

Tale of Two Bakken Spills

Bridger Pipeline Spill
Glendive, MT



Blacktail Creek Spill
Marmon, ND



Steven Merritt – EPA On-Scene Coordinator

Steve Way – EPA On-Scene Coordinator

Oil Spill Statutes and Regulations

- Clean Water Act
 - Oil and Hazardous Substance Liability – Section 311(b)(3)
- Discharge of Oil Regulation – 40 CFR §110
- Criteria:
 - Discharge of oil...
 - Into or upon “navigable waters”, “adjacent shorelines” or which may effect “natural resources” ...
 - In such quantities as “may be harmful” ...
 - Violate applicable water quality standards
 - Cause a film, sheen or discoloration of the water surface
 - Cause a sludge or emulsion beneath the surface or upon shorelines
 - Is prohibited...

Reporting Requirements

- Notice - 40 CFR §110.6
- Any person in charge of a vessel or of an onshore or offshore facility shall, as soon as he or she has knowledge of any discharge of oil from such vessel or facility in violation of section 311(b)(3) of the Act, immediately notify the National Response Center (NRC)
- If direct reporting to the NRC is not practicable, reports may be made to the Coast Guard or EPA predesignated On-Scene Coordinator (OSC) for the geographic area where the discharge occurs.
- The procedures for such notice are set forth in the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR §300, subpart E.

Response Authority and Jurisdiction

- National Oil and Hazardous Substances Pollution Contingency Plan (NCP) - 40 CFR §300.300-324
- OSC Receives NRC Report & Initiates Action:
 - Notify Resource Trustees and States/Tribes
 - Conduct assessment of spill magnitude and severity
 - Remove the discharge and/or mitigate threat of discharge
 - Direct or monitor all actions to remove the discharge
 - Ensure proper disposal of wastes
 - Document, report, and support cost recovery

Response Funding and Approvals

- Funding – 40 CFR §335
- National Pollution Funds Center (NPFC)
 - Administered by the U.S. Coast Guard (USCG)
- Oil Spill Liability Trust Fund (OSLTF)
 - Revenue: Barrel Tax, Cost Recovery and Penalties
 - Expenditures: Case Funding, Claims and Appropriations
- USCG Case Officers and EPA On-Scene Coordinators
 - OSC Justification to Access the OSLTF
 - Approval and Funding of an NPFC Case
 - Strict Adherence to Statutory/Regulatory Criteria

Bridger Pipeline Spill



Bridger Pipeline Break Facts

- Operator: Bridger Pipeline, LLC
- Asset: 12” Poplar Pipeline
- Spilled: 730 bbls of Bakken Crude Oil
- Body of Water: Yellowstone River
- Location: 8 miles southwest of Glendive, MT
- Incident Occurred: 1/17/2015 @ 10:45AM
- NRC Report(s): 1105930, 1105931 and 1105969
- NPFC Case and Ceiling: E15804 - \$400,000

Initial Response Actions

Operator

- Shut Down Pipeline
- Investigate and Notify
- Confirm and Respond
- Secure Source Area
- Join Unified Command
- Address Impacts

Unified Command Focus

- Safety of Public & Crews
- Drinking Water System Decontamination
- Removing Threat of Discharge at Source
- Establishing Oil Containment and Recovery Locations
- Identifying and Mitigating Environmental Impacts

Issue: Dissolved Phase VOCs

- Environmental conditions vs. fate/transport of oil
- Turbulent flow and vertical mixing at depth due to ice cover
- Invalid assumptions about buoyancy, travel times and evaporation



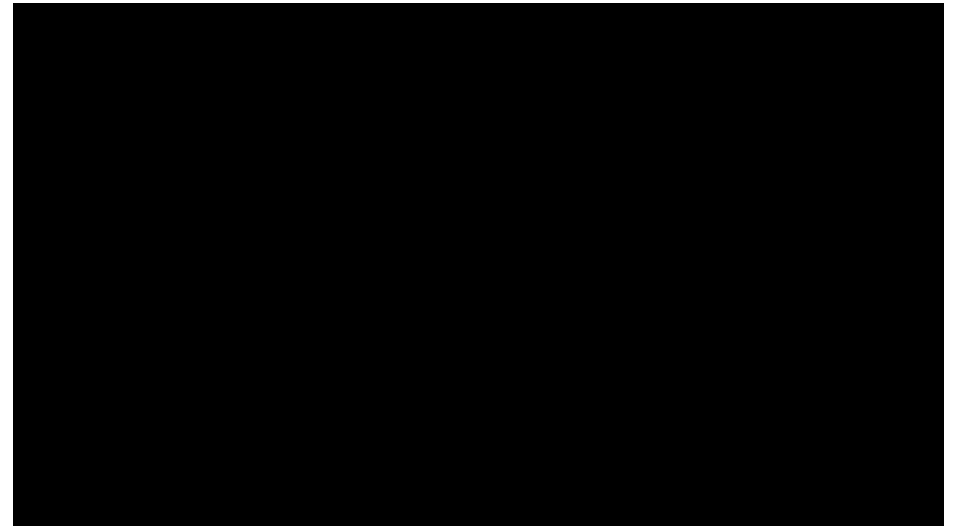
Issue: Contaminated Water Supply



- Notification and normal operations initially precluded contamination
- Aging infrastructure and limited analytical capabilities
- Needed to flush system and provide alternative drinking water supplies
- EPA mobile analytical support was invaluable

Issue: Oil Recovery on Frozen River

- Specialized equipment and tactics for oil recovery on ice
- Limited number of experienced contractors capable
- Environmental factors and response time limited efficacy of these tactics



Blacktail Creek Spill



Blacktail Creek Spill Facts

- Operator: Summit Midstream Partners, LLC
- Asset: 4" Disposal Pipeline
- Spilled: >70,000bbls of Produced Water/Emulsified Oil
- Water Impacted: Blacktail & Little Muddy Creeks
- Location: 10 miles north of Williston, ND
- Incident Date: Unknown
- NRC Report(s): 1105105, 1105983, 1106269
- NPFC Case and Ceiling: E15805 - \$15,000

Initial Response Actions

Operator

- Shut Down Pipeline
- Investigate and Notify
- Confirm and Respond
- Clean-Up/Mitigate
- Revise Estimates
- Coordinate Response Actions with Regulators

Objectives

- Pump and Dispose of Impacted Water
- Contaminated Soil Removal
- Underflow Dam Construction
- Interceptor Trench Construction
- Address Downstream Impacts

Issue: Produced Water/Brine

- Extremely high concentrations of chlorides and other dissolved solids
- Emulsified oil transported in aqueous solution and surface flows
- NPFC support hinged on recoverable oil at the site



Issue: Oil/Water Recovery Approach



- Initial response consisted of pumping fluids from Blacktail Creek and hauling to disposal facility
- During snowmelt, flows were excessive and the contaminants diluted
- Interception trenches were installed to capture groundwater flows before Blacktail Creek

Issue: Produced Water Response ?

- Reportable as discharge of oil because generally some potential for sheen
- Generally not recoverable oil but contains miscible and dissolved phase hydrocarbons
- “Crude oil and petroleum” are exempt from federal regulation under CERCLA;
- CERCLA response may be an option depending on chemical constituents and threat posed
- “Oil field wastes” are exempt from the Resource Conservation and Recovery Act
- “Stormwater runoff from O&G operations” are exempt from the CWA
- Clean Water Act and NPDES viable for enforcing produced water spills
- EPA response funding and cost recovery remain an issue



Takeaways

Bridger Pipeline Spill

Glendive, MT

- Improve downstream water user spill notification systems
- Take precautions for dissolved phase VOC plumes in all spills
- Add winter response tactics to sACPs and increase local capabilities

Blacktail Creek Spill

Marmon, ND

- Develop a coordinated approach to produced water/oil spill response
- Increase inspections/enforcement on upstream production facilities
- Improve regulatory standards for operations

Bakken Spill Prevention Activities

- Spill Prevention, Control and Countermeasures (SPCC) Inspections
- Facility Response Plan (FRP) Inspections
- SPCC and FRP Enforcement
- State Regulatory Authorities
 - MT Department of Environmental Quality
 - MT Department of Natural Resources
 - ND Department of Health
 - ND Department of Mineral Resources

Bakken Spill Preparedness Actions

- Region 8 sub-Area Contingency Plans (sACPs)
- Government-Initiated Unannounced Exercises (GIUEs)
- Preparedness for Response Exercise Program (PREP)
- Industry Oil Spill Cooperatives
 - Sakakawea Area Spill Response, LLC
 - Montana Wyoming Oil Spill Control Cooperative, LLC
- Oil Spill Response Trainings and Tabletop Exercises
- Oil Spill Removal Organization (OSRO) Classification

Bakken Oil Spill Behavior and Fate/Transport Study

- EPA ERT, EPA Regions, DOI, and OHMSETT
- Study Goals:
 - Evaluate benzene and other VOC emissions from a discharge of Bakken oil to support H&S decisions
 - Evaluate physical properties of Bakken oil, including as weathering progresses, to better predict fate/transport
 - Evaluate recoverability of fresh and weathered Bakken oil using standard methods



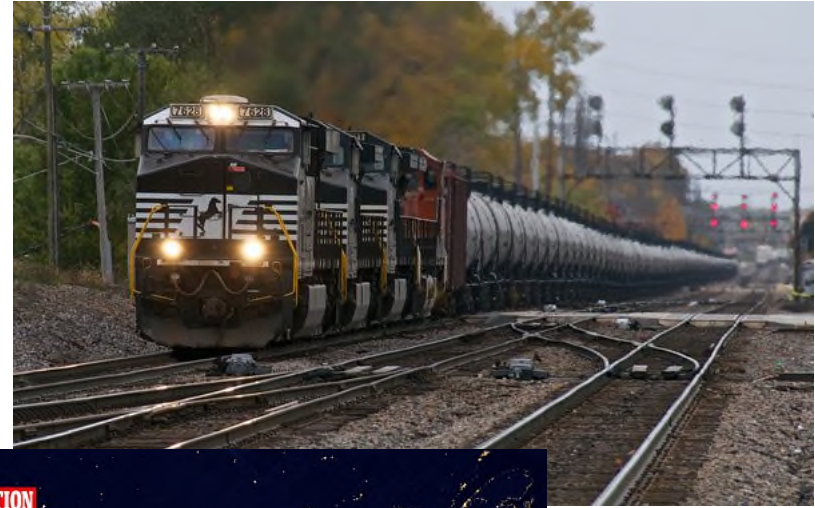
Bakken Oil Spill Behavior and Fate/Transport Study

- Findings:
 - 40% volumetric evaporative loss in a week
 - Recovery with skimmers is effective, increasingly after loss of light ends
 - Rapid dispersion will be an issue in rivers
 - VOC concentrations lower than expected near spill, especially after 6 hours
- See OHMSETT report for more details



Bakken Formation Crude Oil

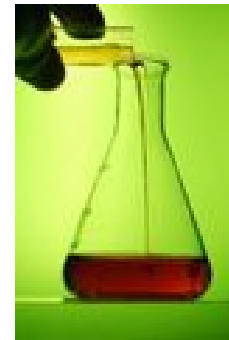
Courtesy Richard Franklin – EPA R10



Bakken Crude Oil Properties

Range of Properties

- Very light crude – Class 2 Oil
 - same oil class as Diesel, #1 Fuel Oil
- API gravity 36° - 44°
 - Oregon sample = 42.5° API
- Benzene content in liquid $< 0.5\%$ by weight
 - Oregon sample = 0.14%, or 1,400 ppm
 - Gasoline = 49,000 ppm, diesel = 1,380 ppm
- Benzene content in air
 - Oregon sample = 0.25 ppm



Bakken Crude Oil Properties

Component Comparison with Fuels

	Oil Type	Bakken Crude	Gasoline*	Diesel*	WTI Crude*
SVOCs	Napthalene	340 ppm	20,000 ppm	/ /	/ /
	2-Methylnapthalene	860 ppm	/ /	/ /	/ /
	Phenanthrane	150 ppm	/ /	/ /	/ /
	1-Methylnapthalene	630 ppm	/ /	/ /	/ /
VOCs	Benzene	1,400 ppm	49,000 ppm	/ /	1,380 ppm
	Toluene	3,100 ppm	250,000 ppm	/ /	2,860 ppm
	Ethylbenzene	740 ppm	30,000 ppm	/ /	1,120 ppm
	m,p-Xylene	3,600 ppm	/ /	/ /	4,290 ppm
	o-Xylene	1,200 ppm	/ /	/ /	/ /
	1,3,5-Trimethylbenzene	870 ppm	/ /	/ /	/ /
	1,2,4-Trimethylbenzene	2,700 ppm	/ /	/ /	/ /
	Isopropylbenzene	200 ppm	/ /	/ /	/ /
	n-Butylbenzene	170 ppm	/ /	/ /	/ /
	Napthalene	275 ppm	/ /	/ /	/ /

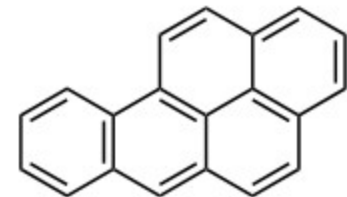
Bakken Crude Oil Properties

Range of Properties

- Sulfur content generally ranges from 0.17- 0.20%
 - Bakken is a “Sweet” crude, very low sulfur
 - Recent sample very low = 0.142%
 - Reports of some sour recent shipments due to crude blending at source oilfield
- Hydrogen Sulfide (H₂S) content < 1.0 ppm
 - Recent sample < 1.0 ppm
- Pour Point
 - Recent sample = -32.8° F (in most all situations - a liquid)

Bakken Crude Oil Properties

- Sp. gr. of Bakken is 0.7 – 0.8, **Floats on water**
 - Sp. gr. - weight of oil/ weight of “pure” water
 - 10 °API = 1.00 s.g. of pure water at 60°F
 - **Recent sample = 0.8134**
- Vapor Density 2.5 – 5.0, heavier than air
 - Vapors can hug ground and travel to an ignition source
- Vapor Pressure moderate, mmHg 280 – 360 @ 60° F
 - Water 12.5 mmHg @ 60° F
 - Gasoline 400 mmHg @ 60° F



Bakken Crude Oil Properties

Gases

- Light crudes tend to have higher concentrations of light ends (i.e., methane, ethane, propane, butanes and pentanes).
- The presence of increasing amounts of dissolved gases and other light ends increases the crude oil's vapor pressure, lowering its flashpoint and lowering its initial boiling point.
- Bakken is a light crude
- Comparison of assay data (1400 samples) on Bakken crude oil with data from non-Bakken crude oils indicates that Bakken crude oil is within the norm with respect to the hazard characteristics of a light crude oil.

Bakken Crude Oil Properties

Gases

Gas Conc	Liquid v/v%	Gas Conc	Liquid v/v%
AFPM Assay		EPA Recent Sample	
Methane (C ₁)	<0.01	Methane	<0.01
Ethane (C ₂)	0.05	Ethane	0.14
Propane (C ₃)	0.80	Propane	0.94
Iso-Butane (iC ₄)	0.46	Iso-Butane	0.44
N- Butane (nC ₄)	2.36	N- Butane	2.17
Total Gas	3.67	Total Gas	3.69

Bakken Crude Oil Properties

Flammability

- NFPA Flammability = 3-4
 - Recent sample = 3
 - Sensitive to static discharge
- Explosive Limits variable:
 - LEL 0.4%
 - UEL 15.0%
 - Recent sample LEL 0.1%
 - Recent sample UEL 4.5%
- Flash point - 40° to 212° F
 - - 74° to 122° F (AFPM data)
 - Recent sample < 74° F
- Auto-ignition Temp > 500° F



Spill Response Considerations

Safety Equipment

For Spill

- 4 or 5 gas monitor with O₂, LEL, H₂S
- PID/FID for VOCs (FIDs may be more sensitive)
- Chemical-specific monitors for benzene
 - Colorimetric tubes
 - PID with benzene tube, e.g. ultrarae
- Additionally, for fire
 - Particulate monitors (e.g., Dataram) for Polynuclear Aromatic Hydrocarbons (PAHs), sampling
 - Monitors or sampling equipment for particulates (smoke)

Exposure Guidelines

Component	ACGIH	NIOSH	OSHA
Petroleum (8002-05-9)	Not established	CEIL: 1800 mg/m ³ TWA: 350 mg/m ³	Not established
Hydrogen sulfide (7783-06-4)	TWA: 1 ppm STEL: 5 ppm	CEIL: 10 ppm	CEIL: 20 ppm
Benzene (71-43-2)	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

Crude Oil Response Considerations

Behavior in River

- Floats
- In faster water will flow in middle of fast river
- When slowing, will go to bank in curve
- Stranding on & adhering to shorelines
- Entrainment
- Binding with sediment
- Dissolution
- Weathering, mousse development



Crude Oil Response Considerations

Behavior in River



Spill Response Considerations

Evaporation

Key factor for light crudes, especially Bakken

Can be the most significant “loss” mechanism early in a spill

Small impact on density

Significant impact on viscosity

Function of: oil type, environmental factors

Crude oil - up to 25% loss in 24 hours

Gasoline - up to 50% loss in 10 minutes

No. 6 fuel oil – 5-10% loss in 40 hours

Oil Spill Response Techniques

Booming - Collection vs Deflection

- EPA's experience to date with light crude spills in inland waterways (decades), recent Bakken spills
 - No inherent problems in collection due to flammability
 - Use typical booming and recovery techniques, including collection
- Ultimately, will be determined by site-specific dynamics, characteristics, weather, water flow (fast/slow), air monitoring results
- If high LEL, may consider TGLO's experience – use series of deflection booms to send oil to a downstream collection point
 - LEL drops due to natural attenuation and stream dynamics