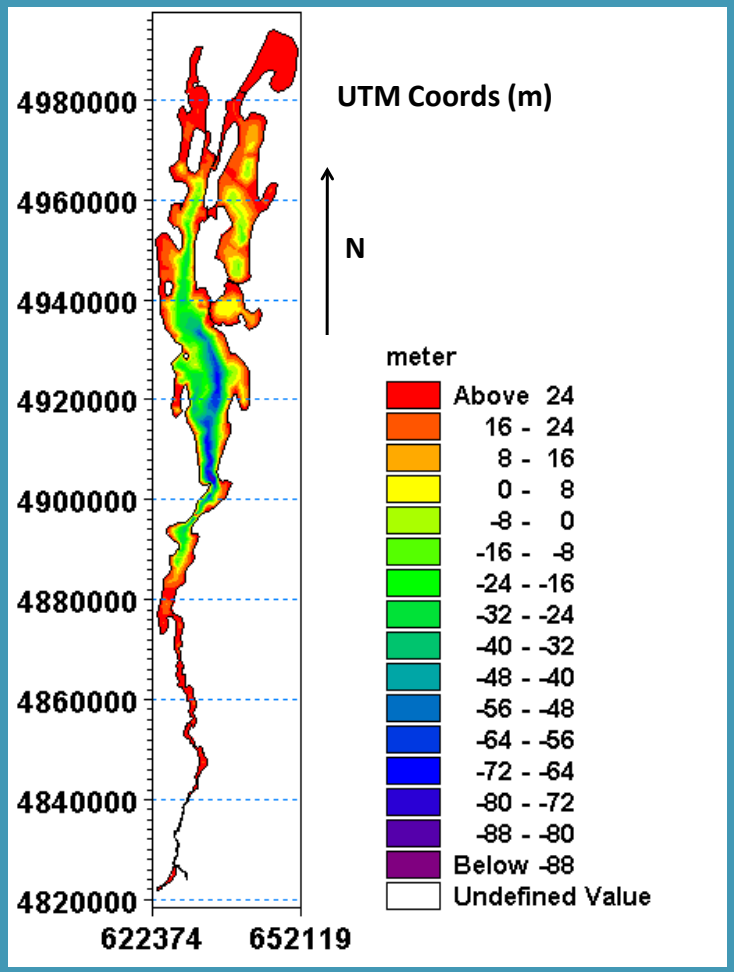
New England Clean Power Link Preliminary Water Quality Modeling

Lake Symposium

October 9, 2014



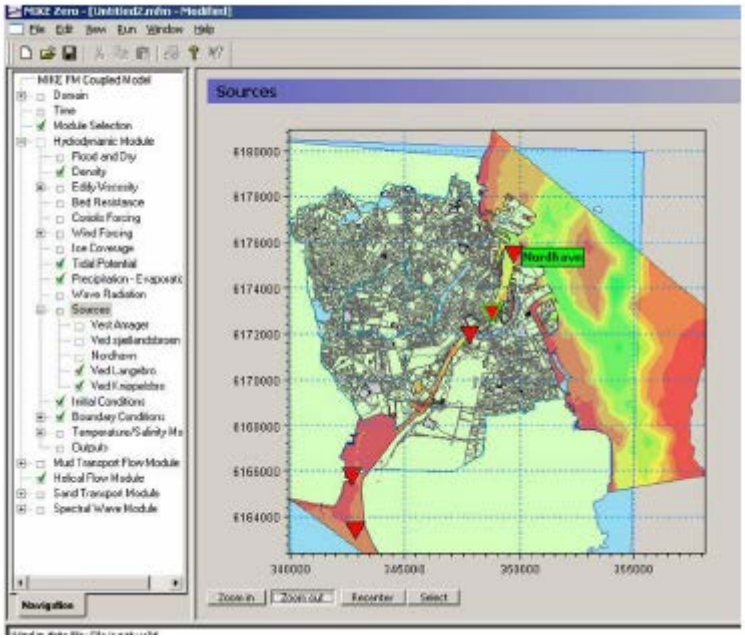
- **Mike3 Model**
- **Model Inputs**
- **Results**
- **Summary**
- **Questions**

PRELIMINARY MODELING – SUBJECT TO CHANGE

Mike3 Model

Danish Hydraulics Institute (DHI)

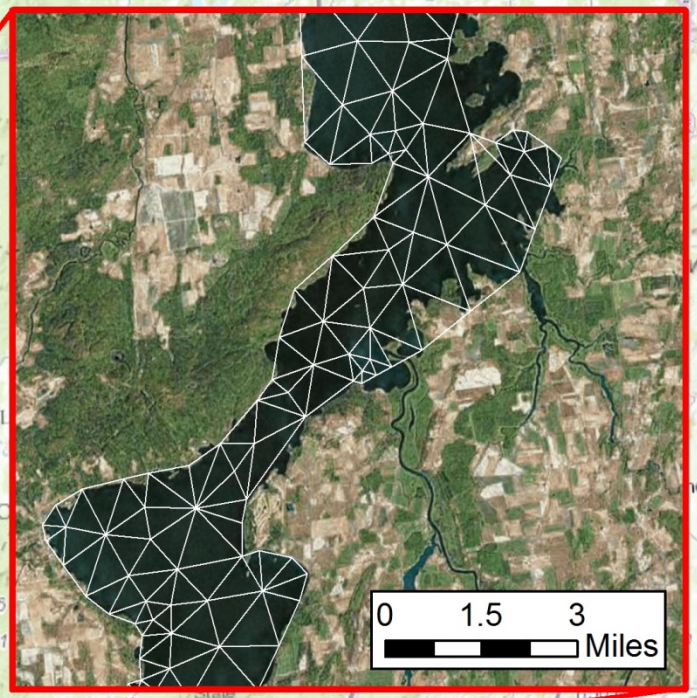
- Widely Used
- Well Tested



Features:

- Three-dimensional
- Time-variable
- Flexible Mesh
- HD – Hydrodynamic Module
- MT – Mud Transport Module

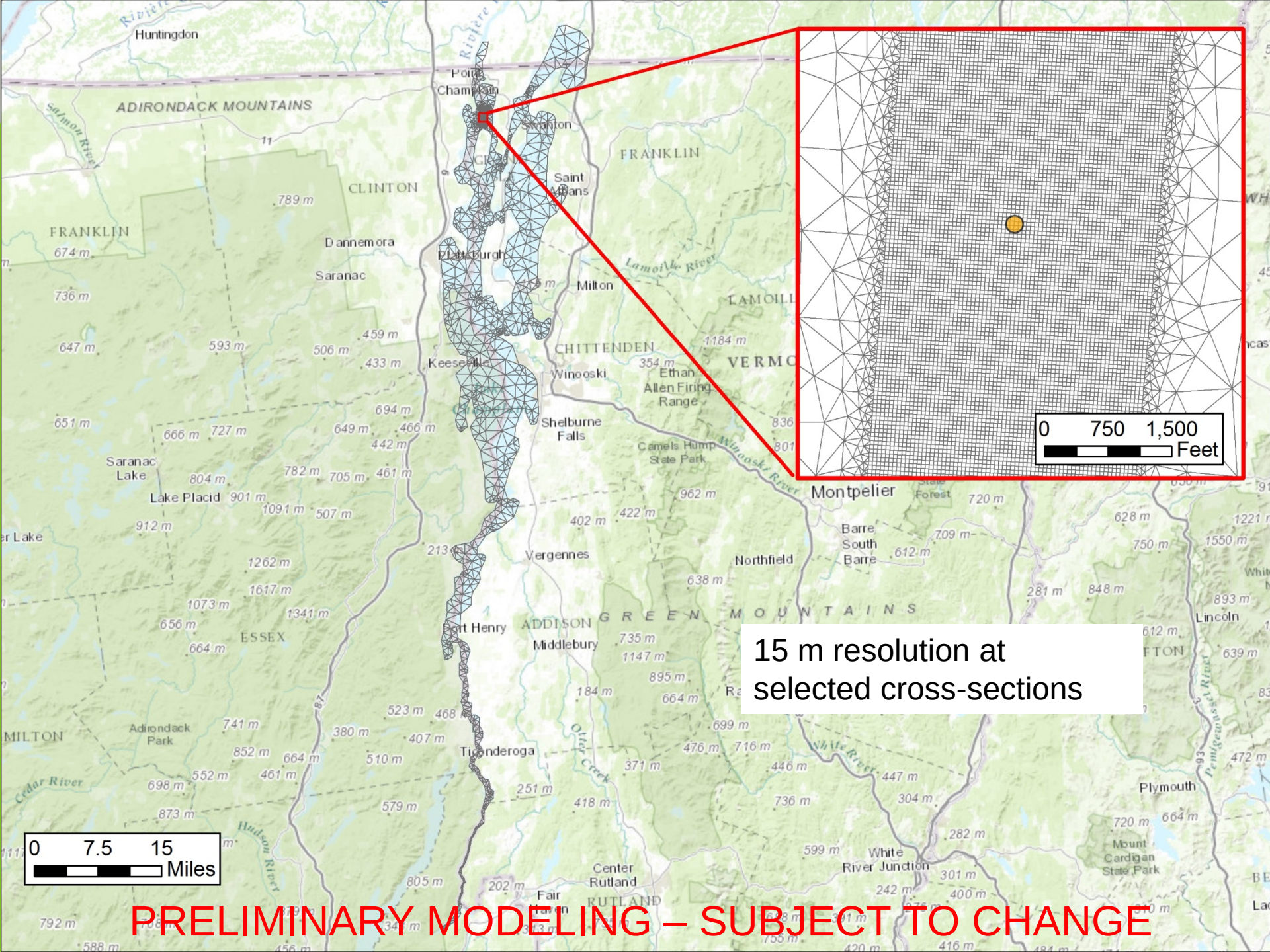
PRELIMINARY MODELING – SUBJECT TO CHANGE



North grid: 2,425 cells
South grid: 3,300 cells
20 sigma layers

0 7.5 15
Miles

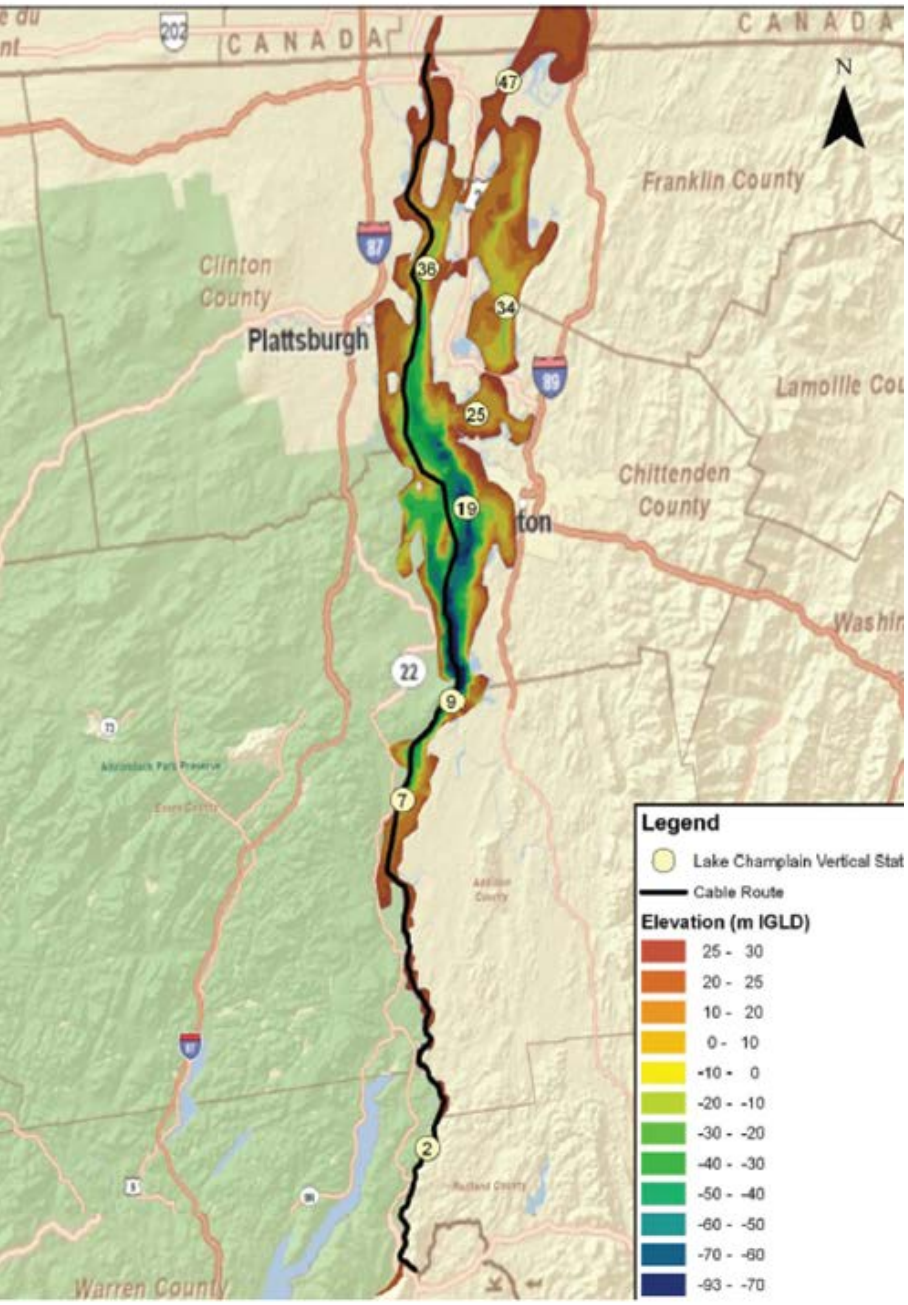
PRELIMINARY MODELING – SUBJECT TO CHANGE

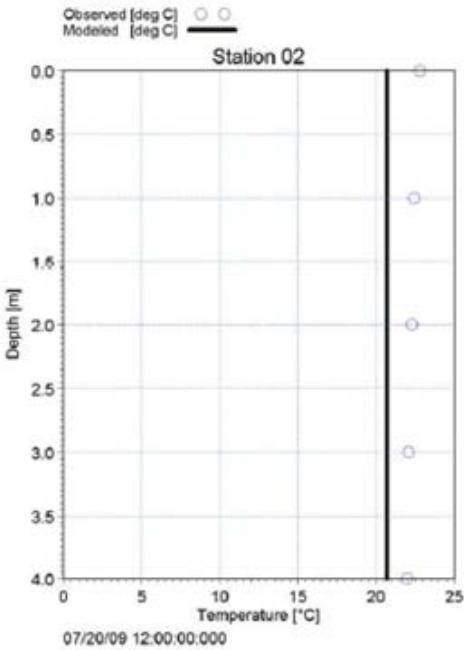

Huntingdon
ADIRONDACK MOUNTAINS
Salmon River
CLINTON
FRANKLIN
Dannemora
Saranac
Plattsburgh
Saint Albans
Swanton
Milton
Lamoille River
CHITTENDEN
Keeseville
Winooski
Ethan Allen Firing Range
Shelburne Falls
Camels Hump State Park
Winooski River
Montpelier
Barre
South Barre
Northfield
Vergennes
Saranac Lake
Lake Placid
ESSEX
Fort Henry
ADDISON
Middlebury
GREEN MOUNTAINS
Lincoln
Adirondack Park
MILTON
Ticonderoga
Otter Creek
White River
Plymouth
Mount Cardigan State Park
White River Junction
Center Rutland
Fair Haven
RUTLAND
Cedar River
Hudson River
Pemigewasset River
0 750 1,500 Feet
0 7.5 15 Miles
15 m resolution at selected cross-sections
PRELIMINARY MODELING – SUBJECT TO CHANGE

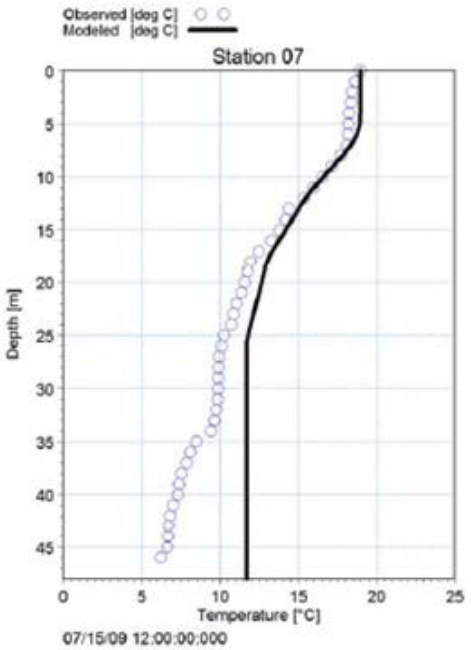
Hydrodynamic Model Input

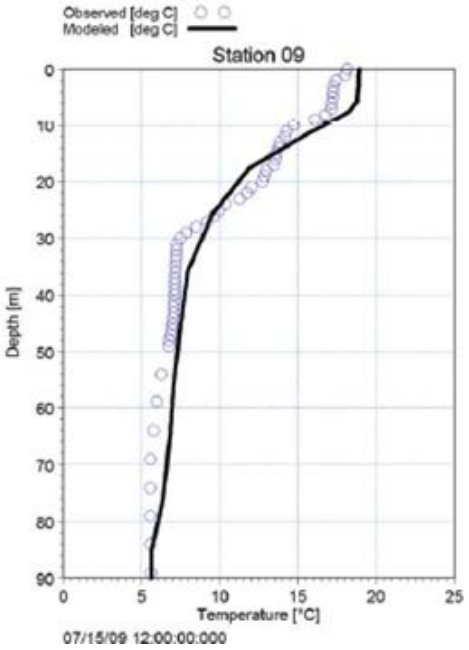
- Bathymetry - Vermont Center for Geographic Information
- Flows – 30 Rivers - USGS, Environment Canada, Quebec Ministry of Sustainable Development Environment and Parks
- Meteorology – Northeast Regional Climate Center

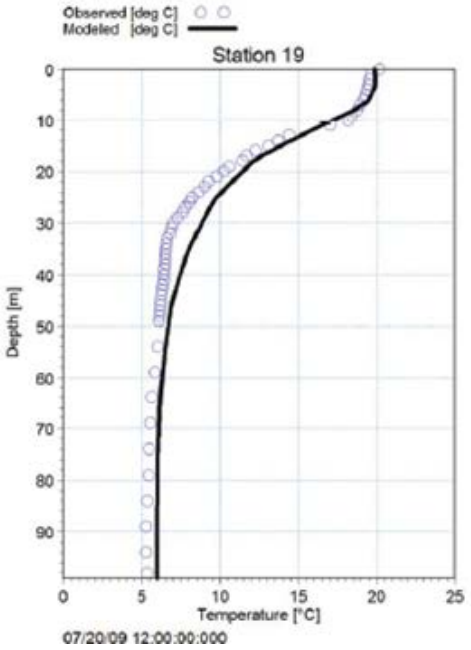
PRELIMINARY MODELING – SUBJECT TO CHANGE







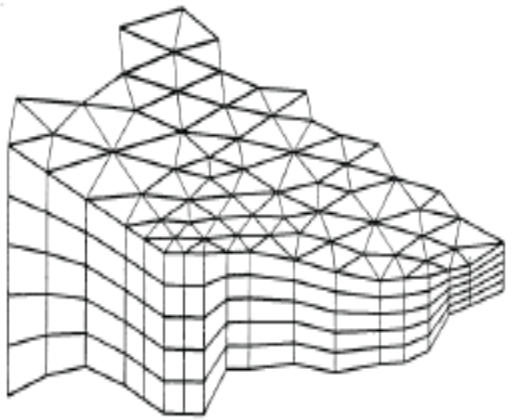




PRELIMINARY MODELING – SUBJECT TO CHANGE

Water Quality Model Input

- Loading rates
  - Total Suspended Solids (TSS)
  - Heavy Metals
  - Phosphorus
- Settling rate
  - Medium silt
  - Stokes Law
- Loading added to bottom layer



Principle of 3D mesh

PRELIMINARY MODELING – SUBJECT TO CHANGE

Loading Information

- Sediment (Marine Research Corp., 2014; HDR, 2010)
- Metals (HDR, 2010)
  - 46 sites
  - As, Cd, Cu, Pb, Ni, Zn, Ag, and Hg
- Phosphorus (Cornwell and Owens, 1999)
  - 19 sites
- Partition coefficients (EPA/600/R-05/074)
  - Median values

PRELIMINARY MODELING – SUBJECT TO CHANGE

Sediment Characteristics

Marine Research Corp., 2014

Sediment type	Saturated Bulk Density (g/cm^3)	Porosity (%)
Lake Champlain sediments	1.2-1.4	87-92
Champlain Sea sediments	1.49-1.69	60-70
Lake Vermont sediments	1.7 -2.2	40-60

The majority of sediment was found to be Lake Champlain sediments

PRELIMINARY MODELING – SUBJECT TO CHANGE

Loading Calculation

$$Q = A \times V \times R$$

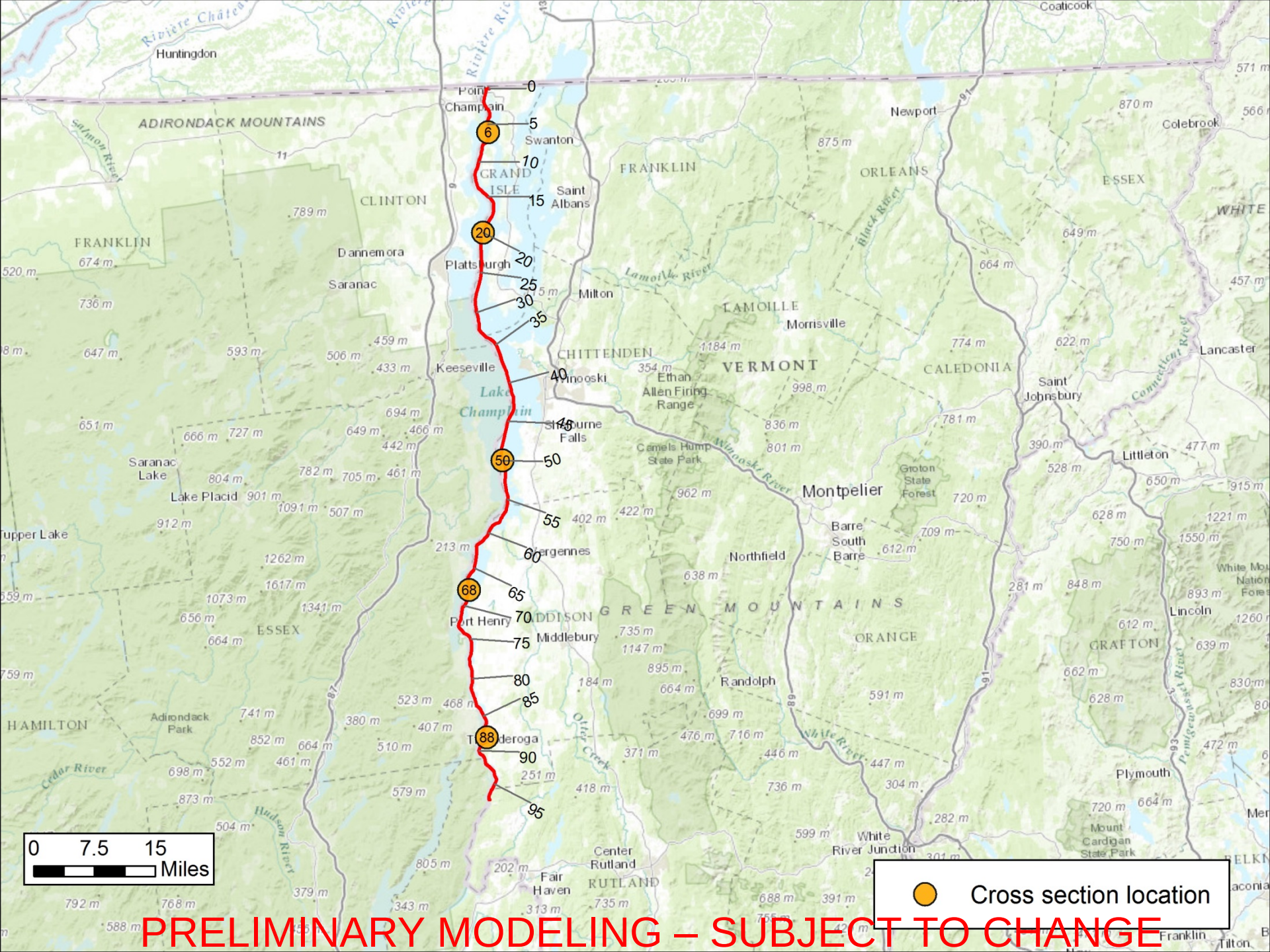
Q – Flow
A – Cross Sectional Area
V – Plow Velocity
R – Release Fraction

- North Lake (MP 0-73)
  - Jet Plow
  - A = 1.1 m^2
  - V = 1.5 mi/d (0.028 m/s)
  - R = 0.30
- South Lake (MP 73-97)
  - Shear Plow
  - A = 0.25 m^2
  - V = 1.5 mi/d (0.028 m/s)
  - R = 0.02

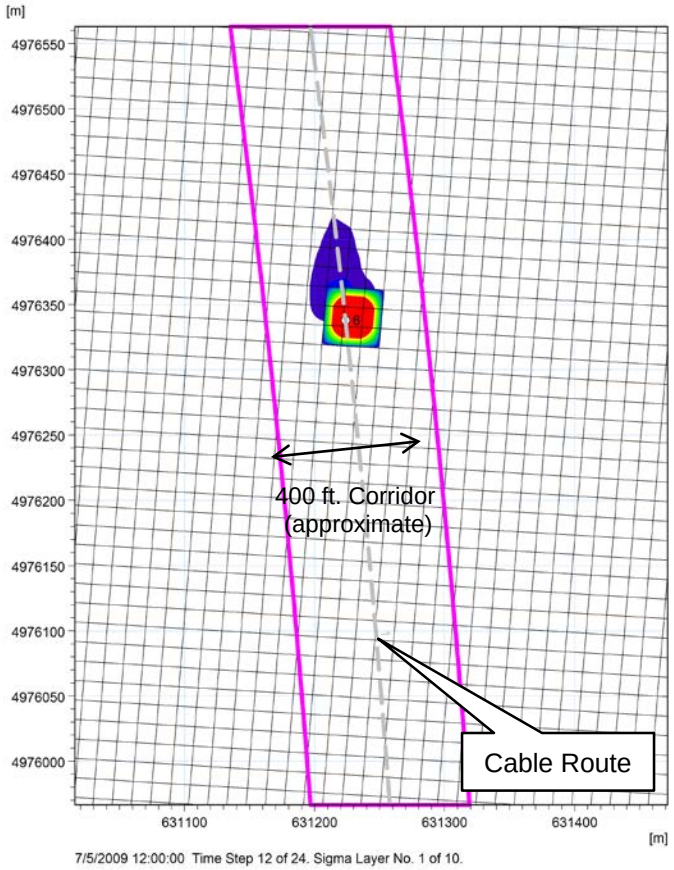
$$W = Q \times C$$

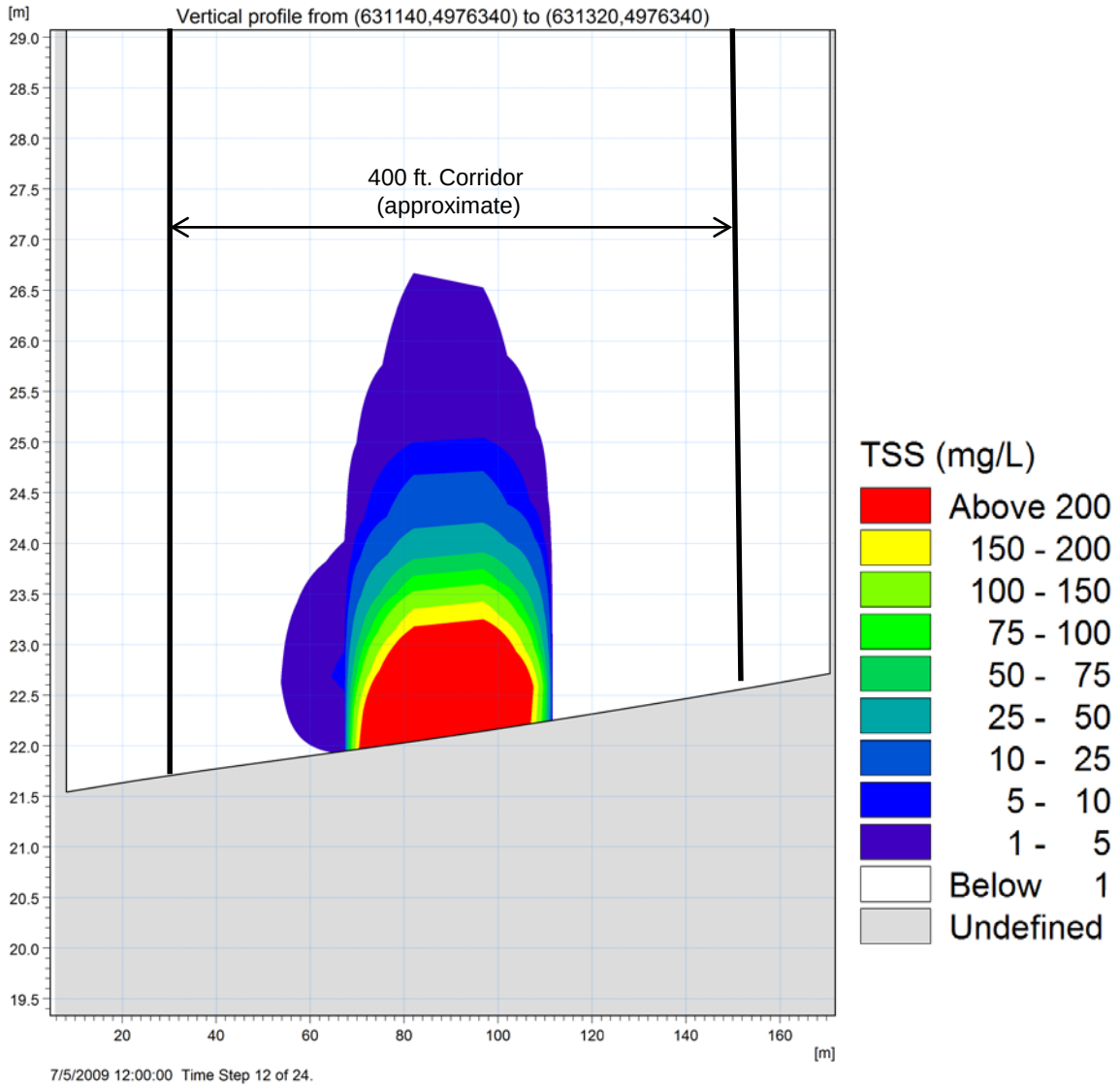
W – Load
C - Concentration

PRELIMINARY MODELING – SUBJECT TO CHANGE


0
5
6
10
15
20
20
25
30
35
40
45
50
50
55
60
65
68
70
75
80
85
88
90
95
Point Champlain
Swanton
GRAND ISLE
Saint Albans
Plattsburgh
Dannemora
Saranac
Milton
Keeseville
Winooski
Ethan Allen Firing Range
Shelburne Falls
Camels Hump State Park
Saranac Lake
Lake Placid
Port Henry
Middlebury
Adirondack Park
Ticonderoga
Montpelier
Barre
South Barre
Northfield
Randolph
White River Junction
Center Rutland
Fair Haven
Newport
Colebrook
Morrisville
Saint Johnsbury
Littleton
Groton State Forest
Lincoln
Plymouth
Mount Cardigan State Park
Huntingdon
Coaticook
Lancaster
Franklin
Tilton
ADIRONDACK MOUNTAINS
GREEN MOUNTAINS
FRANKLIN
CLINTON
ESSEX
ORLEANS
LAMOILLE
CHITTENDEN
ADDISON
HAMILTON
RUTLAND
ORANGE
GRAFTON
CALEDONIA
WHITE
VERMONT
Lake Champlain
Lamoille River
Otter Creek
White River
Black River
Connecticut River
Salmon River
Cedar River
Hudson River
Riviere Chateauguay
Riviere Richelieu
0 7.5 15
Miles
Cross section location
PRELIMINARY MODELING – SUBJECT TO CHANGE

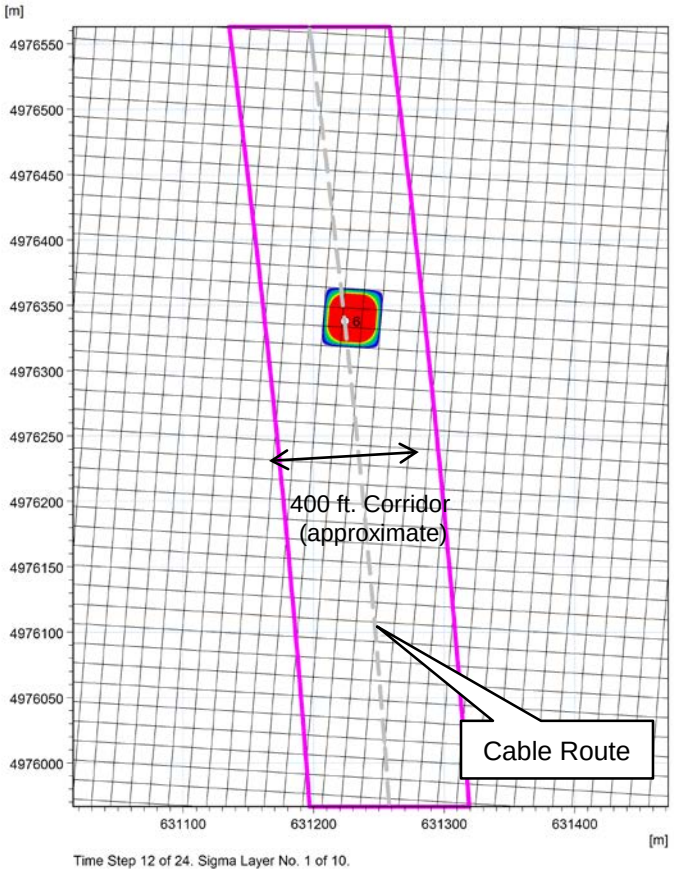
TSS MP 06

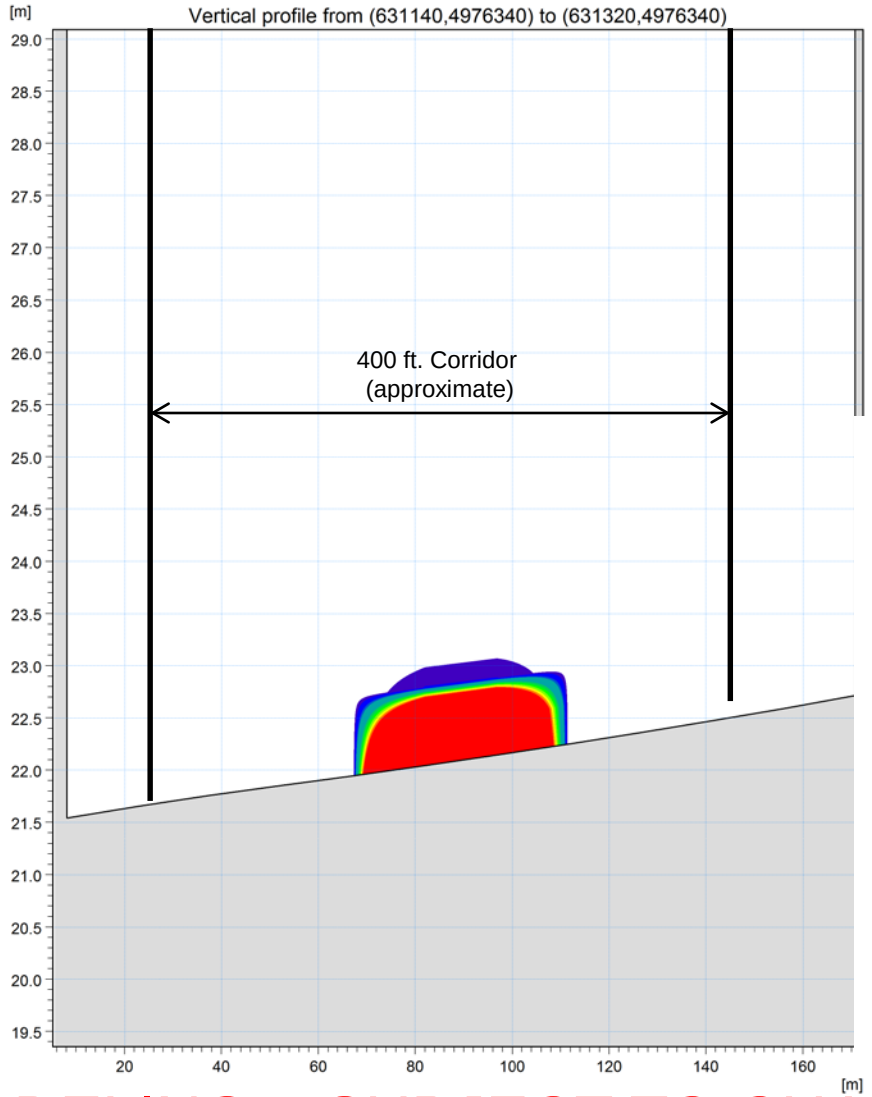


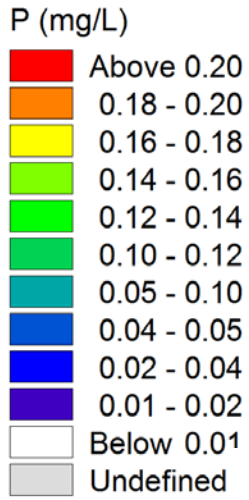


PRELIMINARY MODELING – SUBJECT TO CHANGE

Solid Phosphorus MP 06

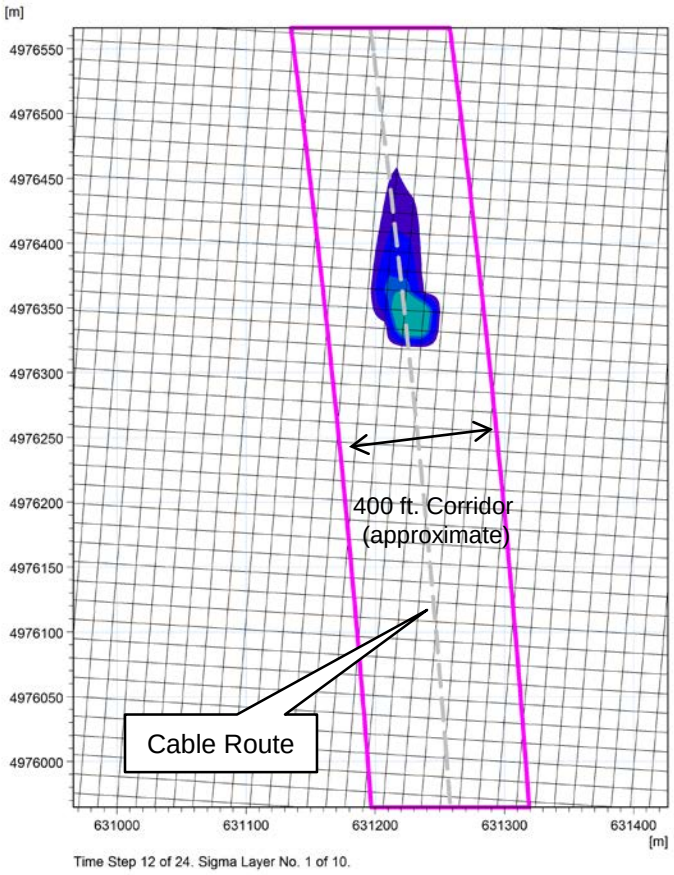


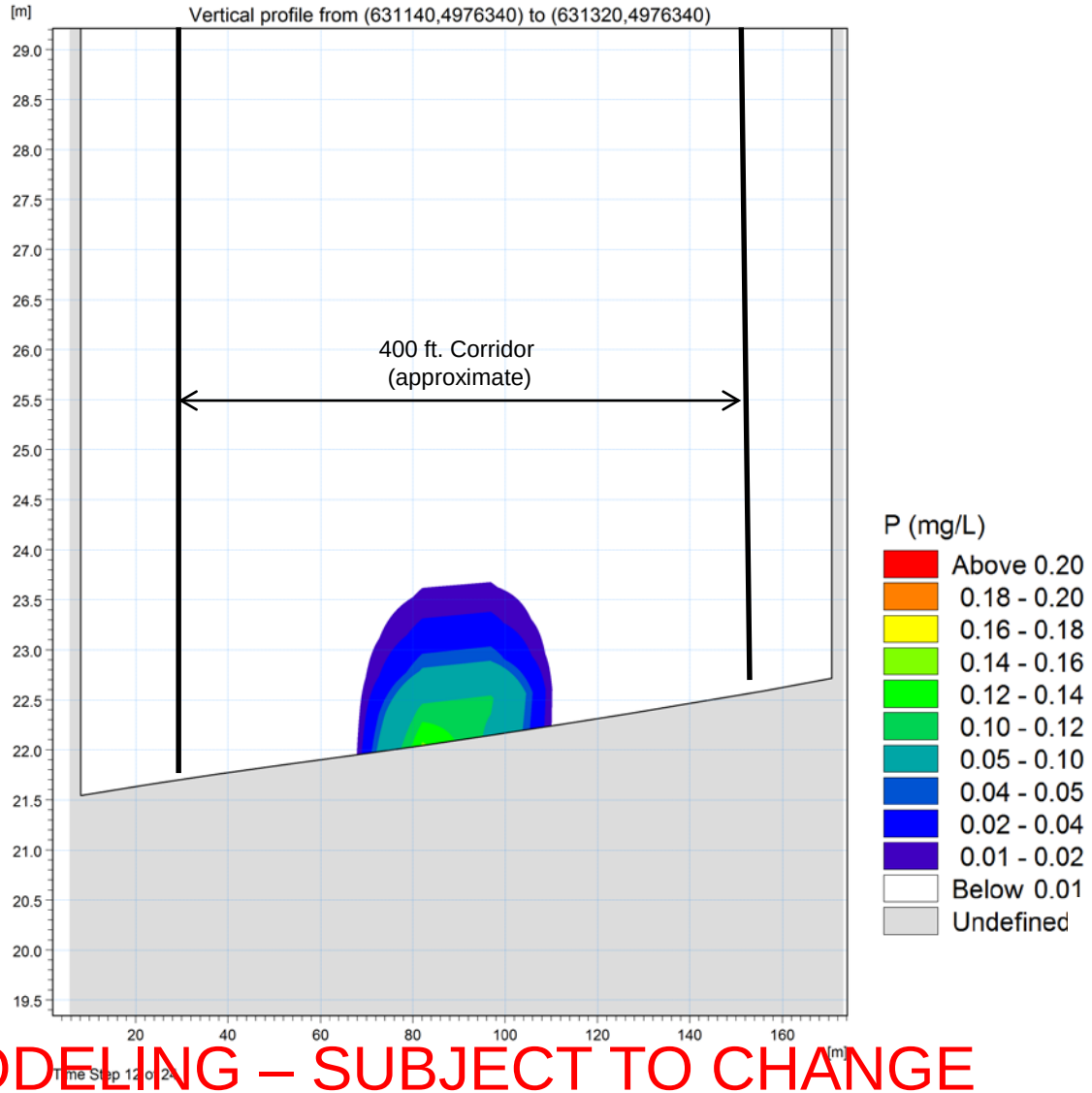




PRELIMINARY MODELING – SUBJECT TO CHANGE

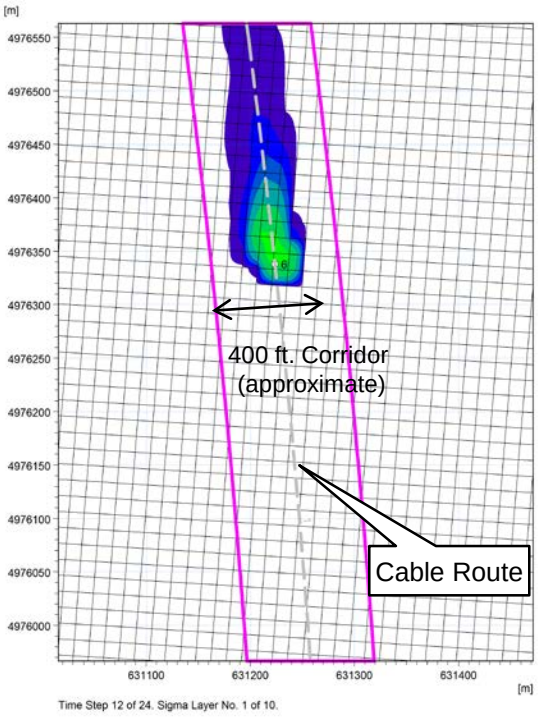
Dissolved Phosphorus MP 06

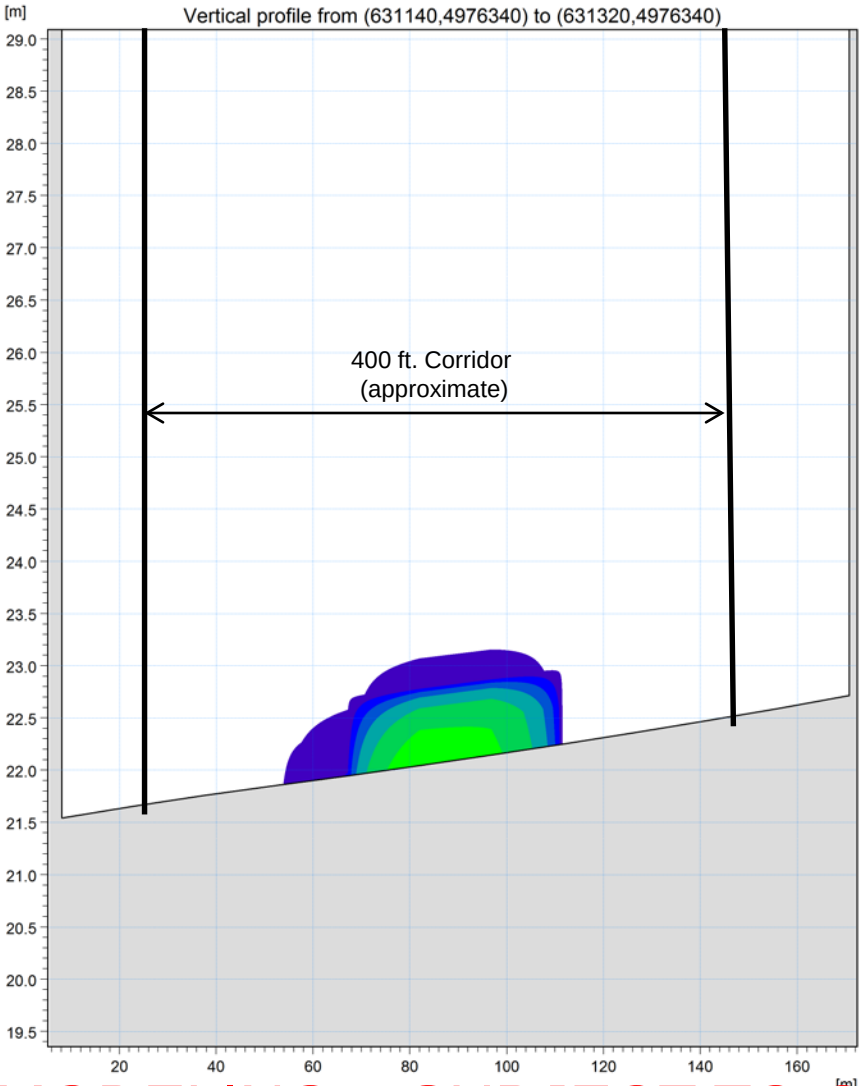


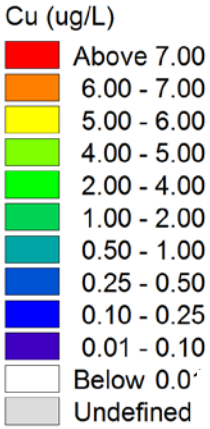


PRELIMINARY MODELING – SUBJECT TO CHANGE

Dissolved Copper MP 06

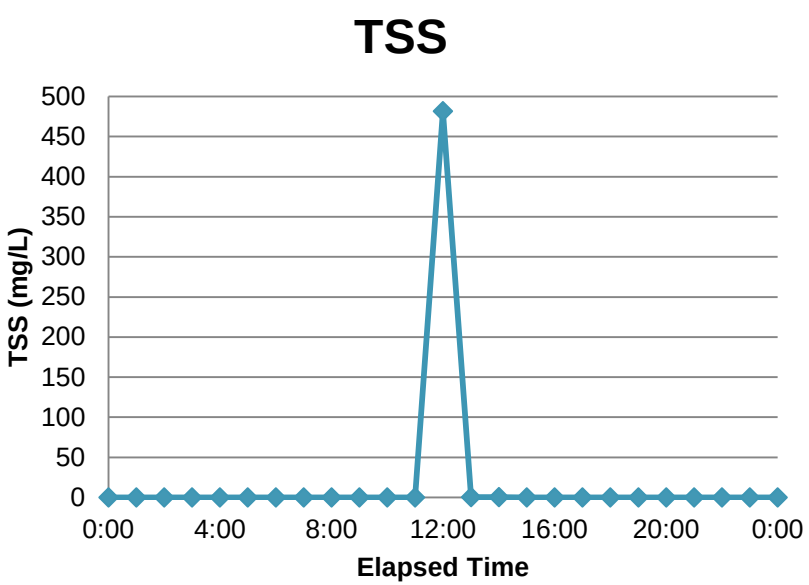


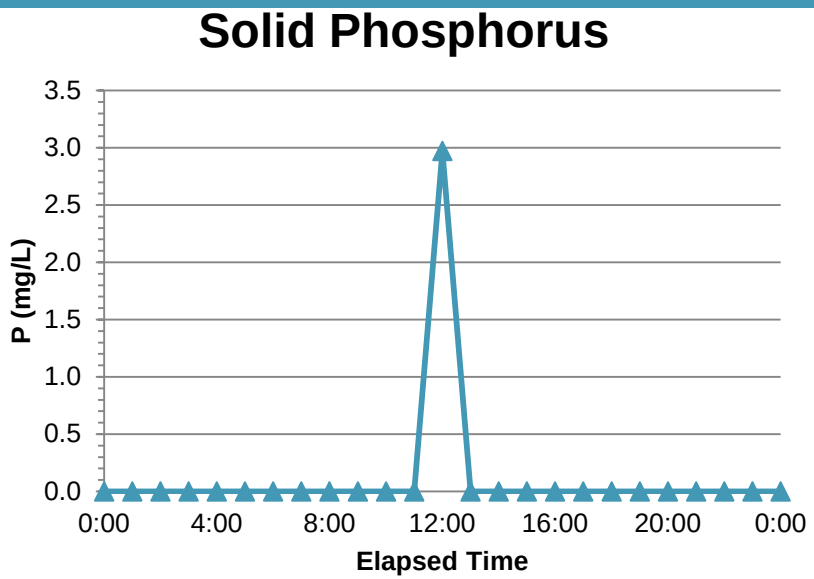


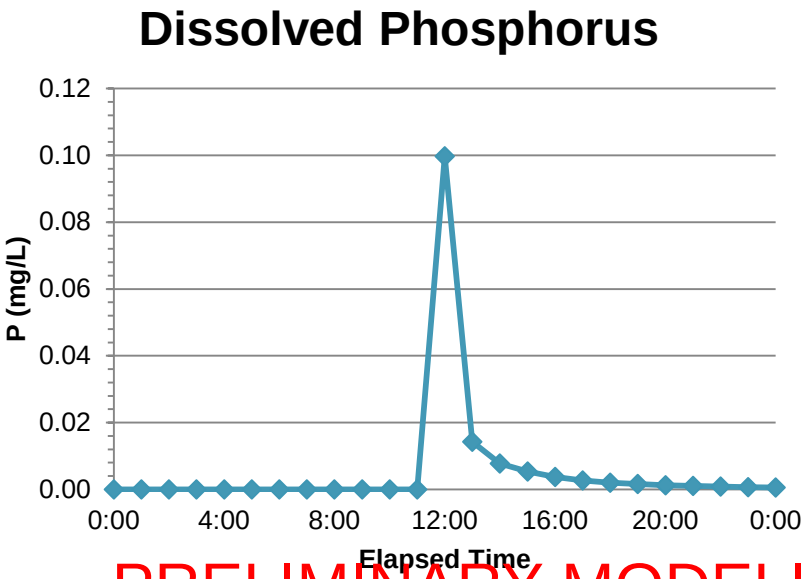


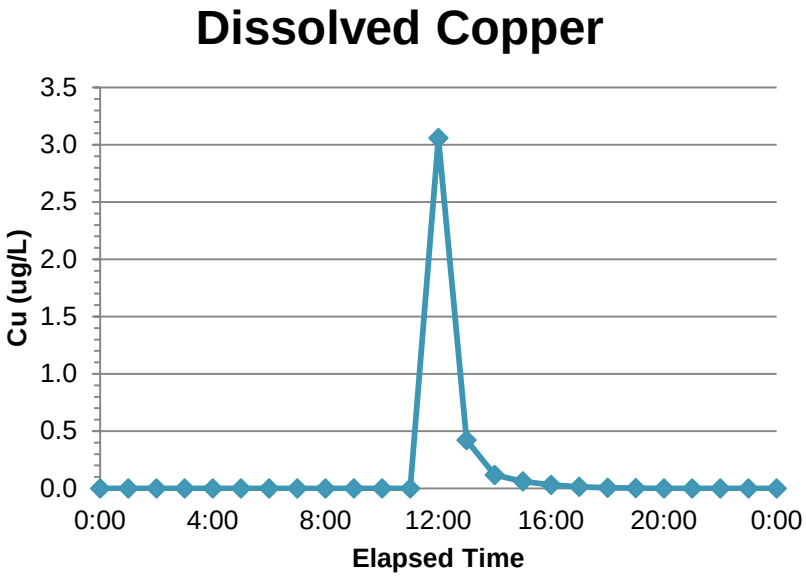
PRELIMINARY MODELING – SUBJECT TO CHANGE

Constituent Time Series MP 6 (maximum)



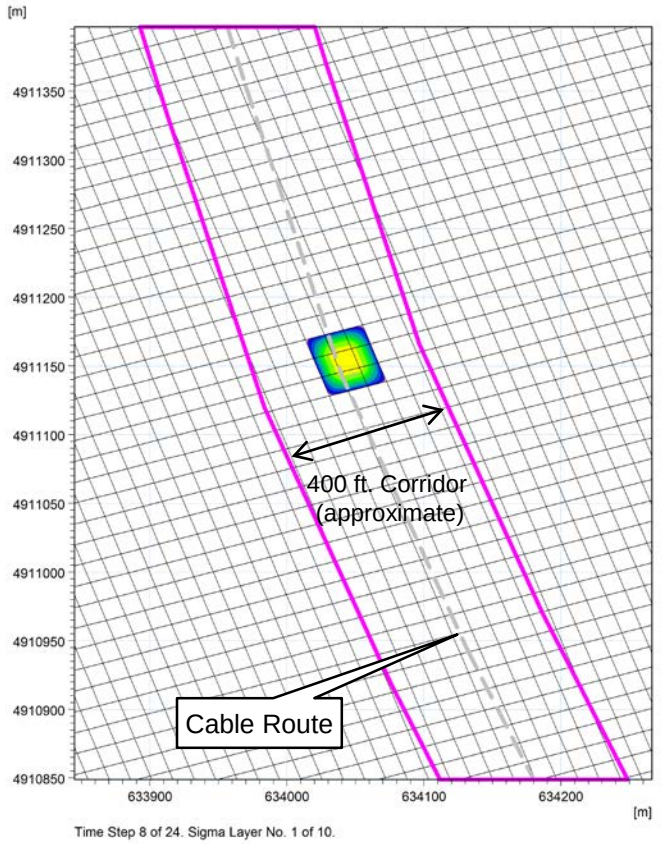


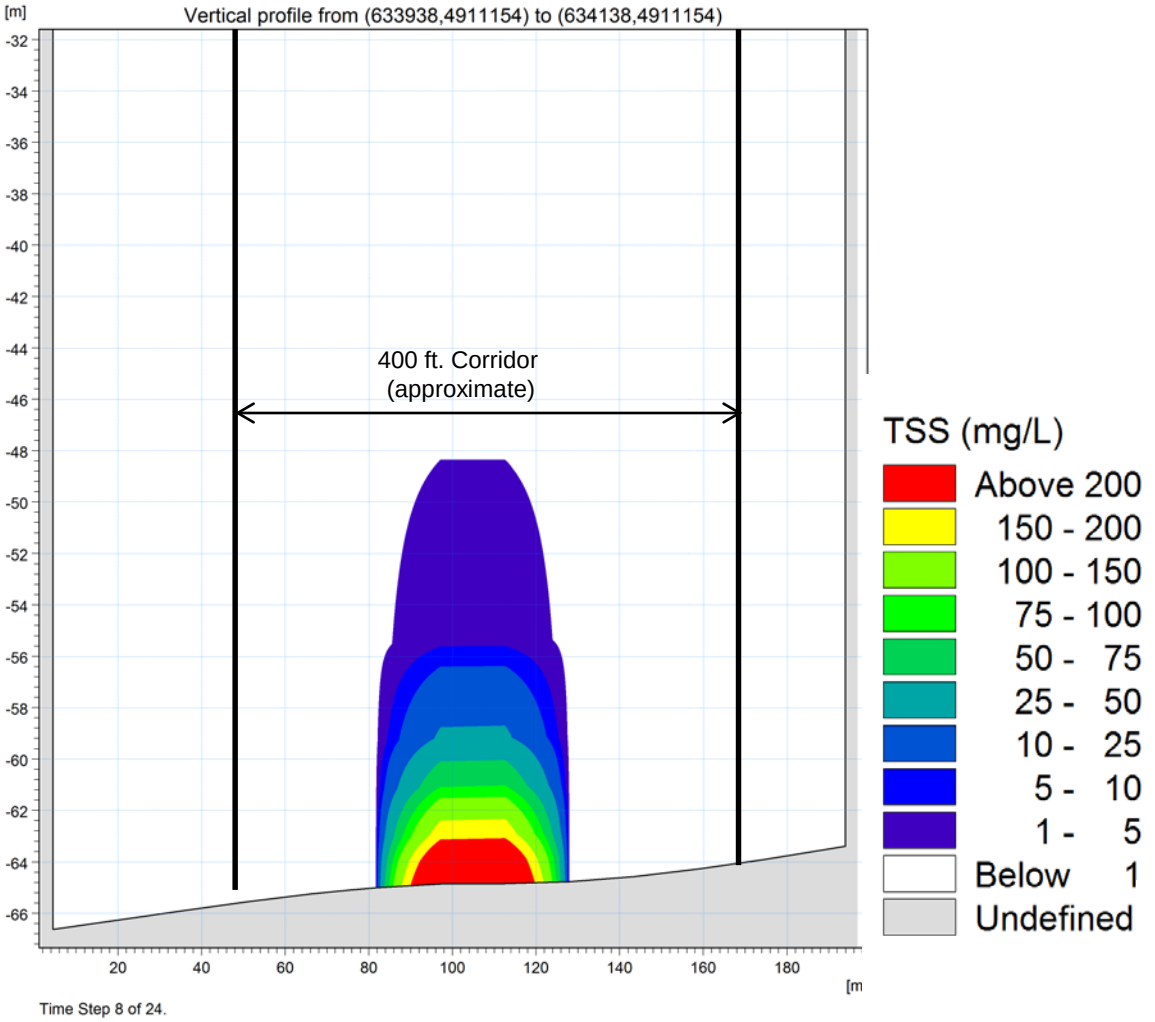




PRELIMINARY MODELING – SUBJECT TO CHANGE

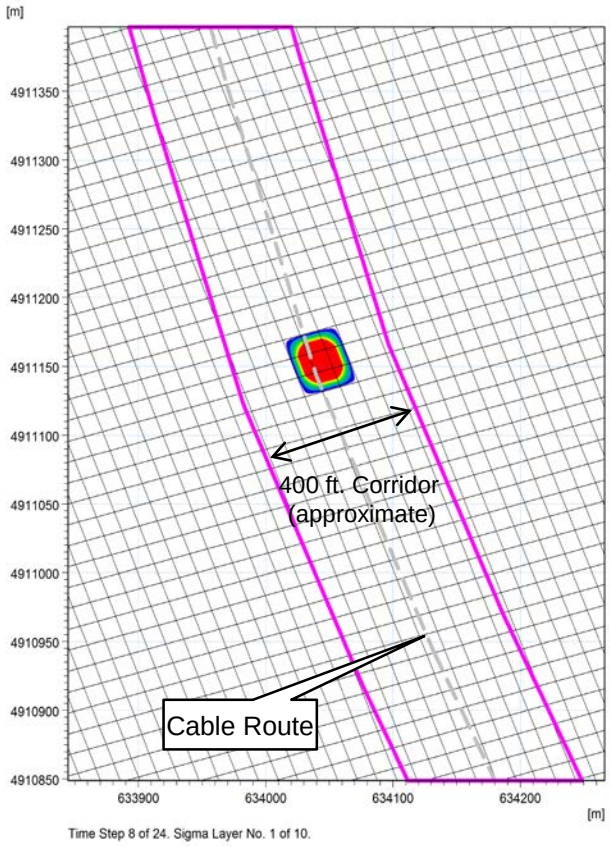
TSS MP 50

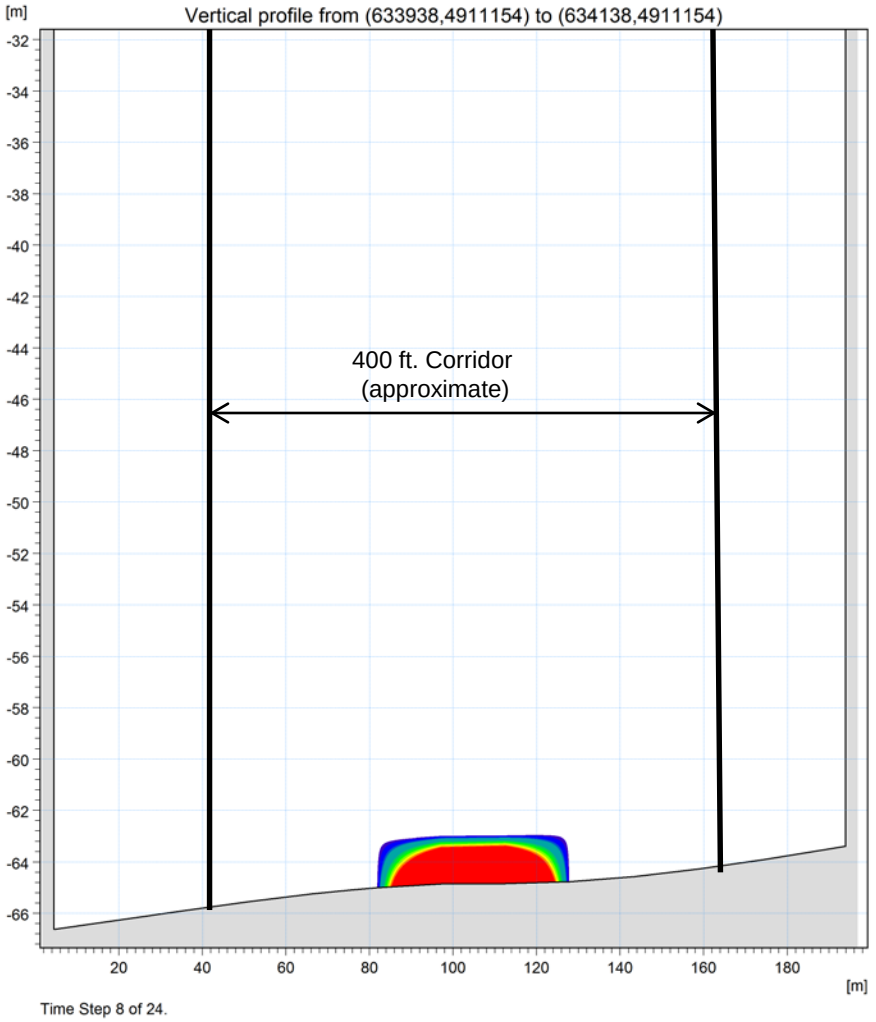


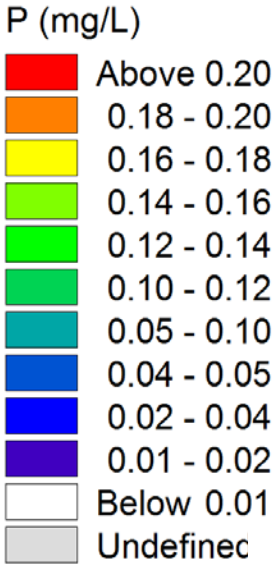


PRELIMINARY MODELING – SUBJECT TO CHANGE

Solid Phosphorus MP 50

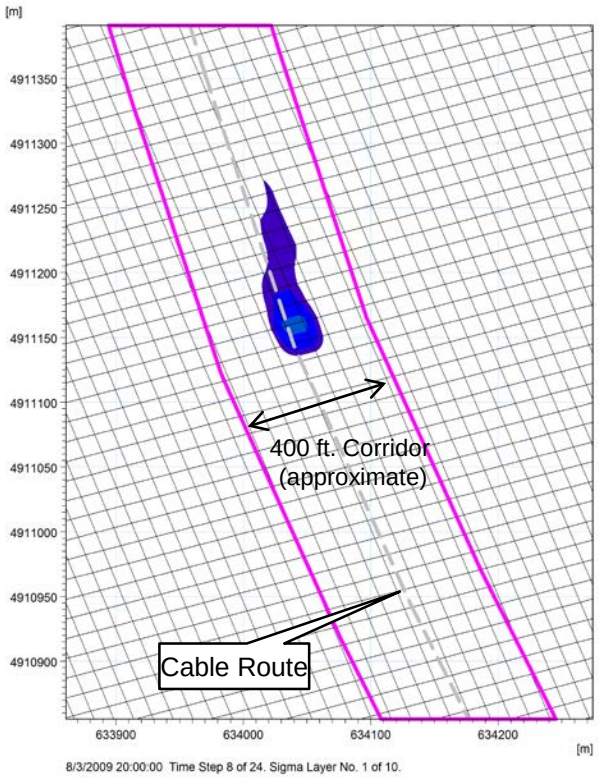


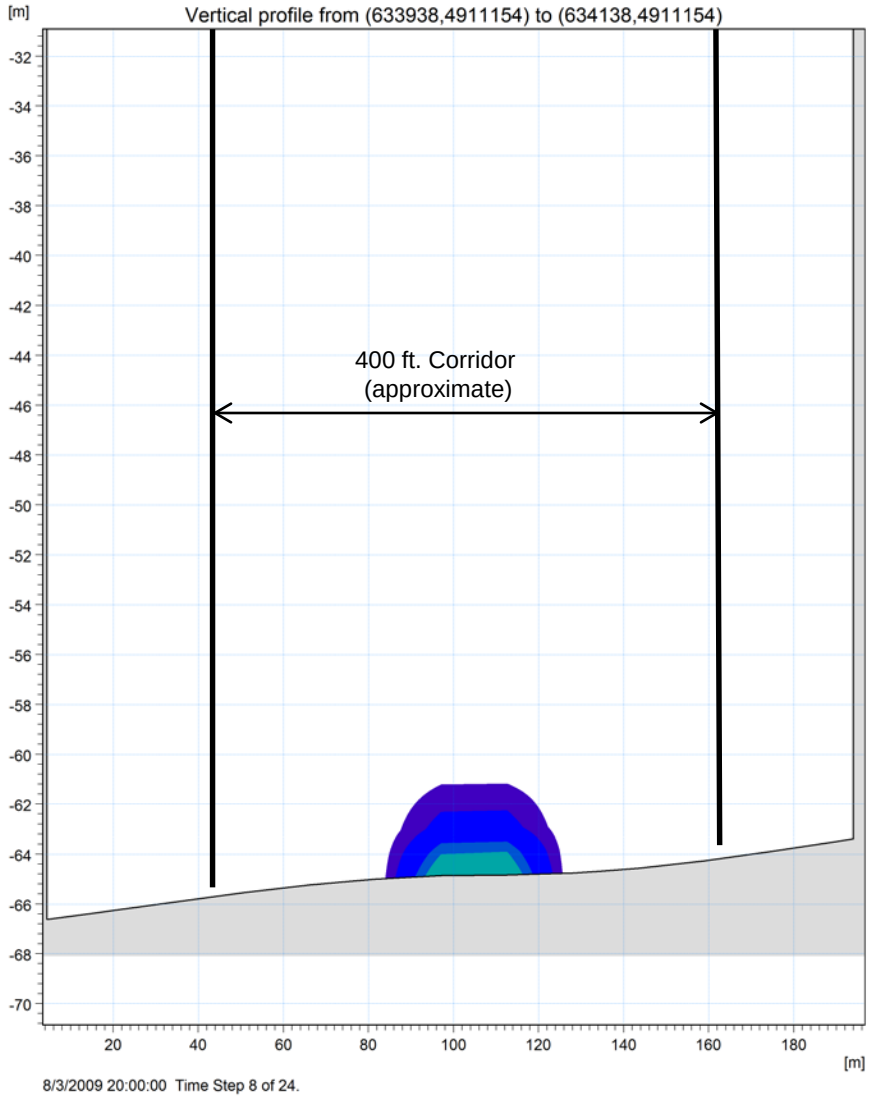


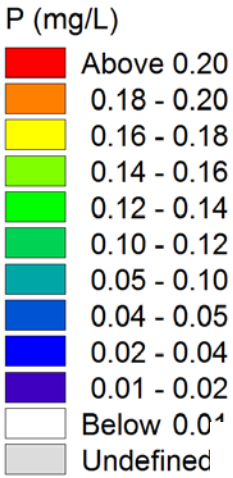


PRELIMINARY MODELING – SUBJECT TO CHANGE

Dissolved Phosphorus MP 50

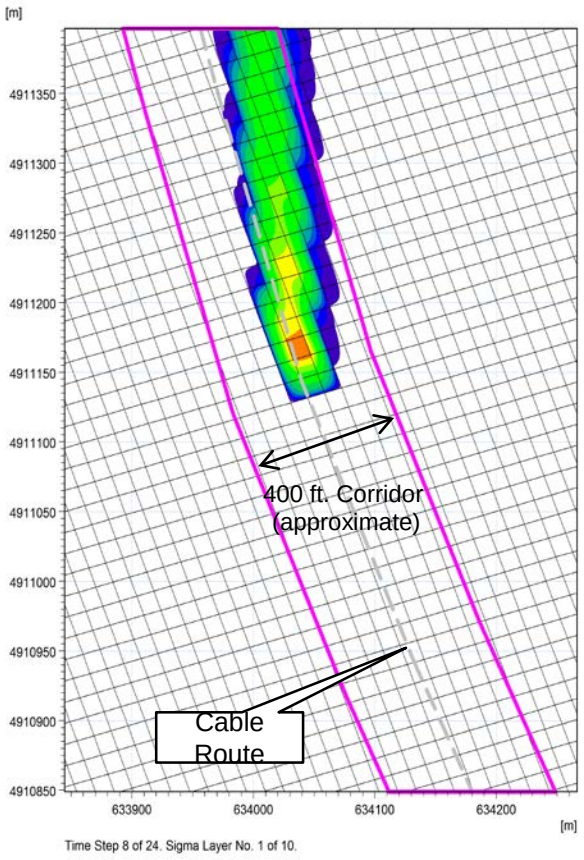


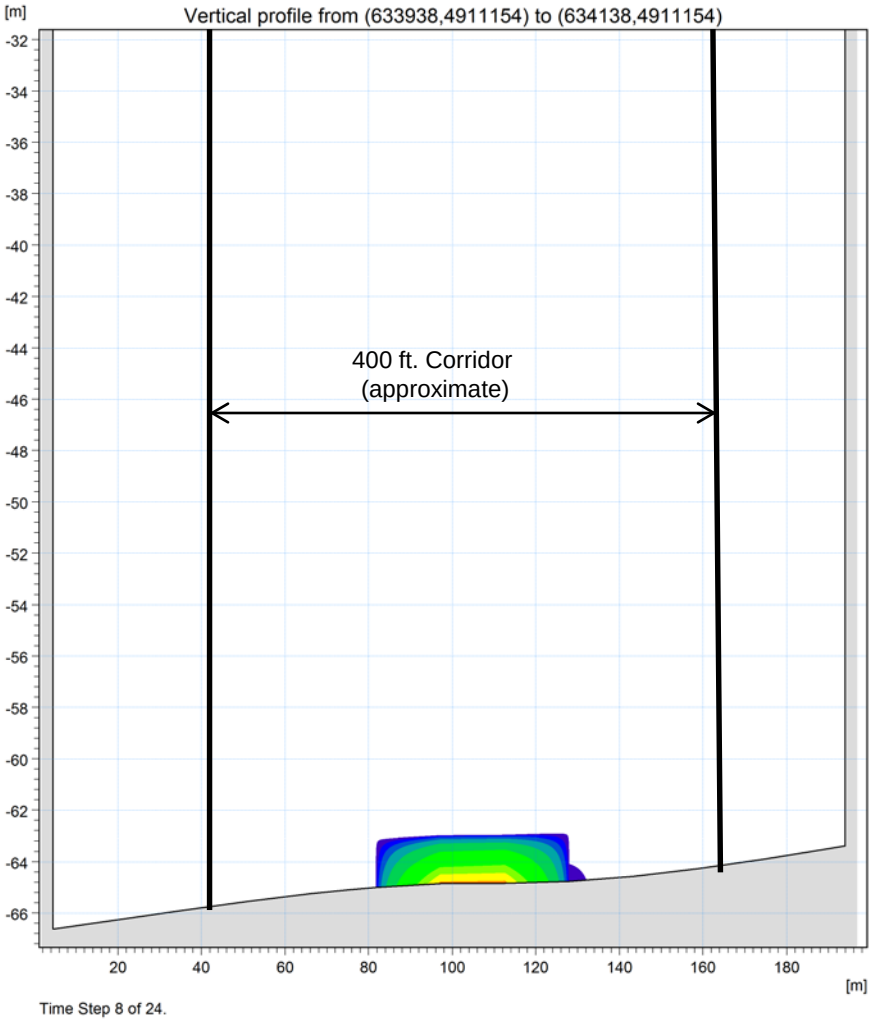


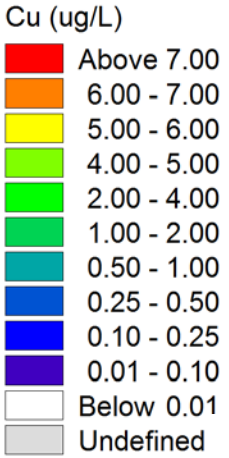


PRELIMINARY MODELING – SUBJECT TO CHANGE

Dissolved Copper MP 50

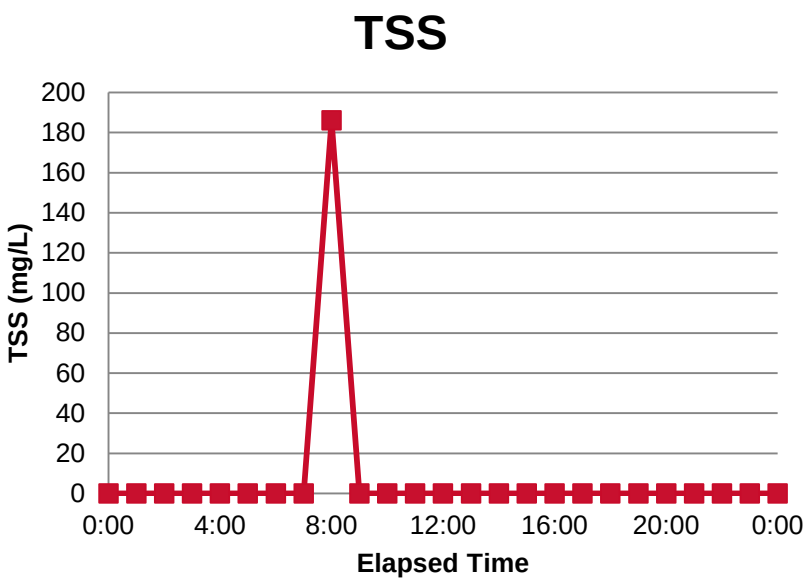


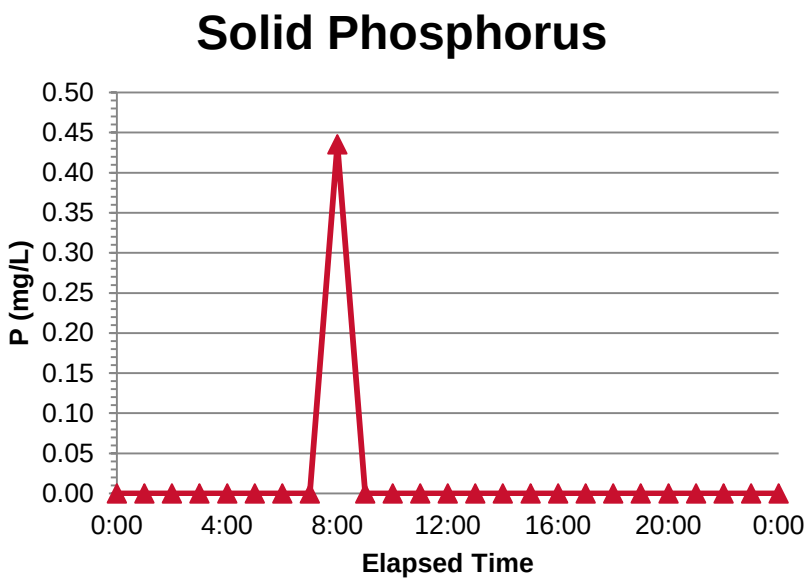


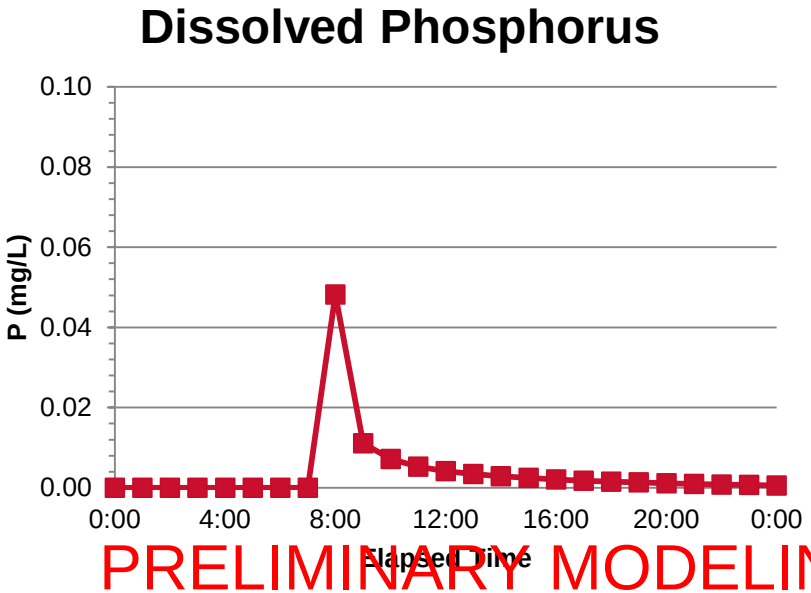


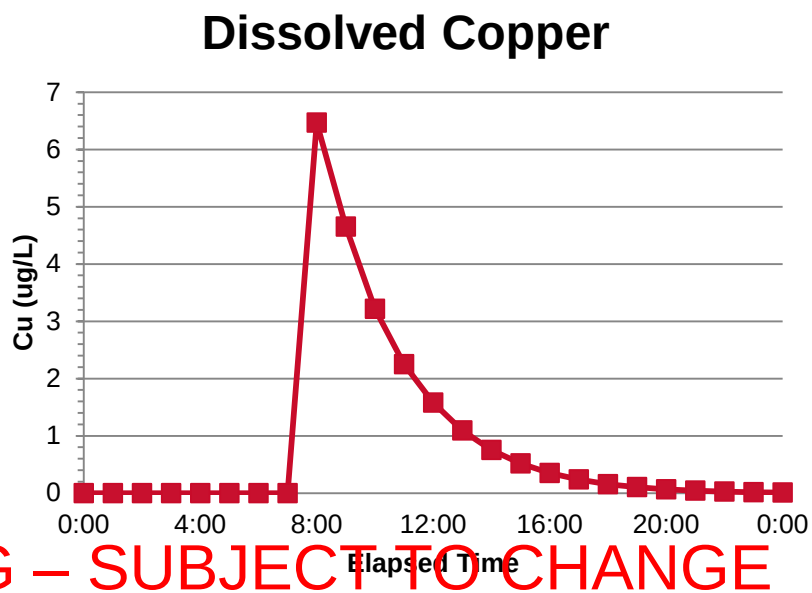
PRELIMINARY MODELING – SUBJECT TO CHANGE

Constituent Time Series – MP 50 (maximum)









PRELIMINARY MODELING – SUBJECT TO CHANGE

Summary

- TSS and Phosphorus concentrations are temporally elevated within 200 ft. of the installation, but quickly return to background levels (TSS <2 hours, P <1 day).
- For all metals, the concentrations will be below the new acute and chronic criteria concentrations within 200 ft. of the installation.

PRELIMINARY MODELING – SUBJECT TO CHANGE