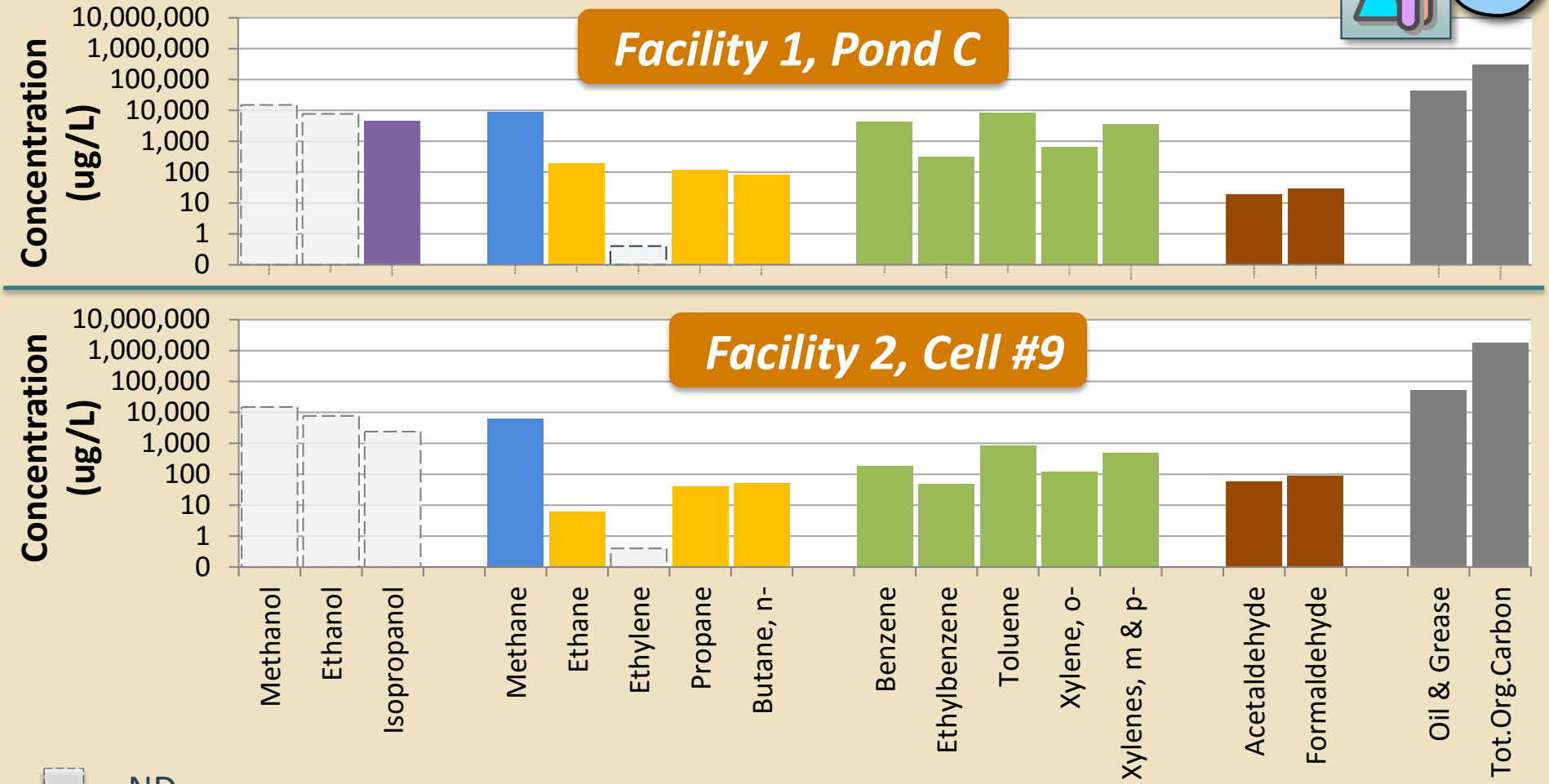
FACILITY 1: *Pond C Sampling*



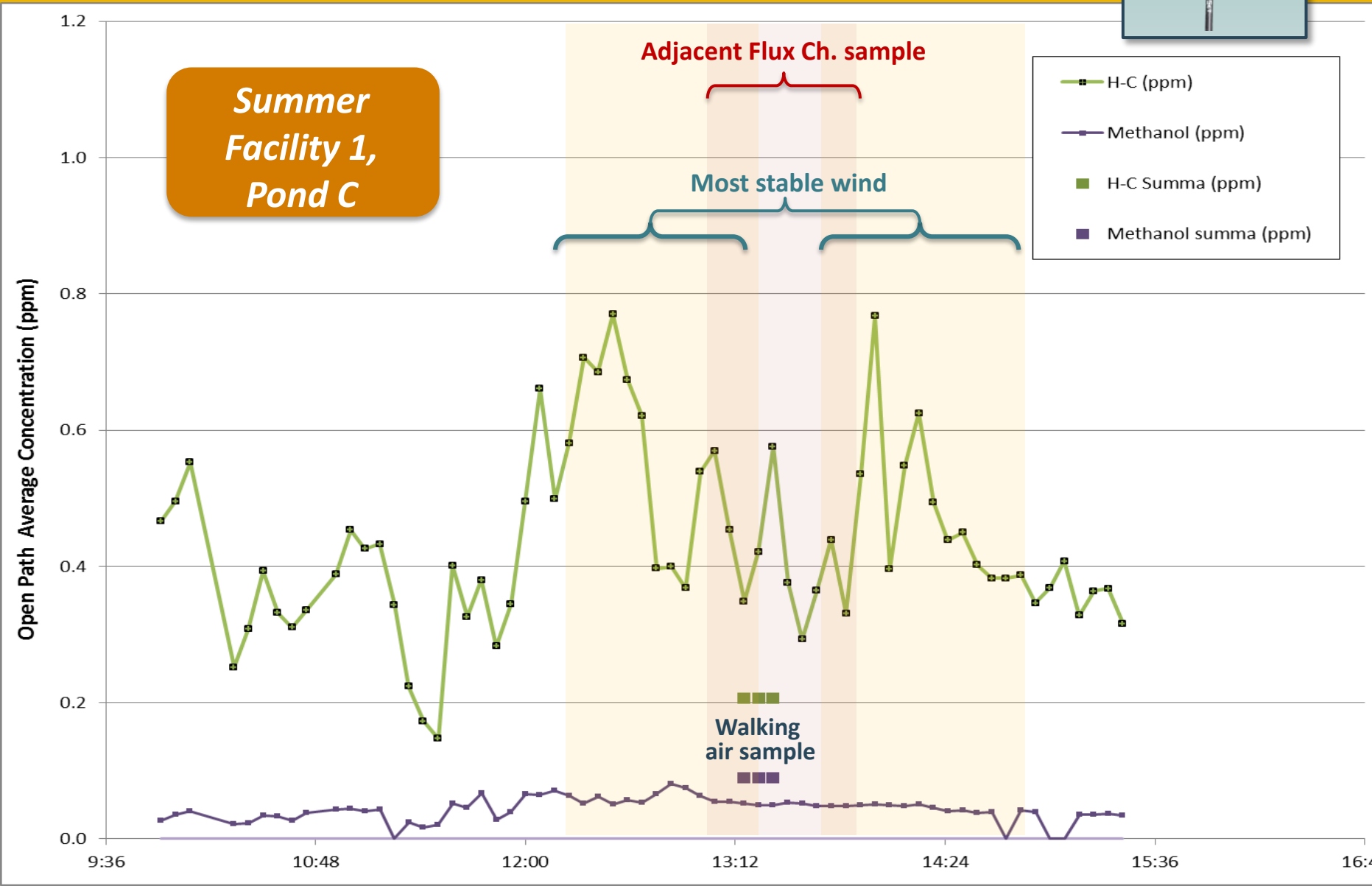


WATER SAMPLING RESULTS – *Receiving Ponds (Summer)*



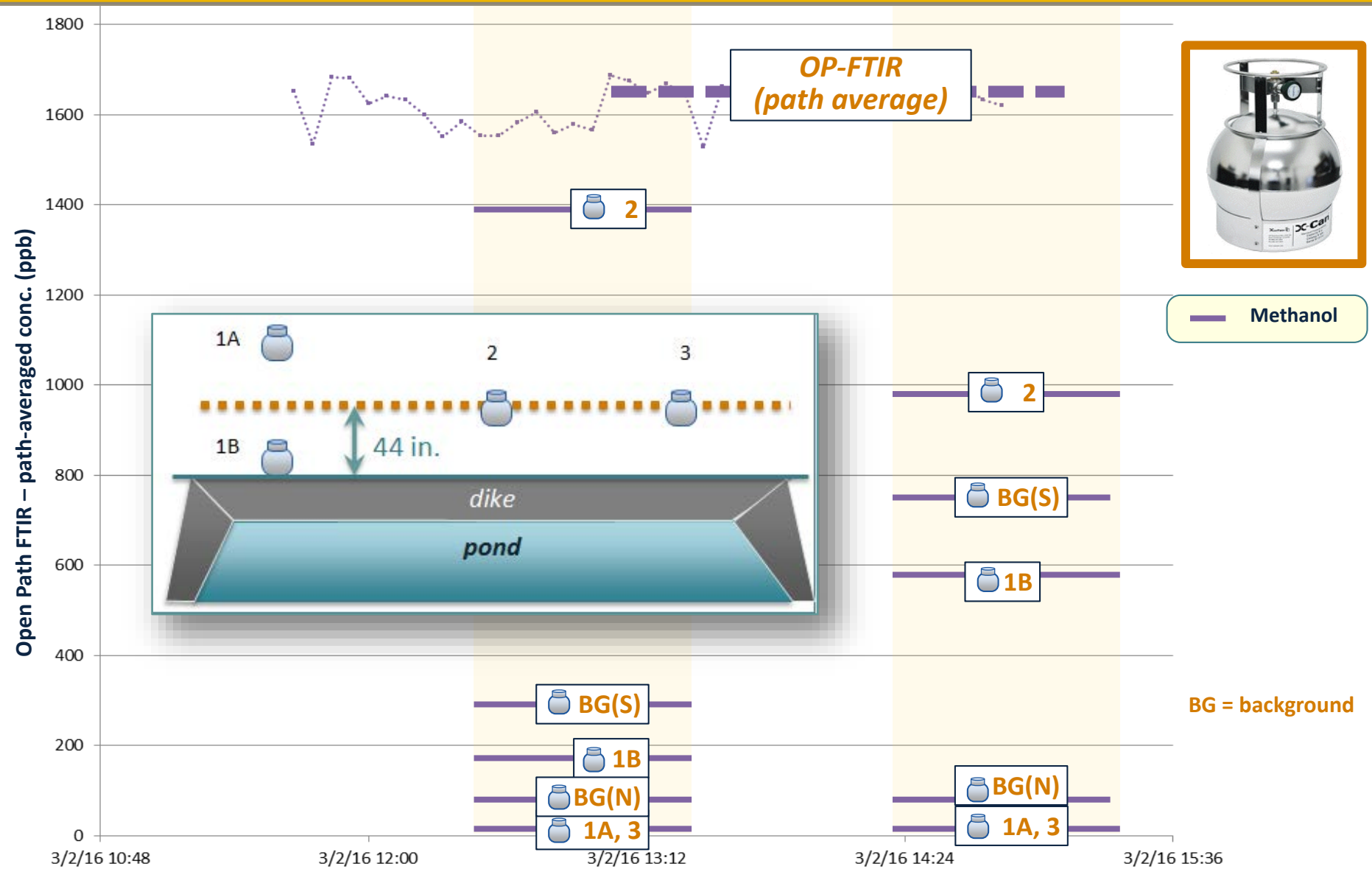


OPEN PATH CONCENTRATIONS

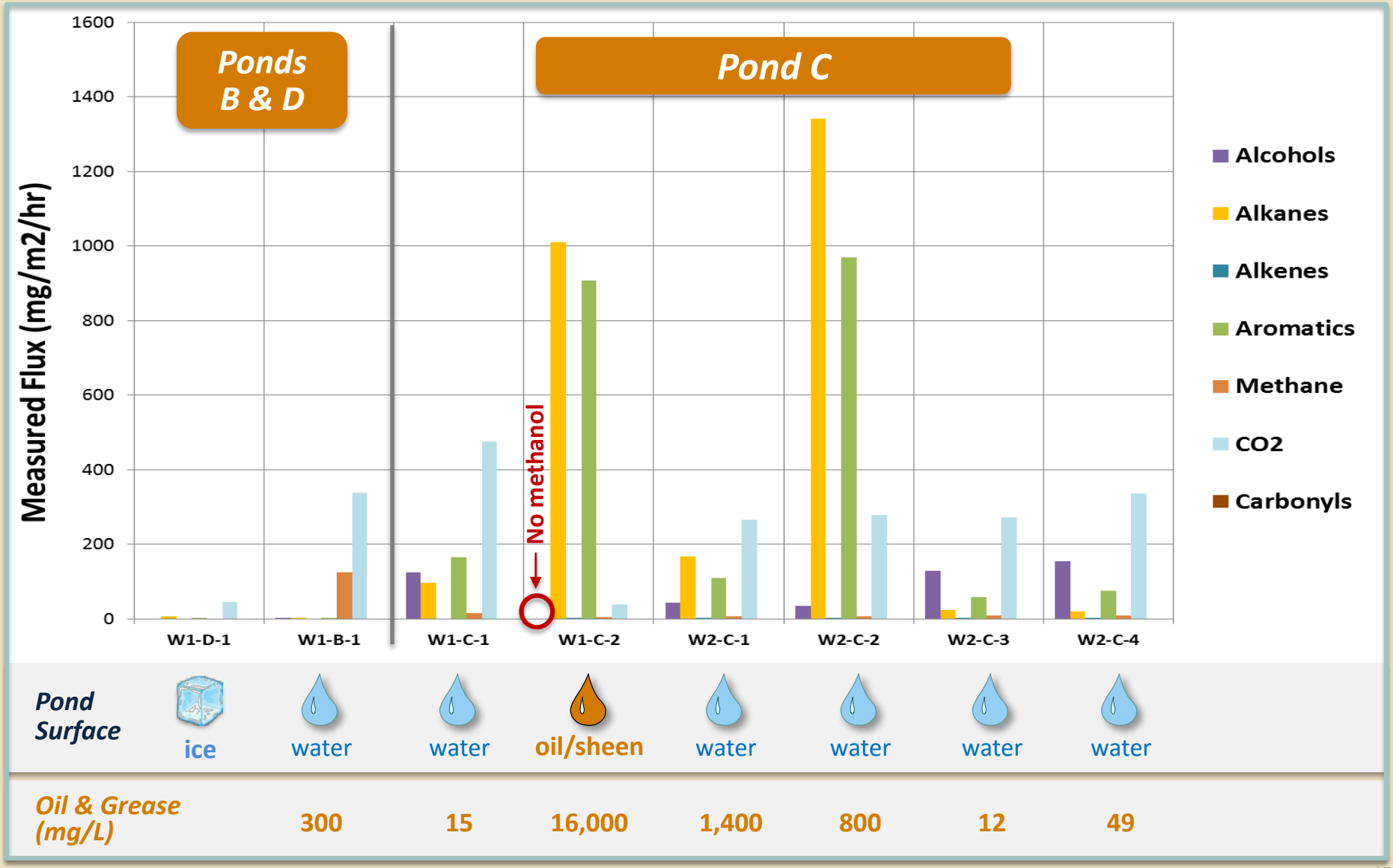


CANISTER ARRAY RESULTS

Winter
Facility 1,
Pond C



FLUX CHAMBER RESULTS *Facility 1*



PREDICTIVE TOOL *Water-Based Model*

Basic Inputs

Output

Pond-Specific Variables

	acres	m^2	ft^2
Pond Surface Area	12.2	49372	531432
		m	ft
Average Water Depth		9	29.5
Wind Speed measurement height (above top of dike)		6	19.7

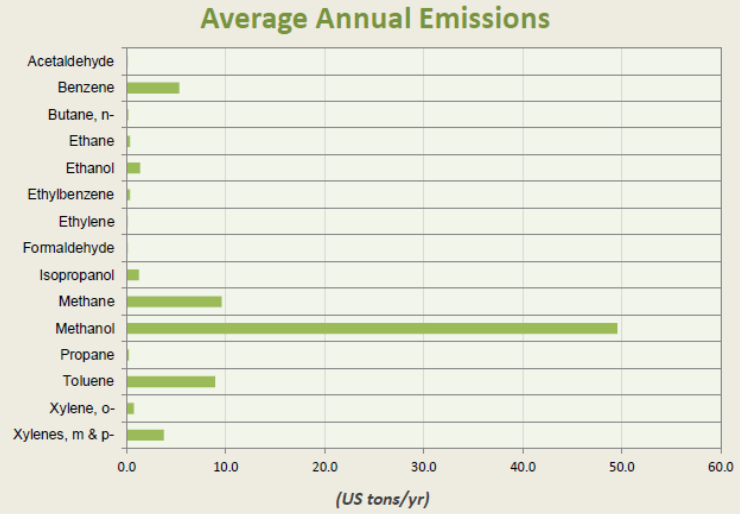
Pond Name	EXAMPLE

	kg/L
Oil density	0.8

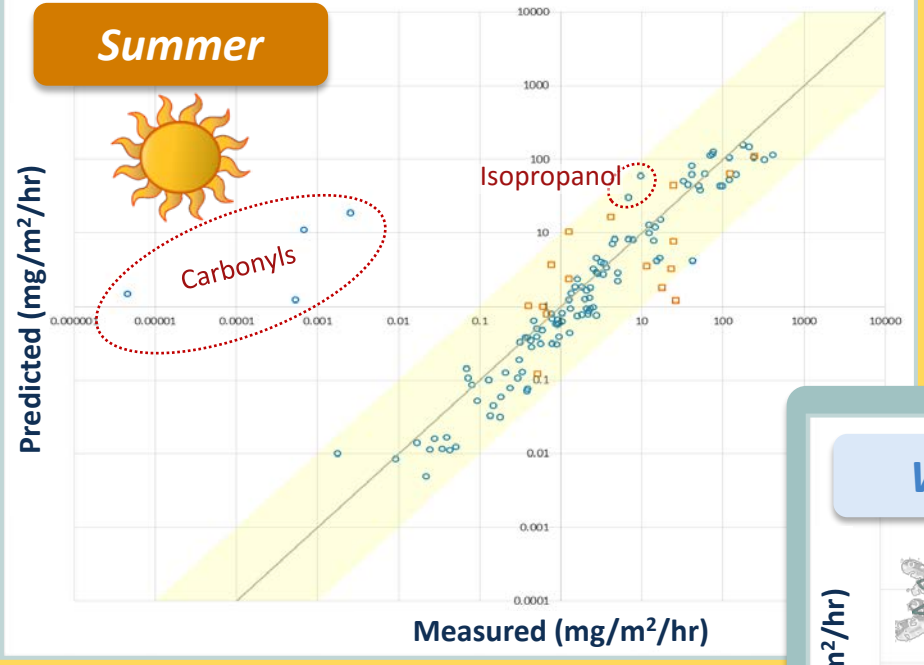
Start Date	End Date	Daily Air Temperature (deg C) *AvgHigh*	Daily Air Temperature (deg C) *AvgLow*	Avg Water Temp @surf. (deg C)	Avg Wind Speed (m/s)	Water Level (below top of dike) (m)	Water Level (below top of dike) (ft)	% of pond surface covered by... *Ice*	% of pond surface covered by... *Oil*	Oil Layer Thickness (mm)
1/1/2015	1/31/2015	1.0	-11.0	2.0	2.0	2.5	8.2	95	0	0
2/1/2015	2/28/2015	-1.3	-16.7	2.5	1.5	2.5	8.2	90	0	0
3/1/2015	3/31/2015	4.2	-10.5	2.5	2.5	2.5	8.2	75	0	0
4/1/2015	4/30/2015	10.3	-5.4	2.5	1.3	2.5	8.2	0	0	0
5/1/2015	5/31/2015	16.0	-1.6	7.2	1.4	2.5	8.2	0	0	0
6/1/2015	6/30/2015	21.1	3.1	12.1	1.0	2.5	8.2	0	0	0
7/1/2015	7/31/2015	25.9	5.8	15.9	1.0	2.5	8.2	0	0	0
8/1/2015	8/31/2015	25.2	4.1	14.7	2.5	2.5	8.2	0	0	0
9/1/2015	9/30/2015	19.7	0.3	9.7	1.0	2.5	8.2	0	0	0
10/1/2015	10/31/2015	12.6	-5.0	3.8	1.5	2.5	8.2	0	0	0
11/1/2015	11/30/2015	3.3	-11.1	2.5	1.5	2.5	8.2	80	0	0
12/1/2015	12/31/2015	-2.7	-16.7	2.0	1.0	2.5	8.2	95	0	0
Annual Avg		***3.0***		***6.5***	***1.5***	***2.5***	***8.2***			

Annual Average Emissions

Constituent	Average Concentration Water (mg/L)	Average Concentration Oil (mole fraction)	Average Emission Rate kg/d	Average Emission Rate (US tons/yr)
Acetaldehyde	0.0348	0	1.7E-01	6.8E-02
Benzene	5.02	0	1.3E+01	5.3E+00
Butane, n-	0.129	0	2.9E-01	1.2E-01
Ethane	0.27	0	7.0E-01	2.8E-01
Ethanol	10	0	3.3E+00	1.3E+00
Ethylbenzene	0.35	0	7.7E-01	3.1E-01
Ethylene	0	0	8.4E-04	3.4E-04
Formaldehyde	0.082	0	2.9E-03	1.2E-03
Isopropanol	5.0	0	3.0E+00	1.2E+00
Methane	4.8	0	2.4E+01	9.6E+00
Methanol	571.9	0	1.2E+02	5.0E+01
Propane	0.202	0	4.6E-01	1.8E-01
Toluene	8.67	0	2.2E+01	8.9E+00
Xylene, o-	0.766	0	1.7E+00	6.8E-01
Xylenes, m & p-	3.86	0	9.3E+00	3.7E+00

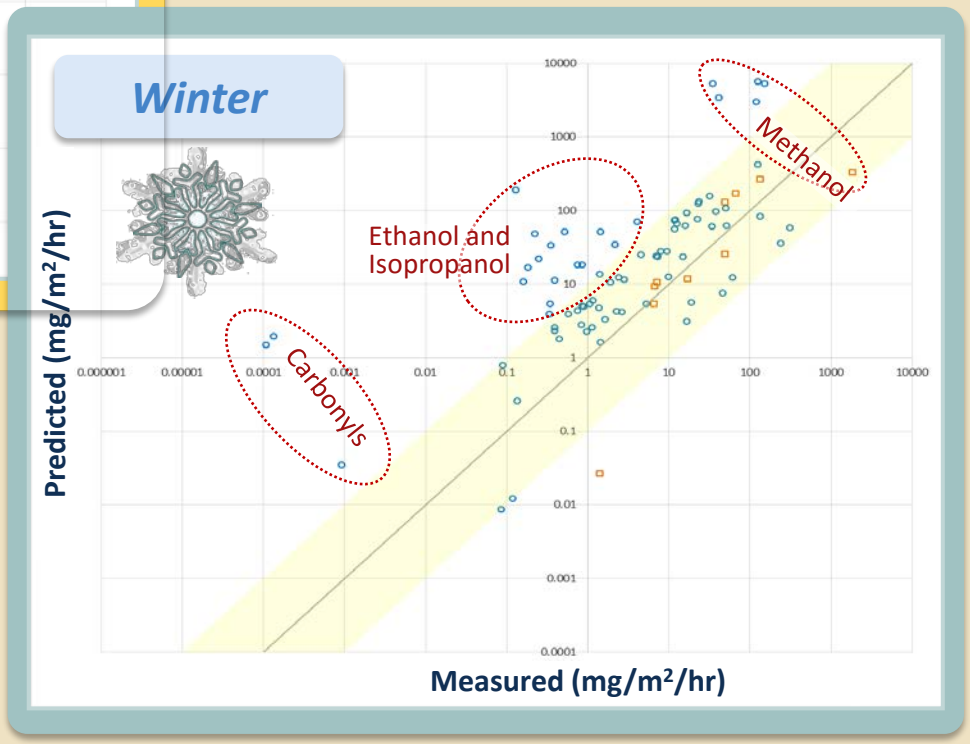


PREDICTED VS. MEASURED EMISSIONS – *Calibrated Model*



- Flux Chamber Measurement

- OP-FTIR Measurement



KEY POINT:

Reduce uncertainty in *average* annual emissions estimates from COWD facilities.

FURTHER WORK

2016 – 2017 Wyoming Pond Emissions Project

- Two additional ponds, different fields and formations, to support tool calibration/modification
- Correlation of source air emissions to water concentrations to support model refinement/calibration
- Incorporation of suggested modifications from current pond emissions study
- Further analysis of oil/sheen impacts on emissions
- Further analysis of microbial activity
- Evaluation of additional backward modeling techniques to use with FTIR and canister measurements
- Calculation of annual emission rate for all facilities

Photo courtesy of WDEQ AQD

THANKS! QUESTIONS?

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