BNSF Ethanol Release
Alma, WI – 11/7/2015

What happened?

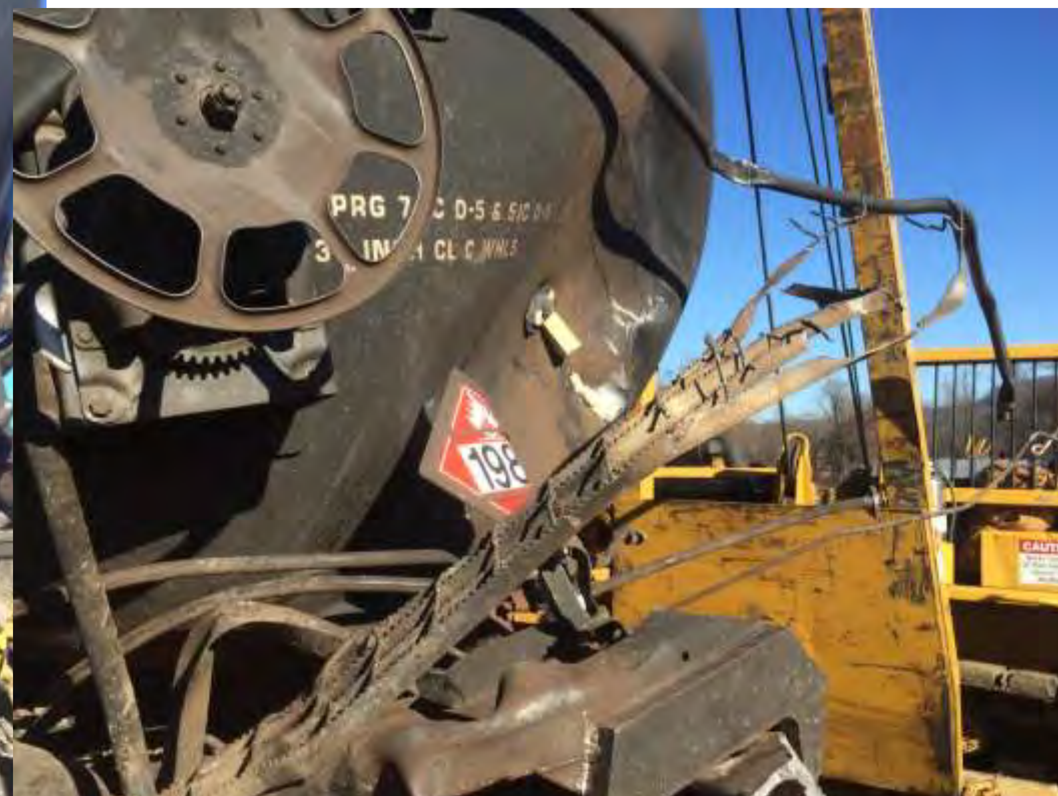
- 0845 Saturday, November 7, 2015
  - 25 rail cars derailed along the rail line on the east side of the Mississippi River in the Upper Mississippi Fish & Wildlife Refuge. *Cause is still unknown, investigation still underway*.
  - 9 derailed cars were carrying denatured ethanol w/ 1-5% gasoline denaturant. *Other cars were empty auto carriers*.
  - 5 of the 9 leaked an amount of ethanol up to approximately 20,000 gallons

Quad Copter Photo

What happened?

- 0845 Saturday, November 7, 2015
  - One ethanol car had a breach, the other 4 leaked out of various valves and manways. *All were older DOT 111 cars.*
  - The majority of the product leaked into the ballast, an unknown amount actually released into the Mississippi.
  - Local FD issued a voluntary evacuation as a precaution, was lifted by 1 PM. *They left after BNSF arrived.*
  - OSC Maguire dispatched early afternoon, arrived mid evening – It was dark…

Breached tank car – Day 2



Wreckage

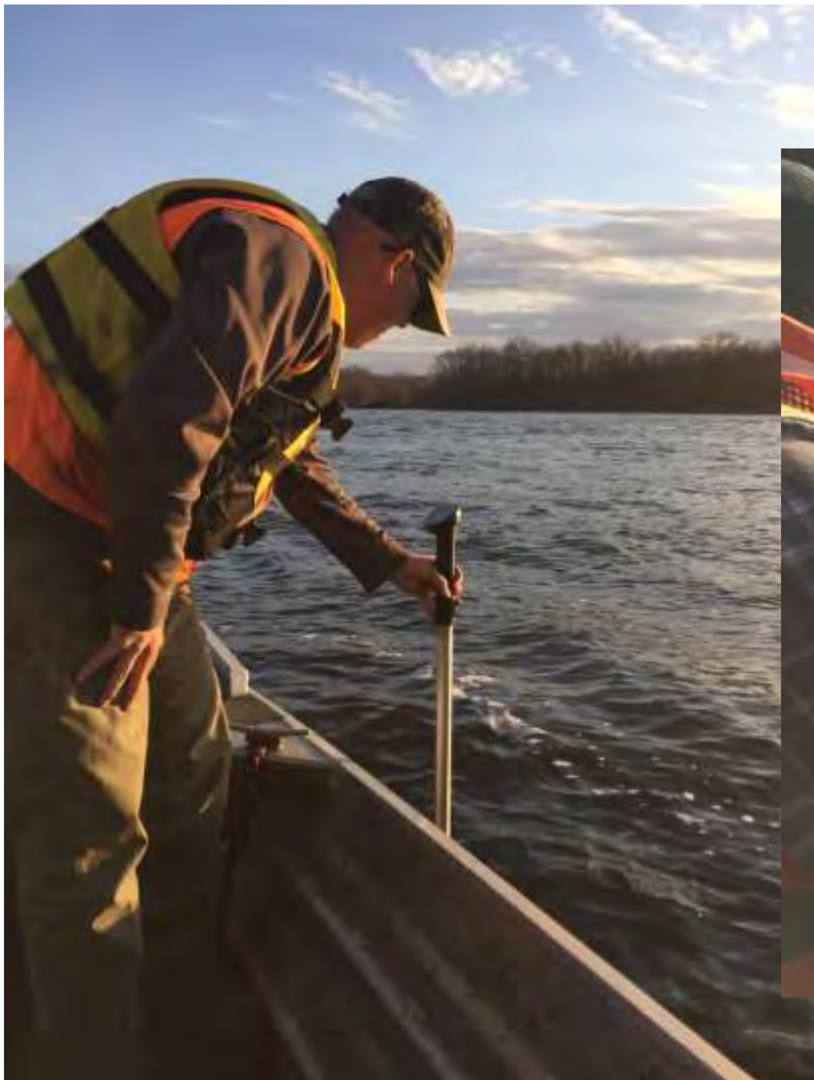
Wreckage/Secondary Spill

Observations

- No sheen ever reported by responders
  - Likely very low % denaturant, closer to 1%
  - Measurable BTEX in ballast (significant) and water column (very low)
- No fish kill or DO drop.
  - Could be due to water conditions or size of system vs. size of spill
- High levels of ethanol in ballast and lower amounts in water column.
  - Could cause long term issues

Observations

Observations



Incident Command Implementation

- BNSF created initial objectives on own and began producing an IAP on own before regulators got there.
- No initial meeting schedule or plans of meetings
- EPA brought in WDNR, USFWS together with BNSF for Unified Command.
- Restructured and began planning P officially on day 2

Media

Media

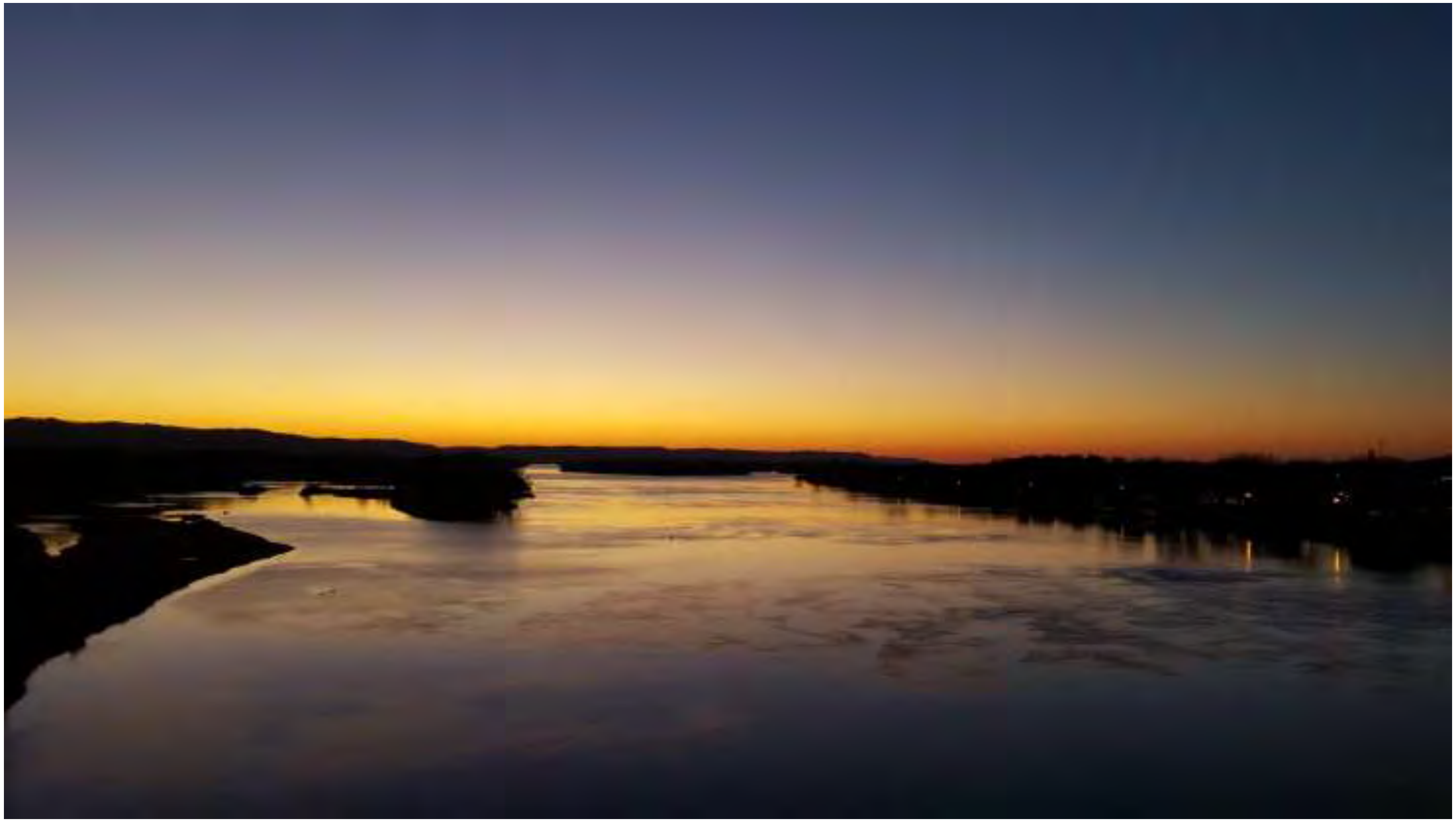
- Senator Tammy Baldwin (D)
- FRA Administrator
- FRA Regional Administrator
- Brass from BNSF
- Local Officials
- Media from Twin Cities, Madison and local areas.

Moving Forward

- WDNR and USFWS involved in oversight of long term monitoring plan

BNSF Ethanol Spill

- Questions?



Galena Illinois BNSF Derailment

Incident Summary

- 1324hrs on March 5
  - Reported to NRC @ 1452hrs
- 21 of 105 BNSF train cars derailed @ MP 171.6
- Crude oil released to ground & Galena Fire made decision to let product burn
- Initial response focus =
  - Life safety
  - Incident stabilization
  - Protection of environment
- 415 personnel initially

Location

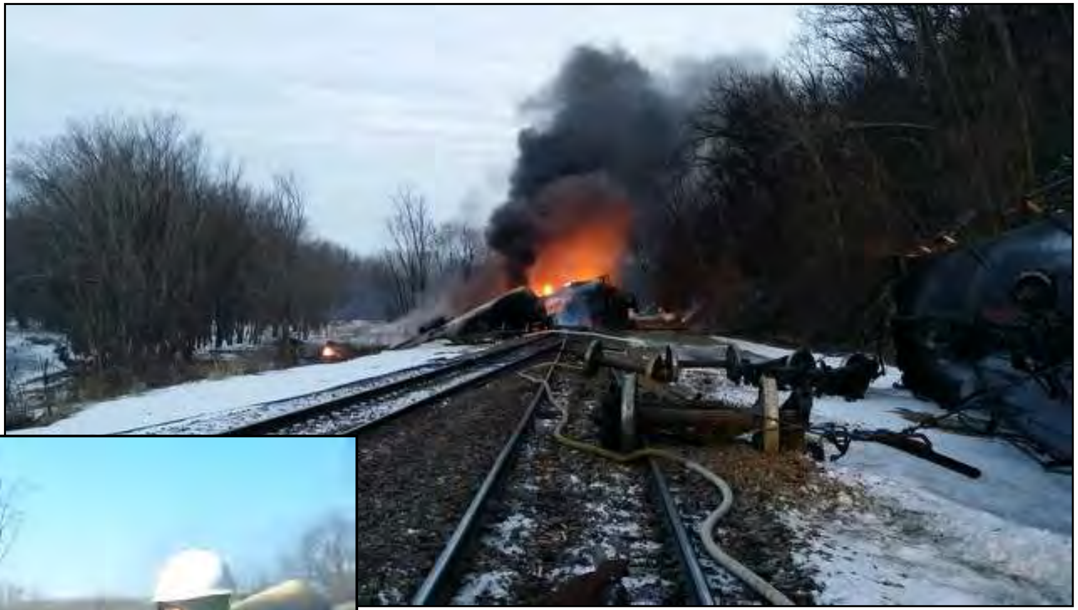

Galena River
Harris Slough
BNSF Rail Line
Mississippi River

Response Activities

- Extinguished fire, investigate FRA and USDOT,
- Roadway access to difficult area
  - 404 permit issued by USCOE
- Move un-impacted cars from the area
- Removed damaged cars from right-of-way
- Excavated contaminated soils under tracks
- Replaced damaged track & resume track ops
  - Over 100 trains had backed up
- Emptied, cleaned, purged, cut up & scrapped cars (hauled out by truck)

12 impacted cars

Friday, March 6



Monitoring & Sampling

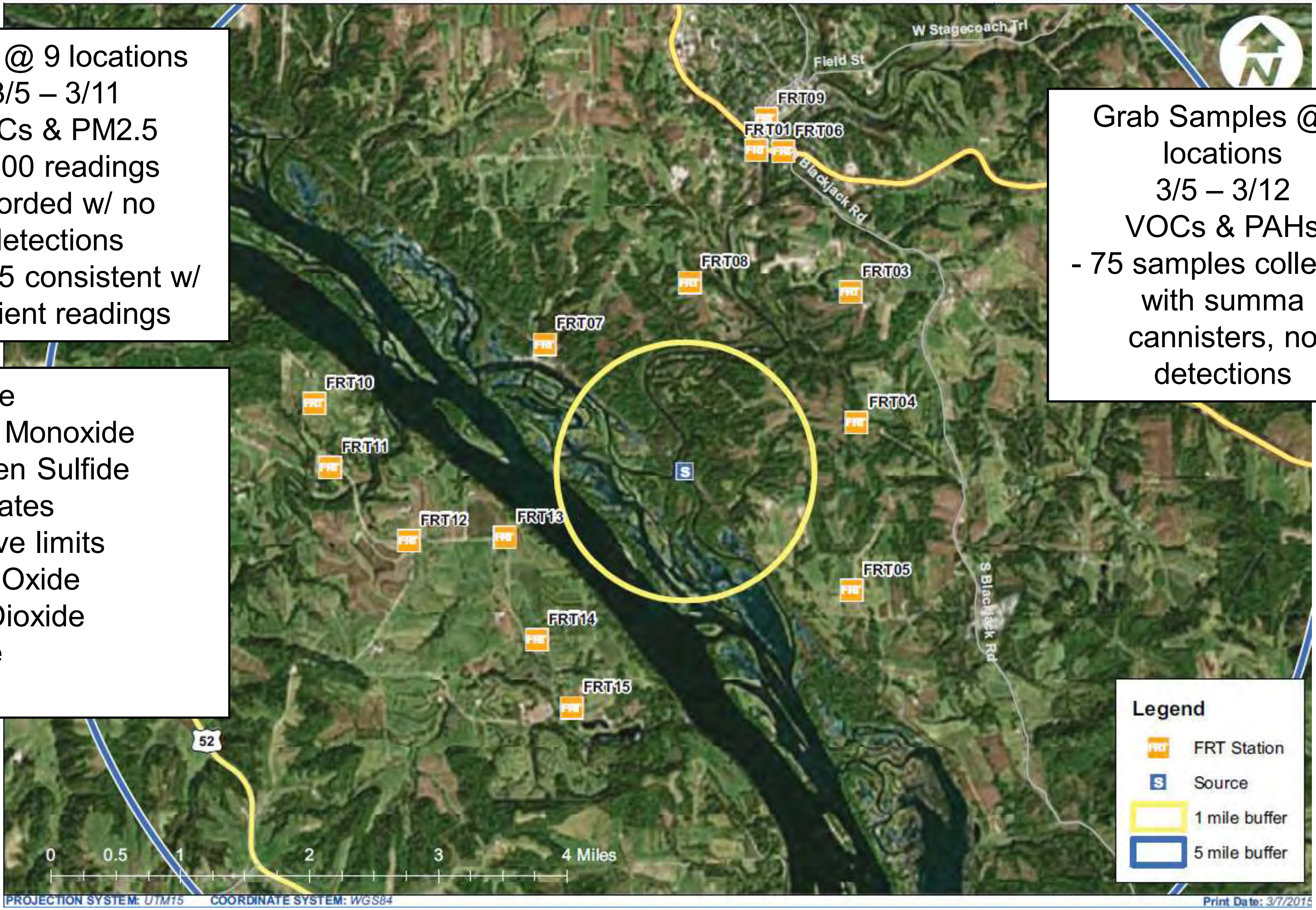
- Air
- Product
  - Fingerprint, SDS, analysis
- Surface Water
- Soil

Galena Water Sampling

Air

Fixed @ 9 locations
3/5 – 3/11
VOCs & PM2.5
- 4300 readings recorded w/ no detections
- PM2.5 consistent w/ ambient readings

Benzene
Carbon Monoxide
Hydrogen Sulfide
Particulates
Explosive limits
Nitrous Oxide
Sulfur Dioxide
Toluene
VOCs



Grab Samples @ 5 locations
3/5 – 3/12
VOCs & PAHs
- 75 samples collected with summa cannisters, no detections

Air Monitoring/Sampling Location Considerations

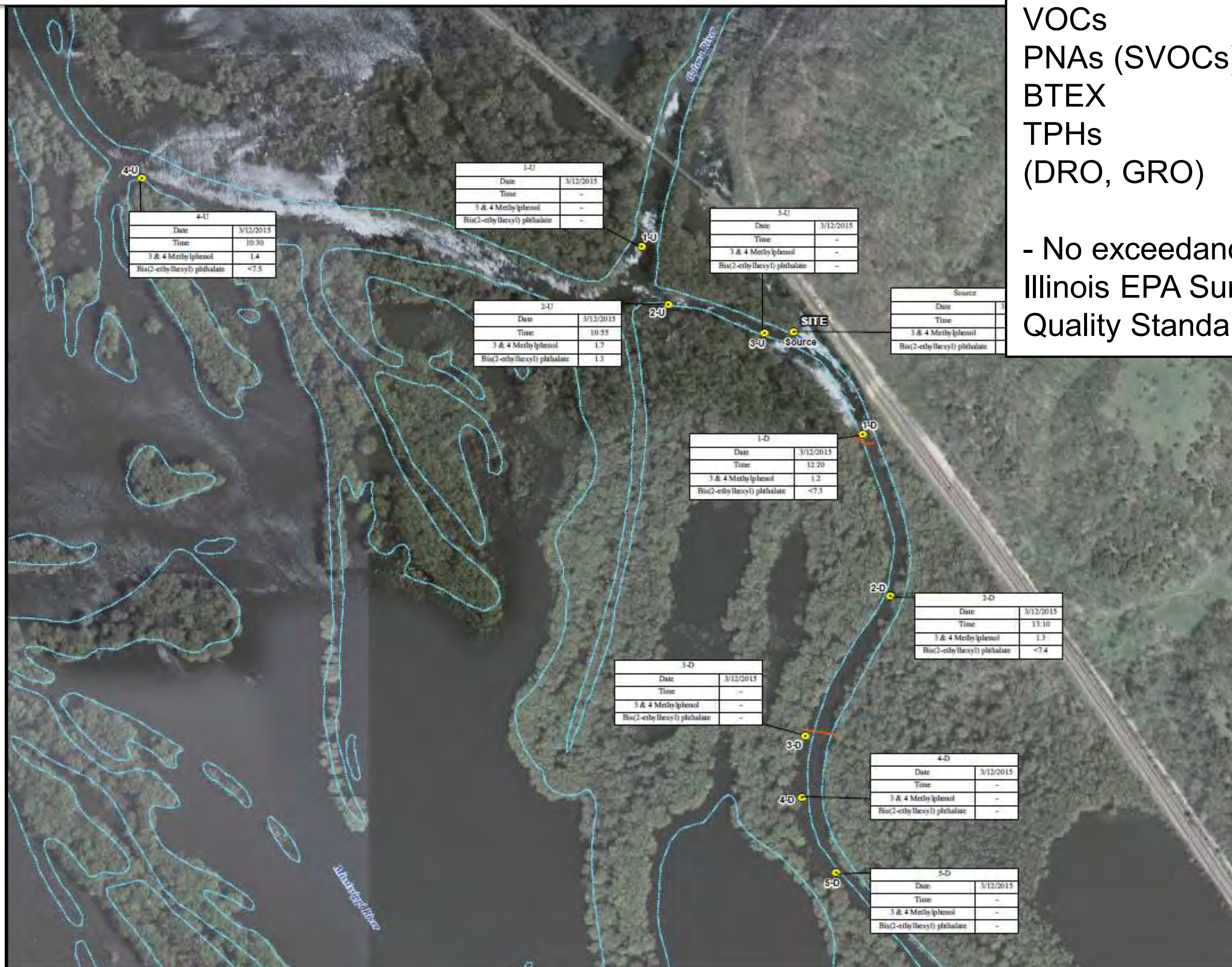
- Meteorological conditions
  - For modeling
  - Determine air monitoring locations
  - Impacts on chemical properties
- Collection areas
  - Dependent on type of recovery
  - Secondary release points
- Staging areas
- Indoor environments
  - Evacuation vs. Shelter In Place
  - Re-occupancy

4 upstream, source, 5 down 3/7 to 3/11
2 upstream, source, 2 down 3/11 to 3/16

Surface Water

Field parameters:
(depth, velocity, Dissolved Oxygen, ORP, temperature, conductivity, pH)
Analytical parameters:
VOCs
PNAs (SVOCs)
BTEX
TPHs
(DRO, GRO)

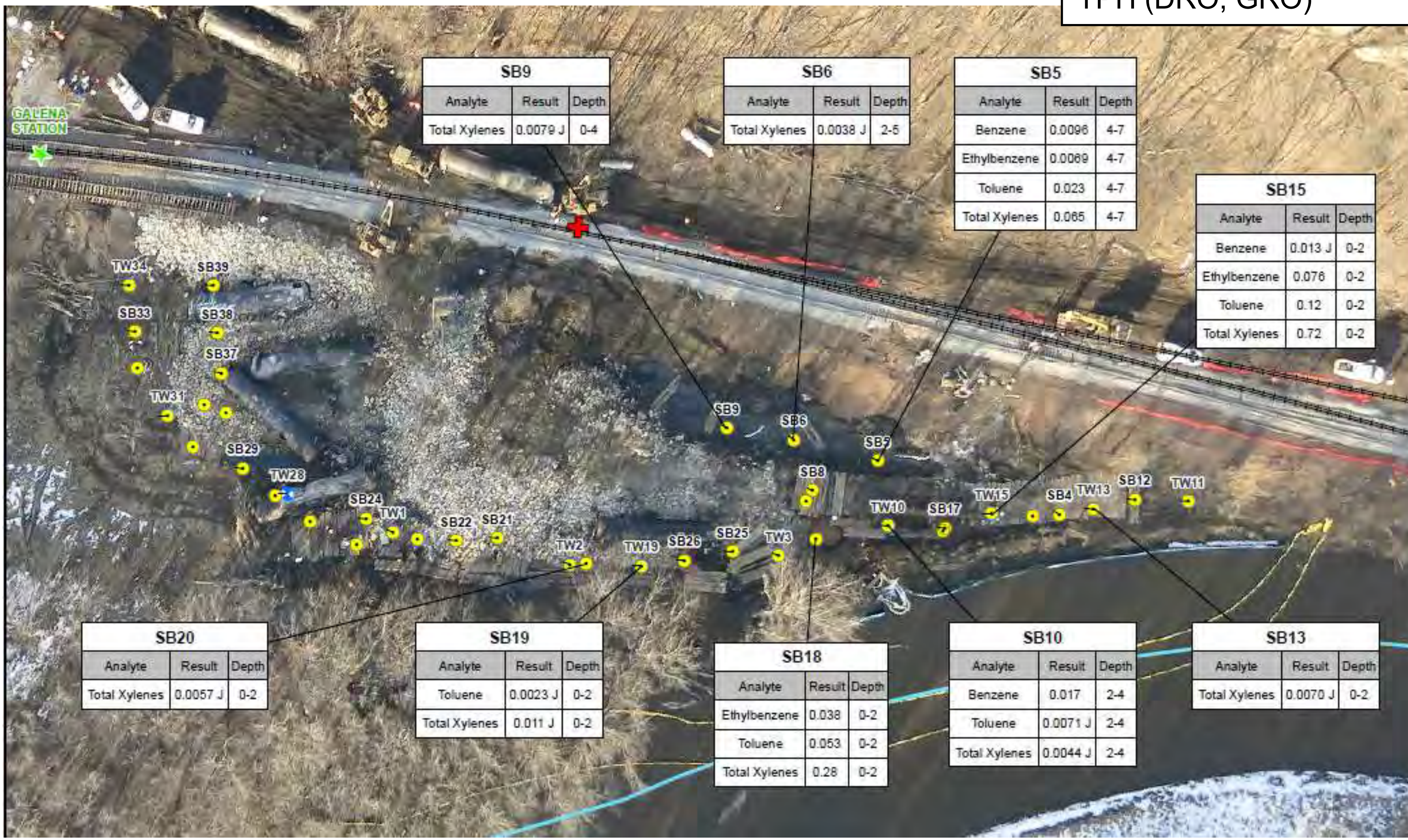
- No exceedances of Illinois EPA Surface Water Quality Standards



Soils

- 143 samples from 35 borings screened
39 samples to lab

PNAs (0'-3', 4'-8')
BTEX
TPH (DRO, GRO)



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Analyte	Result	Depth
Total Xylenes	0.0079 J	0-4

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Toluene	0.0071 J	2-4
Total Xylenes	0.0044 J	2-4

SB13

Analyte	Result	Depth
Total Xylenes	0.0070 J	0-2

Soil and Ground Water Sampling

Canadian Pacific train derailment occurred 1/26/16, 4 miles south of **Brownsville, MN.** A total of fifteen cars derailed along the banks of the Mississippi River.

Photo: Winona Daily News

Plywood containment and recovery were installed. Ice slot with boom installed



Brownsville, Mn Water Sampling and Monitoring:

- Air boat operations were conducted to drill sampling locations in the ice with ice augers.
- YSI meters were used at these sample locations and in open-water near the downstream
- Lock and Dam to monitor for conductivity, pH, and dissolved oxygen, along with depth to bottom measurements and visual sheen inspections.
- Water quality sampling for Oil and Grease (EPA 1664) and Chlorides (SW 9056).


TILX

File: Brownsville_MN_Fig003_AllSampleLocations.mxd

Pinnacle Engineering
11541 95th Ave N.
Minneapolis, MN 55369
(763) 315-4501
www.pineng.com

PROJECT NUMBER: R016055.000 | DRAWN: PM / REVIEWED: PM | DATE: 01/31/2016

Figure 3
All Sample Locations

CP Brownsville Derailment
Brownsville, MN

Legend
- Surface Water Sample Location
- Locomotive
- Rail Car

SW-9			
Date	2/1/16	2/2/16	2/3/16
Oil & Grease (mg/L)	<5.00	<4.48	NS
Chloride (mg/L)	NS	NS	20.8

SW-8			
Date	2/1/16	2/2/16	2/3/16
Oil & Grease (mg/L)	<5.00	<4.48	NS
Chloride (mg/L)	NS	NS	21.3

SW-7			
Date	2/1/16	2/2/16	2/3/16
Oil & Grease (mg/L)	<5.00	<4.44	NS
Chloride (mg/L)	NS	NS	20.6

SW-12			
Date	2/1/16	2/2/16	2
Oil & Grease (mg/L)	<4.48	NS	
Chloride (mg/L)	NS	NS	

Date
Oil & Grease (mg
Chloride (mg/L)

Da
Oil & Greas

Planning and Preparedness for Response Efforts on the Upper Miss

- After Action Reports to identify what worked and improve response efforts
- Planning and Preparedness Training (Prairie Island April 2016)
- Continue Exercises and Training
- Use Templates for Incident Command, Air and Water Sampling, Health and Safety

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Air Monitoring Equipment in Extreme Cold Weather

Effects of Extreme Cold and humidity on Air Monitoring Equipment

* Moisture/condensation is an issue for electronic monitors.
* Battery life can be significantly reduced
* Instrument response time may be significantly slower.
* Sensor function and relative response may be effected by changing temperatures & humidity

Improving performance in cold conditions

- The detector should be thoroughly acclimated to the anticipated use temperature by waiting an appropriate amount of time for the system to stabilize - typically ½ to 1 hour.

- Avoid the use of alkaline batteries, if possible. Alkaline batteries may give as little as 10% of the run time at 0°F (-18°C) than at room temperature. In general, NiMH and NiCad batteries perform best, followed by lead-acid types.

- Liquid Crystal Displays (LCD's) lose contrast and their refresh rate slows at cold temperatures. Adjust the LCD contrast (if possible) and /or cover the display with a warm hand.

Improving performance in cold conditions (continued)

- Be aware any potential for condensation of moisture when remote sampling from below grade to above ground, if topside conditions are less than 40°F.

- Many models of electronic monitoring equipment use temperature compensation and low temperature alarms. Check the instrument manual for specifics on temperature and humidity effects.

- Oxygen and toxic gas sensors contain fluid (water-based) electrolytes and membrane systems that are adversely affected in the event of freezing at very cold temperatures.

Likely Air Monitoring Equipment (for benzene)

Photo Ionization Detectors (PID)

PbbRAE 3000 (benzene correction factor = 0.5)

UltraRAE 3000 (benzene = 50 ppb – 200 ppm)

Temperature Effects On PID

Primarily due to a change in gas density, and thus concentration.

From: The PID Handbook, Third addition, RAE Systems

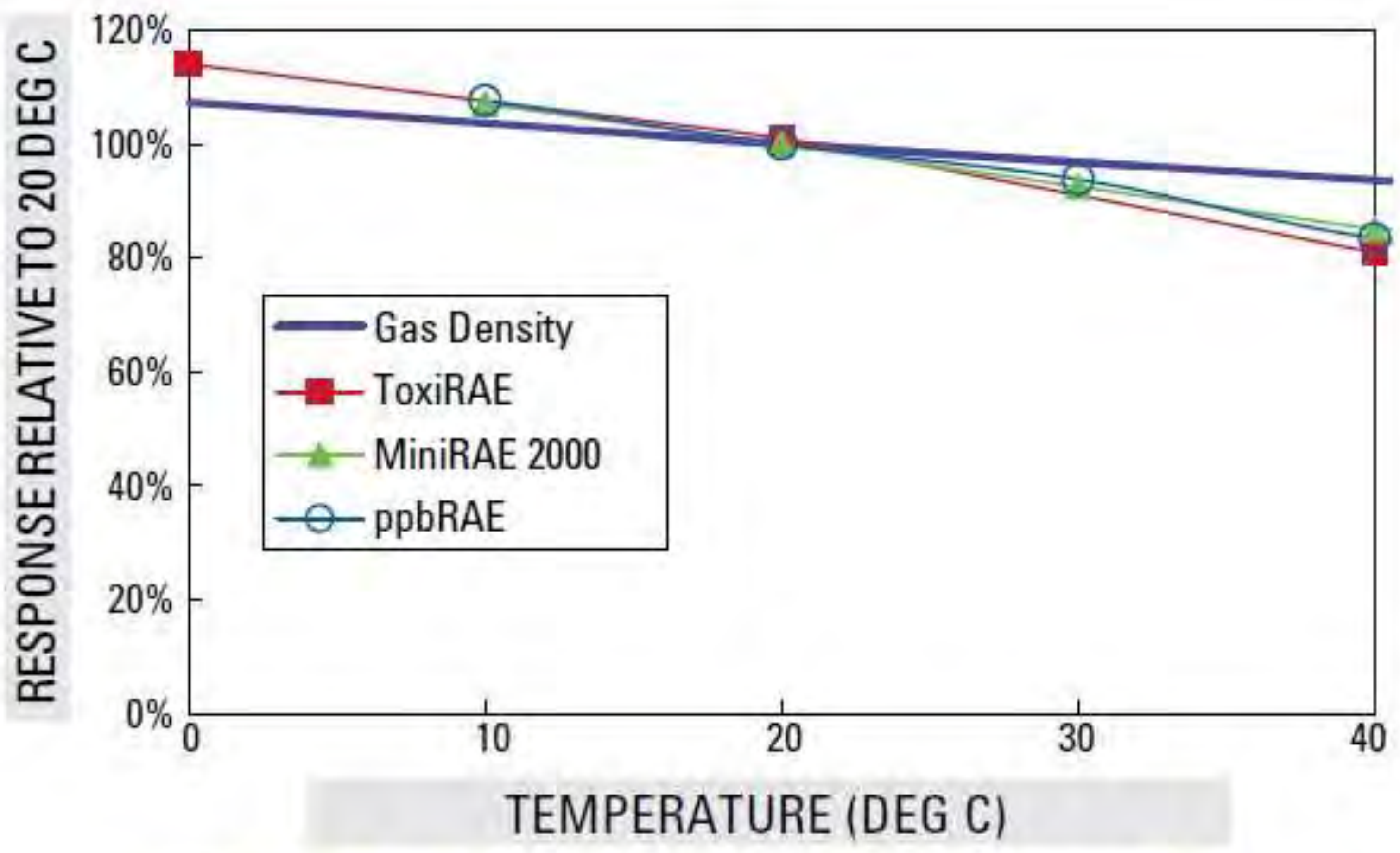


FIGURE 3.3.1. Effect of temperature on three PIDs

Water Vapor Quenching

Depends on the absolute concentration of water vapor, rather than the relative humidity

Humidity-Induced Current Leakage

Apparent response that appears as a rising drift. Caused by condensation on the sensor.

From: The PID Handbook, Third addition, RAE Systems

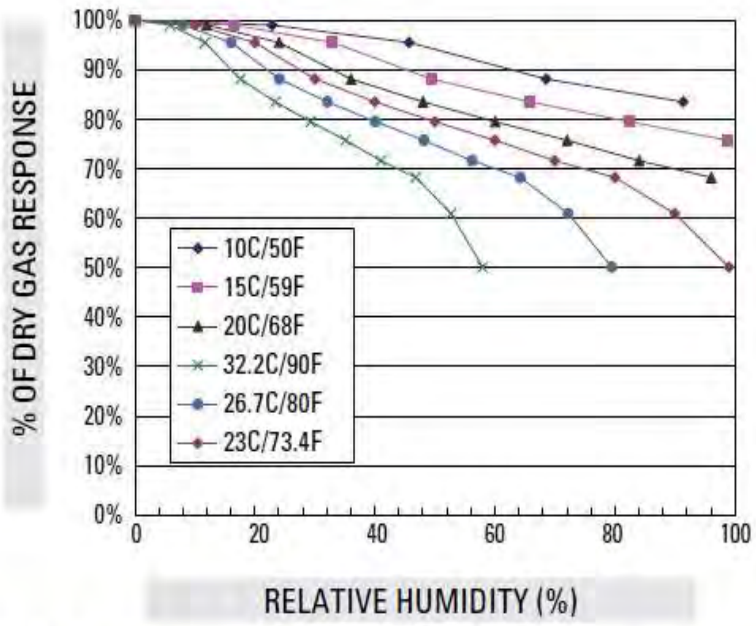


FIGURE 3.2.8. Calculated PID humidity effect curves vs. temperature for MiniRAE 2000

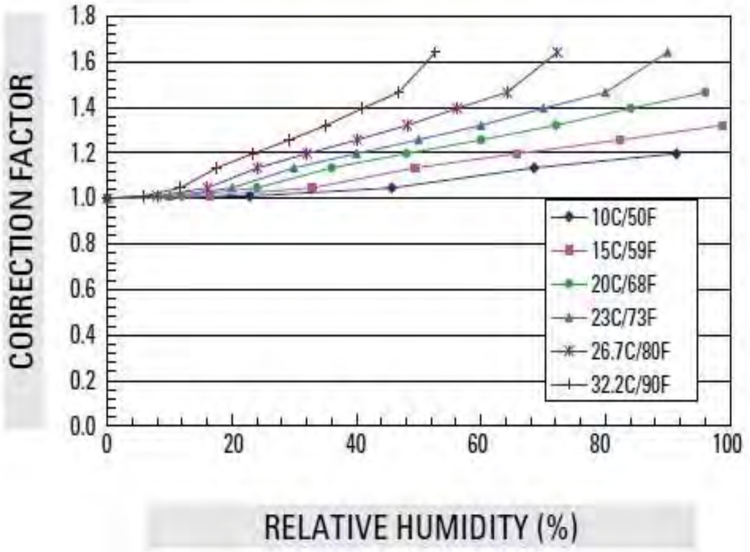


FIGURE 3.2.9. Correction factors for humidity vs. temperature for MiniRAE 2000

Likely Air Monitoring Equipment (for benzene)

Gas Detection tubes

Drager tubes (benzene =0.25 – 400 ppm)

Drager Chip system (benzene = 0.2 – 250 ppm)

Effects of Humidity & Temperature on Gas Detection Tubes

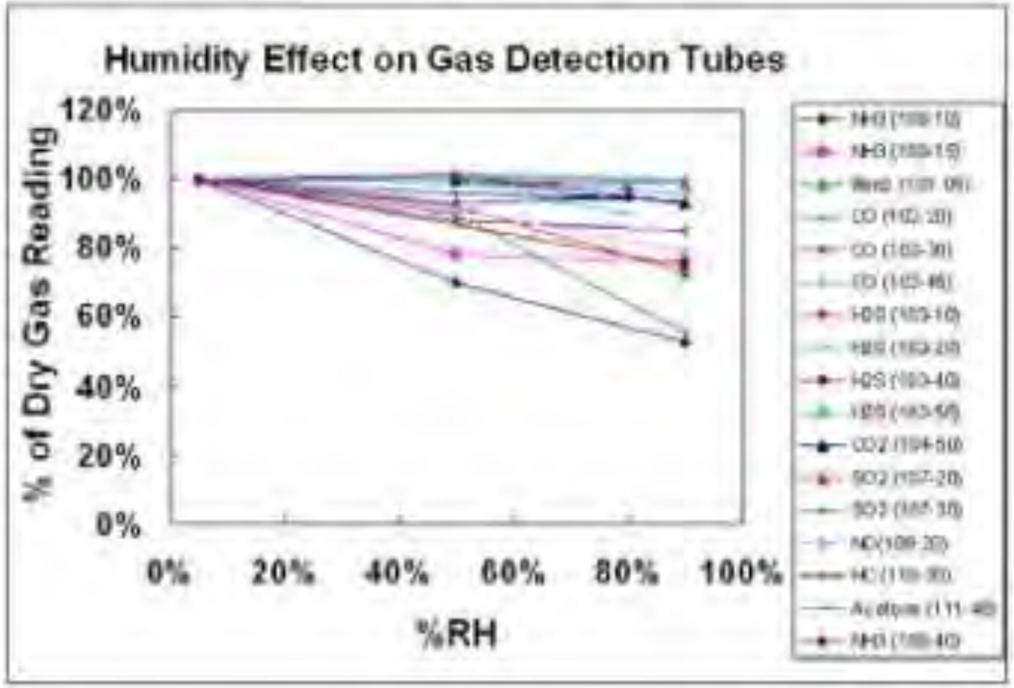


Figure 4-2. Effect of humidity on gas detection tube readings.

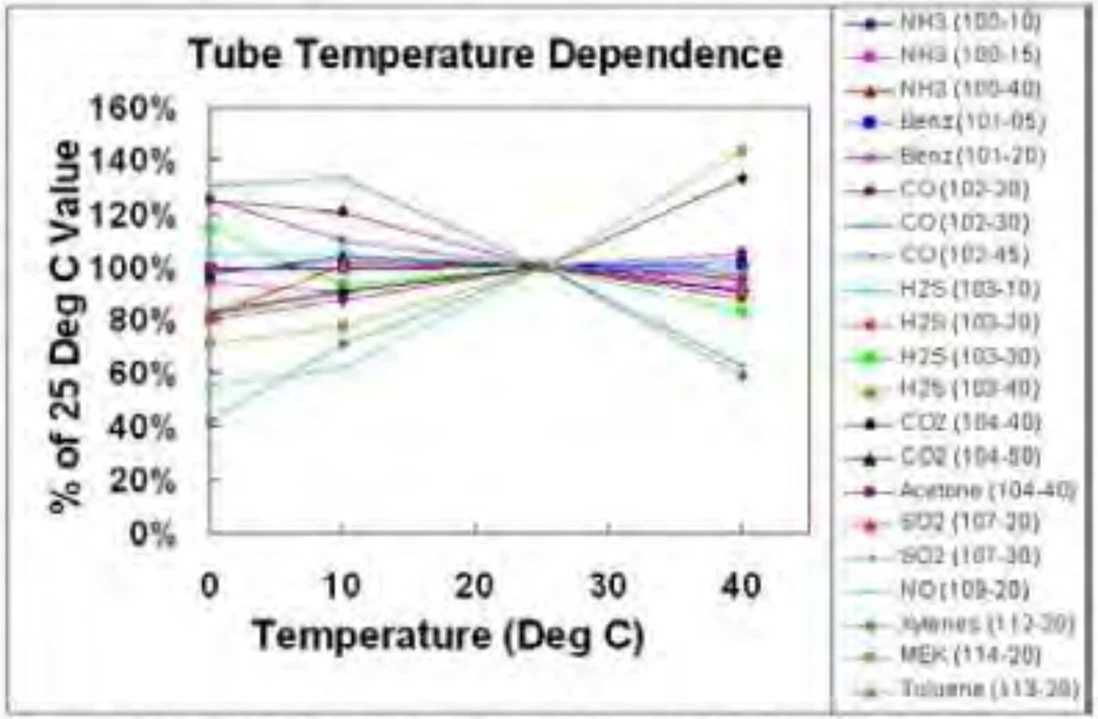


Figure 4-3. Effect of temperature on gas detection tube readings.

From: Gas Detection Tubes and Sampling Handbook, Second addition, RAE Systems

Benzene 0.5/a

Order No. 67 28 561

Application Range

Standard Measuring Range:	0.5 to 10 ppm
Number of Strokes n:	40 to 2
Time for Measurement:	max. 15 min
Standard Deviation:	± 30 %
Color Change:	white → pale brown

Ambient Operating Conditions

Temperature:	10 to 40 °C
Absolute Humidity:	3 to 15 mg H_2O / L

Reaction Principle

$2\ C_6H_6 + HCHO \rightarrow C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2O$

$C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2SO_4 \rightarrow$ p-quinoid compound

Cross Sensitivity

Other aromatics (toluene, xylene, ethyl benzene) are indicated as well. It is impossible to measure benzene in the presence of these aromatics. Petroleum hydrocarbons, alcohols and esters do not affect the indication.

Additional Information

Before performing the measurement the ampoule must be broken and the liquid transferred onto the indicating layer so that it is completely saturated.

Benzene 5/a

Order No. 67 18 801

B

Application Range

Standard Measuring Range:	5 to 40 ppm
Number of Strokes n:	15 to 2
Time for Measurement:	max. 3 min
Standard Deviation:	± 30 %
Color Change:	white → red brown

Ambient Operating Conditions

Temperature:	0 to 40 °C
Absolute Humidity:	max. 50 mg H_2O / L

Reaction Principle

$2\ C_6H_6 + HCHO \rightarrow C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2O$

$C_6H_5\text{-}CH_2\text{-}C_6H_5 + H_2SO_4 \rightarrow$ p-quinoid compound

Cross Sensitivity

Other aromatics (toluene, xylene) are retained in the pre-layer causing a reddish brown discoloration. If the toluene or xylene concentrations are too high the entire pre-layer up to the indicating layer is discolored making a benzene measurement impossible. Petroleum hydrocarbons, alcohols and esters do not affect the indication.

From: Dräger-Tubes & CMS-Handbook 16th edition

Cold Weather Water Quality Monitoring & Instrumentation

UMR Spills Group Winter Spill Response Training

Leo Keller

Hydrologist

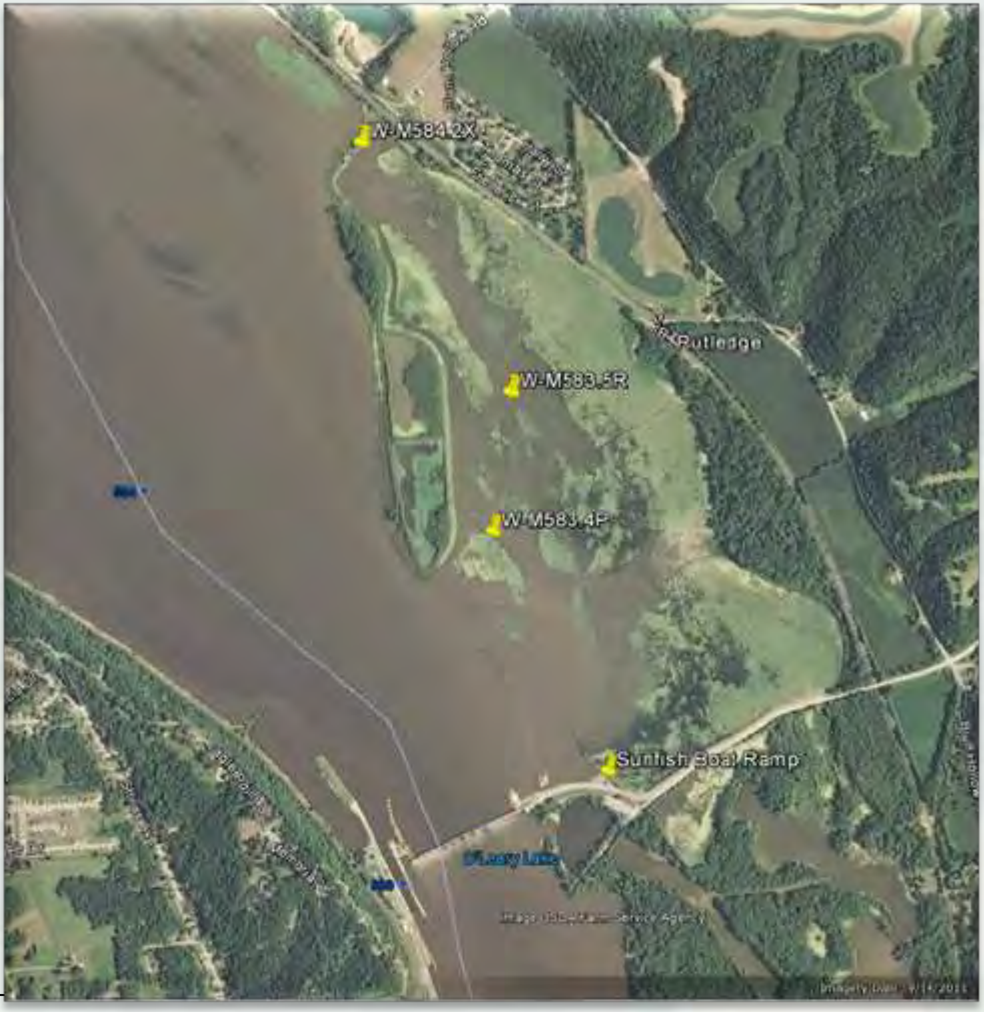
Rock Island District

February 17, 2016

US Army Corps of Engineers
BUILDING STRONG®

Site Considerations

- Contaminant properties
- Backwater, side channel, or main channel
- Potential depths, flows, and ice conditions
- Access



Summer vs. Winter

Equipment

- Airboat, toolbox and protective gear
- GPS and paper maps, long sticks
- Ice auger, spud bar, ice scoop
- Oars, steel post, boat hook
- Enclosures and retrieval devices
- Instruments

Site Measurements

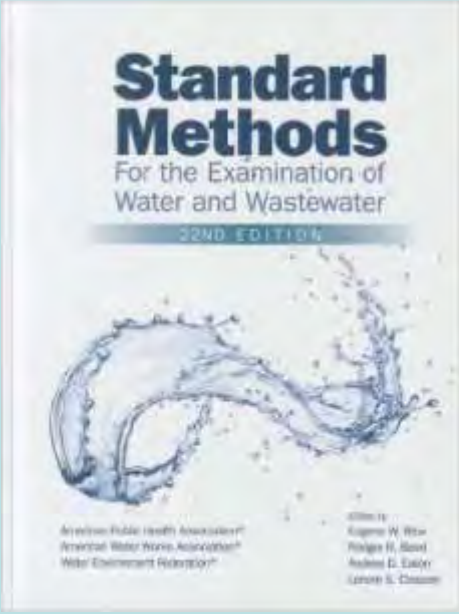
- Air temperature, wind speed and direction, % cloud cover
- Water depth
- Ice thickness and snow depth

  OR

- Wave height and Secchi depth or transparency tube

Grab Samples

- Turbidity
- Total alkalinity
- Total hardness
- Calcium hardness



Handheld Meters

- DO, pH, temperature, conductivity, velocity
- Know proper operation and limitations
- Calibration very important – different procedures for each parameter/instrument

Continuous Monitors

- Multi-parameter Sondes: DO, pH, temperature, specific conductance, turbidity
- Calibrate to expected conditions



Deploying Continuous Monitors

- Methods
  - Enclosure
  - Float/weight system w/ snag line
  - Attach to fixed structure
- Considerations
  - Flow
  - Depth, ice thickness
  - Vandalism

Lessons Learned

- Very cold temperatures:
  - Ice forms on sensors and other equipment
  - Batteries don't last as long
  - Safety – wear layers, take breaks, drink water
- Multiple pairs of gloves, towels
- Consider desired depth compared with length of cable (if high flow, may need weight on sensor)
- In shallow depths, stop auger a few inches above bottom of ice and use spud bar to chip out bottom of hole

Always Prepare for the Worst!

Questions?

Monitoring and Water Sampling in Cold Environments

Steve Faryan, USEPA On-Scene Coordinator

Spill Response Considerations

Safety

- Air monitoring - ***Fire and Personnel Safety***
  - O_2
  - CO
  - Explosive Levels - LEL/UEL
  - H_2S
  - Benzene
  - Organic vapors (VOCs)
  - Sulfur and Nitrogen Oxides
  - Particulates - smoke

Exposure Guidelines

Component	ACGIH	NIOSH	OSHA
Petroleum (8002-05-9)	Not established	CEIL: 1800 mg/m3 TWA: 350 mg/m3	Not established
Hydrogen sulfide (7783-06-4) [Oregon <1]	TWA: 1 ppm STEL: 5 ppm	CEIL: 10 ppm	CEIL: 20 ppm
Benzene (71-43-2) [Oregon 0.25 ppm]	TWA: 0.5 ppm STEL: 2.5 ppm	TWA: 0.1 ppm STEL: 1 ppm	TWA: 1 ppm STEL: 5 ppm
Ethylbenzene (100-41-4)	TWA: 20 ppm	TWA: 100 ppm STEL: 125 ppm	TWA: 100 ppm
Toluene (108-88-3)	TWA: 20 ppm	TWA: 100 ppm STEL: 150 ppm	TWA: 200 ppm CEIL: 500 ppm

Spill Response Considerations

Monitoring Equipment

- For Spill:
  - 4 or 5 gas monitors for O_2, LEL, H_2S
  - PID/FID for VOCs (FIDs are more sensitive for hydrocarbon spills)
  - Chemical-specific monitors for benzene
    - Colorimetric tubes
    - Ultra RAE with benzene tube
    - Benzene specific Monitors
- Additionally, for fire:
  - Polynuclear Aromatic Hydrocarbons (PAHs) sampling
  - Monitors or sampling equipment for particulates (smoke)

H_2S Concentration & Health Effects

Concentration (ppm)	Health Effect
0.01 - 0.3	Odor Threshold (variable)
1.0 - 5.0	Odor, Nausea, eye irritation, headache
20 - 50	Keratoconjunctivitis, lung irritation
100	IDLH, Olfactory fatigue in 3-5 minutes; altered respiration, coughing, drowsiness
100 - 150	Eye & lung irritation, olfactory paralysis
200	Olfactory fatigue shortly; stinging eyes and throat, death after 1-2 hours exposure
250 - 500	Pulmonary edema, convulsions, risk of "knockdown"
500 - 1000	Unconsciousness, risk of respiratory paralysis, loss of muscle control, self-rescue impossible
> 1000	Respiratory paralysis, death

AIR / WATER MONITORING

AIR MONITORING

AIR MONITORING

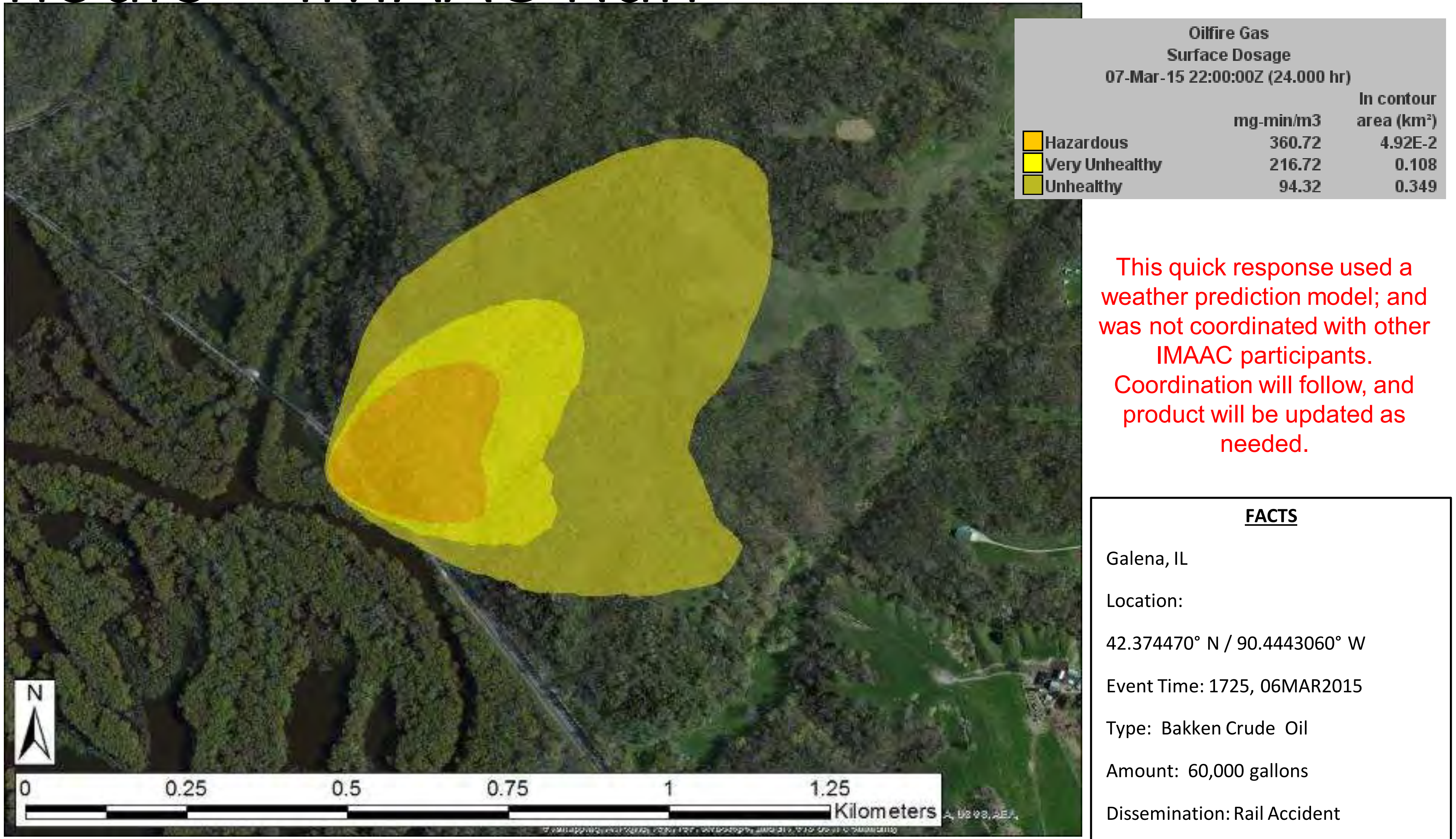
Galena Illlinois Initial Response Activities

- Establishment of safe zone / evacuations
  - 6 homes < 1 mi
  - 4 homes occupied
  - 2 individuals evacuated / 7 refused

- Concern of additional explosion(s) on March 6

IMAAC Model run

24 hours – IMAAC Run



This quick response used a weather prediction model; and was not coordinated with other IMAAC participants. Coordination will follow, and product will be updated as needed.

FACTS

Galena, IL

Location:

42.374470° N / 90.4443060° W

Event Time: 1725, 06MAR2015

Type: Bakken Crude Oil

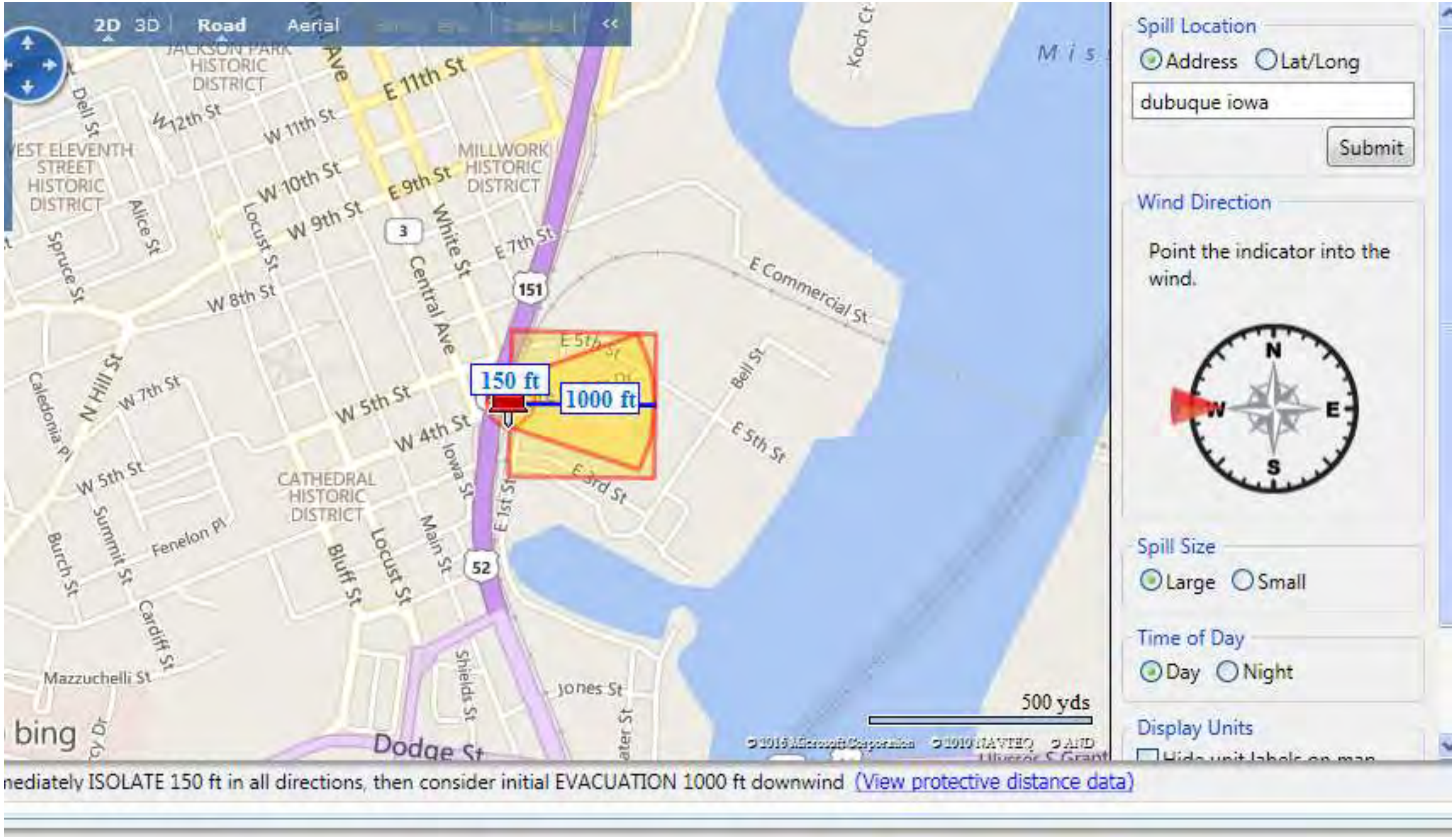
Amount: 60,000 gallons

Dissemination: Rail Accident

Weather: 12 km NAM

Model: HPAC 5.3

Use of Wiser to map isolation Distance



Monitoring & Sampling

- Air Monitoring and Sampling
- Product
  - Fingerprint analysis
  - VOC’s, DRO, GRO, Oil and Grease,
- Surface Water Quality Monitoring and Sampling
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Carbon Monoxide
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PM 2.5 Particulates
Lower explosive limit
Nitrous Oxide
Sulfur Dioxide
Toluene
VOCs

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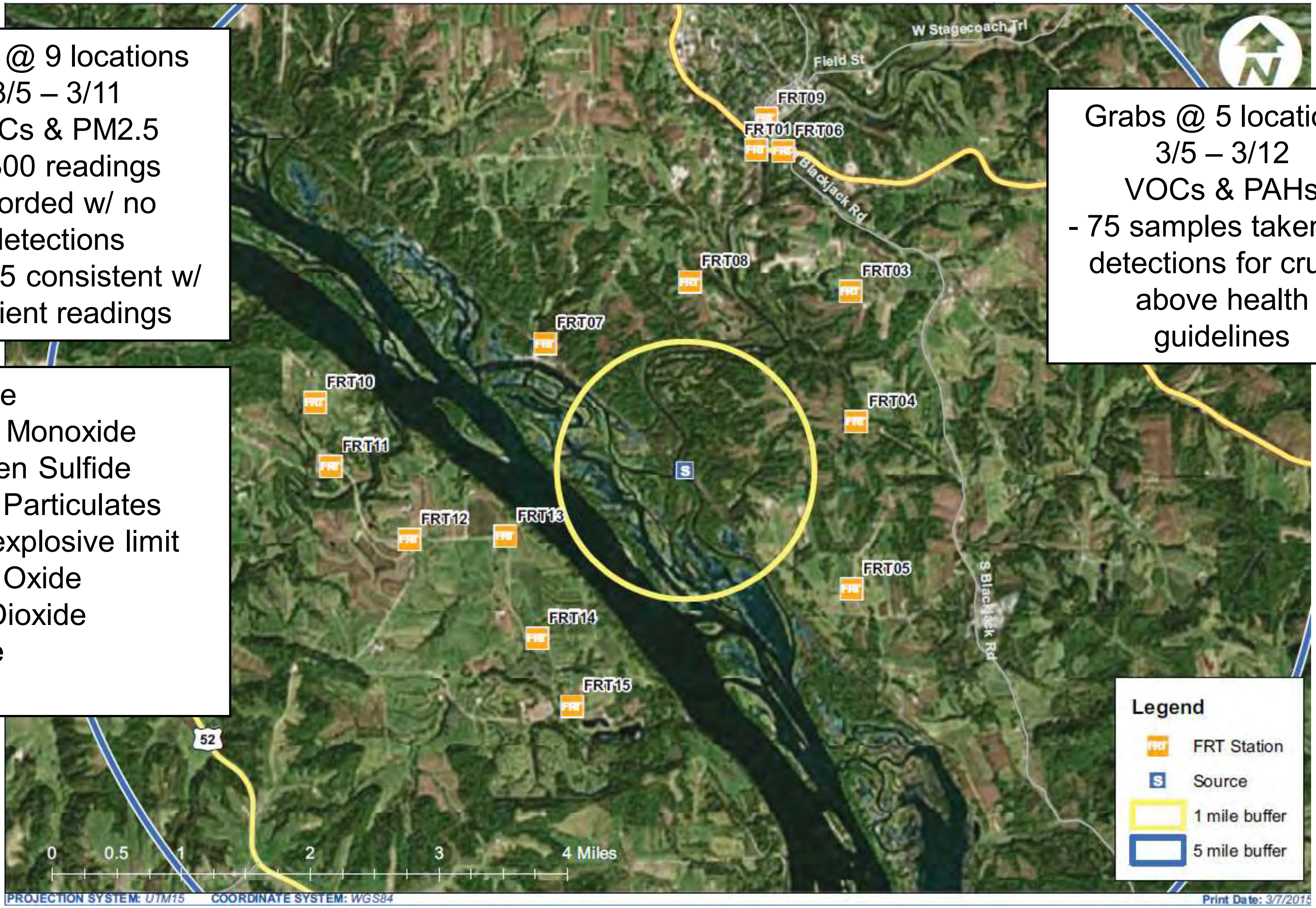
VOCs & PAHs
- 75 samples taken, no detections for crude above health guidelines



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3/7 to 3/11

2 up, source, 2 down
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(depth, flow, DO, ORP, temp, conductivity, pH)
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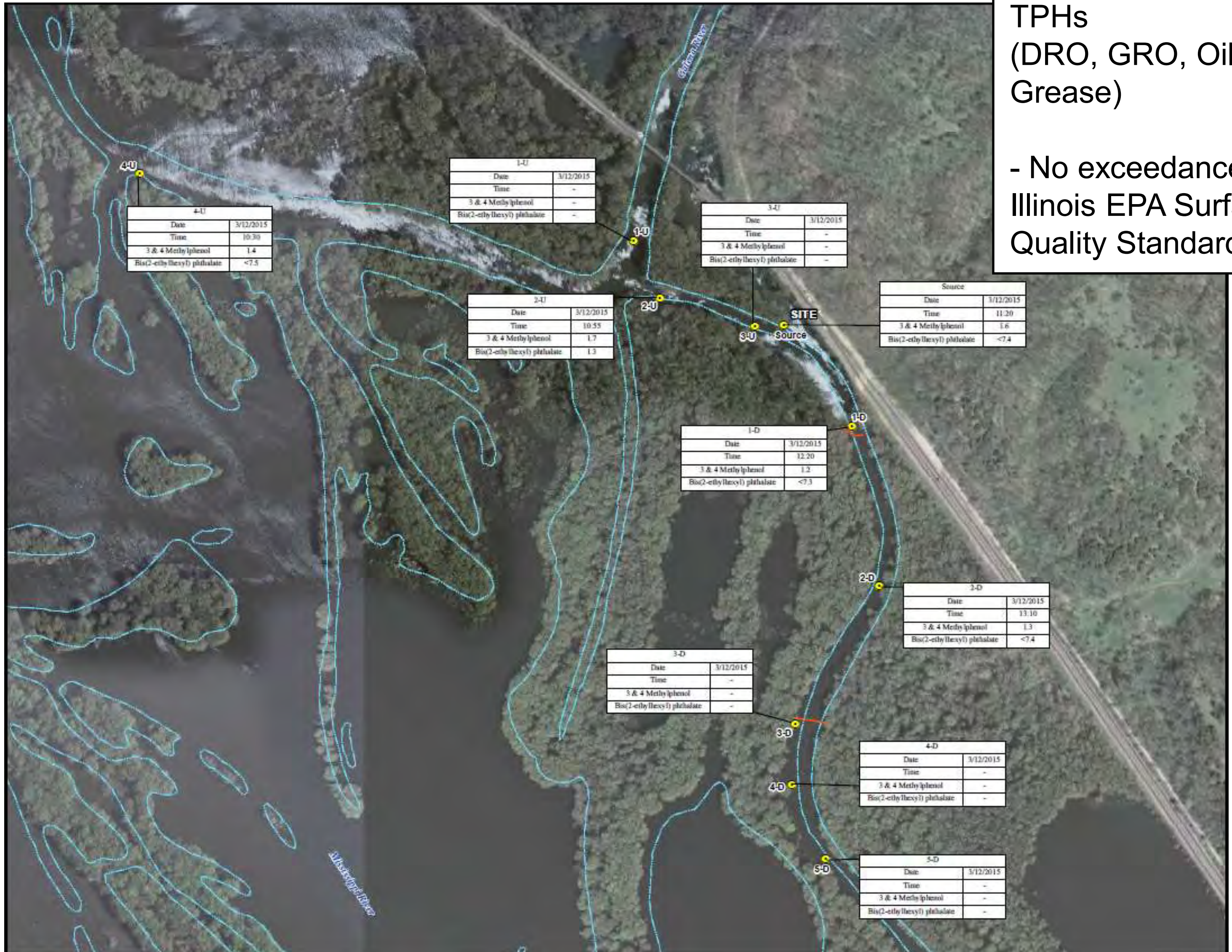

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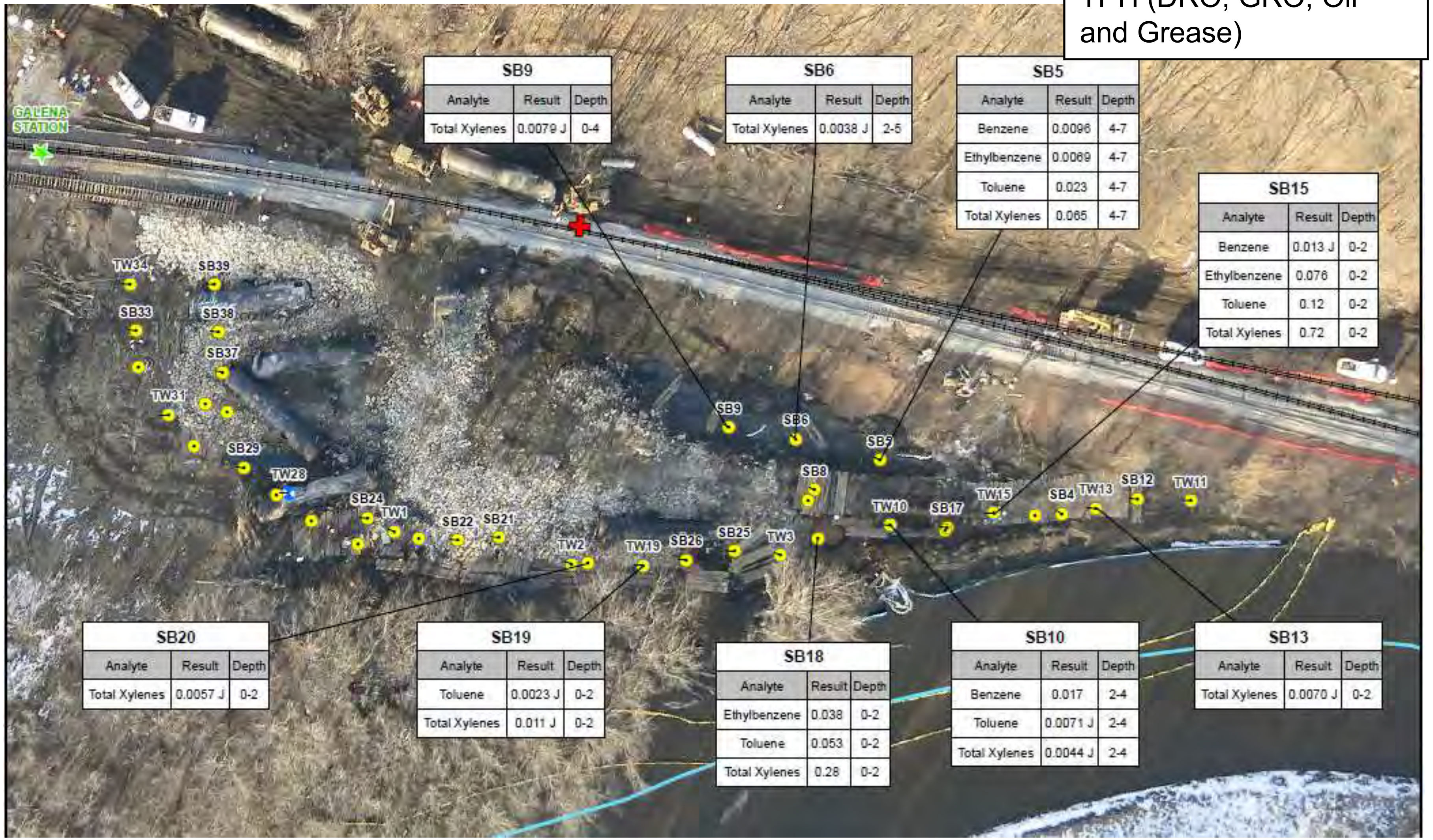

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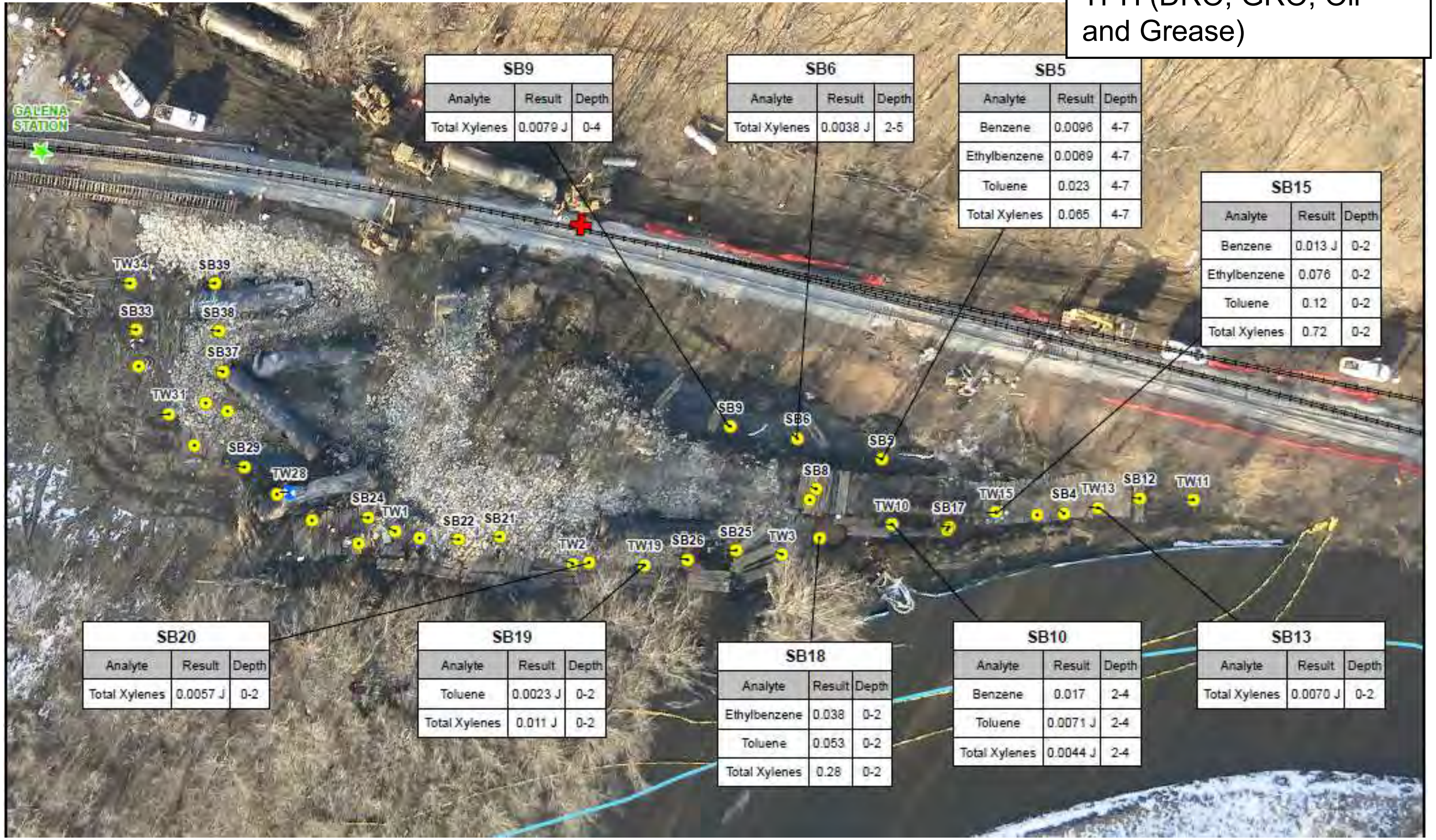

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Questions/Comments/Experiences ?

Steve Faryan, USEPA, On-Scene Coordinator
Faryan.steven@epa.gov
Cell: 312-802-0507

Bakken Crude Awareness

Greg Powell

Unit Train


CBTX742
CBTX741651
CBTX742087
CBTX741956

OHMSETT Testing

Release of Bakken Crude

- Air Monitoring
  - Area Rae's
  - Ultra Rae 3000 / Benzene Tubes
  - TVA 1000
  - Tedlar Bag GCMS Analysis
  - Carbon Tubes (Eight Hour Exposure Evaluation)
  - TAGA Continuous

Bakken Crude Specifics

- Flash Point = 95 degrees plus
- LEL = 0.8%
- UEL = 8.0%
- API Gravity = 45
- Specific Gravity = 0.82
- Benzene Concentration = 1700 – 1900 ppm

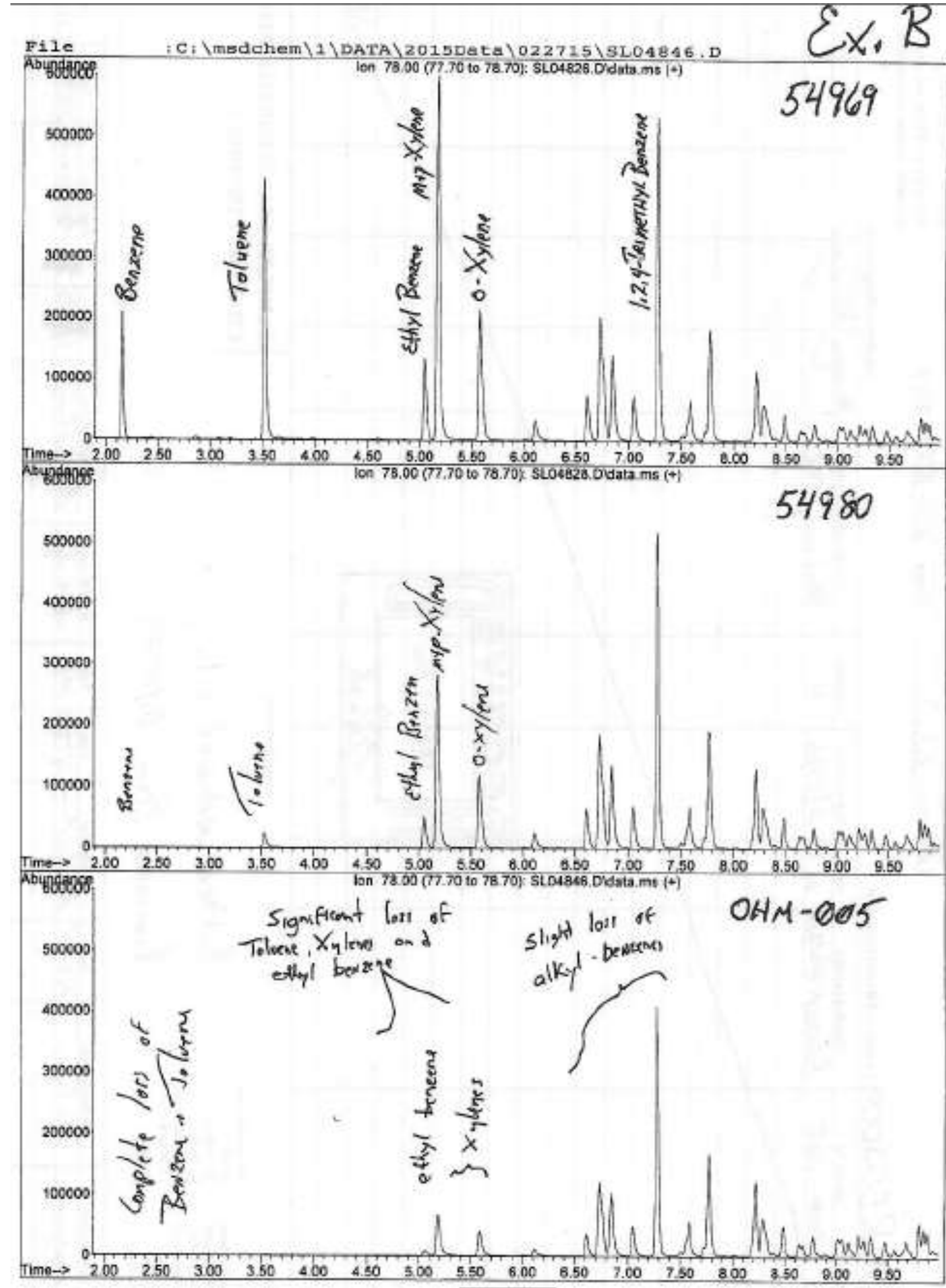
Volatile Compound Reduction With Weathering

- Significant Levels of Light Hydrocarbons in Unweathered sample
- After 24 Hours a Significant Loss of Light Hydrocarbons Up to Nonane and BTEX Compounds
- After Seven Days a Complete Loss of Benzene and Toluene. Significant loss of Xylenes

Initial Concentration

1 Day Weathering

7 Day Weathering



Benzene Air Issues

- OSHA action level = 0.5 ppm
- TWA (8 hrs.) = 1 ppm
- STEL = 15 ppm 15 minutes

Release and TAGA Monitoring

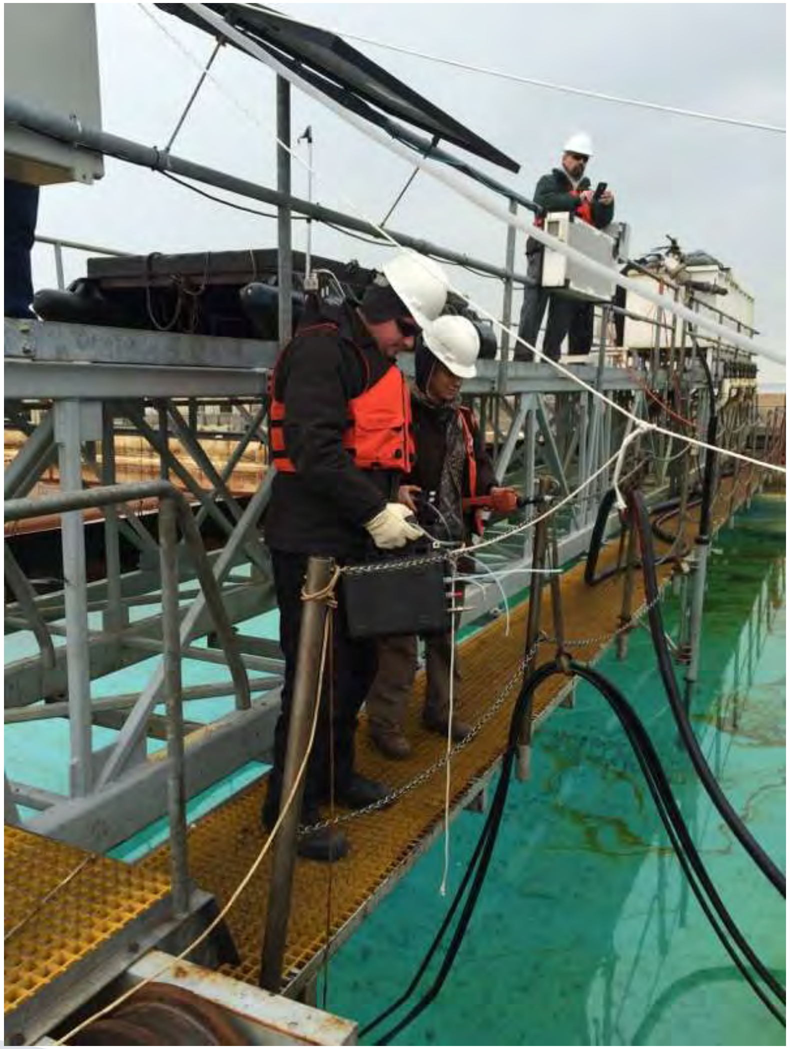
ASTM Skimmer Testing

Additional Skimmer Testing

Grooved Drum Skimmer

- Weathered Oil Recovery Rate
  - 20 gpm
- Fresh Oil Recovery Rate
  - 5 gpm

Air Monitoring



OPEN CUP FLASH POINT

- Fresh Oil-Too volatile and was lost prior to determination
- Oil Weathered One Day-132.0 Degrees Fahrenheit
- Oil Weathered Seven Days-165 Degrees Fahrenheit

QUESTIONS?

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NOAA
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OIL IN ICE

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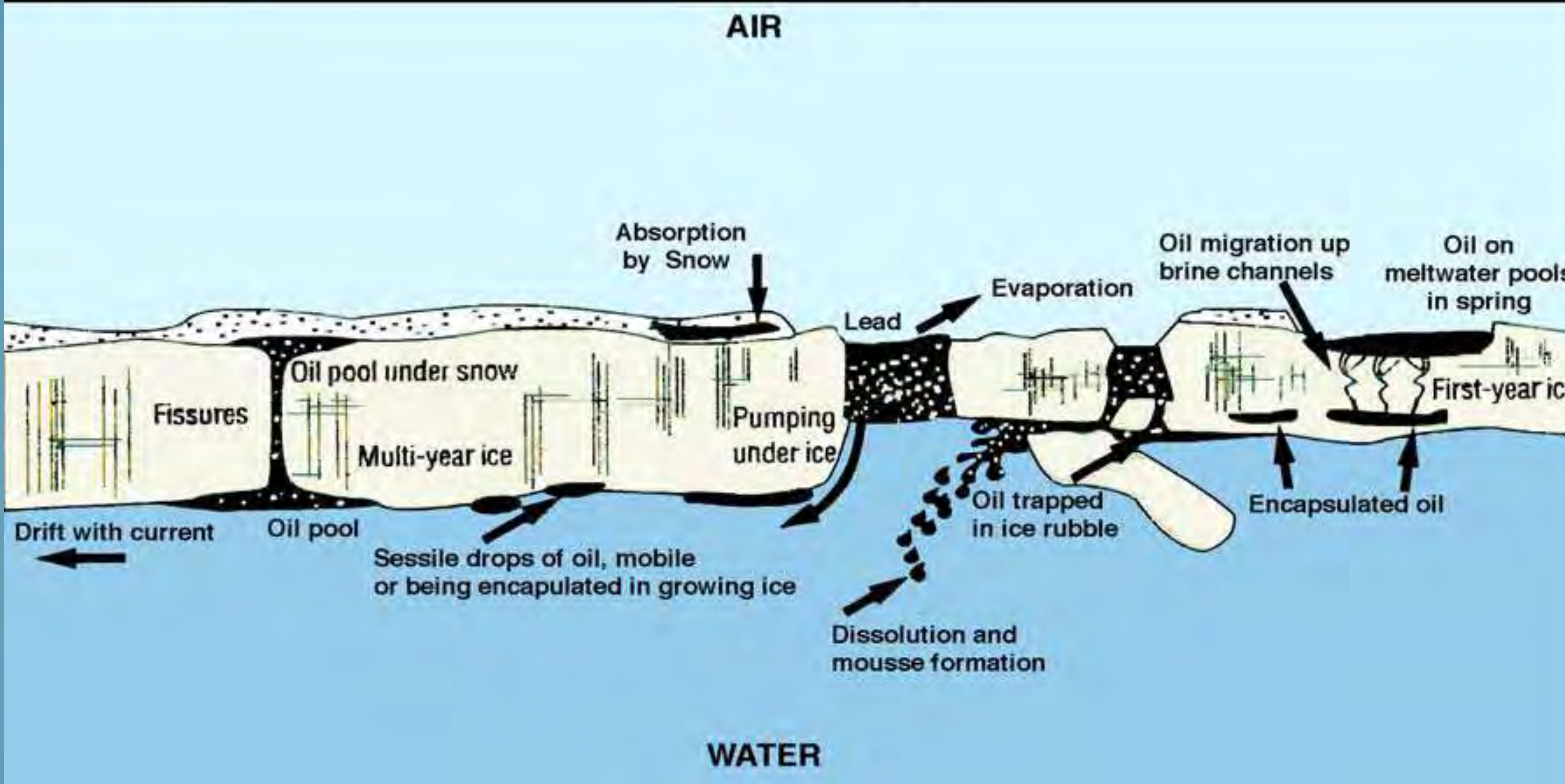
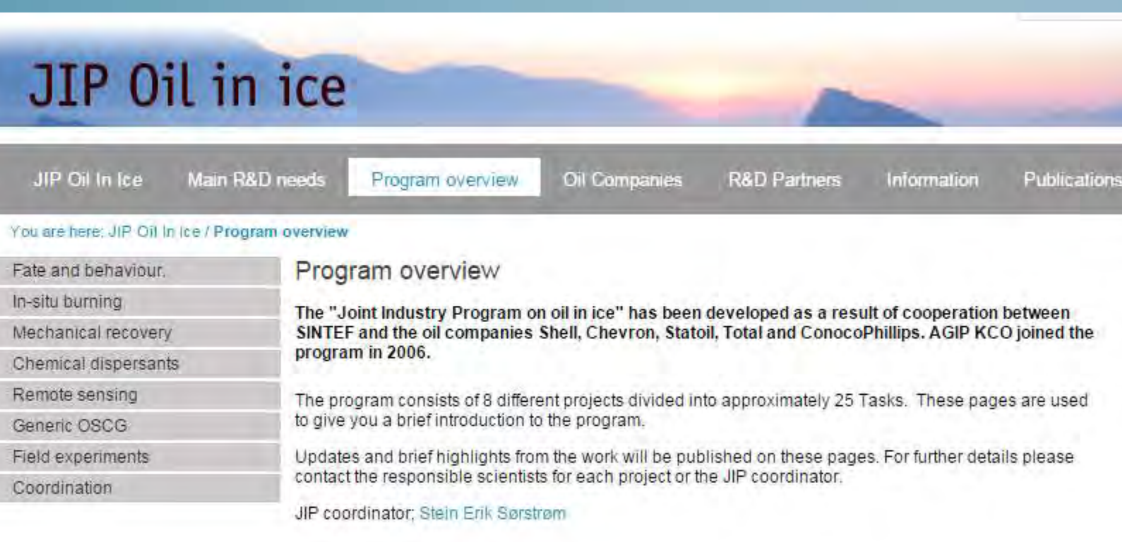
OIL ON ICE



(AFTER BOBRA AND FINGAS 1986)

FACTORS AFFECTING OIL IN ICE FATE AND TRANSPORT

- *Oil Type/Properties (viscosity, pour point, evaporation rates, etc.)*
- *Ice Characteristics (thickness, coverage, roughness, etc.)*
- *Release conditions (subsurface, surface, snow, etc.)*
- *Water conditions (current, temperature)*



Factor	Behavior of oil in ice with increasing ice coverage
Spreading	Dependent on ice types/coverage. Oil thickness can increase with increased ice coverage. Limited knowledge of oil-ice interaction.
Evaporation	Increasing oil thickness due to confinement in ice reduces the rate and degree of evaporation.
Natural Dispersion	Rate will decrease with increasing ice coverage, could be very low due to reduced energy condition in the ice.
Viscosity	Viscosity will increase over time as consequence of increasing water uptake and evaporation, but slower increase than open water.
Drift	In general, if ice coverage is < 30%, same drift as open water. There is limited knowledge of oil-ice interaction.

From the initial state-of-the-art report in the oil-in-ice JIP (Brandvik et al., 2007)

CONCLUSIONS:

At present, field and lab data are only available for a few oil types and studies have focused on sea ice (arctic). Reliable forecasts are dependent on the ability to predict dynamics of ice conditions.

More basic knowledge and a deeper understanding of weathering and transport of oil in ice are needed.

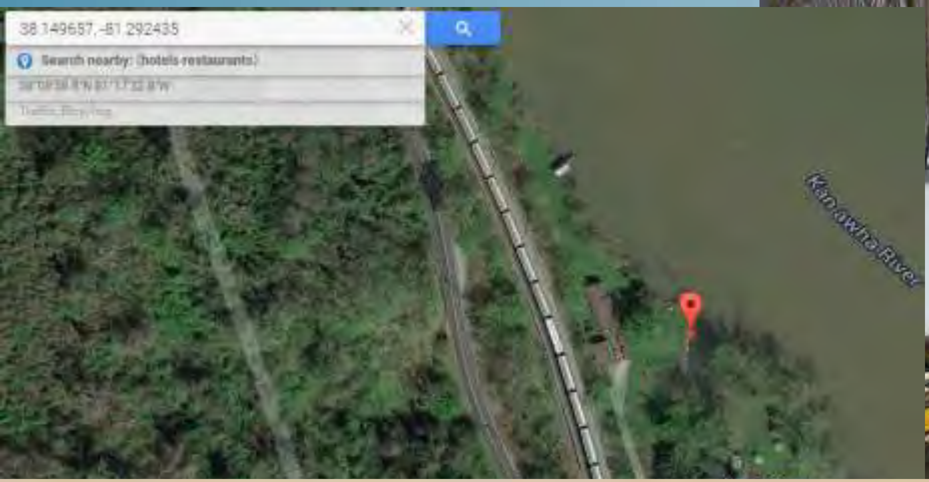
OIL MOVEMENT IN ICE

- Threshold current speed needed to initiate and sustain movement of oil lens or pool along the ice-water interface is ~ 0.5 knots.
- In currents > 0.5 knots, rate of oil movement is complex function of oil and ice properties – it involves progressive filling and draining of under-ice cavities with oil.
- As current speed increases, speed of oil movement increases.
- As ice roughness and oil viscosity increases, speed of oil movement decreases.
- Under perfectly smooth ice, oil will be moved at ~ 1.7 – 2.7 knots by 2-3 knots current.

OIL MOVEMENT IN ICE

- Once stationary, pools of oil are encapsulated by growing ice in <24 hours. The structure is that of a sandwich.
- Until it escapes from the ice, very little weathering or biodegradation will occur. Weathering is typically less than 5%.
- During ice melt, oil can escape from the ice sheet. Depending on the type of ice and the depth of the lens, oil will begin to appear in melt pools about a month before breakup. In typical first-year ice, up to 80% of the oil may appear in the surface melt pools before breakup.
- Oil will also be trapped in slush or broken ice and can travel for great distances, bound up between floes.


CSX TRAIN
DERAILMENT
MOUNT CARBON, WV
FEBRUARY 2015



102,000 gallons of oily-water mixture recovered from containment trenches dug along the river embankment near the derailment site

CSXT eventually determined the train released 378,000 gallons of crude oil during the incident—much of it lost to atmospheric burn, pool fires and ground absorption.

CONTAINMENT

RIVER DILUTION MODEL

How much oil would need to be spilled into the River to get LOC concentrations of benzene at water intake 3.5 miles downstream?

River flow rates ~7,000 cfs.

Any release <145,000 liters (38,000 gallons) over one hour would not exceed 200 ppb for benzene ~3.5 miles downstream of the release.

Concentrations of benzene in the river would not persist for longer than one hour.

If the same quantity of oil were released over the shorter duration, concentrations at the water intakes could exceed the LOC, but the length of persistence would be shorter. Conversely, a release duration exceeding one hour of this quantity would result in lower concentrations at the water intakes, but one of longer duration.

BRIDGER PIPELINE YELLOWSTONE RIVER, MONTANA JANUARY 2015

INCIDENT DETAILS

Release occurred from pipeline under the Yellowstone River ~ 7 river miles upstream of Glendive, MT.

~30,000 gallons of Bakken Crude Oil (high API).

River Ice Coverage: 100% for the first several miles followed by broken ice ~15 miles.

FATE & EFFECT

BTEX concentrations in Bakken can vary between 1 - 5%. Source strength of the dissolved fraction can vary by a factor of 5.

Ice in most of the river, evaporative loss of BTEX expected to be reduced.

Some oil trapped in pockets under the ice and BTEX would continue to bleed into the river until the ice was cleaned or melted.

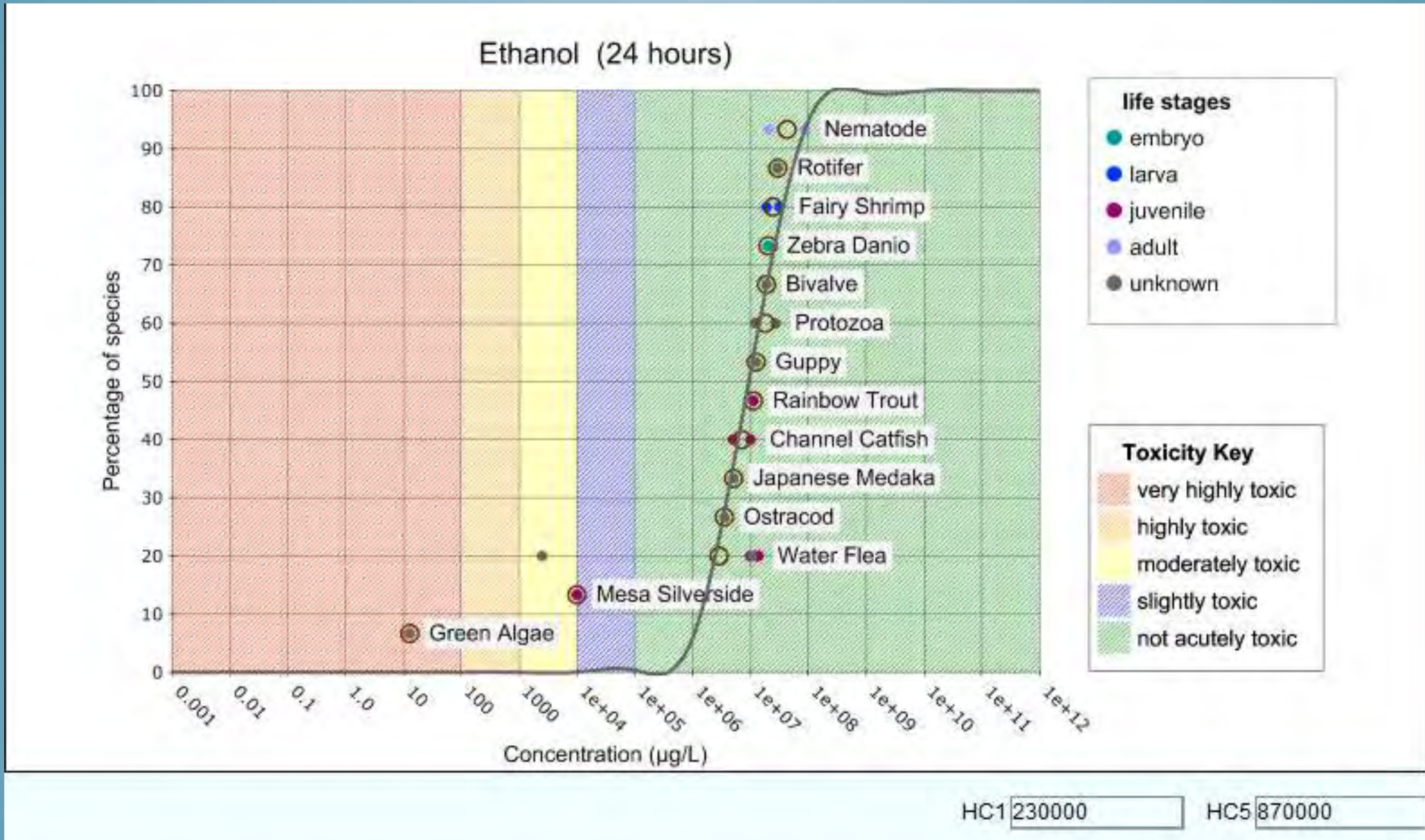
The discharge rate of the Yellowstone River ~7,000 cfs and the Missouri ~20,000 cfs.

Concentration of BTEX in the water would dilute by a factor of 3 in the Missouri River.

Drinking water intakes in Glendive were shut down, unknown if BTEX concentrations exceeded drinking water standards early on.

By day 3, no exceedances were measured.


CPR TRAIN
DERAILMENT
BALLTOWN,
IOWA
FEBRUARY 2015
NCIDENT DETAILS
elease occurred from railcars, initial fire
20,000-30,000 gallons of ethanol (3-5% natural gasoline as
enaturant).



CAFÉ FOR ETHANOL

FIRE & ICE

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QUESTIONS

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