



Equilibrium Environmental Inc.

For a balanced environment...

REMEDIATION TECHNOLOGIES SYMPOSIUM 2025

**Session: Data Analysis, Shaughnessy
Friday October 17th, 9:40am**

METHANOL – NOW YOU SEE IT, NOW YOU DON'T

Anthony Knafla, M.Sc., DABT, P.Biol, QP

Brief Background

- **Anthropogenic sources**
 - Municipal
 - deicing of airplanes at airports
 - Agricultural
 - crop stimulant increasing yield and water efficiency
 - solvent for herbicides, biofuel for agricultural machinery
 - feedstock for producing fertilizers and pesticides
 - Industrial
 - Oil and gas activities (solvent and deicer)
 - Residential
 - cleaning products, windshield washer, paint thinner
 - Natural body
 - 0.5 mg/kg body weight (human); excreted in breath, urine
- **GUIDELINES**
- **CCME (2017) Soil**
 - Coarse Soil 4.6 mg/kg Fine Soil 5.6 mg/kg (all land uses)
 - Limiting pathway – groundwater check
- **EPA (2024)**
 - Coarse Soil 11 mg/kg Fine Soil 37 mg/kg (all land uses)
 - FAL protection DUA protection
 - Groundwater – 19 mg/L (coarse/fine, all land uses)

Oil and Gas Contaminated Site Work Sources

- **Methanol tanks, spheres, lines**

- Well sites, batteries, facilities
- Photo from Reddit



- **Doing hydrocarbon investigations and methanol**

- Terra cores and methanol vials
- (photo from ALS Global)



- **Laboratory work supporting investigations**

- Common lab solvent

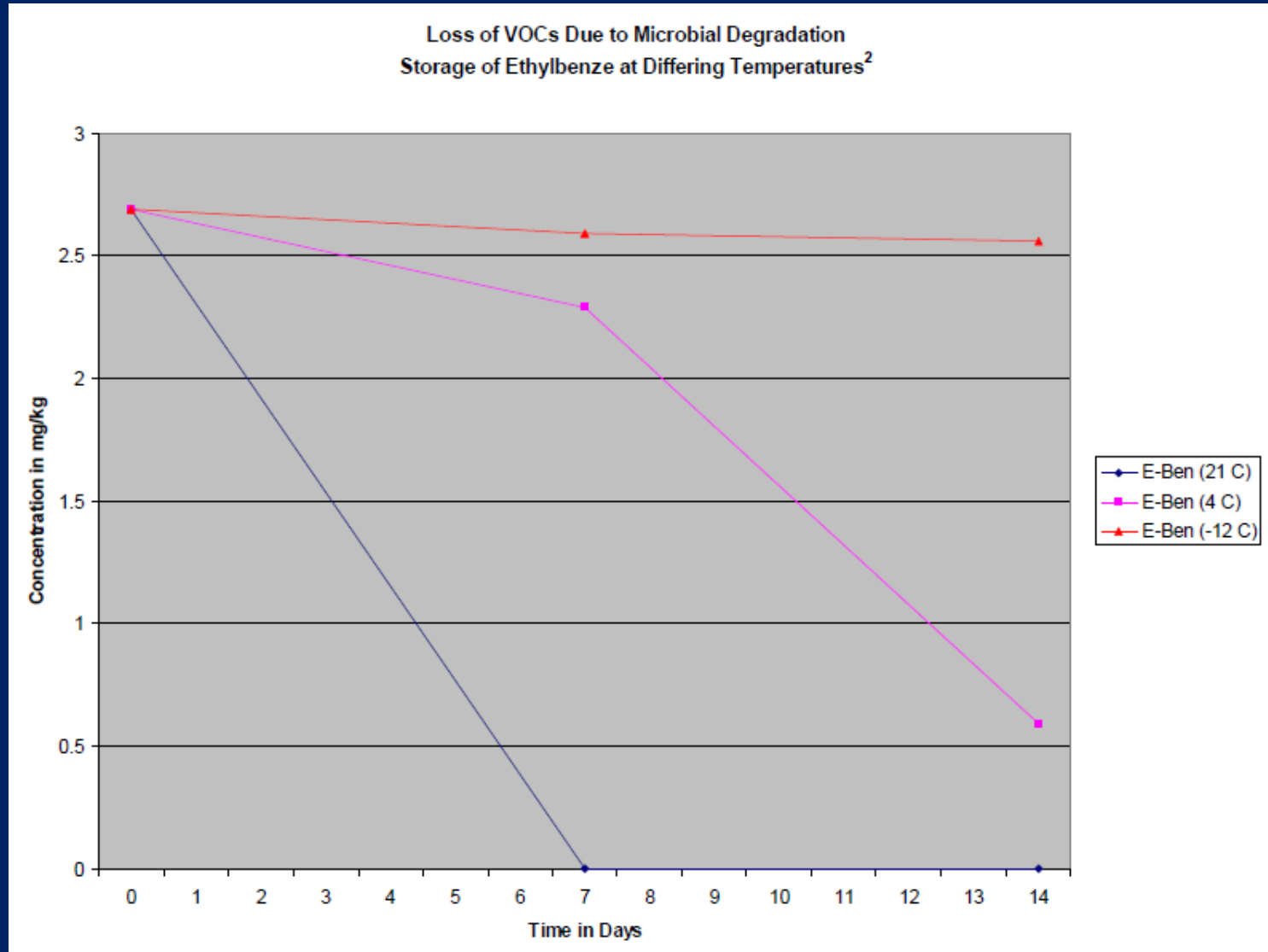


- **Background / other**

- Peat soils beneath pads (highly anaerobic, still an anthropogenic impact)
- Breath

Oil and Gas Contaminated Site Work Sources

- Terracore and methanol vial method introduction to contaminated site work was very important (Exova material)



Physical/Chemical Properties & Environmental Behaviour

- Comparisons of properties with benzene and F1
 - Unitless Henry's Law (Partitioning from Groundwater or Soil Water to Air)
 - Methanol – **0.0002** Benzene – **0.225** F1 Aliphatics C6–C8 – **50**
 - Will you detect methanol in soil vapour? Unlikely
 - Will you detect methanol in field screening with a PID or OVA? Unlikely!
 - Organic Carbon Partition Coefficient
 - Methanol – **0.27** Benzene – **81 g/mL** F1 Aliphatics C6–C8 – **3,981**
 - In a soil sample is methanol bound to soil? Only a little bit, mostly in water
 - Will methanol transport further in groundwater than benzene? YES, although half life is important, benzene ~ 1 year, methanol 0.67 year

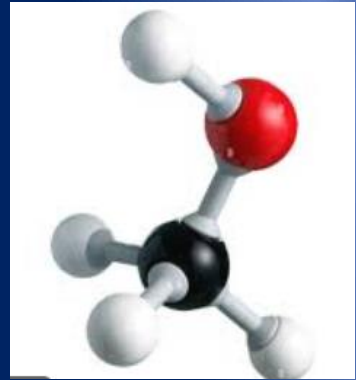
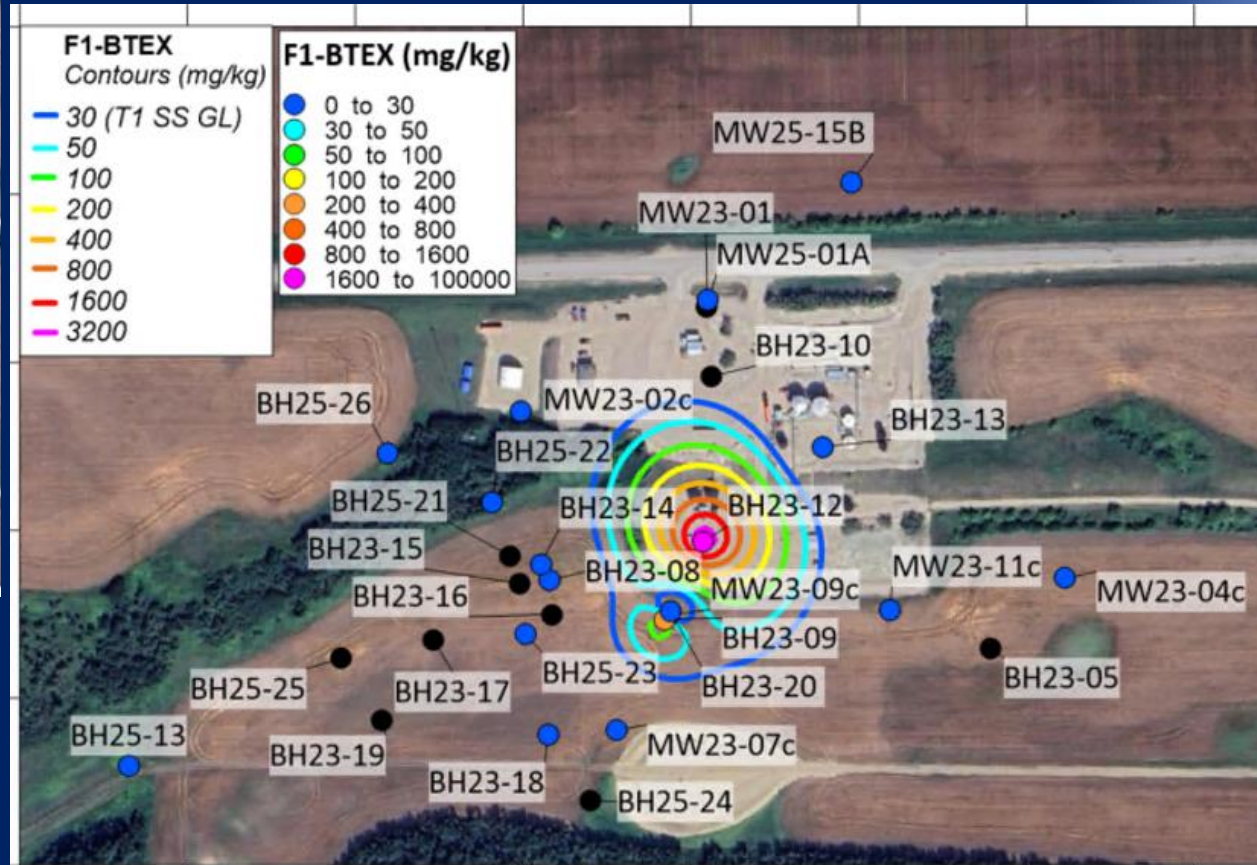
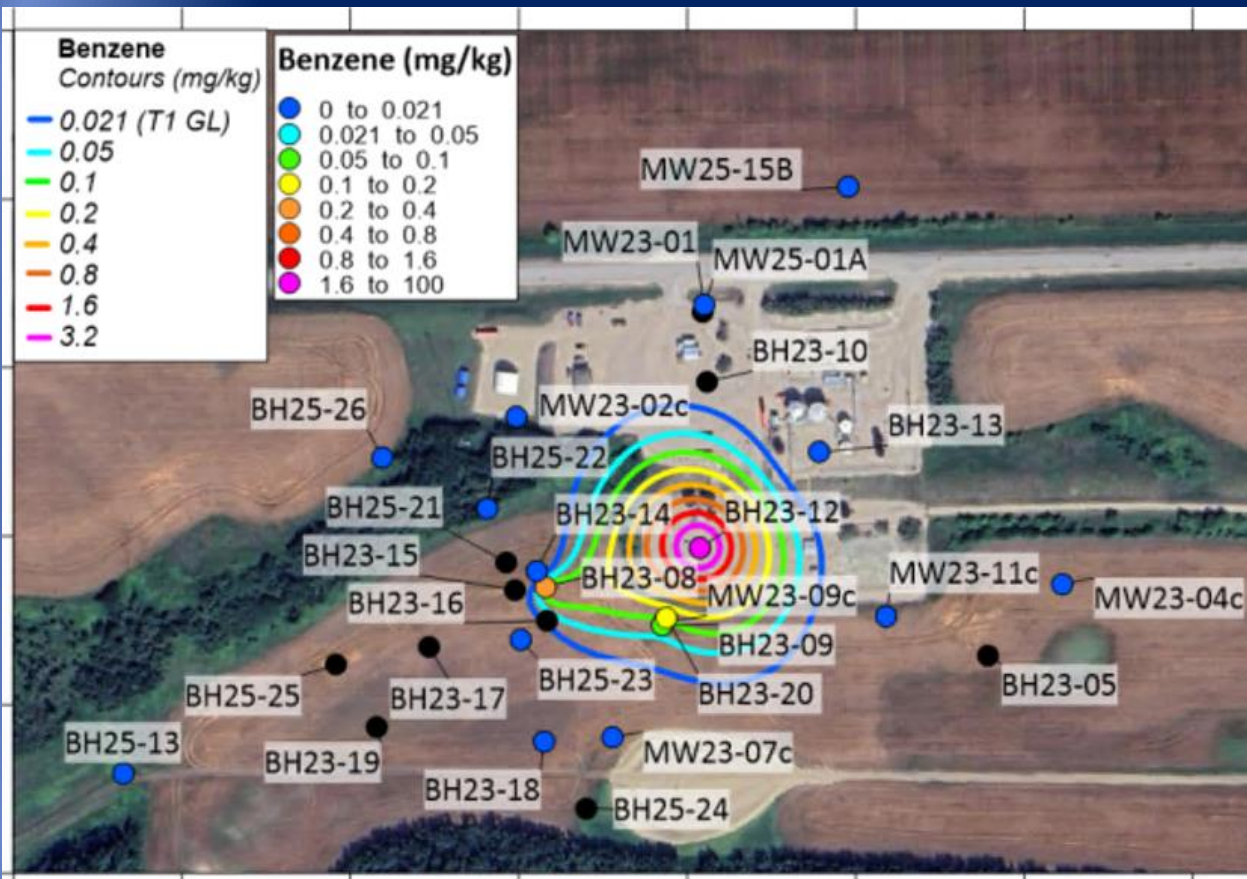


TABLE C-6. CHEMICAL PARAMETERS

	Koc (ml/g)	Source	H' dimensionless	Source	Da (cm ² /s)	Source	Solubility (mg/L)
Trifluralin	9,682	ORNL (2006)	0.00421	ORNL (2006)	1.49E-02	ORNL (2006)	0.184
Other Organics							
Aniline	45	ORNL (2006)	8.26E-05	ORNL (2006)	7.00E-02	ORNL (2006)	36000
Di- <i>n</i> -butyl phthalate	1,460	ORNL (2006)	0.000074	ORNL (2006)	4.38E-02	ORNL (2006)	11.2
Dichlorobenzidine	7,489	ORNL (2006)	2.09E-09	ORNL (2006)	1.94E-02	ORNL (2006)	3.1
Diethanolamine	***1.9	AENV (2010a)	2.20E-12	AENV (2010a)			miscible
Diethylene glycol	0.018	AENV (2010b)	5.30E-09	AENV (2010b)			miscible
Diisopropanolamine	*** 2.2	CCME (2006b)	7.00E-06	CCME (2006b)			870000
Ethylene glycol	0.0072	EC (1999b)	2.50E-06	EC (1999b)	0.108	ORNL (2006)	miscible
Hexachlorobutadiene	994	ORNL (2006)	0.421	ORNL (2006)	5.61E-02	ORNL (2006)	3.2
Methanol	0.27	CCME (2017)	0.0002	CCME (2017)	0.15	CCME (2017)	miscible

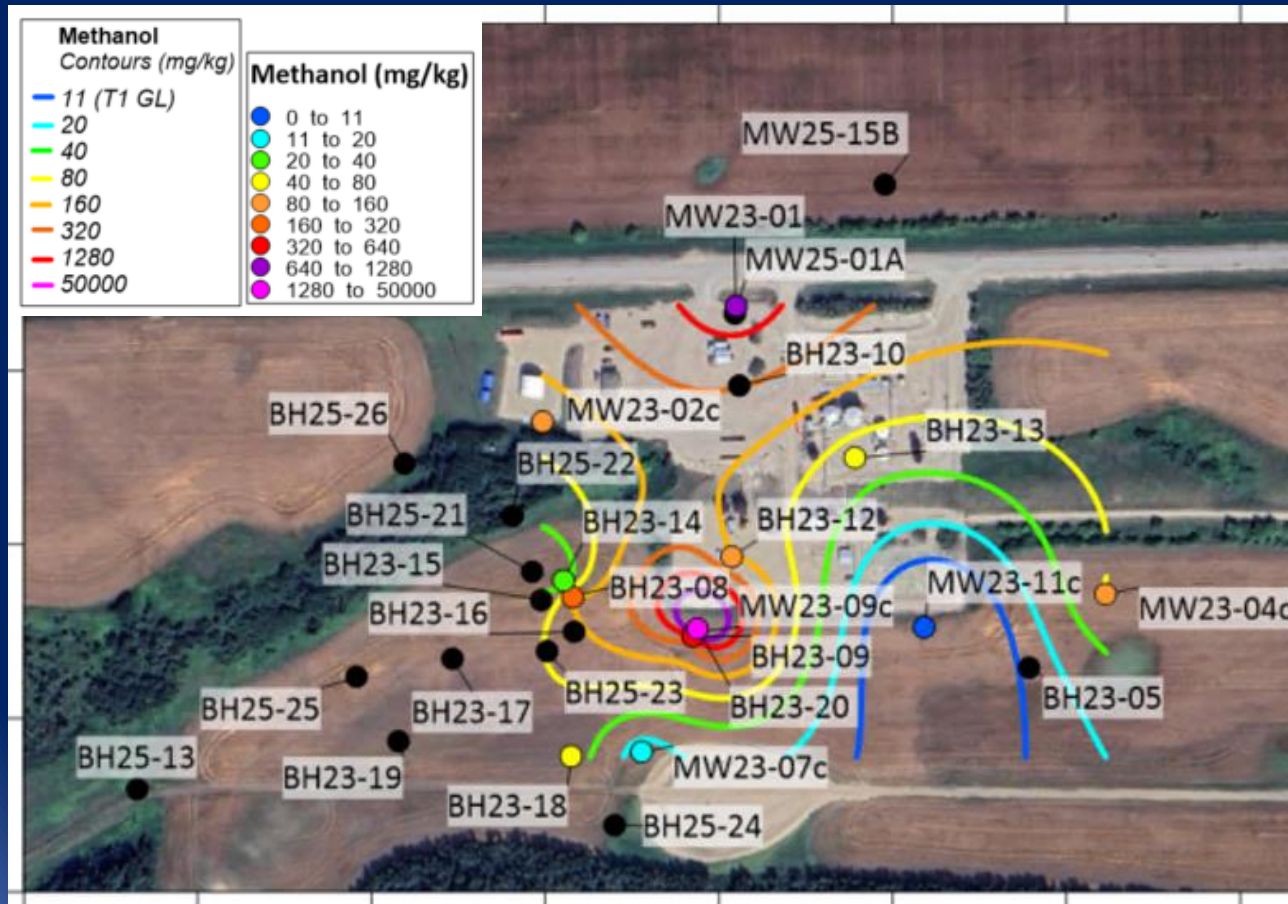
Site Example of Methanol and Hydrocarbon Impacts

- Benzene and F1 impacts in soil somewhat extensive near the facility



Site Example of Methanol and Hydrocarbon Impacts

- Methanol impacts more extensive than benzene and F1-BTEX as per diagram
- Or are they?
- Perfect split duplicates samples taken
- distinct workstation and sampling equipment from hydrocarbons
- distinct coolers for transport



Site Example of Methanol and Hydrocarbon Impacts

- Results?
- From heavily contaminated site to barely contaminated site
- Base method is GC-FID
- Also ran via GC-MS – distinct results and impact areas
- This should not happen

Note formaldehyde

Borehole	Sample Date	Depth	Methanol GC/FID	Methanol GC/FID Batch A	Methanol GC/FID Batch B	Methanol GC/MS Batch B	Formaldehyde
		m	mg/kg	mg/kg	mg/kg		mg/kg
SEQG 2024- coarse soil (<3 m)			11				NG
SEQG 2024- coarse soil (<3 m)			11				NG
MW25-01A	22-Mar-25	9	--	43.2	0.25	9.0	0.005
	22-Mar-25	15	--	51.2	0.25	2.9	5.6
	22-Mar-25	18	--	84	4.9	7.4	185
BH25-13	17-Mar-25	6	--	0.25	0.25	5.1	0.005
	17-Mar-25	7	--	0.25	0.25	13.1	286
	18-Mar-25	24	--	1.1	0.25	4.0	196
	13-Mar-25	3	--	52	0.25	7.3	2.11
	13-Mar-25	5.5	--	123	11.1	9.6	6.05
	13-Mar-25	9	--	438	0.25	1.2	9.73
	13-Mar-25	12	--	432	7.9	30.5	1.2
	13-Mar-25	15	--	657	0.25	26.3	0.19
	14-Mar-25	18	--	26.6	0.25	6.3	285
	14-Mar-25	40	--	32.2	0.25	8.6	4.8
	19-Mar-25	9	--	18.7	0.25	3.2	252
	19-Mar-25	12	--	15.4	0.25	13.2	121
	19-Mar-25	9	--	197	0.25	8.4	163
	19-Mar-25	12	--	16.8	0.25	7.0	207
	19-Mar-25	21	--	9.9	0.25	2.6	204
	23-Mar-25	36	--	3.1	11.3	7.5	212

Site Example of Methanol and Hydrocarbon Impacts

- Second site example of four in total
- Soil samples submitted at different time intervals – March and April results beyond hold times by up to two months
- Some variability between methods, contaminated to not contaminated, but samples beyond hold times are not considered valid for contaminated sites
- Persistence in samples demonstrated

Methanol Analysis on February 2025					Methanol Analysis on March 2025		Methanol Analysis on April 2025
BH ID	Depth	EEI Field Screening Results	Lab 1 (GC-FID)	Lab 2 (GC-MS)	Lab 1 (GC-FID)	Lab 1 (GC-FID)	Lab 2 (GC-MS)
--	--	mg/L	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Alberta Tier 1 Guideline			11 mg/kg				
BH25-05	0.5	--	80	--	10	17.9	6.4
BH25-05	3	0.7	<1.0	0.6	--	--	--
BH25-05	6	-0.1	1.2	0.6	--	--	--
BH25-05	9	-0.1	18	--	16	9.1	33.2
BH25-05	12	--	60	--	32	27.2	25.6
BH25-05	15	--	<1.0	0.6	--	--	--
BH25-05	18	--	<1.0	0.6	--	--	--
BH25-06	0.5	--	180	--	46	56.4	40.1

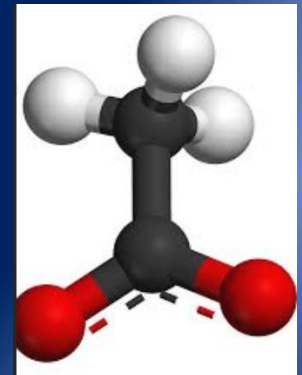
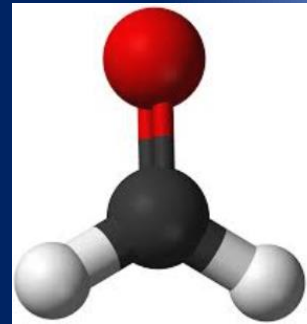
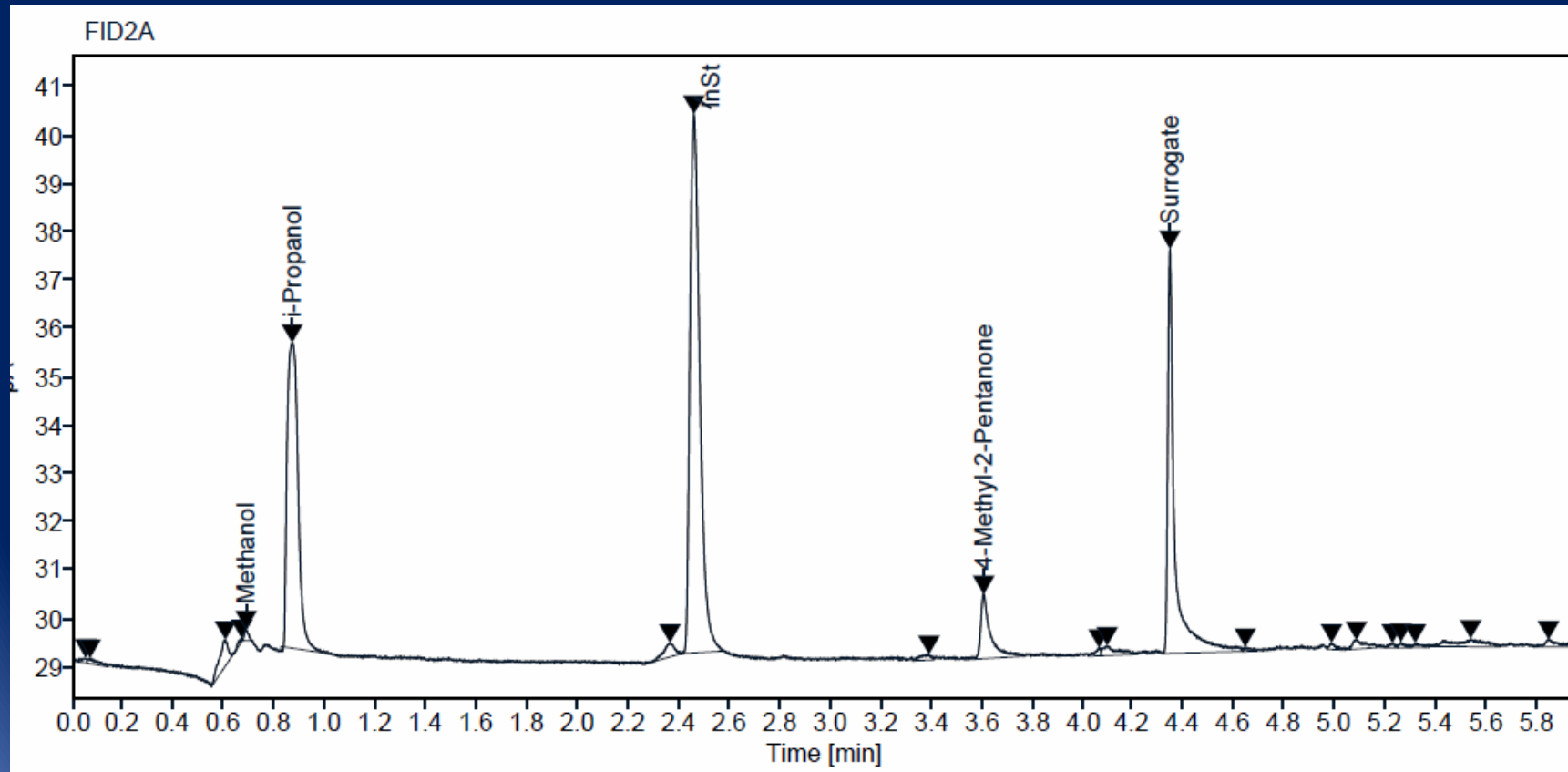
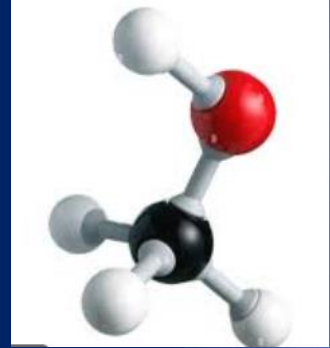
Site Example of Methanol and Hydrocarbon Impacts

- Second site – two locations were redrilled in exact same location
- Methanol is highly soluble, doesn't stick to soil, impacts should be quite diffuse and similar during redrills (would be different if binds strongly to soil leading to a greater risk of 'hot spots' for less mobile contaminants)
- In 2023, concentrations were > 100 mg/kg
- In 2025, concentrations were below Tier 1 guidelines (11 mg/kg for coarse)
- To further complicate matters, all groundwater data from same impacted water bearing zone were all non-detect
- Observed at two other sites – impacts in soil, not in groundwater, that doesn't work for a substance like methanol



Methanol Conundrum

- Dig into literature and chemist's blogs
- Numerous reports of people trying to resolve issue of some unknown chemical co-eluting with methanol
 - Much of this literature from the biological field, not soil and groundwater
 - Some published studies suggest acetate, acetone, formaldehyde, ethanol could elute close to methanol

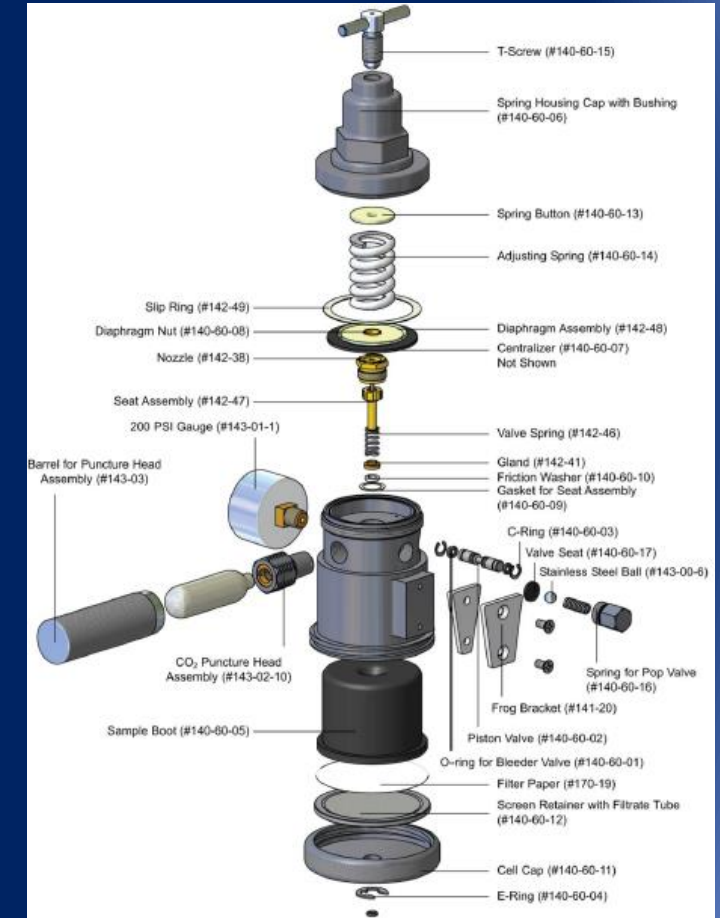


Methanol Field Screening

- Possibility of using PID but with non-standard eV bulb
 - Standard eV bulb of 10.6 will not detect methanol
 - Tried this in the field with 11.7 eV bulb – should be able to catch methanol, unsuccessful
- Develop a field-workable spectrophotometric technique
 - Methods were mostly used in biological and alcoholic beverage producing industries
 - Multiple methods painstakingly tested
 - Many were not going to be effective in the field
 - Found one method that was effective in the field and wouldn't necessarily require an expensive portable spectrophotometer – could just provide a Yes/No answer for delineation

Methanol Field Screening

- **EEl Field Screening Method – modified published method and selection of equipment optimal for field use**
- **#1 – Extract permeate from soil sample processed through a mudpress (easy if GW, step not needed)**
- **#2 – combine permeate with enzyme cascade A and heat to 37 °C – optimal for enzyme activity**



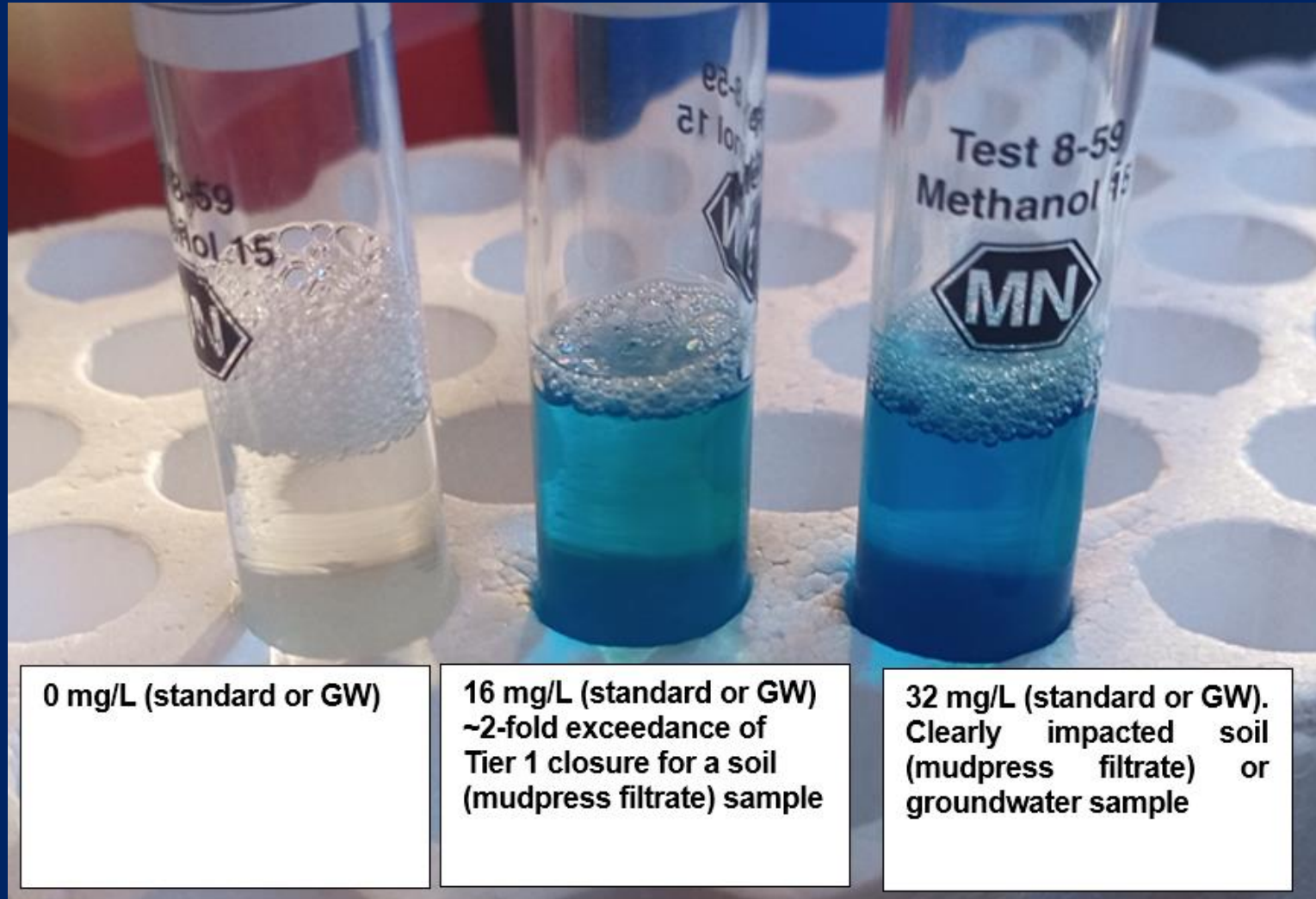
Methanol Field Screening

- **#3 – combine permeate with enzyme cascade A and heat to 37 °C – optimal for enzyme activity**
 - Accuracy of reagent addition is important – use calibrated pipettes, work fine in the field
- **#4&5 – more enzyme steps**
- **#6 – spectrophotometer such as Hach DR3900 – reading – can get quantitative output of above or below Tier 1 guidelines (need to develop standard curve)**



Methanol Field Screening

- **#7 – Take your reading – quantitative output, BUT, also get a chromophore and can look at a simple Blue/Not Blue response for a hit/no hit**



Take Home Points

- If you suspect methanol impacts at a site and need to collect samples,
 - Distinct work station
 - Distinct soil knives
 - Distinct coolers
 - Don't breathe too much on your samples!
 - Consider a field screening technique
 - Collect split duplicate samples and send to different labs
 - Consider running additional analytical techniques such as GC-MS or derivatization
 -
 - Also analyze for formaldehyde
 - This is a one liner requirement in EPA (2024) Tier 1 doc
 - Guideline is very low compared compared to methanol, but is not listed in the Tier 1 document – check the Government of Alberta 2010 Methanol Document



Fin.

Questions?