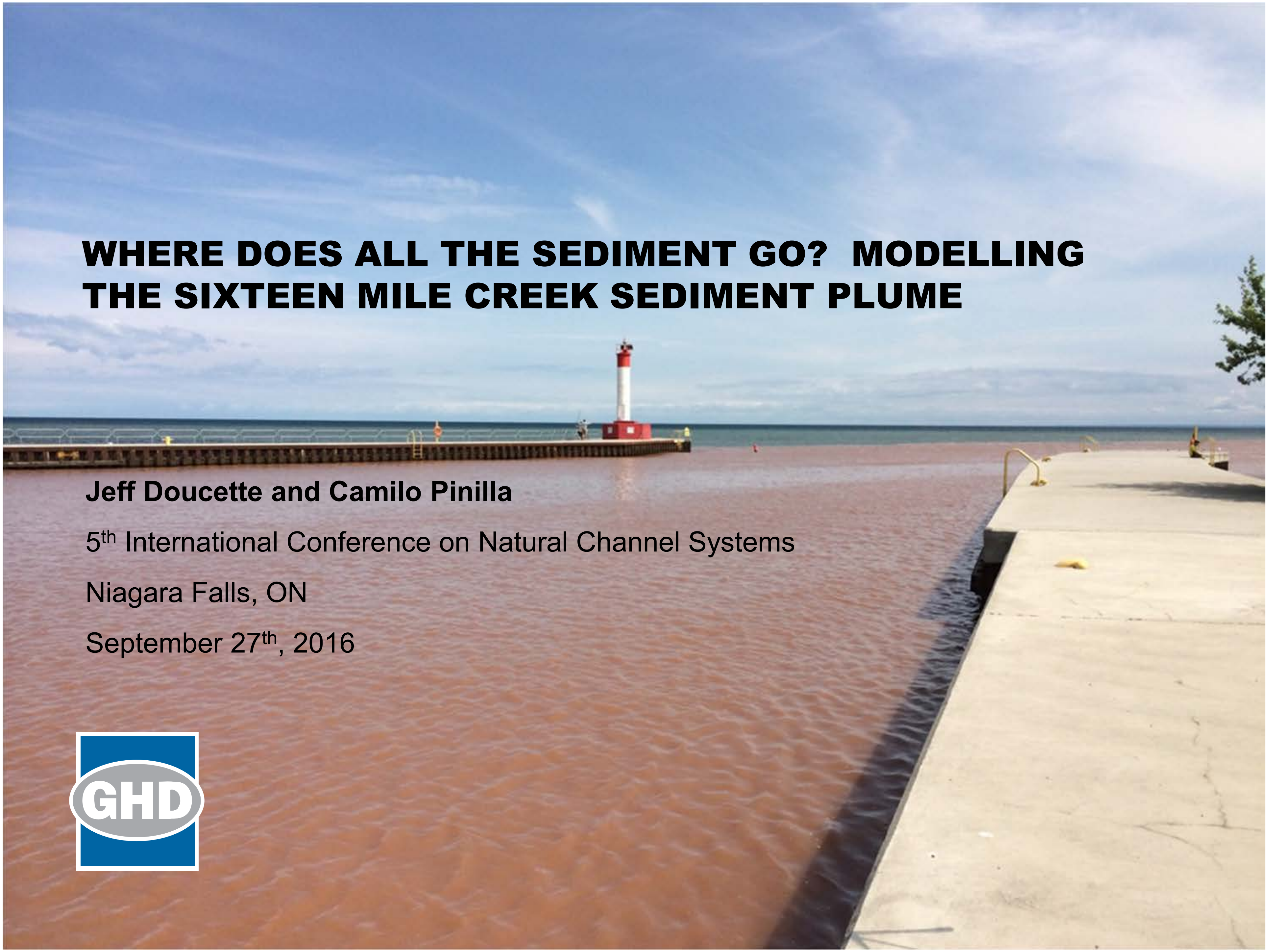


WHERE DOES ALL THE SEDIMENT GO? MODELLING THE SIXTEEN MILE CREEK SEDIMENT PLUME

Jeff Doucette and Camilo Pinilla

5th International Conference on Natural Channel Systems

Niagara Falls, ON

September 27th, 2016

GHD

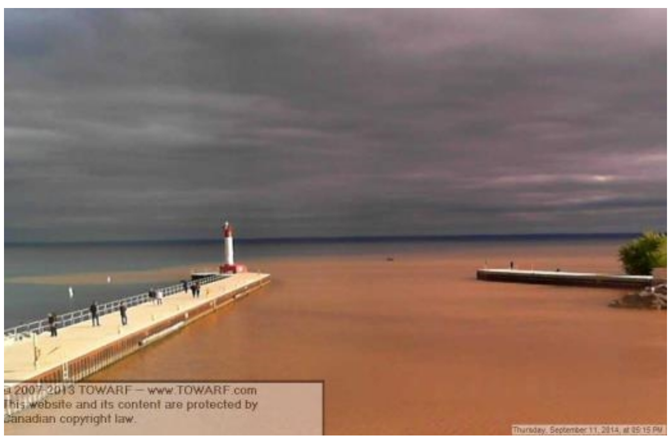
Acknowledgments

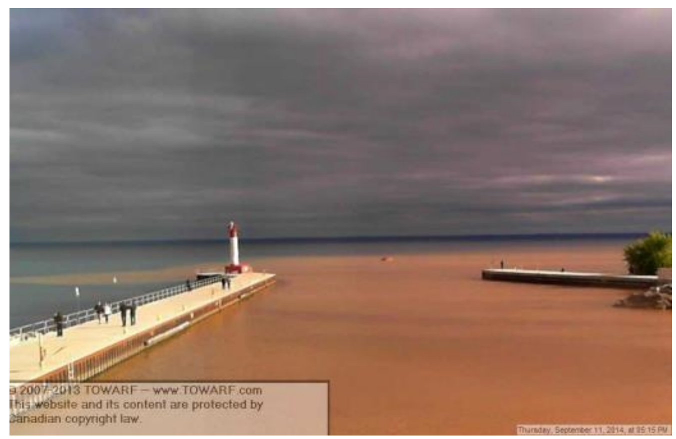
- The Regional Municipality of Halton
- Town of Oakville

Study Aim

- To determine the sediment plume extent and concentration for typical events that cause high levels of turbidity within a water purification plant (WPP) intake in Oakville, Ontario

- Will relocating the WPP intake reduce turbidity from the sediment plume?





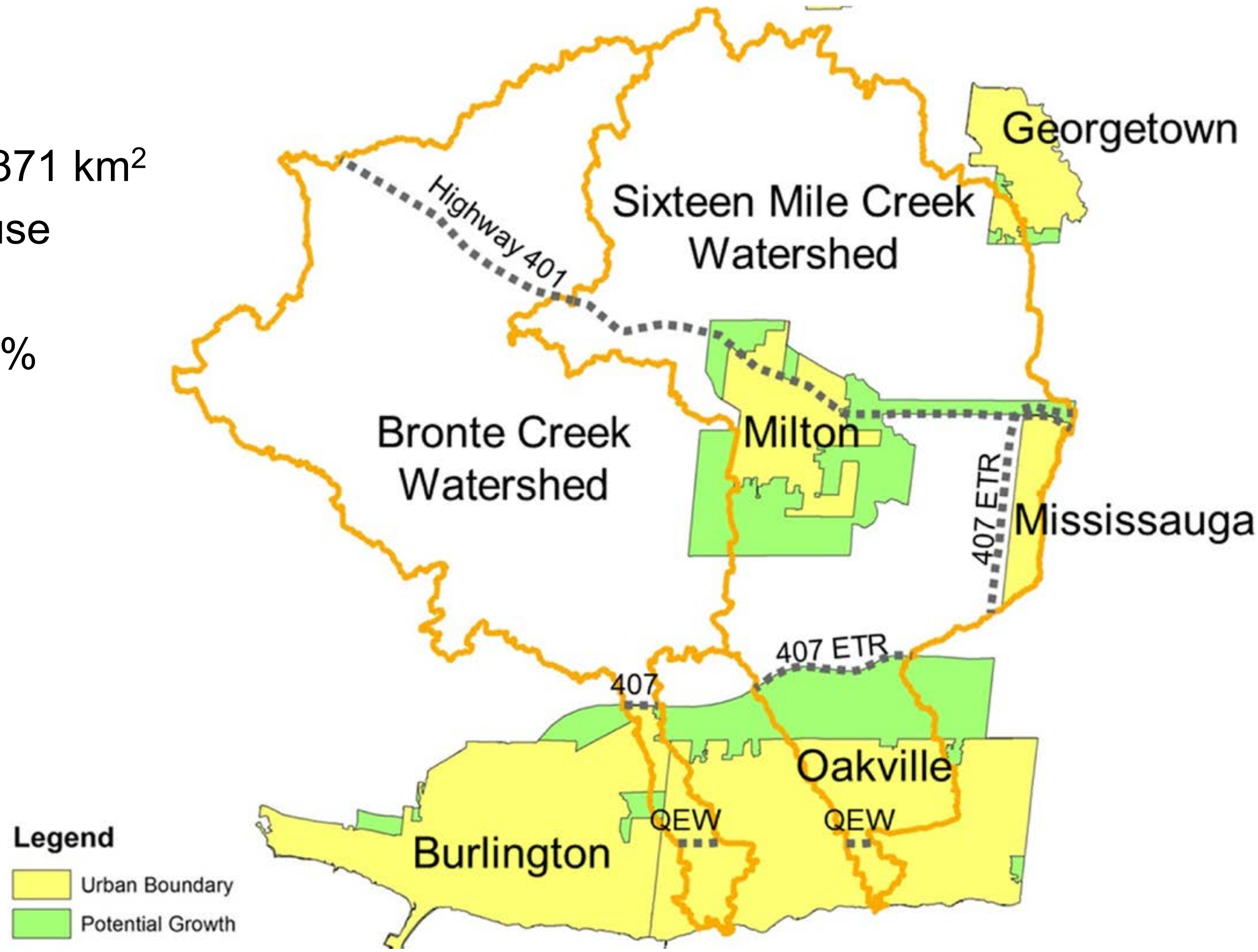
Presentation Overview

- Introduction
- Field Sampling
- Numerical Modelling
- Results
- Potential Solutions

Introduction

Sixteen Mile Creek

- Catchment size 371 km^2
- Catchment landuse
  - Urban 16%
  - Agriculture 47%



Introduction

Sixteen Mile Creek Flows

Event	Discharge (m^3/s)
Regional	1198
100-yr	311
50-yr	279
25-yr	237
10-yr	190
5-yr	160
2-yr	100
1-yr	68
0.5-yr	30

Introduction

Accumulation of 1700 m³/year
Oakville Harbour 2010 to 2013

Creek

Introduction

Bed Sediment Composition

Feature	% Gravel	% Sand	% Silt	% Clay
SWM Ponds	3	15	65	17
Oakville Harbour	0.4	23	54	22
Bronte Harbour	0	31	53	16

Field Sampling

Plume conditions at the entrance of Oakville Harbour on July 28, 2014

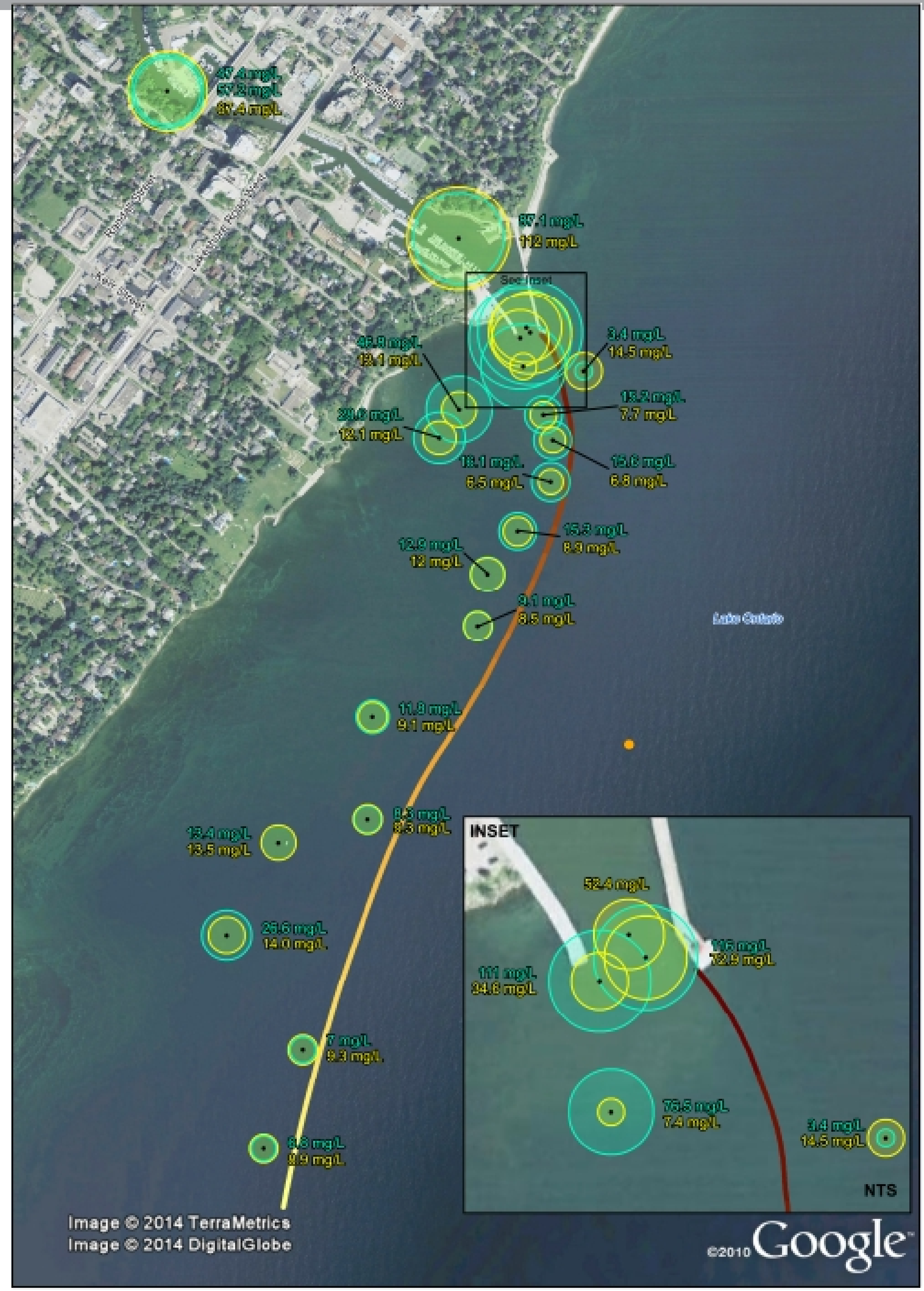
Plume extent offshore of Oakville Harbour on July 28, 2014

Field Sampling

Plume conditions offshore of the mouth on September 11, 2014

Plume extent offshore of Oakville Harbour on September 11, 2014

Field Sampling



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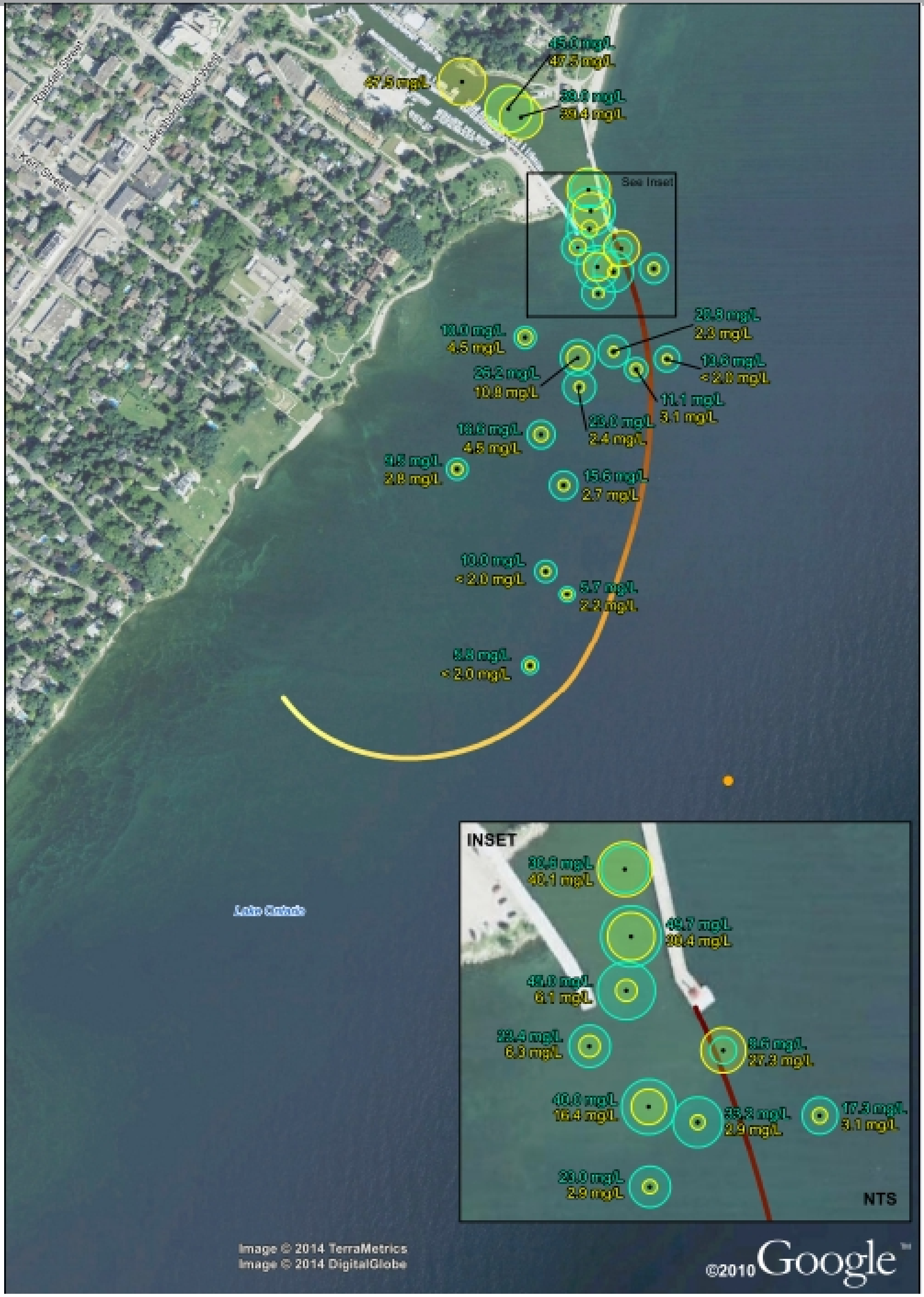
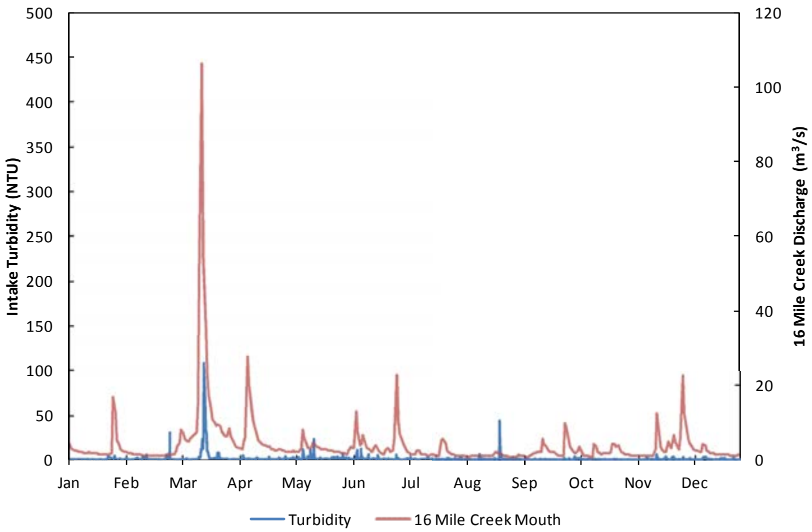
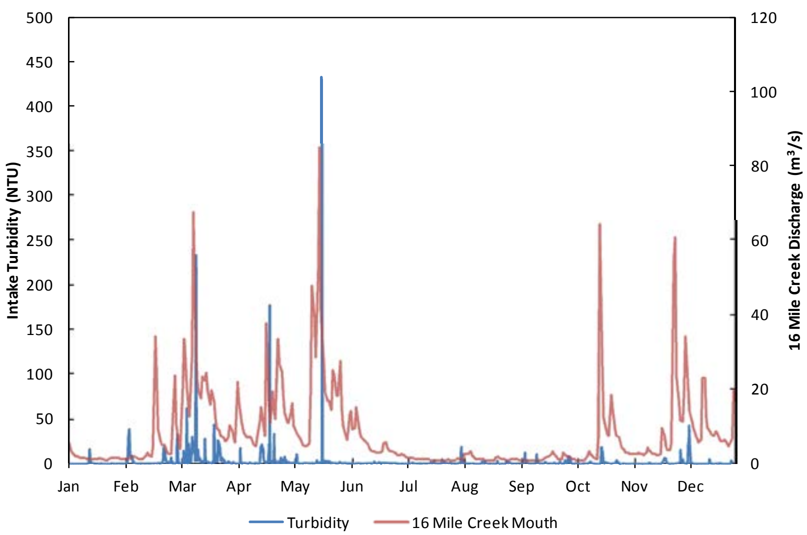


Intake Turbidity

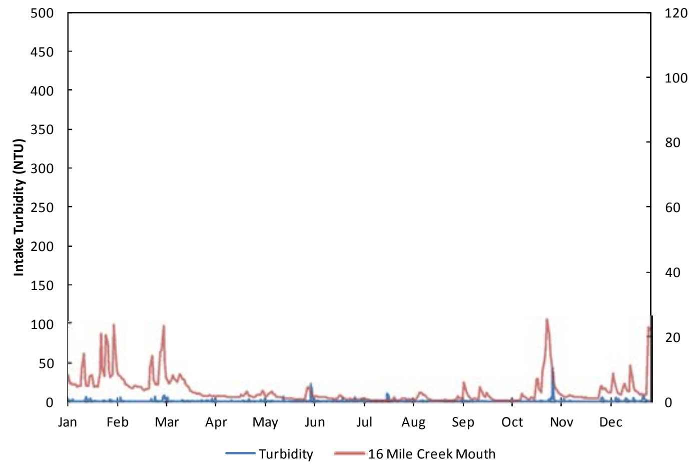
2010



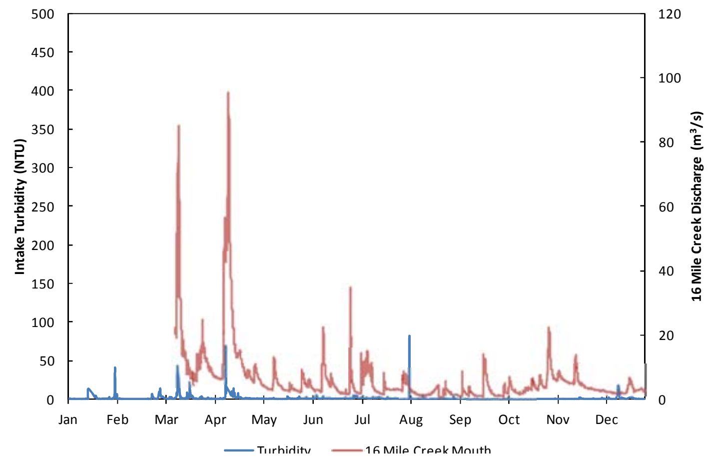
2011



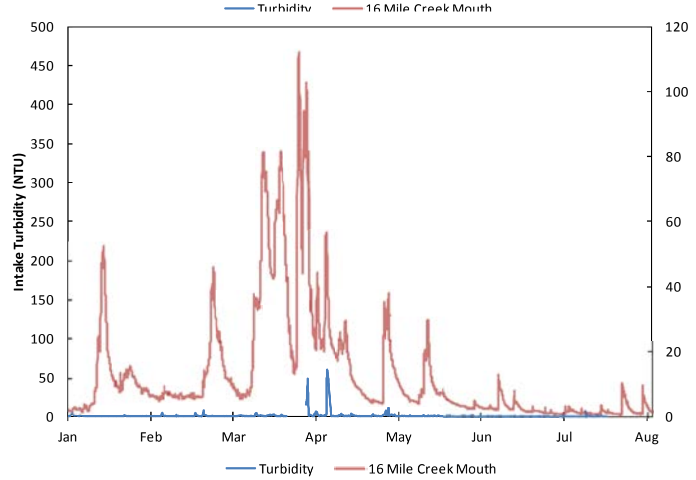
2012



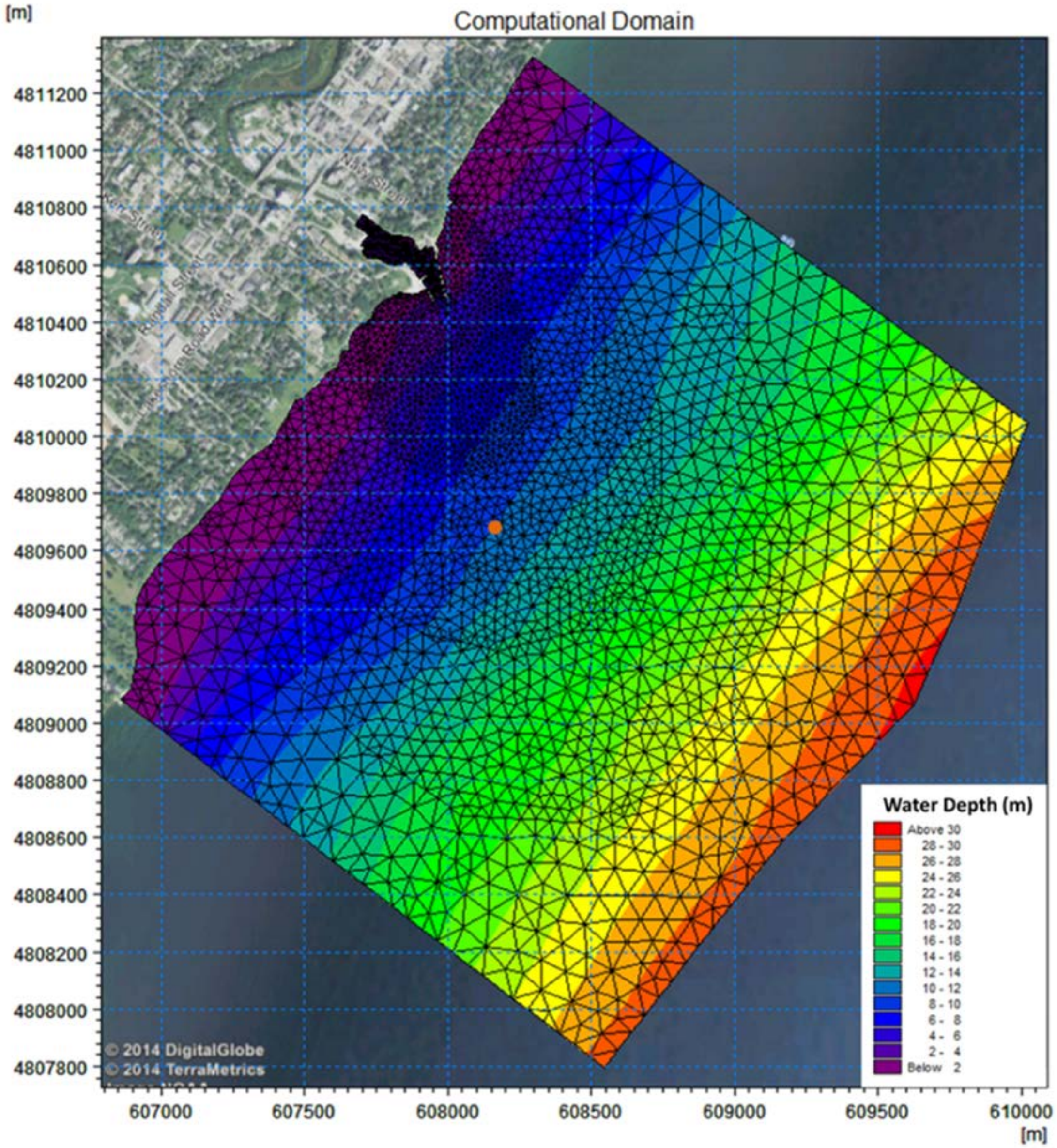
2013



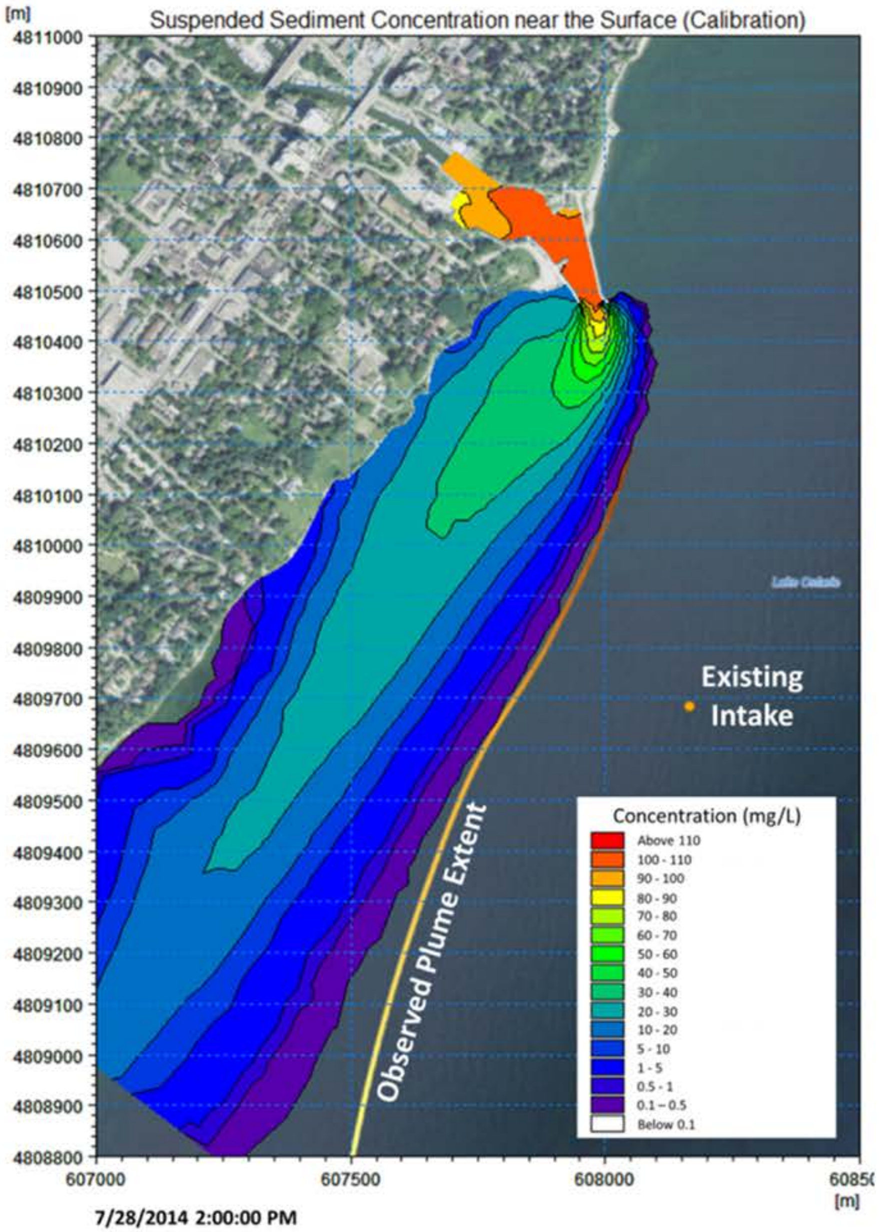
2014

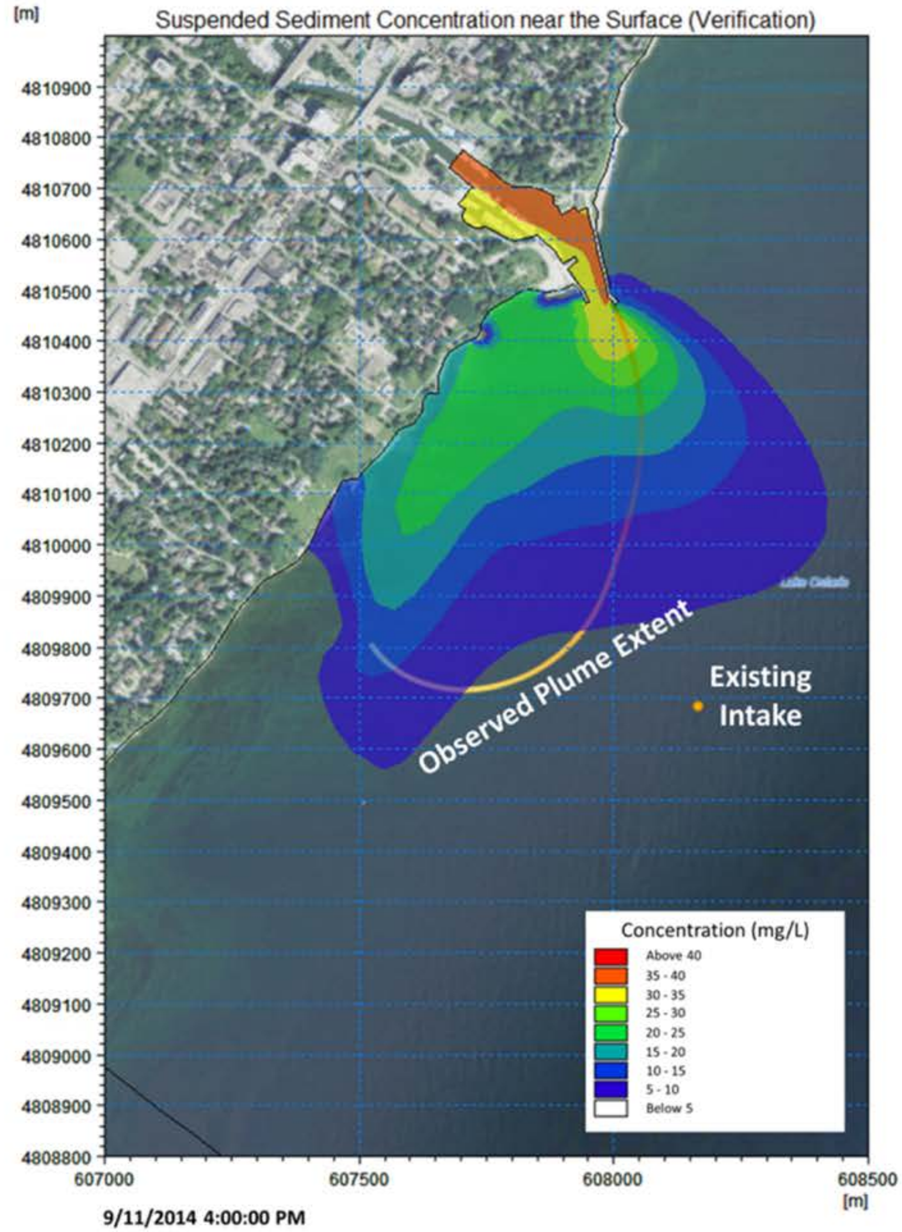


Numerical modelling – Computational Domain



Numerical modelling – Model calibration and validations





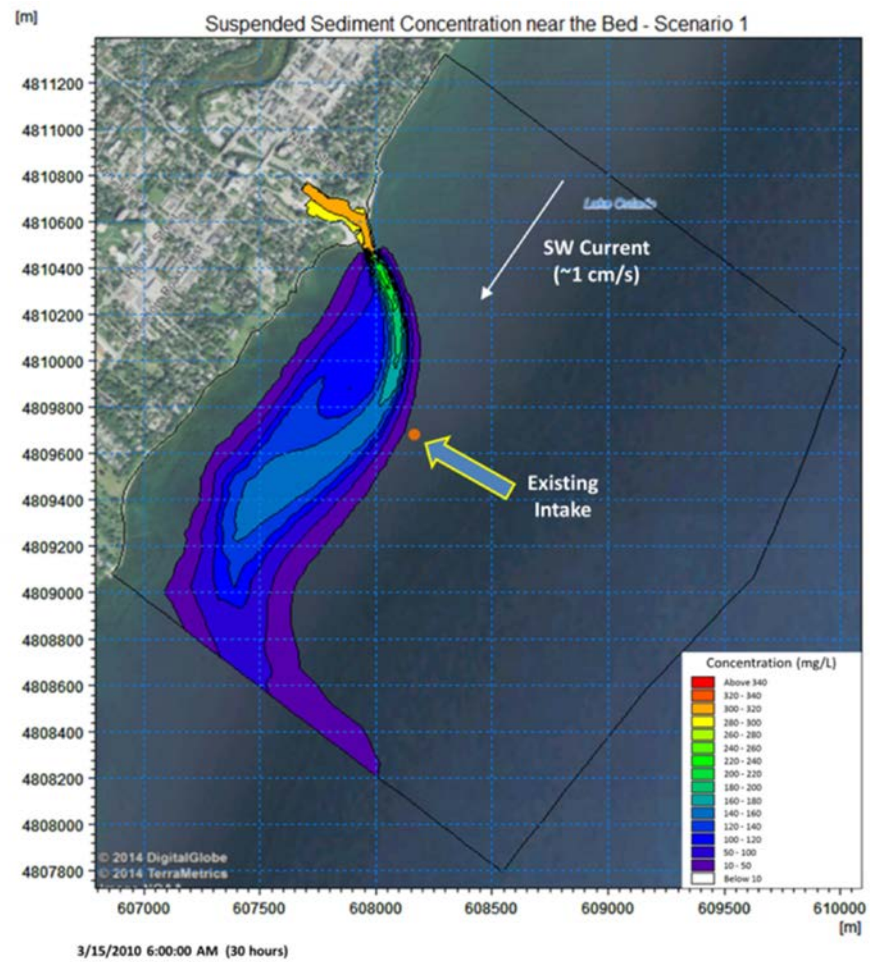
Numerical Modelling – Modelling scenarios

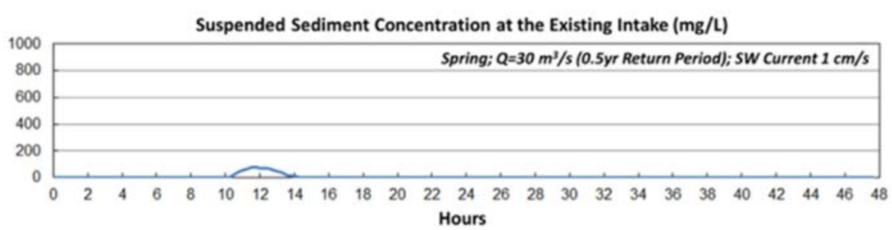
- 29 model scenarios
  - Discharge 30 $m^{3/}s$ to 310 m^3/s (0.5 yr to 100 yr events)
  - Spring and summer temperature conditions
  - Onshore, offshore and southwesterly lake currents

Results of Numerical Modelling

0.5-yr event

1 cm/s SW

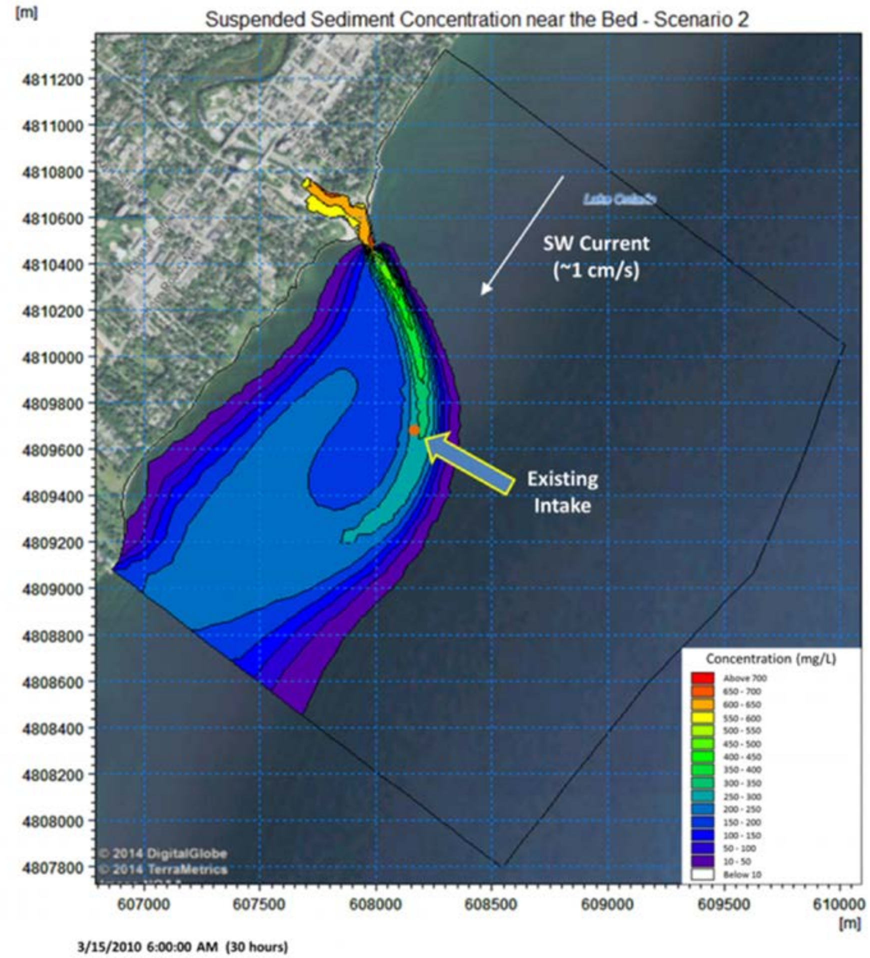


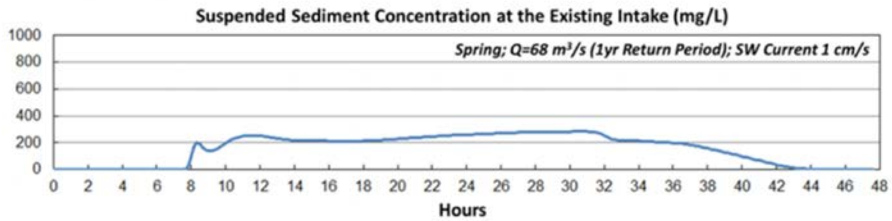


Results of Numerical Modelling

2-yr event

1 cm/s SW

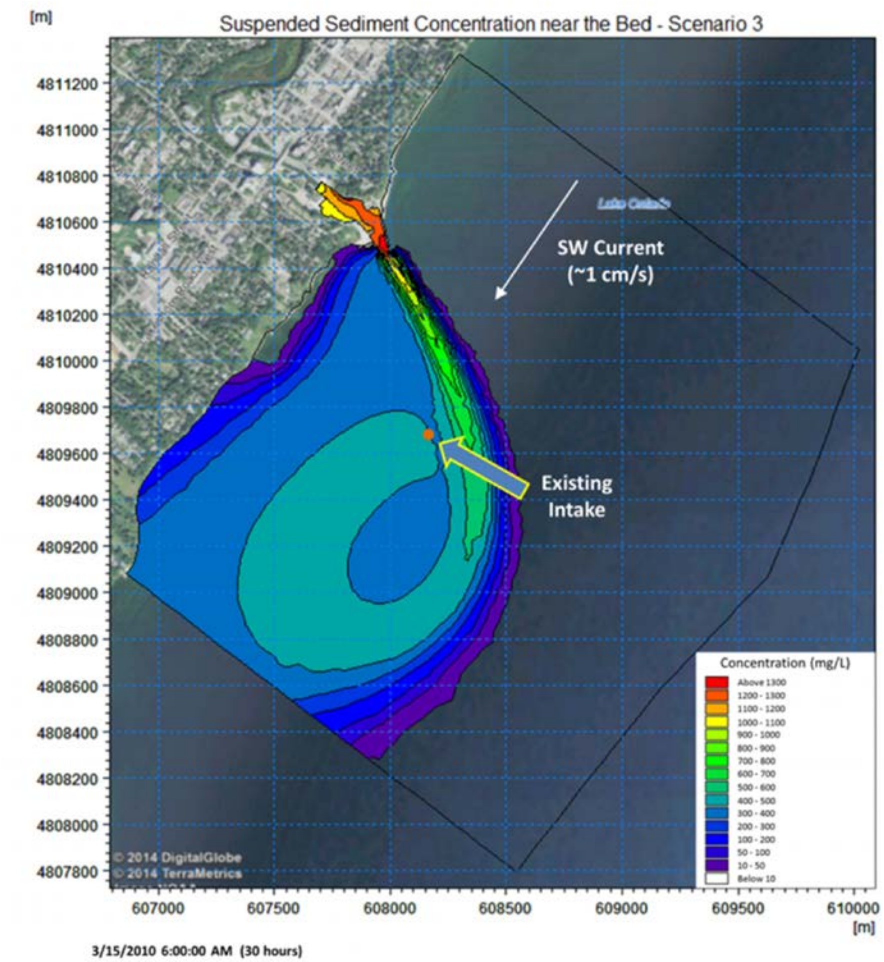


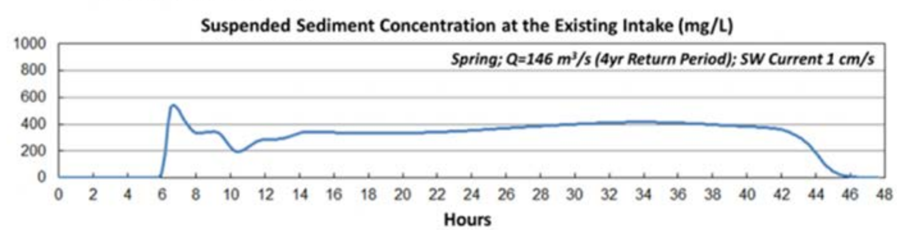


Results of Numerical Modelling

4-yr event

1 cm/s SW

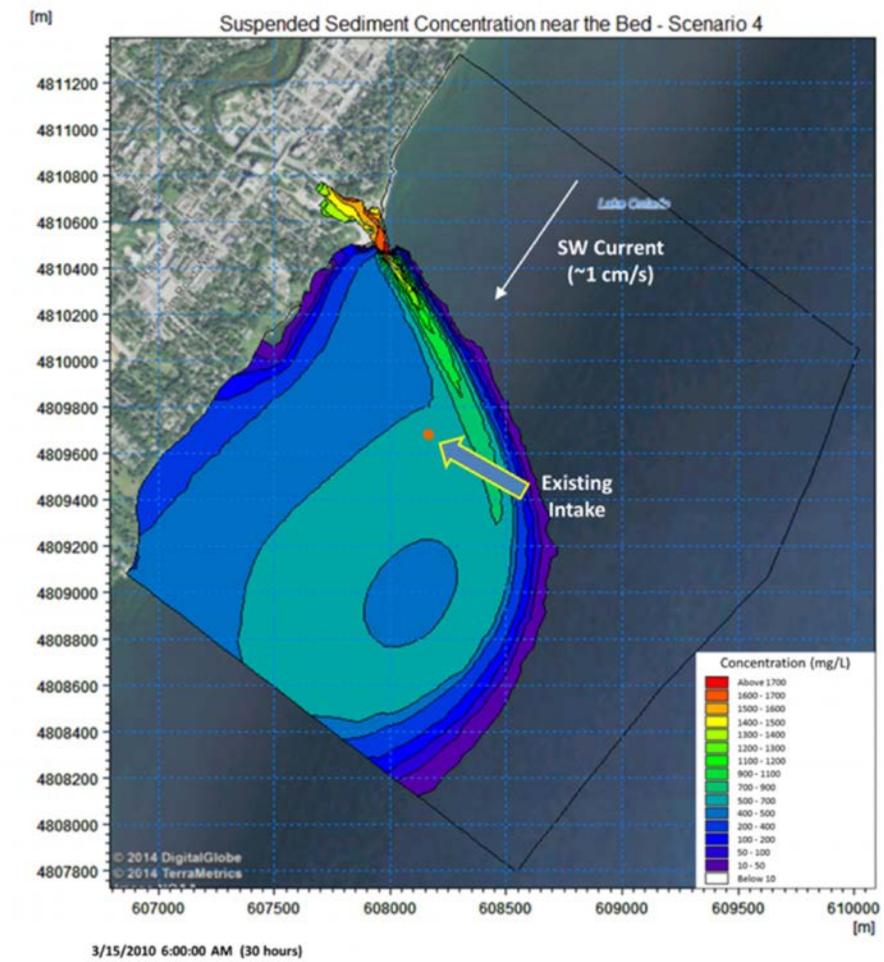


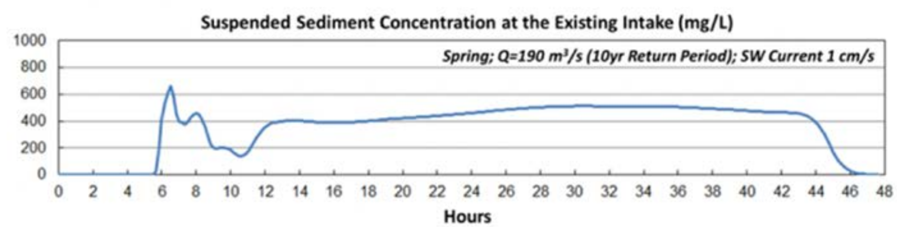


Results of Numerical Modelling

10-yr event

1 cm/s SW

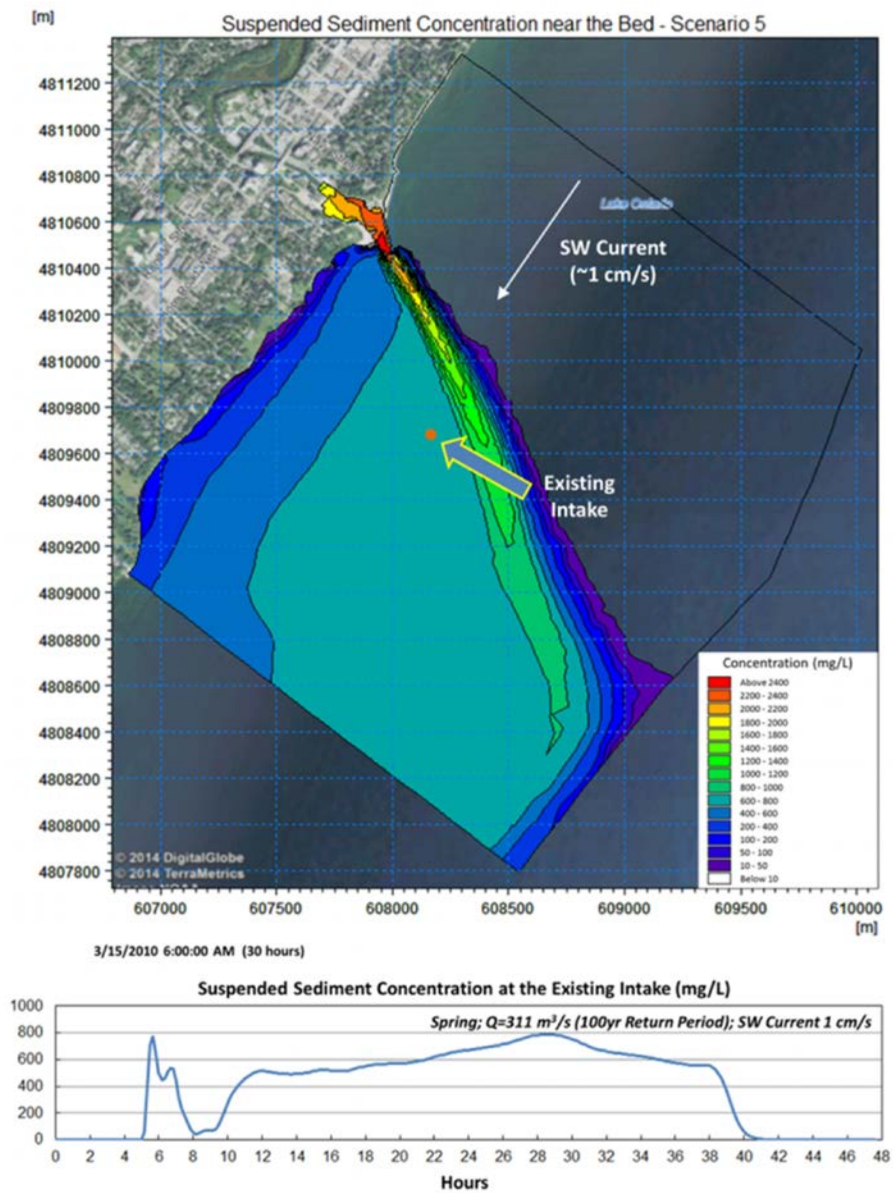




Results of Numerical Modelling

100-yr event

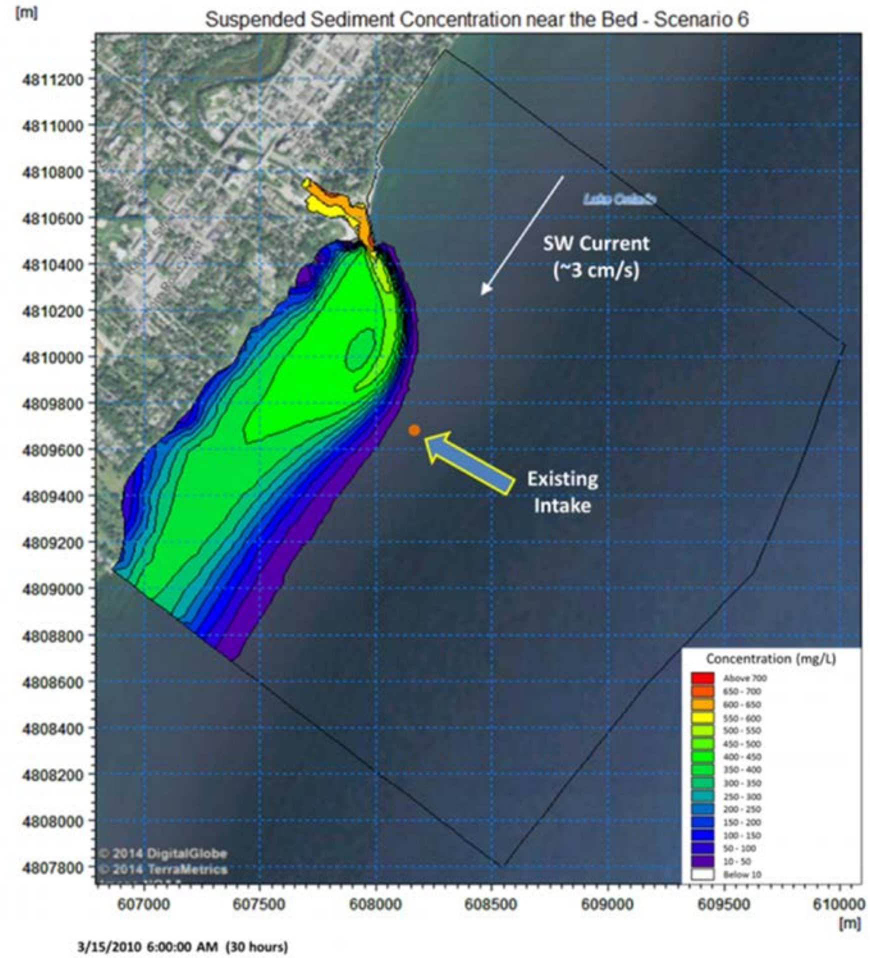
1 cm/s SW

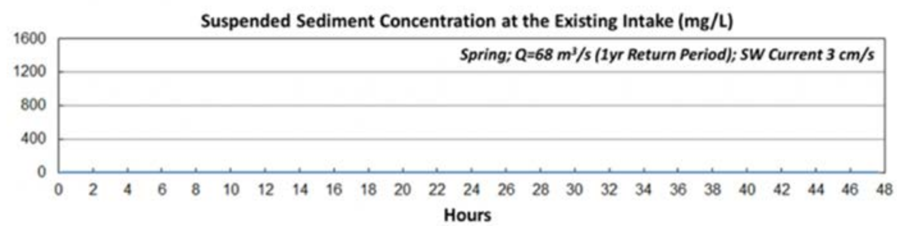


Results of Numerical Modelling

2-yr event

3 cm/s SW

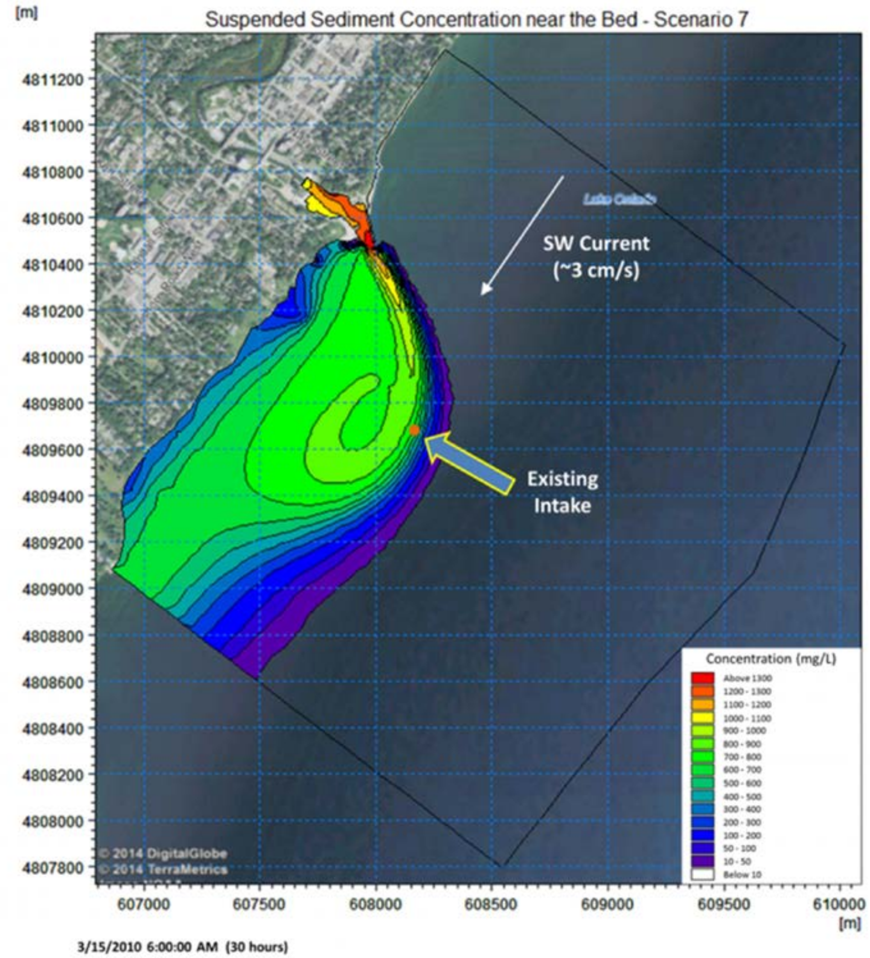


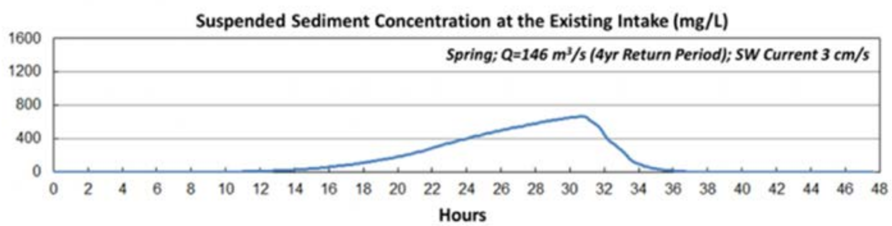


Results of Numerical Modelling

4-yr event

3 cm/s SW

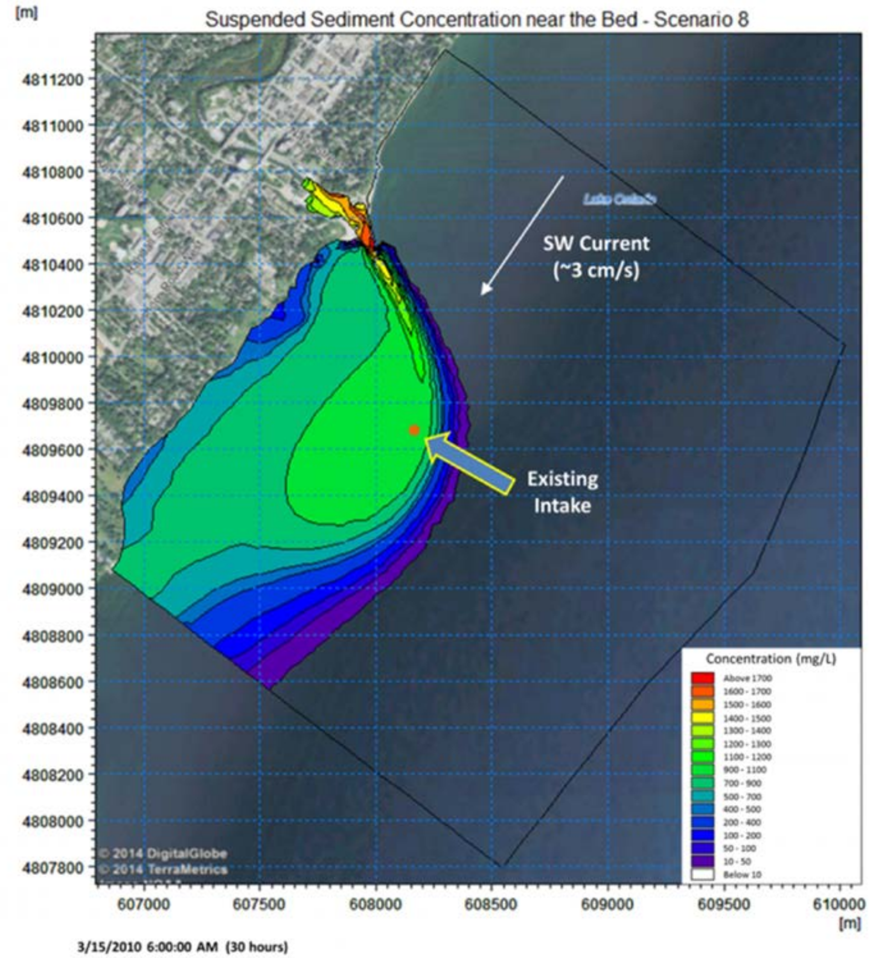


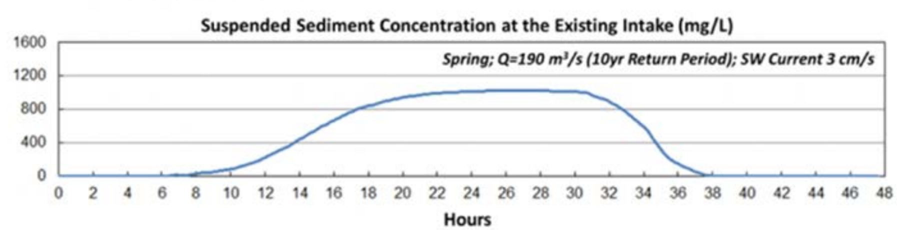


Results of Numerical Modelling

10-yr event

3 cm/s SW

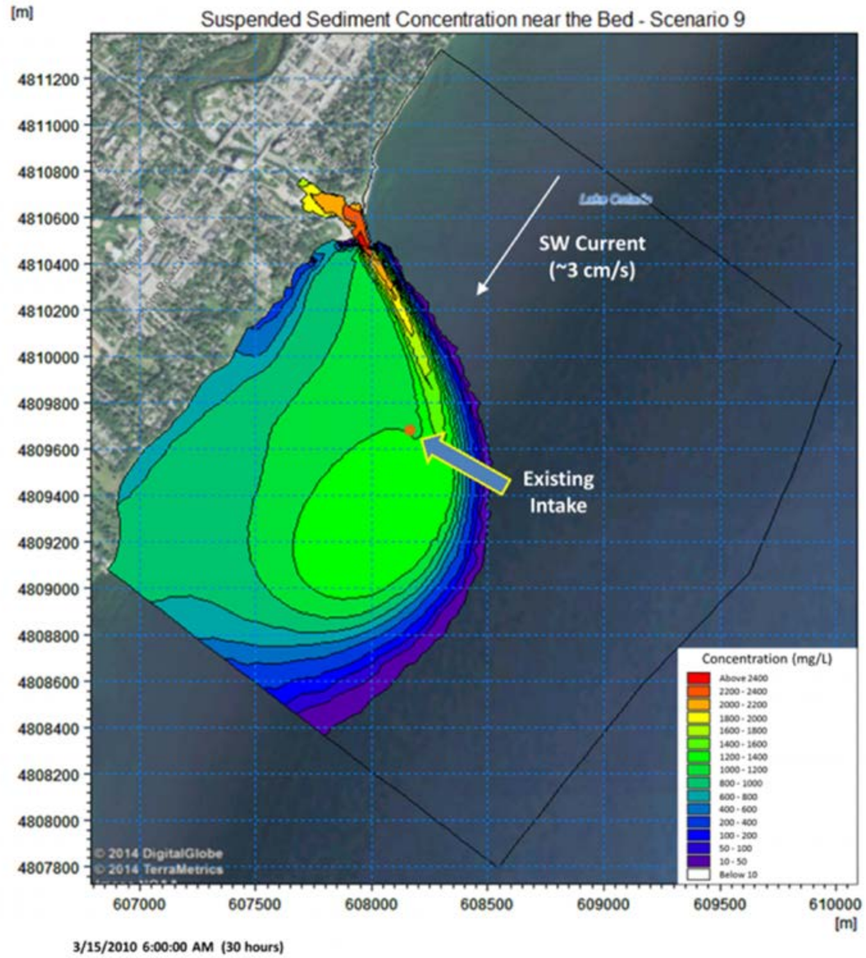


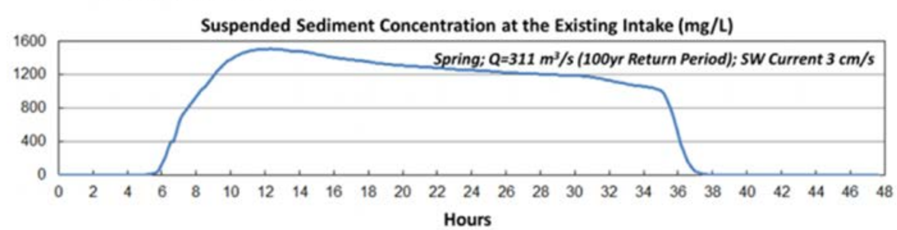


Results of Numerical Modelling

100-yr event

3 cm/s SW

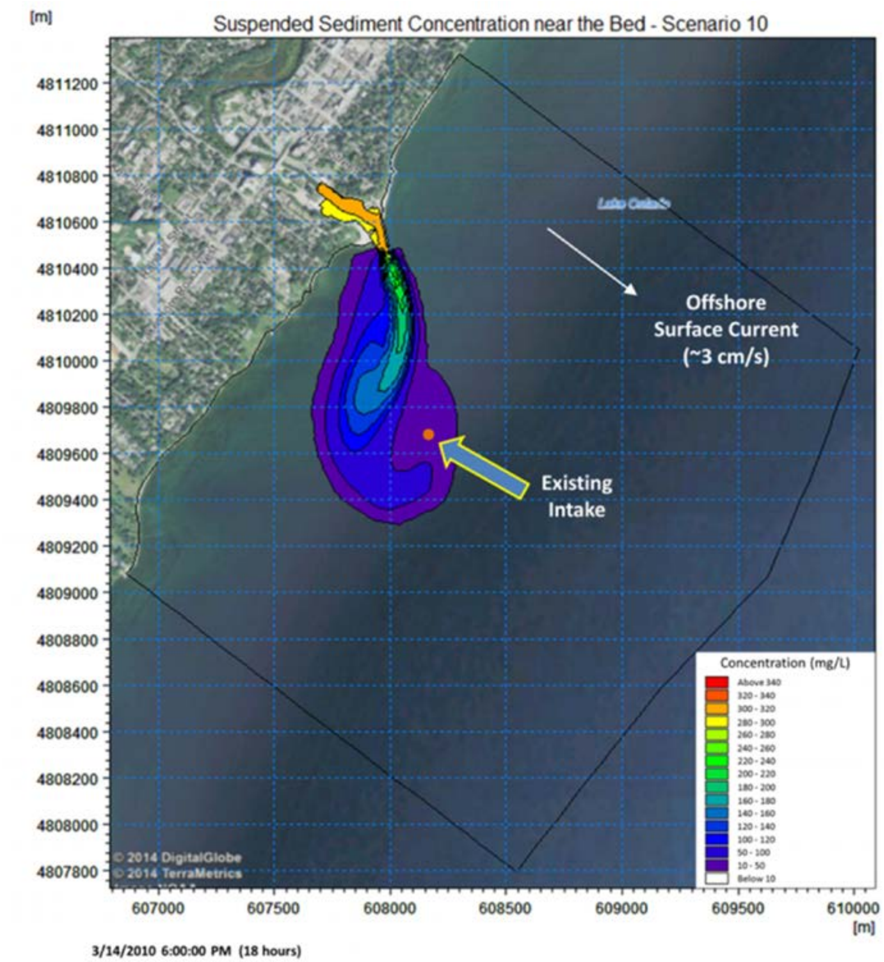


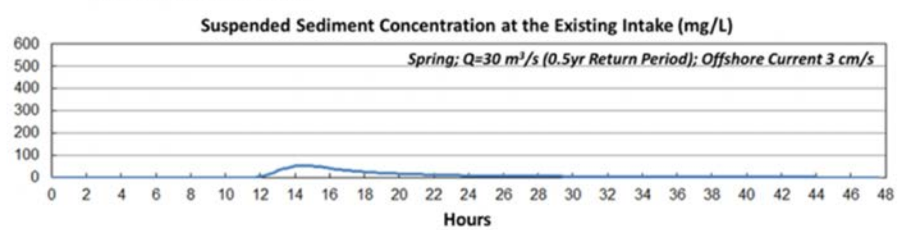


Results of Numerical Modelling

0.5-yr event

Offshore Current





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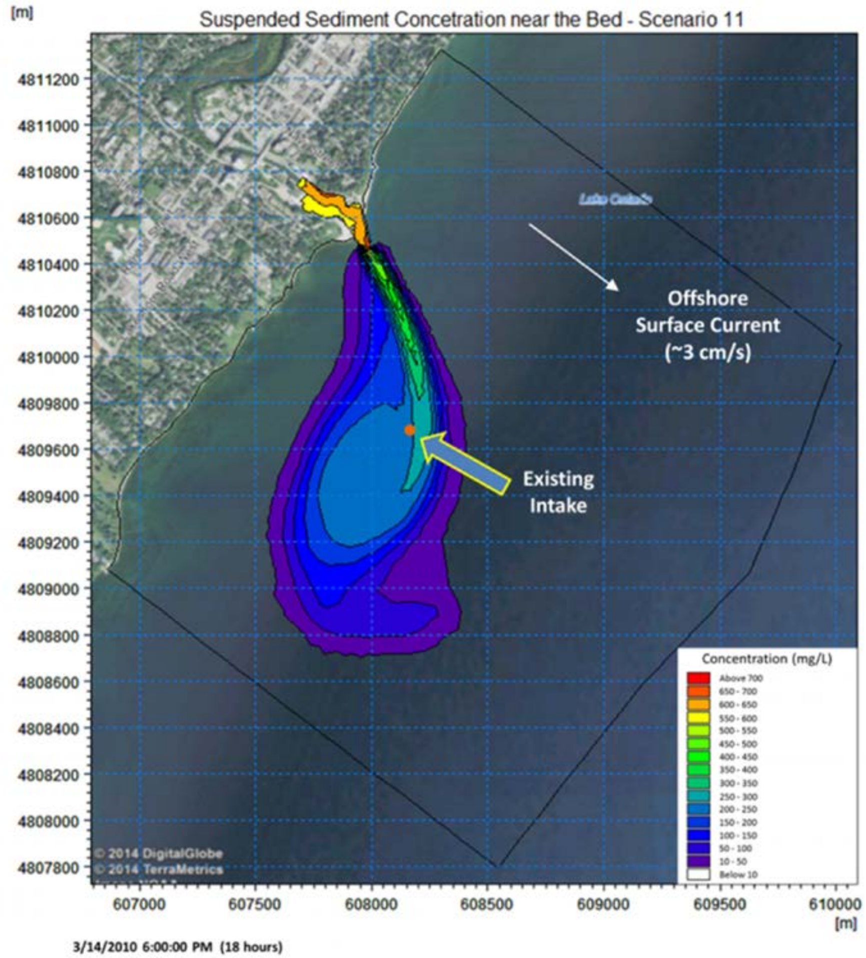
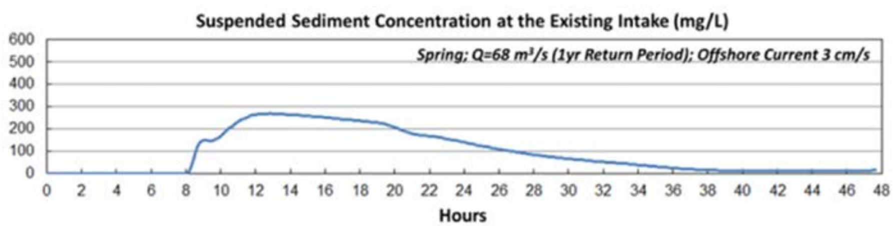
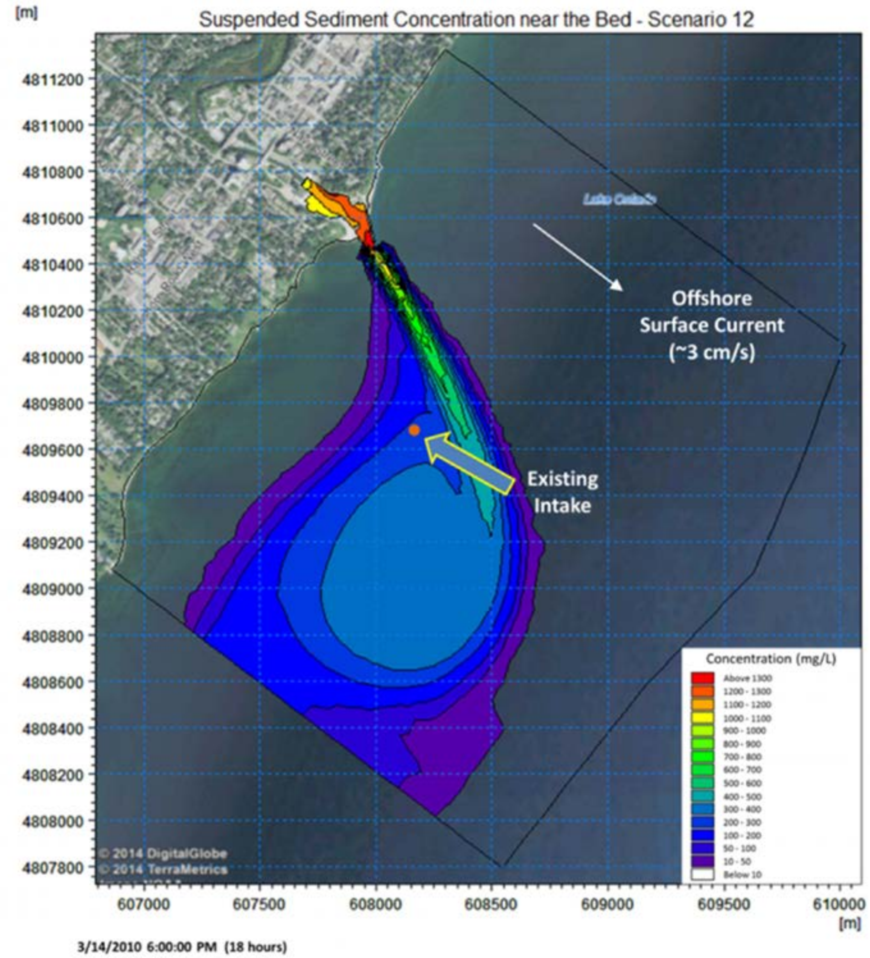
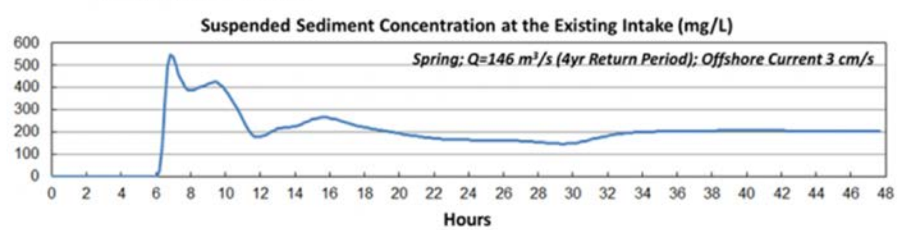




Results of Numerical Modelling





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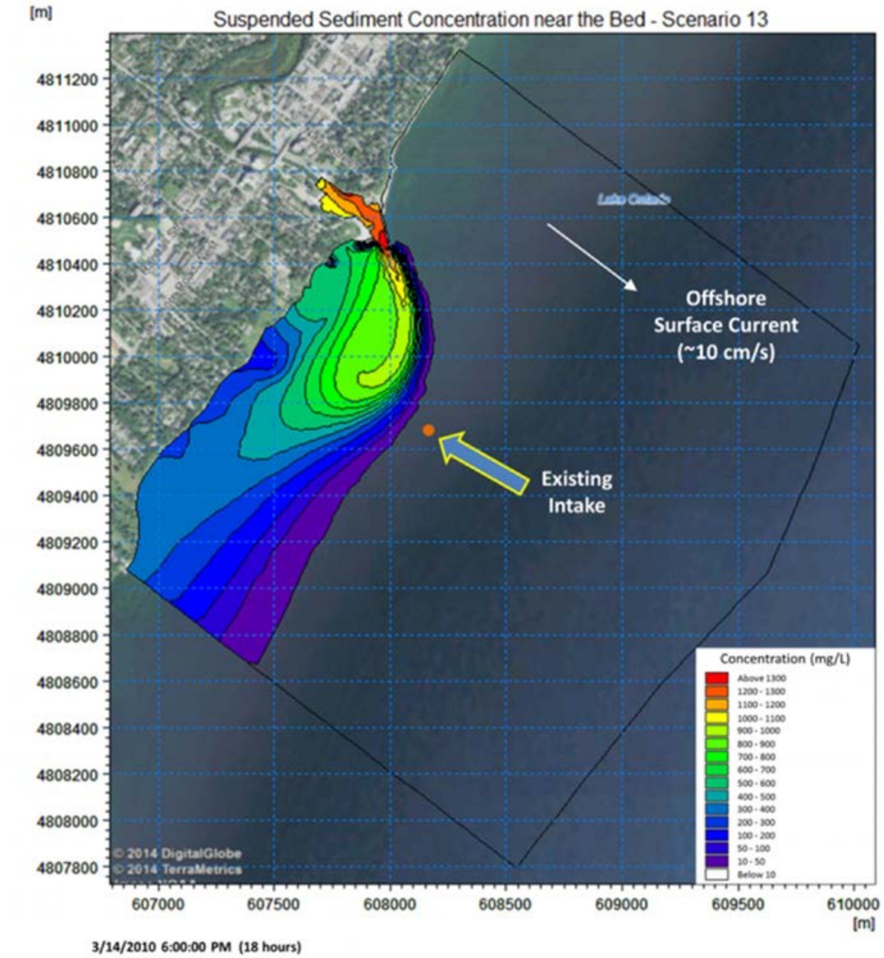

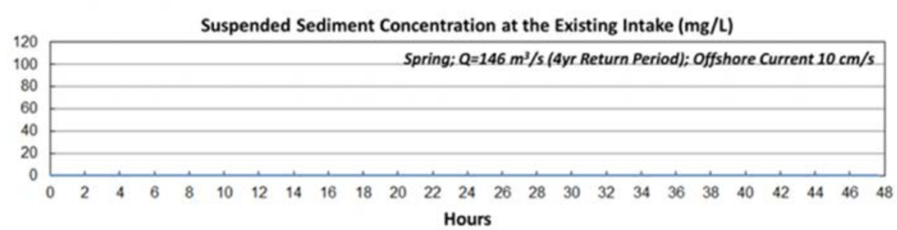

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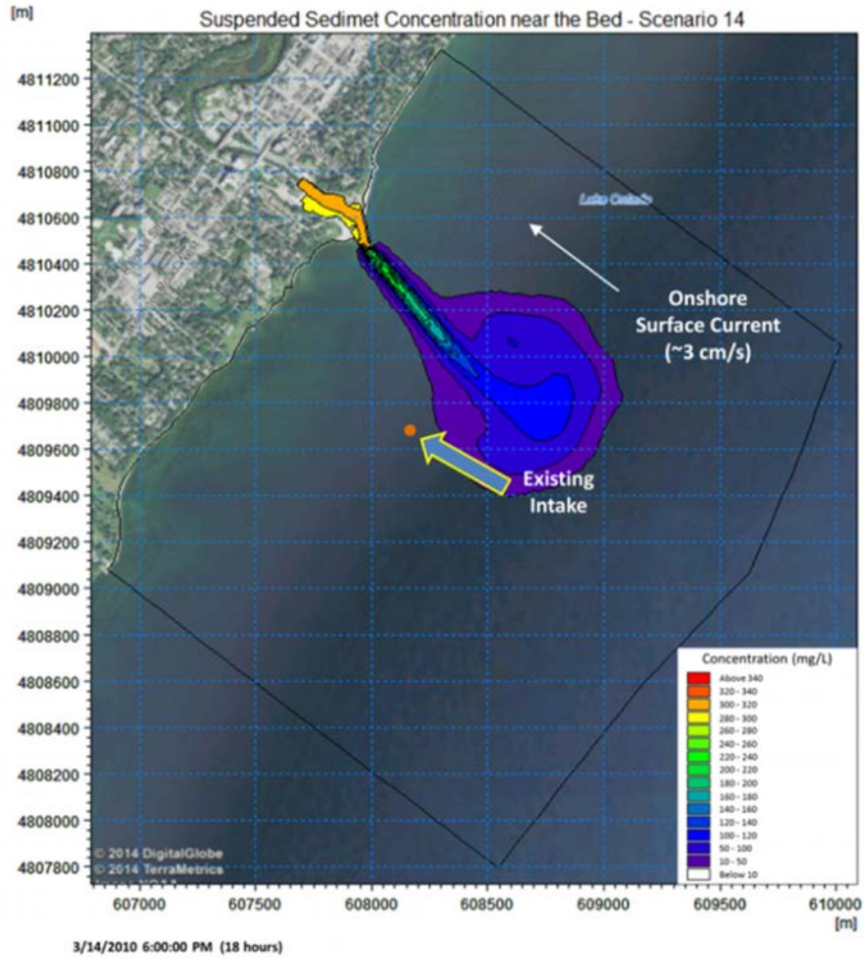
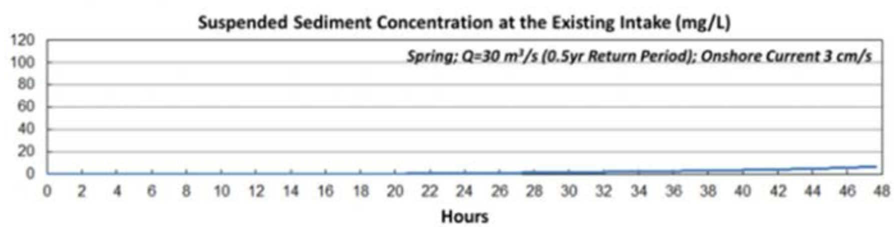
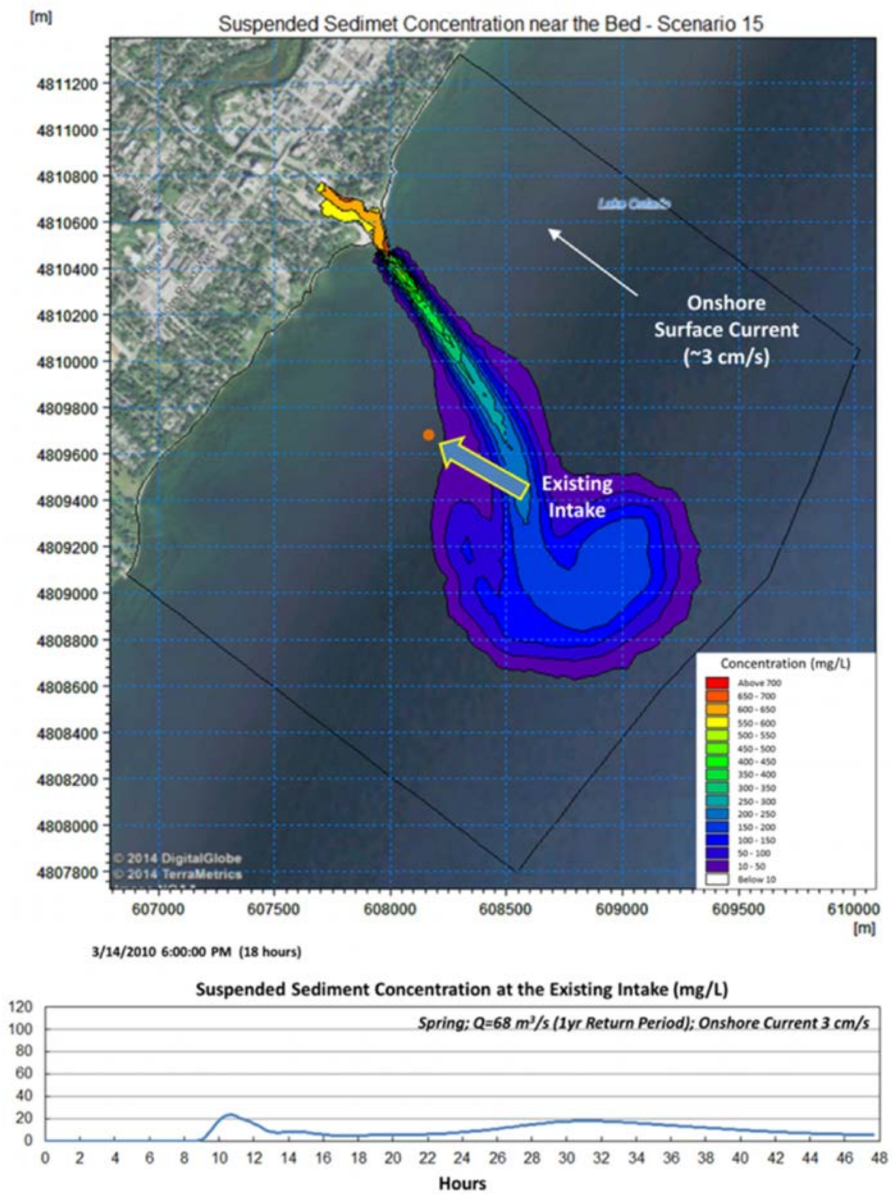




Results of Numerical Modelling

2-yr event

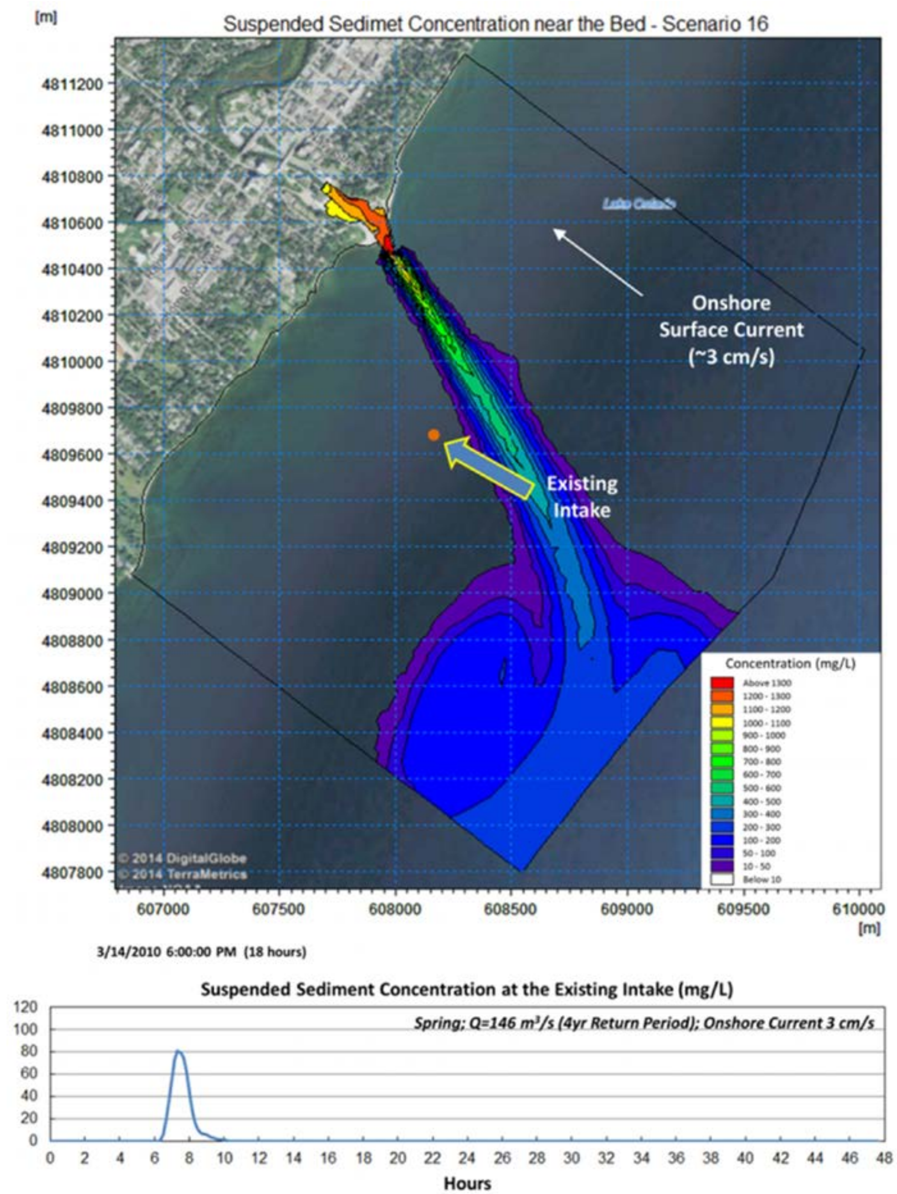
Onshore
Current



Results of Numerical Modelling

4-yr event

Onshore Current



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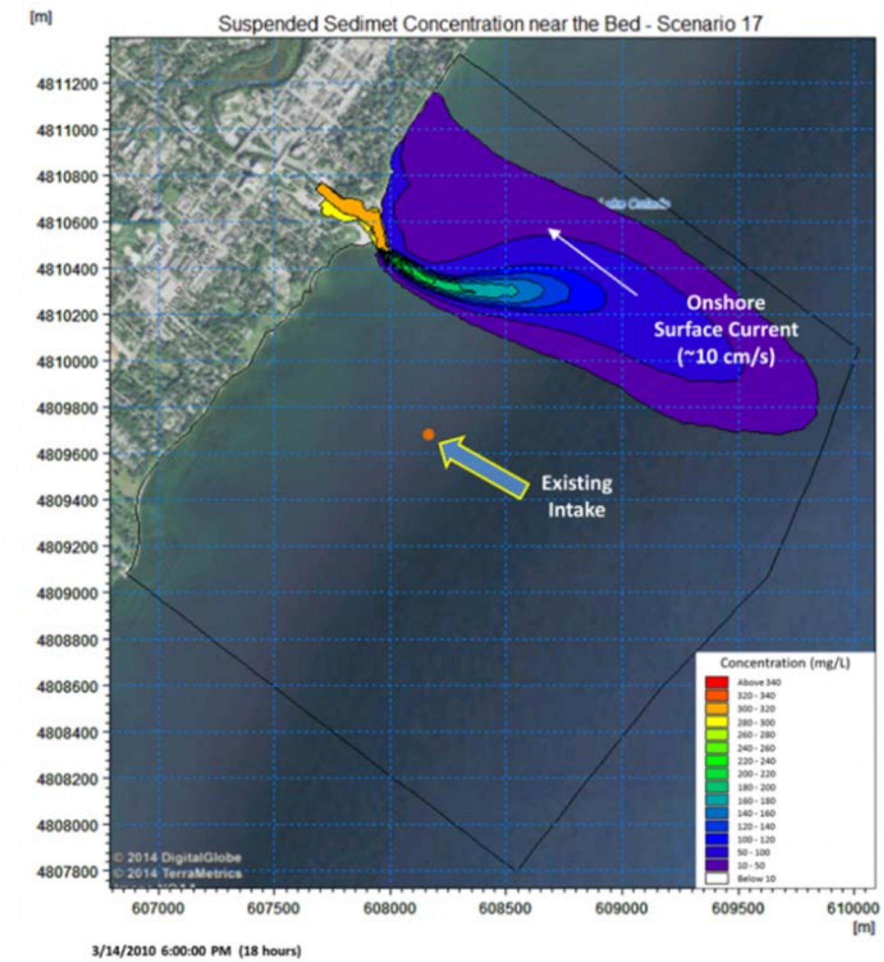

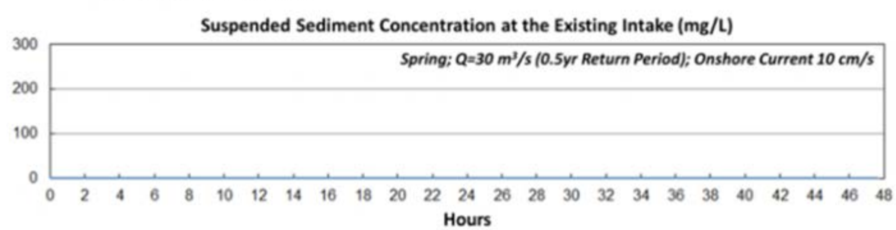

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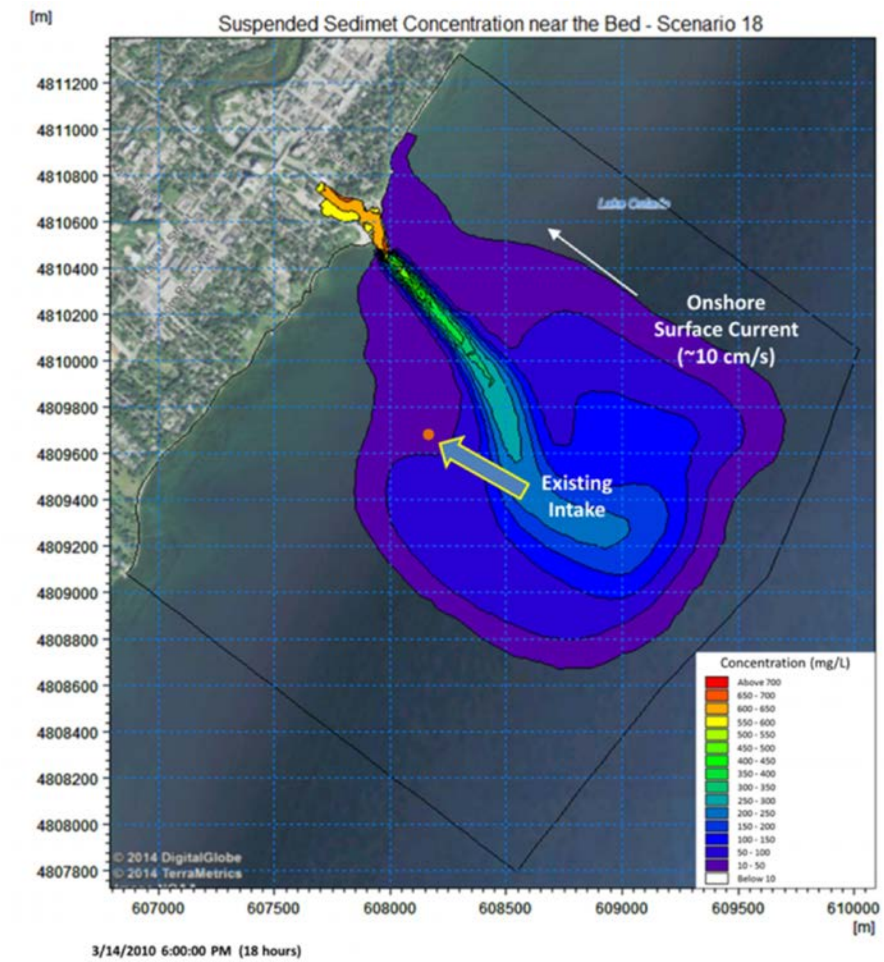

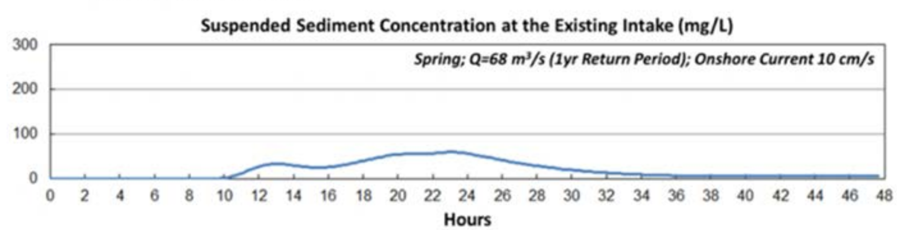

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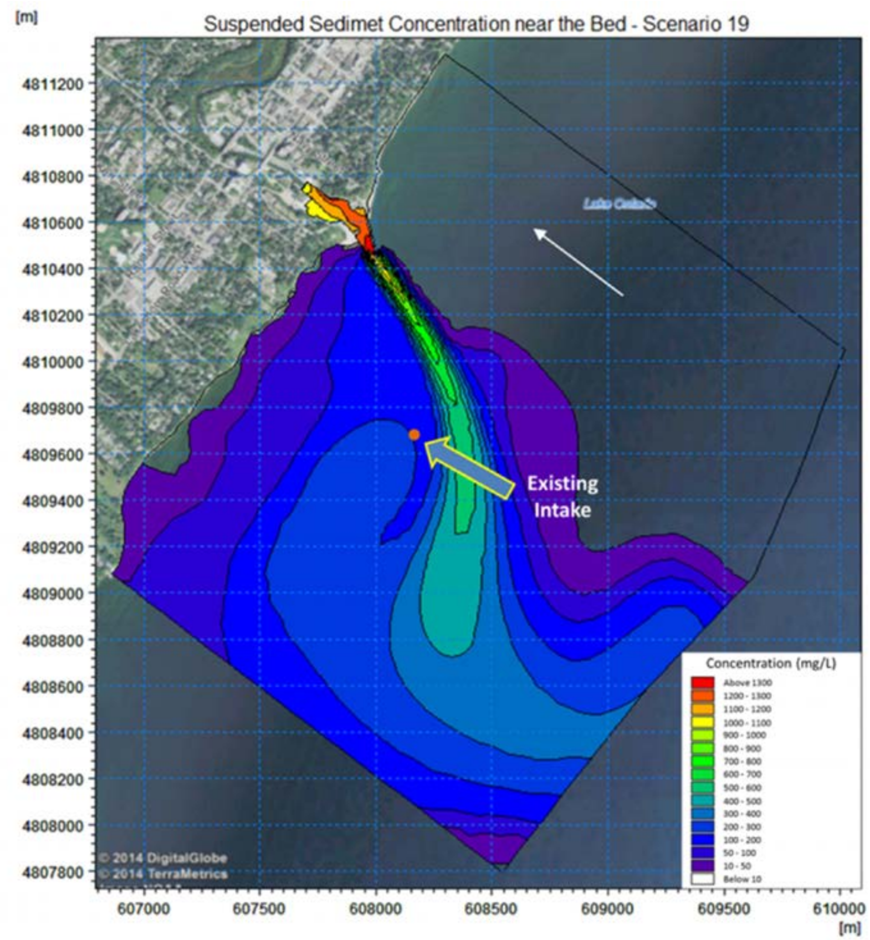

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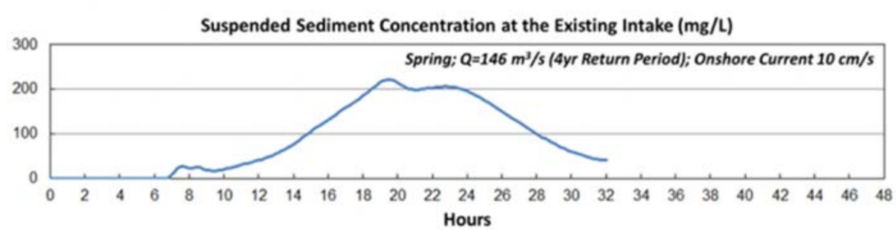

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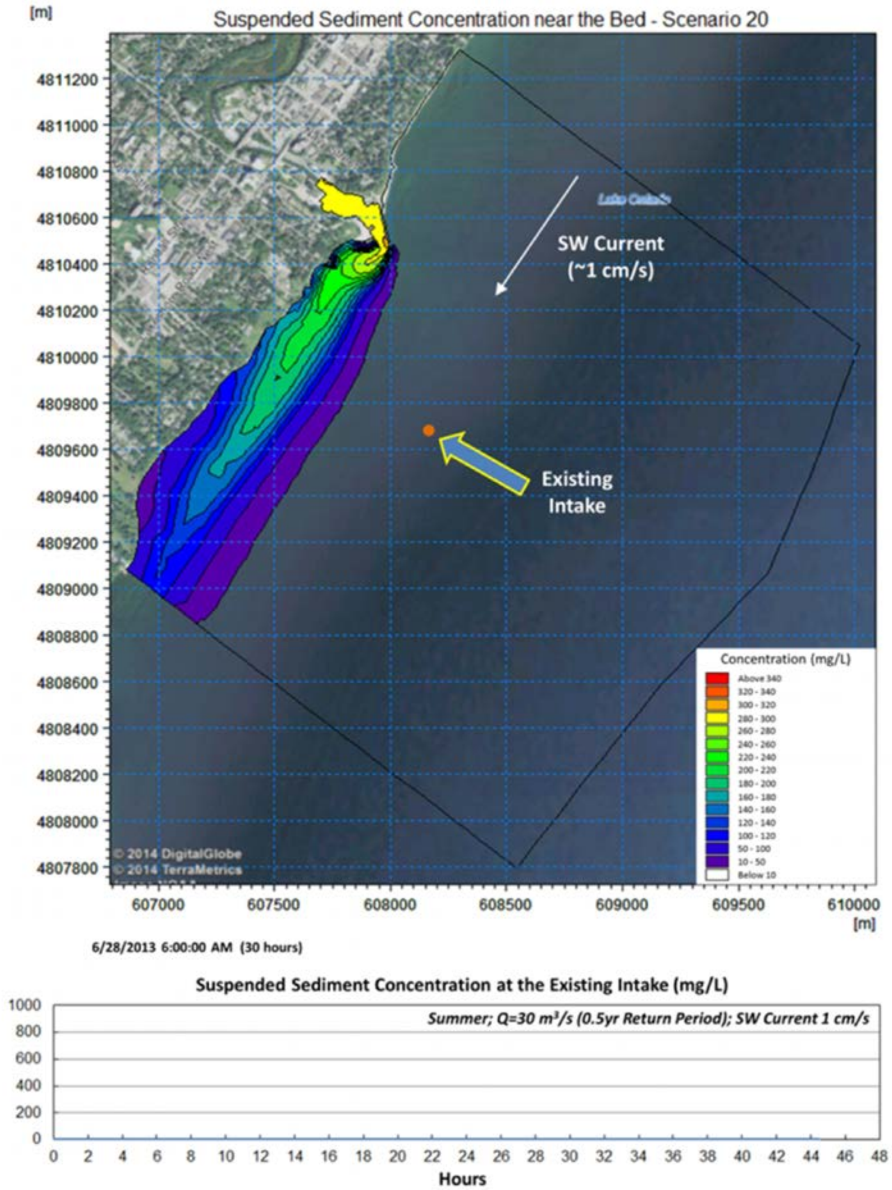

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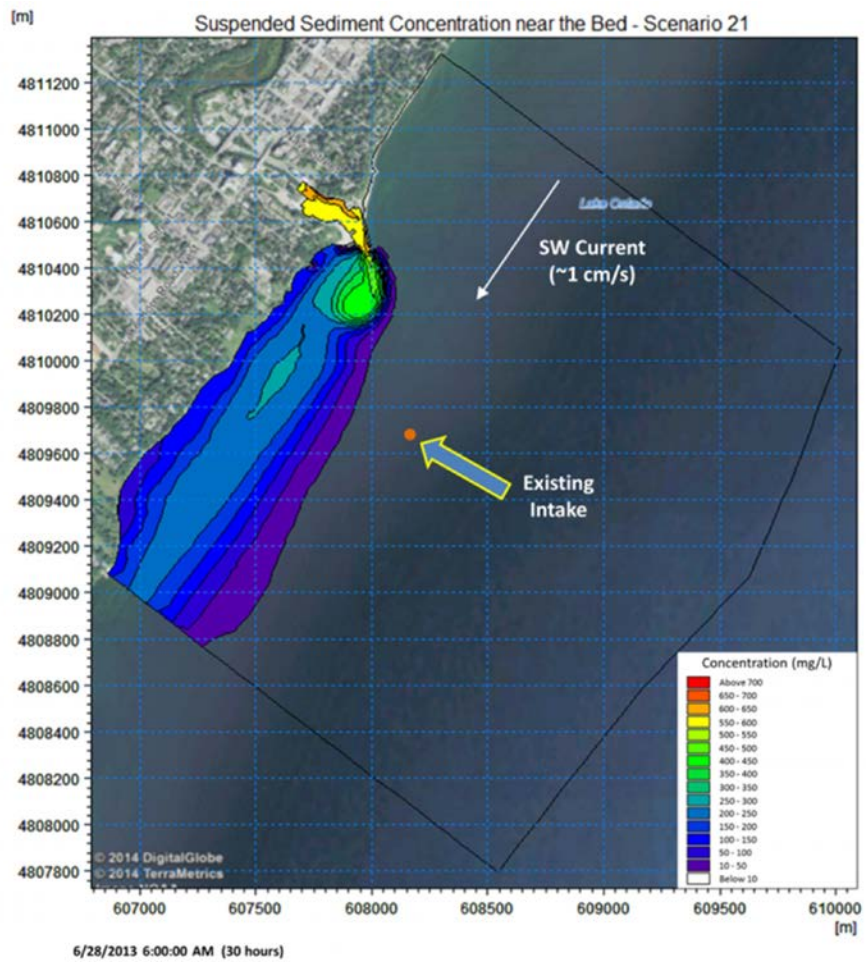

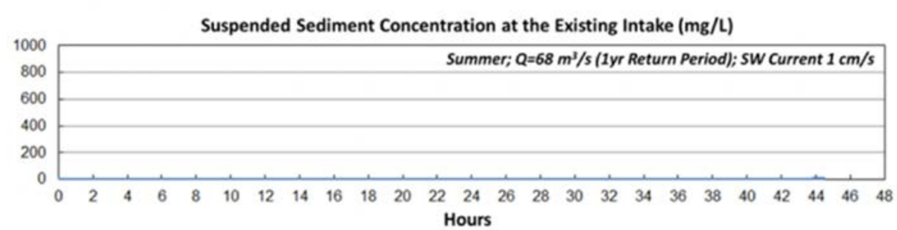

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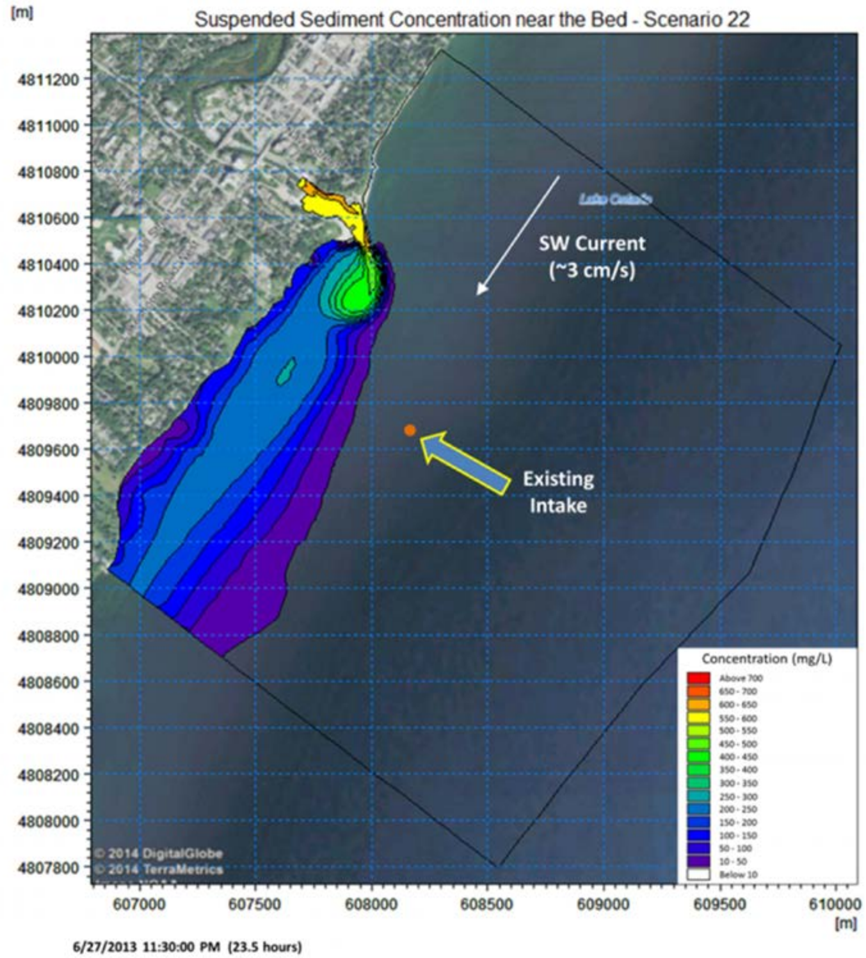

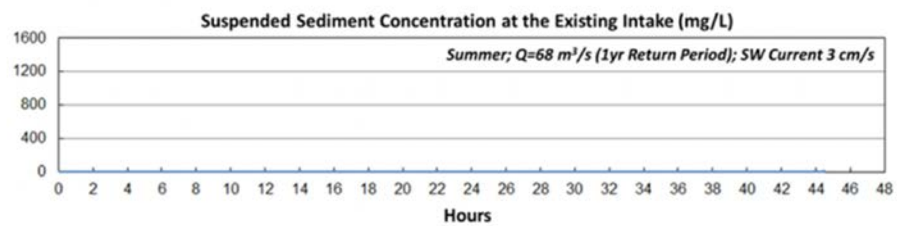

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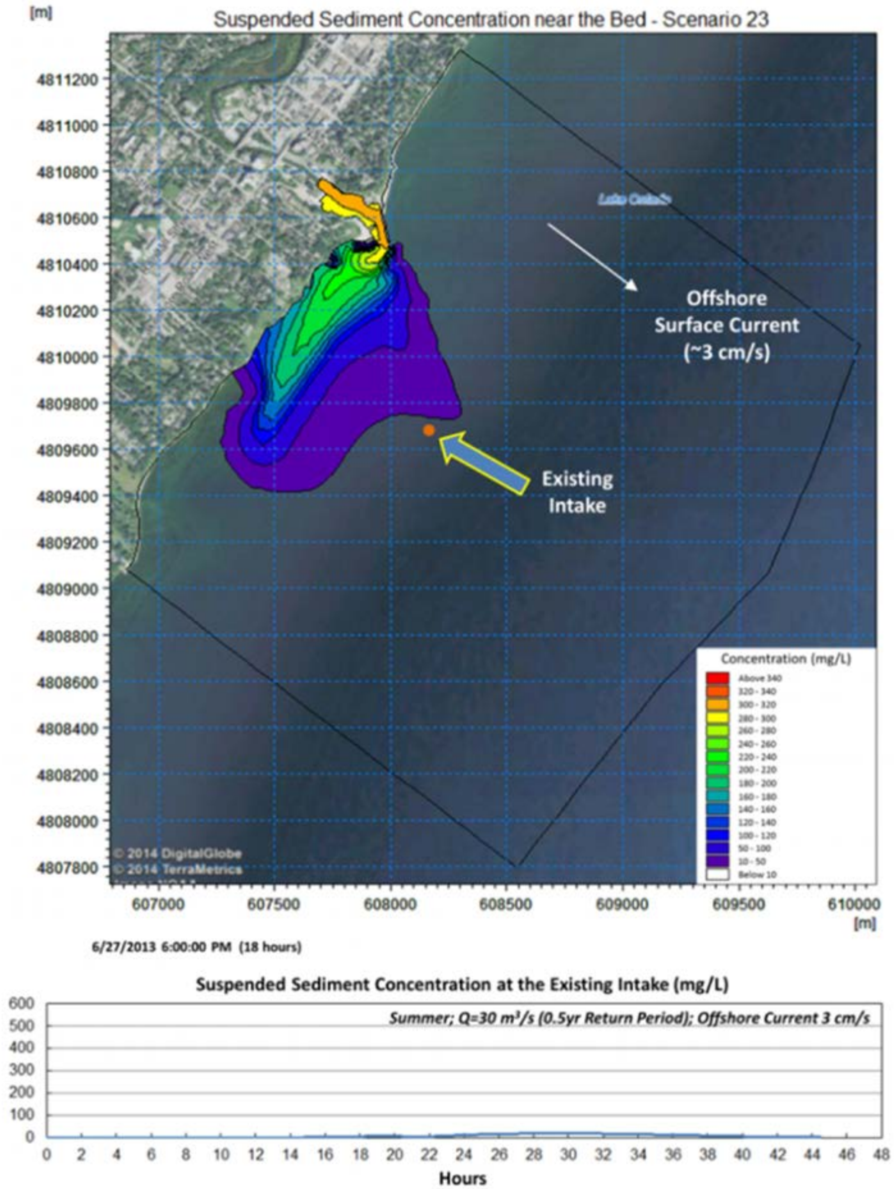

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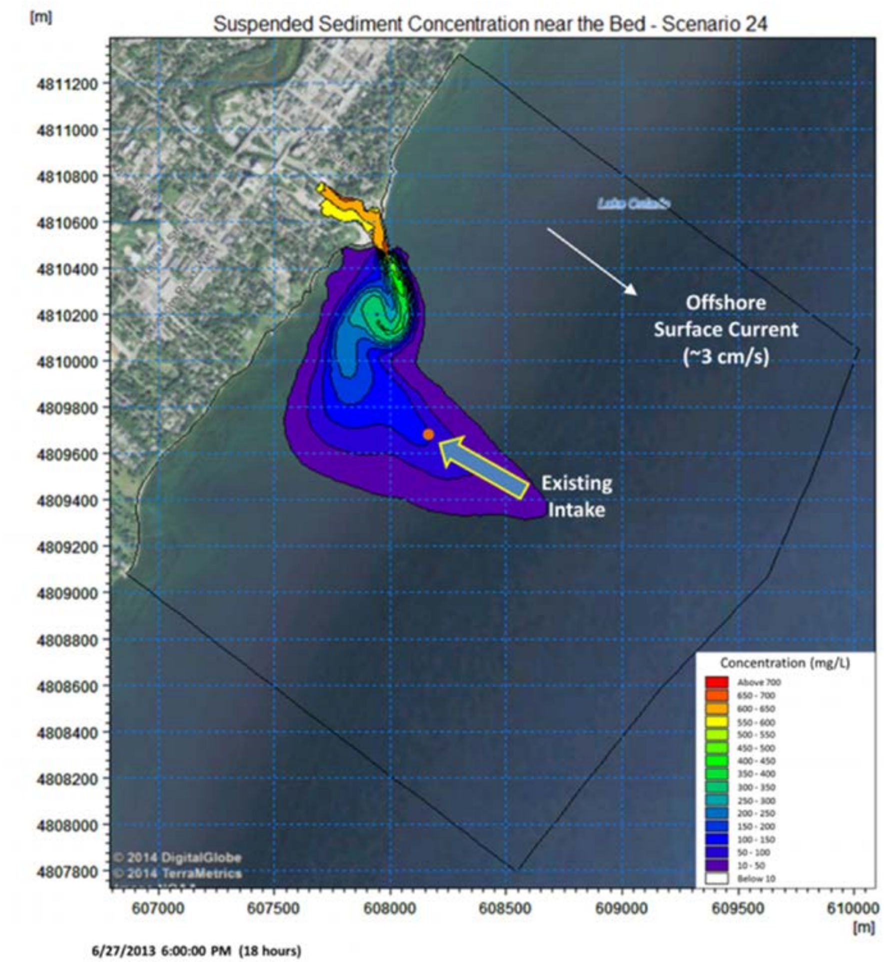

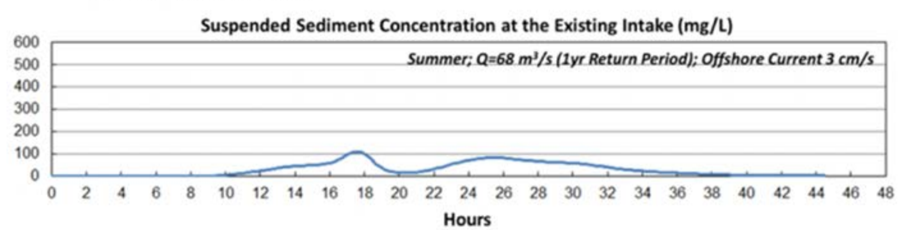

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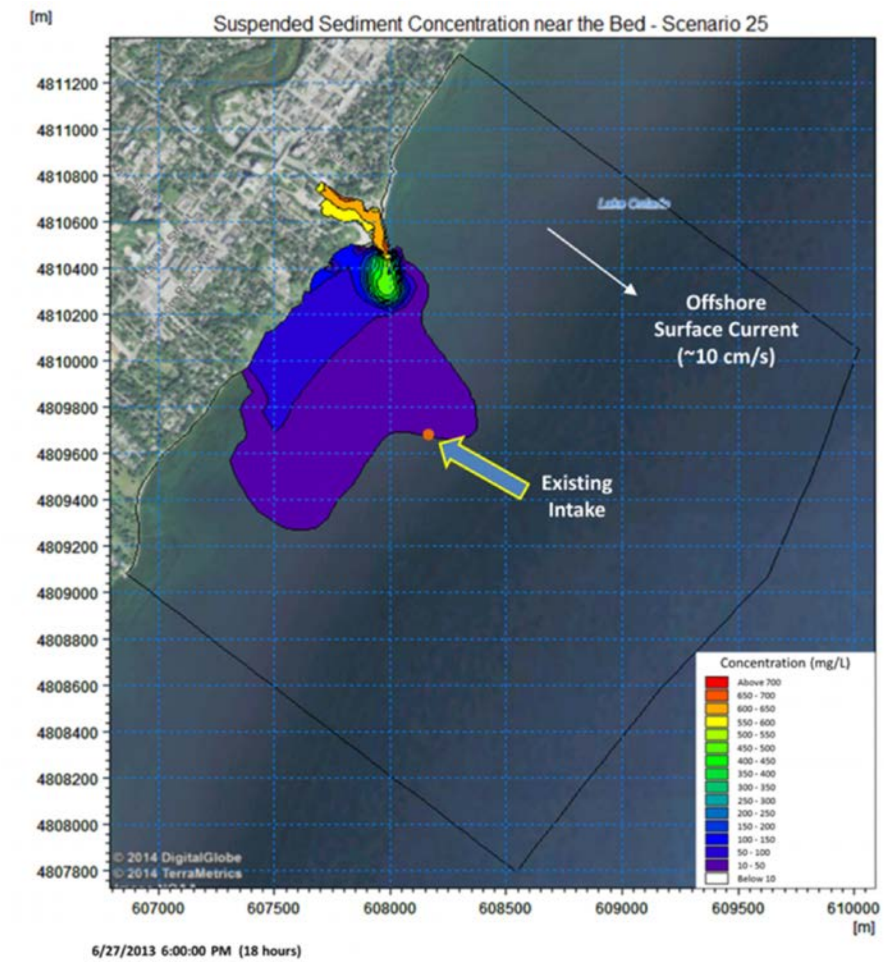

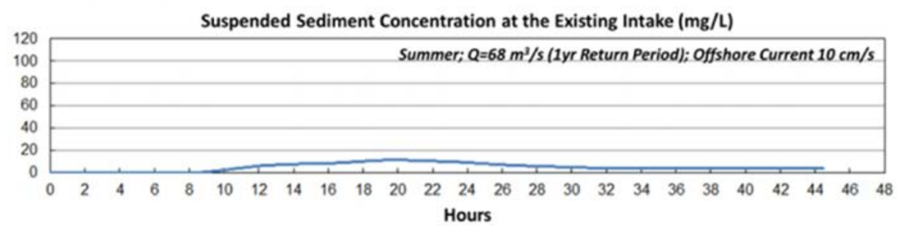

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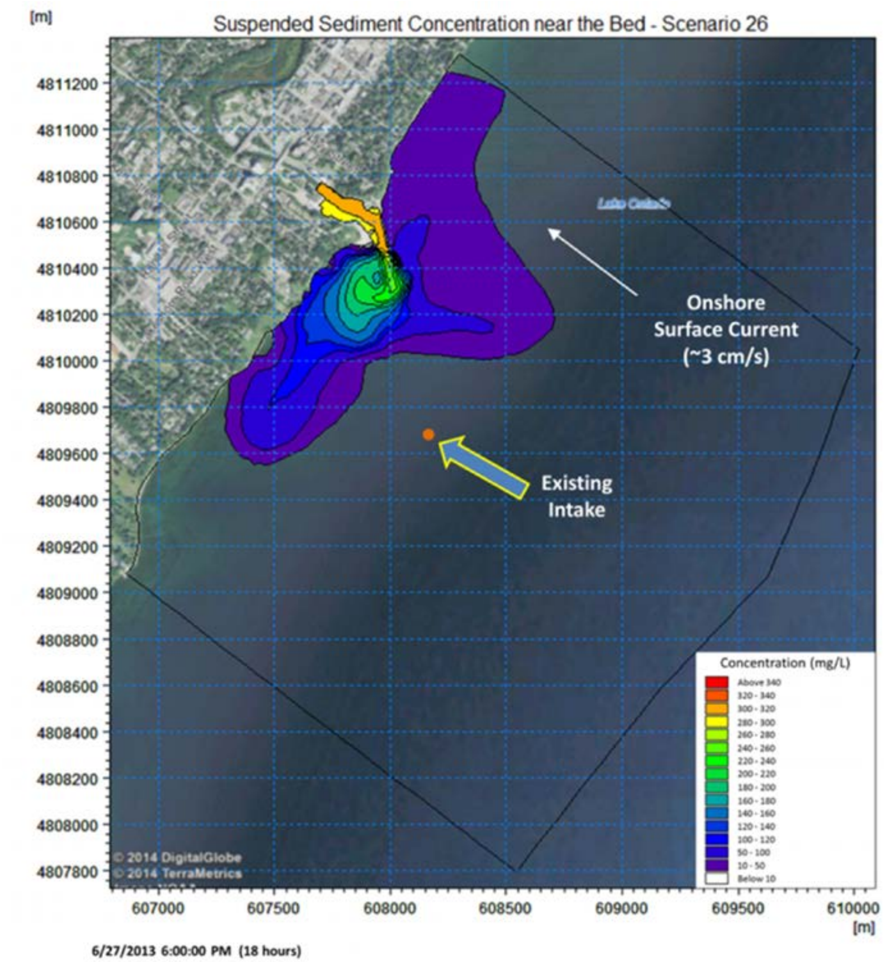

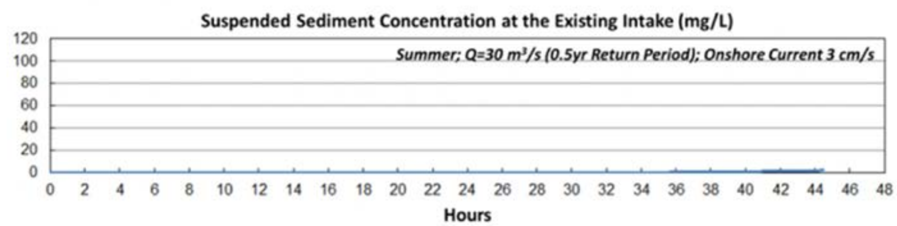

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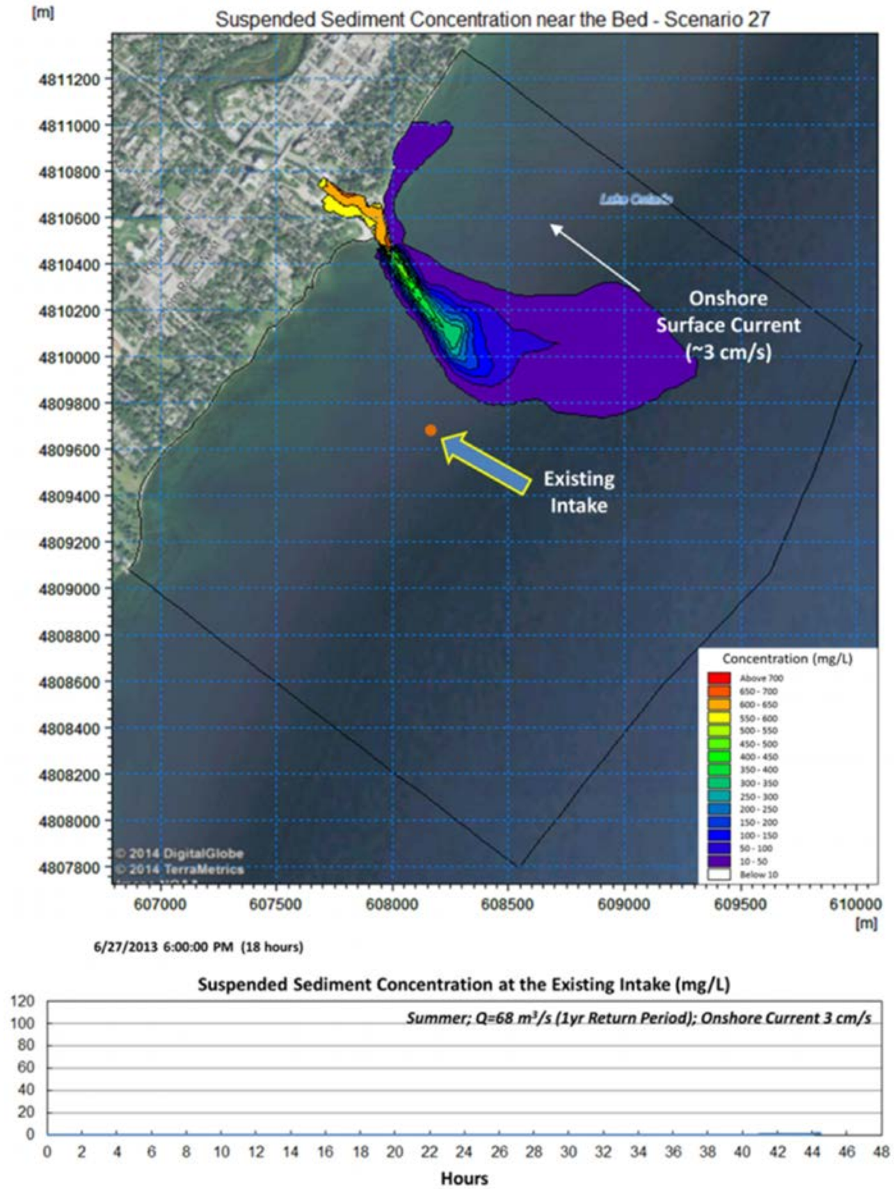

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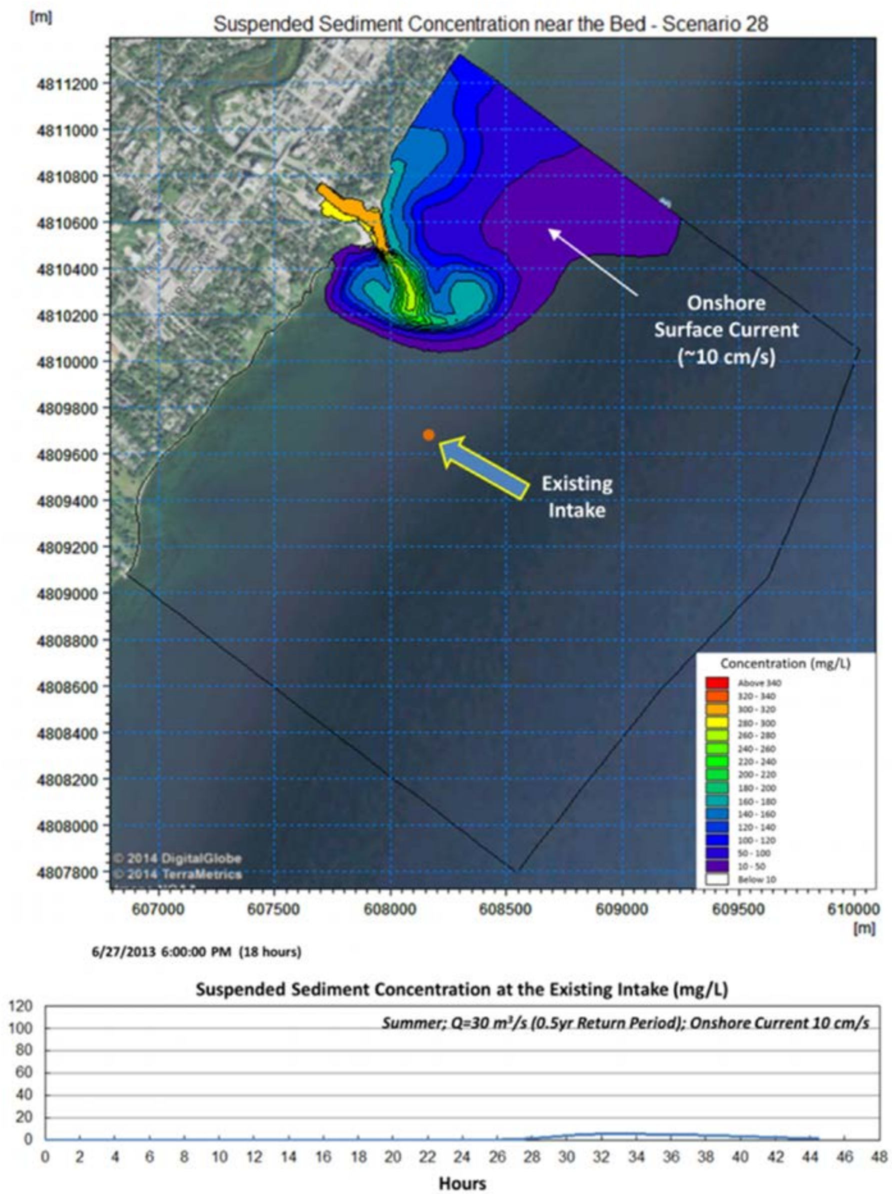

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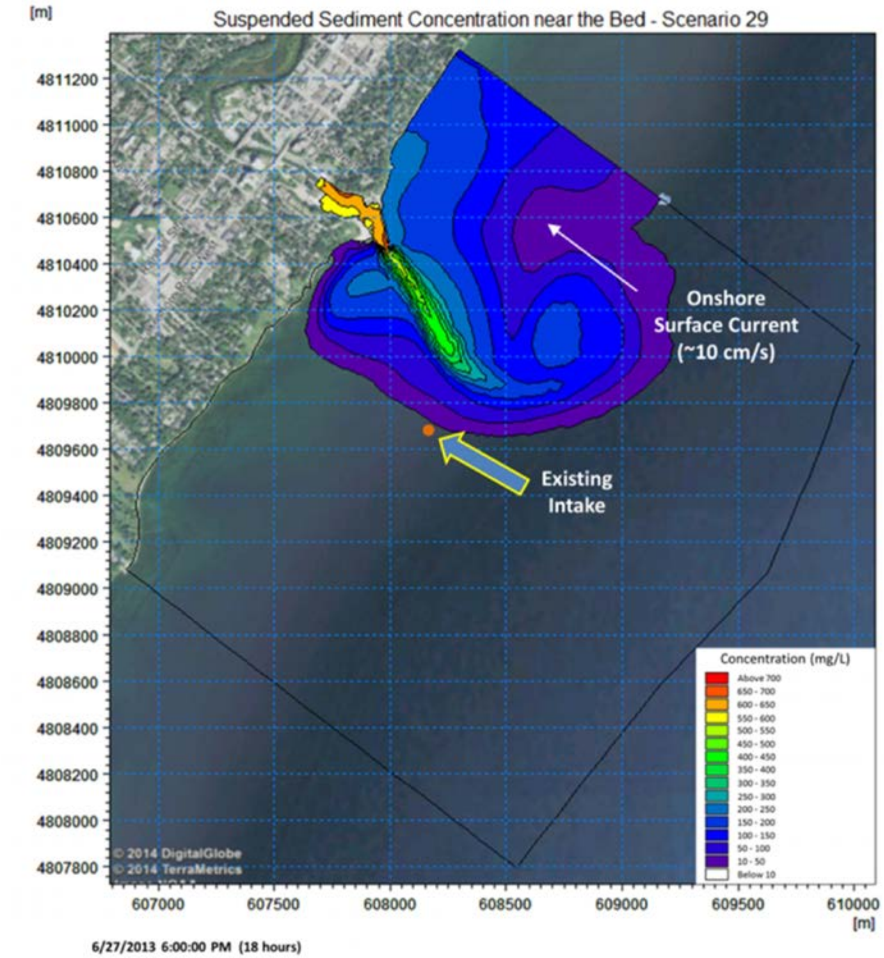

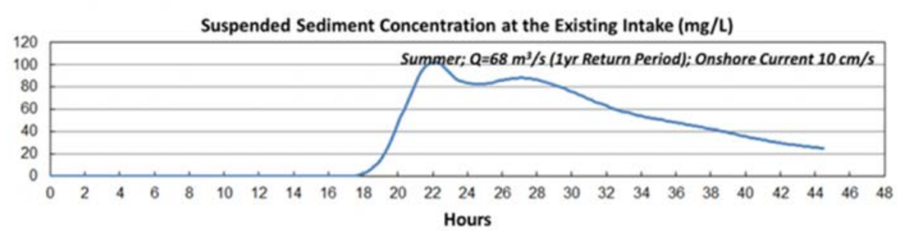

Results

Plume at Bed	Shore parallel currents	Cross shore currents	Creek discharge	Season
Greatest offshore plume extent	weak	Onshore (surface) Offshore (bed)	high	spring
Least offshore plume extent	strong	Offshore (surface) Onshore (bed)	low	summer
Highest TSS at intake	weak SW	Onshore (surface) Offshore (bed)	high	spring

Potential Solutions

- Turbidity will likely improve by relocating the intake further offshore for the more frequent, smaller flows less than the 1-yr return period, however, larger and less frequent flows could still impact an intake located 2 km offshore.
- Rather than relocating the intake, a more cost effective solution could be to obtain prior warning when high turbidity events may occur.
- Creek monitoring could be further augmented by real time measurement of currents and turbidity offshore of Oakville Harbour.


Thank you

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