

Effective Sampling Methods to Characterize an Oil Spill within a River

Matrix Solutions Inc.
Integrated Services • Innovative Solutions



Overview

- Overview of the Oil Spill
- Shoreline Cleanup
- Water and Sediment Characterization
- Learnings



Overview of the North Saskatchewan River Oil Release



- July 21, 2016: Oil leak near the North Saskatchewan River
- Break occurred on land, ~160 m from the south bank
- 225 m³ (+/- 10%) crude oil blended with condensate
- ~60% of the product contained on land



Overview of the North Saskatchewan River Oil Release



Emergency Response Phase Overview

- July 21 to September 30, 2016
- Large, multi-disciplinary, dynamic response effort
 - ~1,200,000 hours spent
 - 2,500 people (including dozens of consulting teams)
- Initial response focused on human health
 - Containment and removal from the river
 - Water quality monitoring with focus on water intakes



Emergency Response Phase

Overview

- Components of the program included:
 - Chemical characterization of the oil
 - Fate and transport of the oil
 - Shoreline Cleanup and Assessment Technique
 - Chemical characterization of water and sediment
 - Wildlife monitoring, rehabilitation, and deterrents
 - Fish and benthic habitat inventory and assessment
 - Fish consumption risk to human health



Emergency Response Phase Overview

- Components of the program included:
 - **Chemical characterization of the oil**
 - **Fate and transport of the oil**
 - **Shoreline Cleanup and Assessment Technique**
 - **Chemical characterization of water and sediment**
 - Wildlife monitoring, rehabilitation, and deterrents
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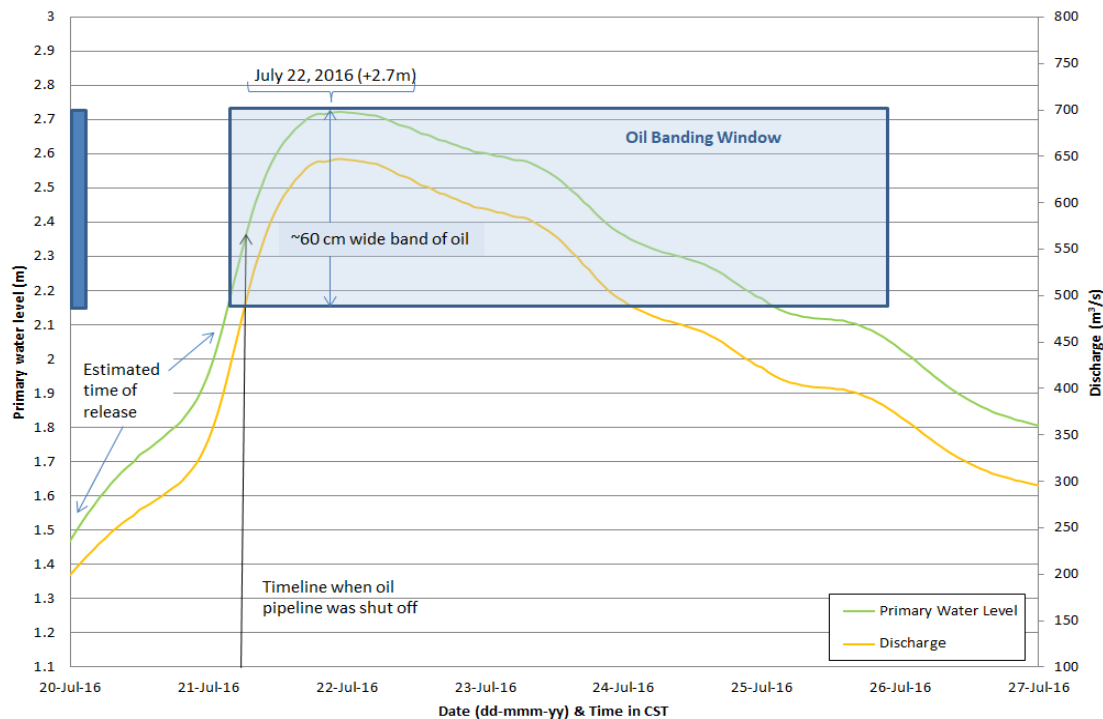


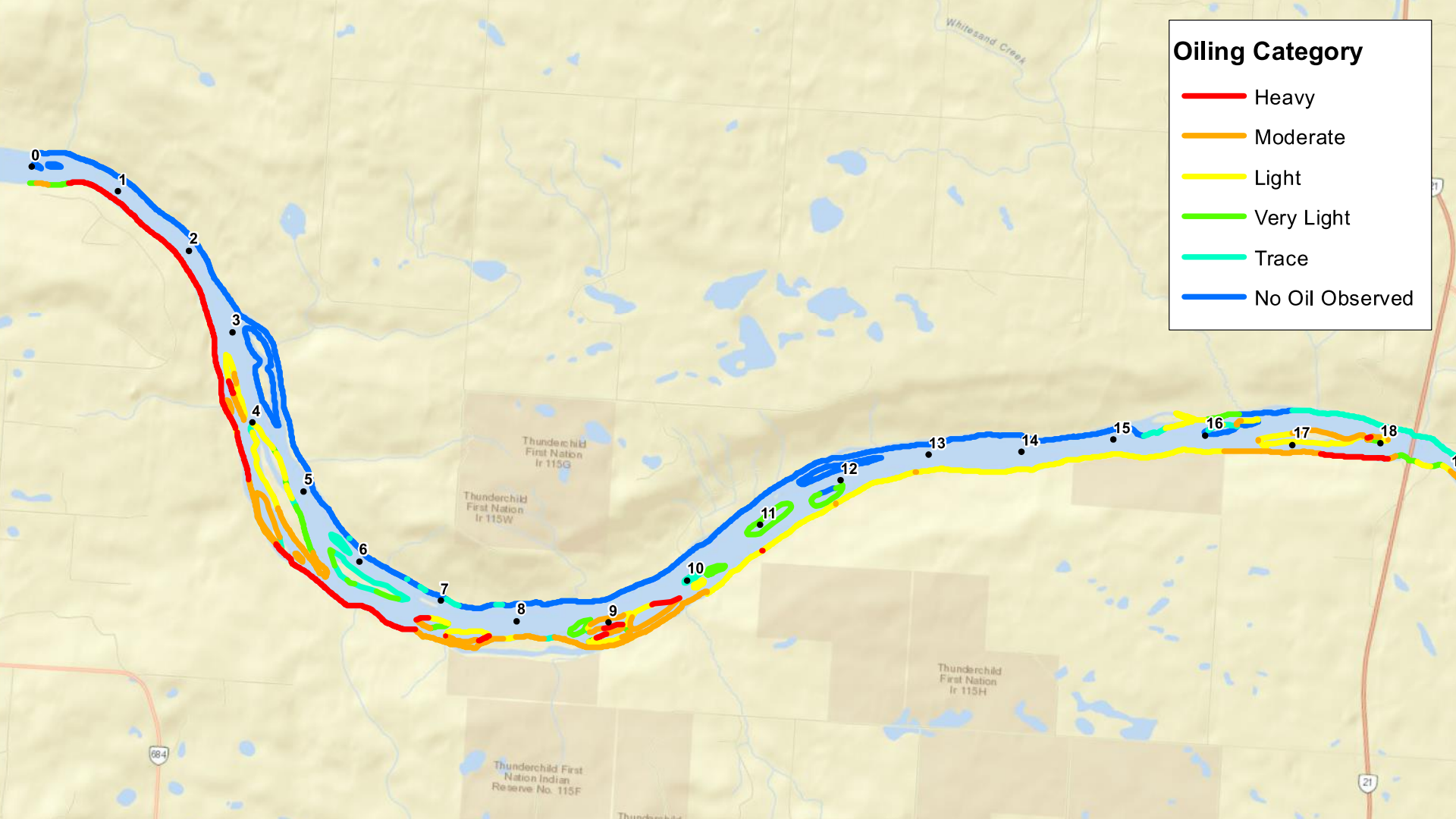
Initial Oiling



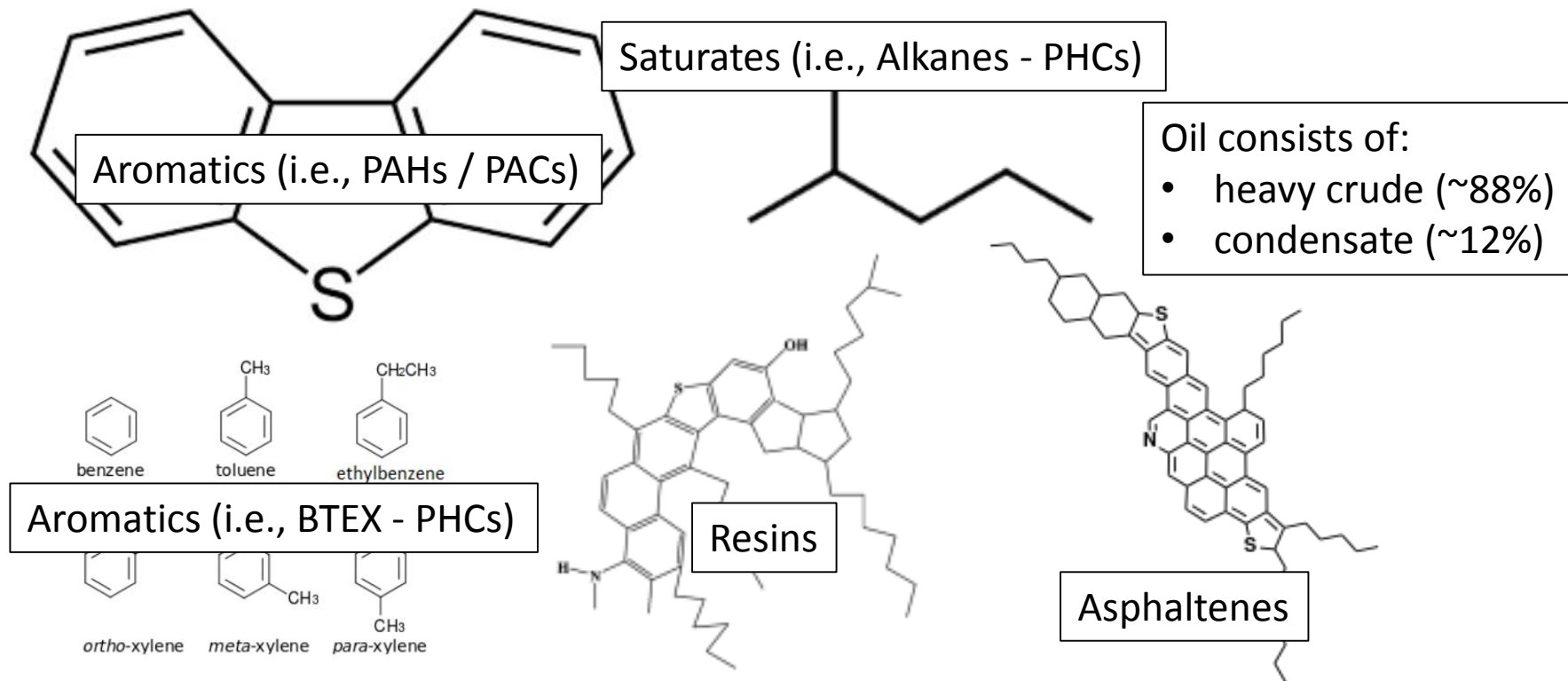
Initial Fate and Transport

- API of 17 – Medium to heavy oil
- Specific gravity 0.925 @15°C
- Lighter than water @ >10°C
- Water temperature >20°C
- Oil floated and deposited on shoreline (60 cm band)

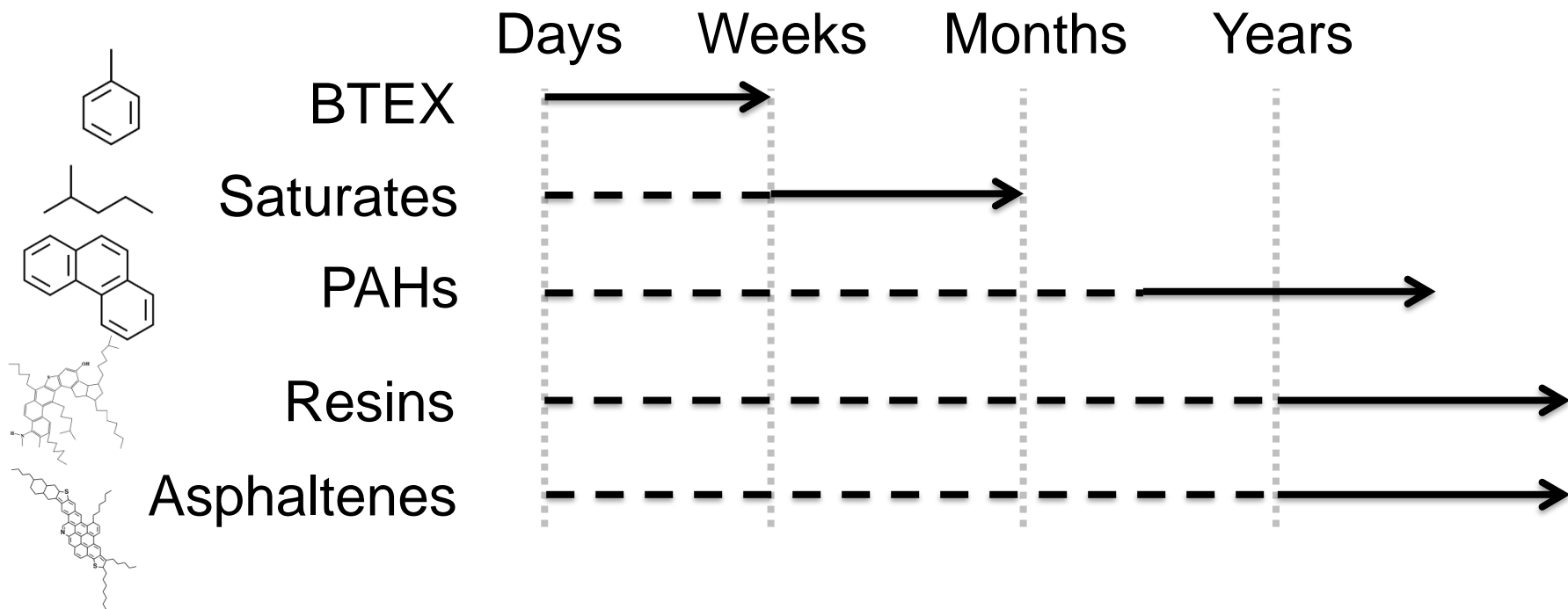


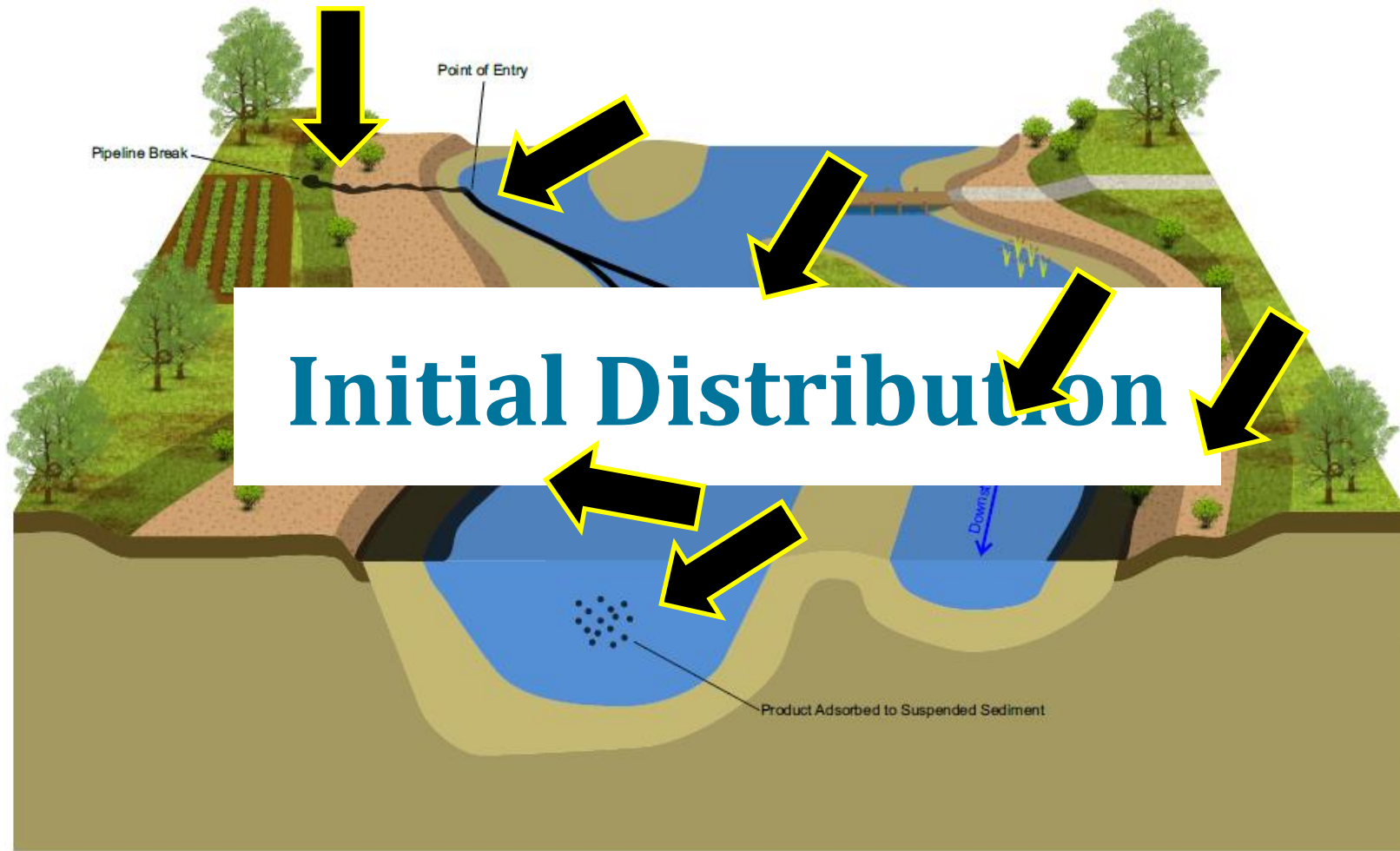


What is the Product?



Weathering Characteristics





Emergency Response Sampling Program

Water and Sediment Sample Count

Area	Surface Water		Sediment	
	Number of Sample Sites*	Number of Samples*	Number of Sample Sites	Number of Samples
Background	29	448	20	69
Division 1 A	24	329	28	55
Division 1 B	18	230	22	42
Division 1 C	24	434	25	110
Division 1 D	27	348	36	88
Division 2	76	746	58	252
Division 3	52	887	50	196
Division 4/5	99	1603	71	491
Infiltration Galleries and Well	6	31	-	-
Tobin Lake	5	32	-	-
Total	360	5088	310	1303

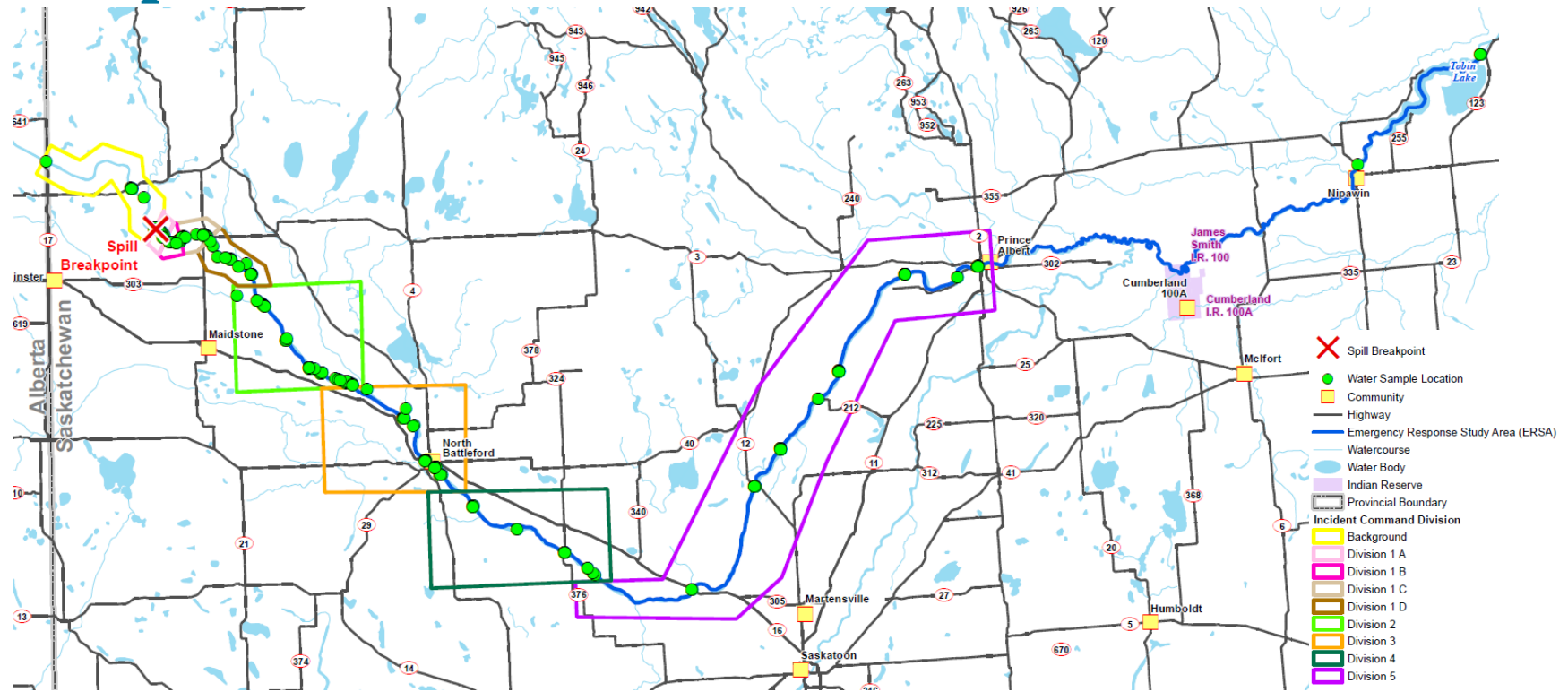
Notes:

- * includes foam and sheen samples
- no samples/sites



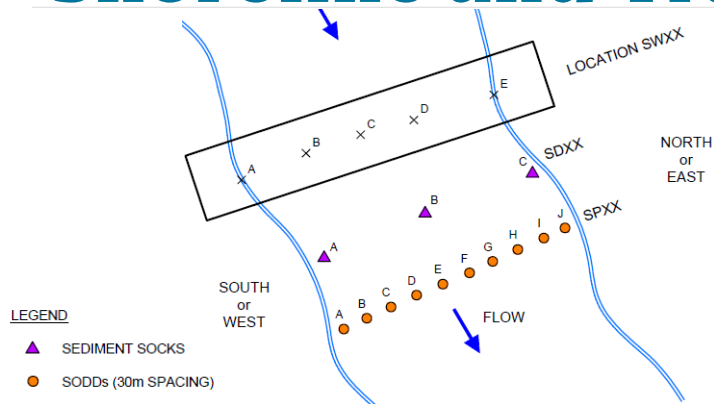
Water Sampling Program

Sample Locations - 2016



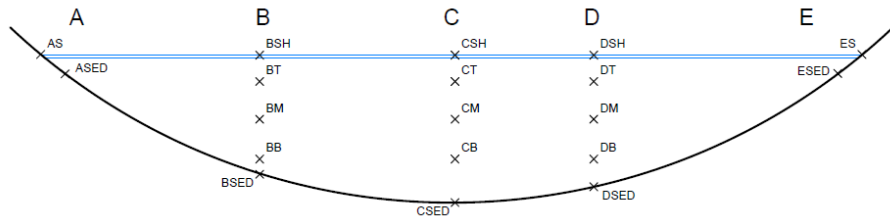
Water Sampling Program

Shoreline and Transect Sampling



Schematic of Transect

INSTREAM SURFACE WATER SAMPLING



Van Dorn Bottle



Shoreline Sampling



Water Sampling Program - City Intakes



North Battleford Intake

Prince Albert Intake



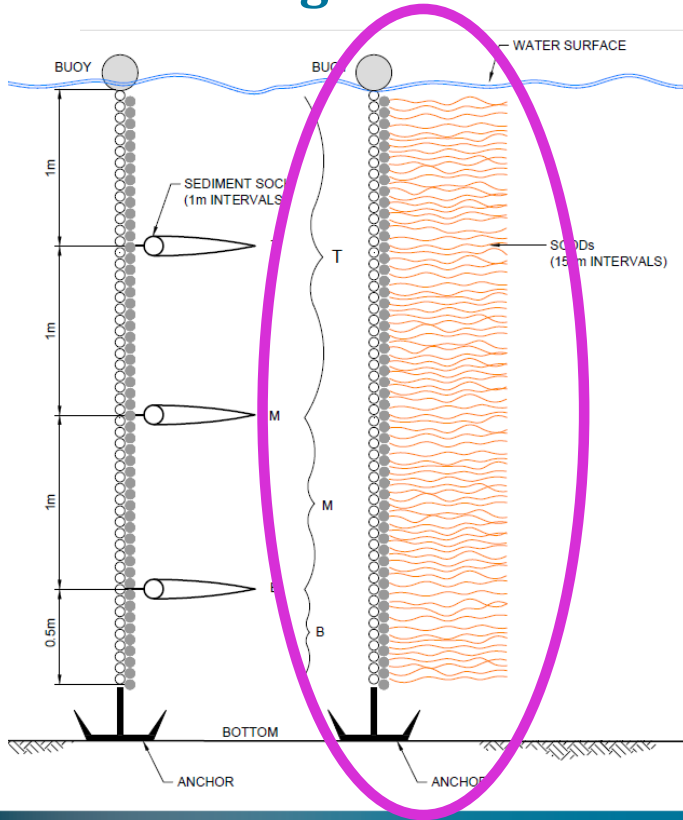
Water Sampling Program

Livestock Sampling Results



Water Sampling Program

Submerged Oil Detection Devices (SODD) Monitoring Results



Transect with Buoy
Attached to SODD



Visual Hydrocarbon
Deposition on SODD

SODD and Sediment
Sock Setup

Water Sampling Program

Foam and Sheen Sampling Results



Free-phase
hydrocarbon,
sheen and foam



Foam
sampling



Water Sampling Program - Groundwater Sampling



Infiltration Gallery Well Samples Being Collected into a Clean Bucket

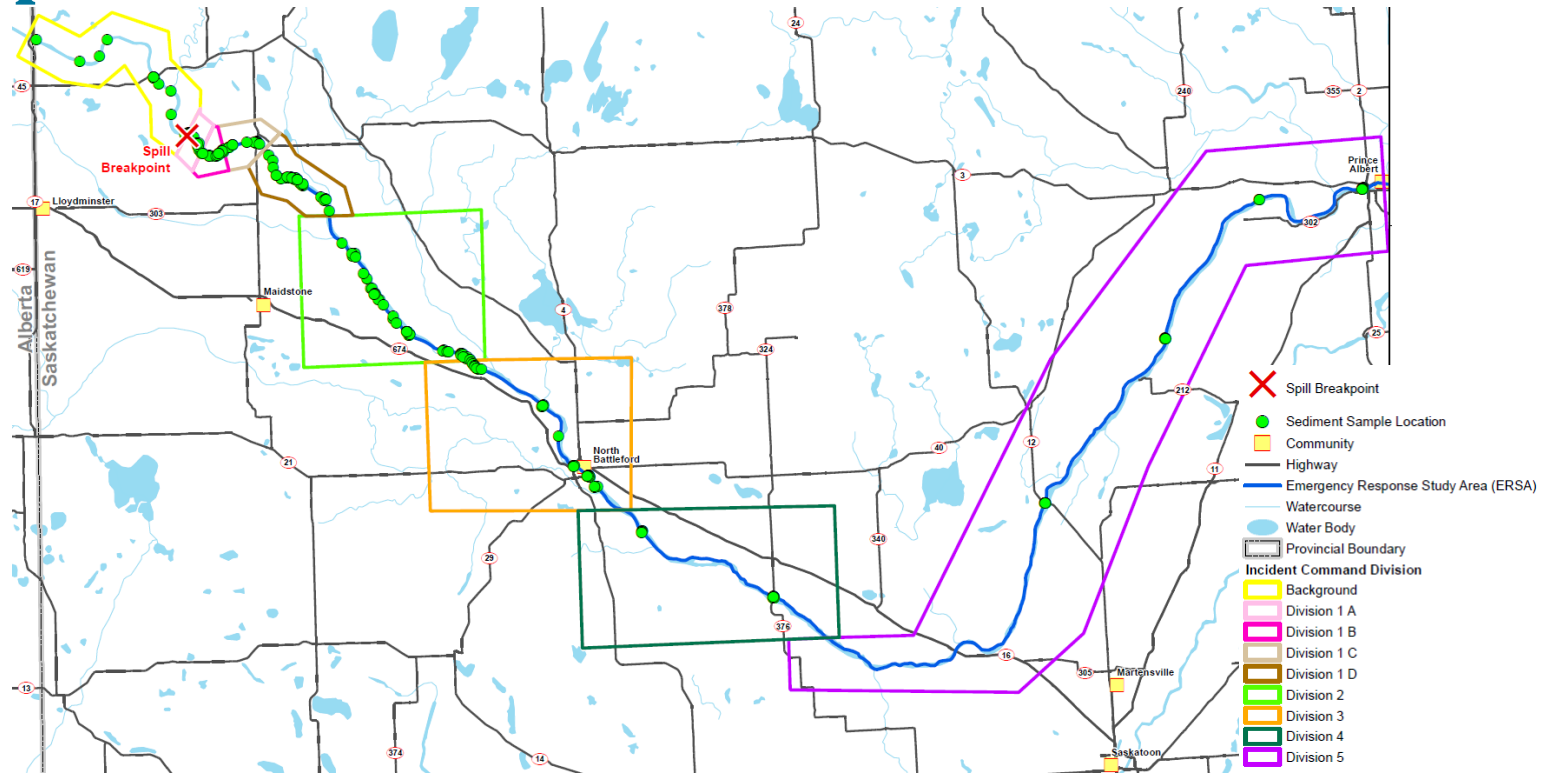
Semi-permeable Membrane Devices (SPMDs)

- Installed at 7 locations for 2 rounds of sampling
- 1 month deployment (per round)
- Measure ultra-trace concentrations of PAHs in water and suspended sediment



Sediment Sampling Program

Sample Locations - 2016

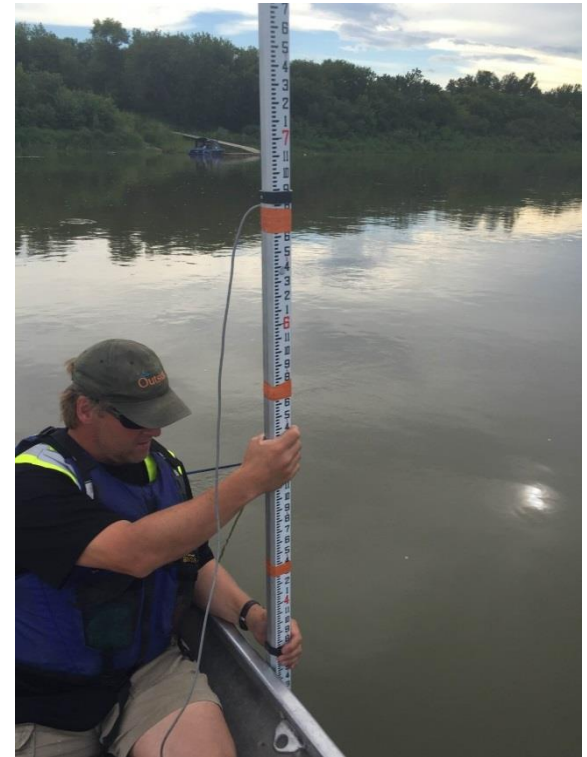


Transect Sampling - Sediment

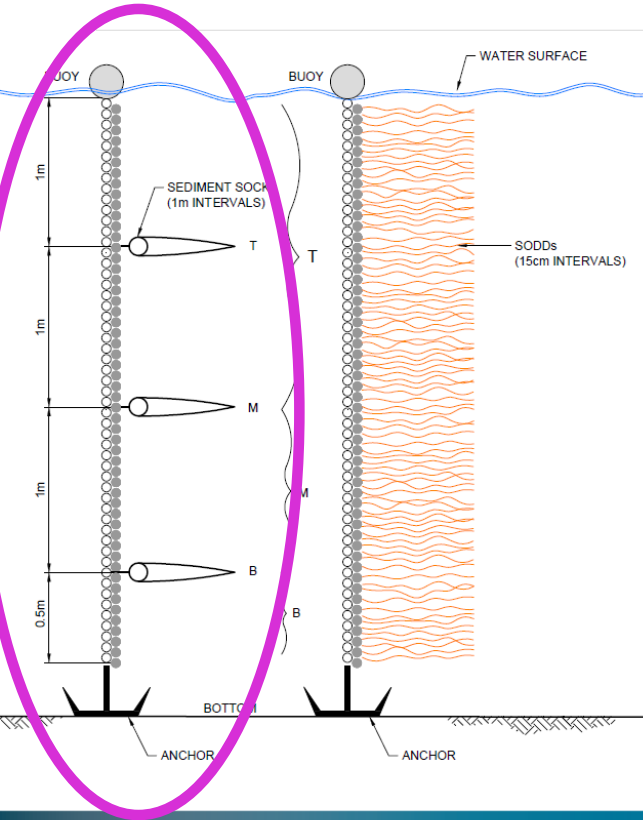


Sediment Sample
Collection using a
Ponar Dredge
(Left)

Measuring Water
Depth and Flow
(Right)



Sediment Sock Sampling



SODD and
Sediment
Sock Setup
(Left)

Sediment
Sock
Sampling
(Right)



Sediment Sampling Program

Suspected Bottom Oil Sampling

- Dredge samples collected at locations where visible oil observed
- Focus was on first 100 Km
- Crews also took samples adjacent to maximum oiling extent identified by SCAT team



Sediment Mopping

- Pilot program conducted on 3 August, 2016
- Crews constructed “mops” using poles and pompoms from the SODDs
- Were to attempt to mop up visible oil from the sediment



Sediment Core Sampling



Sediment Core
Collection using an
AMS Sediment
Sampler (Left)

Sediment Core
(Right)



Bottom Oil Agitation Test (BOAT)



Dredge chain
about to be
lowered

Pinhead sized
globules on Teflon
mesh



Siltation following second trial



Learnings – What Worked?

- Collaborative effort (multiple consultants working together)
- Shoreline Cleanup Assessment Technique
- Water and Sediment Sampling
 - Transect sampling (including livestock and city intakes)
 - Bottom oil sampling (dredge and cores)
 - Semi-Permeable Membrane Devices



Learnings – What Didn't Work Well?

- Submerged Oil Detection Devices – Subjective
- Sediment Socks – Limited Success
- Bottom Oil Agitation Test – Limited Success
- Sediment Mops – Not Effective
- Foam – Very Difficult / Limited Success
- Sheen – Very Difficult / Limited Success

