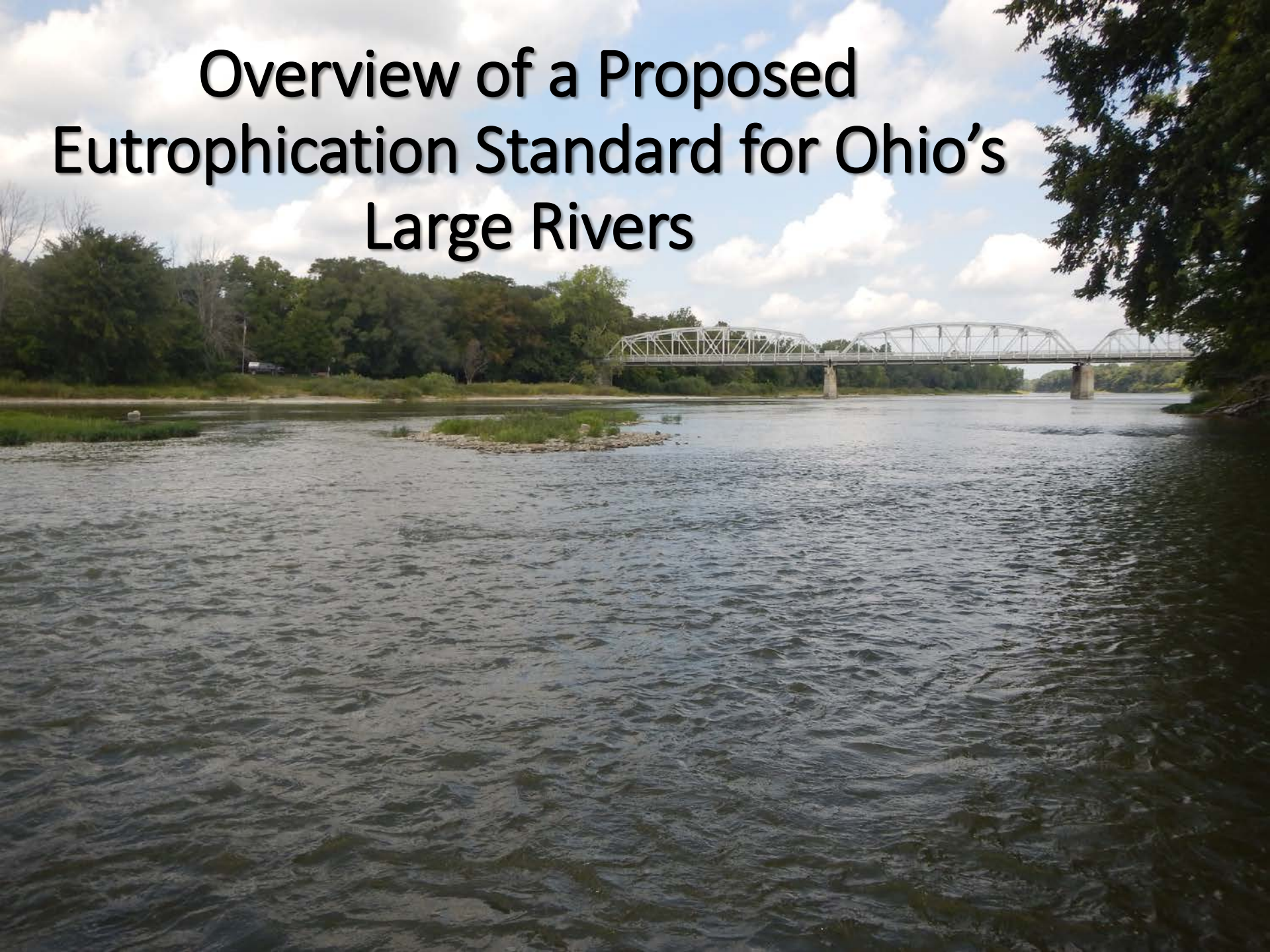


Overview of a Proposed Eutrophication Standard for Ohio's Large Rivers



Eutrophication in Visual Context



GMR when chlorophyll > 100 ug/l

GMR when chlorophyll < 50 ug/l

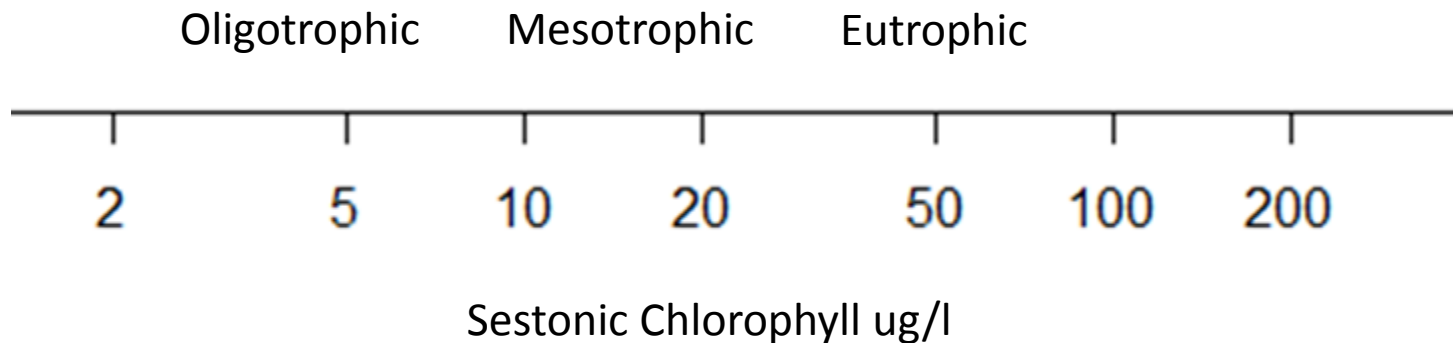


Ohio Chlorophyll Levels in Context

Ohio (all data)	25 th 13	50 th 34	75 th 69	max 337
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Thames Basin Maximums*	25 th 15	50 th 42	75 th 85	max 328
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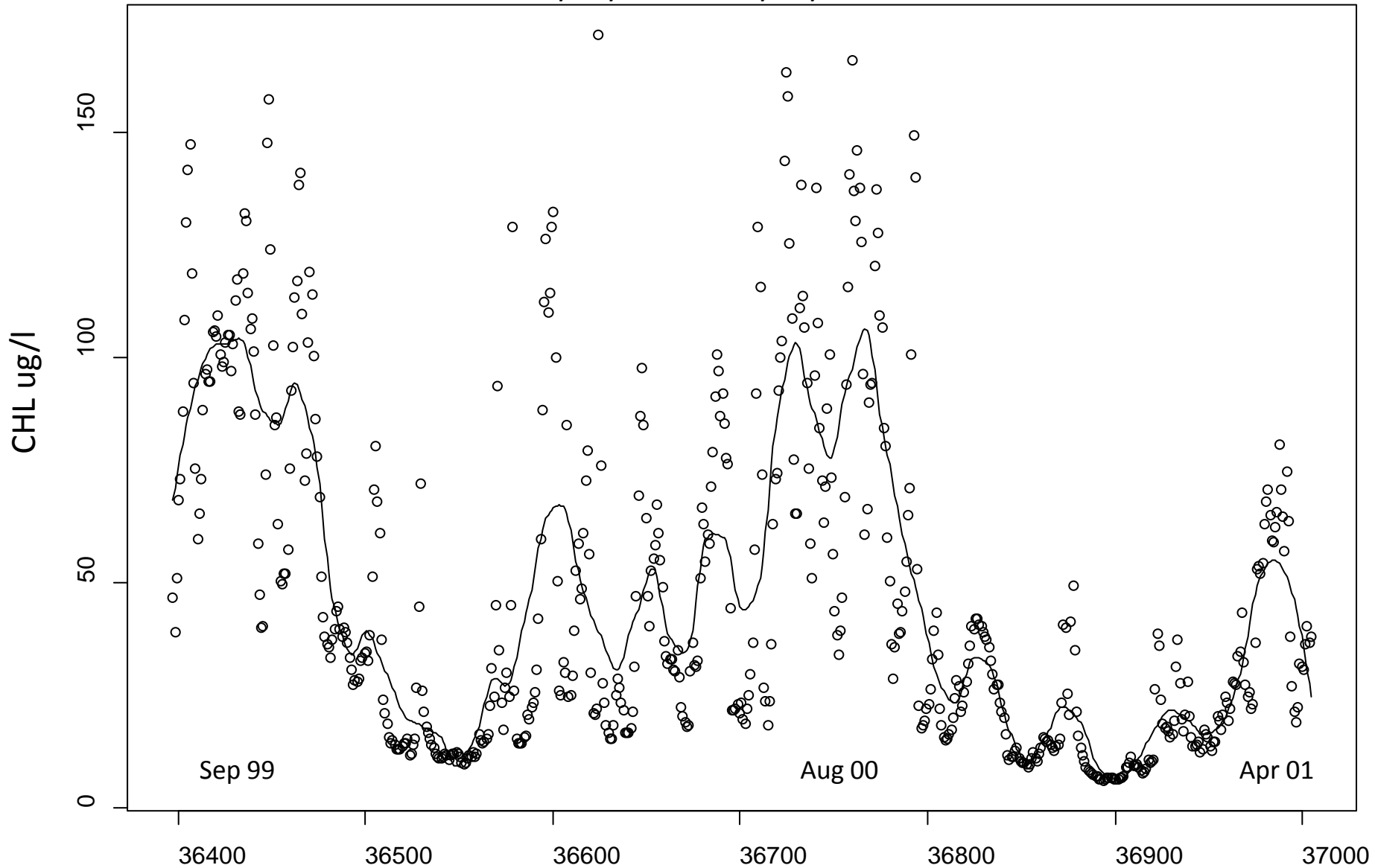
Van Nieuwenhuyse & Jones 1996 (all data)	25 th 4.9	50 th 17	75 th 35	max 170
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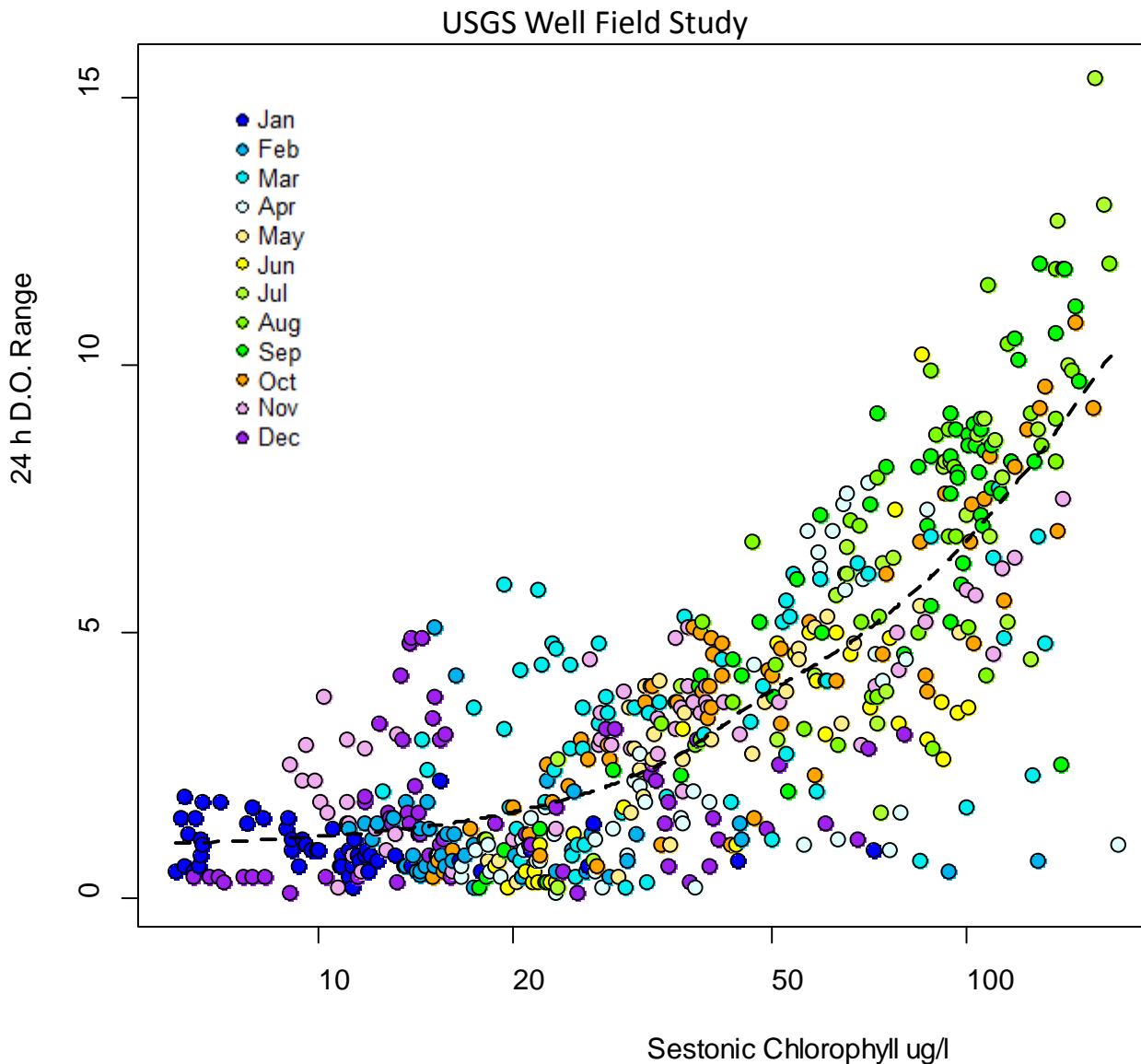
^a 21 sampling stations sampled weekly over three years

Daily Water Column Chlorophyll II in the GMR

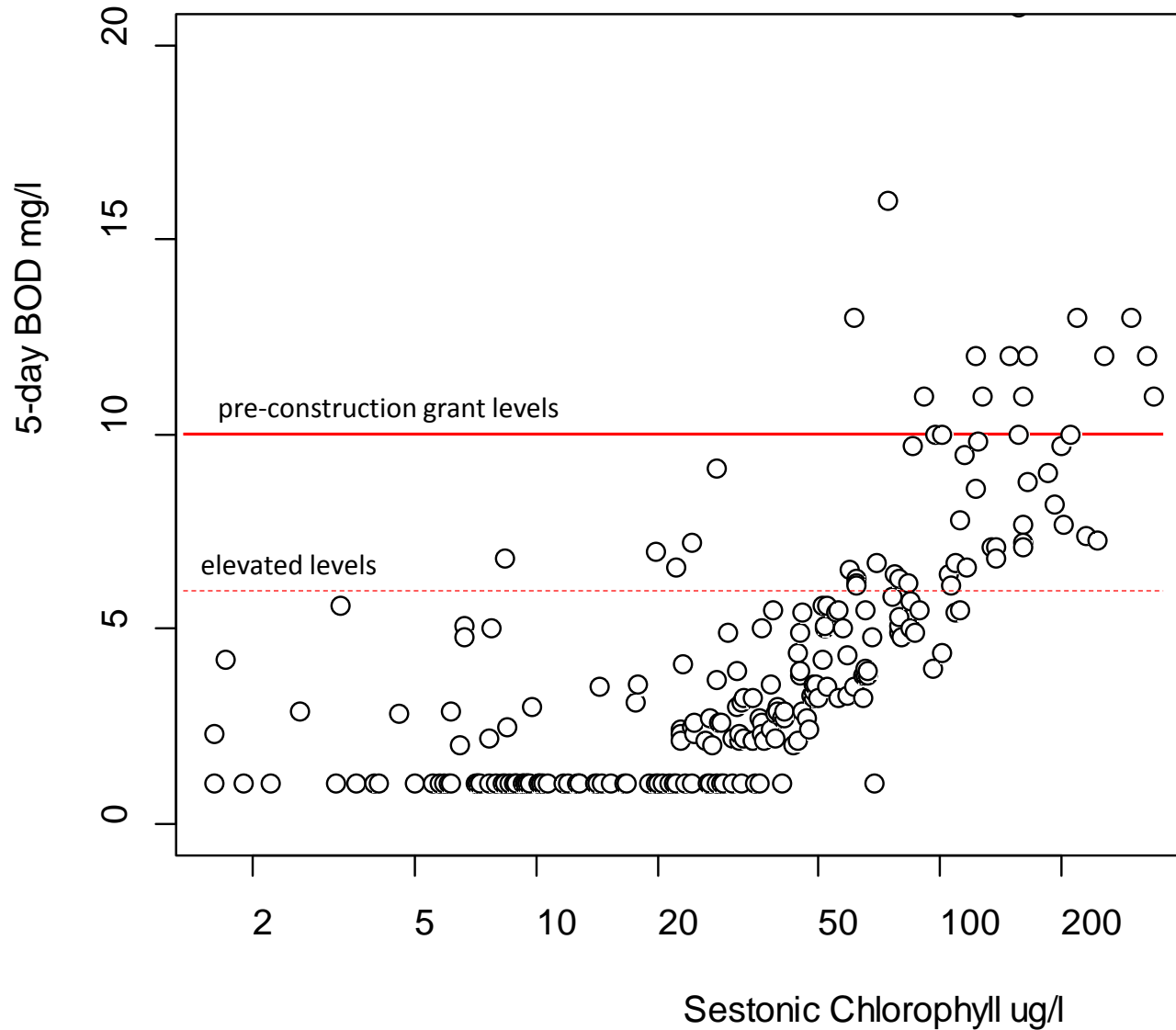
USGS Data From 8/25/1999 to 4/15/2001 Near Bolton Well Field



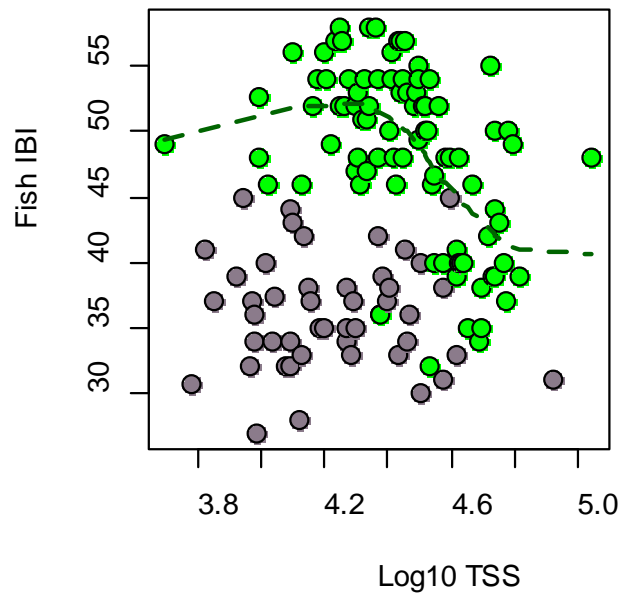
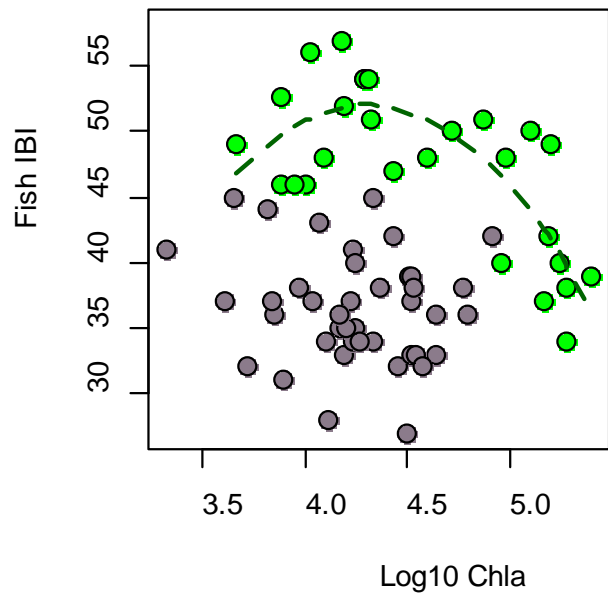
Daily Oxygen Range and ChlorophyllII



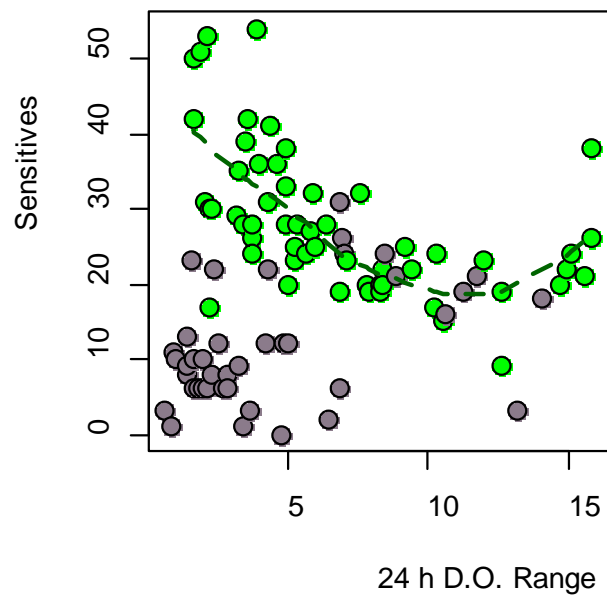
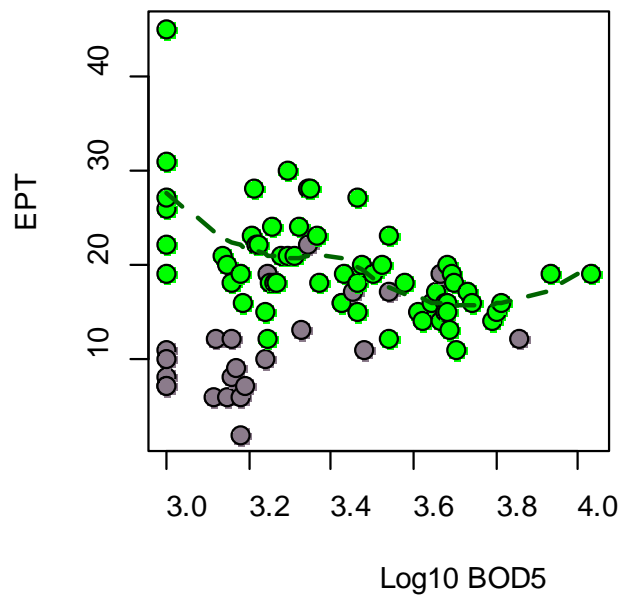
5-day Biological Oxygen Demand and ChlorophyllII



Biological Indicators and Eutrophication



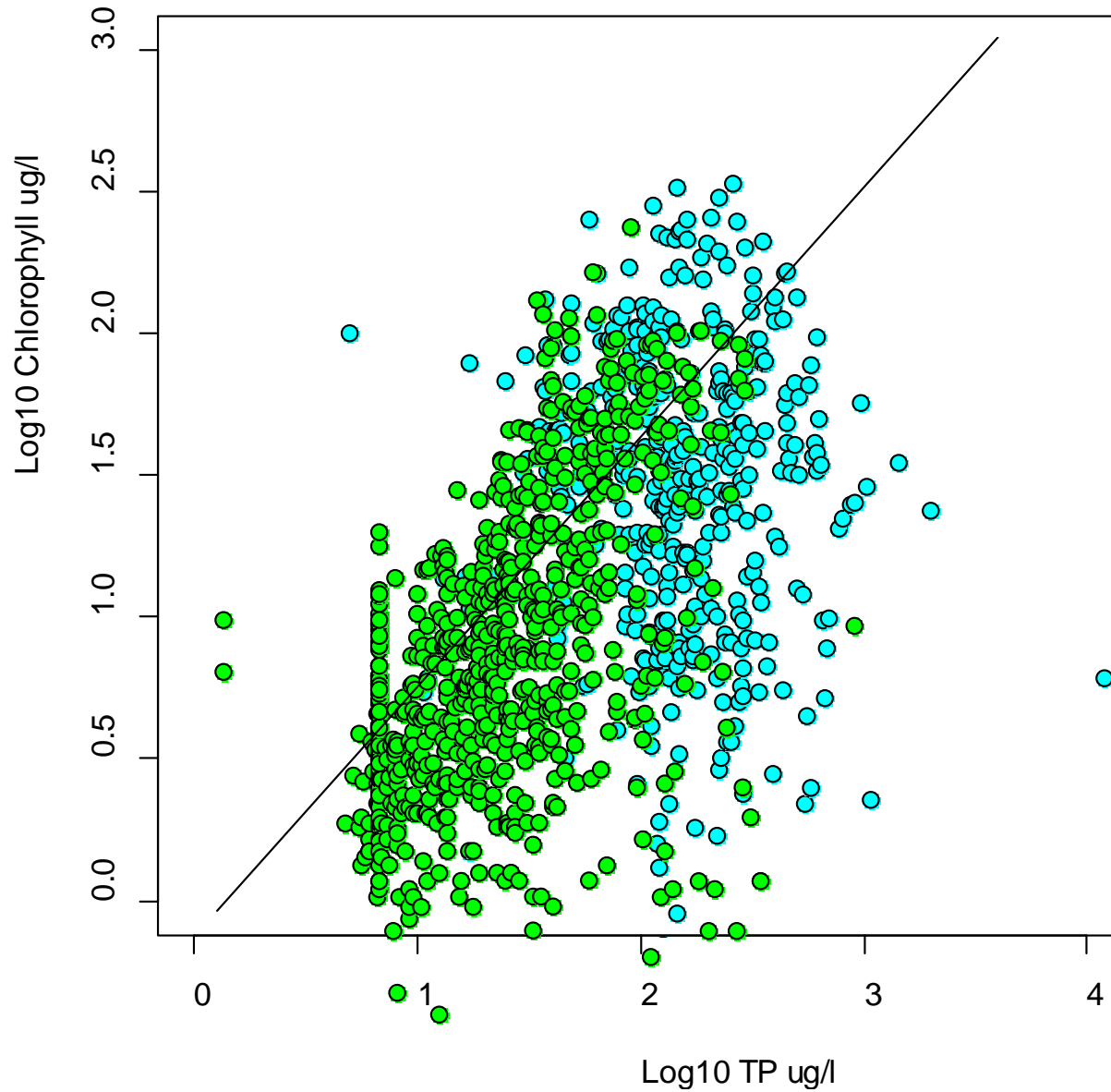
- Rivers w/o legacy problems
- Rivers with legacy problems



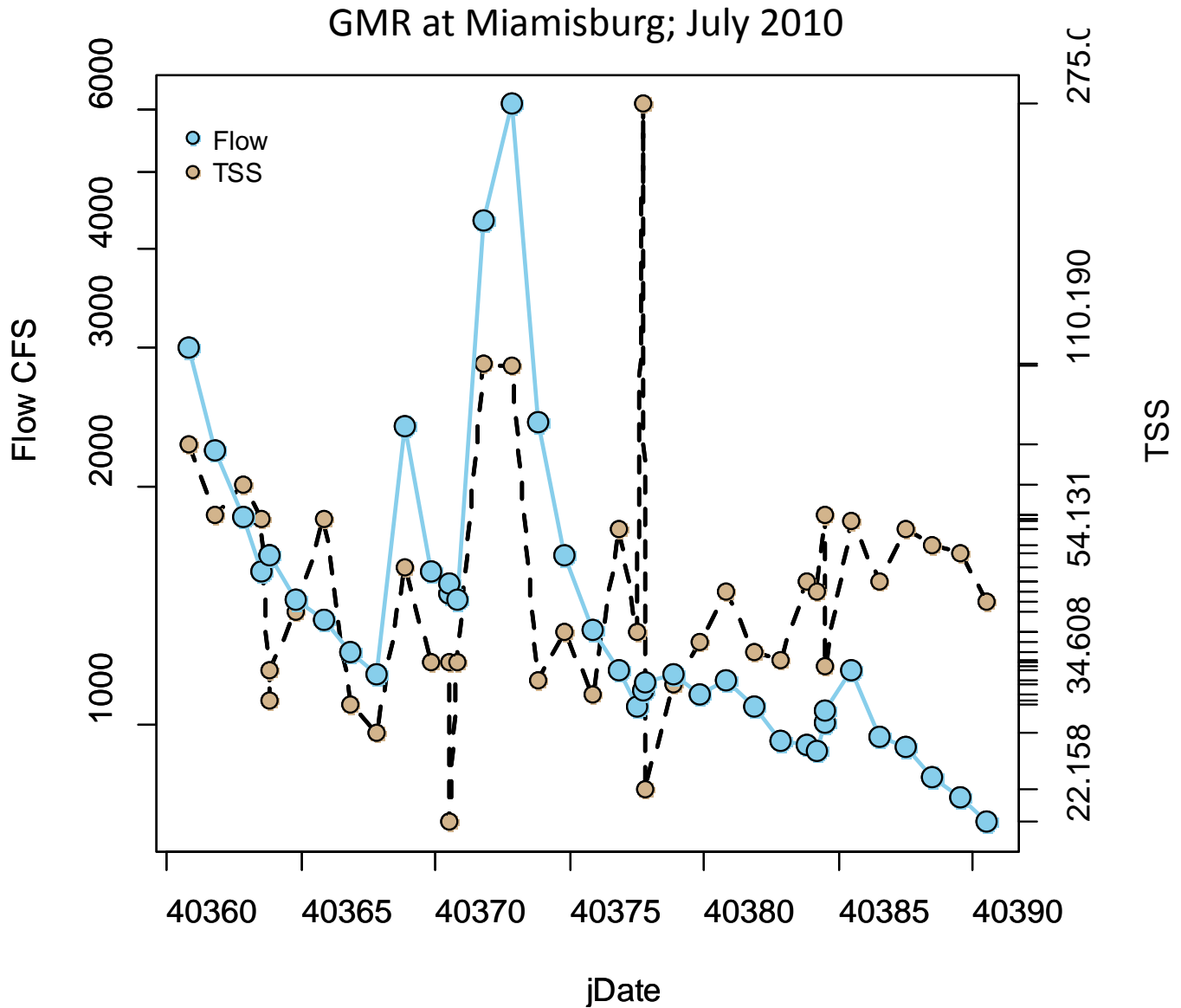
Eutrophication Standard - Box Model

	Acceptable	Enriched or Over Enriched	Over Enriched
Indicator		Chronic Condition	Acute Condition
Sestonic Chlorophyll	<30 ug/l as seasonal average	<p><u>Magnitude</u> 30 < 100 ug/l seasonal average with biological impairment;</p> <p><u>Frequency</u> ≥ 30 < 100 ug/l as seasonal average in two of three years</p>	<p><u>Magnitude</u> ≥ 100 ug/l anytime with biological impairment;</p> <p><u>Frequency</u> ≥ 100 ug/l multiple observations at base flow</p>
BOD5	<2.5 mg/l as seasonal average	<p><u>Magnitude</u> ≥ 2.5 < 6 mg/l seasonal average with biological impairment</p> <p><u>Frequency</u> ≥ 2.5 < 6 mg/l as seasonal average in two of three years</p>	<p><u>Magnitude</u> ≥ 6 mg/l anytime with biological impairment and seasonal average chlorophyll ≥ 30 ug/l</p> <p><u>Frequency</u> ≥ 6 mg/l two or more times during the base flow period</p>
24-Hour D.O. Range	<6.5 mg/l	≥7 mg/l – 9.0 mg/l (default to chlorophyll, BOD5 and biological indicators)	<p><u>Magnitude and Frequency</u> ≥9.0 mg/l anytime with biological impairment</p>
TKN	NA	NA	<p>≥0.75 mg/l May substitute for BOD5</p>
TSS		~20 mg/l; general screening level for inspection of data sets lacking chlorophyll observations.	

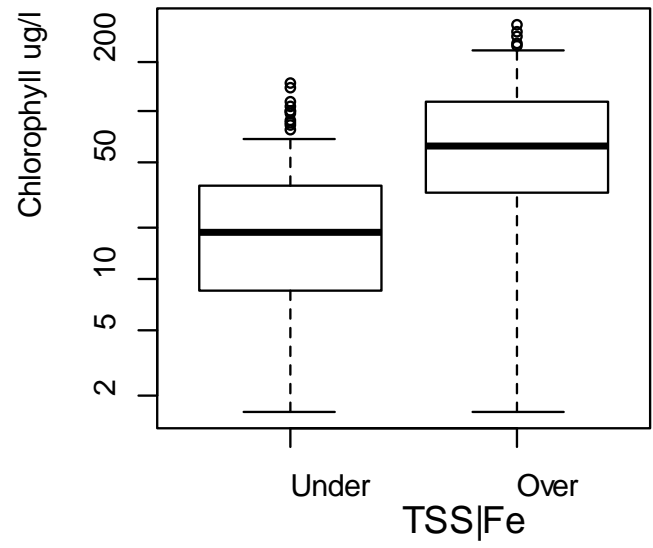
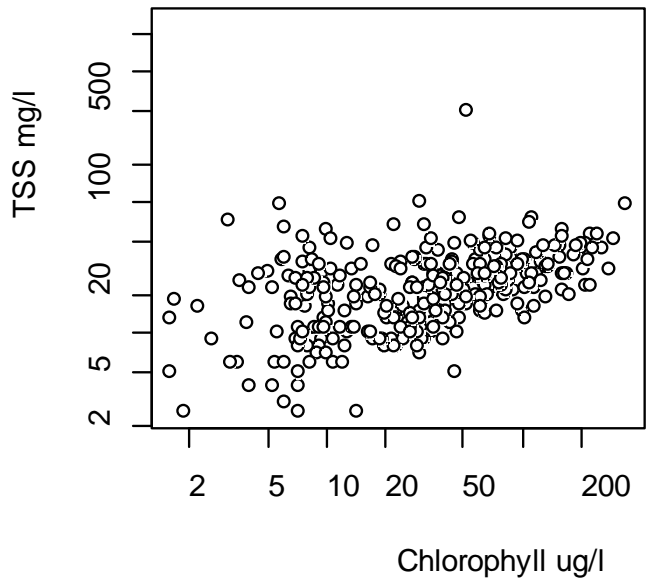
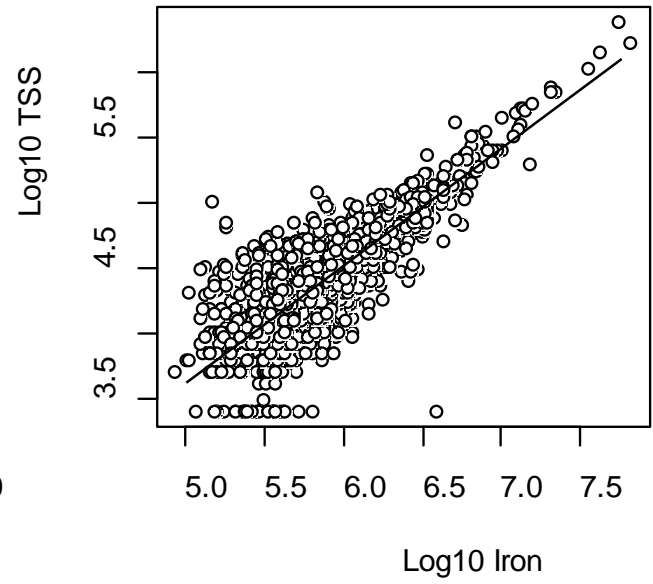
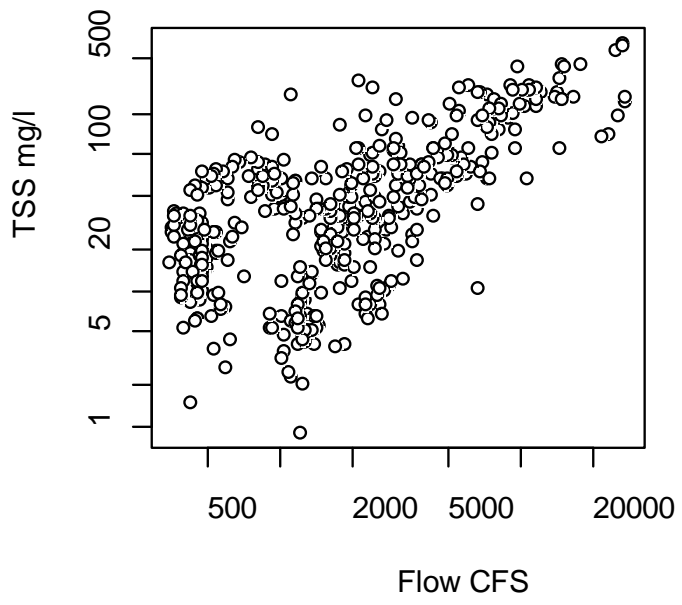
Phosphorus Target



TSS, Flow and Chlorophyll

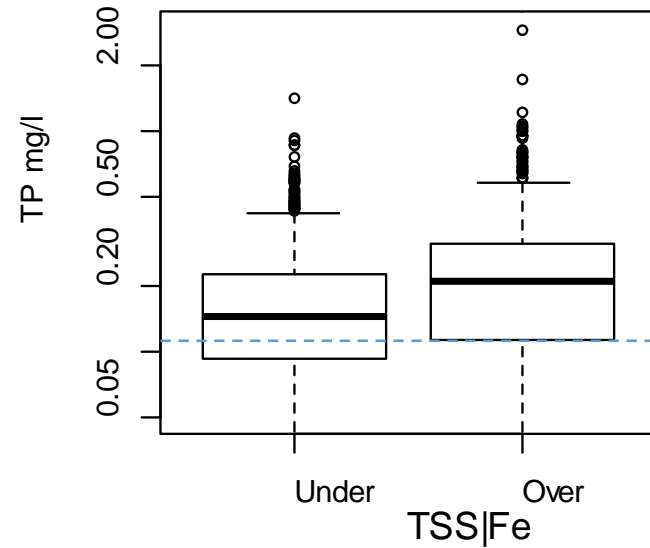
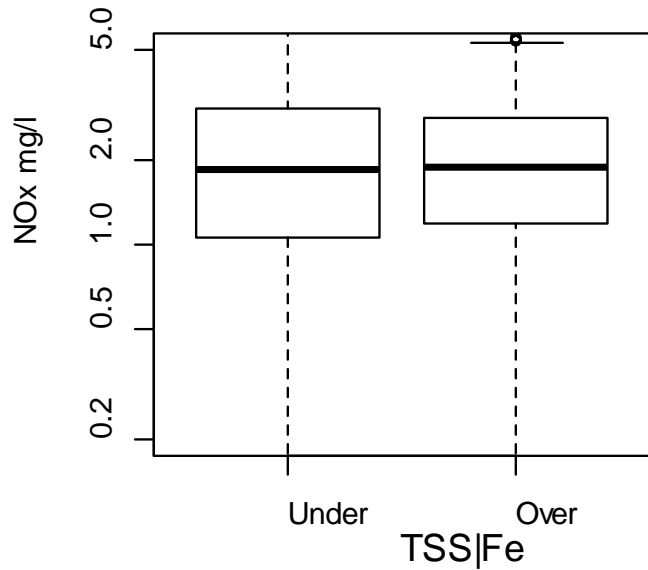
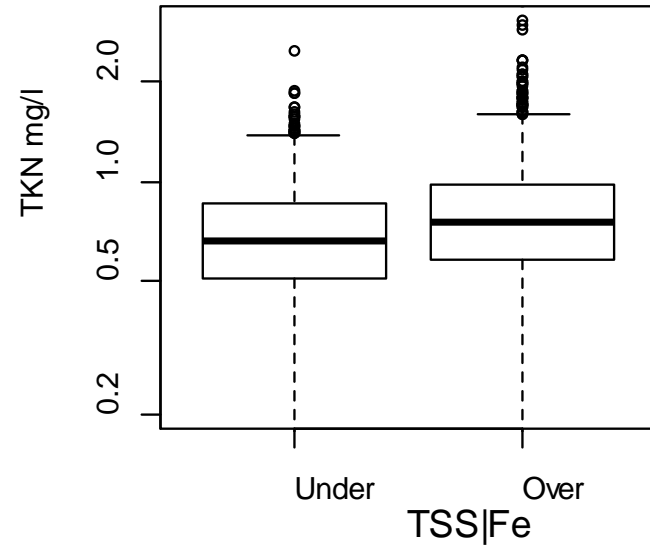
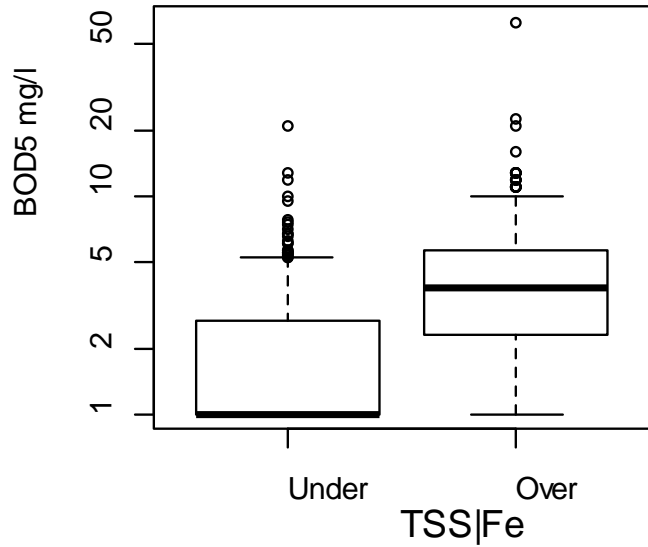


Flow, TSS and Chlorophyll

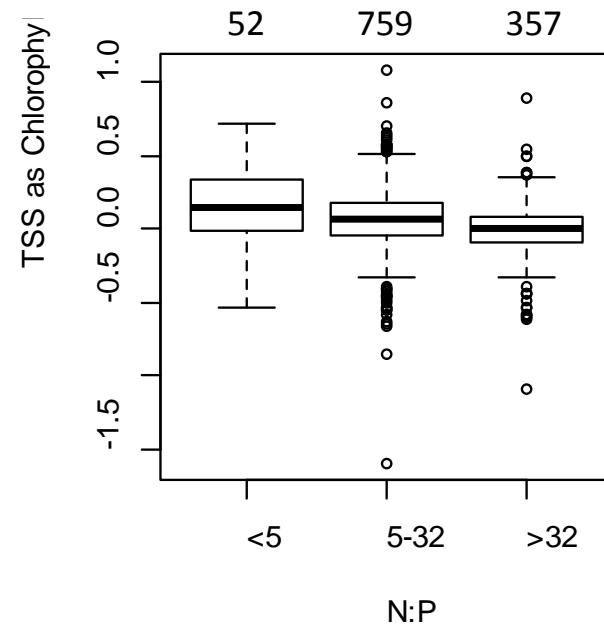
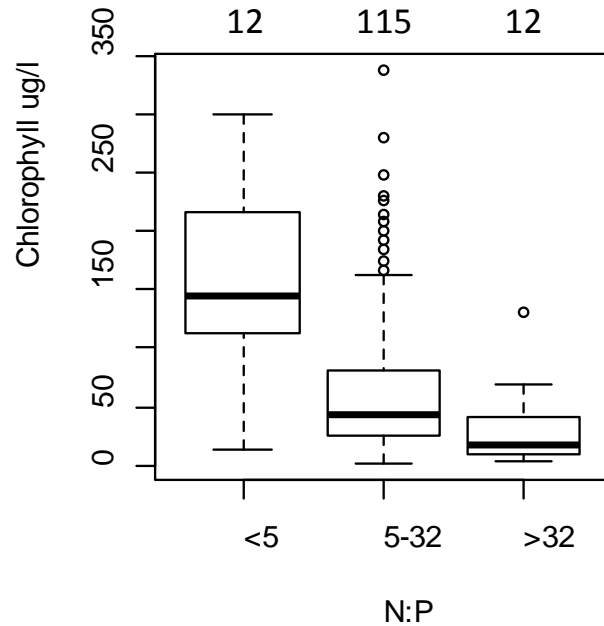
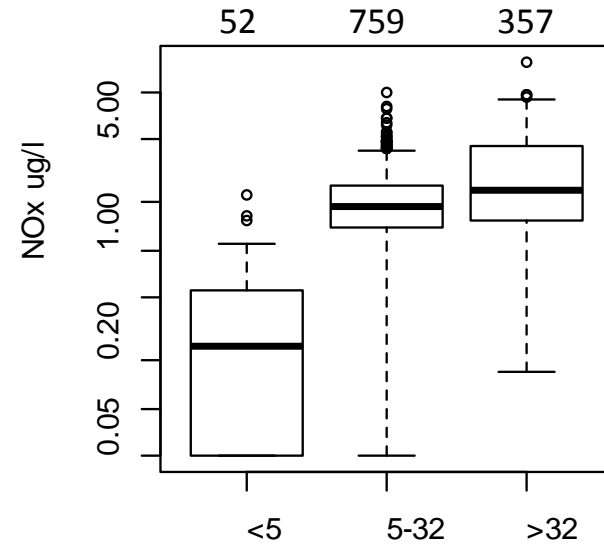
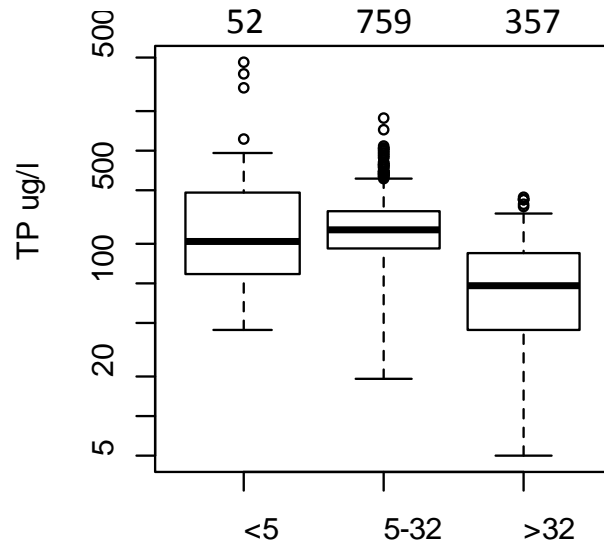


Distributions of Water Quality Parameters

Binned by Whether TSS is Under or Over Predicted



Phosphorus Target



Summary of Findings and Considerations

- Evidence of over-enrichment is compelling
- Eutrophication benchmarks are defensible
 - amenable to a box model
- TP target ~ 130 ug/l
 - seasonal average; summer base-flow conditions

Going Forward

Immediate & Near-Term

1. Peer-review publication
2. Share technical document and begin dialogue with EPA

Medium-Term

3. Start ESO
4. Add aspects of implementation to technical document

Long-Term

5. Conclude ESO
6. Produce rule package