The Stressor ID Process

Biological Impairments in the Elm Creek Watershed

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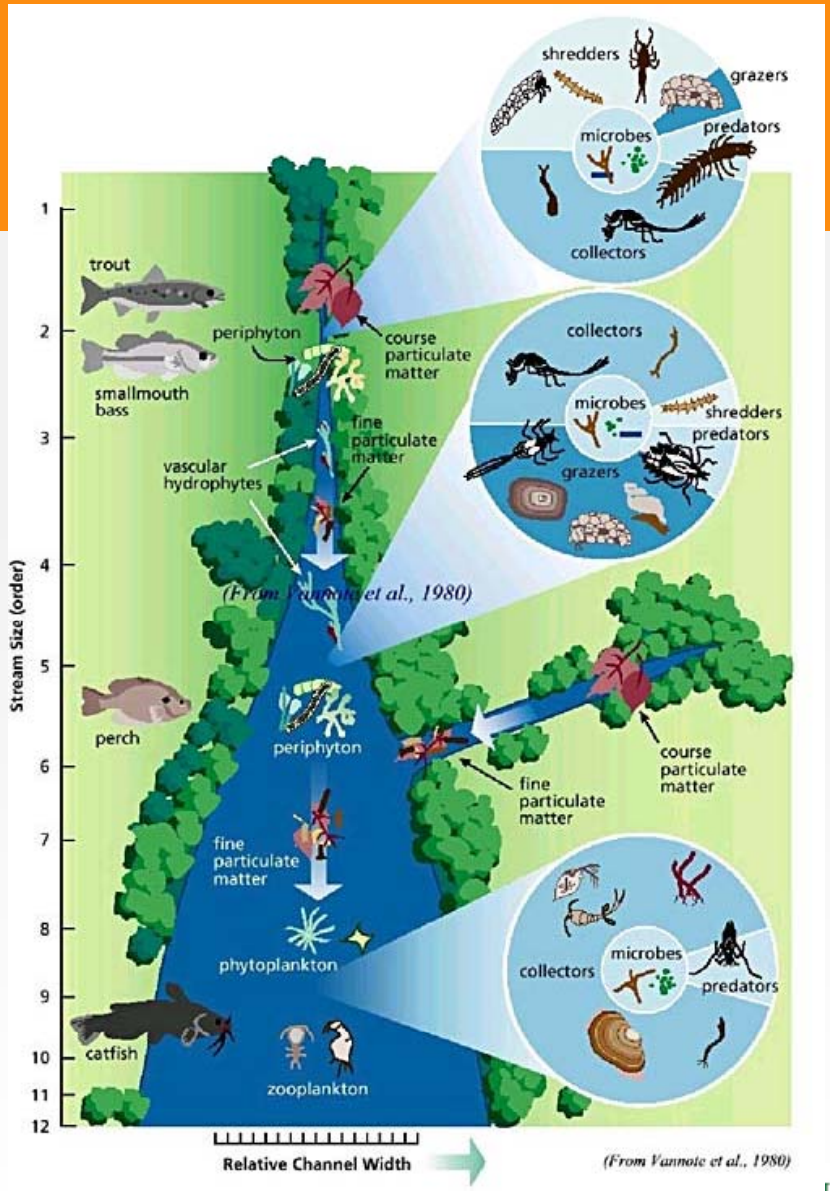
Biotic Integrity

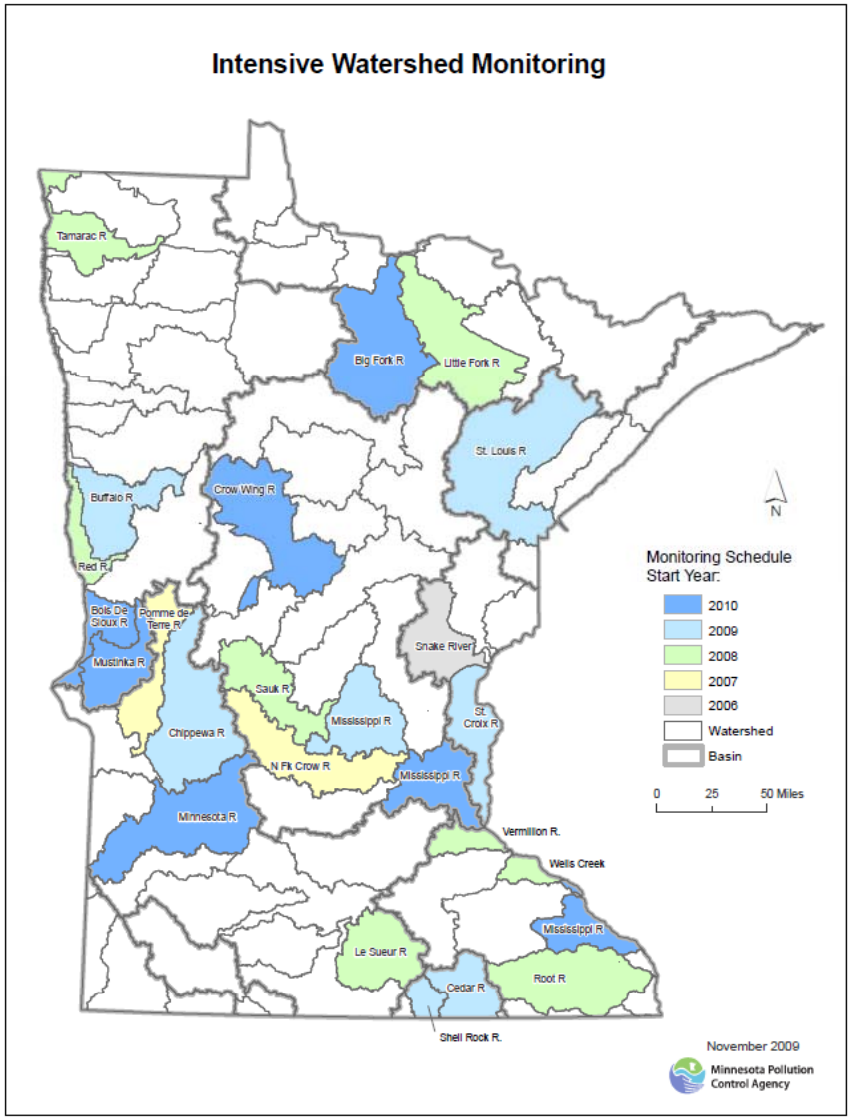
- Clean Water Act
  - "physical, chemical and <u>biological integrity"</u>…
- Based on biological community structure and species characteristics



Biota as Diagnostic Tools

- Taxa characteristics
  - Pollution (in)tolerance
    - Sensitive and insensitive species
  - Substrate requirement
  - Life history characteristics
  - Life stage

Biocriteria and Watershed Assessment



- Biotic endpoints integrate stressors over space and time
- Tiered Aquatic Life Uses (TALU)
  - Utilize biocriteria as the primary data for water resource assessment

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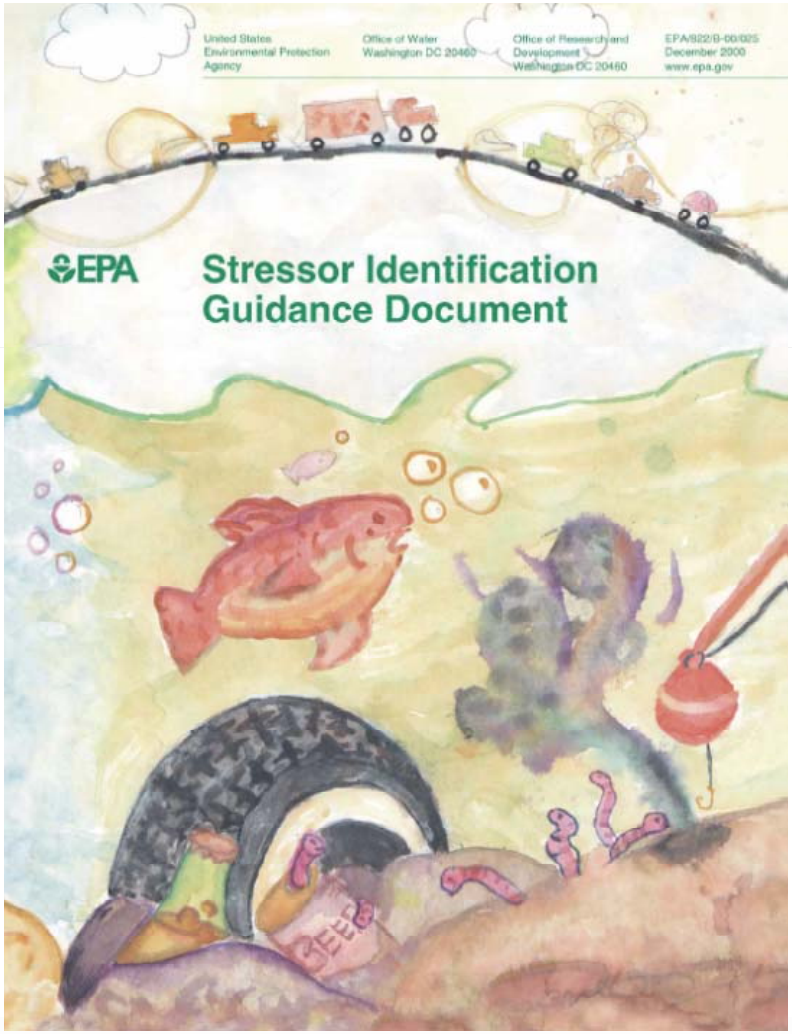
Stressor ID and the TMDL Process

- Assessment
  - Identify stream reaches with biotic impairments
- Stressor ID
  - Identify likely causes of biological impairments
- TMDL
  - Identify target reductions for key stressors to improve biotic integrity



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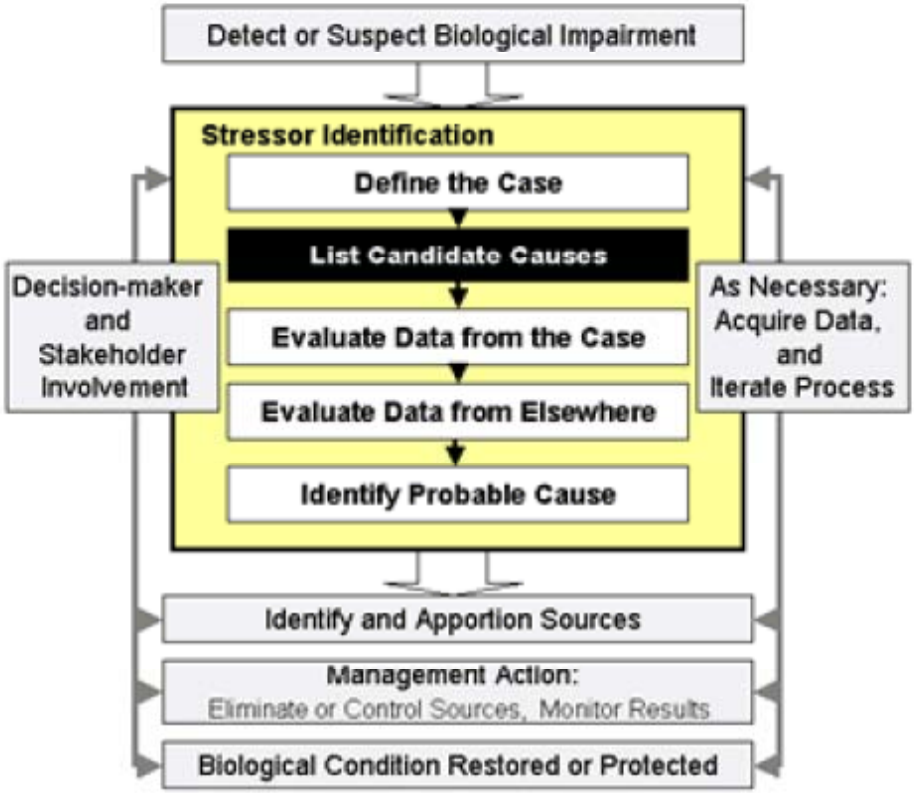
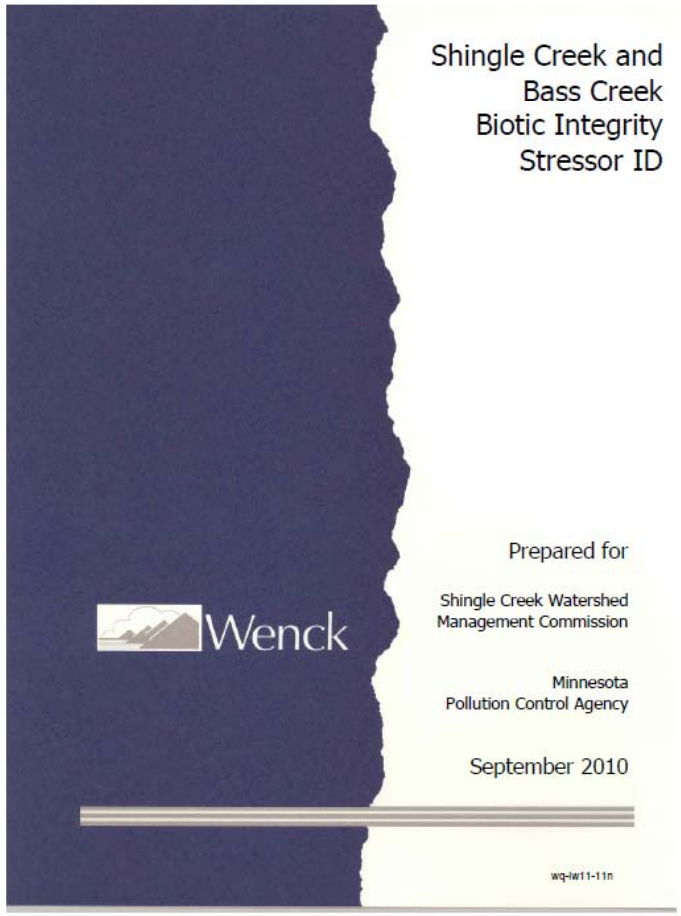
Stressor ID Report





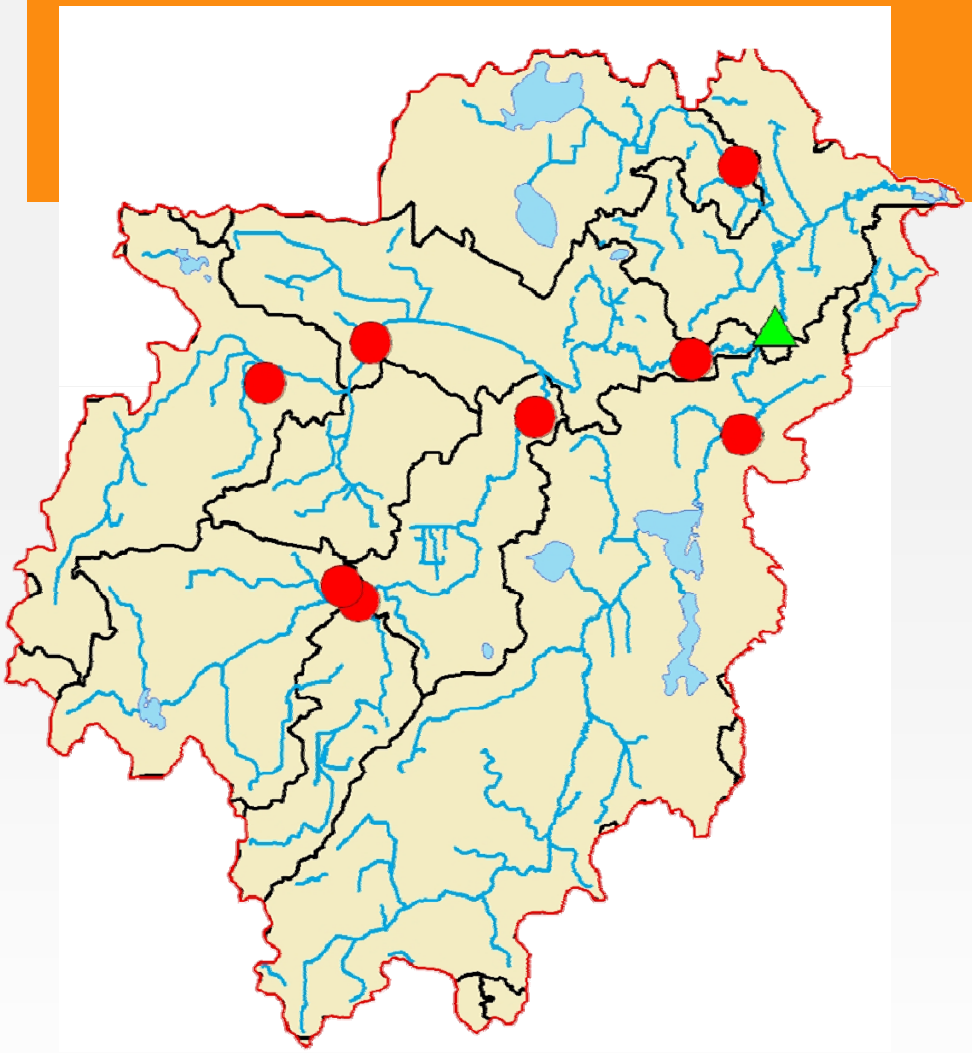
Data Collection Process

- Biotic Impairments
  - MPCA

Minnesota Pollution Control Agency

- Potential Stressors
  - MPCA
  - Three Rivers
  - Hennepin County
  - City of Maple Grove
  - USGS

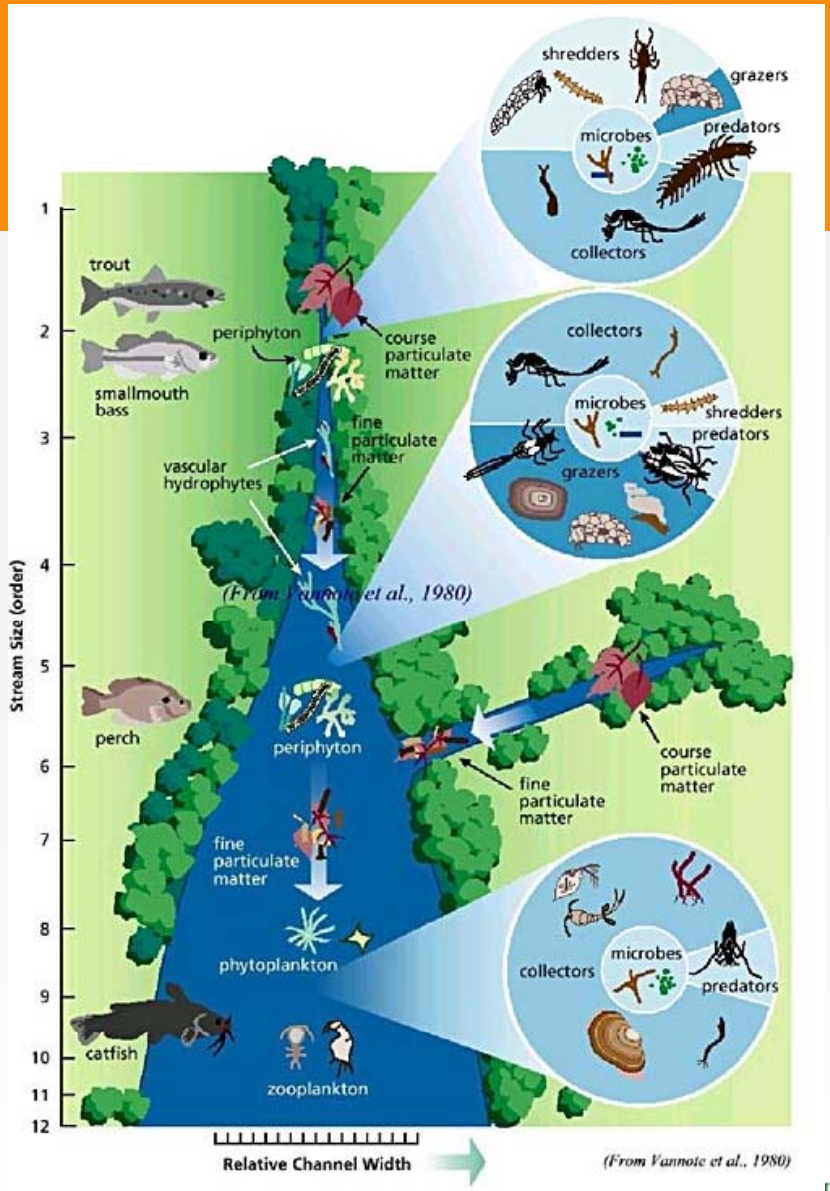
MPCA Sampling



- "New" Sites
  - Fish
  - Invertebrates
  - Water Quality
- Existing biological data
  - DNR

Evidence for Biotic Impairments

- Index of Biotic Integrity (IBI)
  - Fish and Invertebrates
- Compare existing assemblages to regional references using different organism/community attributes



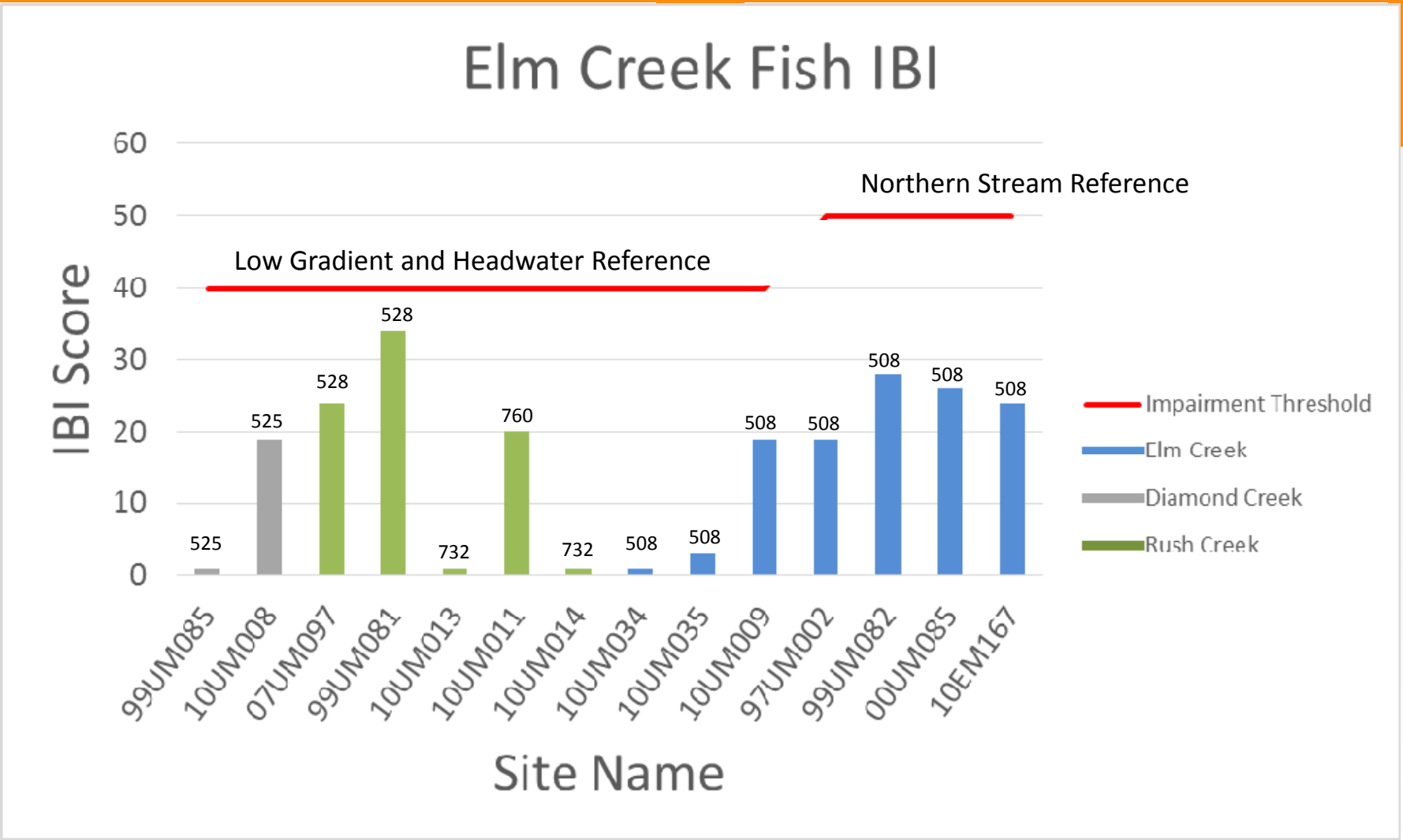
MN IBI Regional References and AUIDs

Table 3-1. Draft numeric biocriteria for Minnesota rivers and streams organized by warmwater and cold water ecotypes, stream and river classification strata within each, and the corresponding Exceptional, General, and Modified Uses (NA – not applicable).

Class #	Class Name	EU	GU	MU
	Fish			
1	Southern Rivers	71	46	NA
2	Southern Streams	67	49	33
3	Southern Headwaters	74	53	32
4	Northern Rivers	63	35	NA
5	Northern Streams	63	47	32
6	Northern Headwaters	69	42	22
7	Low Gradient Streams	70	41	15
10	Southern Cold water	82	46	NA
11	Northern Cold water	66	39	NA
	Invertebrates			
1	Northern Forest Rivers	76	43	NA
2	Prairie Forest Rivers	48	31	NA
3	Northern Forest Streams RR	83	51	NA
4	Northern Forest Streams GP	78	49	36
5	Southern Streams RR	61	36	24
6	Southern Forest Streams GP	69	43	28
7	Prairie Streams GP	69	42	21
8	Northern Cold water	49	27	NA
9	Southern Cold water	75	45	NA

- Assessment Unit ID
  - Elm Creek
    - 07010206-508
  - Rush Creek, Main
    - 07010206-528
  - Rush Creek, S. Fork
    - 07010206-732
  - Rush Creek, S. Fork
    - 07010206-760
  - Diamond Creek
    - 07010206-525

Fish IBI



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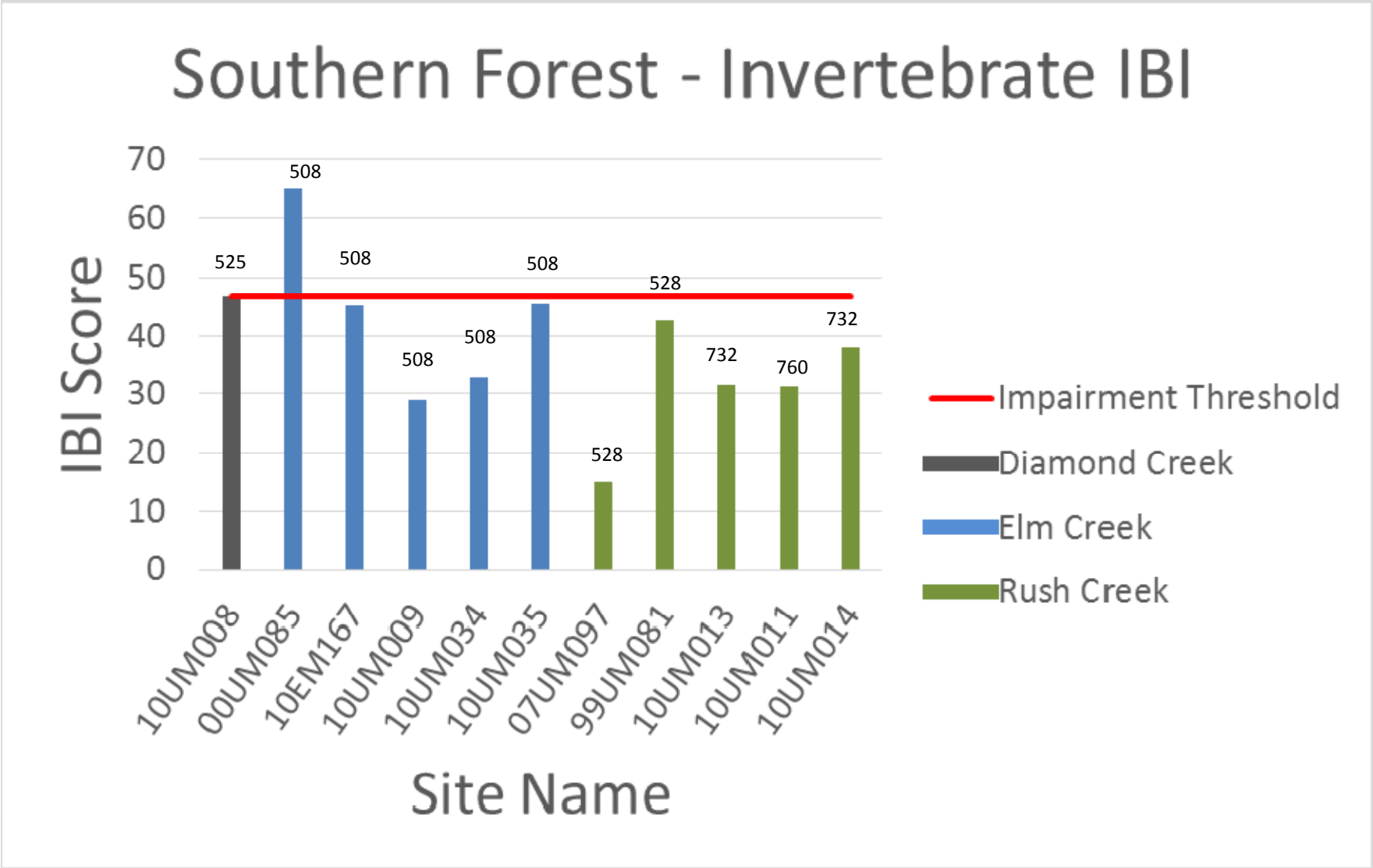
Invertebrate IBI



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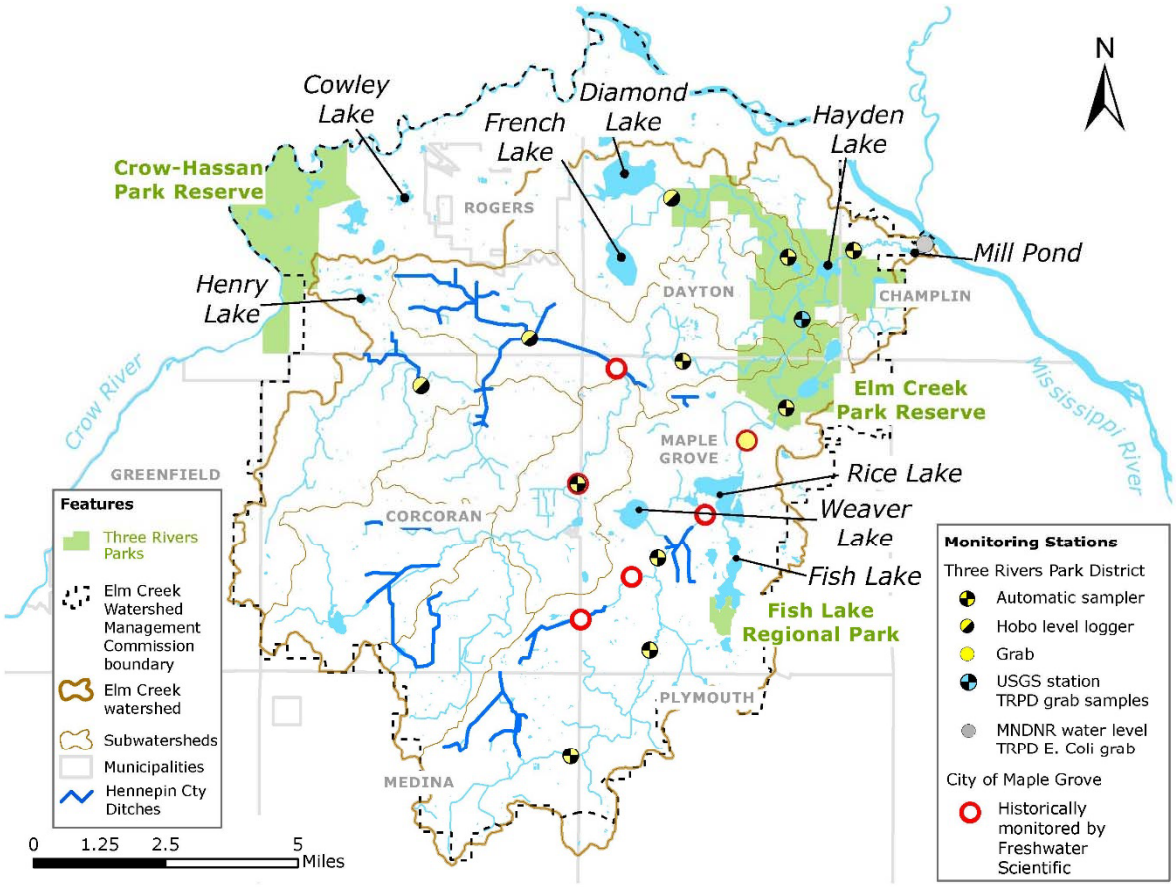
303d Listed Impairments

Watershed	AUID	Reach	Site ID	Fish IBI		Invertebrate IBI	
				Score	Threshold	Score	Threshold
Diamond Creek	07010206-525	French Lake to Unnamed Lake	99UM085	1	40		
Diamond Creek	07010206-525	French Lake to Unnamed Lake	10UM008	19	40	46.8	46.8
Rush Creek	07010206-528	Headwaters to Elm Cr.	07UM097	24	40	15.0	46.8
						5.7	46.8
Rush Creek	07010206-528	Headwaters to Elm Cr.	99UM081	34	40	42.6	46.8
Rush Creek	07010206-528	Headwaters to Elm Cr.	99UM081	26	40		
Rush Creek	07010206-760	S. Fork (Unnamed Ditch to Co. Ditch 16)	10UM013	1	40	31.4	46.8
Rush Creek	07010206-732	S. Fork (Unnamed Lake to Rush Cr.)	10UM011	20	40	31.3	46.8
Rush Creek	07010206-732	S. Fork (Unnamed Lake to Rush Cr.)	10UM014	1	40	37.9	46.8
Elm Creek	07010206-508	Headwaters to Mouth	10UM034	1	40	32.9	46.8
Elm Creek	07010206-508	Headwaters to Mouth	10UM035	6	40	45.6	46.8
Elm Creek	07010206-508	Headwaters to Mouth	10UM035	3	40		
Elm Creek	07010206-508	Headwaters to Mouth	10UM009	19	40	29.0	46.8
Elm Creek	07010206-508	Headwaters to Mouth	97UM002	19	50		
Elm Creek	07010206-508	Headwaters to Mouth	97UM002	29	50		
Elm Creek	07010206-508	Headwaters to Mouth	97UM002	35	50		
Elm Creek	07010206-508	Headwaters to Mouth	99UM082	28	50		
Elm Creek	07010206-508	Headwaters to Mouth	00UM085	26	50	65.1	46.8
Elm Creek	07010206-508	Headwaters to Mouth	10EM167	24	50	45.1	46.8

Existing Stressor Data

- Water quality sampling
  - 5-30+ years of data
  - >17 sites
- Elm Creek Channel Study



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Candidate Causes

- Physical Stressors
  - Altered flow
  - Habitat alteration
  - Channel connectivity

- Chemical Stressors
  - Dissolved Oxygen
  - pH
  - Temperature
  - Nutrients
  - Contaminants
  - Sediments
  - Ionic strength

Summarizing the Data

Site Name	Impairment	Data Years	Laboratory Parameters																						Field Parameters									
			TN		NH4		NO3		TP		SRP		TS		TSS		VSS		Chl		BOD		E. Coli		DO		Temp		Cond		pH		t-Tube	
			mg/L	n	mg/L	n	mg/L	n	mg/L	n	mg/L	n	mg/L	n	mg/L	n	mg/L	n	mg/L	n	mg/L	n	100ml	n	mg/L	n	Deg C	n	us/cm	n		n	cm	n
Lower Elm Creek																																		
ECRL	DO; E. Coli;	1	3.86	11					0.456	11	0.247	11			21.45	11			118.7	22	6.5	11	138	29										
ECW		1	1.77	16					0.211	16	0.095	16			13.72	16	8.4	15	86.7	16	5.0	12	73	30										
EC81		3	1.99	76					0.282	79	0.139	69			18.90	76	6.7	33	110.0	43	3.8	28	202	59										
USGS		23	1.74	267	0.20	681	1.56	205	0.170	831	0.230	73	341.00	65	20.00	419			52.2	204					8.4	243	10.3	265	568.0	326	7.7	322		
USGS (TRPD)		2	1.06	41					0.165	41	0.107	41			3.43	41	< 4	19	51.6	41	1.6	27	121	59			10.2	20					60.0	20
ECHO		2	1.71	60					0.345	60	0.210	56			6.48	60	< 4	28	75.2	42	3.0	29	97	59			10.6	20					42.7	20
MPO		2																					67	50										
Upper Elm Creek																																		
Hamel		7	1.75	182	0.10	32	0.70	14	0.243	182	0.091	129	205.00	4	36.73	158	3.4	40	182.9	76	2.1	29	399	97	6.7	24	14.0	23	1421.3	22	7.3	24	85.5	21
ECER	DO; E. Coli; Chloride (?)	7	1.62	159	0.07	31	1.21	13	0.306	160	0.130	117	505.33	3	39.25	137	7.8	33	69.3	69	2.7	28	369	91	7.5	20	13.7	20	565.4	20	7.4	20	93.2	18
EC77		4	1.43	129					0.222	131	0.106	85			41.39	132	7.1	35	89.2	71	2.5	28	297	99	8.6	22	14.7	22	572.9	21	7.3	21	96.1	24
MC1A and MC1B *		2	2.73	17					0.383	20	0.183	12			16.42	16																		
MC2		2	1.51	29					0.167	32	0.068	23			26.99	29																		
EC1		3	1.23	45					0.209	48	0.143	40			12.33	46																		
Rush Creek																																		
RT	DO; E. coli; Biota	4	1.79	97					0.391	99	0.243	62			24.92	99	< 4	27	69.7	70	2.7	29	137	99	6.8	25	14.8	25	465.8	22	7.4	24	77.0	36
RCSL / RC101*		4	2.09	76					0.571	76	0.400	49			83.66	75	< 4	17	148.8	60	2.3	24	449	97	4.3	23	14.4	22	1105.1	21	7.2	22	70.0	21
RC116		4	3.15	61					0.490	61	0.274	35			33.76	60	< 4	17	60.2	62	4.7	24	398	98	5.7	23	16.0	22	572.7	23	7.3	21	67.1	19
RCTH		4	2.39	46					0.518	46	0.213	32			21.09	43	< 4	17	75.2	47	2.5	22	427	70	5.7	11	14.5	9	649.0	8	7.4	9	77.3	12
RC		2	1.69	12					0.362	12	0.301	10			3.64	15																		
Diamond Creek																																		
DC	E. coli	4	1.35	96					0.209	100	0.126	64			15.54	96	< 4	25	39.6	71	2.3	26	340	99	9.2	24	14.3	24	512.1	23	7.4	24	88.7	36
SD		3	3.07	38					0.310	38	0.144	14			9.60	38			59.4	40	2.6	12	504	66	5.8	22	14.3	22	472.8	20	7.4	20	80.1	27
DCZ		4	4.24	60					0.440	60	0.115	35			57.06	60	6.7	19	75.9	62	3.2	23	604	94	5.9	23	13.9	22	461.6	21	7.4	22	23.5	29
Fish Lake																																		
FL2	Nutrients	1							0.232	16	0.122	16																						
FL4		1							0.589	11	0.233	11																						
FL5		1							0.502	8	0.283	8																						
FL6*		2	1.32	7					0.158	27	0.395	21			6.30	4																		
FL7		1							0.422	16	0.175	16																						

Summary Table 2. in 2011 Data Summary

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Stressors Likely to Be Ruled Out

- Physical Stressors
  - Altered flow
  - Habitat alteration
  - Channel connectivity

- Chemical Stressors
  - Dissolved Oxygen
  - Nutrients ?
  - Ionic strength ?
  - Temperature ?
  - pH
  - Contaminants
  - Sediments

Instream Nutrient Criteria

- Draft criteria
  - Elevated TP

    AND
  - One or more response variable

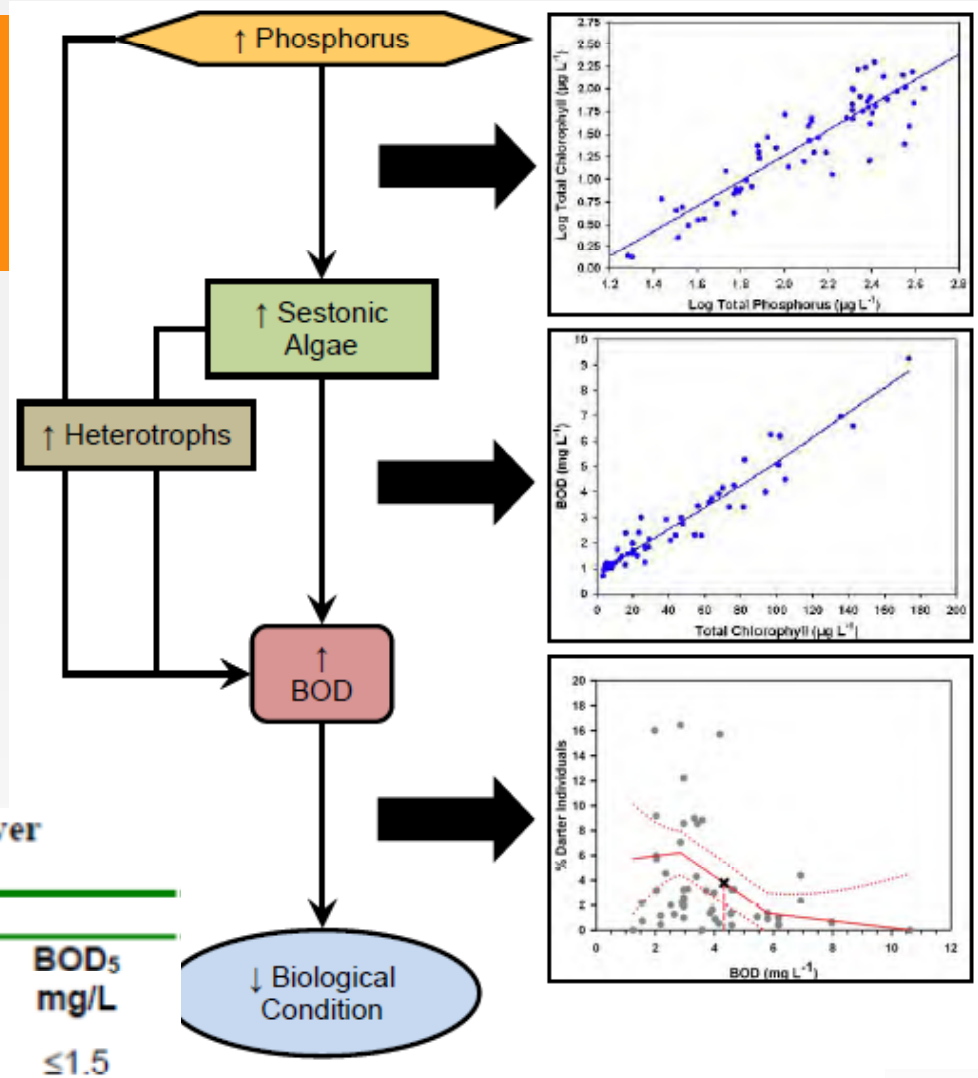

Table 24. Draft river eutrophication criteria ranges by River Nutrient Region for Minnesota.

	Nutrient	Stressor		
Region	TP µg/L	Chl-a µg/L	DO flux mg/L	BOD_5 mg/L
North	≤50	≤7	≤3.0	≤1.5
Central	≤100	≤18	≤3.5	≤2.0
South	≤150	≤35	≤4.5	≤3.0

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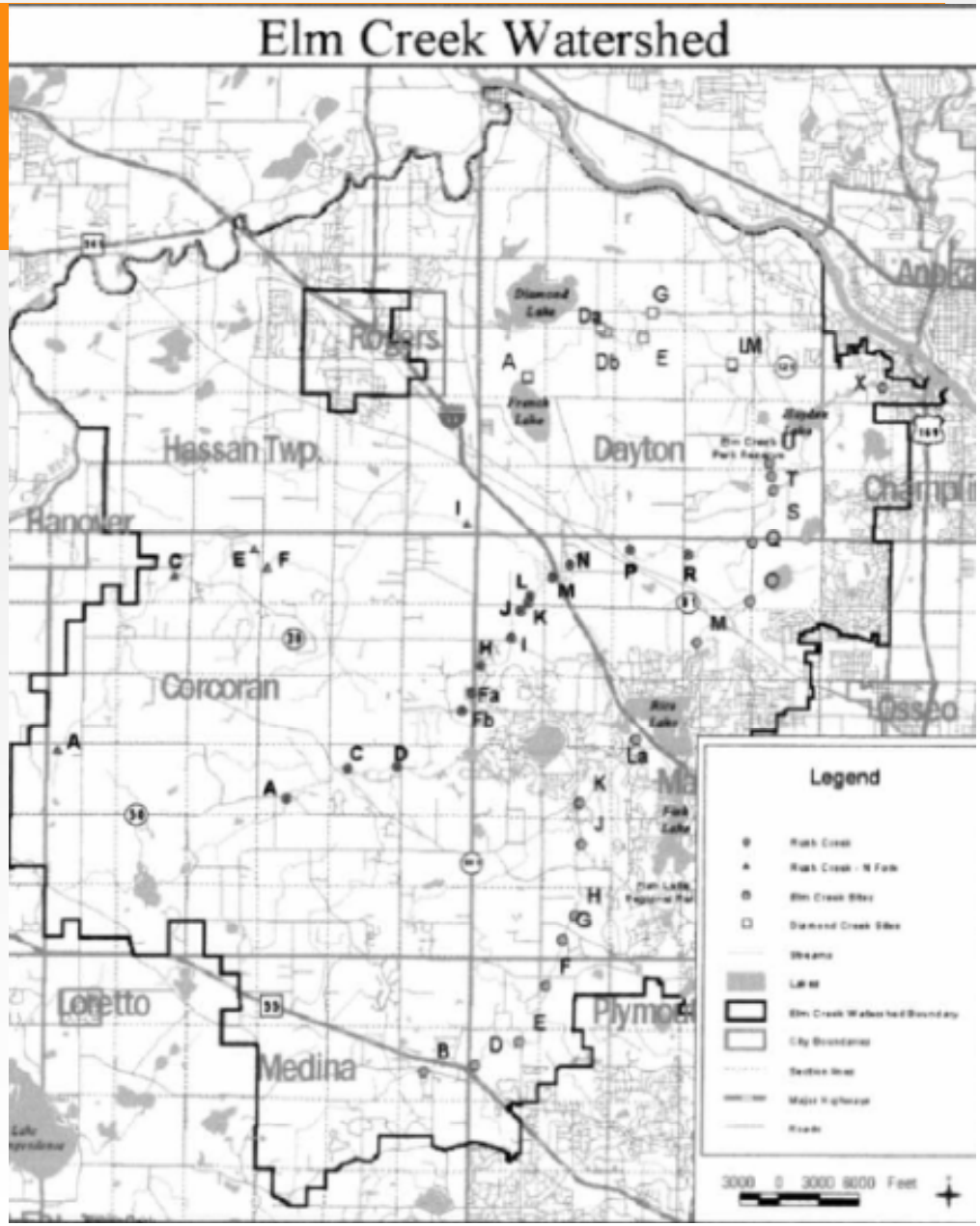
Stressors Likely to Be Ruled Out

- Physical Stressors
  - Altered flow
  - Habitat alteration
  - Channel connectivity

- Chemical Stressors
  - Dissolved Oxygen
  - Nutrients
  - Ionic strength
  - Temperature ?
  - pH
  - Contaminants
  - Sediments

Habitat and Flow Alteration

- Meisbauer and Dindorf (2000)
  - "the Elm Creek channel study"



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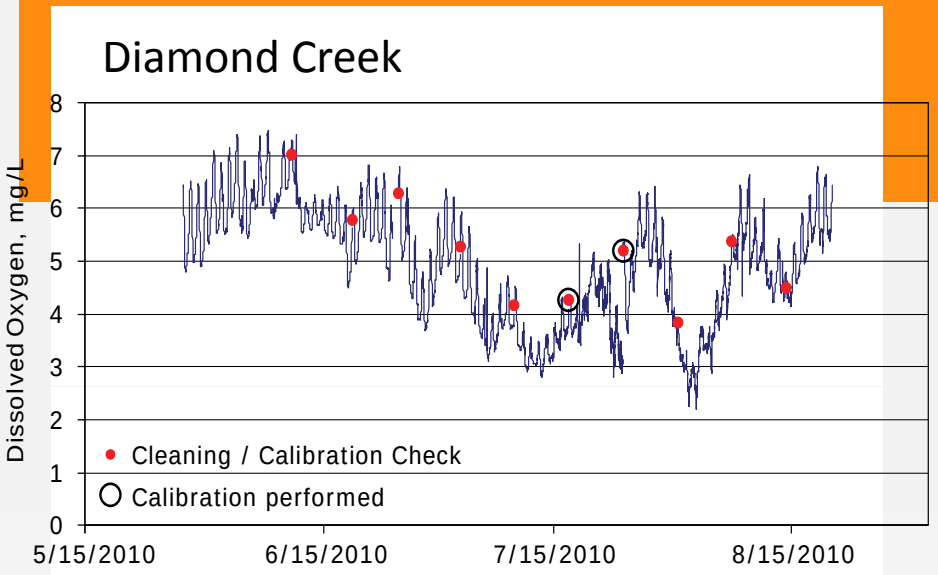
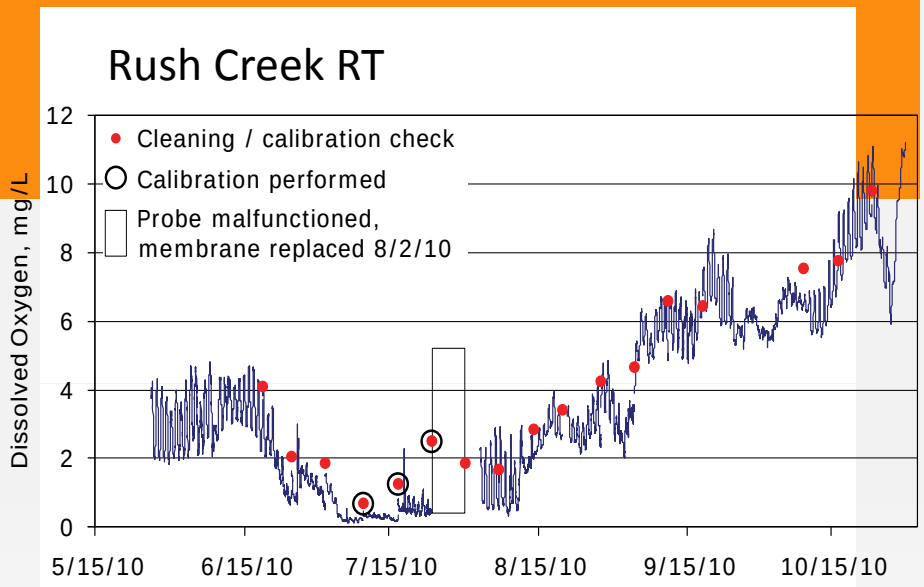
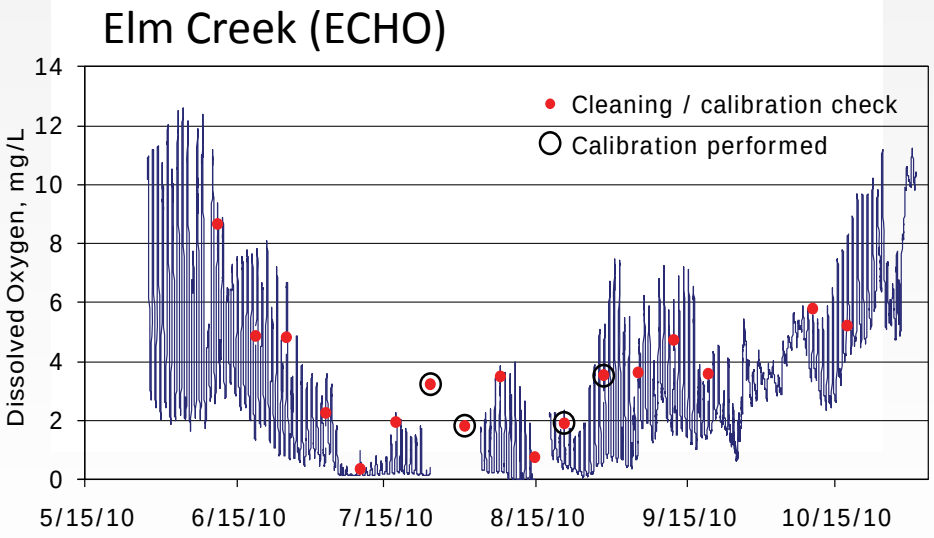
Channel Connectivity

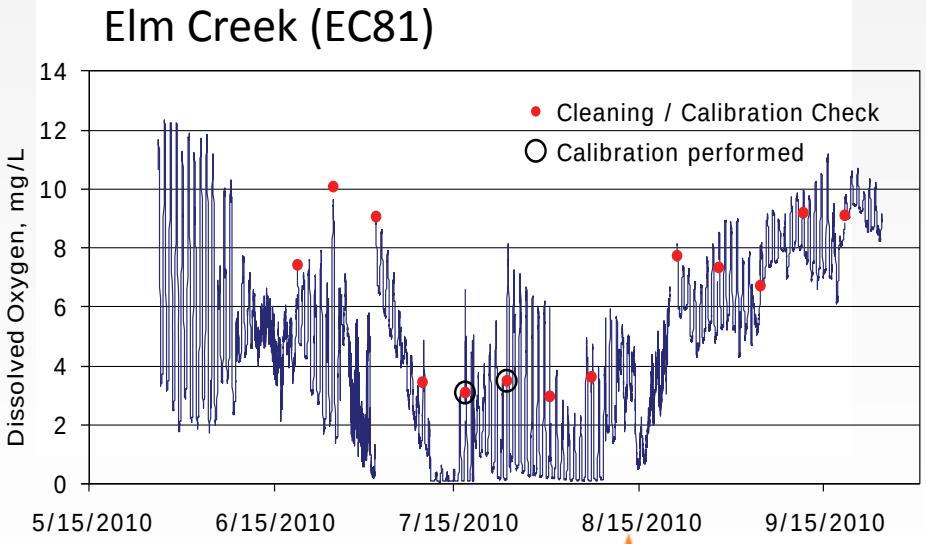
- Migration Barriers
  - Mill Pond Outlet
  - Culverts

Dissolved Oxygen









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Newly Reported Stressors

- Nutrients
  - TP concentrations at all sites exceed proposed instream nutrient criteria

- Chloride
  - Chloride concentrations are at or above chronic (230 mg/L) and acute chloride standards (860 mg/L) at two sites:
    - Elm Creek (Hamel)
    - Rush Creek (Shannon Ln)

Fish Taxa Detail

Attribute	Site				
	County Ditch 16	Diamond Creek	Elm Creek	Rush Creek	Rush Creek, South Fork
# Darter and sculpin	0.0	0.0	0.0	1.0	0.0
% Detritivore Taxa	-	-	10.0	-	-
% Detritivore Indiv.	-	-	29.1	-	-
% Dominant Species	-	-	57.7	-	-
% DELT	0.0	0.0	1.2	0.0	0.0
# of Generalists	-	-	6.5	-	-
# Headwater species	0.0	0.0	0.0	0.0	0.0
% Headwater species	-	-	-	0.0	-
% Insectivore (Minnow)	0.0	0.0	0.0	2.5	0.0
% Insectivores	0.0	8.3	16.8	21.3	0.0
% Intolerant	-	-	0.0	-	-
% Mature Female	-	-	2.8	-	-
% Minnow	0.0	0.0	5.0	2.5	0.0
# Tolerant/ m2	0.000	0.020	0.027	0.111	0.006
% Omnivore	-	-	-	25.0	-
% Pioneer	33.3	33.3	25.5	19.3	16.7
# Sensitive Taxa	0.0	0.0	0.0	0.3	0.0
% Sensitive Taxa	-	-	2.9	-	-
# of Lithophiles	0.0	0.5	0.5	1.7	0.5
% Lithophiles	-	-	22.3	-	-
% Serial Spawners	-	-	23.7	-	-
% Tolerant Taxa	100.0	83.3	83.3	63.7	75.0
# Very Tolerant Species	-	-	4.0	-	-
# Wetland Species	-	-	-	1.0	-
Average IBI	**0**	**10**	**19**	**29**	**10**

Invertebrate Taxa Detail

Site Name	Clinger Taxa	Intolerant Taxa	POET	Predator Taxa	Total Taxa	Collector-Filterer %	5% Dom.	% Trich.	% Non-Hydro	HBI_MN (Low DO)
Diamond Creek	10	0	4	14	37	52.7	51.7	5.4	0.0	7.0
Elm Creek	10	1	13	14	46	14.6	53.1	13.0	4.8	7.3
Elm Creek	10	0	7	7	30	45.5	70.3	13.3	0.9	7.1
Elm Creek	7	1	3	9	29	4.1	64.6	3.4	0.0	7.4
Elm Creek	7	0	3	8	31	41.9	71.6	3.2	0.0	6.9
Elm Creek	12	0	7	7	36	37.7	69.0	8.3	1.3	7.3
Rush Creek	1	0	3	10	32	1.3	71.8	0.0	0.0	8.3
Rush Creek	0	0	2	8	25	0.6	86.2	0.0	0.0	9.4
Rush Creek	11	0	8	9	37	14.0	58.9	8.1	1.6	7.5
Rush Creek, South Fork	9	0	5	3	26	39.2	68.0	3.8	0.0	7.3
Rush Creek, South Fork	7	0	2	13	35	22.4	48.1	2.9	0.6	7.4
Rush Creek, Co. Ditch 16	7	0	5	8	37	7.0	60.7	5.4	1.3	8.0

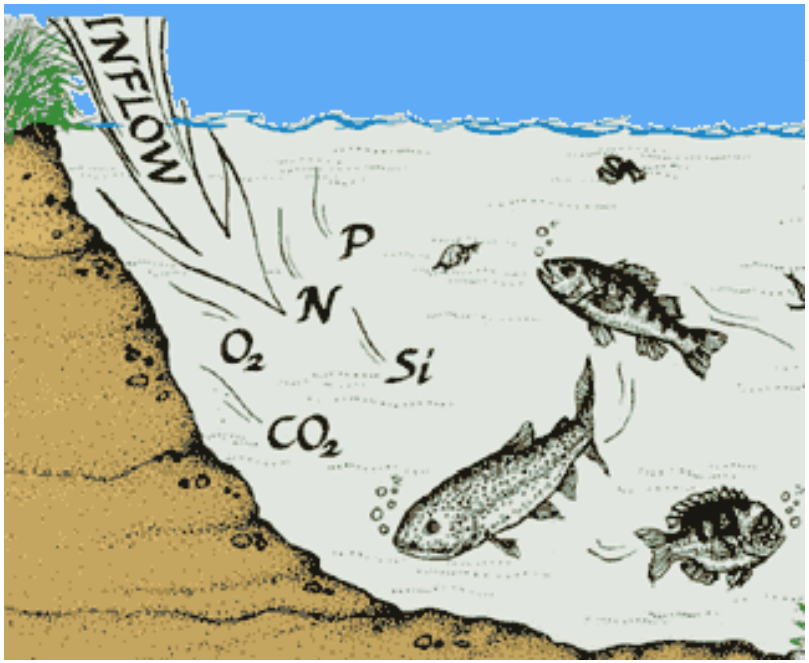
Linkages Among Stressors

- Physical Stressors
  - Altered flow
  - Habitat alteration
  - Channel connectivity

- Chemical Stressors
  - Dissolved Oxygen
  - Nutrients
  - Temperature
  - Ionic strength
  - pH
  - Contaminants
  - Sediments

Next Steps

- Finalize and Integrate Modeling Results



- Finalize Causal Analysis

Questions?

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