North Saskatchewan River Spill 2016 Assessment and Restoration

CLRA Alberta
February 27th 2020

global **environmental** and **advisory** solutions

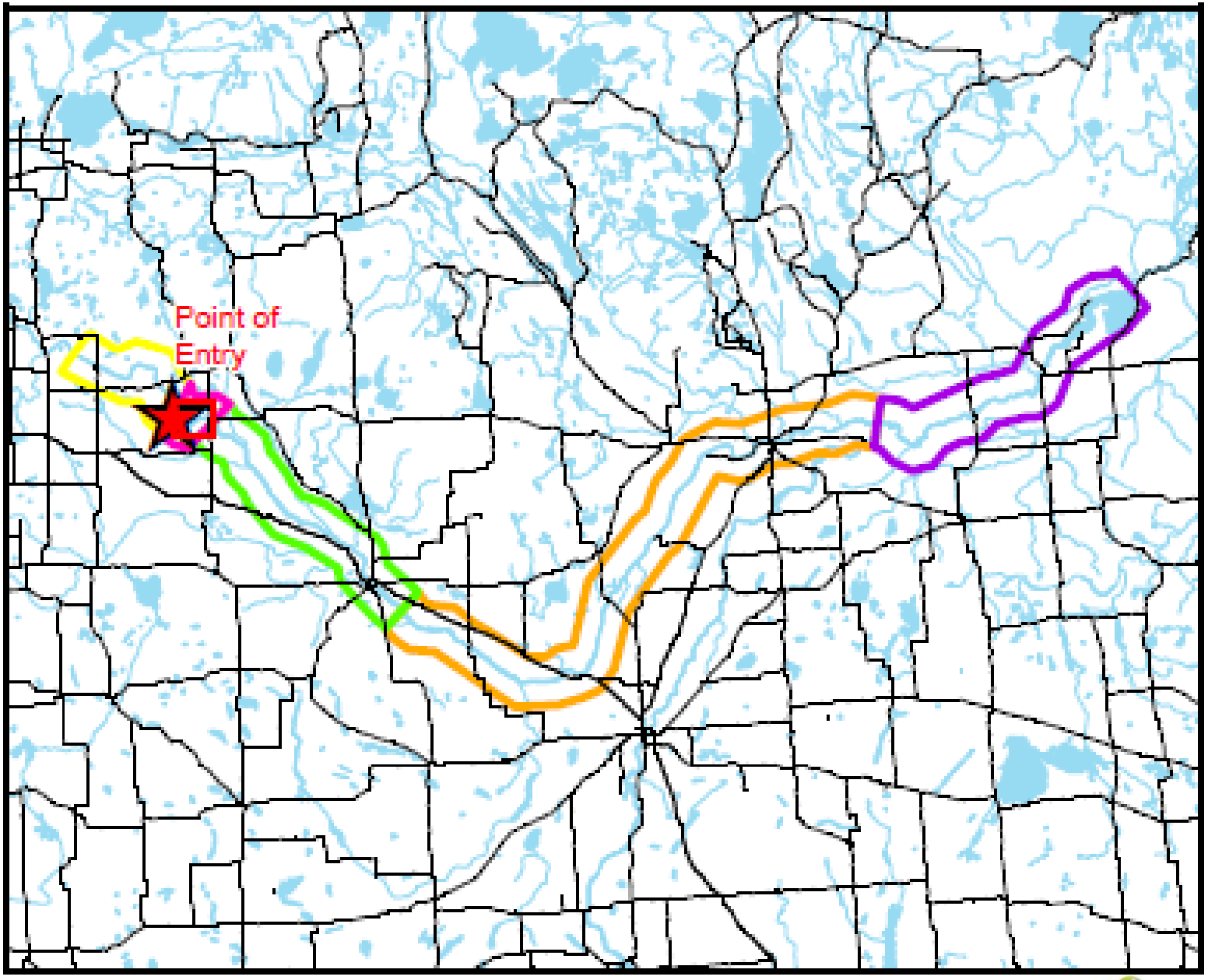
SLR

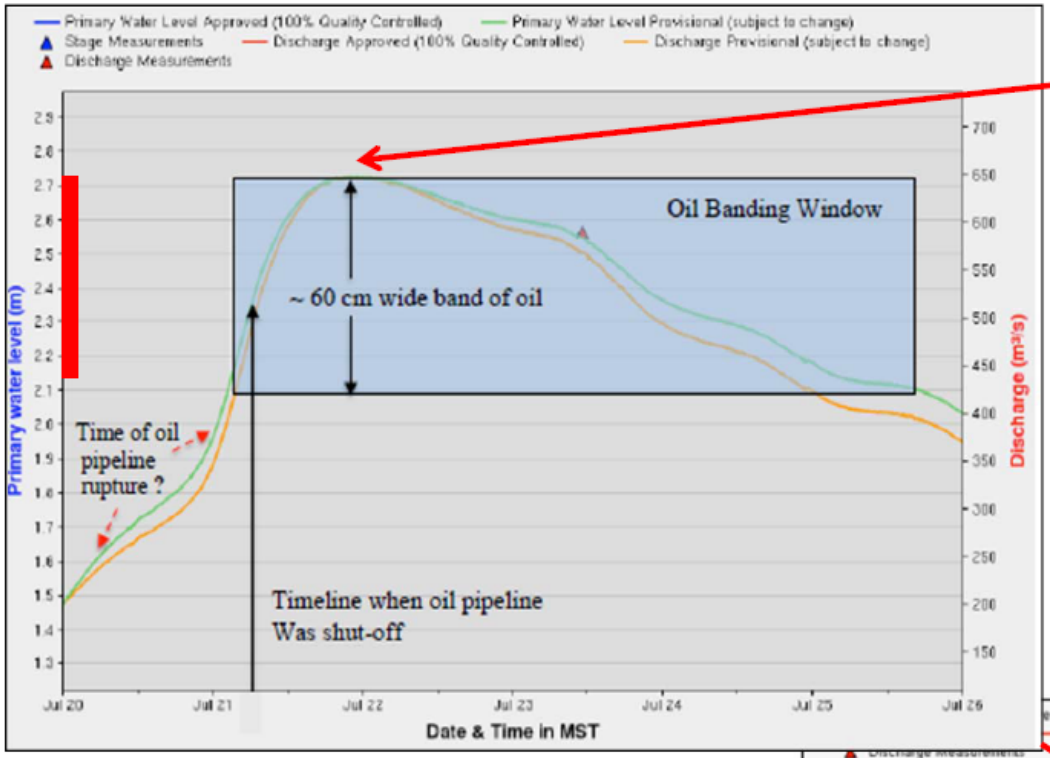
NSR Spill Point of Entry

July 2016

- 225 m3 of diluted heavy oil spilled from pipeline near Maidstone.
- More than 90 per cent of the oil was recovered.
- *Fisheries Act* Authorization issued on August 4 for *emergency circumstances*.

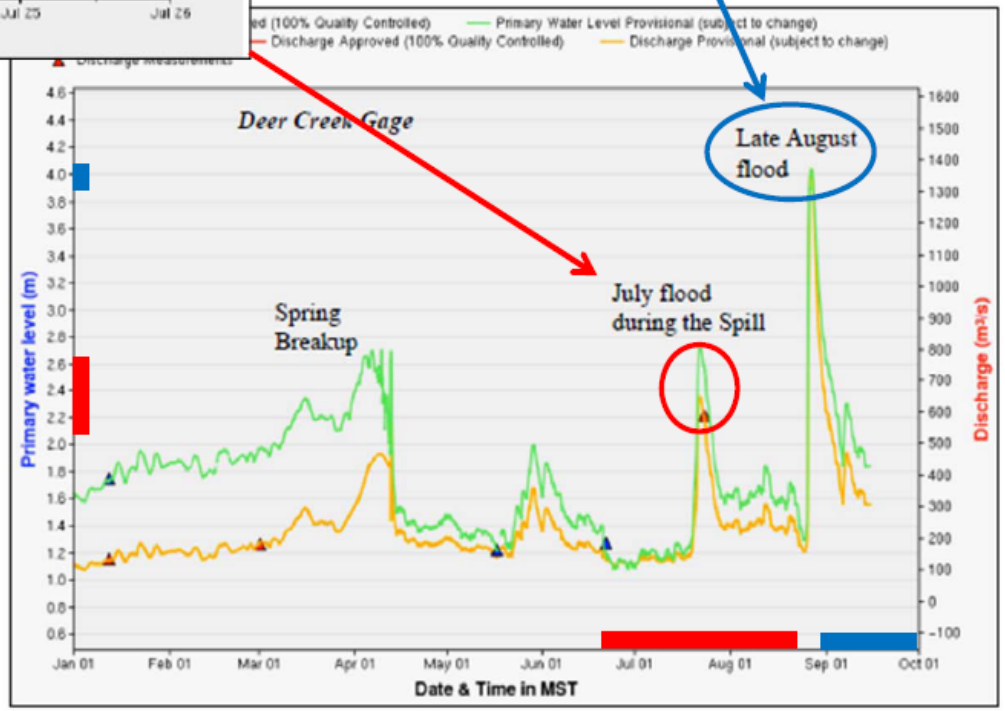
Study Area





22nd July (+2.7m)

27th August (+4.0 m)



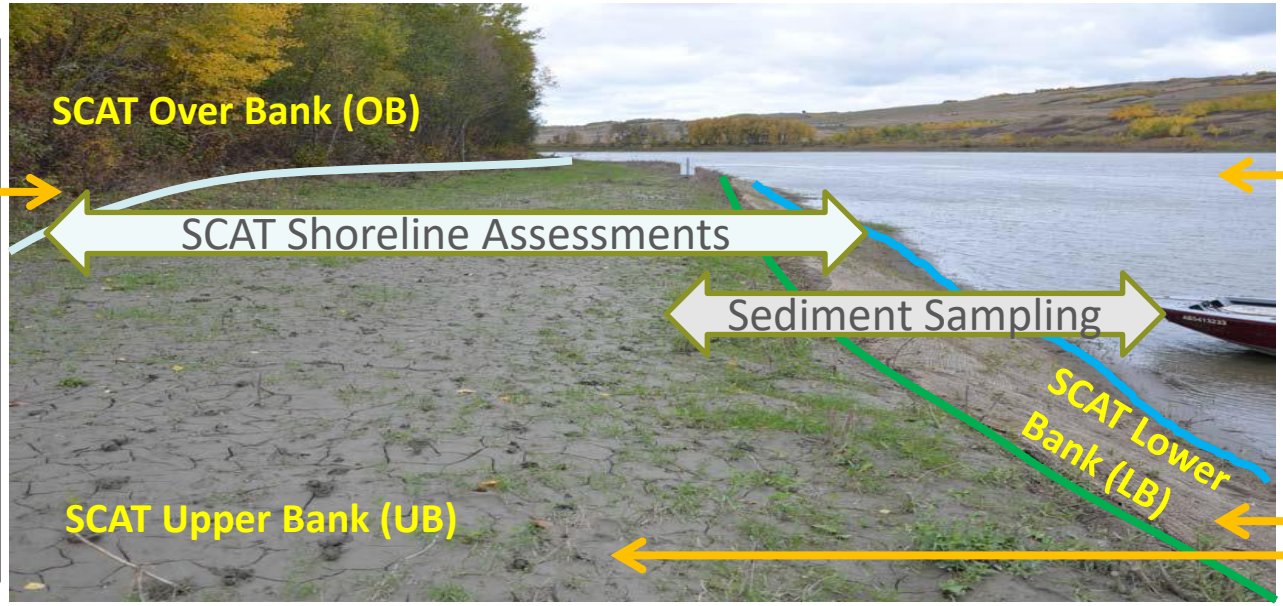
2016 Water Levels

(green)

Based on Deer Creek

SCAT Shoreline Assessments

Above 1-2 year ordinary high water mark (shoreline): **Soil** (Over Bank vegetation and stranded debris)



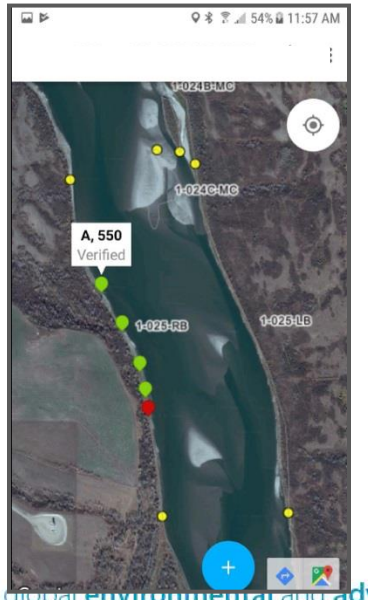
Submerged Sediment

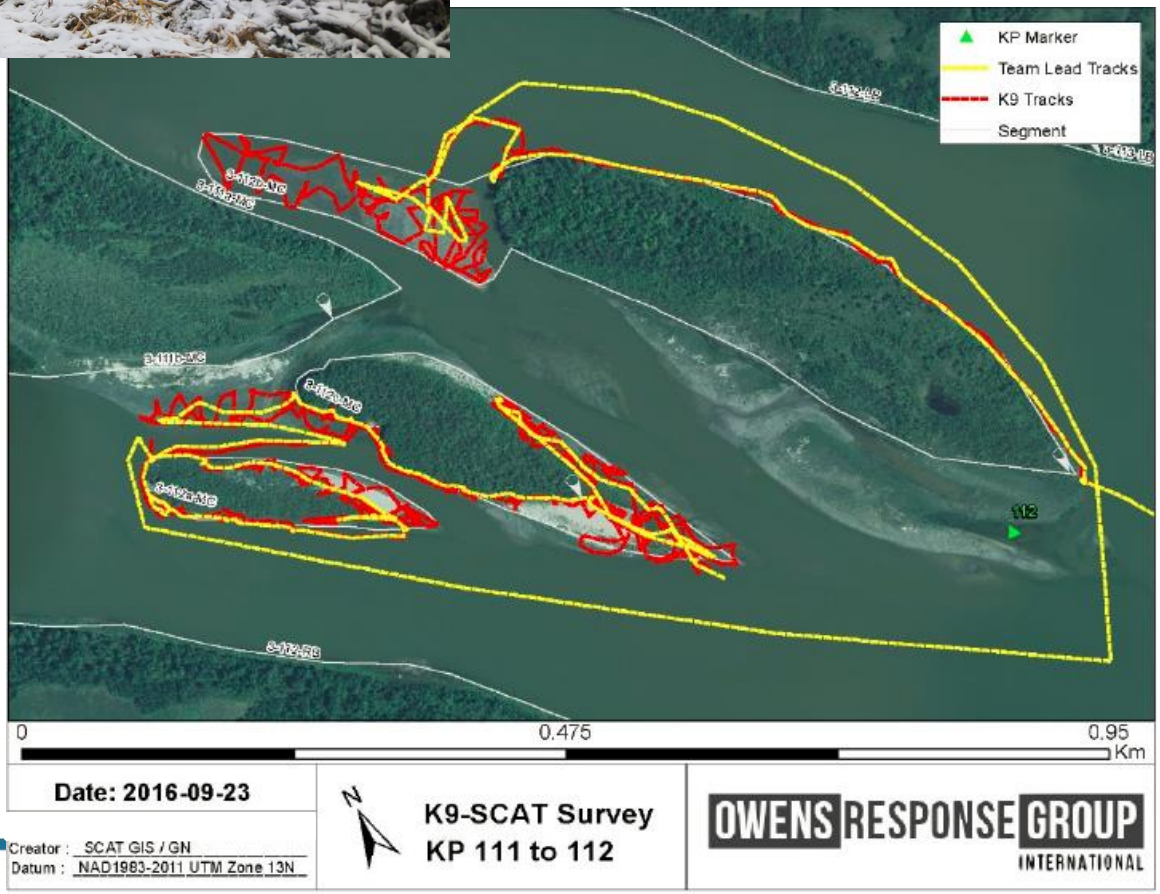
Below 1-2 year ordinary high water mark (shoreline): **Exposed Sediment**

K9 SCAT

718 km out of total survey length of 960 km in 2017

K9 alert App



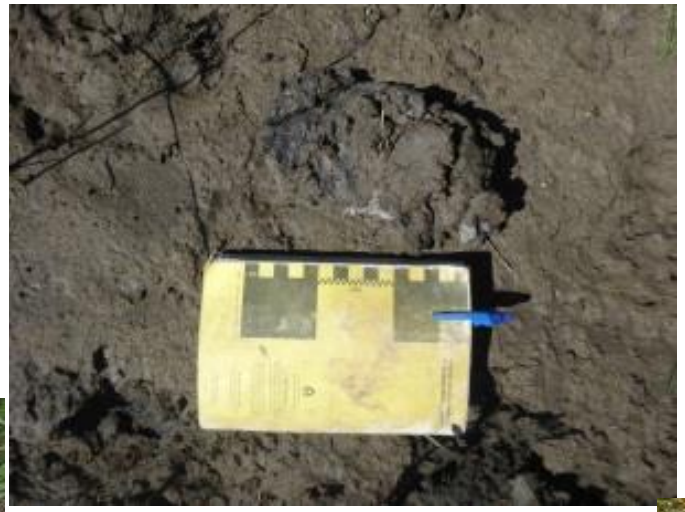


global environmental and advisory solutions

Examples of Oiling

Segment	225-RB, Zone C
Oiling	Zone C - 120-m long: 7 pieces of wood debris were detected with both sticky and weathered Cover, Coat, and Stain oiling; averaging 20 cm in length with a maximum size of 45 cm. The majority of oiling was located within a single stick pile.

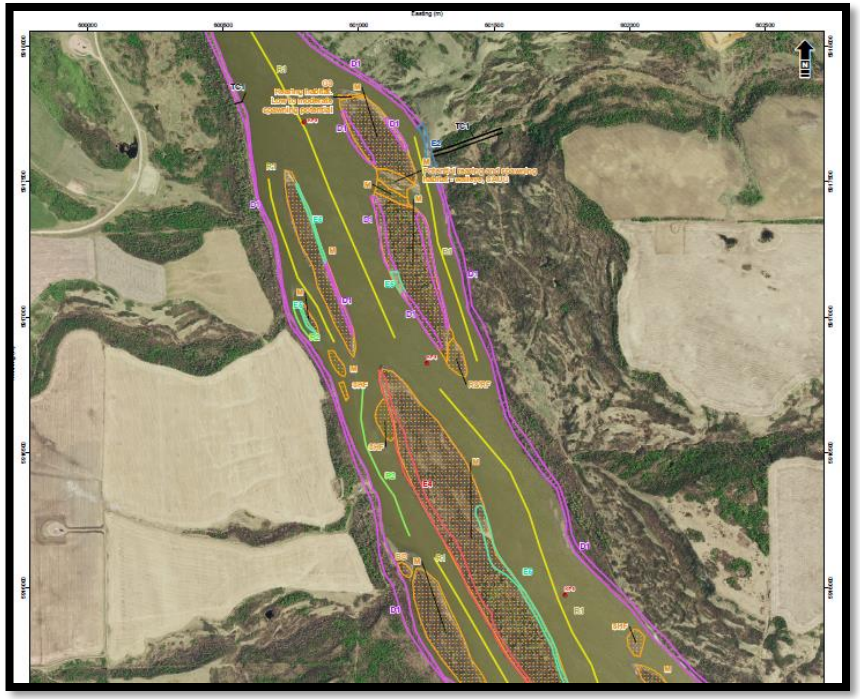
Examples of Oiling

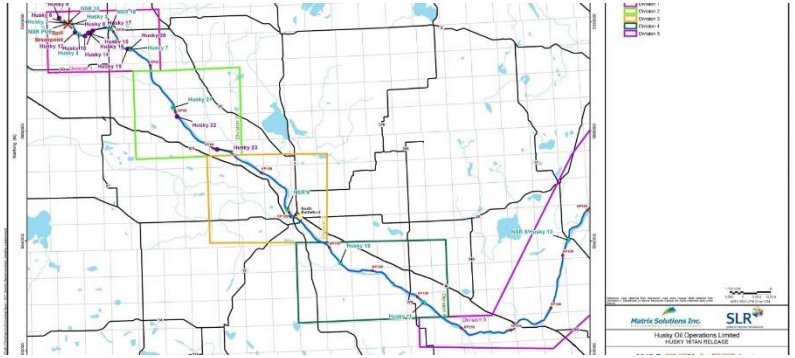


Patties (>10 cm in size) and larger **mats** (mixed with twigs, sticks and vegetation)

Study Area

- Representative habitat
- Fish and benthic invertebrate collections





Detect change, if it occurred, in fish and benthic macroinvertebrate communities, as a result of the NSR spill.

- Ecosystem-level effects
- Localized comparative level of effects

Fish Consumption Advisory
Preliminary Human Health Risk Assessment

Carcinogenic and non-carcinogenic risks were found to be acceptable for the consumption of fish from areas downstream of the POE

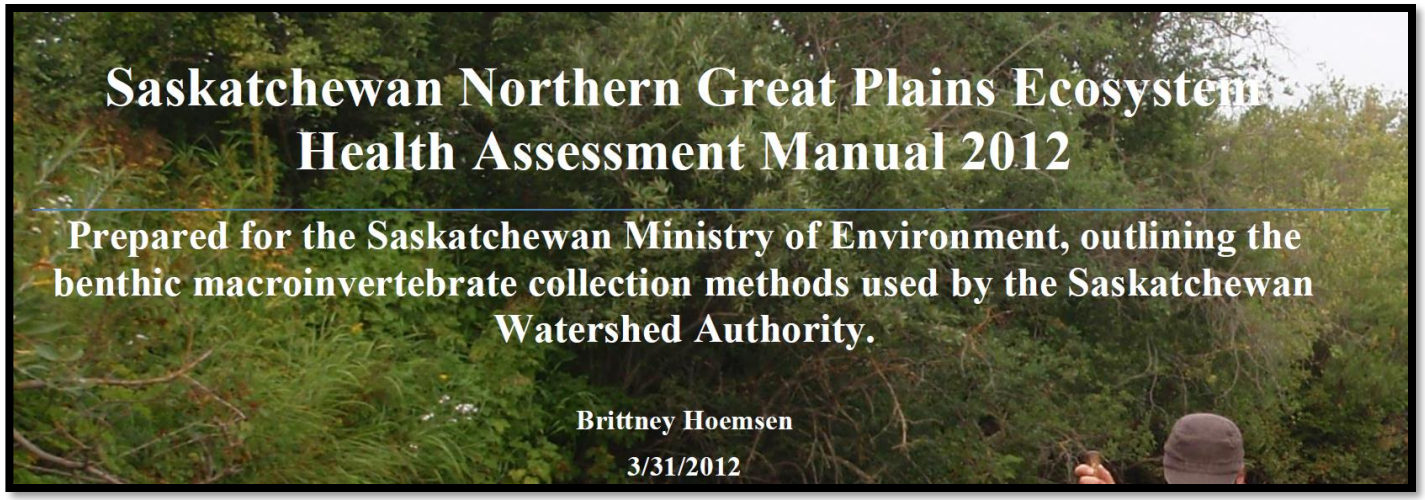
Recent findings appear to show tissue concentration associated more with fish species analyzed than location of capture

Organoleptic Taste Panel

- Taste panel for fish tissue from upstream reference and Division 1, 2 and 5
- 9 flavour selection categories ranging from dislike extremely to like extremely much
- All divisions showed more responses on the like slightly to like extremely part of the range
- No significant difference in taste preference among fish collection zones

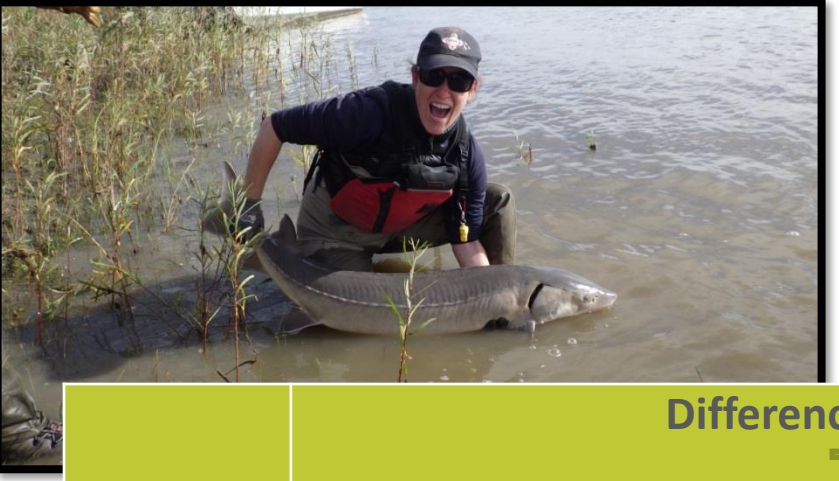
Taint detected in one sample upstream and two samples more than 40 km downstream from point of entry

Benthic Community Assessment



Fish Community Assessment

- Sampled multiple habitat types using a variety of gear types

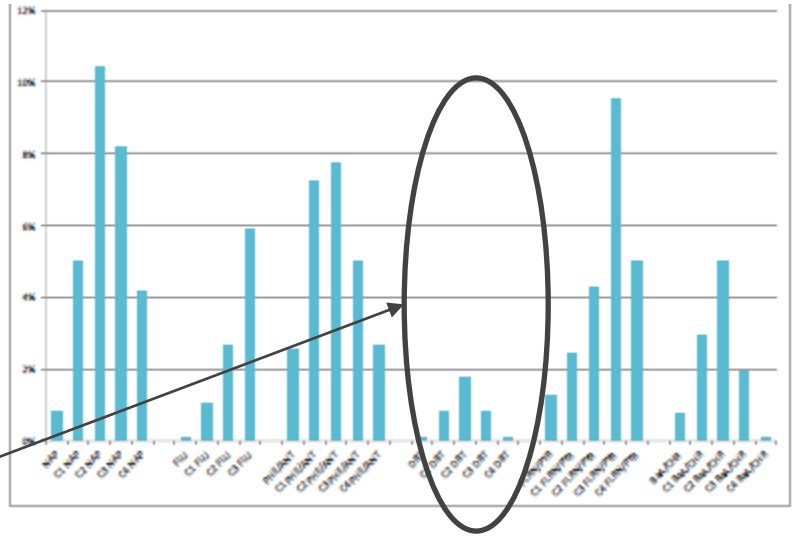


Study Design

	Difference in condition expected over time →		
Difference in condition based on type or location of site ↓	2016 Reference Condition	2017 Reference Condition	Observed difference in 2016 and 2017 ecosystem condition represents background variation.
	2016 Exposure Condition	2017 Exposure Condition	Condition of 2016 exposure site poorer than 2017 site if recovery occurred
	Condition of 2016 exposure site poorer than 2016 reference site if affected	Condition of 2017 reference similar to 2017 exposure site if recovery occurred	

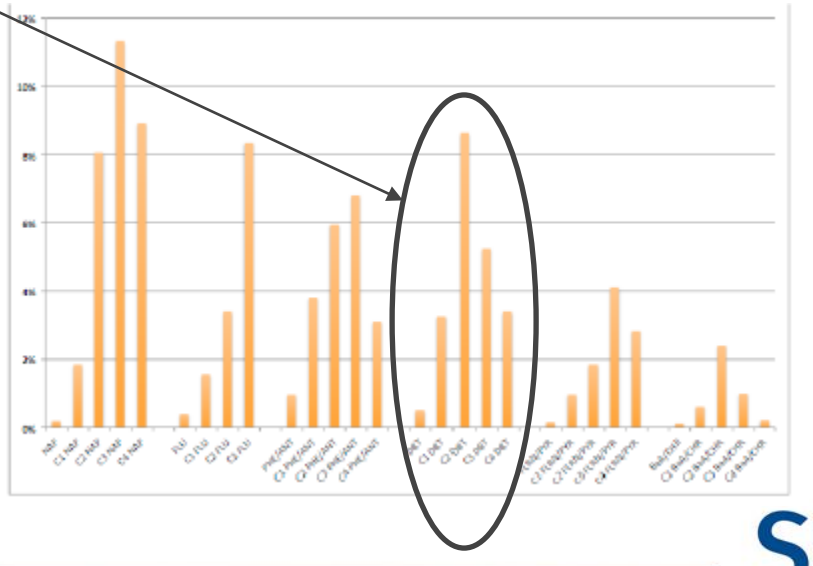
PAH Fingerprinting

Upstream Reference Sample



PAH Signature

Downstream Product of Spill



PAH Fingerprinting

chemistry matters

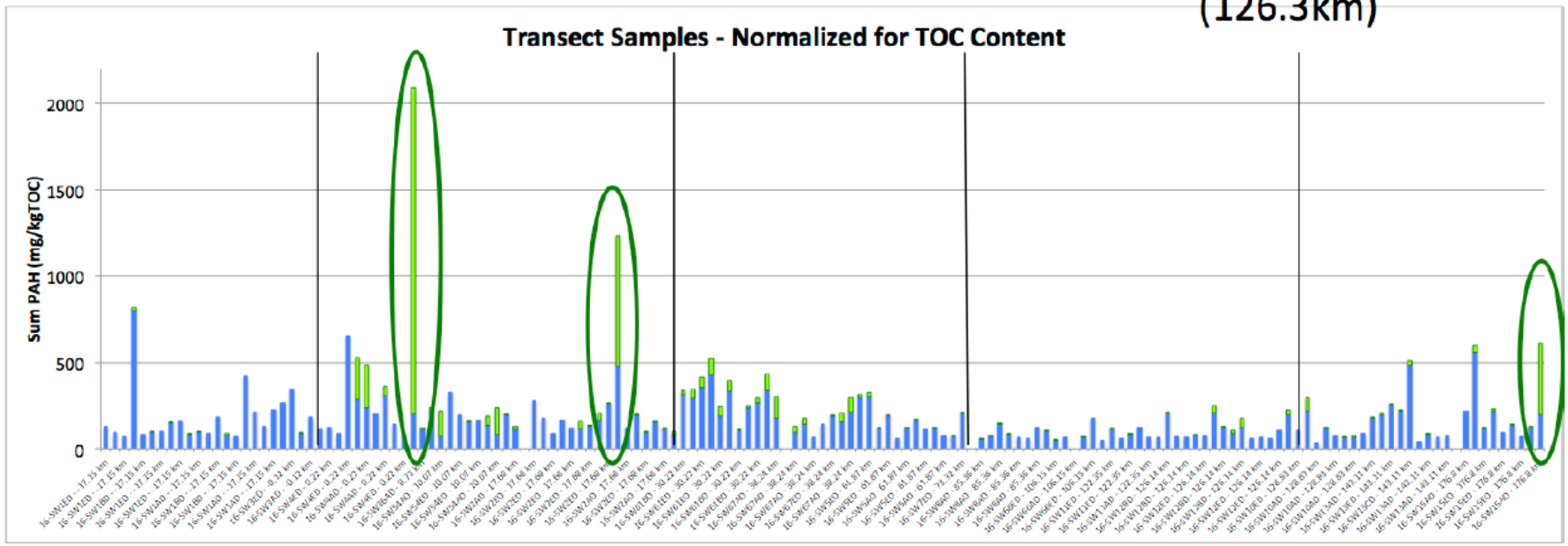
Source Apportionment of PAHs in Sediment from the North Saskatchewan River

POE

Hwy 21 Bridge (17.8km)

Paynton Ferry (73km)

North Battleford (126.3km)



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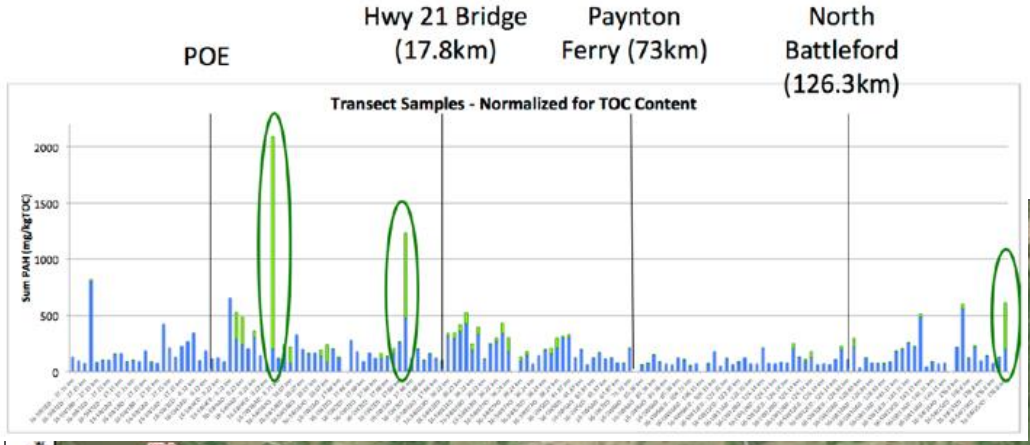
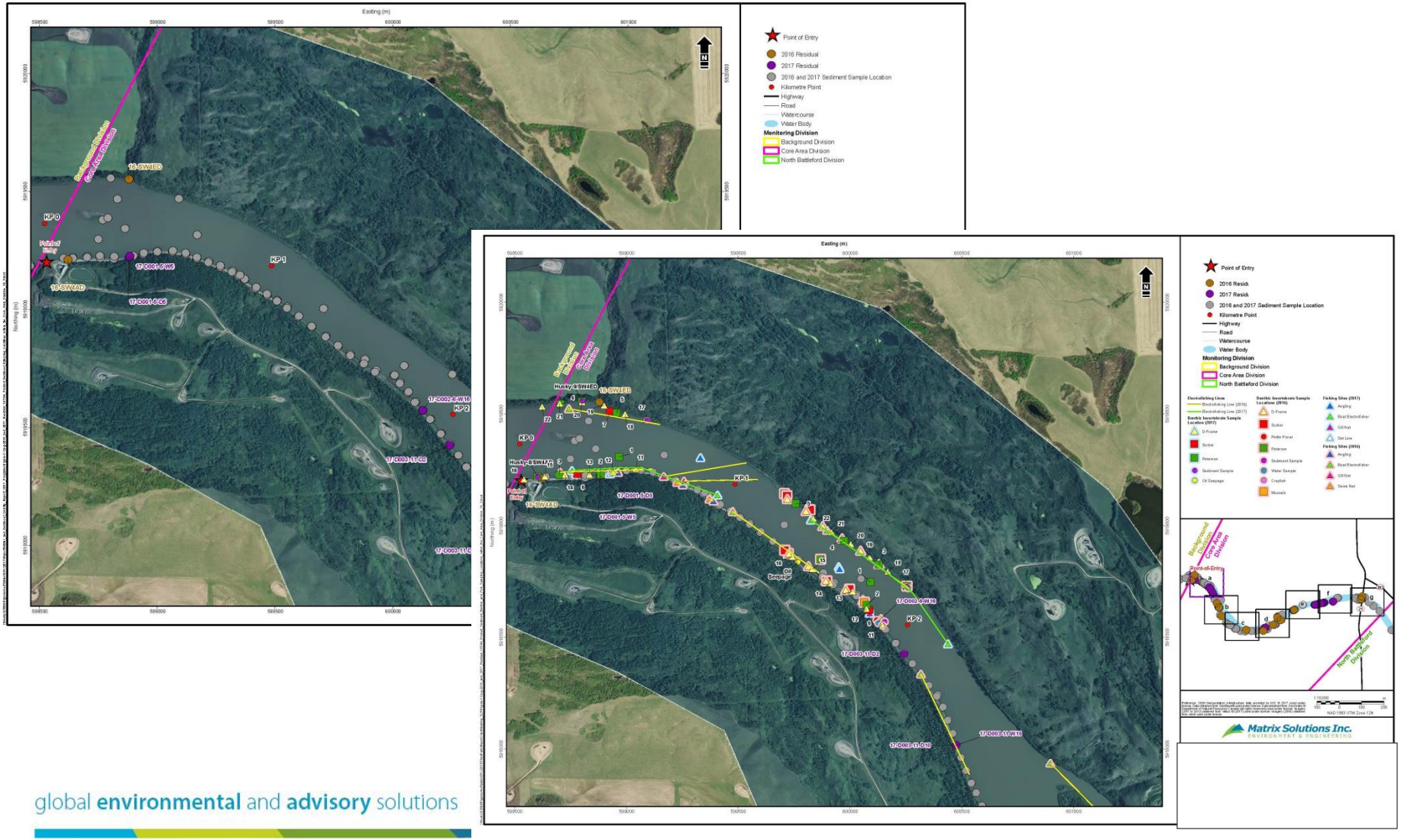


Localized Comparative Analysis



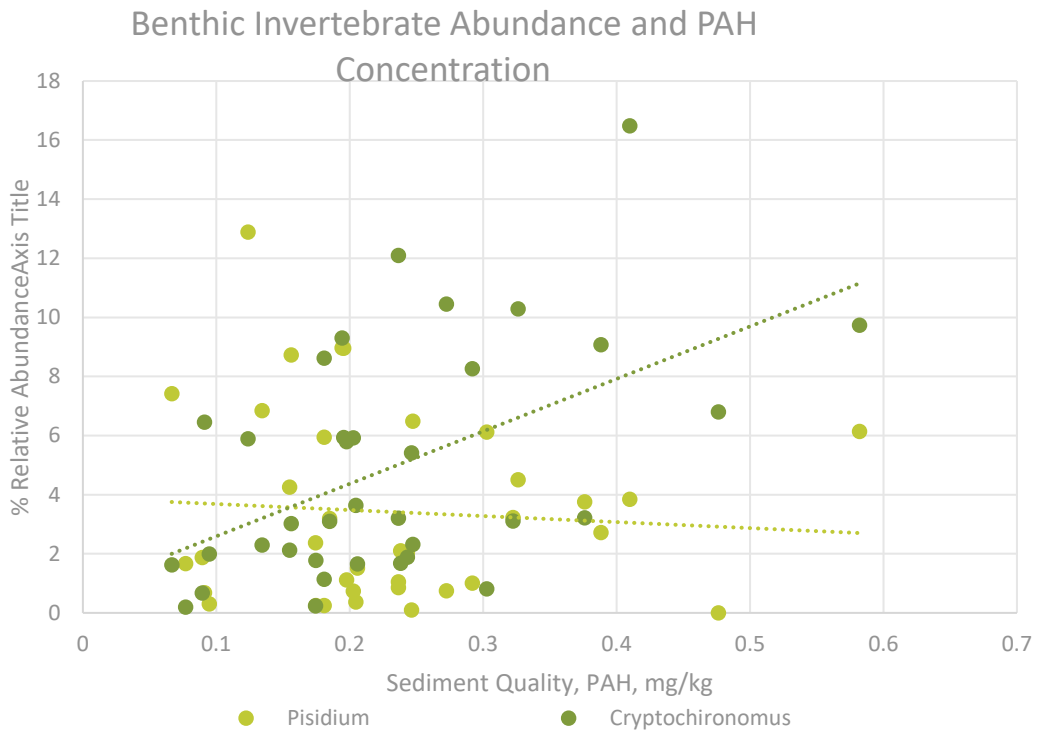
Localized Comparative Analysis

Community	Year	Reference	Exposure
Fish	2016	20	13
Fish	2017	36	14
Benthic	2016	3	5
Benthic	2017	18	5

- Identified intermediate reference and exposure sites downstream from the spill location

Ecosystem Analysis

Indicator	Benthic Macroinvertebrate	Fish
Total Abundance (m^2)	X	
Biomass (g/second)		X
Margalef Wealth of Species ($d=S-1/\log_e N$)	X	X
Shannon-Weiner Diversity Function Index ($H=-Sum(Ni/N)*\log2(Ni/N)$)	X	X
Evenness Index ($J=H/\log_e S$)	X	X
% EPT Taxa	X	
Indicator Species	X	X

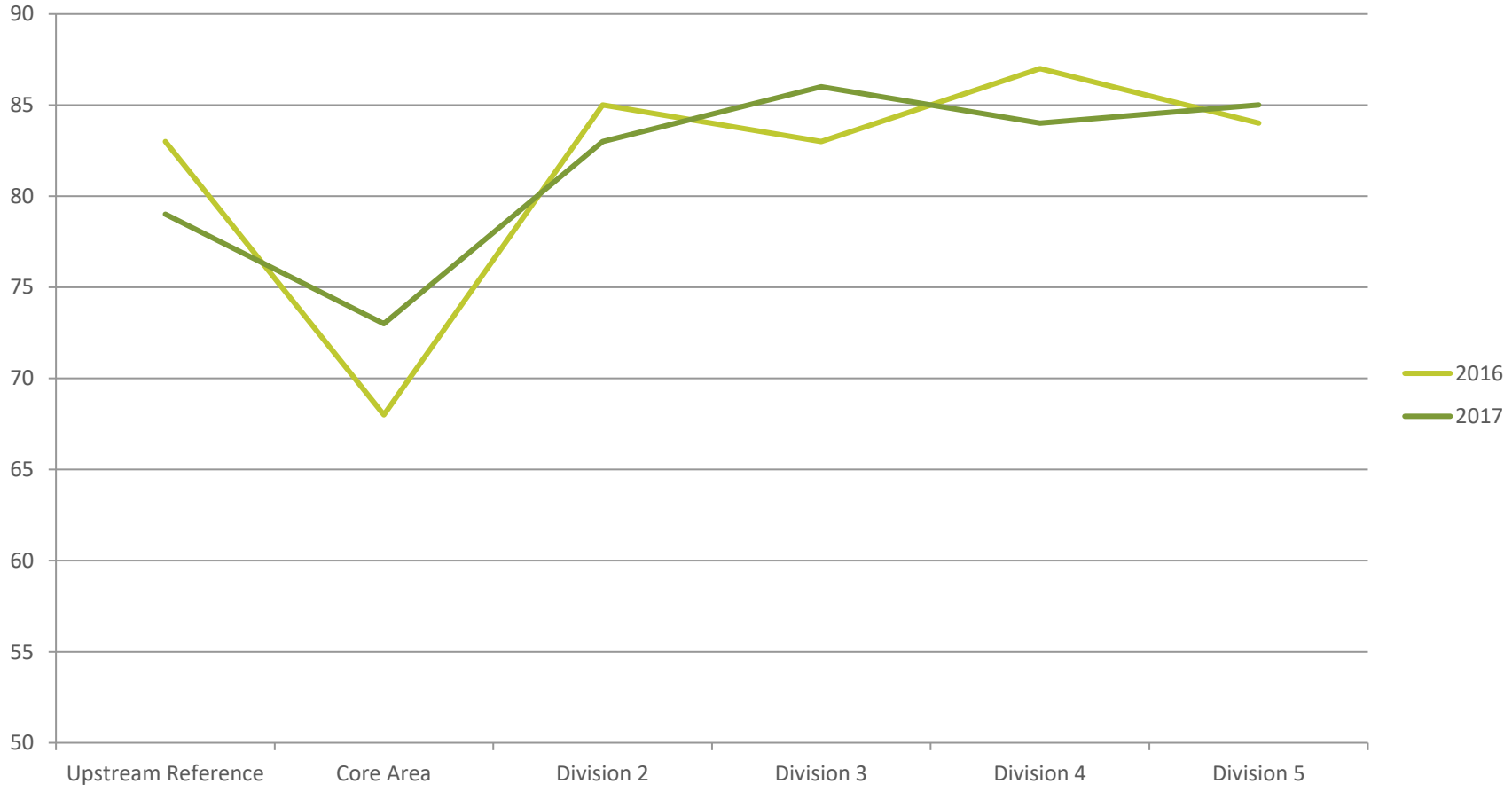


Localized Comparative Analysis – Select Taxa

Figure 6. Response of Pisidium and Cryptochironomus to Concentrations of PAHs in Sediment.

2016					
KP	Condition	Location	Tolerant	Sensitive	Consistent with Expectation
1.5	Exposure	NSR 3	5.9	2.4	Y
6.5	Exposure	NSR 4	16.2	10.8	Y
18.5	Exposure	NSR-10	33.3	0	Y
2017					
KP	Condition	Location	Tolerant	Sensitive	
1.5	Exposure	NSR 3	1.77	0.25	Y
6.5	Reference	NSR 4	5.9	9.0	Y

How Much is Enough?
Fish: Noise Sensitive Species
Hearing Specialist and Generalists



Offsetting – Limiting Factors

- Evaluation of alternatives

Perch height & pool depth

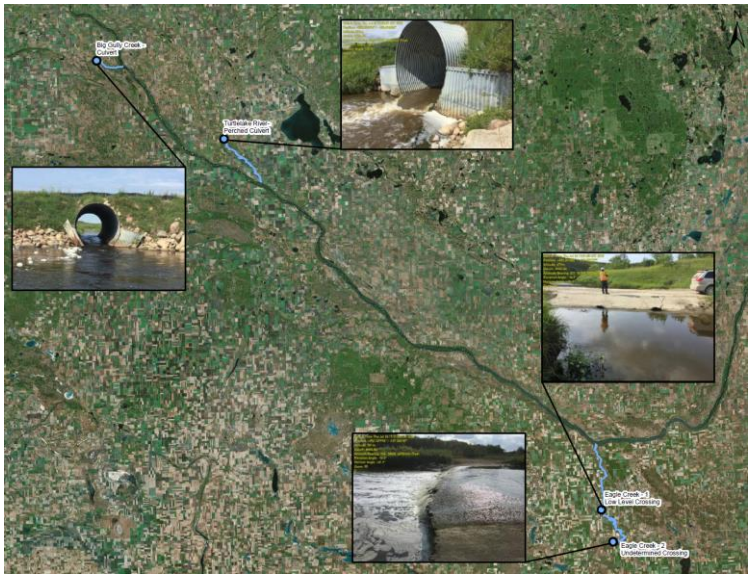
Inlet Velocity

Barrel Velocity

Flow depth

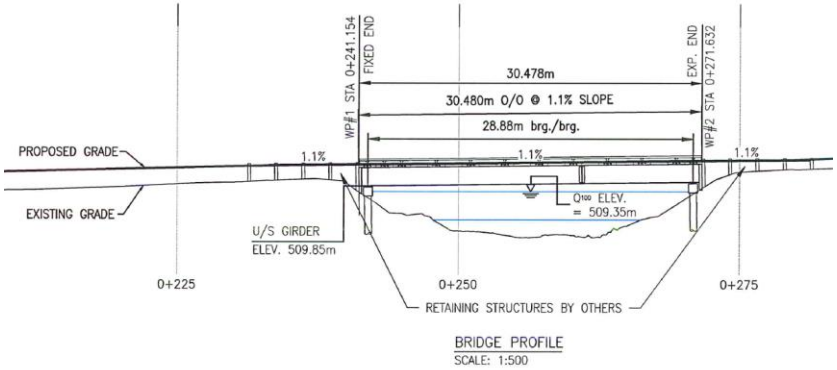
Preferred Alternative – Eagle Creek Barrier to Fish Passage

- Barrier under all flow conditions
- Reinstate access to 136 km if stream habitat
- Reinstate access to 2,500 km2 aquatic habitat



Offset created a large surplus bank

Pre-Offset Condition



BRIDGE PROFILE
SCALE: 1:500

Fish Salvage

Adapt to conditions

Riffle Construction

Washing in

Commissioning Riffle

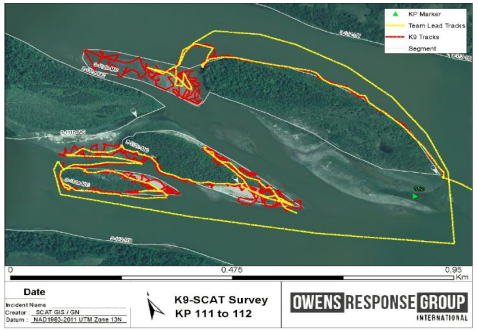
Restoration

Restoration

Five Months Later – Sept 20, 2019

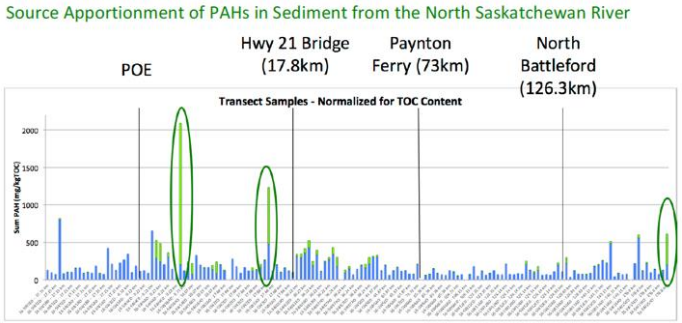
Conclusions

Novel methods for detection



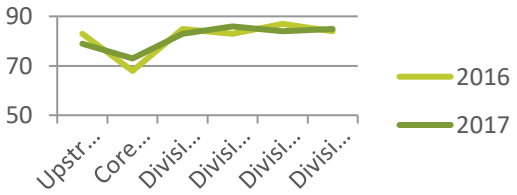
chemistry matters

Novel methods study design



Unexpected analysis

How much is enough?



Offset – address limiting factors