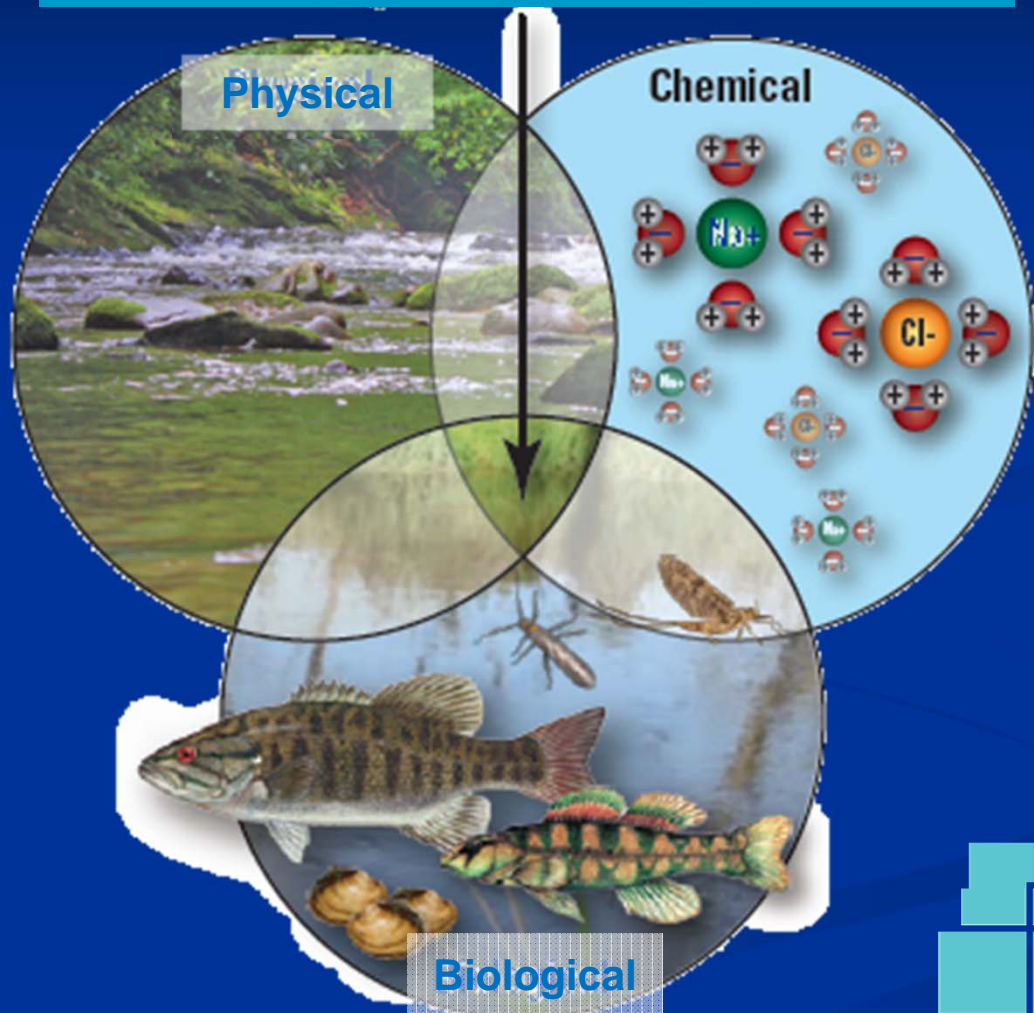


Root River Ecological “Stream Health”



SEWRPC

Serving the counties of
Kenosha, Milwaukee,
Ozaukee, Racine, Waubesa,
Washington, and Waukesha

Darters-Riverine Specialists,



Johnny Darters, guarding male



Johnny Darters, mating pair



Johnny Darters, Fry



Slenderhead darter



IMAGE HOSTED BY
FORUM.NANFA.ORG

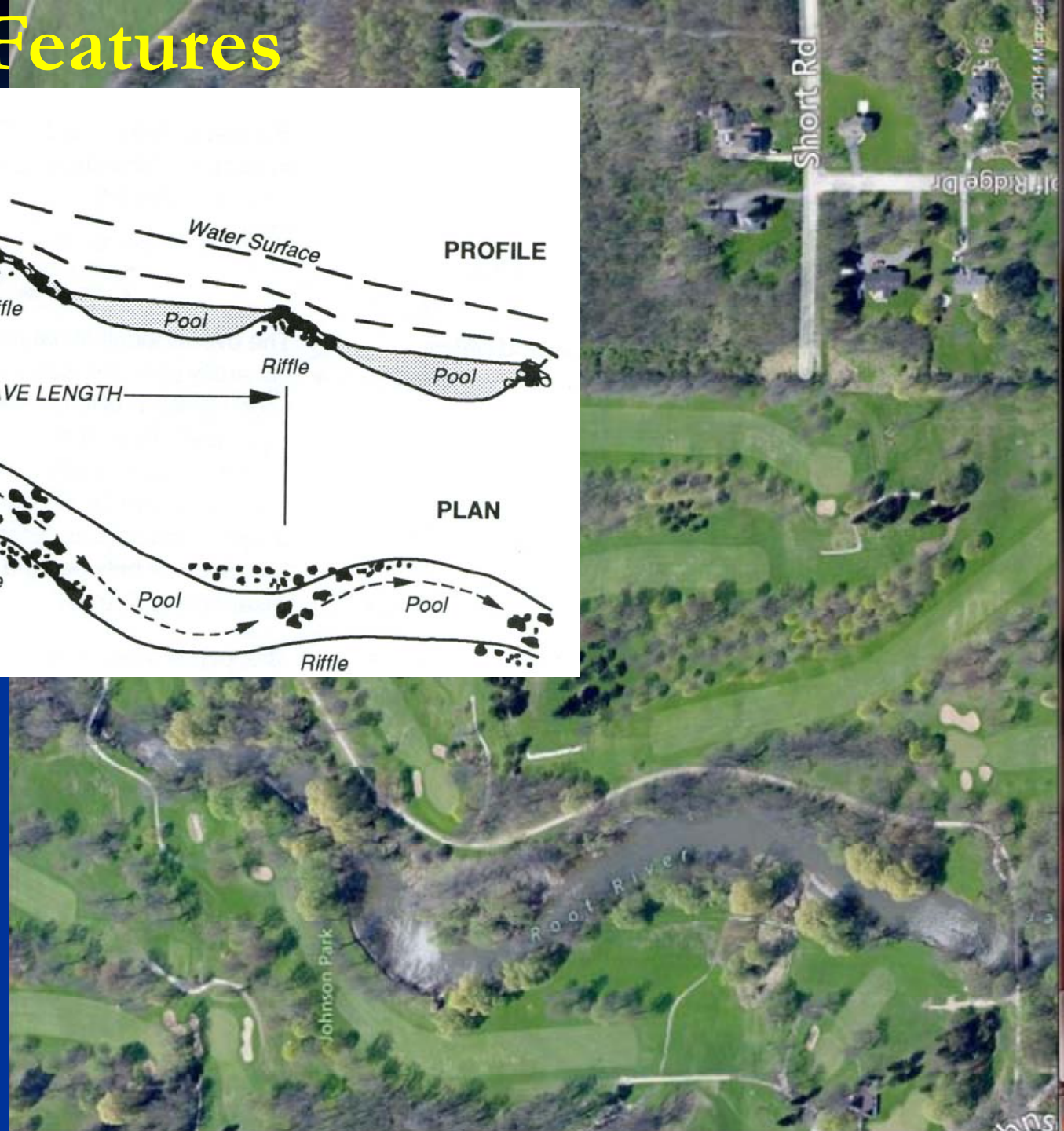
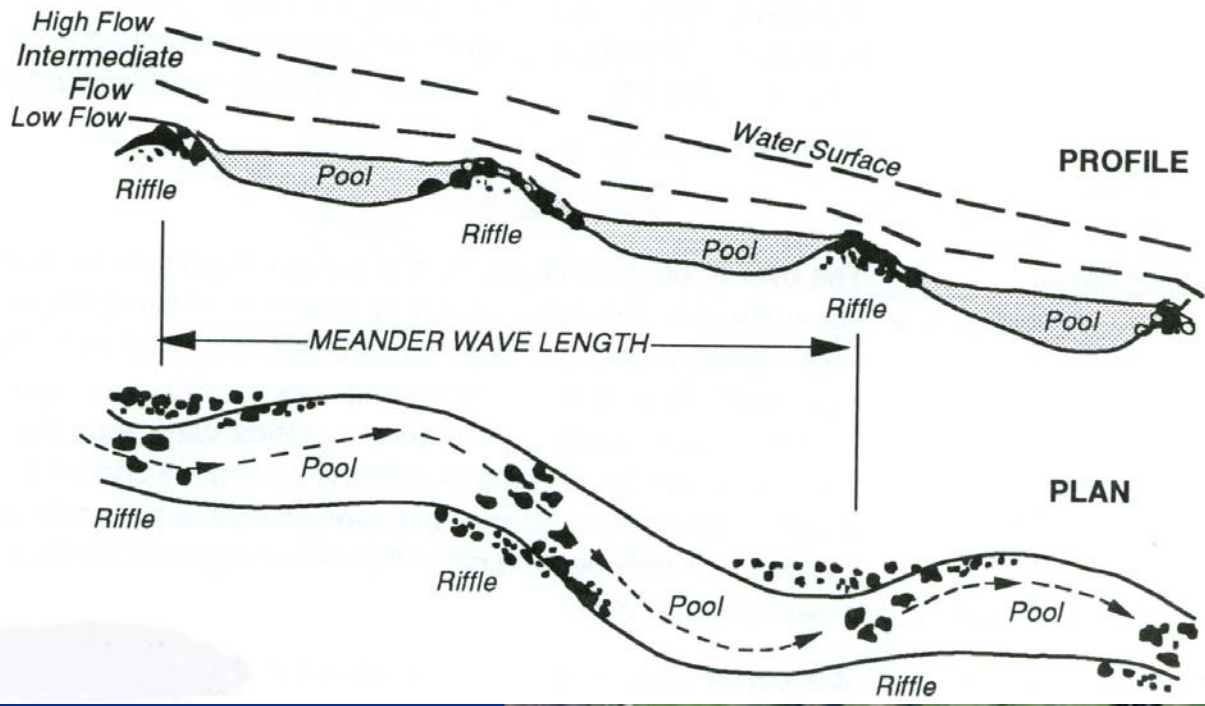
Blacksided darter



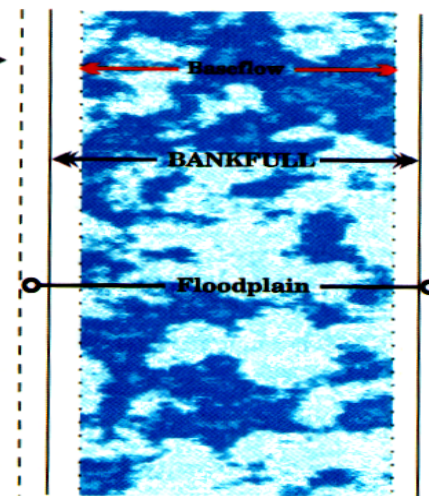
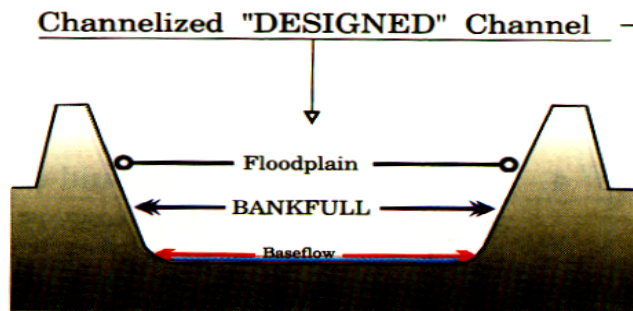
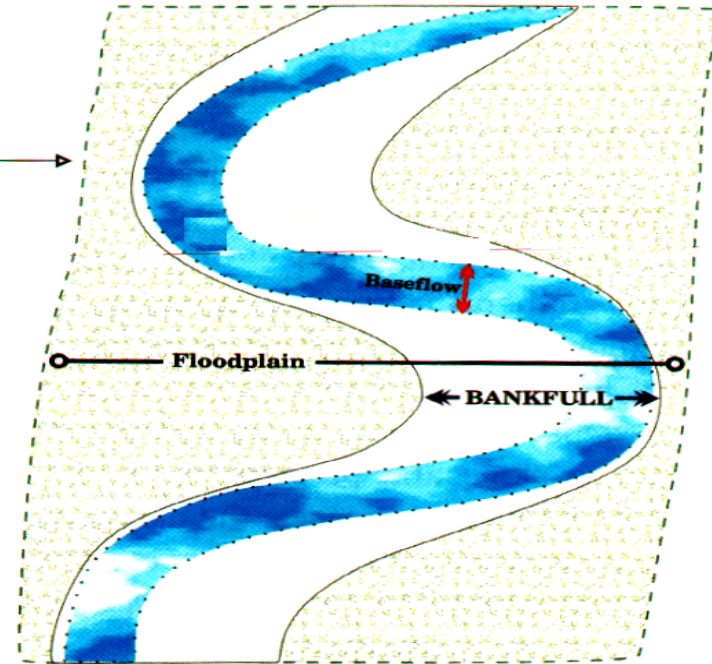
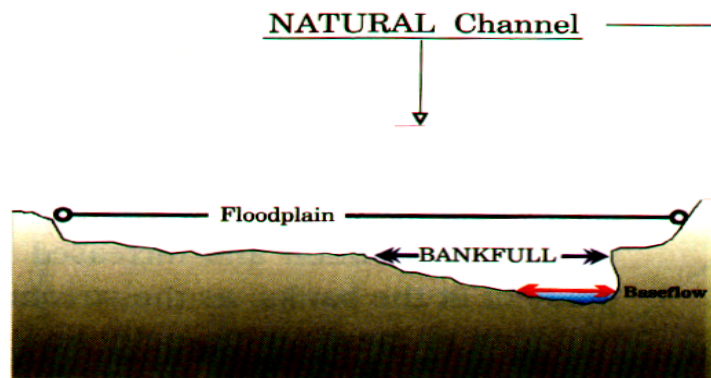
Iowa darter



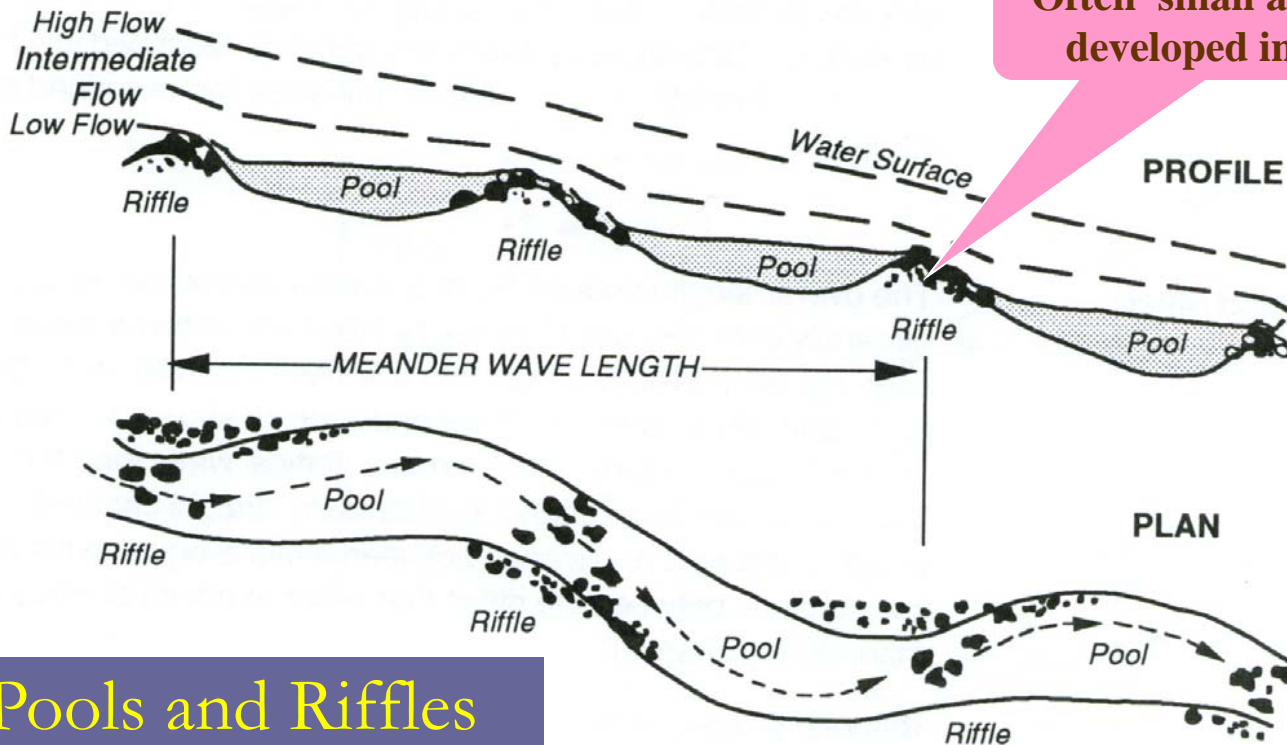
Riffle-Pool Features



A Natural Stable Stream vs A Ditched Stream



Agricultural Ditch Characteristics



Often small and poorly developed in a ditch

Pools and Riffles

Longnose Sucker-Riverine Dependand



John Lyons

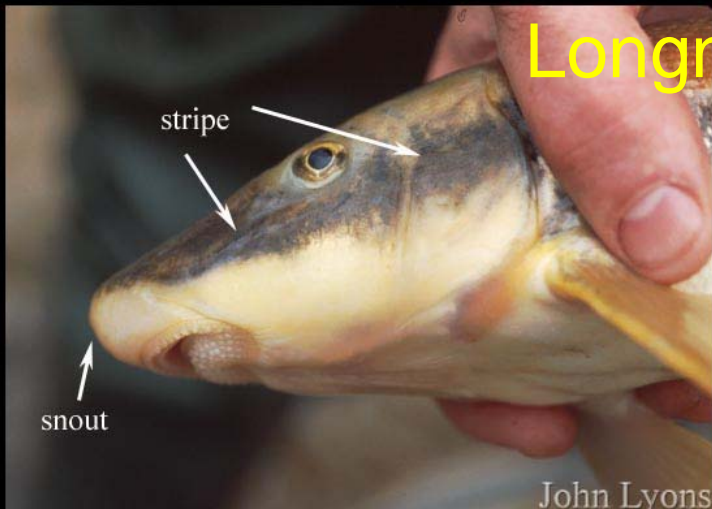


John Lyons

John Lyons



Longnose Sucker-Spawning Migration



River Monster!



Jeremy Wade: African Tigerfish

River Monster!

Northern Pike

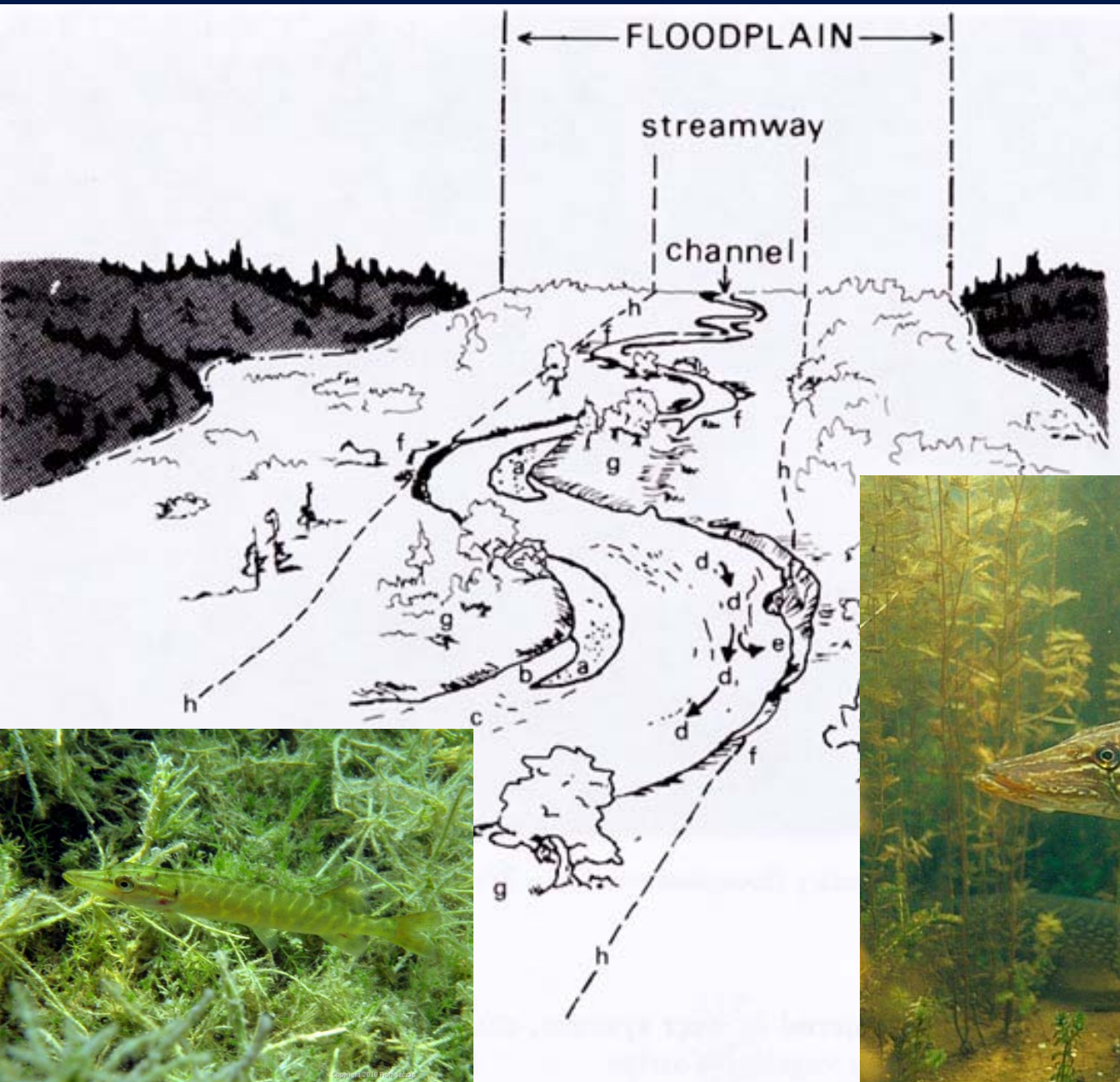


River Monster!

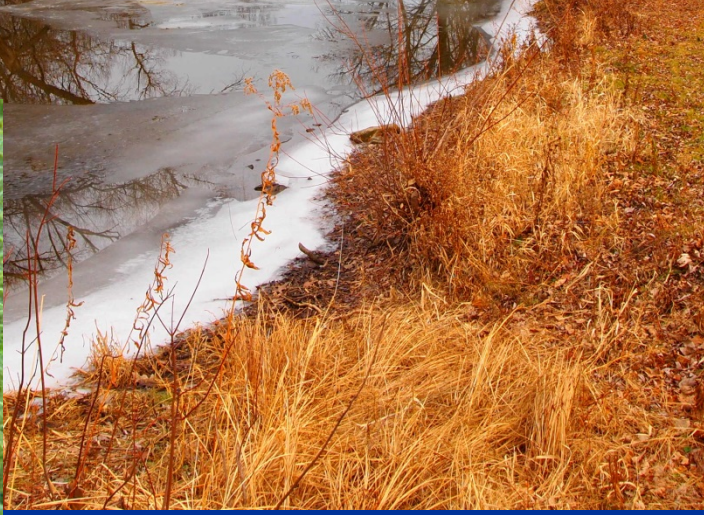
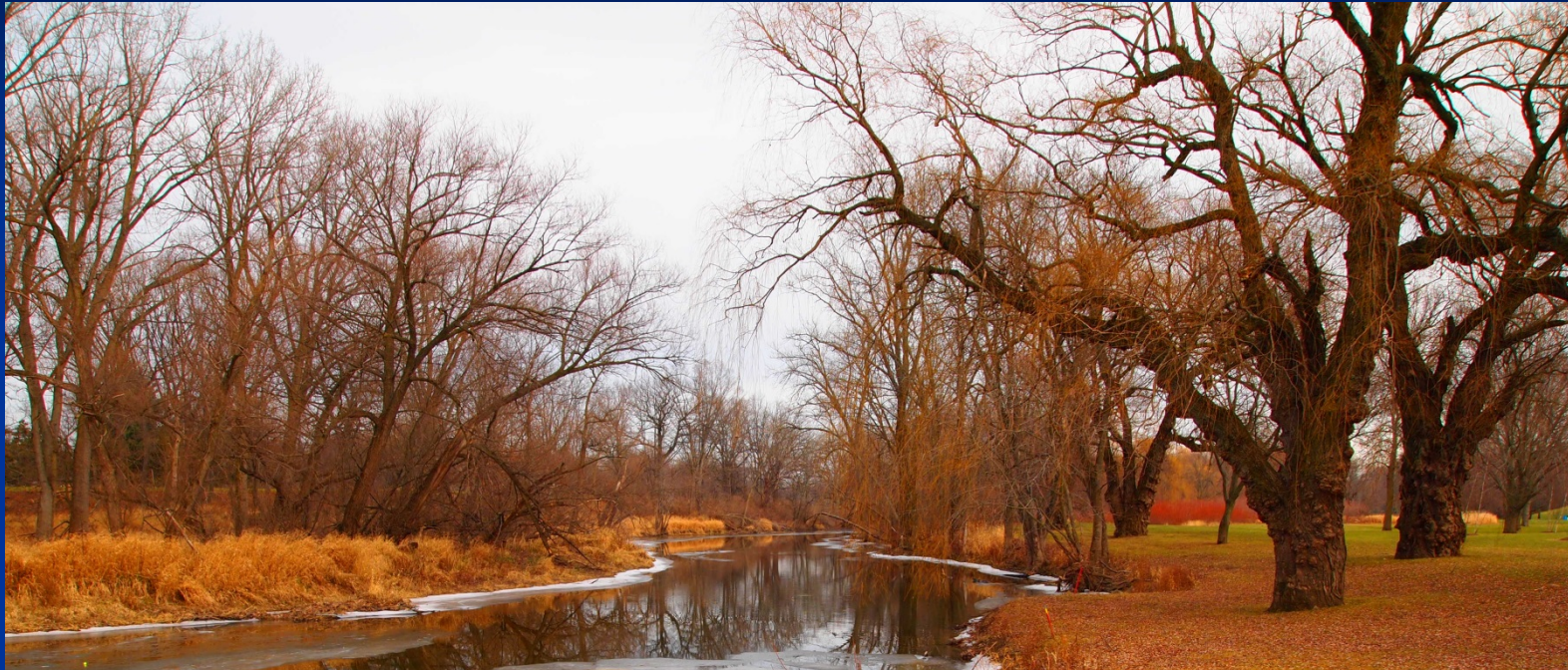
Northern Pike



Northern Pike: highly dependent on stream and floodplain connectivity & coolwater temperatures



Northern Pike: highly dependent on stream and floodplain connectivity & coolwater temperatures



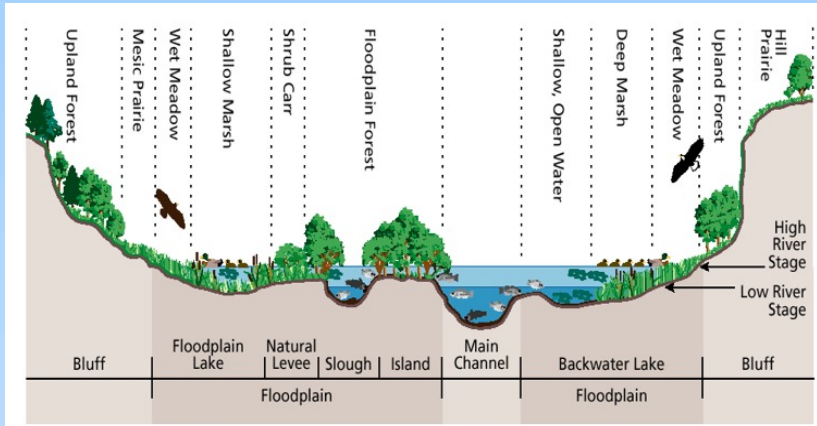
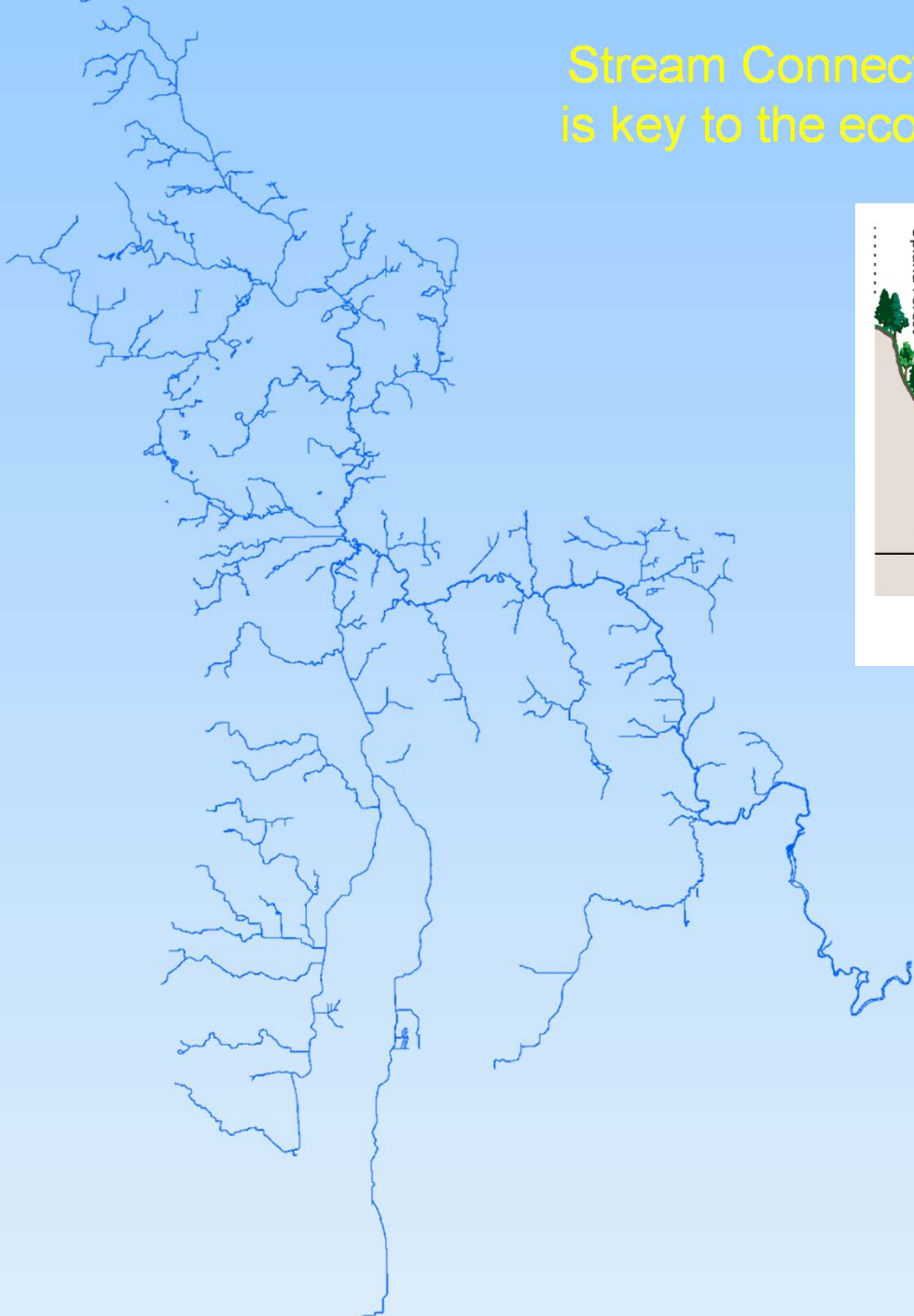


OZAUKEE FISH PASSAGE PROGRAM



AFTER FISHWAY

Stream Connectivity (Longitudinal and Lateral) is key to the ecological health of the Root River



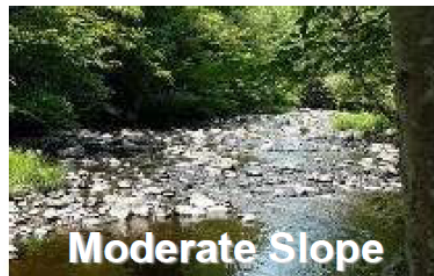
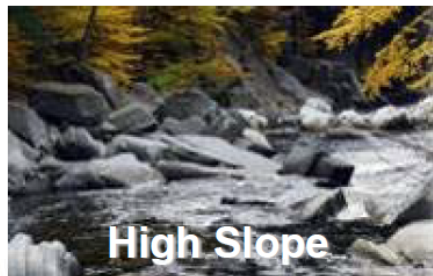
(From Sparks, Bioscience, 1995)

Problem: Aquatic communities respond to many environmental variables..

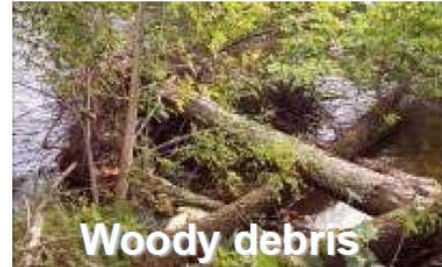
- Streamflow, stream size, position



- Basin characteristics



- Habitat



- Land cover, water quality, connectivity

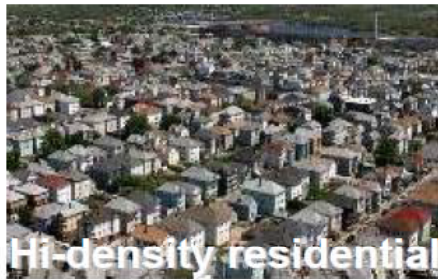


Problem: ...aquatic communities also respond to many human alterations.

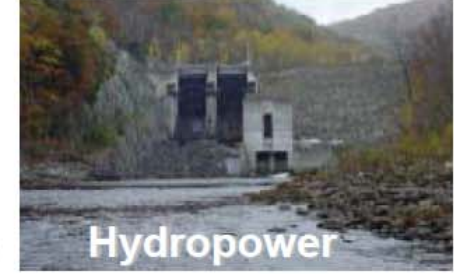
- Water-use (withdrawals, returns)



- Land cover/land-use/imperviousness



- Water quality, habitat loss, flow fluctuations

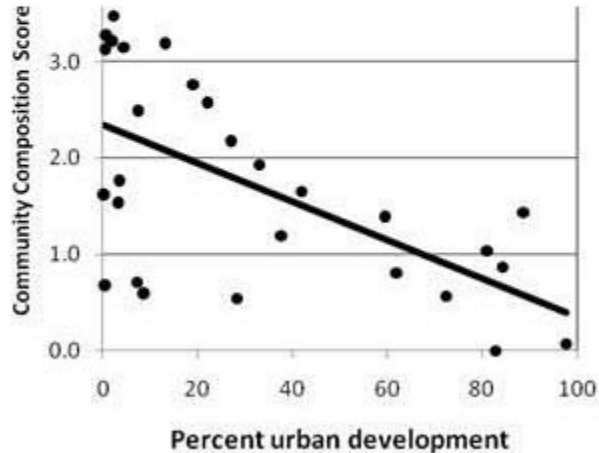


- Connectivity, impoundment, channelization

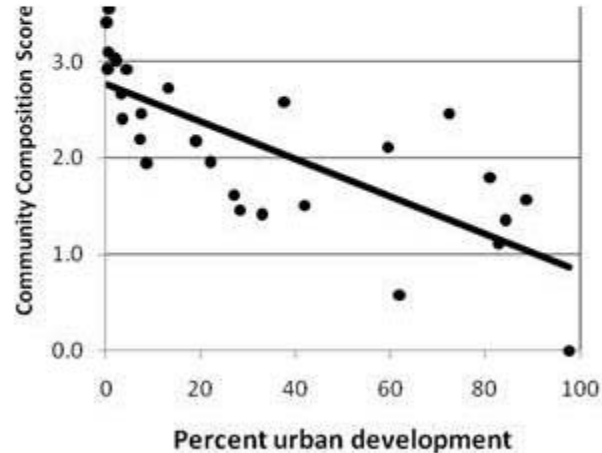


All Biological Communities Showed Signs of Negative Impacts from Urban Development

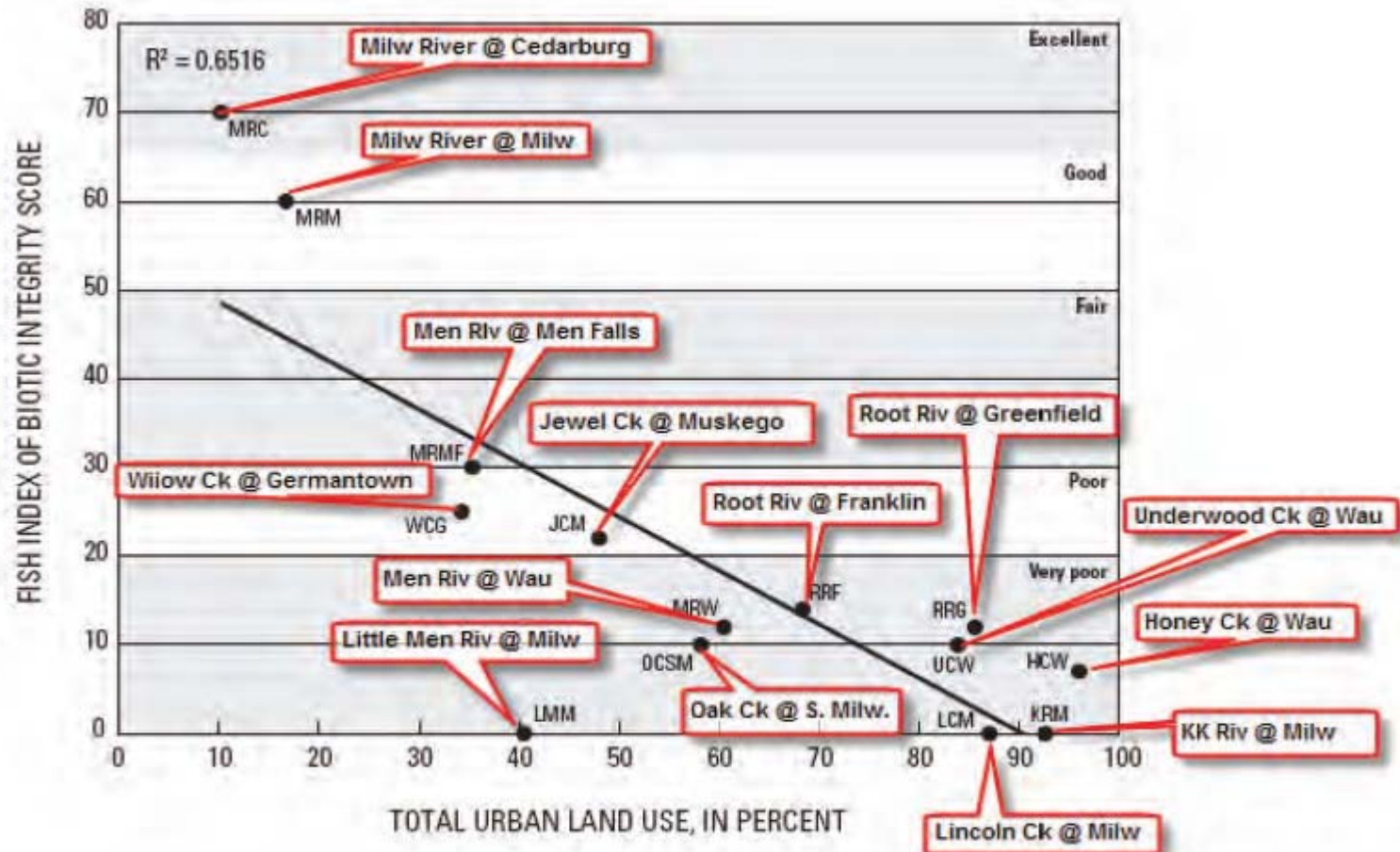
Algal Communities



Aquatic Insect Communities

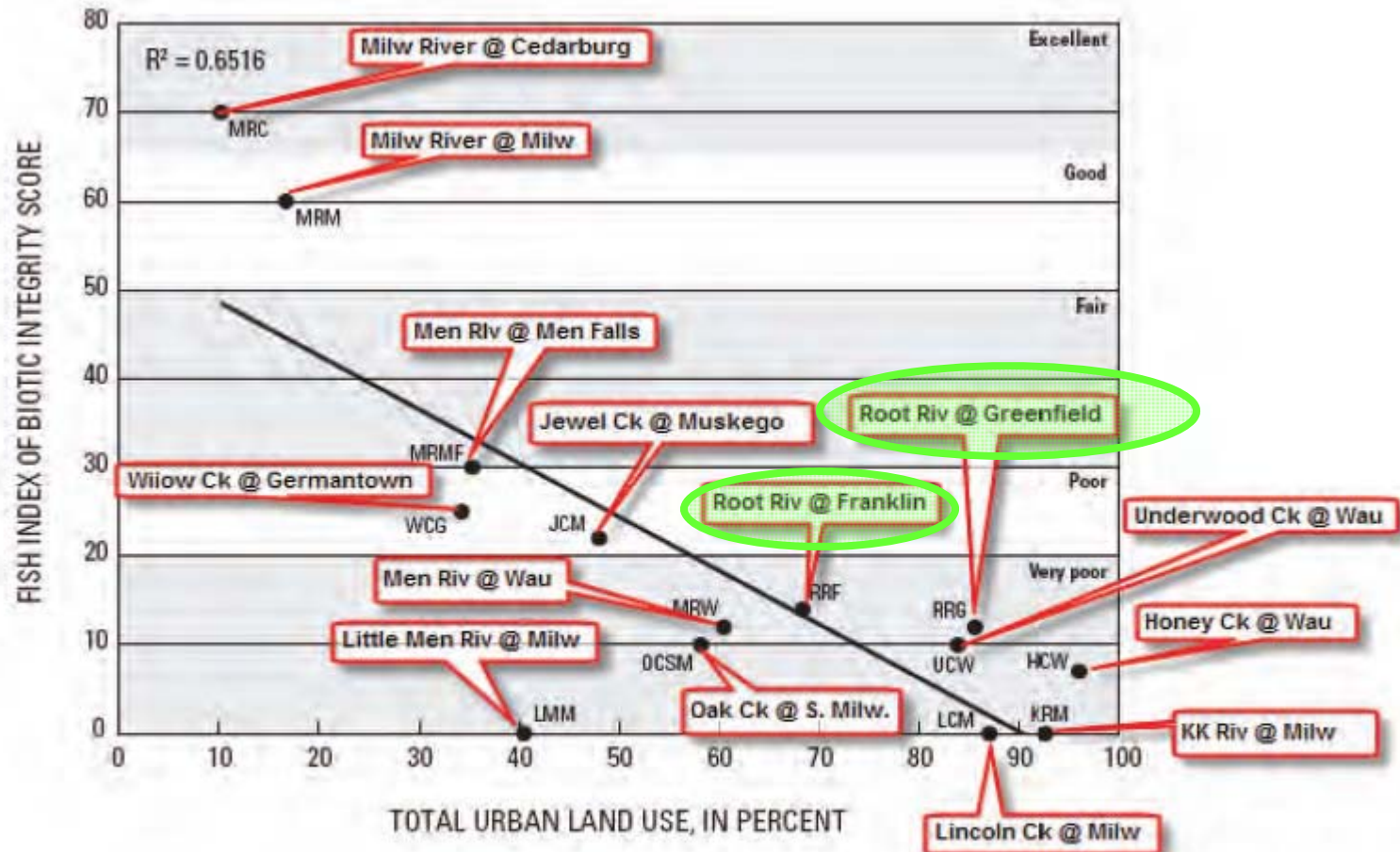


Fish IBI Scores Compared to Percent Urban Land Use Among Sites in the Greater Milwaukee Watersheds



Source: U.S. Geological Survey, Water Quality Characteristics for Selected Sites Within the Milwaukee Metropolitan Sewerage District Planning Area, Wisconsin, February 2004-September 2005, *Scientific Investigations Report 2007-5084*, 2007.

Fish IBI Scores Compared to Percent Urban Land Use Among Sites in the Greater Milwaukee Watersheds



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Average Trophic-Level Rankings and Aggregate Bioassessment Ranking Among Stream Sites Within the Milwaukee Watersheds

Site	Average Trophic-Level Ranking			Aggregate Bioassessment Ranking
	Fish ^a	Invertebrates ^b	Algae ^c	
				Quartile 1
Milwaukee River near Cedarburg	1.00	1.33	2.00	1.44
Milwaukee River at Milwaukee	2.00	2.67	6.00	3.56
Jewel Creek at Muskego	5.00	6.00	1.50	4.17
Menomonee River at Menomonee Falls	3.00	7.33	4.00	4.78
				Quartile 2
Willow Creek at Maple Road near Germantown	4.00	6.17	7.00	5.72
Root River near Franklin	6.00	6.67	8.50	7.06
Root River at Grange Avenue at Greenfield	7.50	11.00	7.00	8.50
				Quartile 3
Menomonee River at Wauwatosa	7.50	8.33	10.00	8.61
Oak Creek at South Milwaukee	9.50	7.33	9.50	8.78
Little Menomonee River at Milwaukee	13.00	8.33	6.50	9.28
				Quartile 4
Honey Creek at Wauwatosa	11.00	8.17	9.00	9.39
Underwood Creek at Wauwatosa	9.50	10.33	8.50	9.44
Lincoln Creek at N. 47th Street at Milwaukee	13.00	9.67	12.00	11.56
Kinnickinnic River at S. 11th Street at Milwaukee	13.00	11.67	13.50	12.72

Good
Quality

Poor
Quality

NOTE: IBI = Index of Biotic Integrity; EPT = Ephemeroptera, Plecoptera, and Trichoptera; HBI = Hilsenhoff Biotic Index. Fill color indicates quartile of ranking (quartile 1, blue; quartile 2, light blue; quartile 3, light orange; quartile 4, orange; each column is considered independently).

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Good
Quality

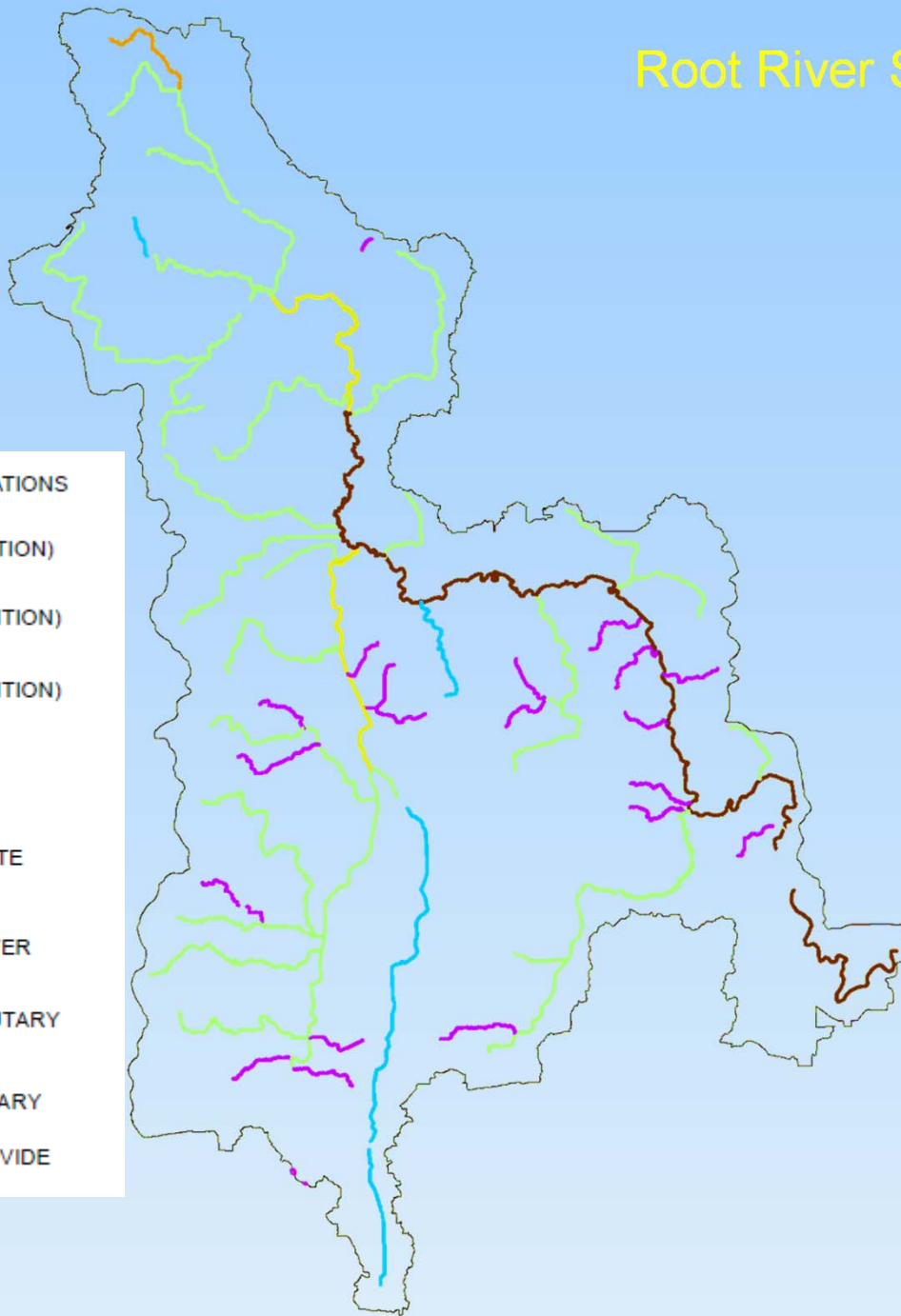
Poor
Quality

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Root River Stream Classification

FISHERIES STREAM CLASSIFICATIONS (see Table 38)

-  COOL (COLD TRANSITION) HEADWATER
-  COOL (WARM TRANSITION) HEADWATER
-  COOL (WARM TRANSITION) MAINSTEM
-  WARM HEADWATER
-  WARM MAINSTEM
-  MACROINVERTEBRATE
-  NO CLASSIFICATION
-  MAINSTEM ROOT RIVER REACH AREAS
-  REACH AREAS TRIBUTARY TO THE ROOT RIVER
-  WATERSHED BOUNDARY
-  SUBCONTINENTAL DIVIDE



Aggregate Biological Rankings among Reaches in the Root River: 2000-2013

Stream Reach ^a		Fisheries				Invertebrates HBI	Habitat Rating
		Warmwater IBI	Cool (warm transition)	Cool (cold transition)	Headwater IBI		
Tributary Reaches							
Upper Reaches of the Watershed that Discharge to the Mainstem Reaches RR-10 and RR-13	RR-1	N/A	Fair	--	Fair	--	Good-Very Good
	RR-2	N/A	--	--	--	--	--
	RR-3	N/A	--	--	--	Fair	--
	RR-4	N/A	Poor-Fair	--	Fair-Good	Poor	Good-Very Good
	RR-5	N/A	Poor	--	Poor	--	Good-Very Good
	RR-6	N/A	Poor-Fair	--	Fair-Good	Fair-Good	Poor-Fair
	RR-7	N/A	--	--	--	Fairly Poor-Fair	--
	RR-8	N/A	--	--	--	Fairly Poor	--
	RR-9	N/A	--	--	--	Good	--
	RR-11	N/A	--	--	--	Good-Very Good	--
Lower Reaches of the Watershed that Discharge to the Mainstem Reaches RR-17 and RR-22	RR-12	N/A	--	--	--	--	--
	RR-14	N/A	Good	--	Fair	Poor-Good	--
	RR-15	N/A	Fair	Good	Poor-Fair	Fairly Poor	Good-Very Good
	RR-16	N/A	Poor-Fair	--	--	Poor-Fairly Poor	Fair
	RR-18	N/A	--	Fair	Fair	Fairly Poor-Very Good	Fair-Very Good
	RR-19	N/A	Poor-Fair	--	Poor-Fair	Fairly Poor	Good-Very Good
	RR-20	N/A	Fair	--	Fair	Fairly Poor	Poor
RR-21	N/A	Fair	--	Good	Poor-Fair	Very Poor-Good	
Mainstem Root River Reach Areas							
	RR-10	--	N/A	N/A	N/A	--	--
	RR-13	Very Poor-Fair	N/A	N/A	N/A	Fairly Poor-Fair	Fair-Very Good
	RR-17	Very Poor-Good	N/A	N/A	N/A	Fairly Poor-Fair	Poor-Very Good
	RR-22	Fair-Good	N/A	N/A	N/A	Fair-Good	Poor-Fair
	RR-23	Fair-Excellent	N/A	N/A	N/A	Fair	Good-Very Good

Historic (1900-1999) vs Current (2000-2013) Native Fish Species Composition

Upper
Tributary
Reaches

Historic Current
32 15

Mainstem U.S. Dam

Historic Current
32 29

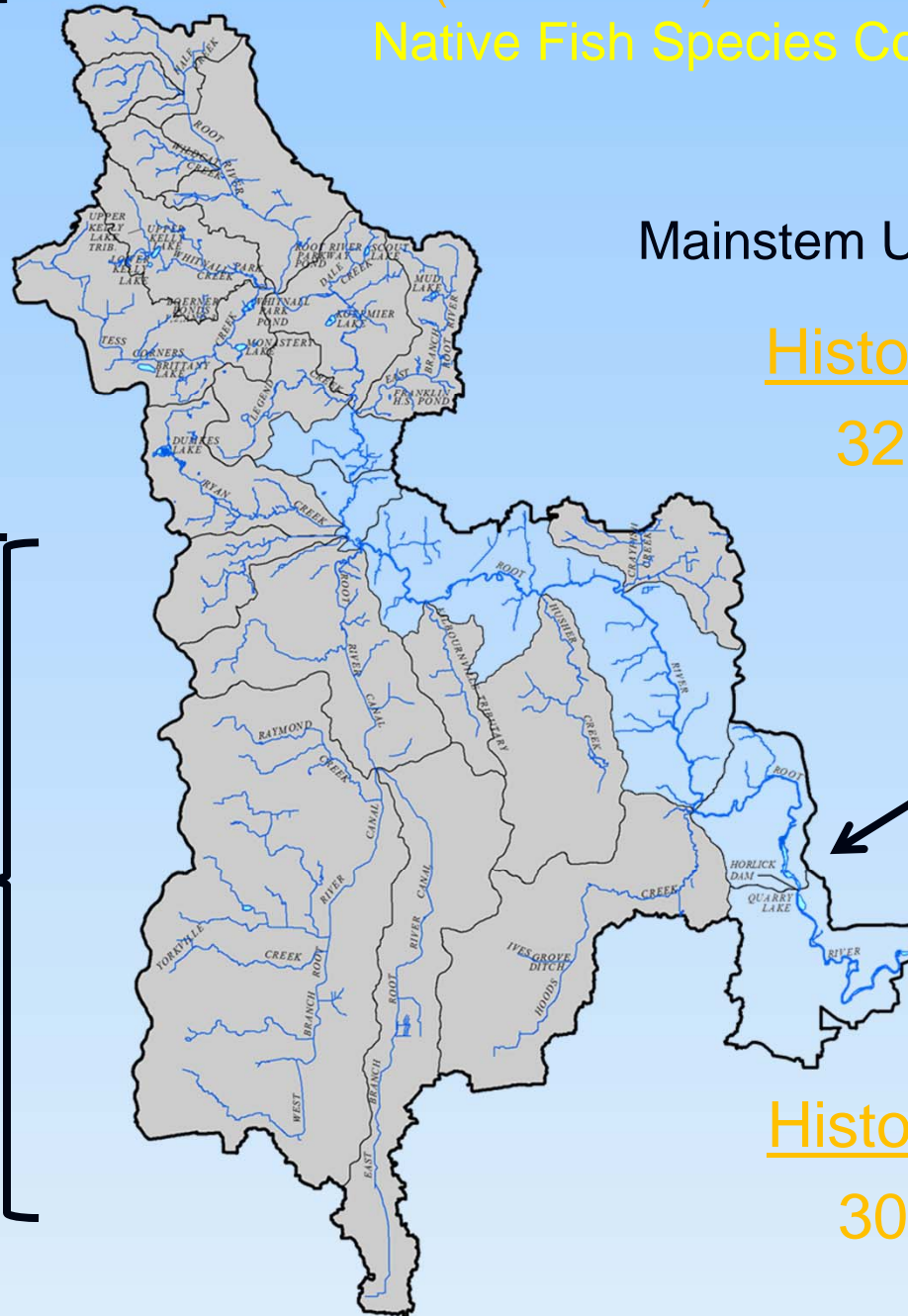
Lower
Tributary
Reaches

Historic Current
38 20

Horlick Dam

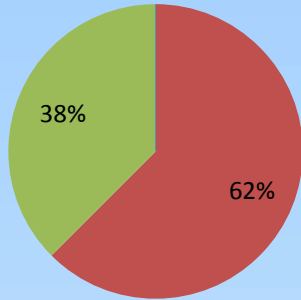
Mainstem
D.S. Dam

Historic Current
30 30

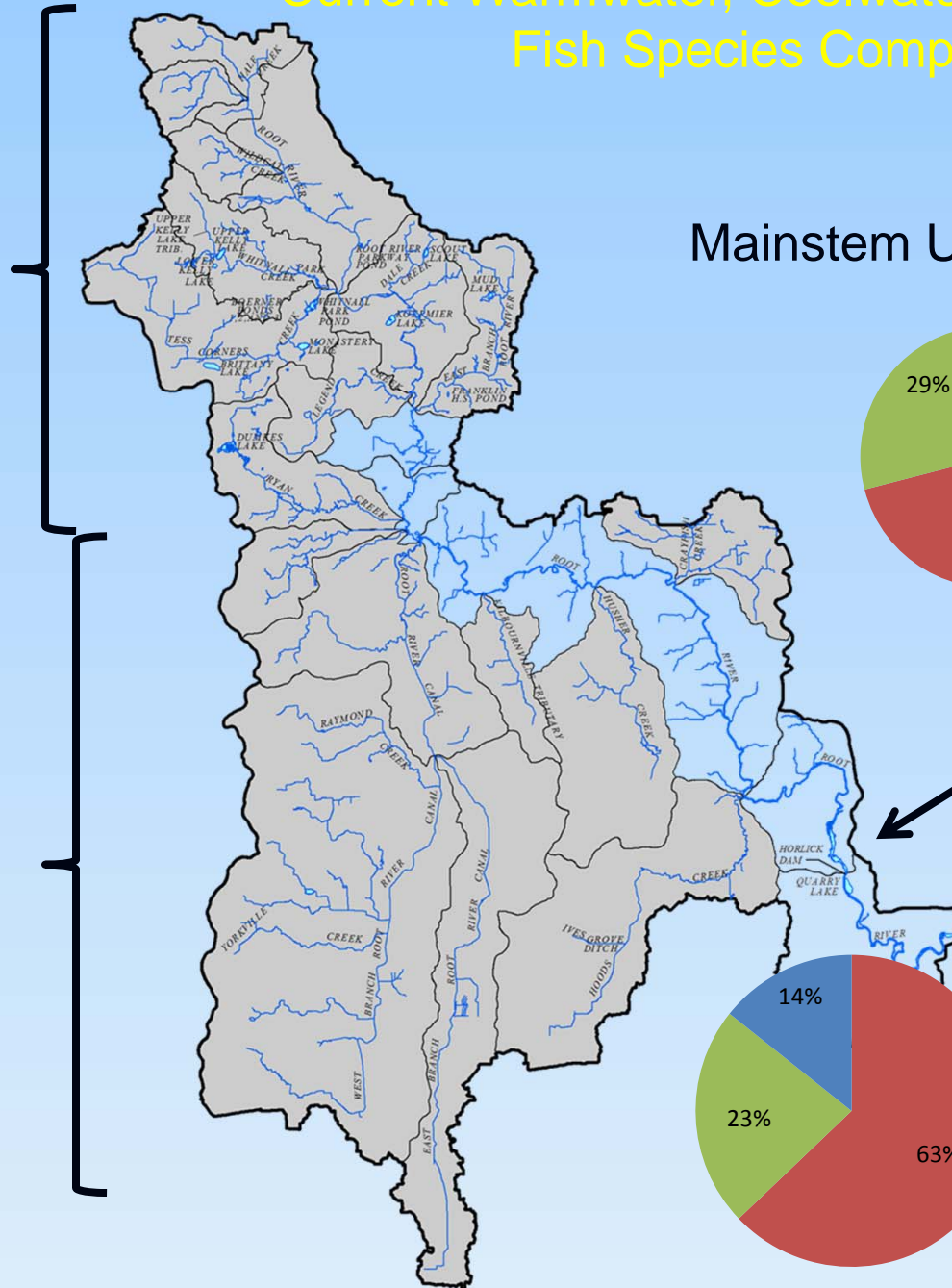
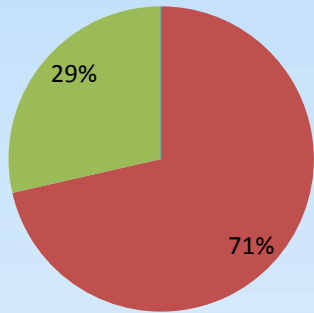


Current Warmwater, Coolwater, and Coldwater Fish Species Composition

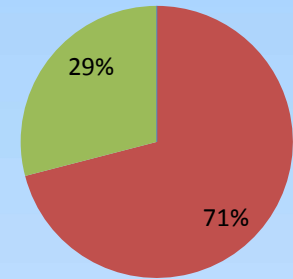
Upper
Tributary
Reaches



Lower
Tributary
Reaches

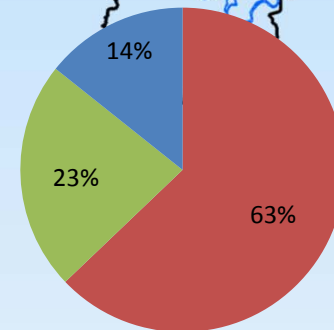


Mainstem U.S. Dam



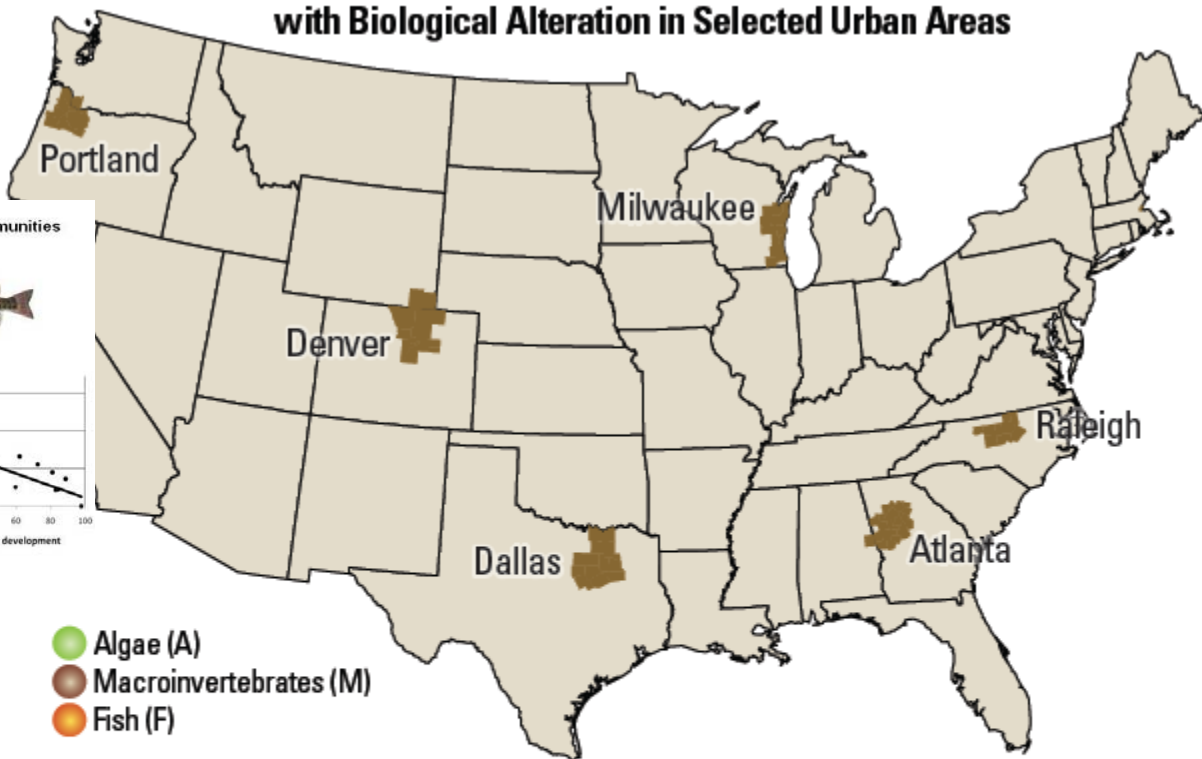
Horlick Dam

Mainstem
D.S. Dam

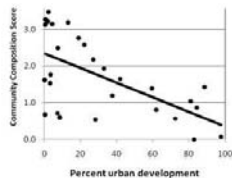


- Warmwater
- Coolwater
- Coldwater

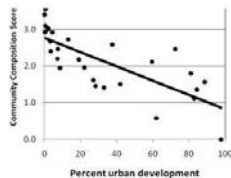
Physical and Chemical Factors Associated with Biological Alteration in Selected Urban Areas



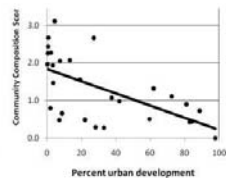
Algal Communities



Aquatic Insect Communities



Fish Communities



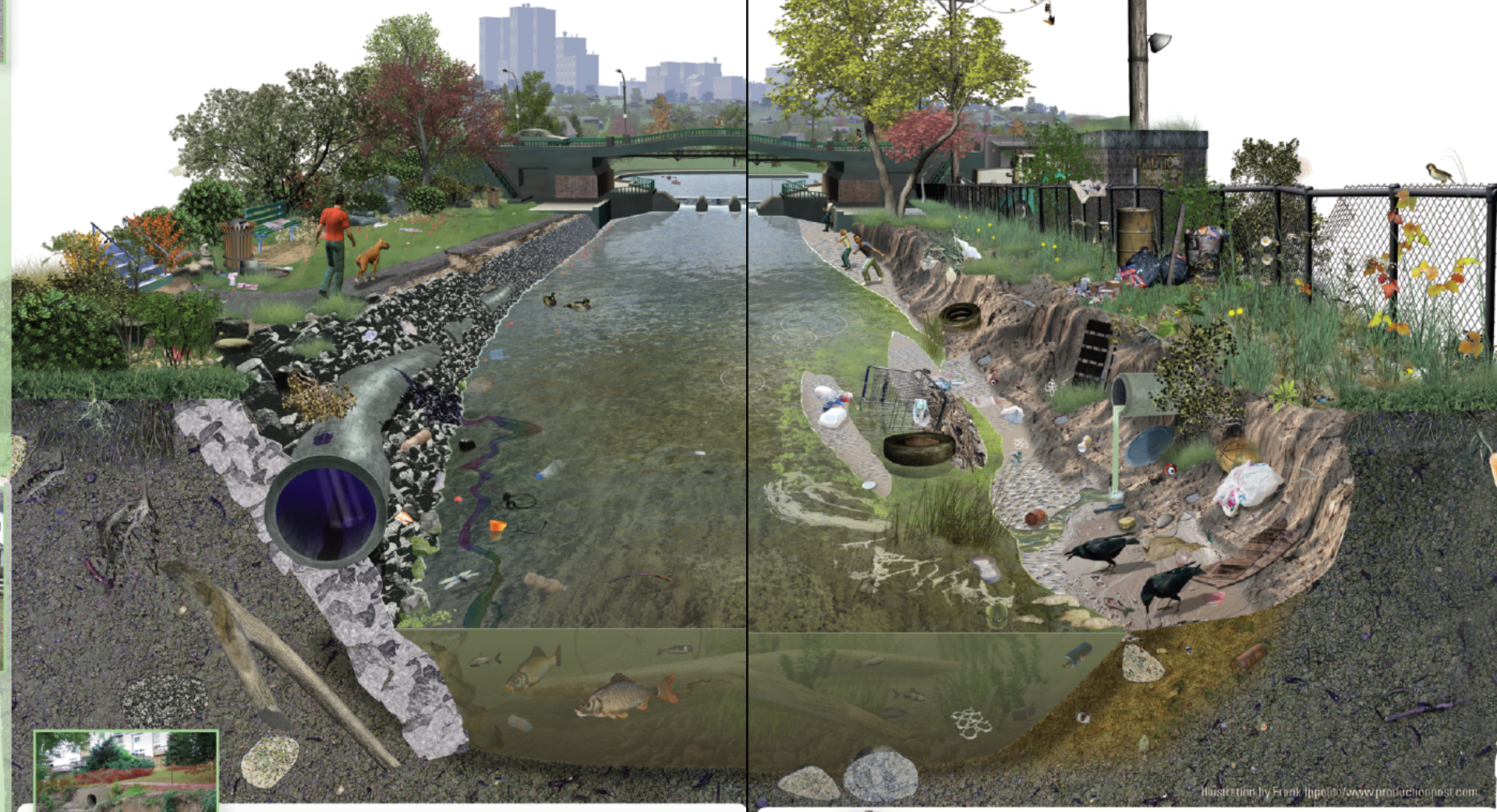
- Algae (A)
- Macroinvertebrates (M)
- Fish (F)

Location	Portland	Denver	Dallas	Milwaukee	Atlanta	Raleigh
Factor	A	M	F	A	M	F
Streamflow	●	●	●	●	●	●
Temperature	●	●	●	●	●	●
Sediment	●	●	●	●	●	●
Salinity	●	●	●	●	●	●
Nutrients	●	●	●	●	●	●
Contaminants	●	●	●	●	●	●

(USGS, Ecological Health in the Nation's Streams, 1993–2005)

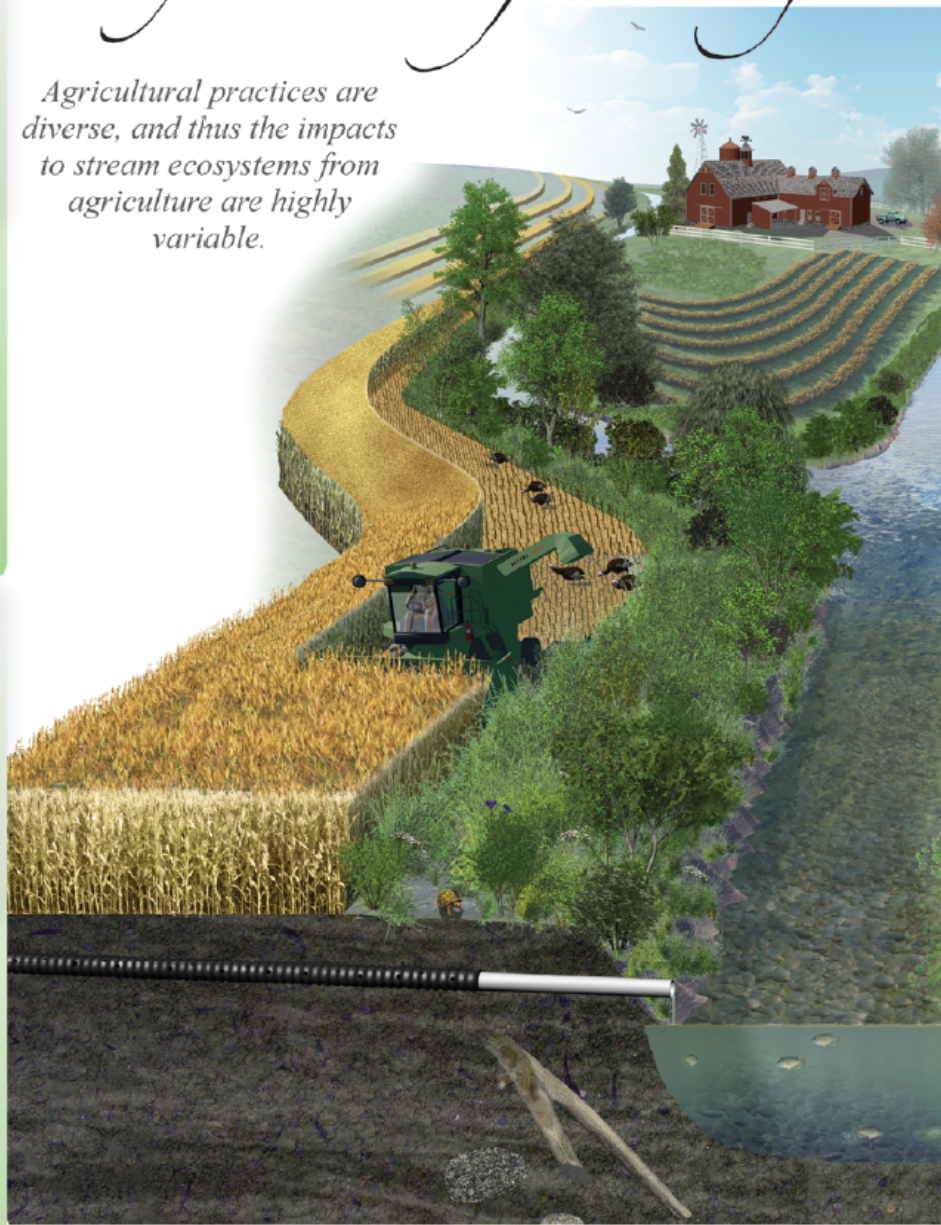
Dynamics of an Urban Stream Ecosystem

Urban development may have significant impacts on stream ecosystems that are often obvious to the casual observer.



Dynamics of an Agricultural Stream Ecosystem

Agricultural practices are diverse, and thus the impacts to stream ecosystems from agriculture are highly variable.



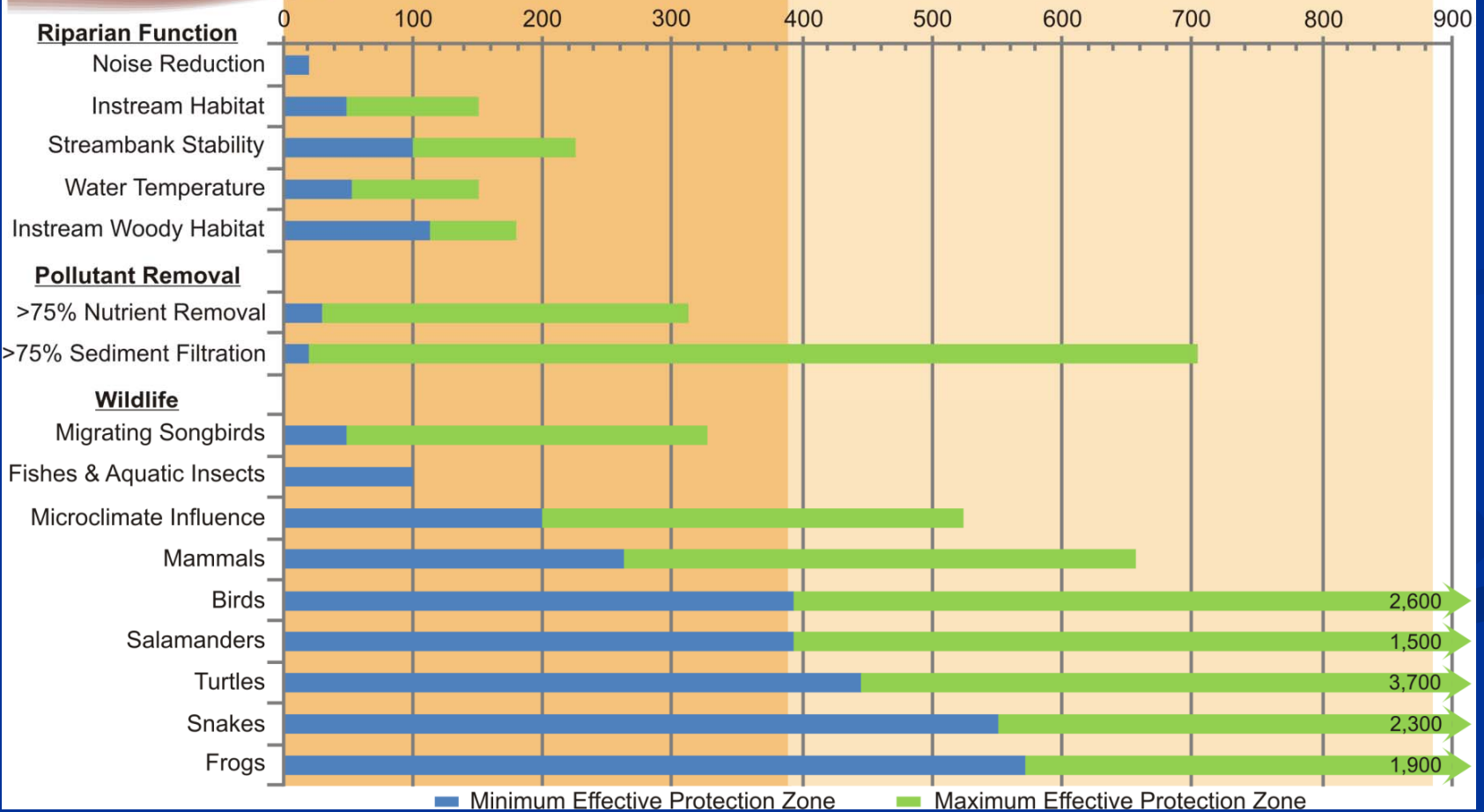
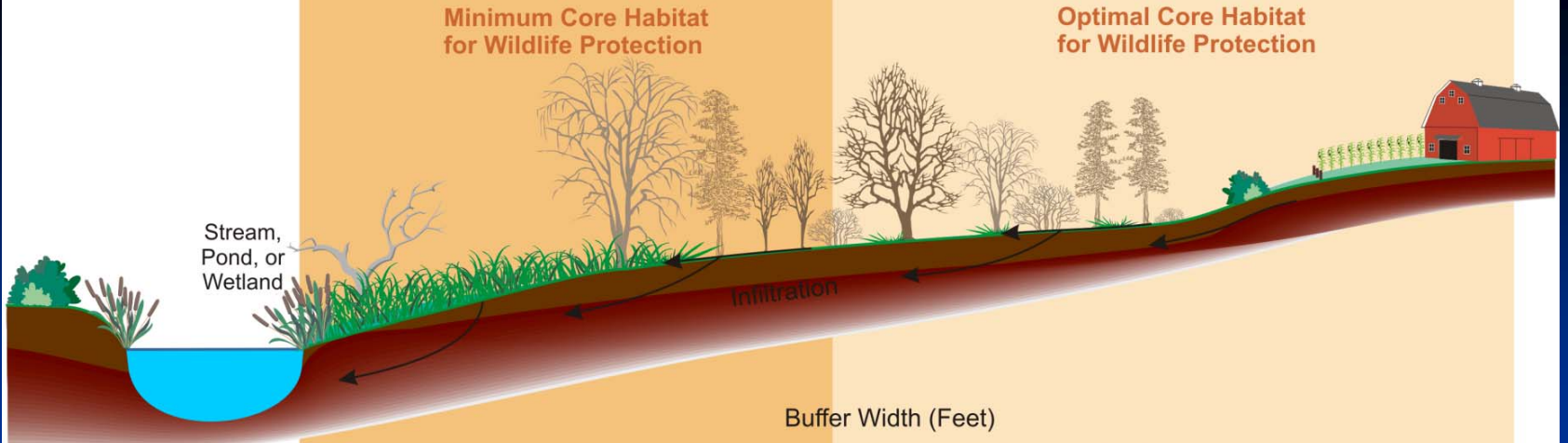
Physical habitat: Some agricultural practices reduce the quality of

Fish communities in agricultural streams may be

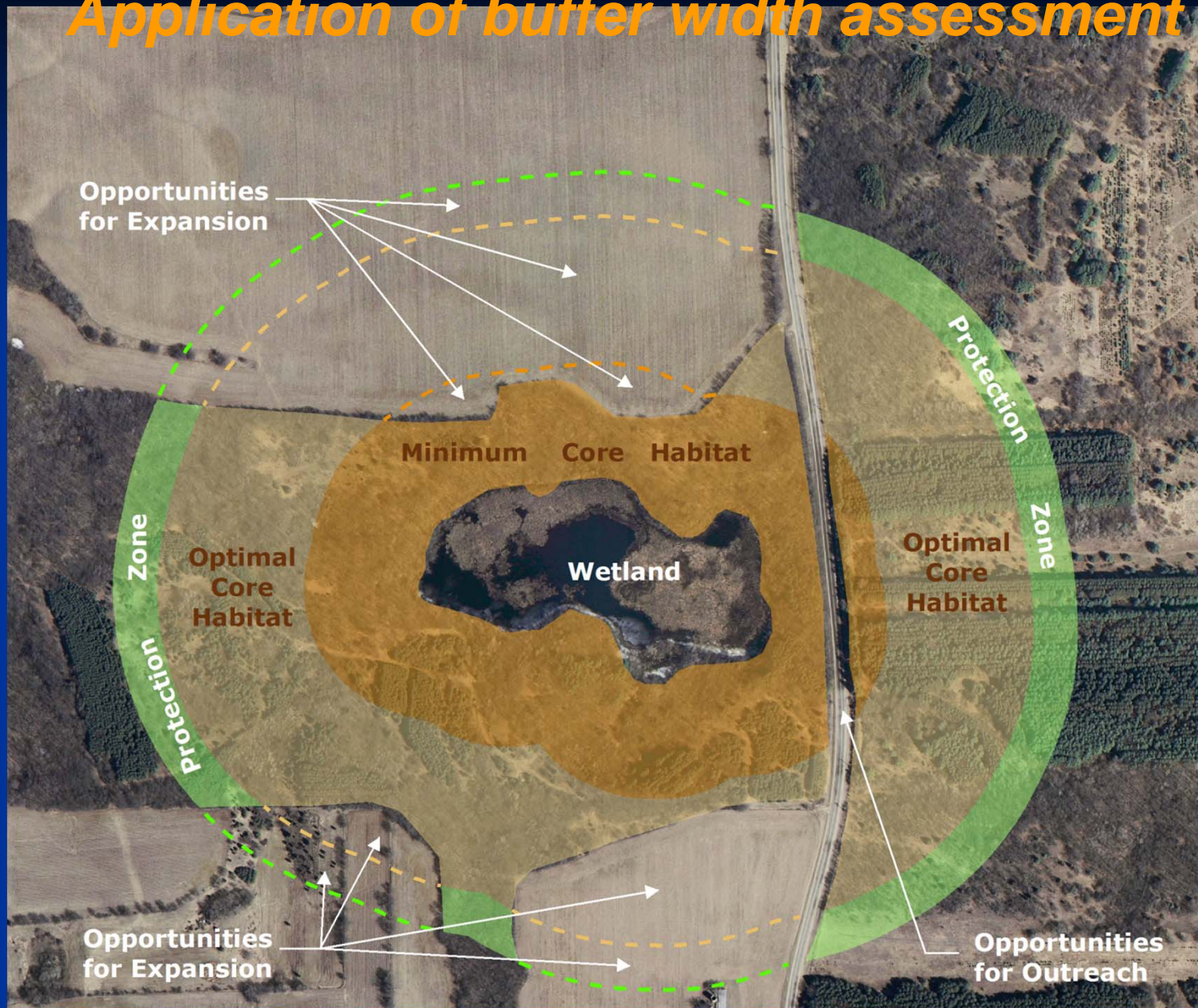
Illustration by Frank Ippolito/www.productionpost

Prioritization Scheme-Protect the integrity of the existing landscape

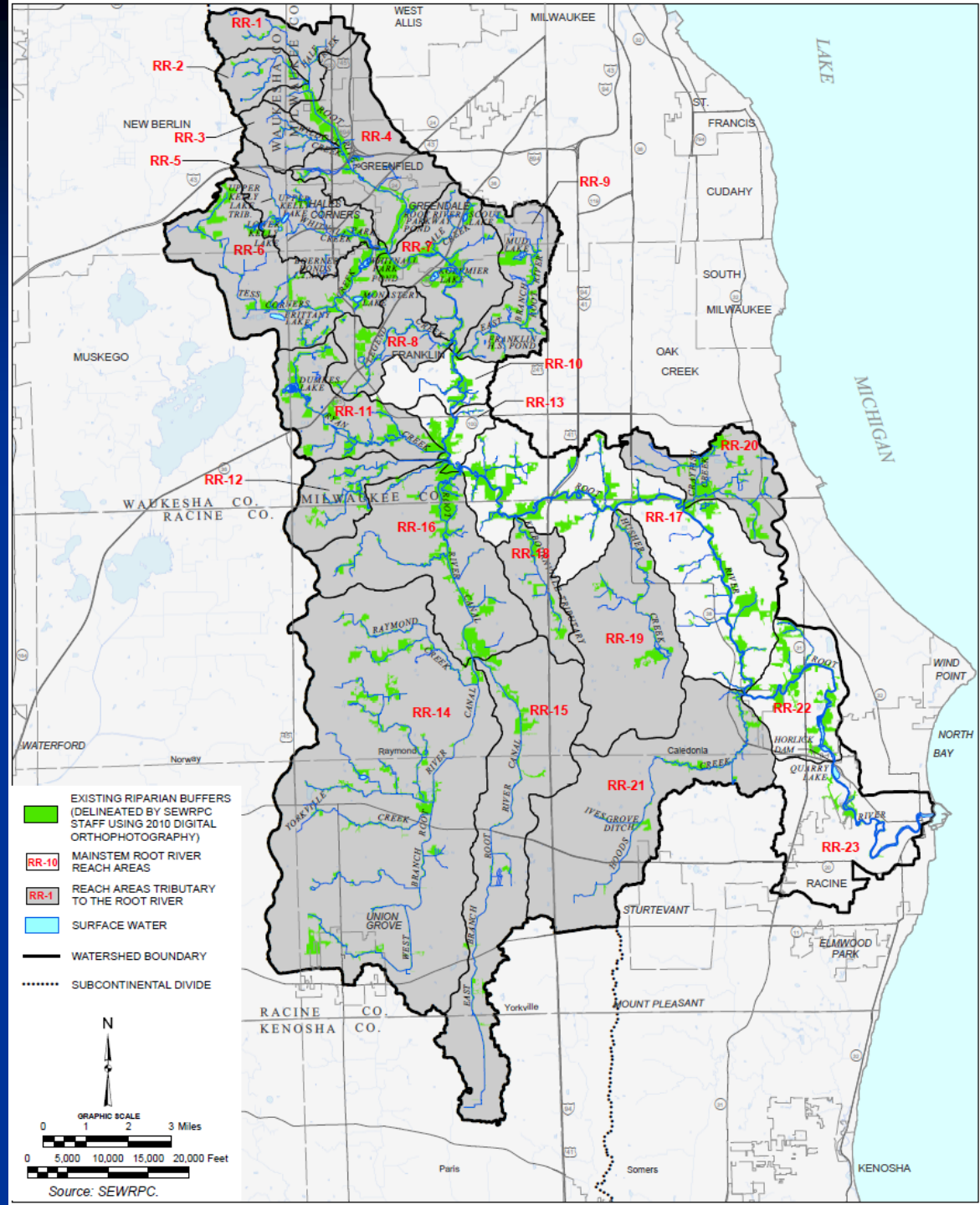




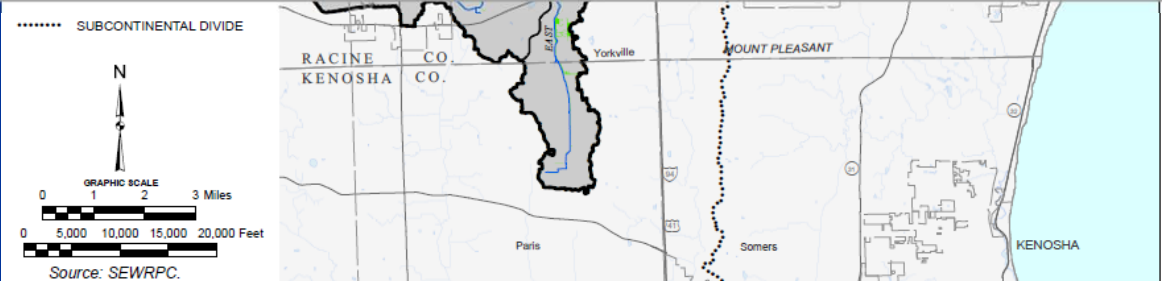
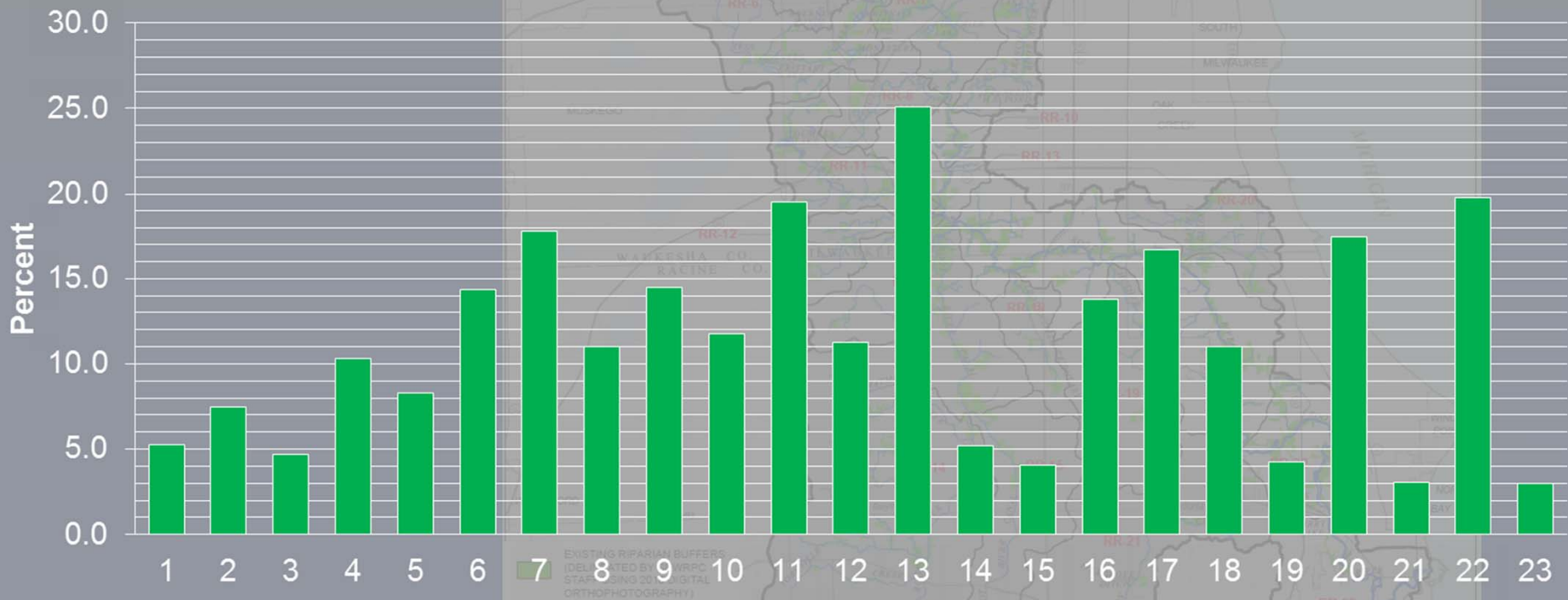
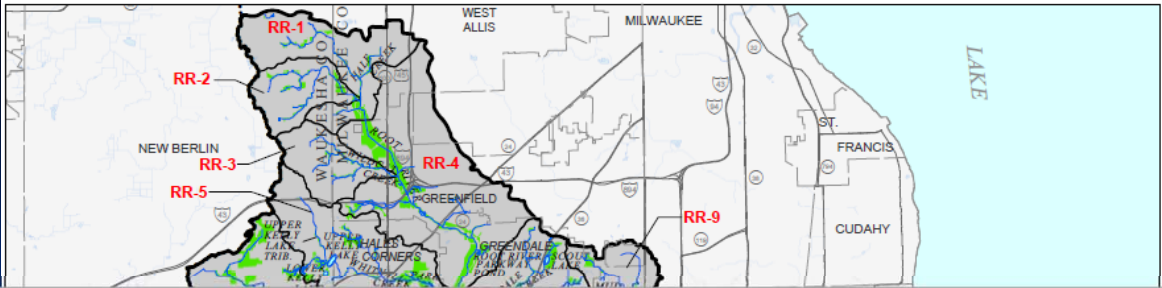
Application of buffer width assessment



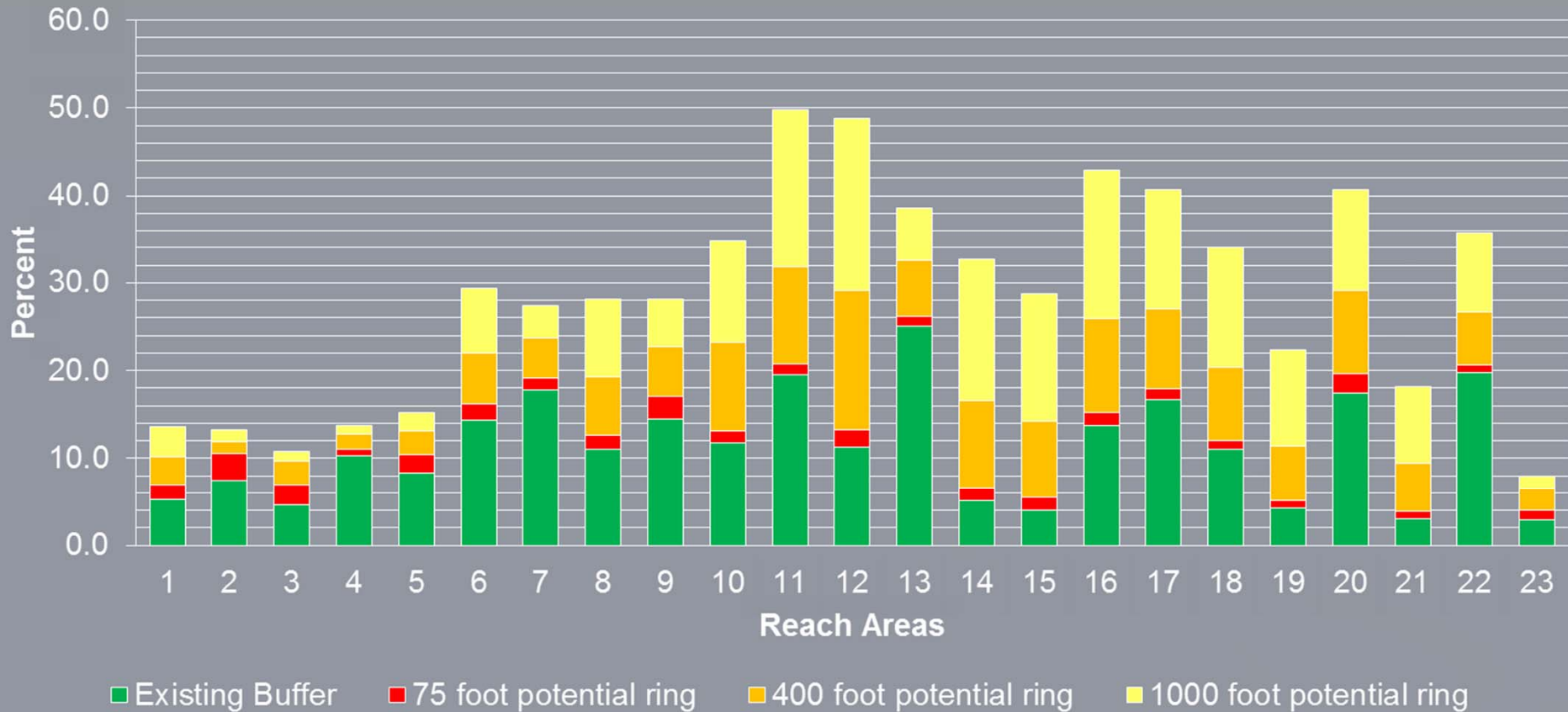
Existing Riparian Buffers



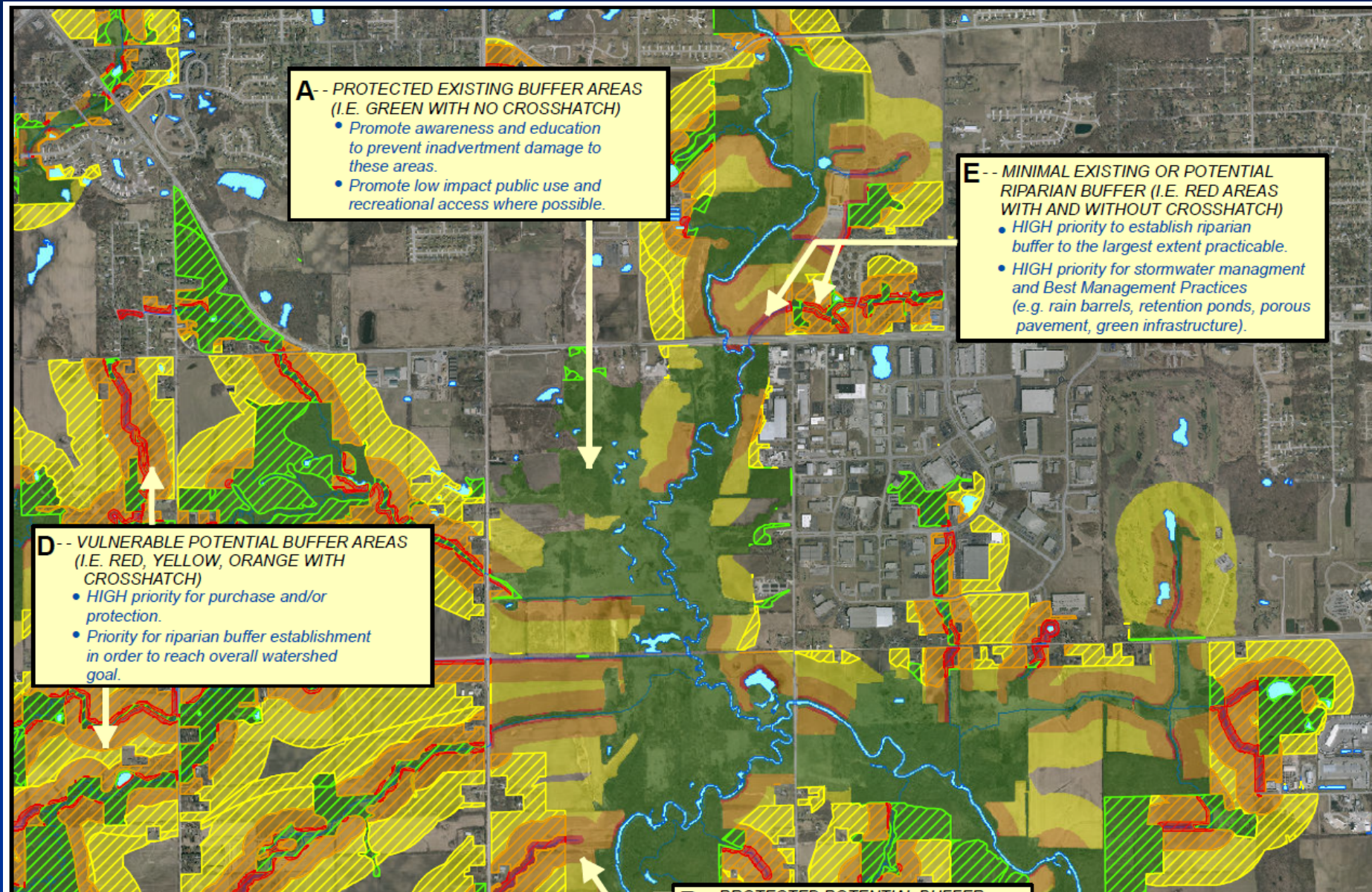
Existing Riparian Buffers



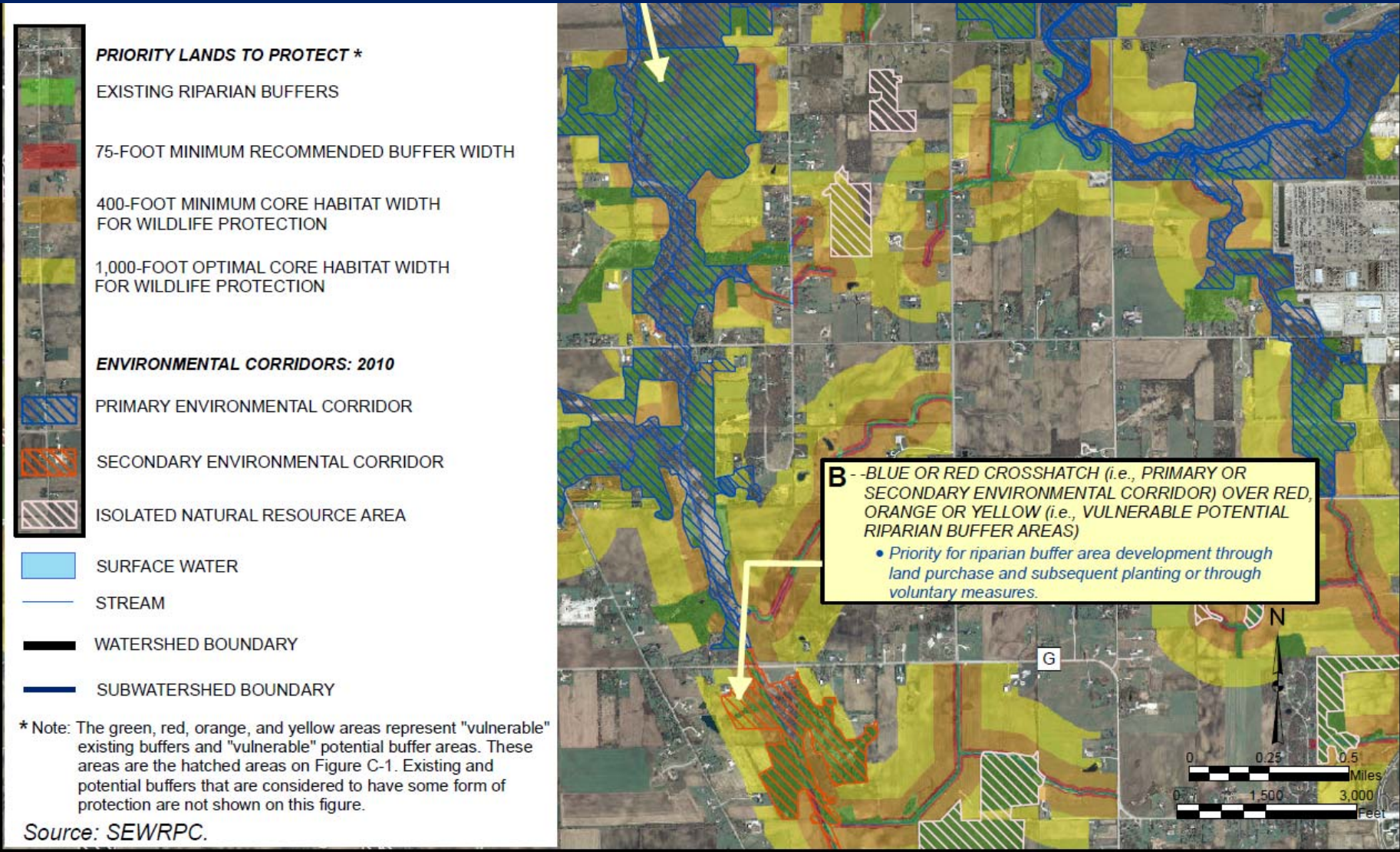
Potential Buffer among reaches within the Root River Watershed



Potential Buffer among reaches within the Root River Watershed



Potential Buffers & Environmental Corridors among reaches within the Root River Watershed



Potential Buffers & Groundwater Recharge among reaches within the Root River Watershed

C -- RED, YELLOW, AND/OR ORANGE (i.e., VULNERABLE POTENTIAL RIPARIAN BUFFER AREAS) UNDER BLUE CROSSHATCH (i.e., HIGH GROUNDWATER RECHARGE)

- High priority for implementation of riparian buffer areas where practicable either through land purchase and subsequent planting or through voluntary/incentive-based measures.

D -- GREEN (i.e., VULNERABLE EXISTING RIPARIAN BUFFERS) UNDER BLUE CROSSHATCH (i.e., HIGH GROUNDWATER RECHARGE)

- High priority for purchase and/or protection.

E -- BLUE CROSSHATCH (i.e., HIGH GROUNDWATER RECHARGE) OVER AGRICULTURAL LAND

- Priority for protection of infiltration functions,
- Discourage development or, if development will take place, promote infiltration technologies (i.e., porous pavement, rain gardens).
- Priority for protection from pollution (i.e., projects to prevent over fertilization or chemical use).

PRIORITY LANDS TO PROTECT *

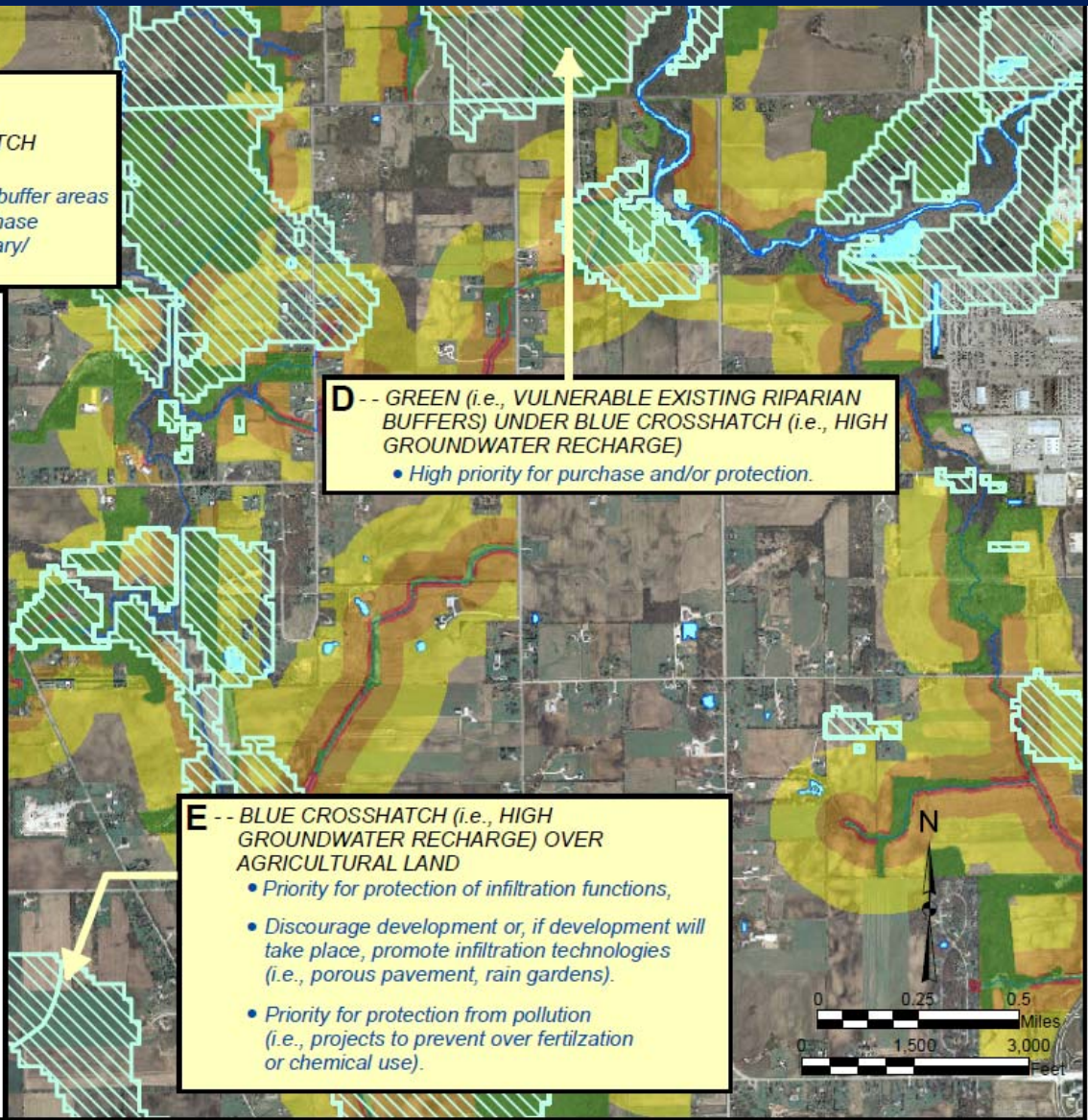
- EXISTING RIPARIAN BUFFERS
- 75-FOOT MINIMUM RECOMMENDED BUFFER WIDTH
- 400-FOOT MINIMUM CORE HABITAT WIDTH FOR WILDLIFE PROTECTION
- 1,000-FOOT OPTIMAL CORE HABITAT WIDTH FOR WILDLIFE PROTECTION

AREAS OF HIGH AND VERY HIGH GROUNDWATER RECHARGE POTENTIAL

- HIGH GROUNDWATER RECHARGE POTENTIAL
- SURFACE WATER
- STREAM

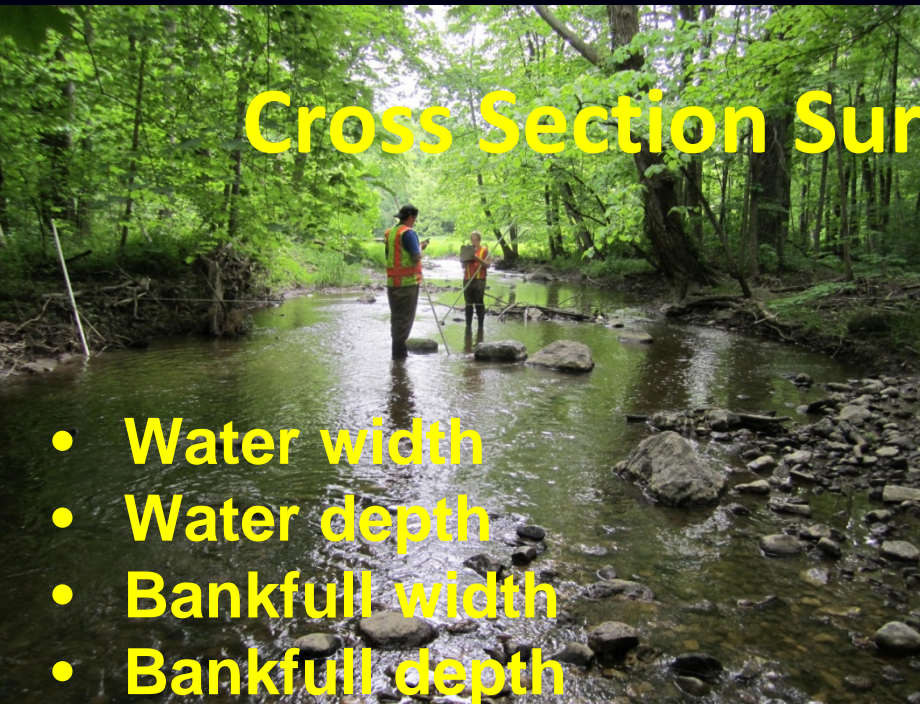
* Note: The green, red, orange, and yellow areas represent "vulnerable" existing buffers and "vulnerable" potential buffer areas. These areas are the hatched areas on Figure C-1. Existing and potential buffers that are considered to have some form of protection are not shown on this figure.

Source: SEWRPC.




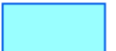




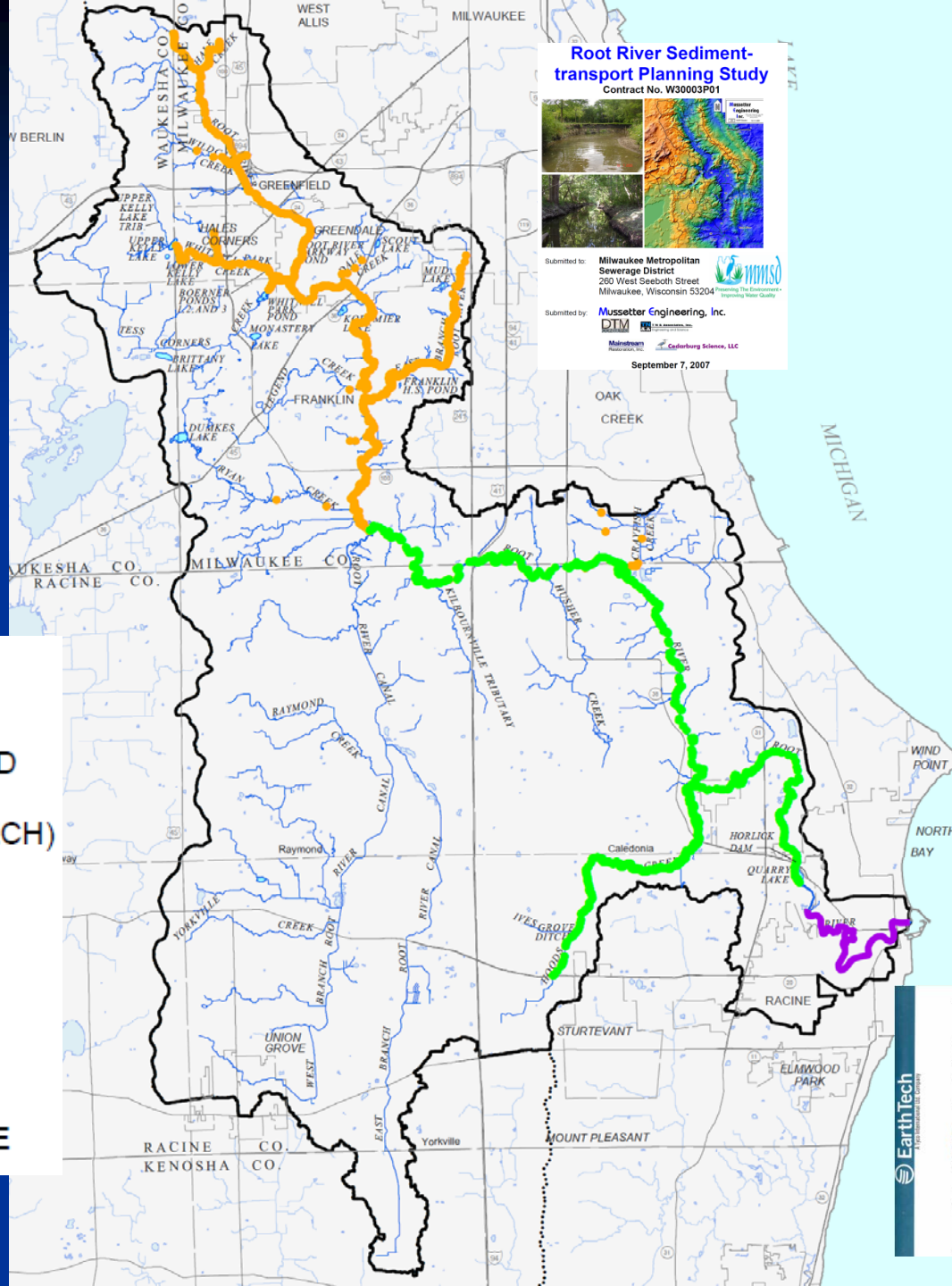
Cross Section Survey-Physical data

- Water width
- Water depth
- Bankfull width
- Bankfull depth
- Bank height, slope, undercut measurements
- Bank erosion
- Instream woody habitat, cover assessed
- Substrate (rocks, gravel, sand, clay, muck)
- Riparian (stream side) buffer vegetation
- Channel obstructions/jams
- Trash, debris jams



Aerial Extent of Root River Watershed Studies


-  EXTENT OF SEDIMENT TRANSPORT STUDY
-  EXTENT OF OUTFALL AND STREAMBANK EROSION ASSESSMENT (EARTHTECH)
-  EXTENT OF SEWRPC STREAM SURVEY
-  SURFACE WATER
-  WATERSHED BOUNDARY
-  SUBCONTINENTAL DIVIDE



Report

Root River Outfall and Streambank Erosion Assessment

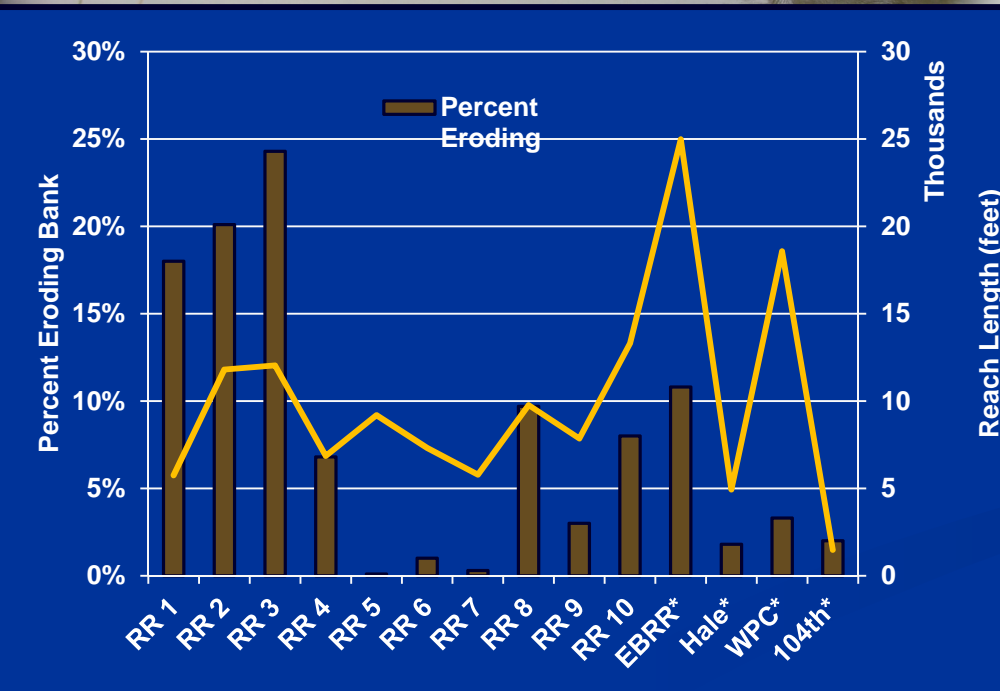
Prepared for the City of Racine



City of Racine
100 N. Michigan Avenue
Racine, WI 53402

Prepared by:
EarthTech
1200 S. Broadway, Suite 400
Milwaukee, WI 53204

August 2007



Trash in Channel

- 22 large trash items
- 12 tires



Woody Debris Jams

- 17 Reach 1
- 40 Reach 2
- 1 Reach 3





**Fish passage
Assessments**

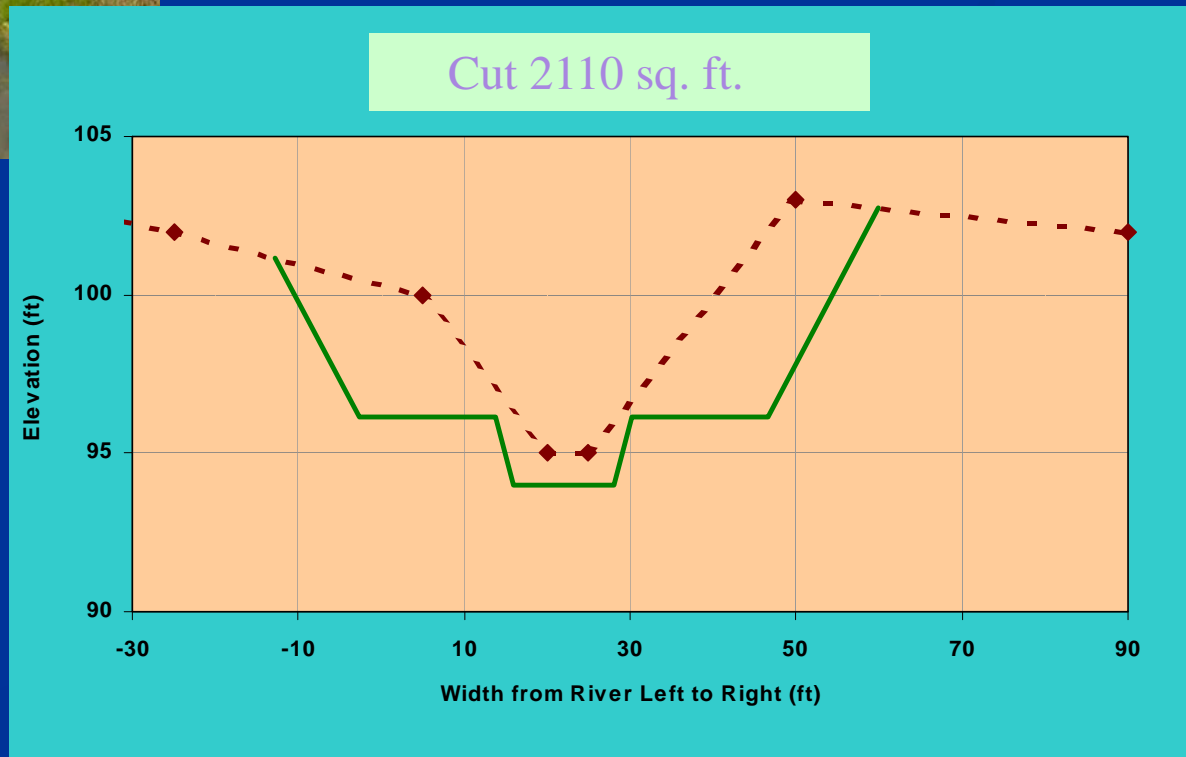


Two-Stage Channels



Dan Mecklenburg
Soil & Water Conservation
ODNR

Andy Ward
FAB Engineering
Ohio State University

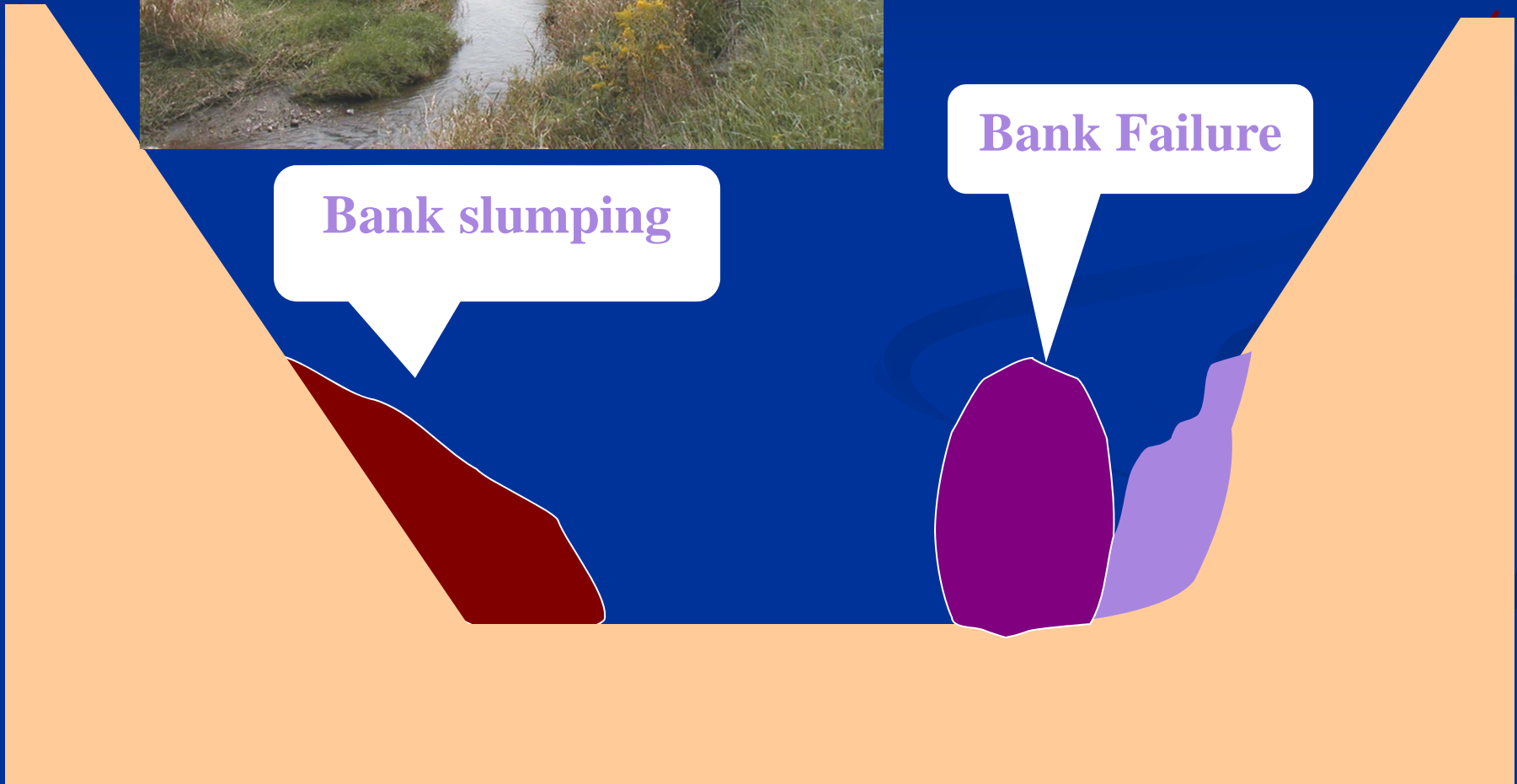




Two-Stage Design
can help prevent bank
slumping & Failure

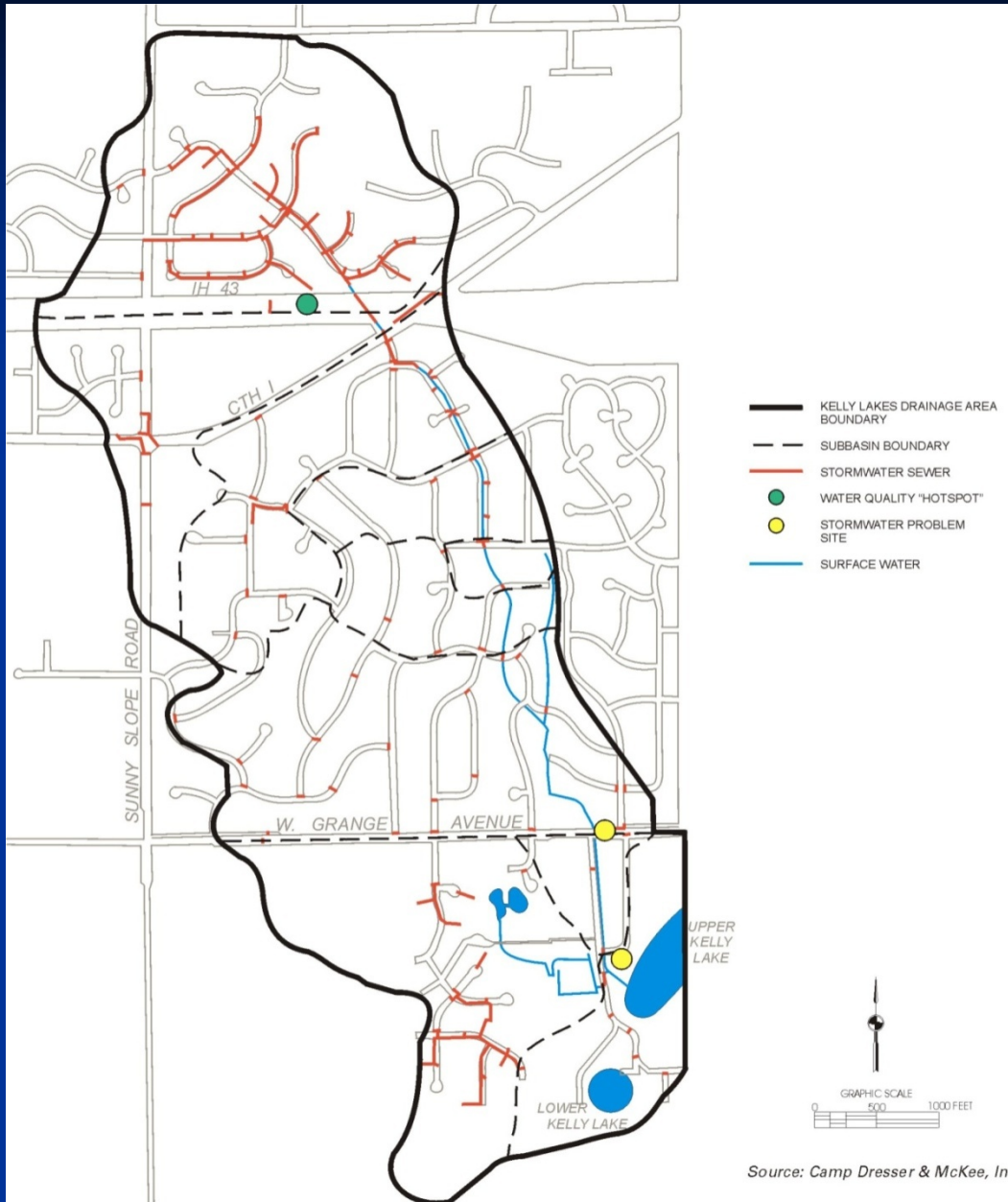
Bank slumping

Bank Failure



Kelly Lakes Watershed Project Goals: Recreate a naturally Meandering stream

Reconnect the stream and its floodplain

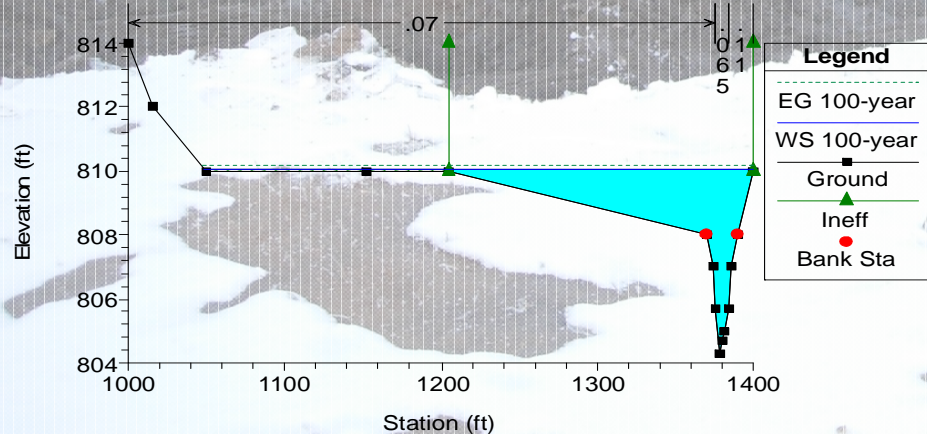


Historic fill was removed and floodplain reconnected



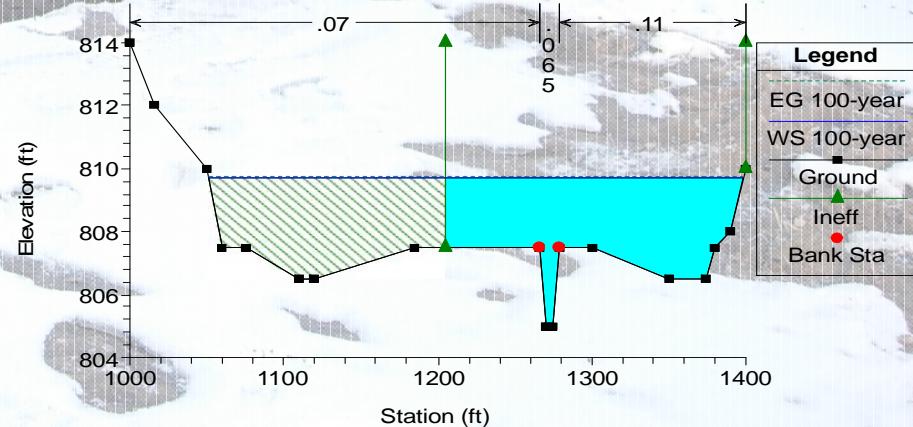
Existing Conditions

Upper Kelly Lakes Tributary Plan: Plan 22 4/2/2004
 UKL Tributary Cross Sec. Added From 2000 large-scale topo map



Proposed Conditions

Upper Kelly Lakes Tributary Plan: Plan 21 4/2/2004
 UKL Tributary Cross Sec. Added From 2000 large-scale topo map



Opportunities within highly urban settings!

PRE-PROJECT 2003



- Channelized ditch
- Historic floodplain fill
- Invasive species dominate

POST PROJECT 2005



- Meandered stream
- Reconnected floodplain
- Wetland diversity added
- Native species restored

POST PROJECT 2012



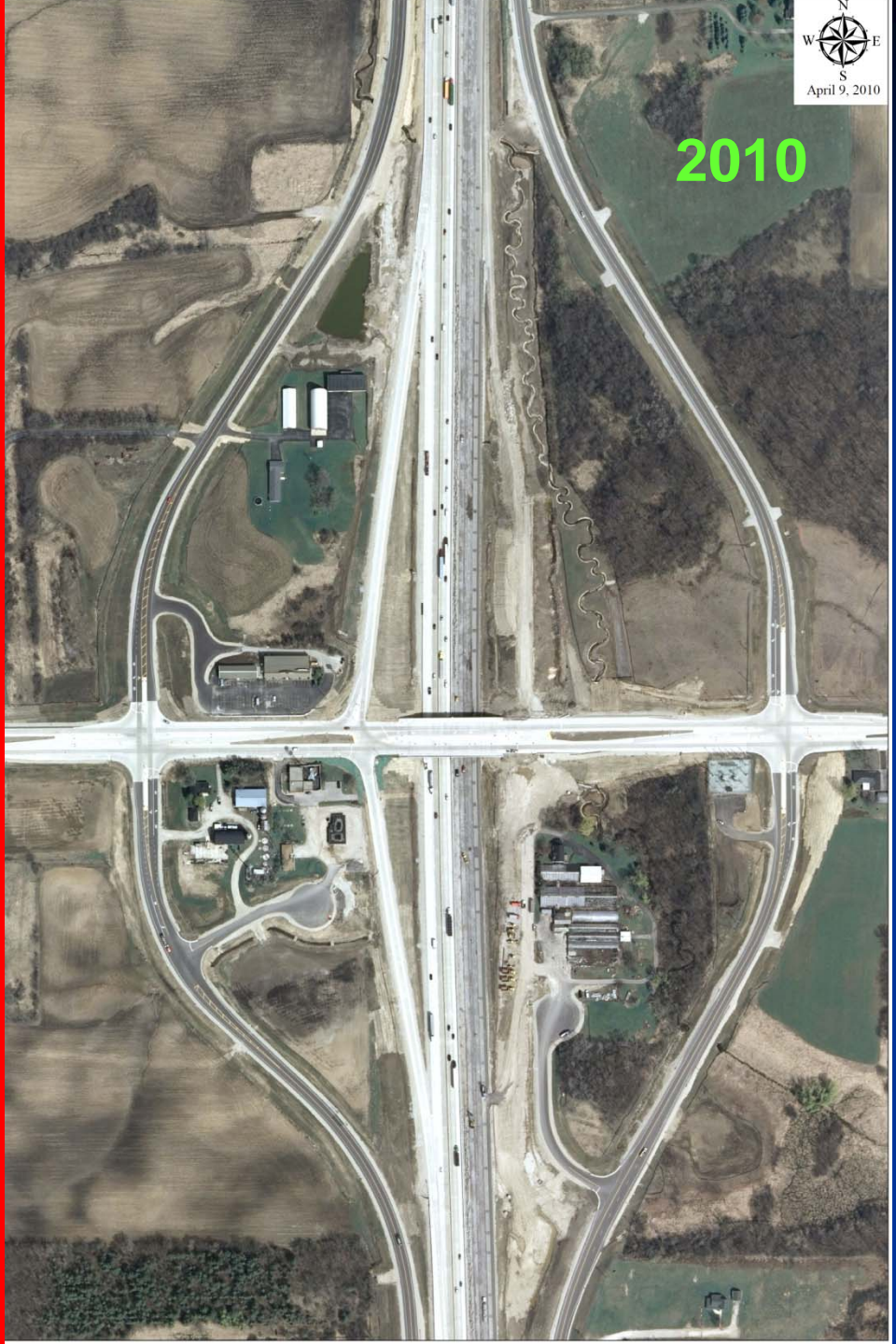
- Stable streambed and banks
- Functioning floodplain
- Improved water quality, habitat, and wildlife

I-94 AND CTH G INTERCHANGE PROJECT, RACINE COUNTY



April 15, 2005

2005



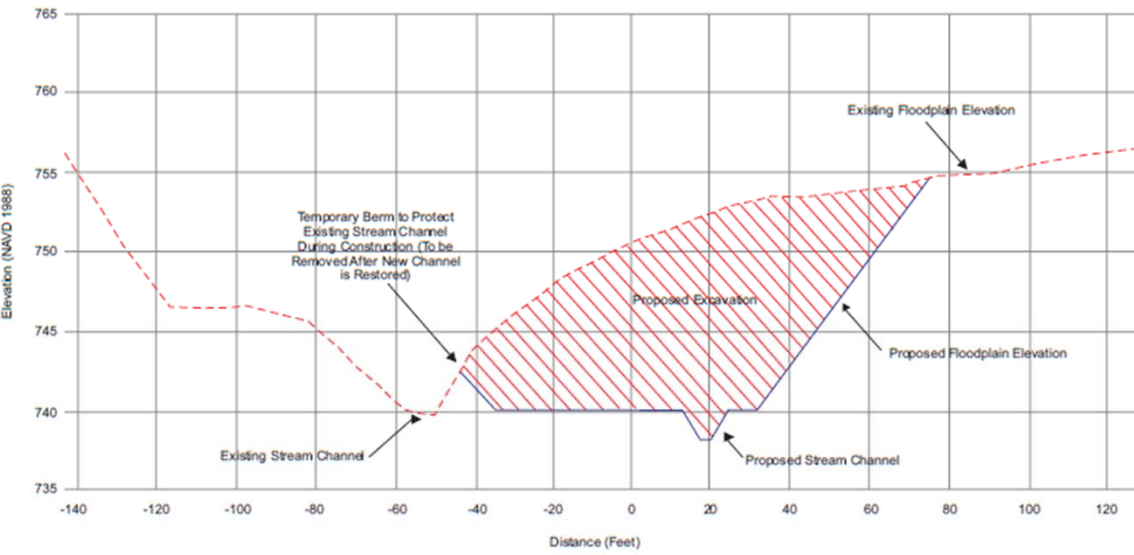
April 9, 2010

2010

I-94 AND CTH G INTERCHANGE PROJECT, RACINE COUNTY



UNNAMED TRIBUTARY TO THE EAST BRANCH ROOT RIVER CANAL TYPICAL EXISTING AND PROPOSED FLOODPLAIN CROSS-SECTION

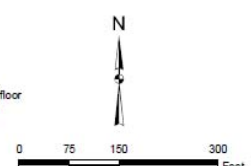


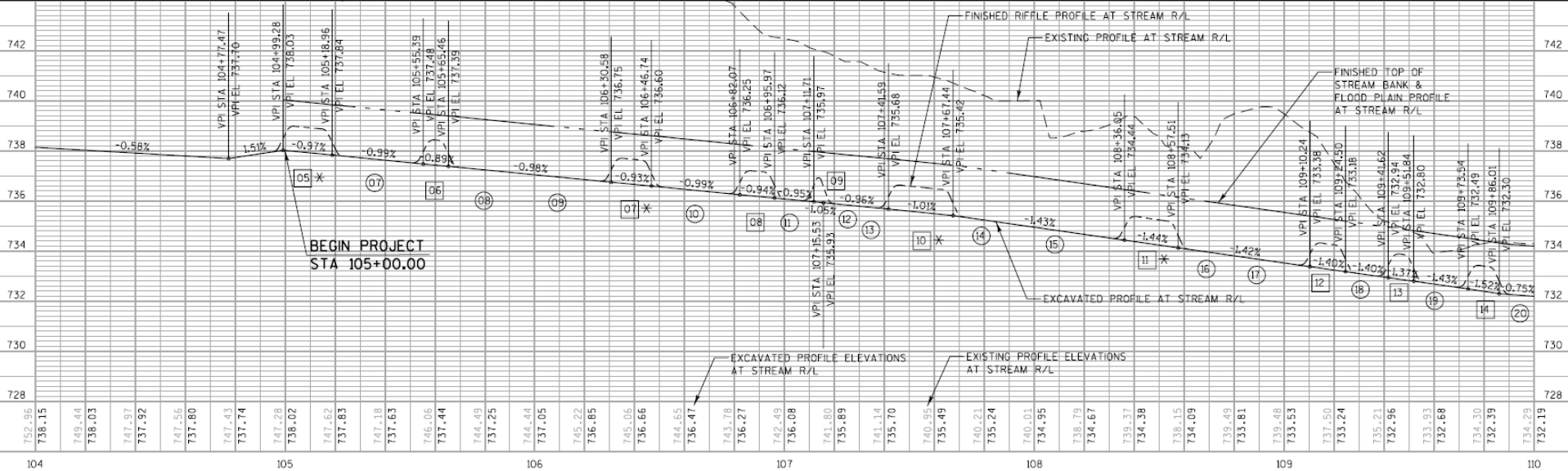
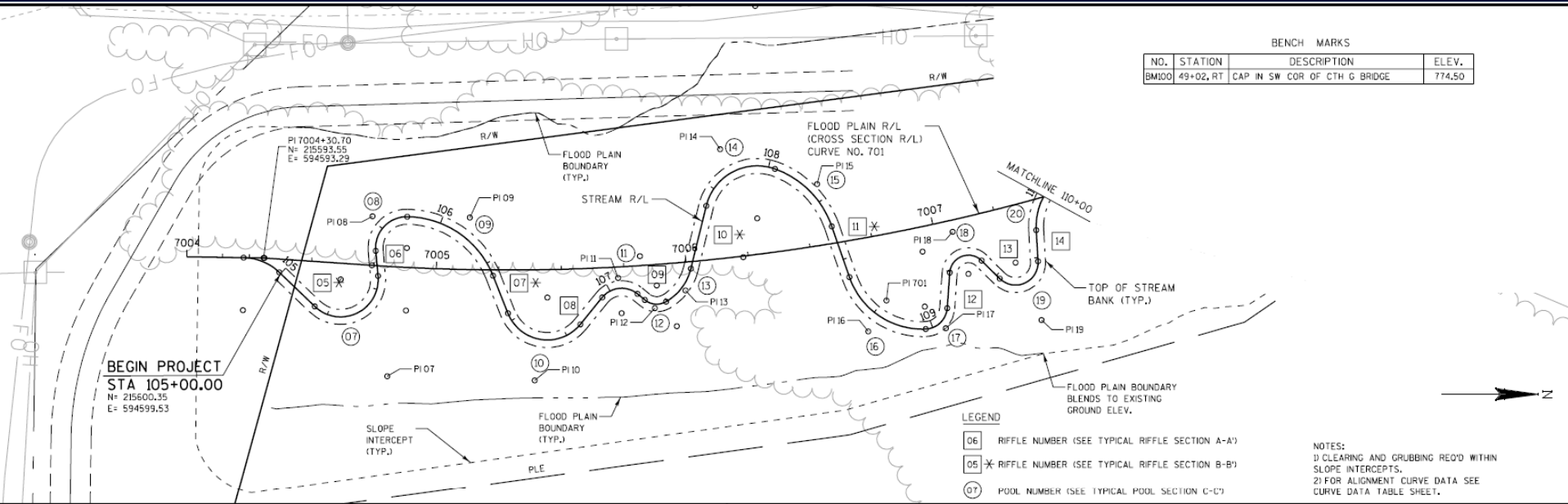
NOTE: Floodplain is defined here as a relatively flat valley floor formed by floods that overtop the banks of the stream and not as the area inundated during the regulatory 100-year recurrence interval flood.

Source: Wisconsin Department of Transportation and SEWRPC.

- Approximate Floodplain
- Proposed Stream Alignment
- Existing Stream Alignment
- Riffe
- Riffe Number

NOTE: Floodplain is defined here as a relatively flat valley floor formed by floods that overtop the banks of the stream and not as the area inundated during the regulatory 100-year recurrence interval flood.







Completed construction in 2008: three years later in 2011 it is the highest quality site for bugs in the Root River



Photo Credit: Alan Cressler



Need to continue to be vigilant, communicate, and ready to take advantage of opportunities to improve water quality and wildlife on the Root River