Chloride in Vermont's rivers and streams

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LAKE CHAMPLAIN WATERSHED DEICING CONFERENCE

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Presentation topics

- Chloride basics; impacts to aquatic life
- Water Quality Standards in VT
- Chloride in Vermont streams
- Stromwater regulations
- Workshop benefits

Chloride basics

SOURCES AND IMPACTS

Sources of Chloride in Water

Trends in Chloride Usage

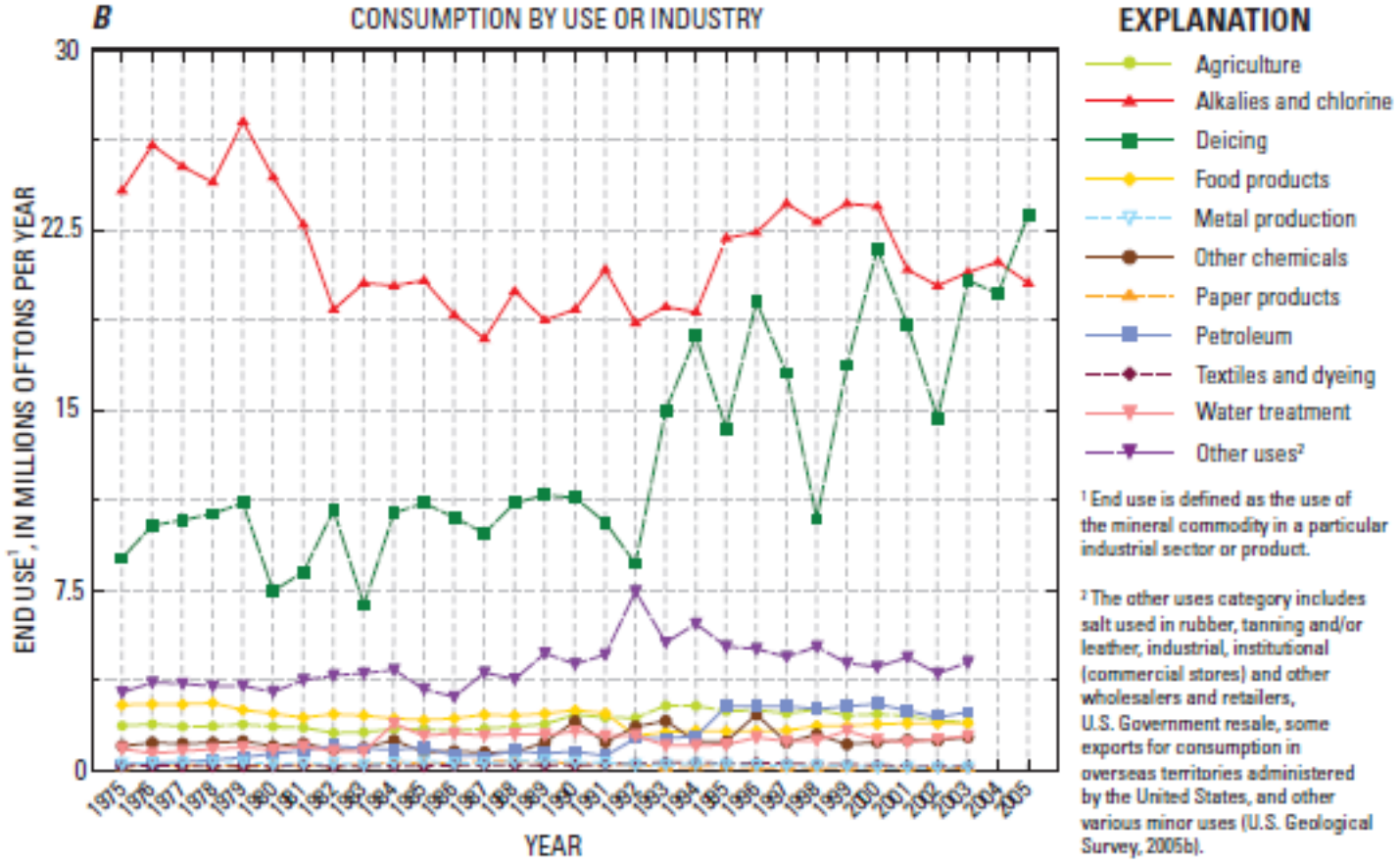
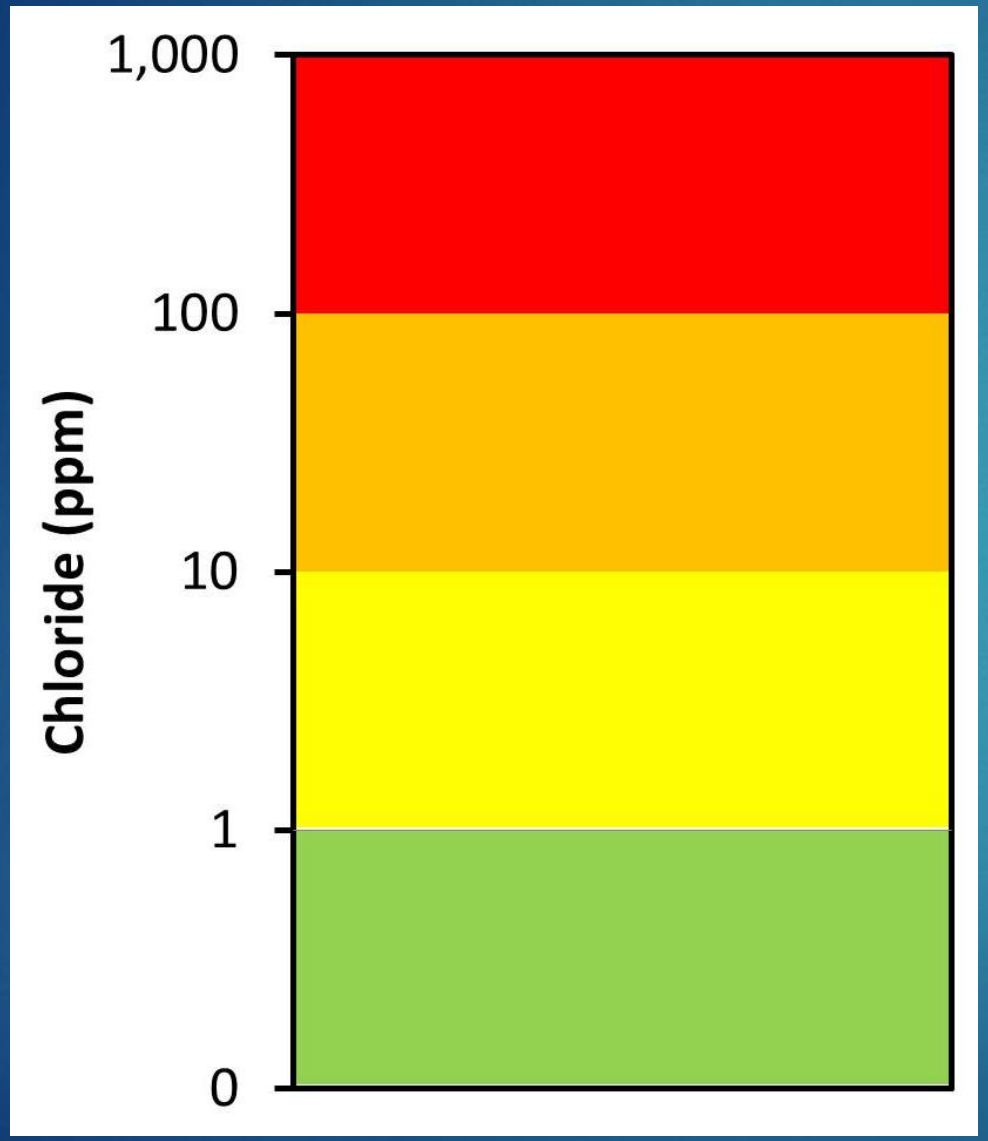


Figure 1. Salt use and consumption in the United States by *(A)* all end users, 1975–2003 (data from U.S. Geological Survey, 2005b), and *(B)* consumption by use or industry, 1975–2005 (data from U.S. Geological Survey, 2005b; Kostick and others, 2007).

Mullaney et al 2009

Chloride aquatic life impacts



High Chronic and Acute Impacts

Mod Chronic and Acute Impacts

Low Chronic Impacts

No Impacts

Chloride impacts on aquatic life

- 50 to 230mg/L
  (Morgan et al. 2007; Environment Canada 2000)
- 240 to 2500mg/L
  (Blasius & Merritt 2002; Berbow & Merritt 2004)
- 5 to 30mg/L
  (Palmer & Yan 2013; Dalinsky et al. 2014)
- 500 to 1000mg/L
  (Affenzeller et al. 2009; Dickman & Gochnauer 1978)

Vermont Water Quality Standards

CHLORIDE

Chloride criteria - 2014

	Chronic	Acute
Magnitude	230 mg/L	860 mg/L
Duration	Four day average	One hour average
Frequency	once per 3 year period	

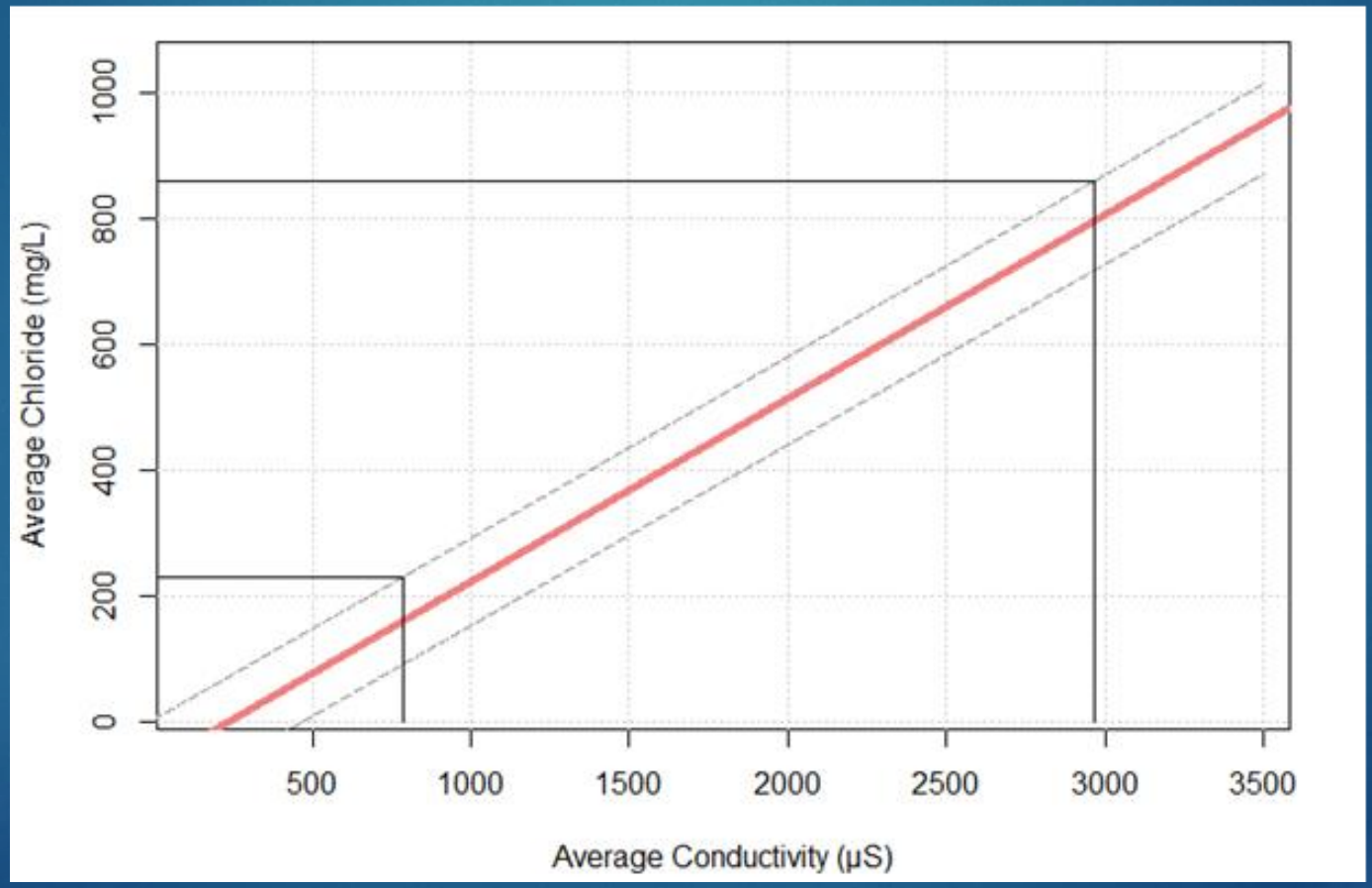
- WQS to protect aquatic life use in waterways
- Data driven
- Exceedances = impaired (303d listed)

Assessment approach

- Tight relationships can be constructed between Cl- and conductivity
- Conductivity is readily measured in-situ using multiprobes
- Workshop topic

Conductivity/Chloride relationship

Chloride (mg/l) = -69.72 + 0.292 * Specific Conductance (uS)



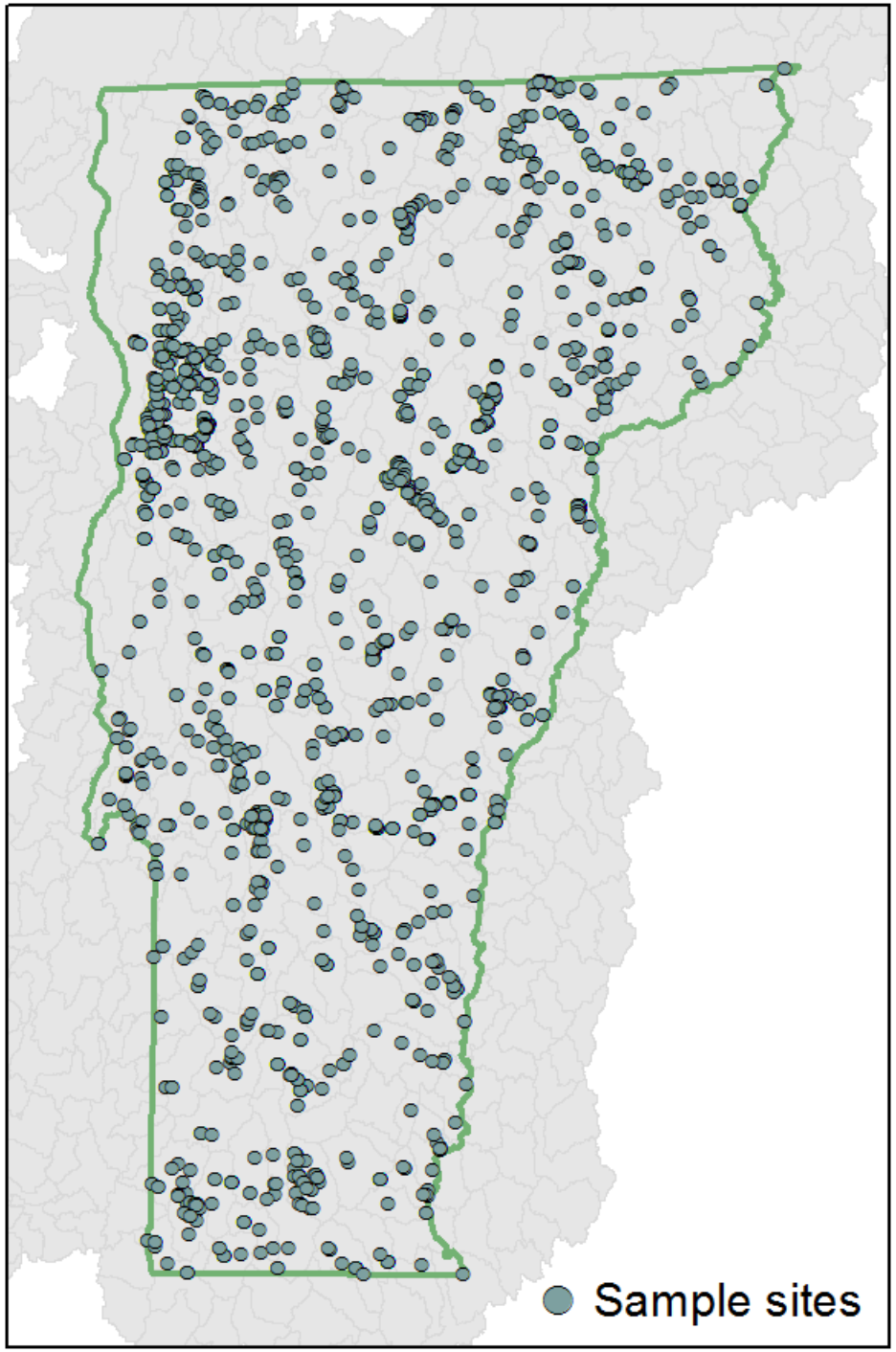
Critical Periods for High Chloride Concentrations

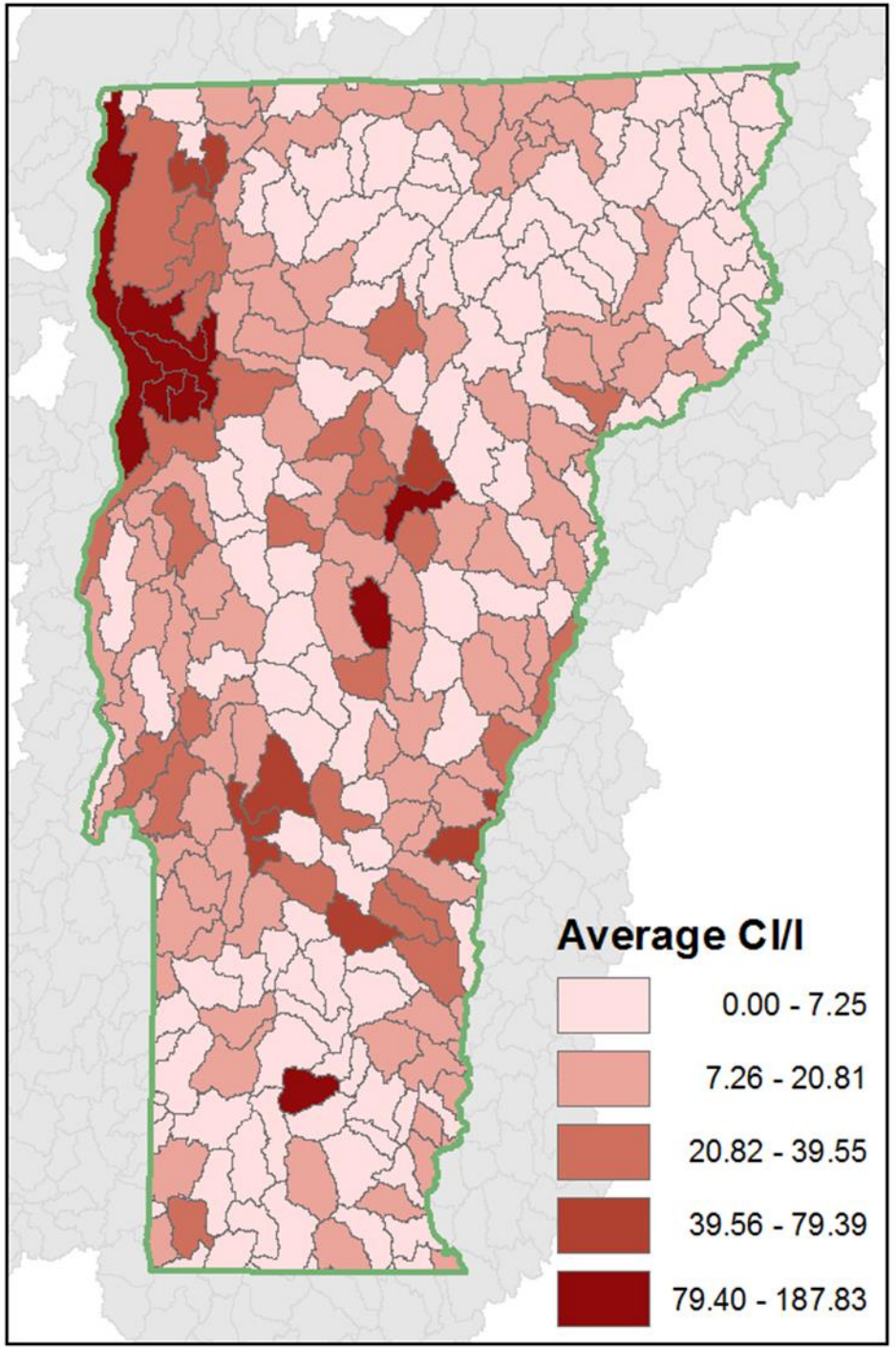
- Winter melt/runoff events
  - Chloride can flow with meltwater into waterways from areas treated with deicing salt
    - Snowbanks
    - Impervious surfaces
    - Adjacent land
- Summer low flow conditions
  - Chloride residues can percolate freely into shallow groundwater and into waterways

Chloride concentrations - streams

2005 – 2016

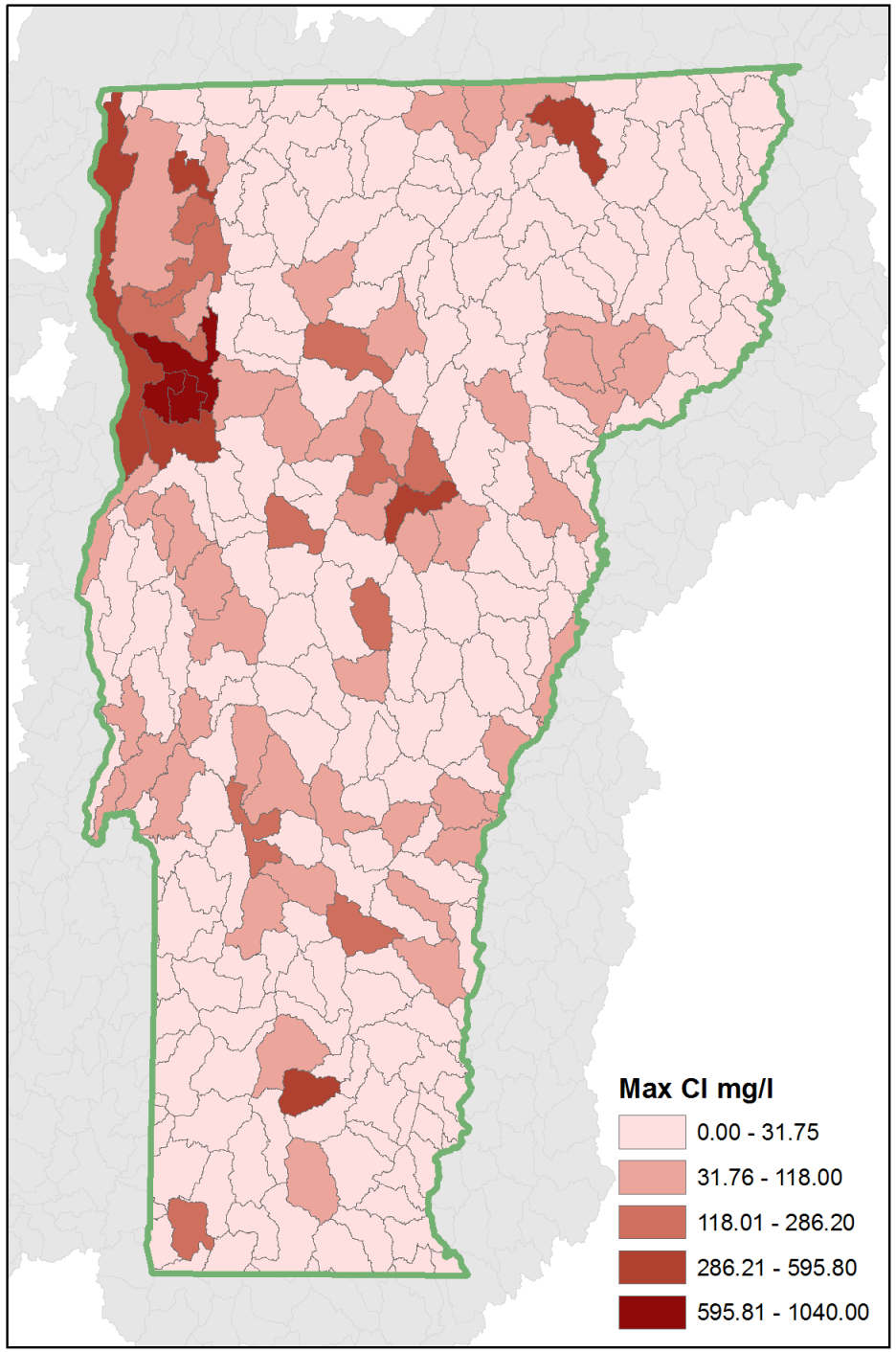
INCLUDES SOME CHLORIDE TARGETED AREAS

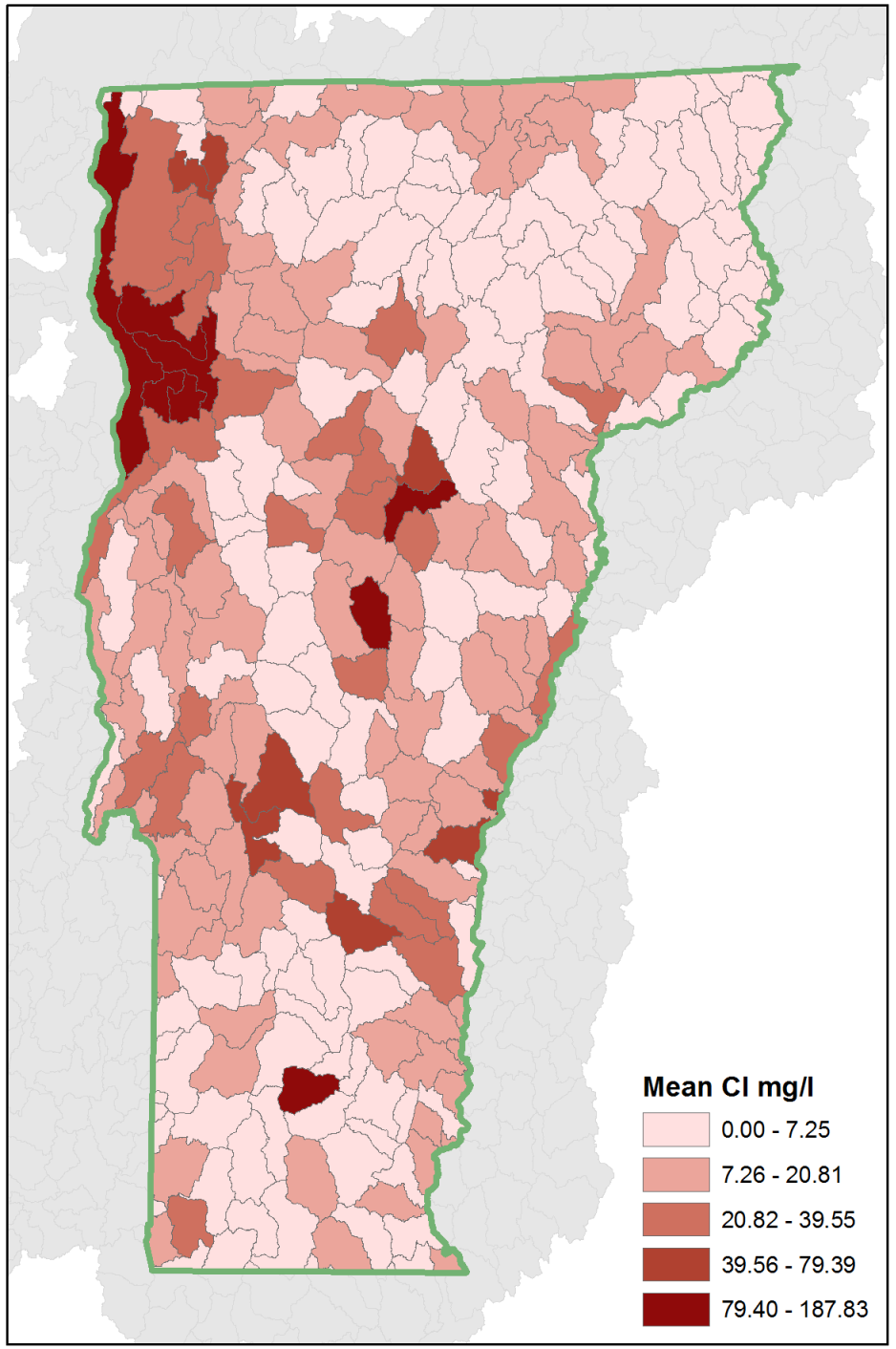




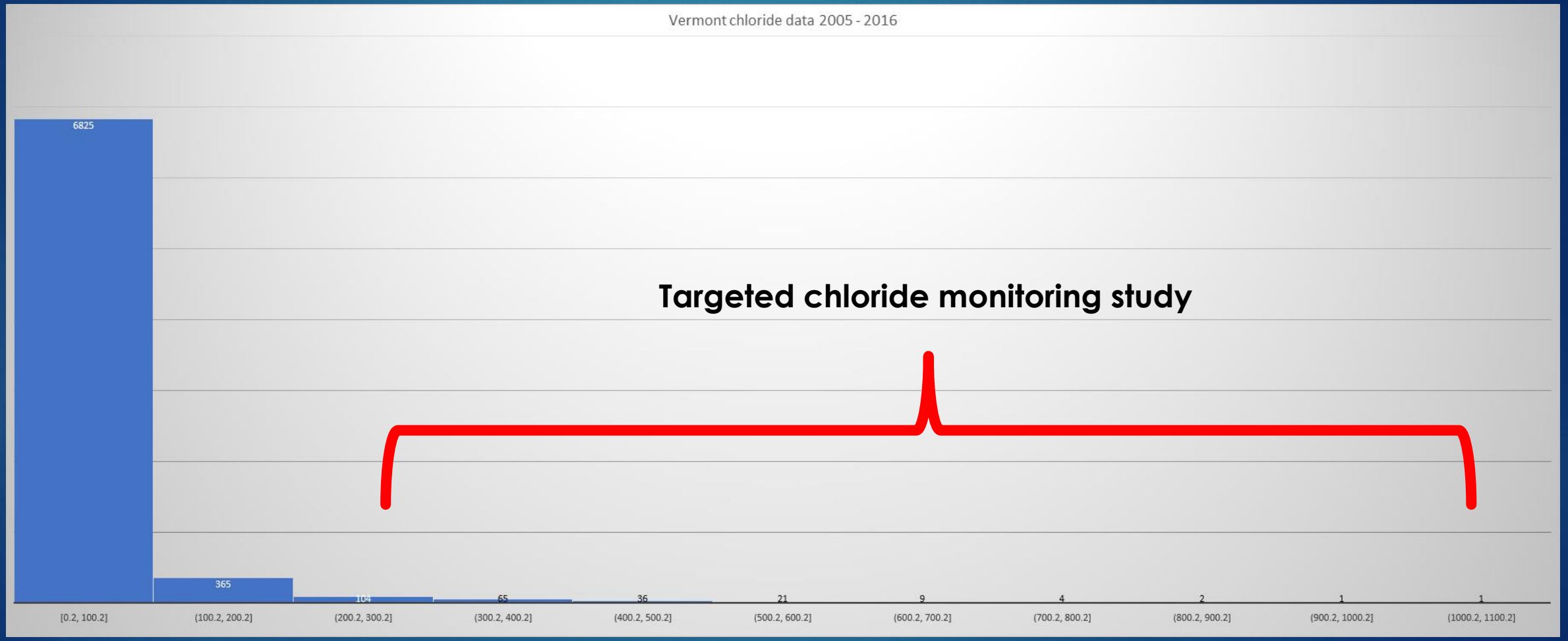
Chloride sample sites

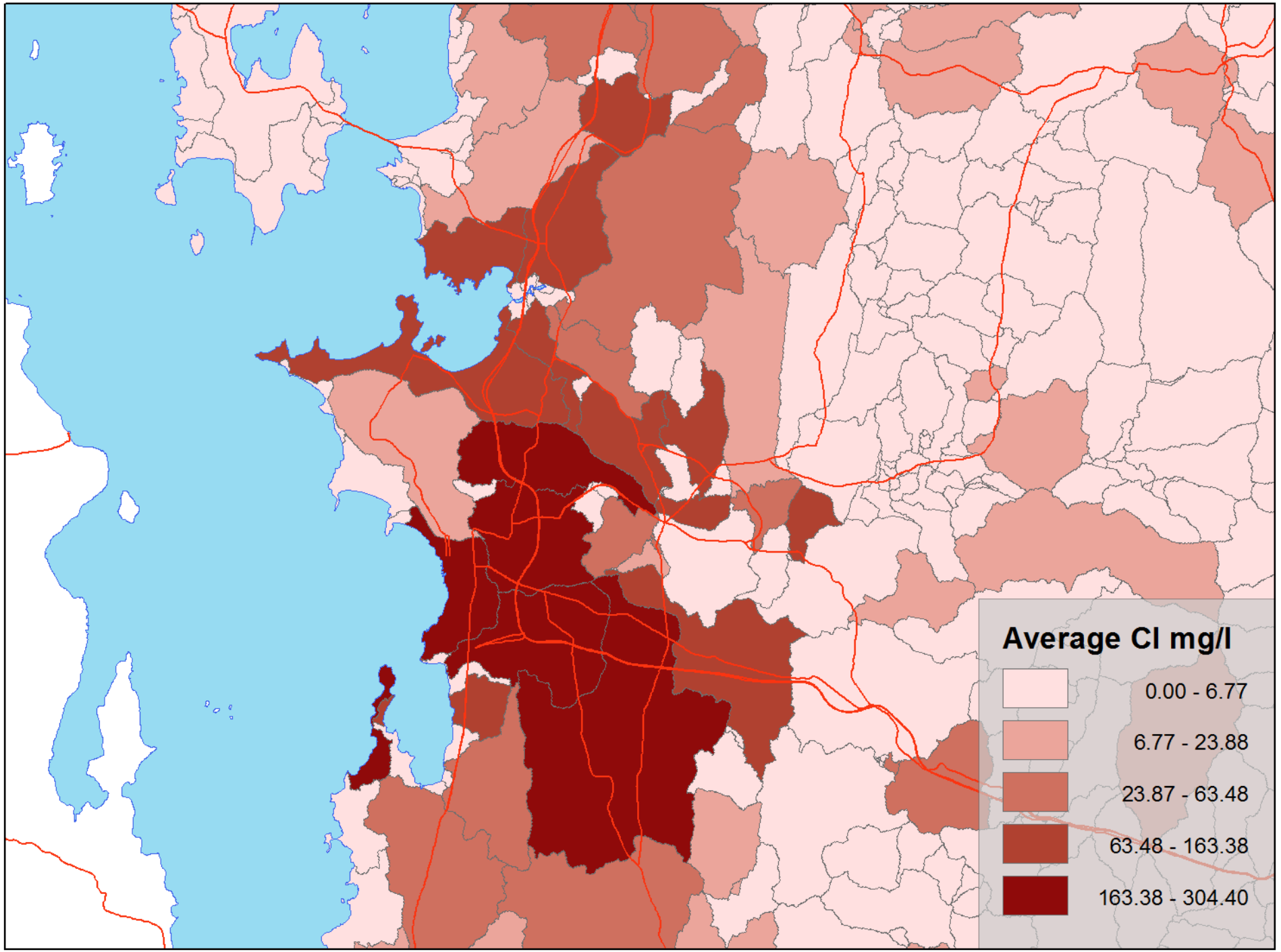
2005-2016


Max Cl mg/l
0.00 - 31.75
31.76 - 118.00
118.01 - 286.20
286.21 - 595.80
595.81 - 1040.00


Mean Cl mg/l
0.00 - 7.25
7.26 - 20.81
20.82 - 39.55
39.56 - 79.39
79.40 - 187.83

Vermont stream data 2005 - 2016




Average Cl mg/l
0.00 - 6.77
6.77 - 23.88
23.87 - 63.48
63.48 - 163.38
163.38 - 304.40

Vermont Stormwater regulations

APPLICABLE TO CHLORIDE

Stormwater Program
Regulatory Requirements related to Chloride

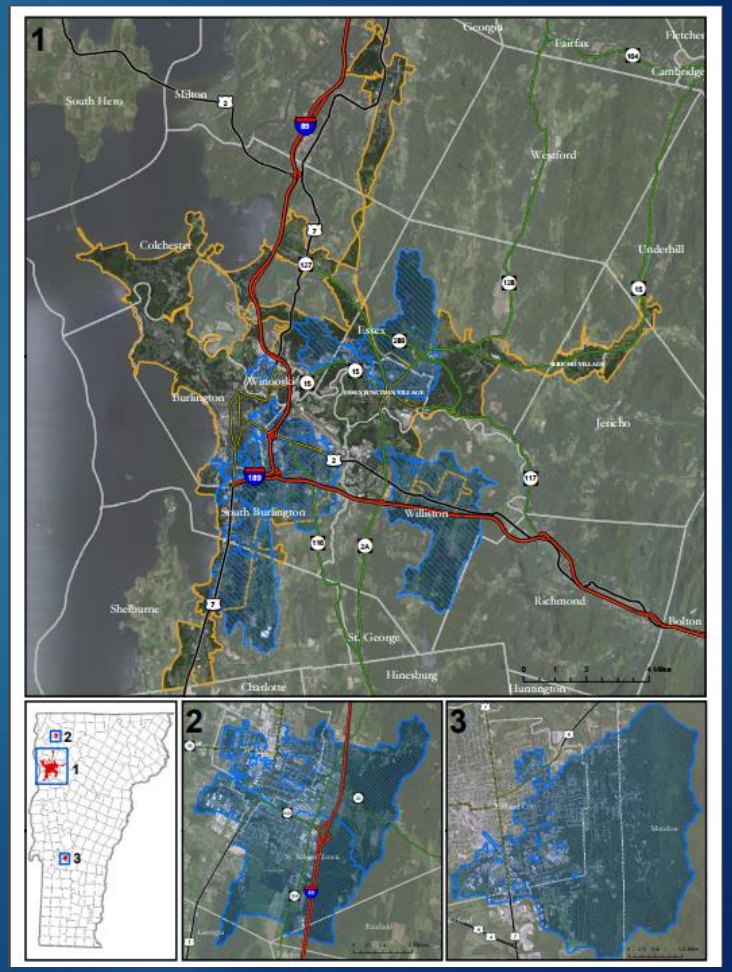
MSGP – Multi-Sector General Permit

- Stormwater discharges from certain categories of industrial activity
- All regulated facilities must enclose or cover salt piles and minimize exposure when adding to or removing salt from the piles

Stormwater Program
Regulatory Requirements related to Chloride

MS4 Permit – Municipal Separate Storm Sewer System (MS4)

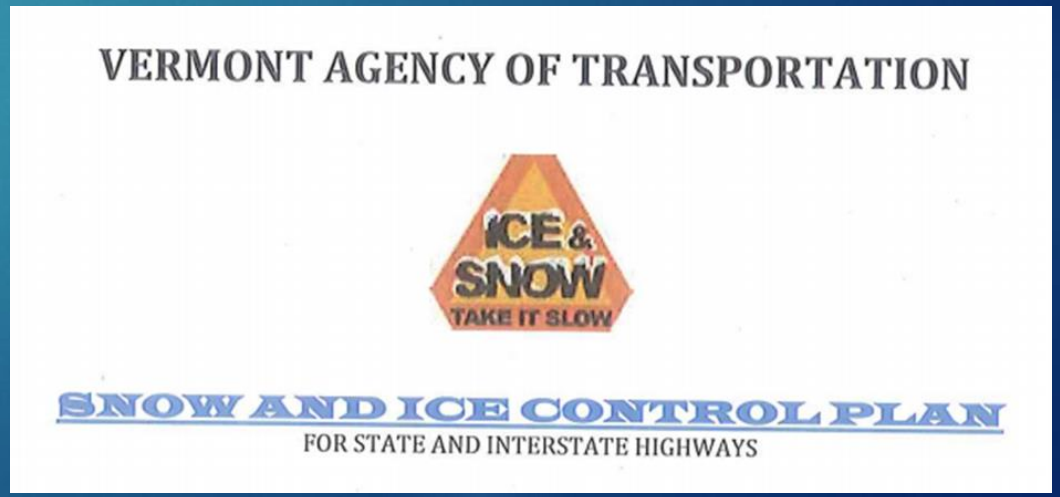
- Stormwater discharges from municipal conveyances within census designated urbanized areas and stormwater impaired watersheds
  - 12 municipalities (Burlington, Colchester, Essex, Essex Junction, Milton, Rutland Town, St. Albans City and Town, Shelburne, South Burlington, Williston, and Winooski)
  - UVM, BTV, and VTrans



MS4 Permit Requirements
for Impaired Waters in need of a TMDL

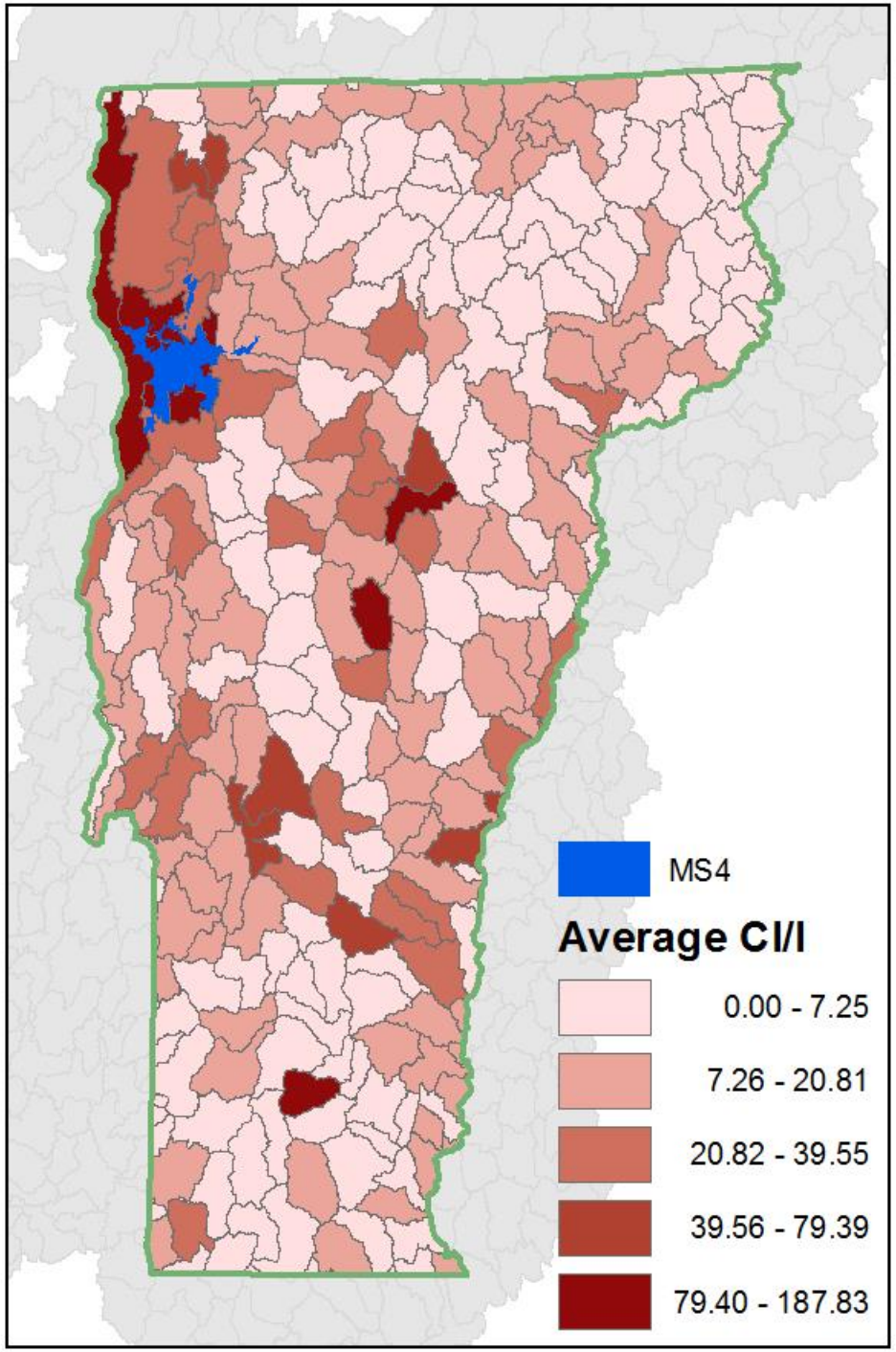
- Develop a response plan to address how municipal discharges will be controlled to ensure compliance with the WQS

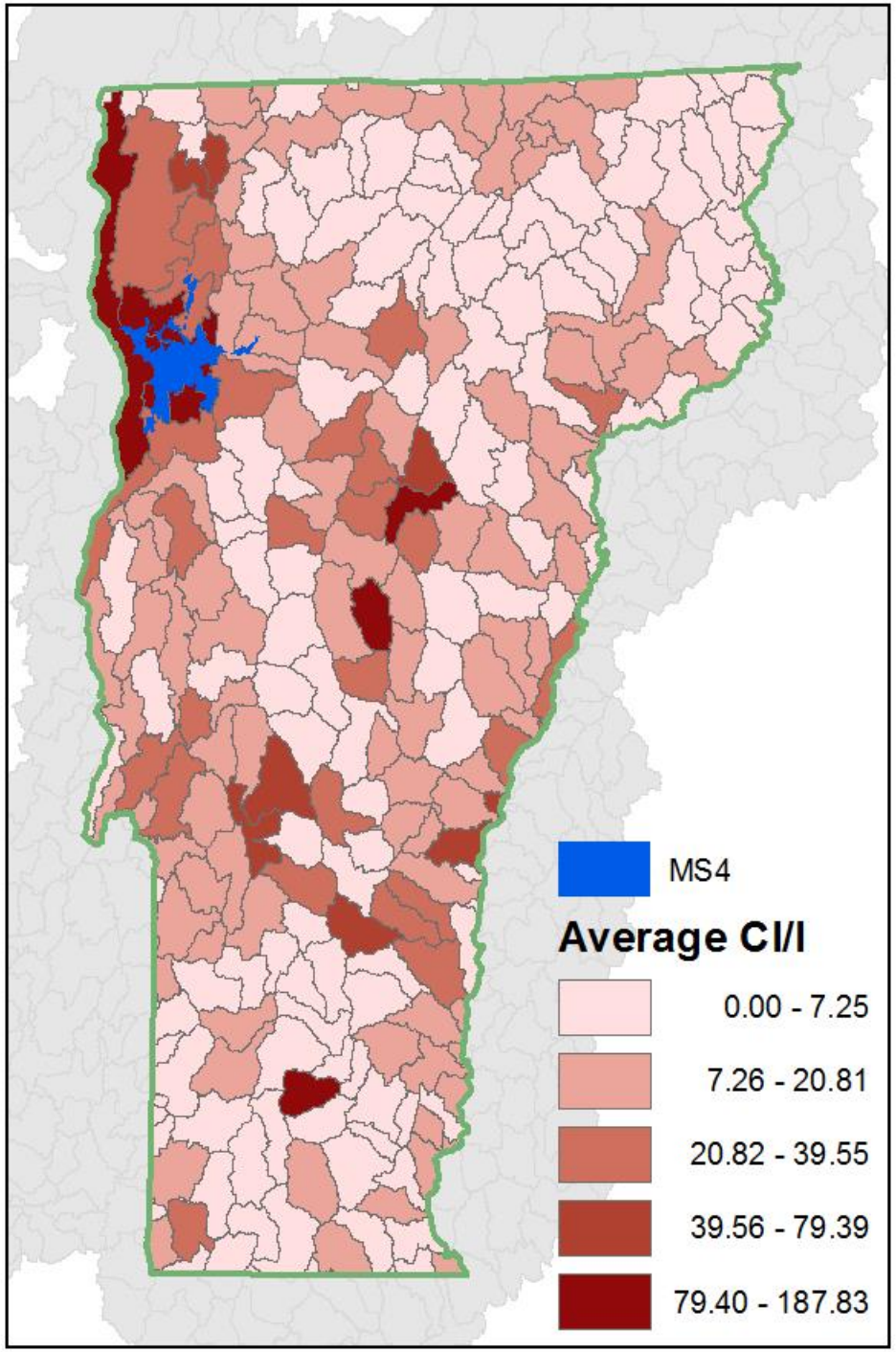
- Achieve an increased level of control through additional BMPs or enhancement of existing BMPs



What might a response plan include?

- Evaluate needs and revisit desired conditions
- Maximize physical removal of snow vs. salt
- Anti-icing vs. de-icing
- Use alternatives or incorporate non-chloride products
- Applicator is properly trained in all aspects of winter maintenance
- Housekeeping


MS4
Average CI/I
0.00 - 7.25
7.26 - 20.81
20.82 - 39.55
39.56 - 79.39
79.40 - 187.83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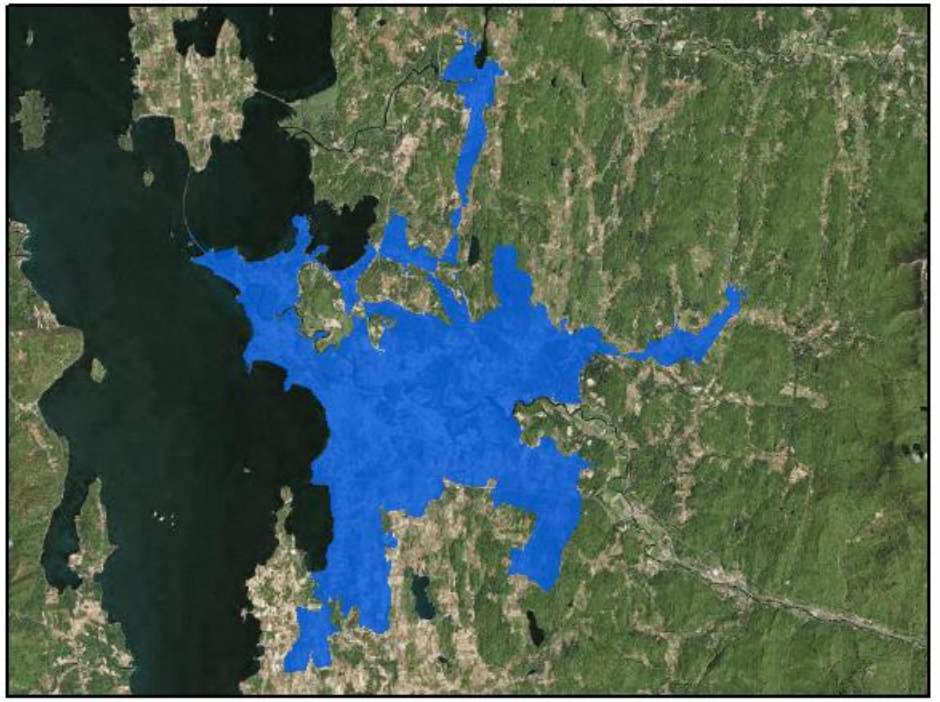
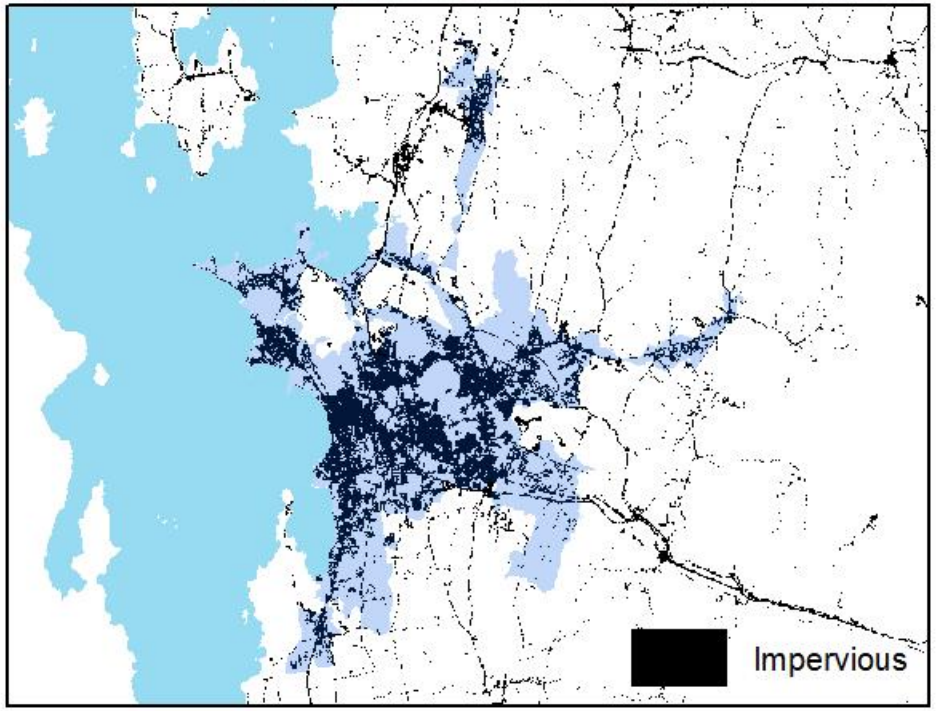
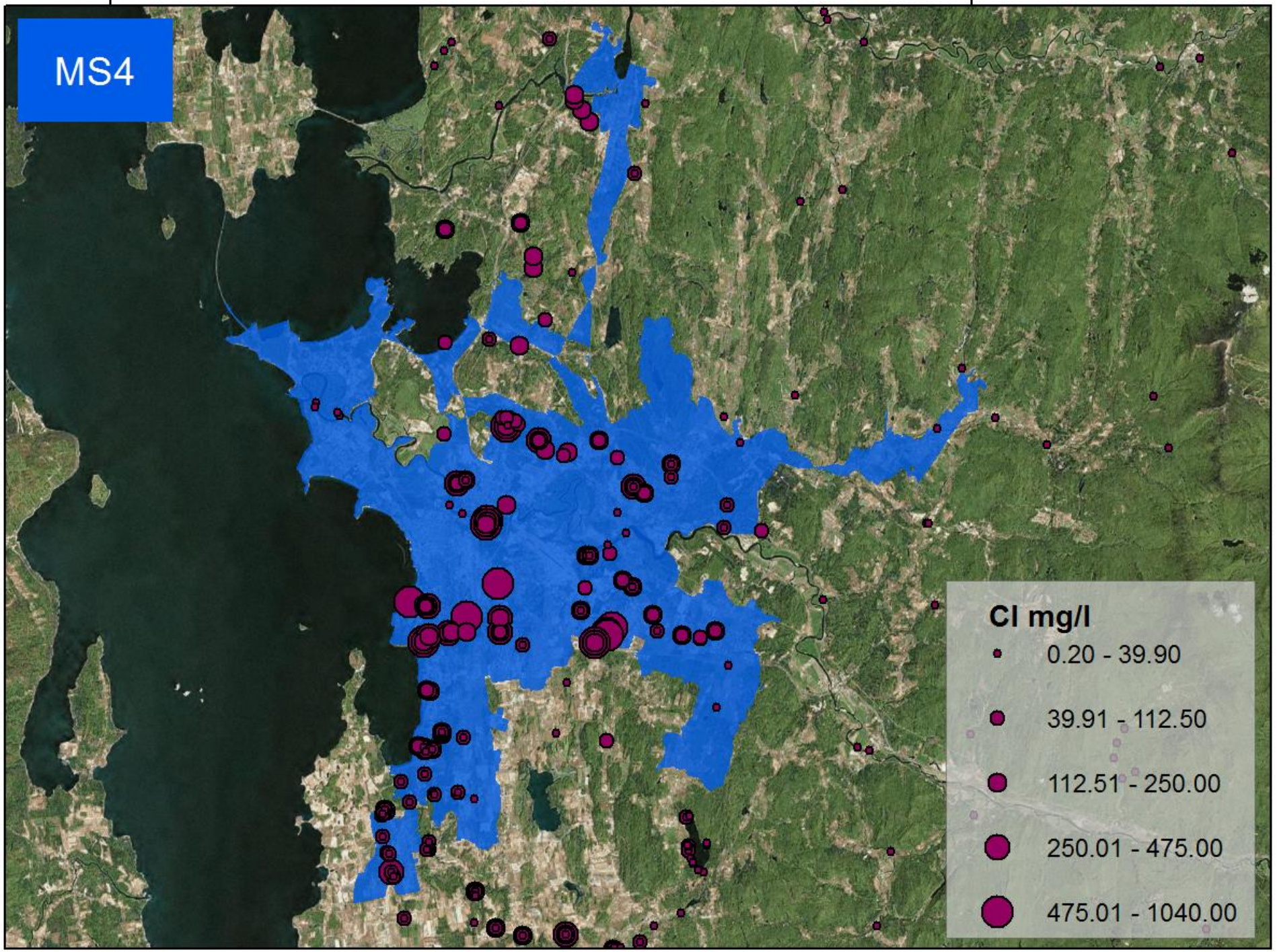



Impervious


MS4
Cl mg/l
0.20 - 39.90
39.91 - 112.50
112.51 - 250.00
250.01 - 475.00
475.01 - 1040.00

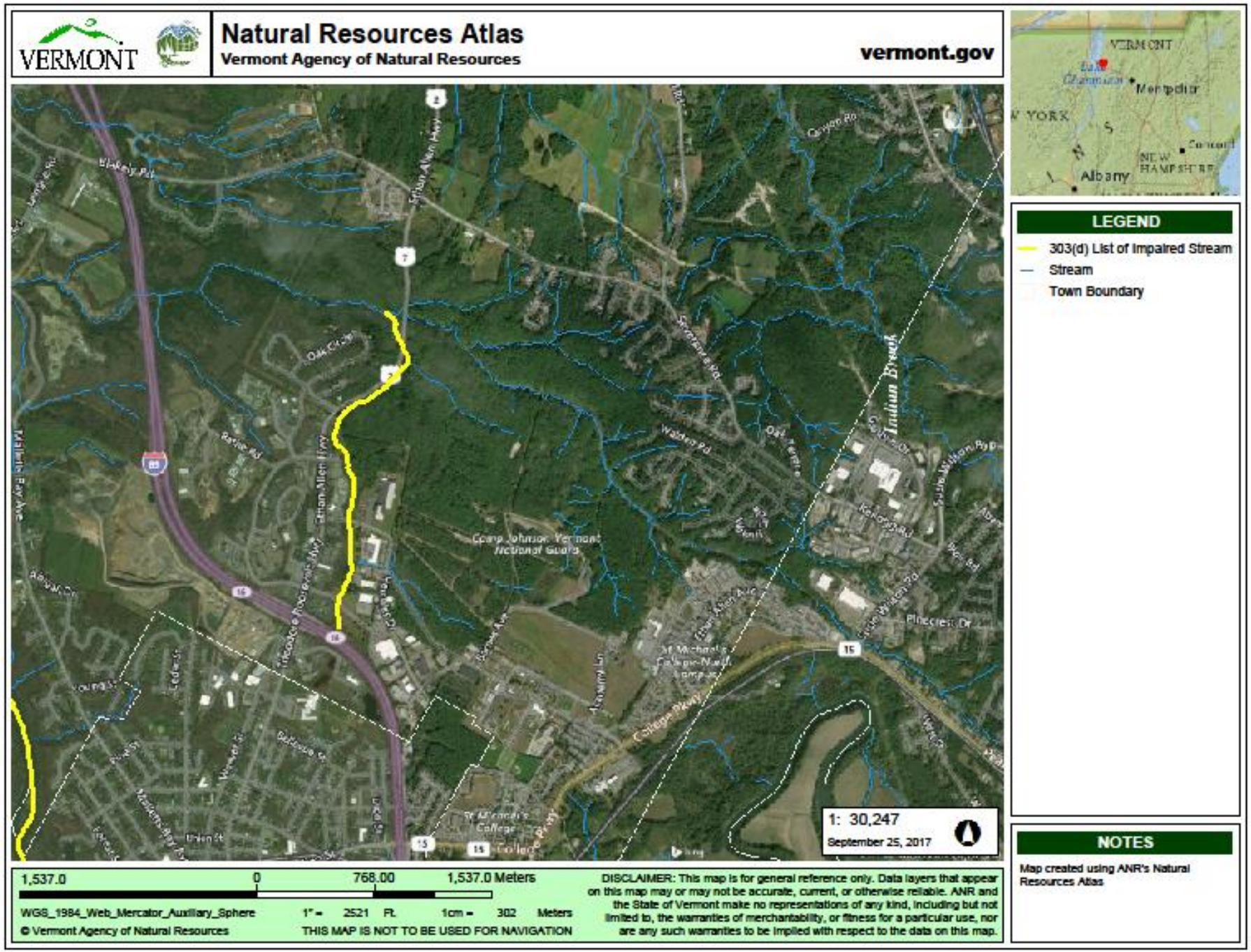
Chloride impaired streams

MS4 PERMIT APPLICATION

WATERSHED CONDITIONS

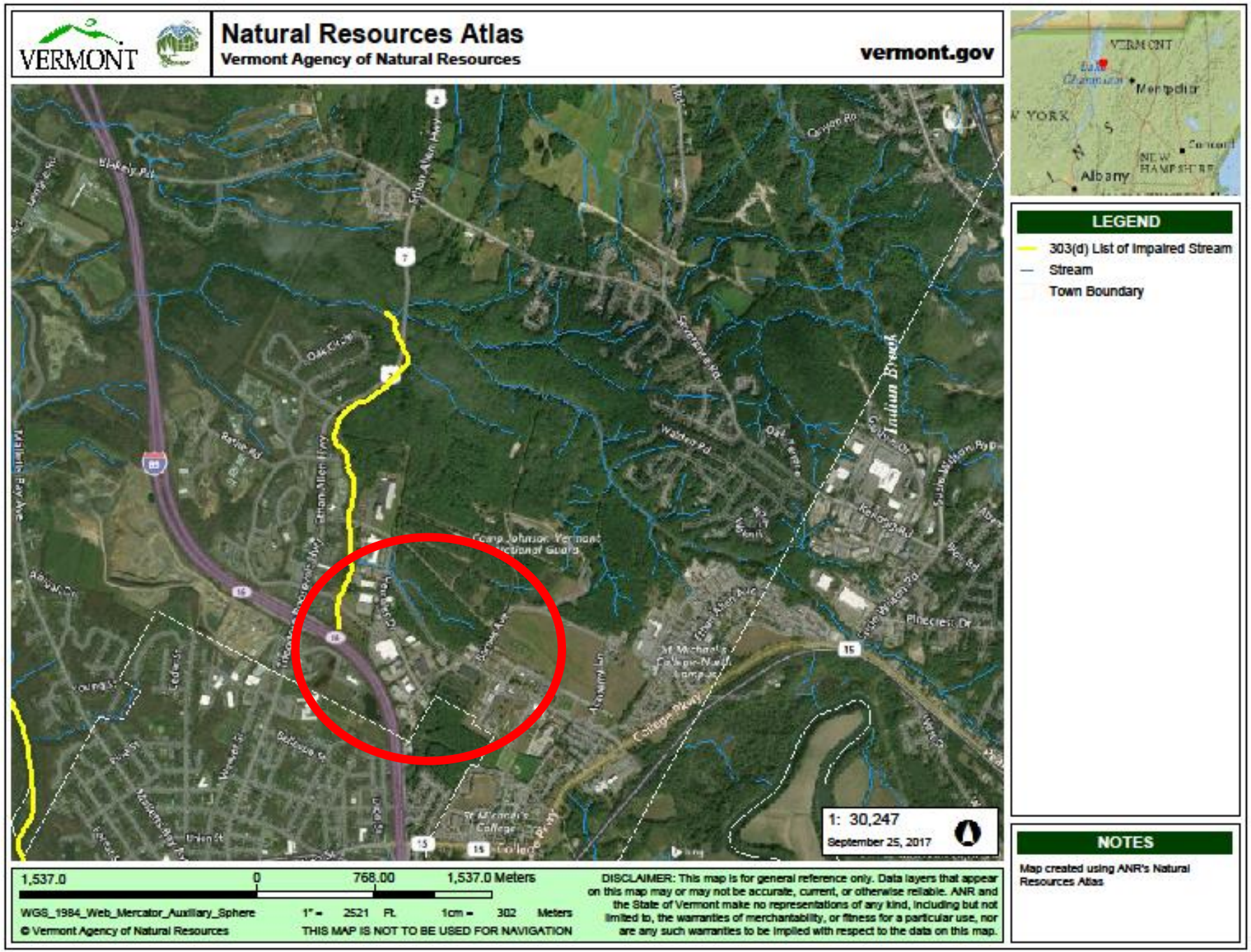
MS4 provisions applicable to two impaired streams

- Muddy Brook – Williston MS4, VTrans TS4
- Sunnyside Brook – Colchester MS4, VTrans TS4



Sunnyside Brook trib:

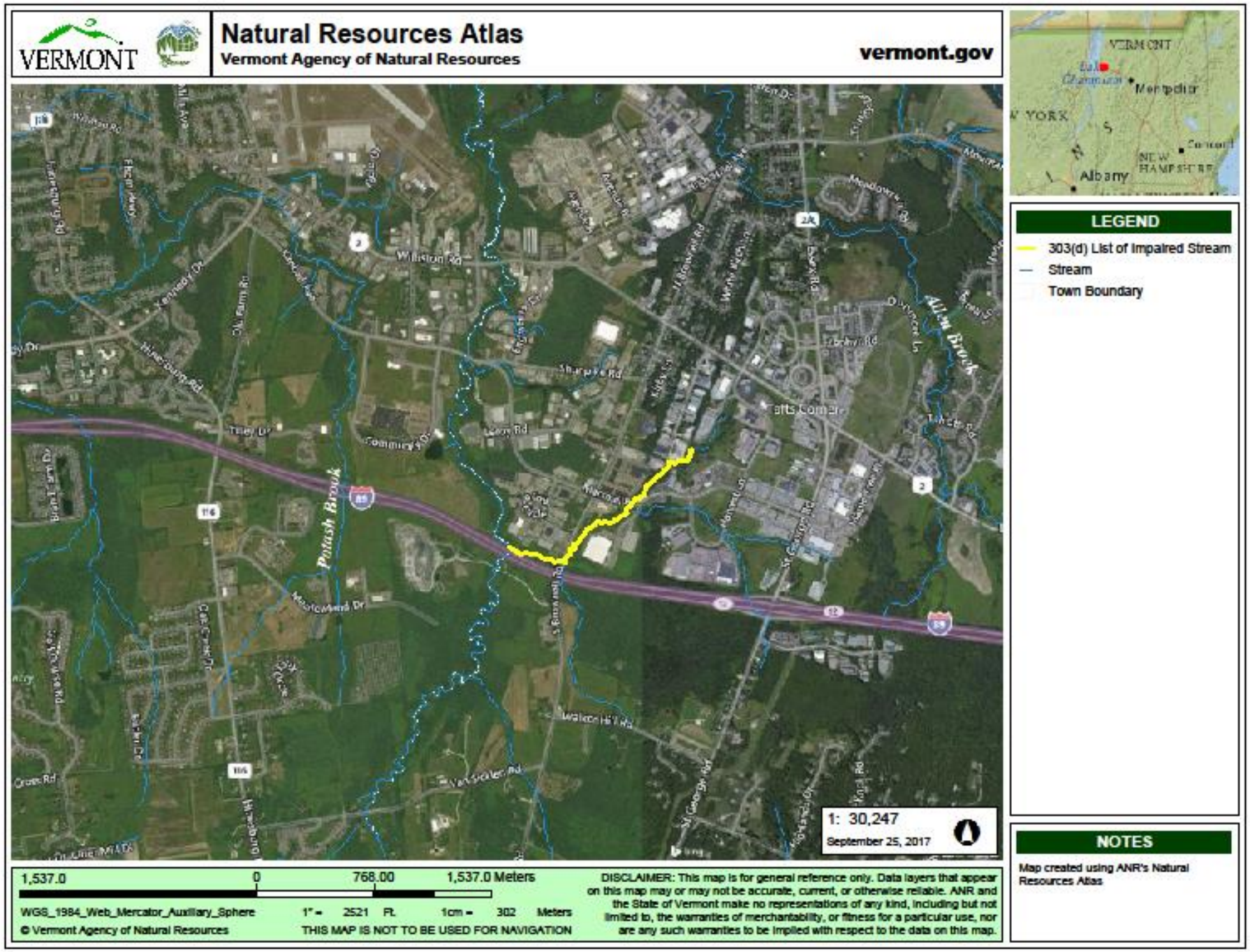
Chloride impaired stream



Sunnyside Brook trib:

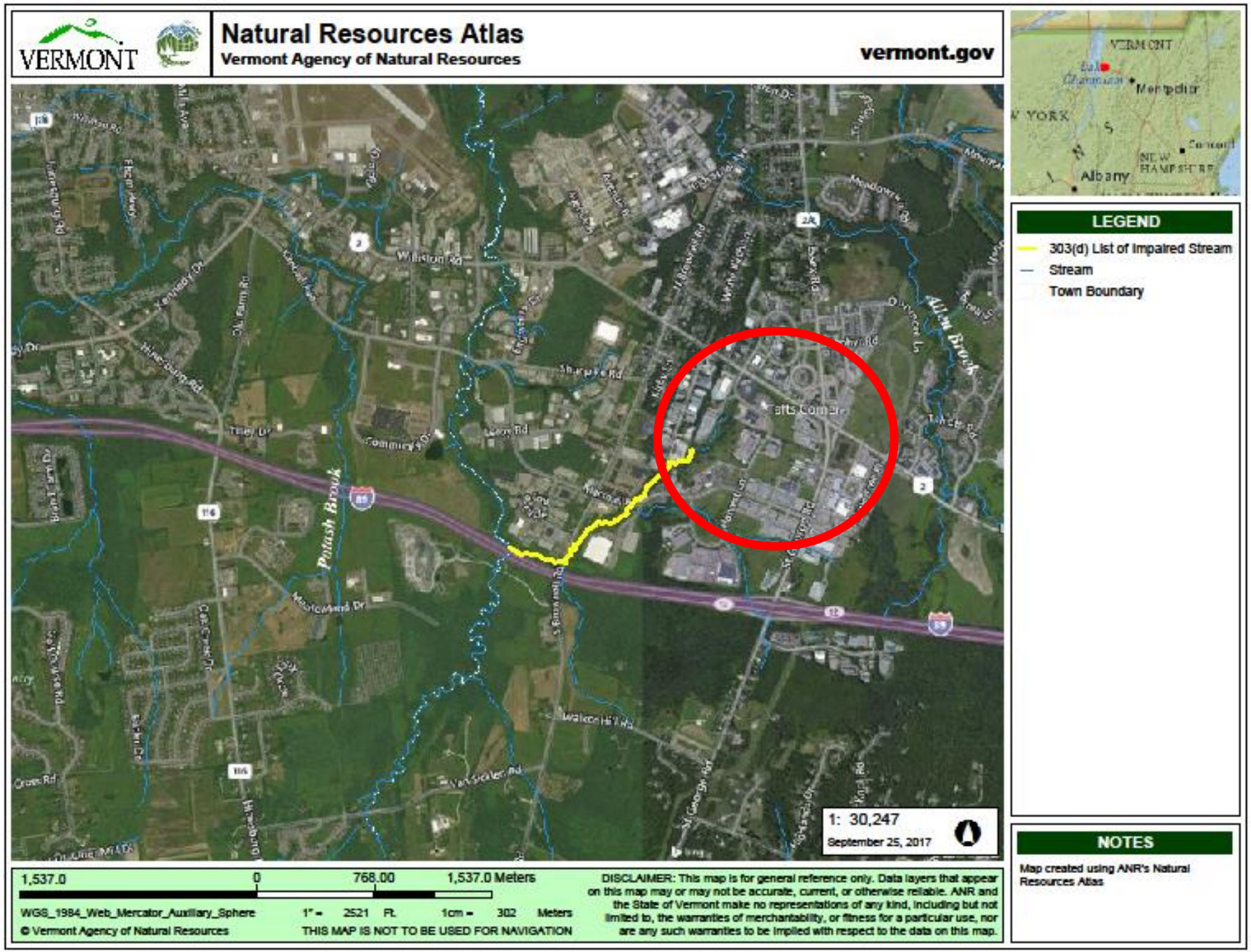
Chloride impaired stream

Headwaters a mix of roads and private parking lots



Muddy Brook trib:

Chloride impaired stream



Muddy Brook trib:

Chloride impaired stream

Headwaters a mix of roads and private parking lots

Future monitoring

- Targeted chloride monitoring likely to uncover more Cl impaired streams; possibly outside of MS4 permit areas
- VTDEC Urban Stream Assessment Report 2007
  - Examined urbanized streams in a range of biological attainment status for Cl- concentrations
  - Good starting point to verify impacts/impairments
- Expand monitoring to other potentially impacted areas

Workshop benefits

- Great opportunity to hear from other regions on things that have worked for Cl reduction
  - Reproducible in VT?
- Response plan components
  - Provides great opportunity for VT MS4 municipalities to learn about practices they my need to incorporate into their MS4 permit requirements
- Education for applicators: public and private entities
  - Cost/benefit win-win
- Applicators can bring information home as a cost-benefit for towns and clients