Quantifying Nutrient and Sediment Loads during Spring Runoff in the Missisquoi River Basin

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EPSCoR Symposium 3/30/15

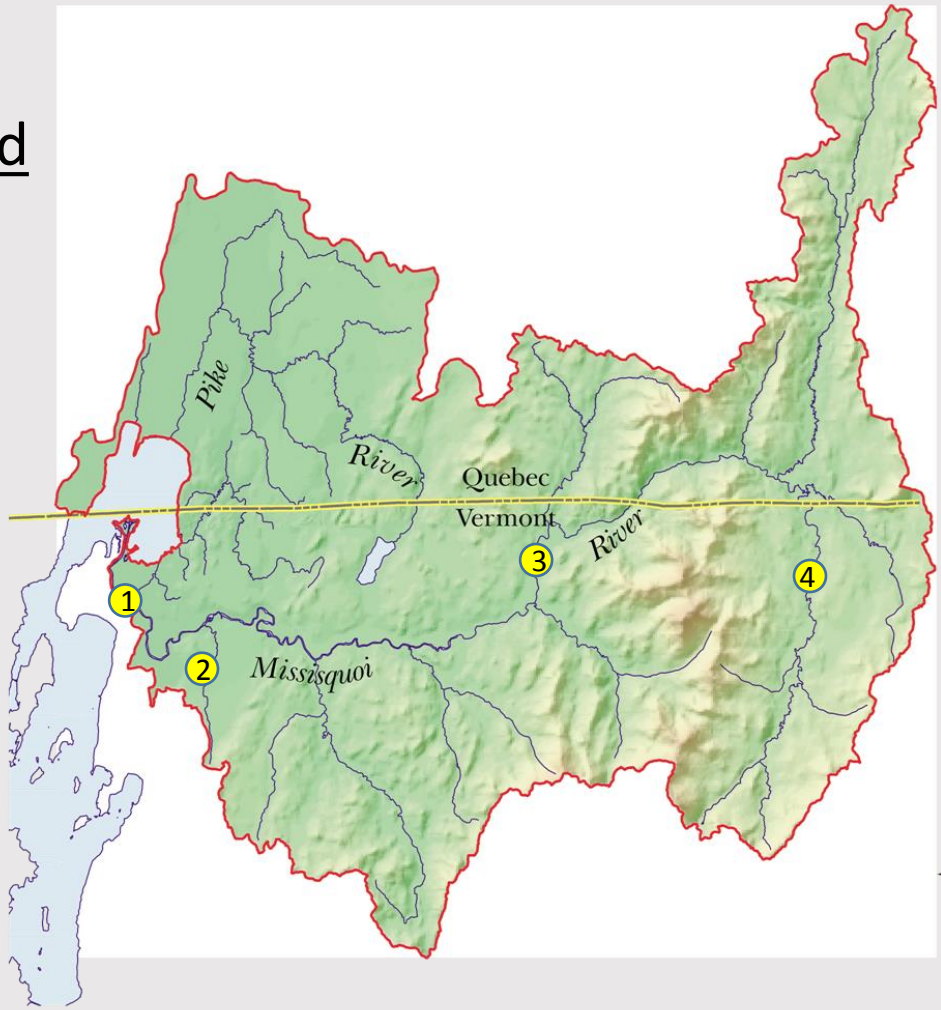
Introduction

- VT-EPSCoR Intern- 2 years
- Quantifying external nutrient loads from the Missisquoi River
- Efforts did not capture critical data during spring snowmelt runoff period
- Explored different load estimation methods
- Explored spatial and seasonal relationships of:
  - Total phosphorus (TP)
  - Total nitrogen (TN)
  - Total suspended solids (TSS)

Missisquoi River Watershed

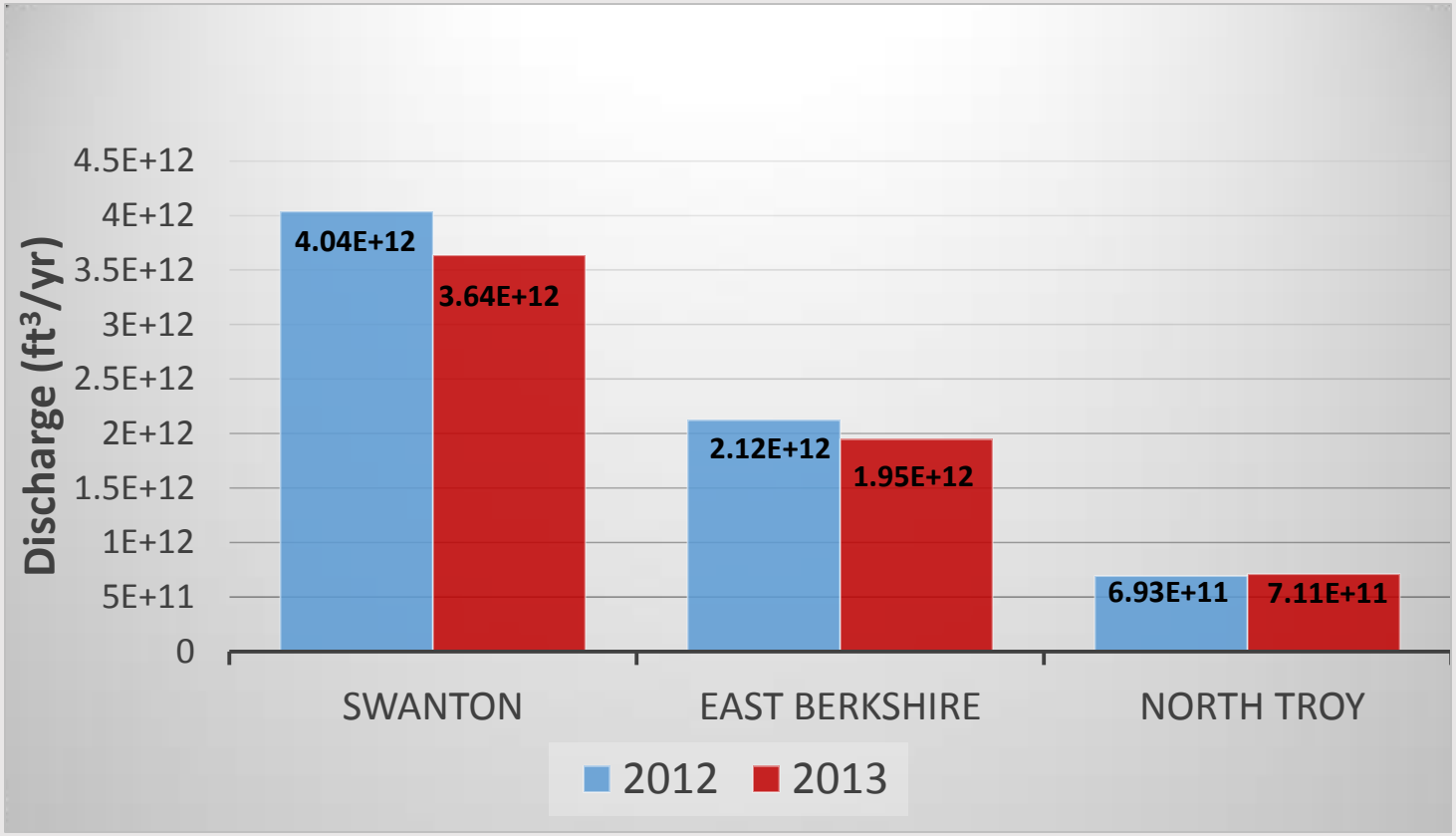
1. Swanton
2. Hungerford Brook
3. East Berkshire
4. North Troy

Swanton USGS Gauge Station

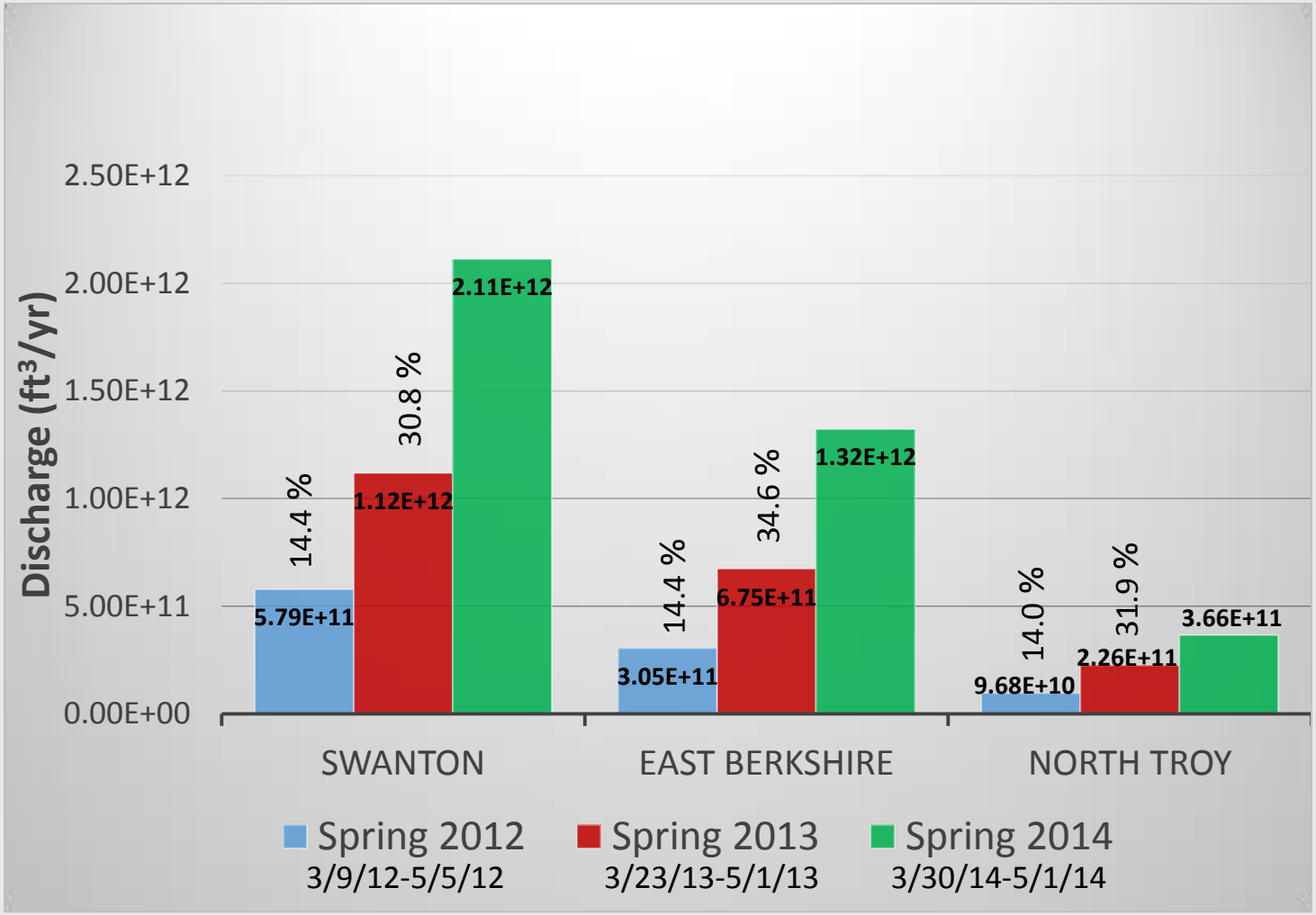


Map by Northern Cartographic

Annual Missisquoi River Discharge



3/30-5/1 Missisquoi River Discharge

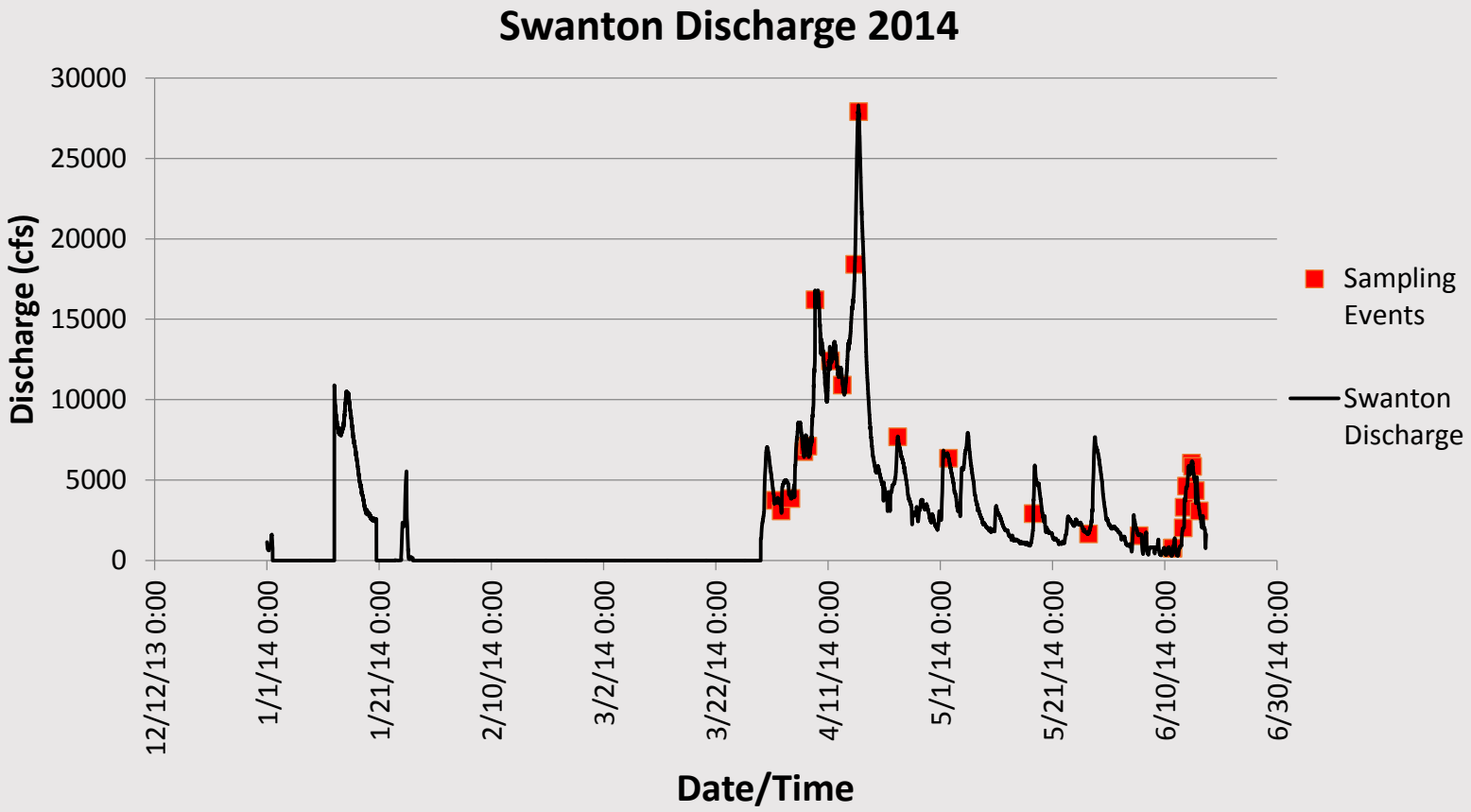


Methods

- "Spring" Sampling 2014
  - Combined with RACC 2012-2013 Samples
- RACC Lab Analysis, TP, TN, TSS
- Linear Regression Loading Model
- Weighted Regression on Time, Discharge, and Season R Script Loading Model

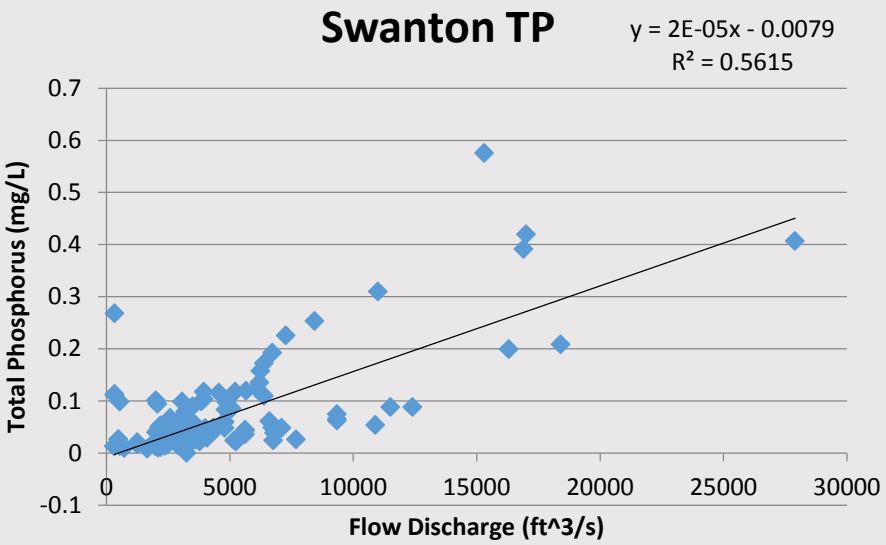
Ice Jam on Missisquoi River at East Berkshire Spring 2014

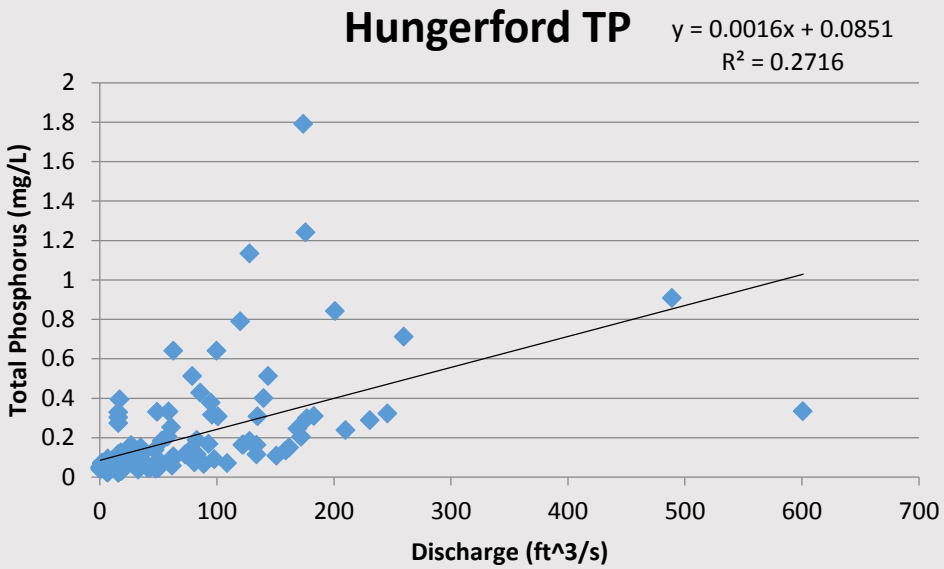
Spring Sampling 2014

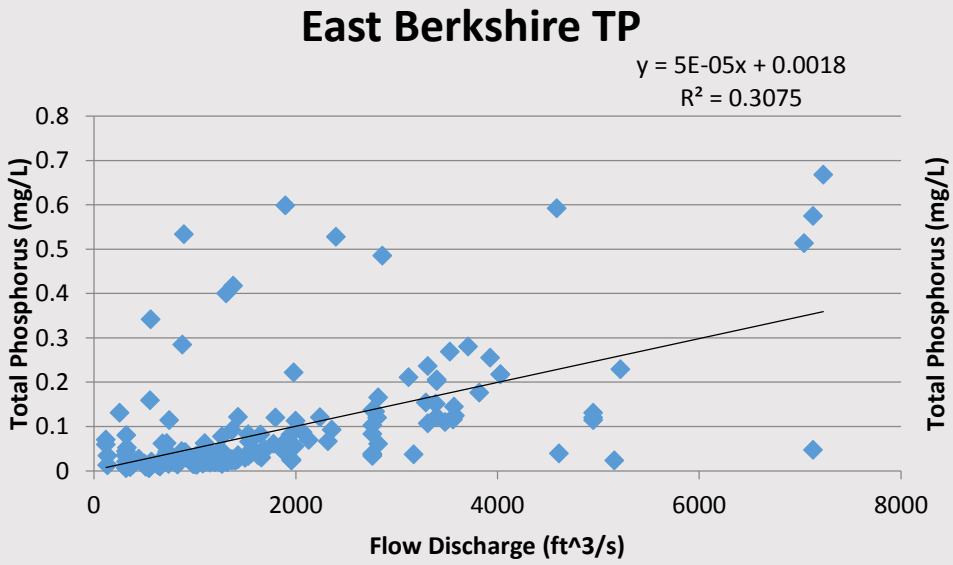


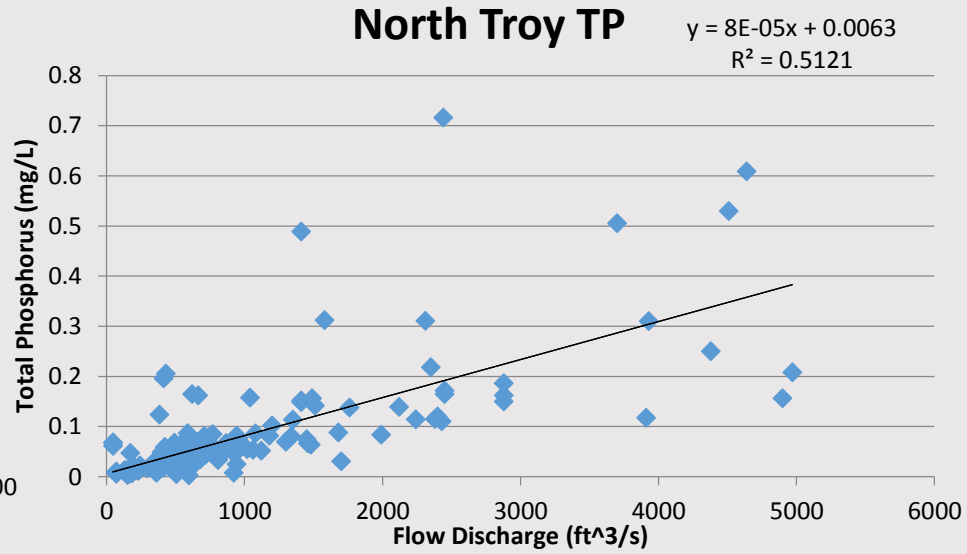
Peak Spring Snowmelt	Rain on Snow Storm Event	Spring Storms
3/30-4/14	4/15-4/18	4/19-5/1

Regressions with all RACC Data



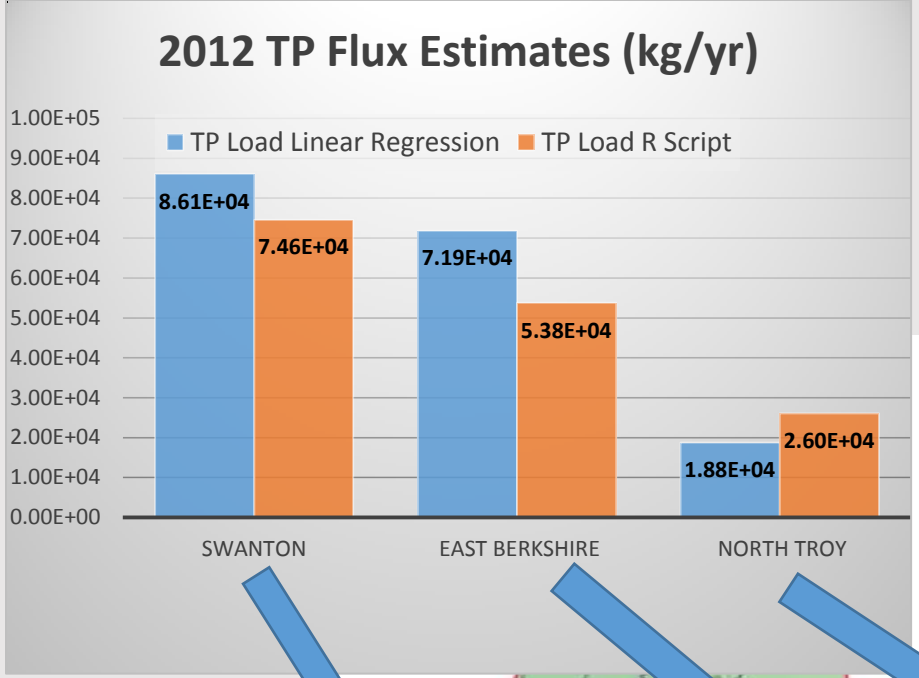


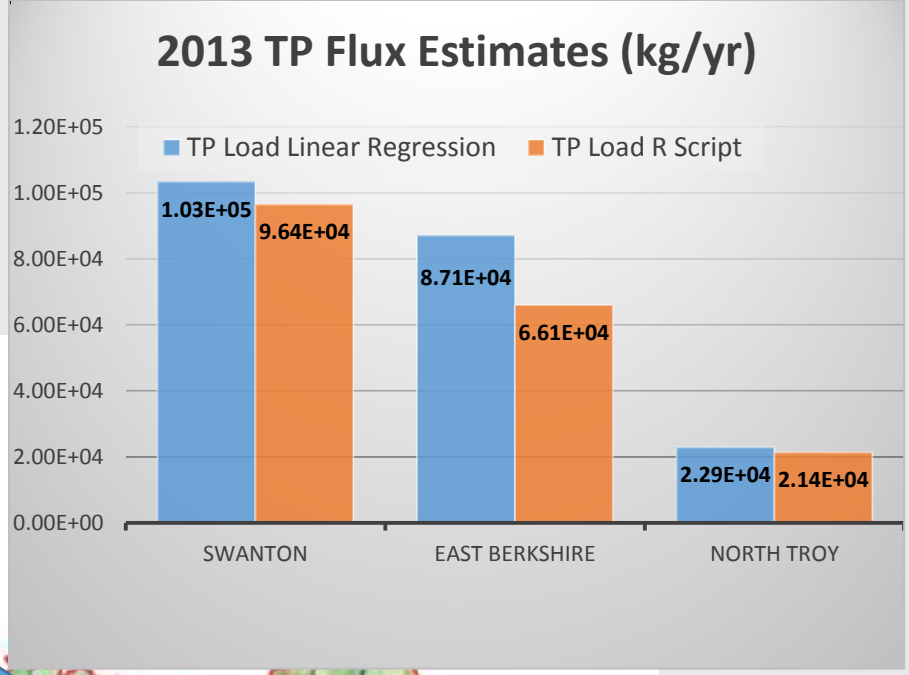


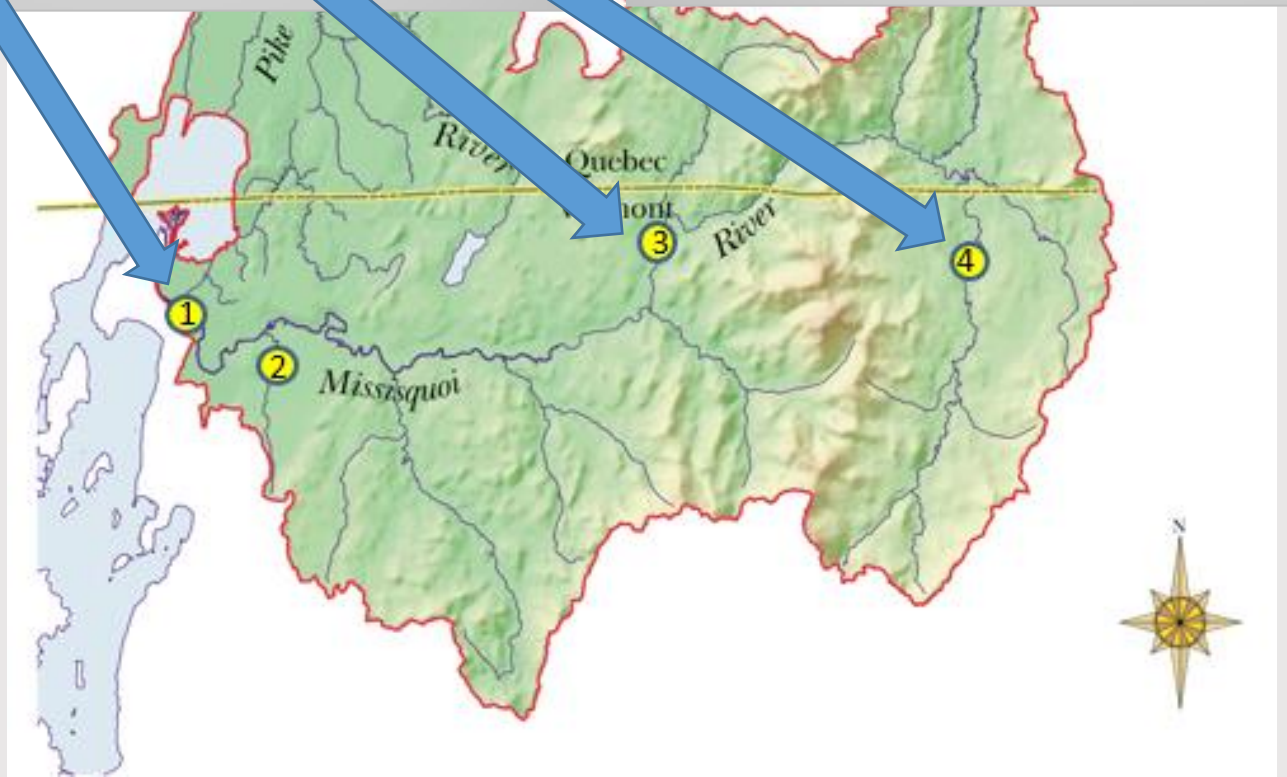


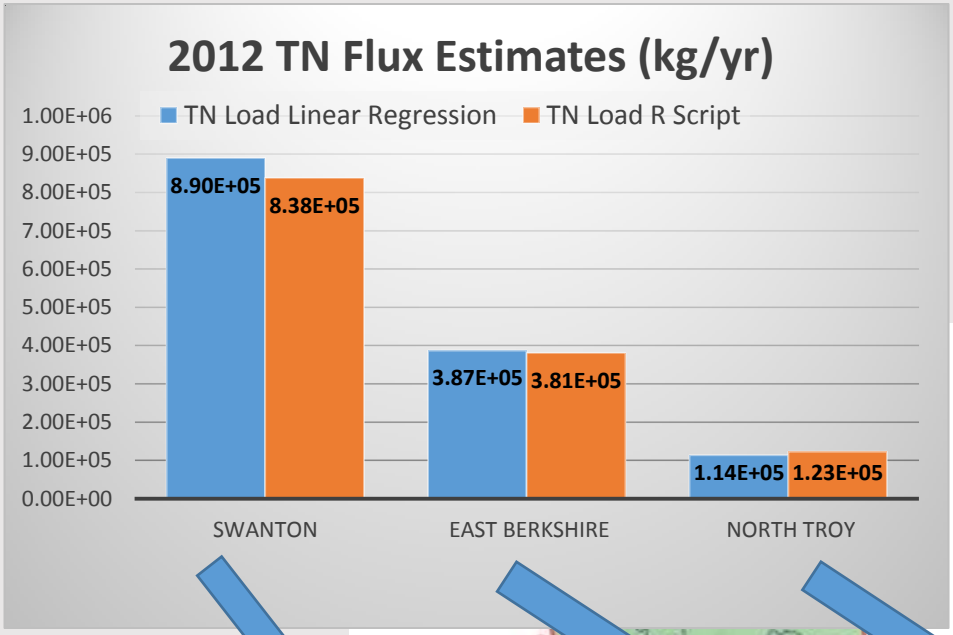
R Script: EGRET Package

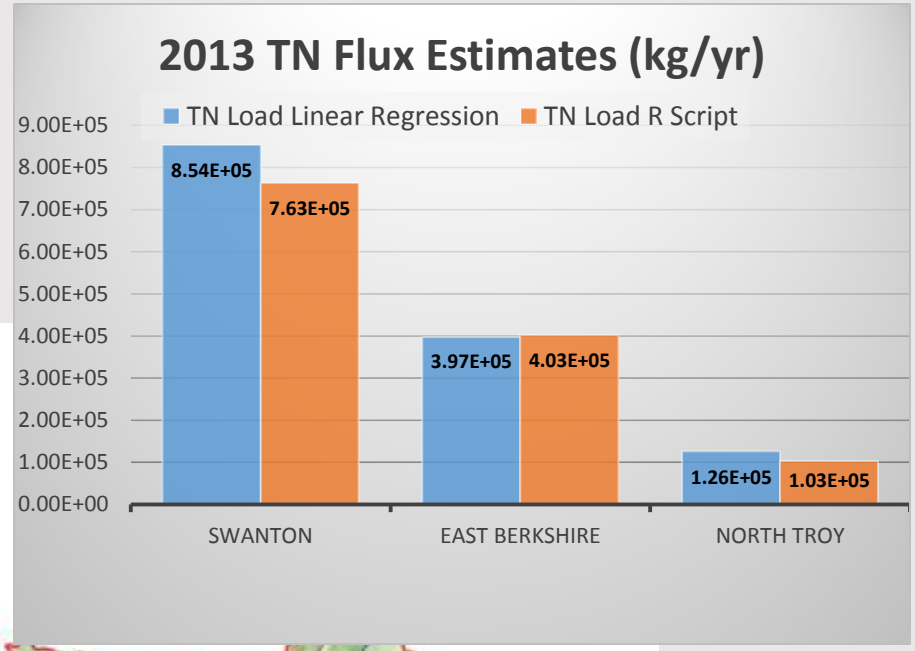
- Exploration and Graphics for RivEr Trends
- Analysis of long-term changes in river-water quality and stream flow, including “Weighted Regressions on Time, Discharge, and Season” (WRTDS)
- Uses water quality sample data, daily stream flow data, and meta data from USGS web services or from user-supplied files
- Computes for every day in study period an estimate of concentration and an estimate of flux

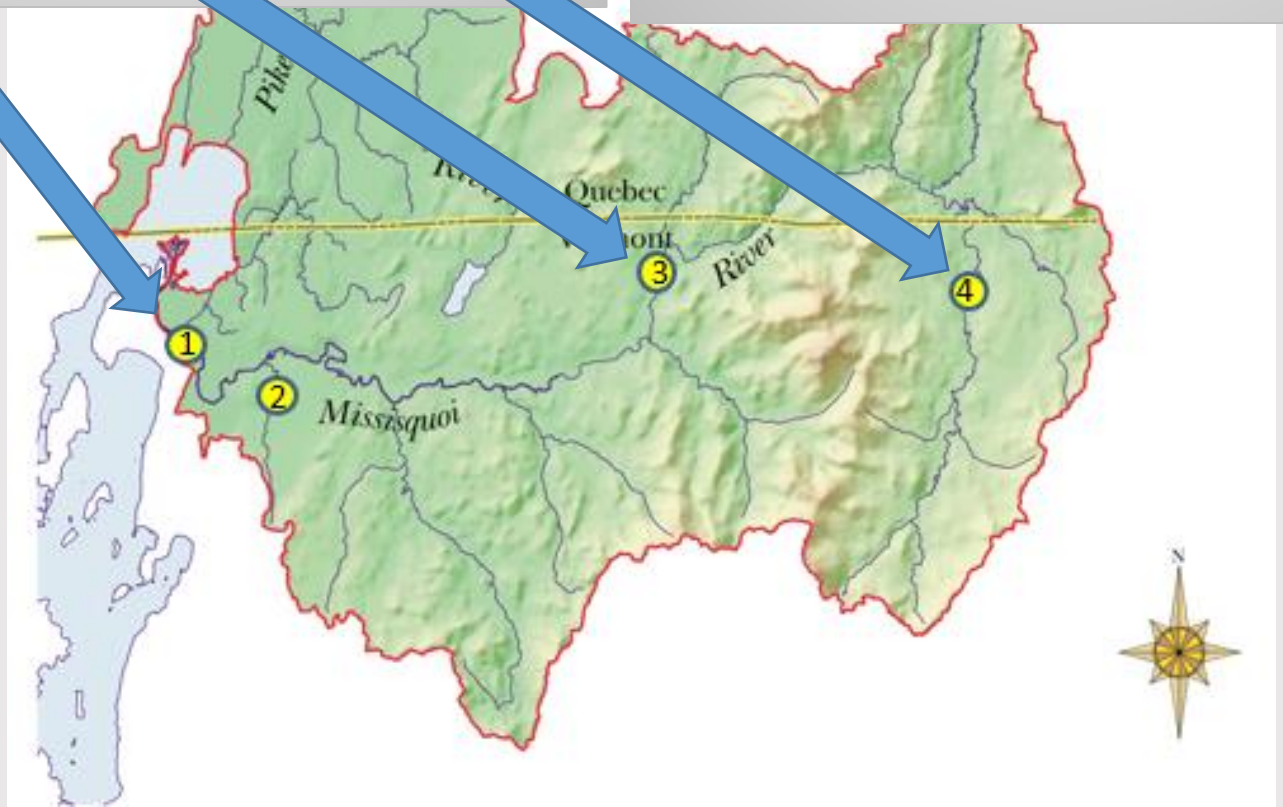

2012 TP Flux Estimates (kg/yr)
TP Load Linear Regression
TP Load R Script
1.00E+05
9.00E+04
8.00E+04
7.00E+04
6.00E+04
5.00E+04
4.00E+04
3.00E+04
2.00E+04
1.00E+04
0.00E+00
8.61E+04
7.46E+04
7.19E+04
5.38E+04
1.88E+04
2.60E+04
SWANTON
EAST BERKSHIRE
NORTH TROY

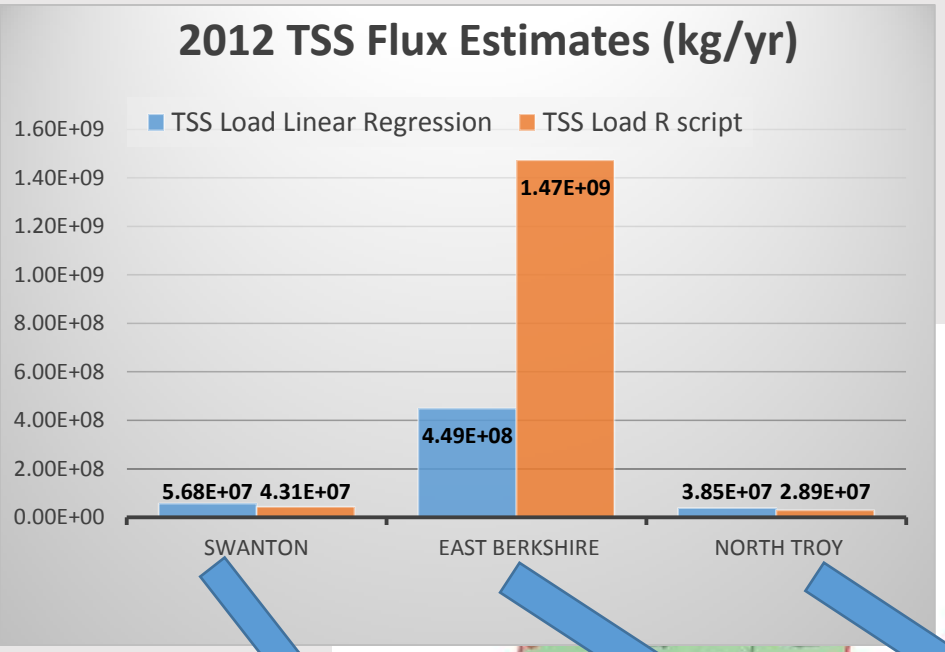

2013 TP Flux Estimates (kg/yr)
TP Load Linear Regression
TP Load R Script
1.20E+05
1.00E+05
8.00E+04
6.00E+04
4.00E+04
2.00E+04
0.00E+00
1.03E+05
9.64E+04
8.71E+04
6.61E+04
2.29E+04
2.14E+04
SWANTON
EAST BERKSHIRE
NORTH TROY

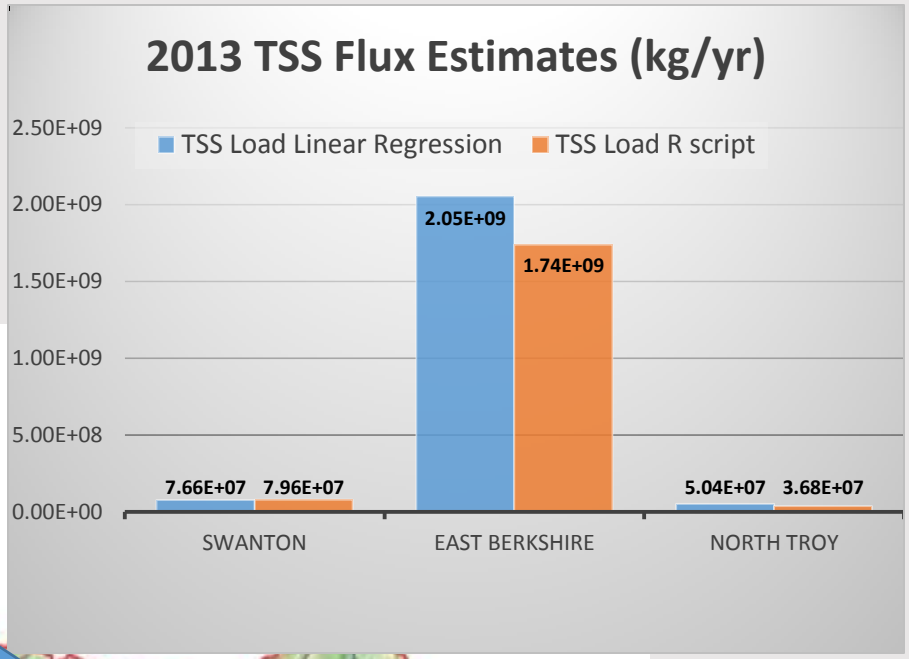

Pike
River
Quebec
River
Missisquoi
1
2
3
4
N


2012 TN Flux Estimates (kg/yr)
TN Load Linear Regression
TN Load R Script
1.00E+06
9.00E+05
8.00E+05
7.00E+05
6.00E+05
5.00E+05
4.00E+05
3.00E+05
2.00E+05
1.00E+05
0.00E+00
8.90E+05
8.38E+05
3.87E+05
3.81E+05
1.14E+05
1.23E+05
SWANTON
EAST BERKSHIRE
NORTH TROY

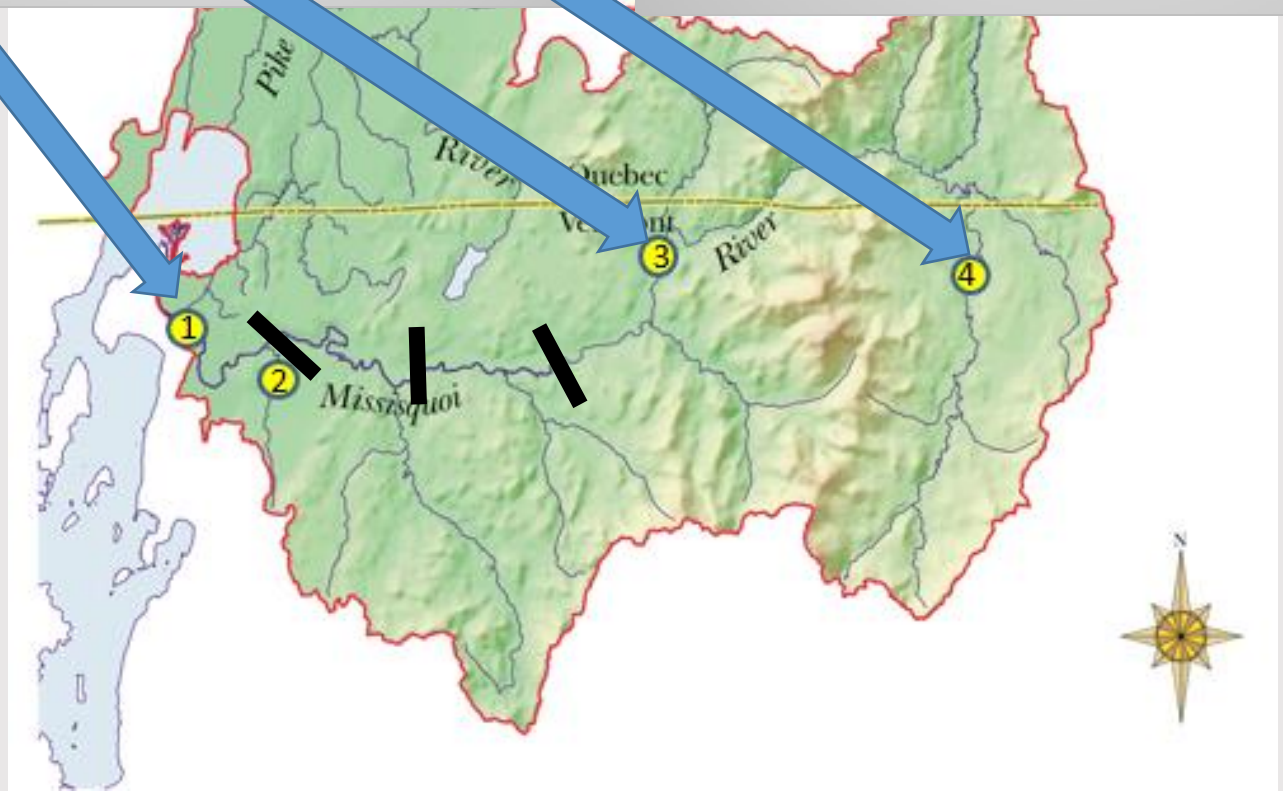

2013 TN Flux Estimates (kg/yr)
TN Load Linear Regression
TN Load R Script
9.00E+05
8.00E+05
7.00E+05
6.00E+05
5.00E+05
4.00E+05
3.00E+05
2.00E+05
1.00E+05
0.00E+00
8.54E+05
7.63E+05
3.97E+05
4.03E+05
1.26E+05
1.03E+05
SWANTON
EAST BERKSHIRE
NORTH TROY


Quebec
River
Missisquoi
1
2
3
4
N


2012 TSS Flux Estimates (kg/yr)
TSS Load Linear Regression
TSS Load R script
1.60E+09
1.40E+09
1.20E+09
1.00E+09
8.00E+08
6.00E+08
4.00E+08
2.00E+08
0.00E+00
5.68E+07
4.31E+07
4.49E+08
1.47E+09
3.85E+07
2.89E+07
SWANTON
EAST BERKSHIRE
NORTH TROY


2013 TSS Flux Estimates (kg/yr)
TSS Load Linear Regression
TSS Load R script
2.50E+09
2.00E+09
1.50E+09
1.00E+09
5.00E+08
0.00E+00
7.66E+07
7.96E+07
2.05E+09
1.74E+09
5.04E+07
3.68E+07
SWANTON
EAST BERKSHIRE
NORTH TROY

Dams


Pike
River
Quebec
River
Missisquoi
1
2
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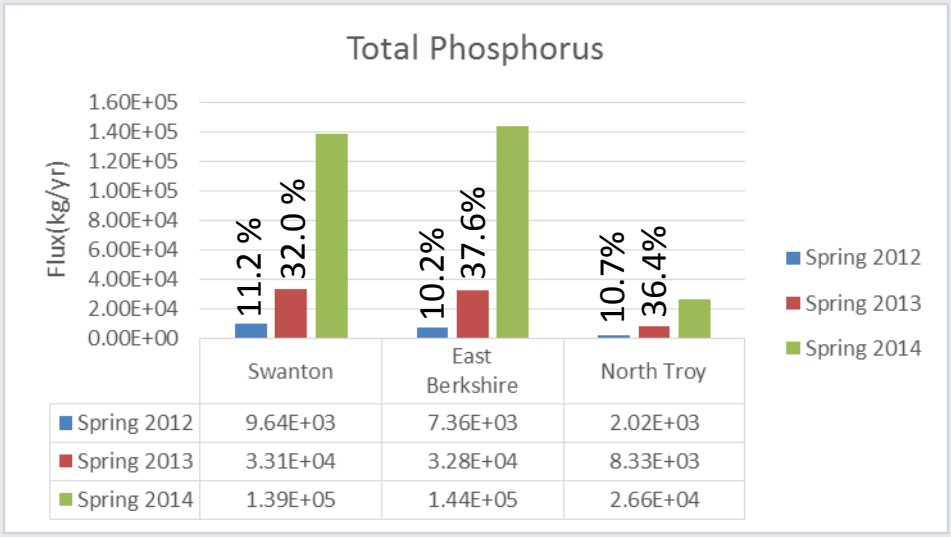
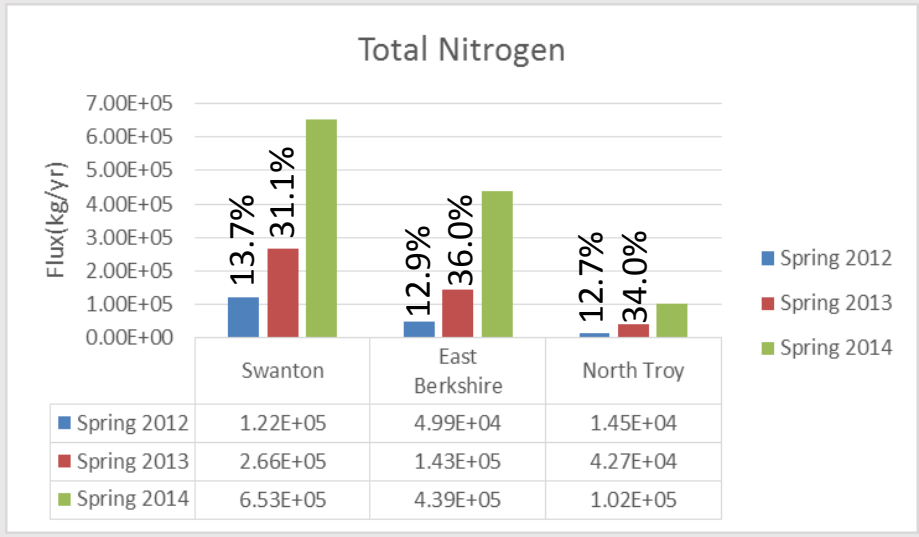
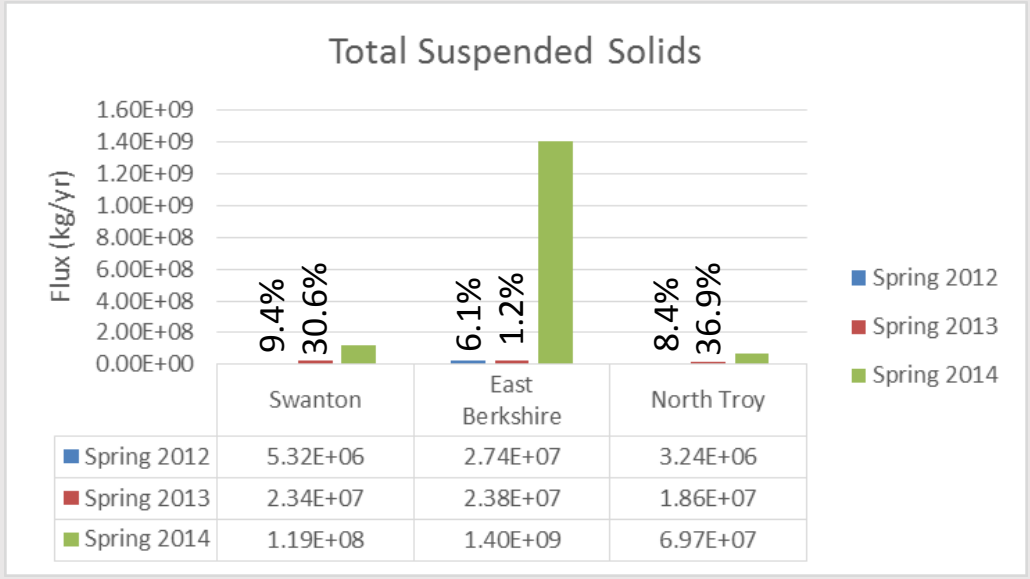
N

Spring Results –Linear Regression Model







Conclusions

- Spring runoff discharge is a large percentage of annual discharge
  - Spring snowmelt varies dramatically on inter annual basis
- Linear Regression Model is good for comparative purposes
  - Higher estimates than WRTDS R Script
- Critical time period of nutrient and sediment loading
  - Spring loading is ~30% of annual loading in 2013
  - Varies greatly based on snowmelt period
- Loading generally increases upstream to downstream
  - Dams remove large amount of sediment and TP
- Need more monitoring during spring snowmelt and general work on large scale watershed loading
  - Use for land management practices seasonally and spatially

Acknowledgements

- Andrew Schroth
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Questions?

Big Falls- Missisquoi River, North Troy, VT