Oak Creek Watershed Restoration Plan

Summary Chapter 4 – 2nd half May 2020

Authors:

Laura Herrick, PE, CFM – Chief Environmental Engineer
Tom Slawski, Ph.D – Chief Biologist
Joe Boxhorn, Ph.D. – Principal Planner
Aaron Owens – Senior Planner
Justin Poinsatte, Ph.D. – Senior Specialist-Biologist

Topics

- Review 2nd half of Chapter 4 "Inventory Findings"
- Next steps
- Comments


Chapter 4
Inventory Findings

Chapter 4 Inventory Findings

- This chapter describes:
  - The findings of planning inventories
    - Physical characteristics of streams
    - Water quantity conditions
    - Water quality conditions
    - Sources of water pollution
    - Current management practices
    - Recreational access and use
    - Archeological inventory

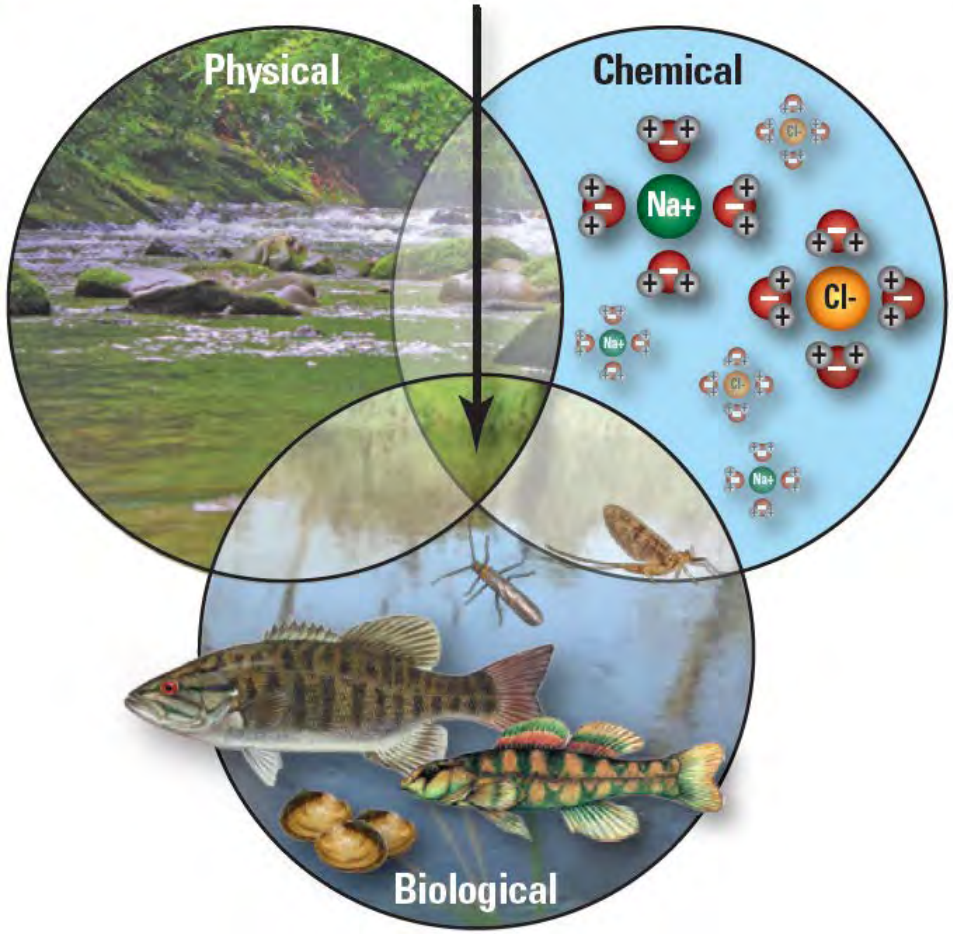
Chapter 4

- The portions of the chapter to be reviewed include:
  - Physical characteristics of streams
  - Flooding evaluation
  - Water quality conditions (2nd part)
    - Water temperature
    - Toxic substances
    - Biological conditions
    - Water quality comparison to use objectives
  - Sources of water pollution
  - Current management practices
  - Recreational access and use
  - Archeological inventory

Chapter 4

- The interaction of a stream's physical, chemical, and biological components determines its ecological health
- All 3 components, and thus the health of a stream system itself, are a direct reflection of the watershed including riparian areas, upland areas, and the built environment
- This Chapter describes the historical and recent conditions of the physical, chemical, and biological components of streams within the Oak Creek watershed

Figure 4.1
Ecological Stream Health




Physical Characteristics of
Streams in the Watershed

Channel Modifications, Channelization, and Disconnected Floodplain

- Historical survey maps indicate large wetland complexes occupied areas of North Branch Oak Creek and the Mitchell Filed Drainage Ditch
  - These streams were likely the result of channels being dug to drain the wetlands in the areas in order to cultivate the land
- The entire length of the mainstem of Oak Creek has been modified to some degree
- Modifications to streams in the Oak Creek watershed include:
  - Channel straightening
  - Channel deepening and lowering of the channel profile
  - Channel widening
  - Disconnection from a functional floodplain
  - Placement of concrete channel bottom and/or sidewalls
  - Installation of dams, drop structures, road bridges, and culverts
- Large portions of the surveyed principal streams in the Oak Creek watershed were disconnected from their floodplains
  - It is estimated that 55, 38, and 41 percent of the total length of Oak Creek, North Branch Oak Creek, and the lower portions of the Mitchell Field Drainage Ditch, respectively, are at least partially disconnected from the floodplain
  - Floodplain functionality in these areas is greatly hindered

Channel Modifications, Channelization, and Disconnected Floodplain

- Channel modifications come at a high ecological and aesthetic cost including:
  - Reduced diversity of instream habitat types (pools/riffles/runs)
  - Low baseflow water velocities which can lead to excessive deposition of silt
  - Greatly decreased connection of streams to their floodplain
    - This reduces storage capabilities to disperse flood waters, decrease destructive energy, and allow pollutants to settle out across the floodplain
  - Increased streamflow velocities during peak-flow
  - Streambank and streambed erosion

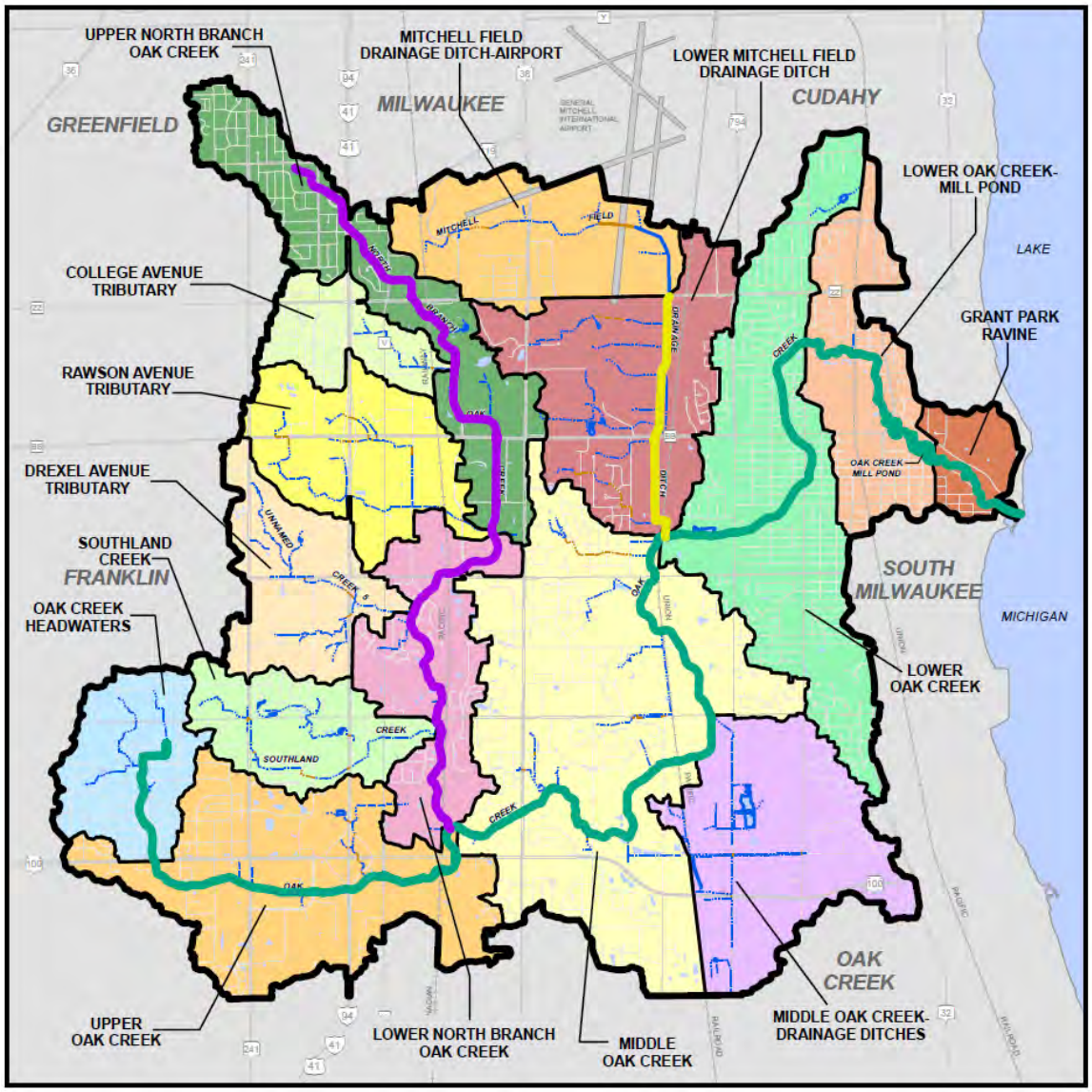
Instream Survey and Inventory

- Instream surveys of Oak Creek, North Branch Oak Creek, and the lower portions of the Mitchell Field Drainage Ditch included:
  - Physical stream inventory
    - Located and assessed infrastructure
      - Bridges, culverts, dams, drop structures, stormwater and other outfalls
    - Located areas of bank erosion
    - Located debris jams
    - Located large trash items in the streams
    - Located important biological, hydrological, and geomorphic features
  - Habitat assessment
    - Transect surveys
    - Locations of deep pool and riffle habitats

Assessment Areas and Surveyed Streams

- While this Chapter includes data and analysis of the entire Oak Creek watershed, instream surveys were conducted within the 3 principal streams including:
  - Oak Creek mainstem (14 miles of instream surveys conducted)
  - North Branch Oak Creek (6 miles of instream surveys conducted)
  - Mitchell Field Drainage Ditch (2 miles of instream surveys conducted)

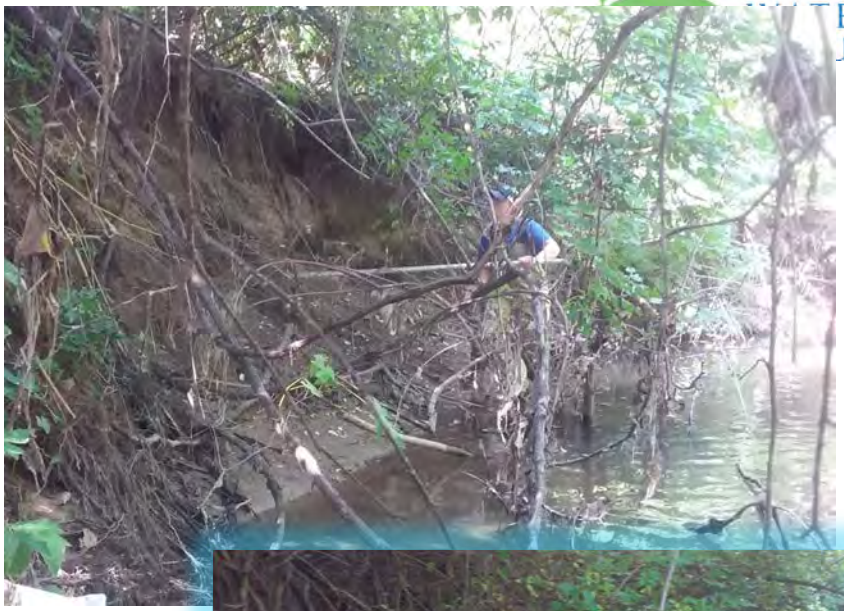
- When appropriate, data is analyzed based on the 15 assessment areas that make up the watershed (see map to right and Chapter 3 for description of areas)



OAK CREEK WATERSHED BOUNDARY
ASSESSMENT AREA BOUNDARIES
OAK CREEK MAINSTEM (INSTREAM SURVEYS CONDUCTED)
NORTH BRANCH OAK CREEK (INSTREAM SURVEYS CONDUCTED)
MITCHELL FIELD DRAINAGE DITCH (INSTREAM SURVEYS CONDUCTED)
PERENNIAL STREAM
PERENNIAL STREAM (ENCLOSED)
INTERMITTENT STREAM
INTERMITTENT STREAM (ENCLOSED)

Streambank Erosion

- Streambank erosion is a normal function of a stream system and not all streambank erosion is "bad"
  - Streambank erosion can provide needed bed material, channel diversity, and promote varied aquatic habitats
- However, excessive streambank erosion associated with a heavily altered and unstable stream system can contribute to:
  - Water quality degradation by releasing too much sediment (and associated nutrients) to the water
  - Aquatic habitat degradation caused by sedimentation
  - Damage to vital infrastructure (roads, culverts, and stormwater infrastructure)



Streambank Erosion

- A total of 147 streambank erosion sites were observed totaling about 2.4 stream miles
  - 33 sites (2,341 linear feet)—slight lateral recession (horizontal) (0.01-0.05 feet per year)
  - 82 sites (6,951 linear feet)—moderate lateral recession (0.06-0.2 feet per year)
  - 31 sites (3,139 linear feet)—severe lateral recession (0.3-0.5 feet per year)
  - 1 site (171 linear feet)—very severe lateral recession (greater than 0.5 feet per year)
- Inventoried erosion throughout the watershed are estimated to contribute 698 tons of sediment annually, containing 420 pounds of phosphorus, 1,020 pounds of nitrogen, and 2,180 pounds of biochemical oxygen demand.
- Grant Park Ravine assessment area had the highest percentage of its banks actively eroding and is estimated to contribute the greatest sediment load (197.5 tons per year, largely due to one very severe erosion site.
- Middle Oak Creek assessment area had the most individual erosion sites (39 sites) and the most erosion sites considered to have "severe" lateral erosion (7)

Figure 4.8
Examples of Lateral Recession Rate Categories for Streambank Erosion Surveyed in the Oak Creek Watershed

Stormwater & Other Outfalls

- Discharges from stormwater outfalls typically contain pollutants washed off of surfaces on the landscape and can contribute to streambed and streambank erosion. Occasionally, discharges can also contain bacteria originating from pet or other animal waste, cross-connections between sanitary and storm sewers, illicit discharges, or degrading sewer infrastructure.

- Understanding where outfalls are located, where the effluent discharges into the stream system, and general conditions of each outfall can help assess water quality issues, track upland sources of pollutants, indicate where best management practices or retrofits are most likely to be effective, and help municipalities remedy problems affecting the functionality of their stormwater systems.

- An inventory of stormwater and other outfalls in the watershed was integrated from several sources including SEWRPC staff instream surveys, municipal inventories, and an assessment by the City of Racine Public Health Department. The master inventory includes the following attributes (where available):
  - Location and photo of outfall
  - Pipe size, material composition, and general condition
  - Presence of flow at time of observation

- A total of 299 outfalls are part of the integrated master inventory, 43 of which were considered to be in poor or failed condition.

Stormwater & Other Outfalls

OAK CREEK WATERSHED FUTURE

Table O.1
Known Outfalls Within the Oak Creek Watershed

Sequence Number[a]	Outfall Identifications[b]	Ownership	Water Body	Assessment Area	Longitude	Latitude	Condition	Dimensions (inches)	Notes
1	RHDOF37	Unknown	Oak Creek Mainstem	Grant Park Ravine	42.90676	-87.84205	--	--	Corrugated metal pipe
2	MC27; RDFOF38	Milwaukee County	Oak Creek Mainstem	Grant Park Ravine	42.90693	-87.84300	--	12	North side of Creek; near manhole L6
3	RHDOF39	Unknown	Oak Creek Mainstem	Grant Park Ravine	42.90697	-87.84346	--	--	Corrugated metal pipe
4	MC26; RHDOF40	Milwaukee County	Oak Creek Mainstem	Grant Park Ravine	42.90721	-87.84353	--	12	Oak Creek Parkway, north side of Creek; near manhole L4B
5	RHDOF41	Unknown	Oak Creek Mainstem	Grant Park Ravine	42.90742	-87.84390	--	--	Outfall submerged; Concrete endsection
6	RHDOF42	Unknown	Oak Creek Mainstem	Grant Park Ravine	42.90771	-87.84495	--	--	--
7	RHDOF43	Unknown	Oak Creek Mainstem	Grant Park Ravine	42.90767	-87.84518	--	--	--
8	SM46	City of South Milwaukee	Oak Creek Mainstem	Grant Park Ravine	42.90741	-87.84550	--	10	Near manhole J13E
9	OSWO1; MC25	Milwaukee County							
10	OSWO2; SM45; RHDOF44	City of South Milwaukee							
11	MC22; RHDHAW	Milwaukee County							
12	OSWO3; MC24	Milwaukee County							
13	MC23	Milwaukee County							
14	OSWO4	Unknown							
15	OSWO5; MC21; RHDOF45	Milwaukee County							
16	OSWO6; SM44; RHDOF48	City of South Milwaukee							
17	OSWO7; SM43	City of South Milwaukee							

Map O.1
Locations of Known Outfalls Within the Oak Creek Watershed

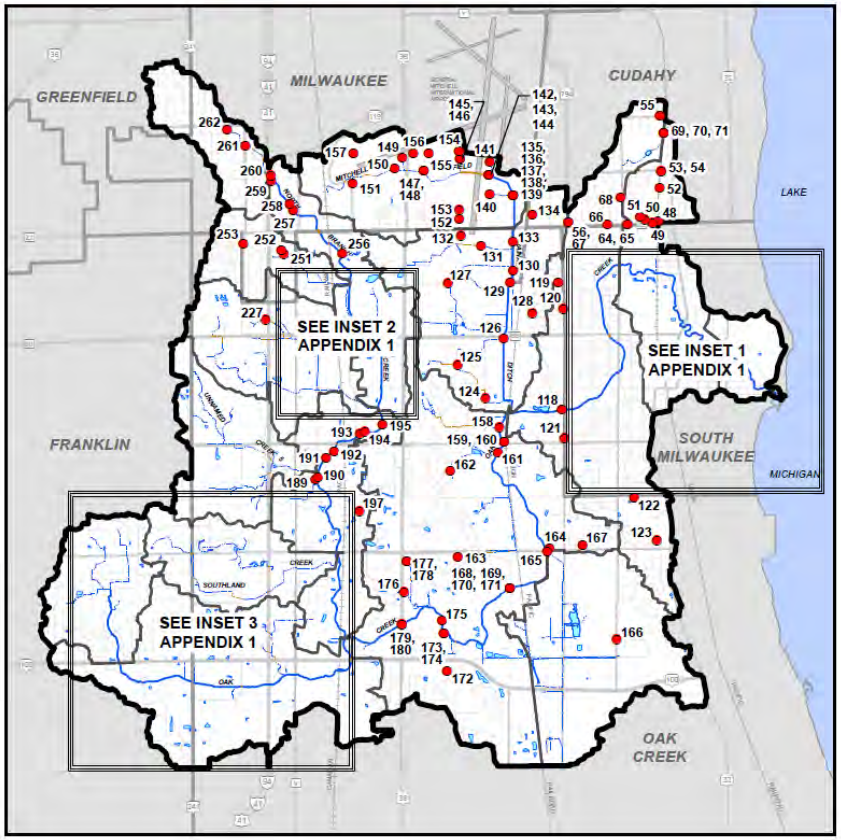


Figure O.1 (Continued)

Habitat Assessment —Transect Surveys

The following for each transect survey were measured:

- Bankfull width
- Bank height/slope (shape), undercut bank measurements
- Channelized bank height/width
- Water width
- Fish & macroinvertebrate cover types & amount
- Stream shading

Measured at 5 points along the transect:

- Bankfull depth
- Water and sediment depths
- Substrate composition
  - clay, silt, sand, gravel, cobble, boulders

Habitat Assessment —Transect Surveys

Transect surveys help:

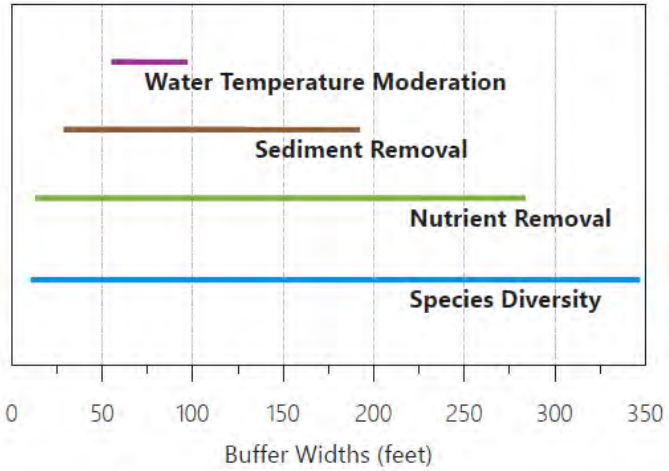
- Quantify available habitat for aquatic organisms (pools, riffles, runs, substrate types, cover, woody debris, shading)
- Give insight regarding physical process and channel change over time (natural and human induced)
- Define the range of flow variation (baseflow, bankfull, flood flow)

- Tell story of that particular habitat site and when analyzed collectively can tell a story about conditions at larger scales (reach and watershed scales)
- Identify problem areas
- Provides a baseline of information to compare to future studies
- Transect surveys were conducted at 162 locations along Oak Creek, North Branch, and Mitchell Field Drainage Ditch

Riparian Buffer Analysis

- Riparian buffers are natural and relatively undisturbed landscapes adjoining waterbodies and include wetlands, marshes, meadows, forests, grasslands, and prairies
- Riparian buffers can include a range of complex vegetation structure, soils, food sources, and are extremely vital for wildlife
- Riparian buffers help protect surface and groundwater quantity and quality, protect and provide fisheries and wildlife habitat, reduce potential flooding, prevent bank erosion, moderate water temperatures, and limit harmful effects of climate change
- The functionality of riparian buffers is largely dependent upon width of the buffer perpendicular to the water body as well as continuity
- Protecting and expanding the remaining riparian corridor width and continuity are the foundation for protecting and improving the fishery, wildlife, and recreation within the Oak Creek watershed
- 75-foot minimum recommended buffer width; 400-foot minimum core habitat width for wildlife; 1,000-foot optimum core habitat width for wildlife protection

Figure 4.23
Range of Buffer Widths for Providing Specific Buffer Functions



Note: Site-specific evaluations are required to determine the need for buffers and specific buffer characteristics.

Source: Adapted from A. J. Castelle and others, "Wetland and Stream Buffer Size Requirements-A Review," Journal of Environmental Quality, Vol. 23.

Riparian Buffer Analysis-Current Status

Map 4.5
Existing and Potential Riparian Buffer Areas Within the Oak Creek Watershed: 2015

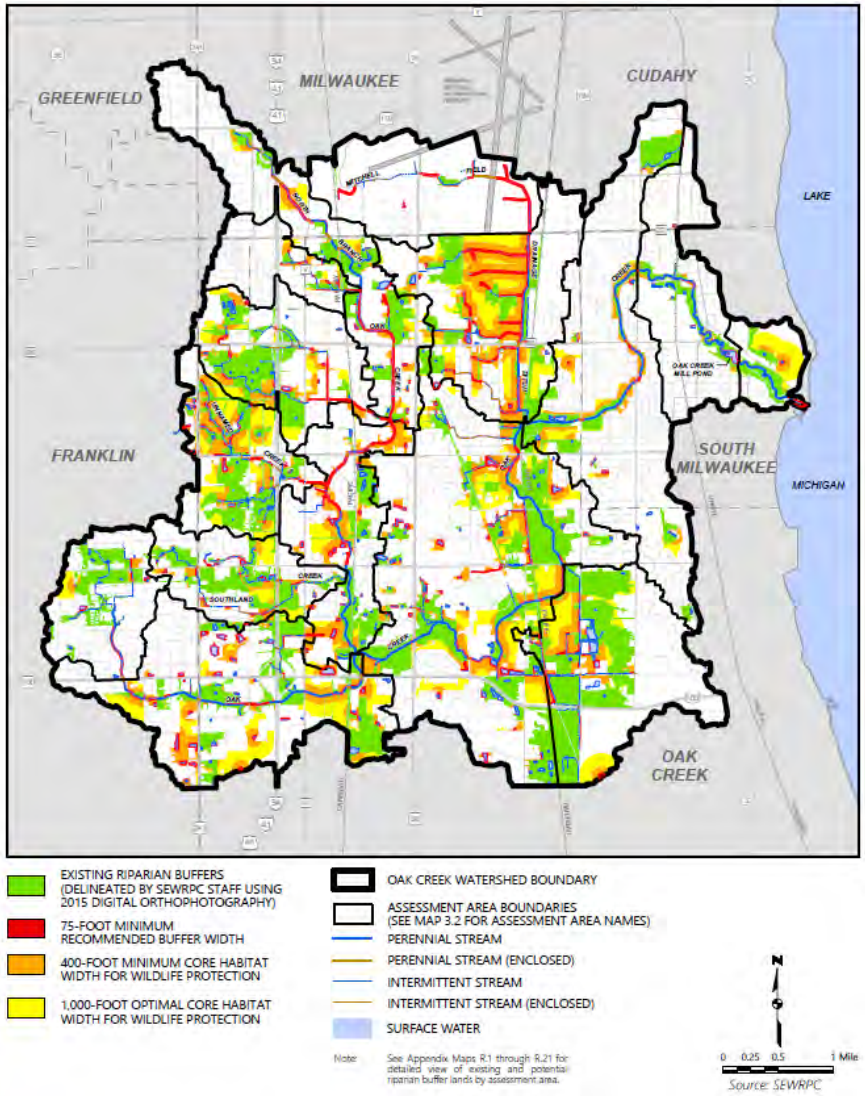
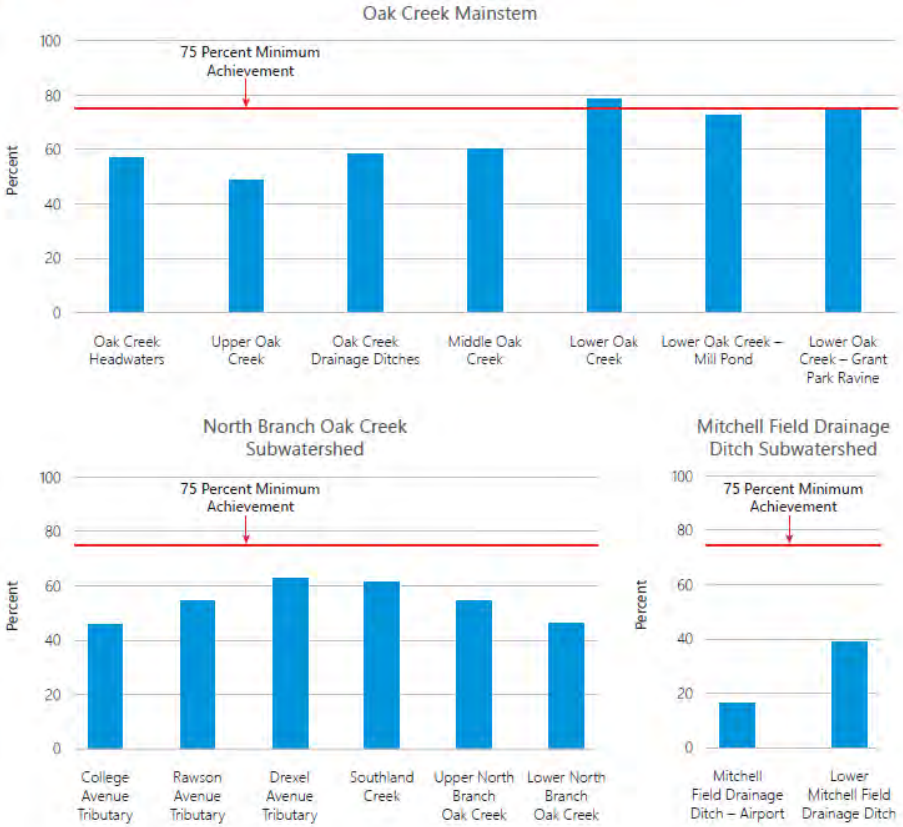


Figure 4.25
Percent of Riparian Buffers Areas Meeting the 75-Foot Minimum Recommended Buffer Width Among Assessment Areas of the Oak Creek Watershed: 2015



Source: SEWRPC

Stream Crossing, Dams, and Drop Structures

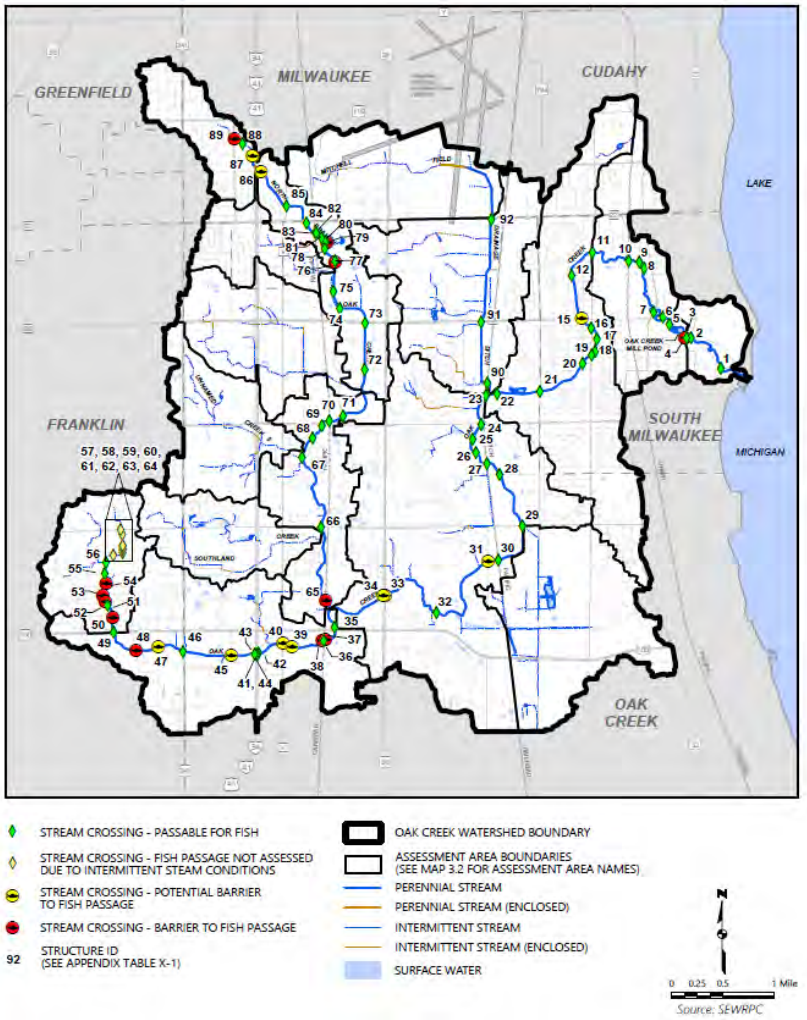
- Bridges, culverts, dams, weirs, and drop structures can affect stream widths, water and sediment depths, water velocities, substrate composition, and can pose physical and/or hydrologic barriers to the movement of fish and other aquatic organisms

- Streams within the Oak Creek watershed have well over 100 structure crossings. Along the principal streams surveyed by SEWRPC staff, 90 stream crossings were observed and surveyed (62 along Oak Creek, 25 along North Branch Oak Creek, 3 along the lower portions Mitchell Field Drainage Ditch)

- Fish require freedom of movement to fulfill their needs of feeding, growth, protection from predators, and spawning. It is vitally important to the health of the fishery within the Oak Creek watershed to maintain hydrologic connections up and down the mainstem of Oak Creek as well as to the smaller tributary streams.

- Fish passage assessments for stream crossings in the watershed:
  - Oak Creek had 8 fish passage impediments and 8 potential or partial impediments
  - North Branch Oak Creek had 4 fish passage impediments and 2 potential or partial impediments
  - In addition to human built structures, large woody debris jams can cause fish passage impediments. There were 37 woody debris jams observed by SEWRPC staff that were large enough to impede fish passage and will likely persist for multiple years without intervention.

Map 4.14
Stream Crossings and Fish Passage Assessment for Surveyed Streams in the Oak Creek Watershed: 2016-2017



Instream Habitat Assessment-Conclusions

- A modified version of the low gradient stream habitat index was used to assess the current habitat conditions of streams within the Oak Creek Watershed. The habitat index incorporates several habitat variables that are well established as strongly influencing fish communities and biotic integrity and include:
  - Percent and age of channelization
  - Instream cover
  - Bank erosion
  - Stream sinuosity (amount that a stream meanders)
  - Standard deviation of thalweg depth (measure of the variability of stream depths)
  - Riparian buffer vegetation

- Index scores show that all the assessment areas of the Oak Creek watershed where the data is available have strong scores for the relatively low amount of bank erosion, the variability of stream depths, and age of channelization (which generally, but not always, is associated with ecosystem recovery from disturbance)

- The mainstem of Oak Creek and North Branch Oak Creek subwatershed assessment areas were all in the "fair" to "good" range for riparian buffer coverage, while the assessment areas within the Mitchell Field Drainage Ditch ranged from "poor" to "fair"

- Many of the streams within the watershed are heavily channelized which is reflected in the low habitat scores for both sinuosity of the streams and the percent of channelization in all areas of the watershed except the lower and headwater portions of Oak Creek's mainstem, and the Drexel Avenue and Rawson Avenue Tributary assessment areas

- Instream cover ranged from "fair" to "good" quality in Oak Creek's mainstem; from "poor" to "fair" in North Branch Oak Creek; and "poor" in the Mitchell Field Drainage Ditch

Instream Habitat Assessment-Conclusions

- Total stream habitat scores for the mainstem of Oak Creek assessment areas ranged from "fair" to "excellent." The Grant Park Ravine assessment area, which is one of the least impacted stream reaches in the watershed, received the highest quality instream habitat score.
- Total stream habitat scores for the tributary stream reaches ranged from "fair" to "poor."
- Habitat scores are generally consistent with findings of fisheries and macroinvertebrate surveys conducted throughout the watershed (surveys are discussed in more detail in the biological conditions section below).
- Lower overall habitat scores were almost always associated with the most highly modified stream reaches.
- Although some reaches of streams within the Oak Creek watershed show some signs of recovery from past modifications, these reaches will likely not recover in a reasonable amount of time without human intervention.

Table 4.11
Stream Habitat Criteria Scores for Mainstem Oak Creek Assessment Areas: 2016-2017

Habitat Criterion	Grant Park Ravine	Lower Oak Creek – Mill Pond	Lower Oak Creek	Middle Oak Creek	Upper Oak Creek	Oak Creek Headwaters
Channelization Percent (score)	1-5 (6)	10-20 (3)	90-100 (0)	90-100 (0)	90-100 (0)	50-60 (3)
Channelization Age in Years (score)	>50 (15)	>50 (15)	>50 (15)	>50 (15)	>50 (15)	>50 (15)
Instream Cover (score)	Good (24)	Good (18)	Fair (12)	Fair (7)	Fair (12)	Fair (7)
Bank Erosion Percent[a] (score)	26.6 (7)	14.1 (9)	13.0 (9)	12.4 (9)	6.8 (10)	14.2 (9)
Sinuosity (score)	1.21 (5)	1.33 (9)	1.02 (0)	1.04 (0)	1.04 (0)	1.06 (4)
Thalweg Depth Standard Deviation (score)	0.98 (10)	0.92 (10)	0.98 (10)	0.96 (10)	0.71 (10)	0.37 (9)
Buffer Vegetation—Percent of Buffers Meeting 75 Foot Minimum Width[b] (score)	74 (8)	73 (8)	79 (8)	61 (6)	49 (4)	57 (5)
Total Habitat Score	Excellent (75)	Good (72)	Fair (54)	Fair (47)	Fair (51)	Fair (52)

Note: Background colors indicate the low-gradient stream habitat score given to each tributary reach: Poor (red), Fair (yellow), Good (green), and Excellent (blue). See Map 3.2 for the location of each tributary reach.

Table 4.12
Stream Habitat Criteria Scores for Tributary Assessment Areas: 2016-2017

	North Branch Oak Creek						Mitchell Field Drainage Ditch (MFDD)	
Habitat Criterion	Lower NBOC	Upper NBOC	Southland Creek	Drexel Avenue Tributary	Rawson Avenue Tributary	College Avenue Tributary	Lower MFDD	MFDD Airport
Channelization Percent (score)	61-75 (0)	90-100 (0)	61-75 (0)	40-60 (3)	40-60 (3)	90-100 (0)	100 (0)	100 (0)
Channelization Age in Years (score)	>50 (15)	>50 (15)	>50 (15)	>50 (15)	>50 (15)	>50 (15)	>50 (15)	>50 (15)
Instream Cover (score)	Fair (15)	Poor (0)	N/A	N/A	N/A	N/A	Poor (1)	N/A
Bank Erosion Percent[a] (score)	10.5 (9)	5.5 (10)	N/A	N/A	N/A	N/A	12.5 (9)	N/A
Sinuosity (score)	1.04 (0)	1.02 (0)	N/A	N/A	N/A	N/A	1.01 (0)	1.03 (0)
Thalweg Depth Standard Deviation (score)	0.78 (10)	0.61 (10)	N/A	N/A	N/A	N/A	0.96 (10)	N/A
Buffer Vegetation—Percent of Buffers Meeting 75 Foot Minimum Width[b] (score)	46 (4)	55 (5)	61 (6)	63 (6)	54 (5)	46 (4)	39 (3)	16 (0)
Total Habitat Score	Fair (53)	Poor (40)	Incomplete[c]	Incomplete[c]	Incomplete[c]	Incomplete[c]	Poor (38)	Incomplete[c]

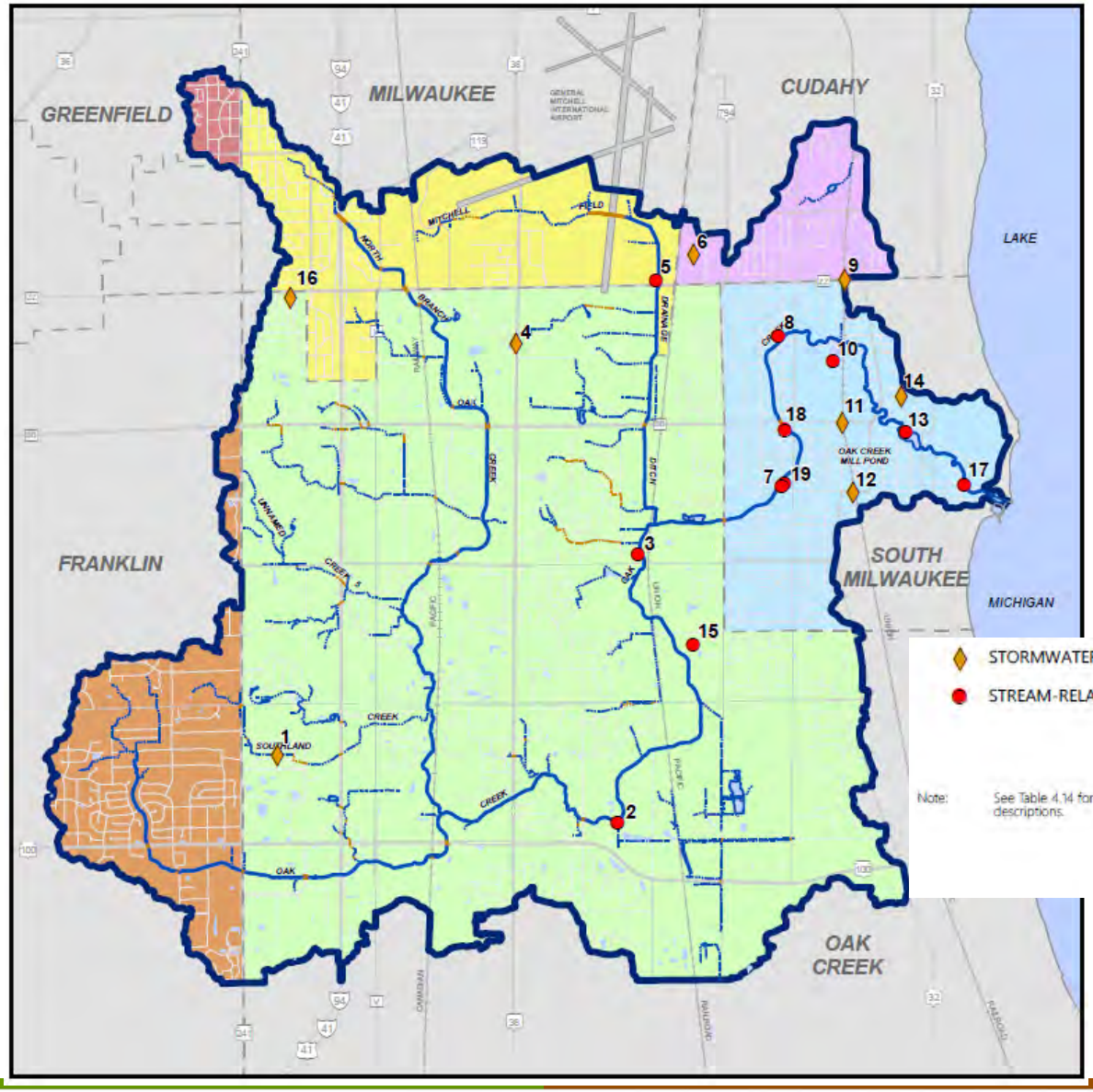
Flooding Evaluation

July 2, 2000 flood – E. Forest Ave. at Oak Creek mainstem

Flooding Evaluation

- Additional information was added to the Flooding Evaluation section
  - Map 4.15 showing the flooded road crossings based on FEMA riverine studies
  - Map 4.16 and Table 4.14 show locations for both riverine and stormwater flooding based on input from stakeholders and public officials

Flooding Evaluation – Map 4.16



- Locations are described in Table 4.14 of text

Water Quality Conditions (2nd part)

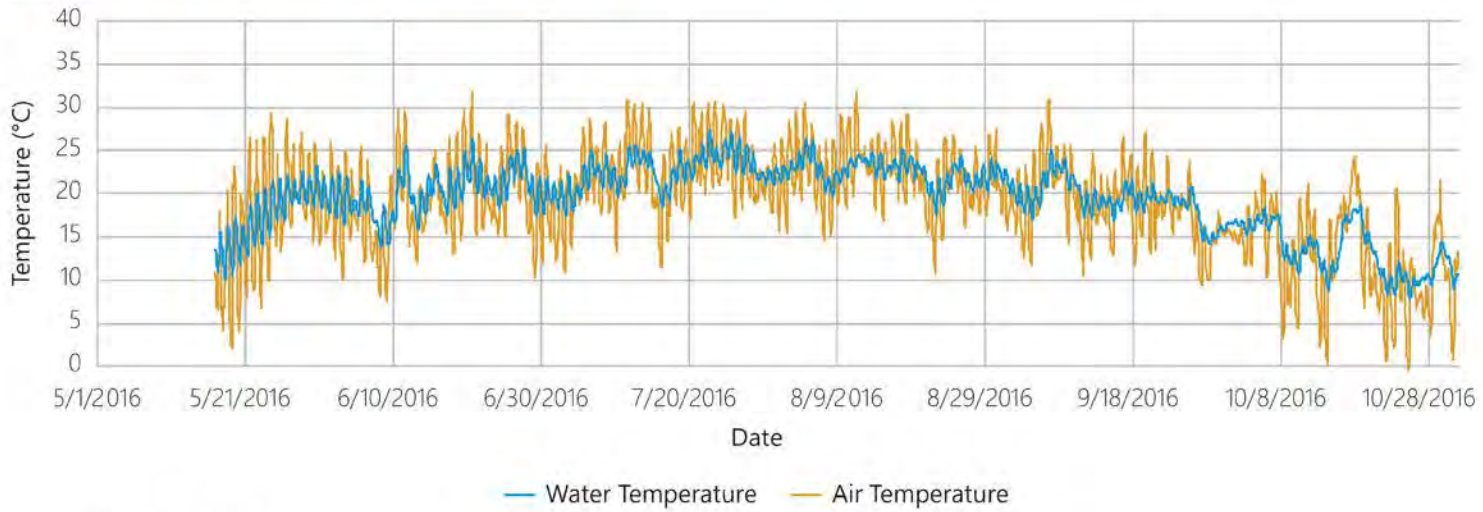
Water Quality

- Constituents discussed include:
  - Water temperature
  - Bacteria
    - Fecal Coliform
    - *E. coli*
  - Chlorophyll-*a*
  - Dissolved oxygen
  - pH
  - Chloride
  - Specific conductance
  - Total suspended solids
  - Turbidity
  - Nutrients
    - Phosphorus
    - Nitrogen
  - Metals
  - PFAS
  - "Emerging pollutants"
  - Toxic Substances
  - Fish
  - Macroinvertebrates

Water Quality Monitoring

- Water Temperature
  - Affects instream physical and chemical processes
    - Solubility of substances, rates of chemical reactions
  - Affects suitability of stream and pond as habitat for aquatic organisms
  - Strongly affected by air temperature
    - Also influenced by solar heating, shade, groundwater discharge, point source discharge, stormwater runoff
    - Impoundments can have a warming effect
  - Complicated temperature standards based upon month of year and average minimum streamflow

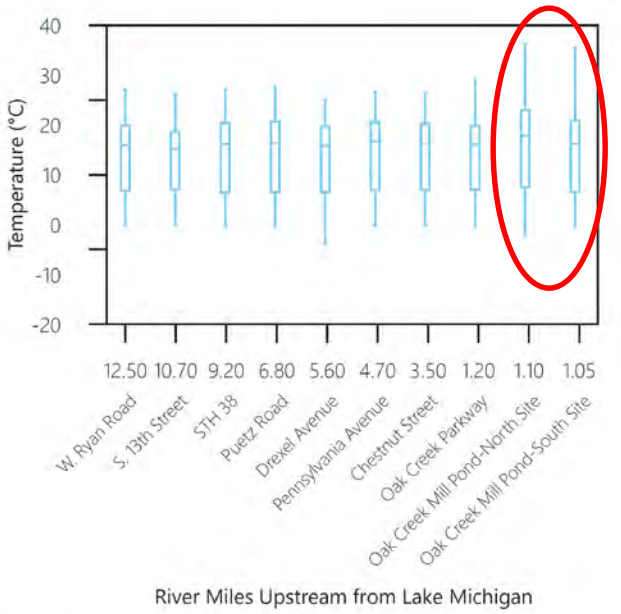
Figure 4.58
Hourly Water Temperature from the Mainstem of Oak Creek at STH 38 (RM 9.2): May – October, 2016



Source: SEWRPC

- Continuous temperature monitoring shows that water temperature varies on daily, weekly, seasonal, and long-term time scales
- Changes in water temperature follow changes in air temperature, with time lags dependent on the scale of variation

Figure 4.57
Continuously Collected Water Temperature at Sites Along the Mainstem of Oak Creek: May 2016 – October 2017



Mill Pond sites

Note: See Figure 4.10 for description of symbols and Table 4.19 for location of sample sites.

Source: SEWRPC

- Continuous temperature monitoring shows ranges of water temperature at various stream and pond sites in the watershed
- Water temperatures in the Mill Pond are substantially warmer than those in the mainstem of Oak Creek
  - This is especially the case in the north lobe of the Mill Pond

Water Quality Monitoring

- Water Temperature analysis shows:
  - Temperatures at stream sites comply with standards, sometimes exceeding sublethal criterion
  - Temperatures in Mill Pond often exceed standards
  - Mill Pond acts to warm sections of Oak Creek downstream of the dam
  - North Branch of Oak Creek warms Oak Creek during warm weather, cools it during cold weather
  - Mitchell Field Drainage Ditch appears to have little effect on thermal regime in Oak Creek

Water Quality Monitoring

- Perfluroalkyl and Polyfluoroalkyl Subtances (PFAS)
  - Over 5,000 chemicals used for many purposes
  - Highly persistent, linked to some health effects
  - Sources includes fire-fighting training & response, industrial facilities, wastewater treatment plants, landfills
  - 6 PFAS chemicals detected in groundwater and soil at 2 sites on Wisconsin Air National Guard Base at Mitchell Field
  - Also detected in groundwater at former 440th Air Force Reserve Tactical Lift Wing Station at Mitchell Field

Water Quality Monitoring

- Toxic Substances
  - Pesticides
    - Some herbicides, DEET often detected in surface water
    - Historical data of legacy pesticides detected in fish tissue
  - Polycyclic Aromatic Hydrocarbons (PAHs)
    - Detected in surface water and sediment
  - Polychlorinated Biphenyls (PCBs)
    - Detected in sediment, especially near mouth of Oak Creek
  - Molybdenum
    - Detected in some wells, chemical testing indicates geological source

Water Quality Monitoring

- Toxic Substances
  - Metals
    - Some detected in surface water and/or sediment
  - Impacts
    - At some locations concentrations of metals, PAHs, and/or PCBs in sediment may be high enough to have impacts on bottom-dwelling organisms


Biological Conditions

Overview of Biotic Indices

- Biotic indices evaluate water conditions using known tolerances of observed taxa to environmental stressors
  - Aquatic organisms integrate stressor effects over time
  - Indices often use species presence, a tolerance score, and sometimes species abundance in evaluation
- Fish Indices
  - Wisconsin DNR has adopted indices by Lyons et al.
  - Separate indices developed for stream thermal and flow regimes
- Macroinvertebrate Indices
  - Several indices are commonly used in Wisconsin
  - Address different environmental stressors or aspects of macroinvertebrate community
- Mussel Indices
  - Wisconsin DNR has not yet adopted a mussel-based index
  - Mussels are very sensitive to environmental pollutants
    - Presence alone is positive indicator for water quality

Examples of Intolerant Species

Fishery Conditions and Species

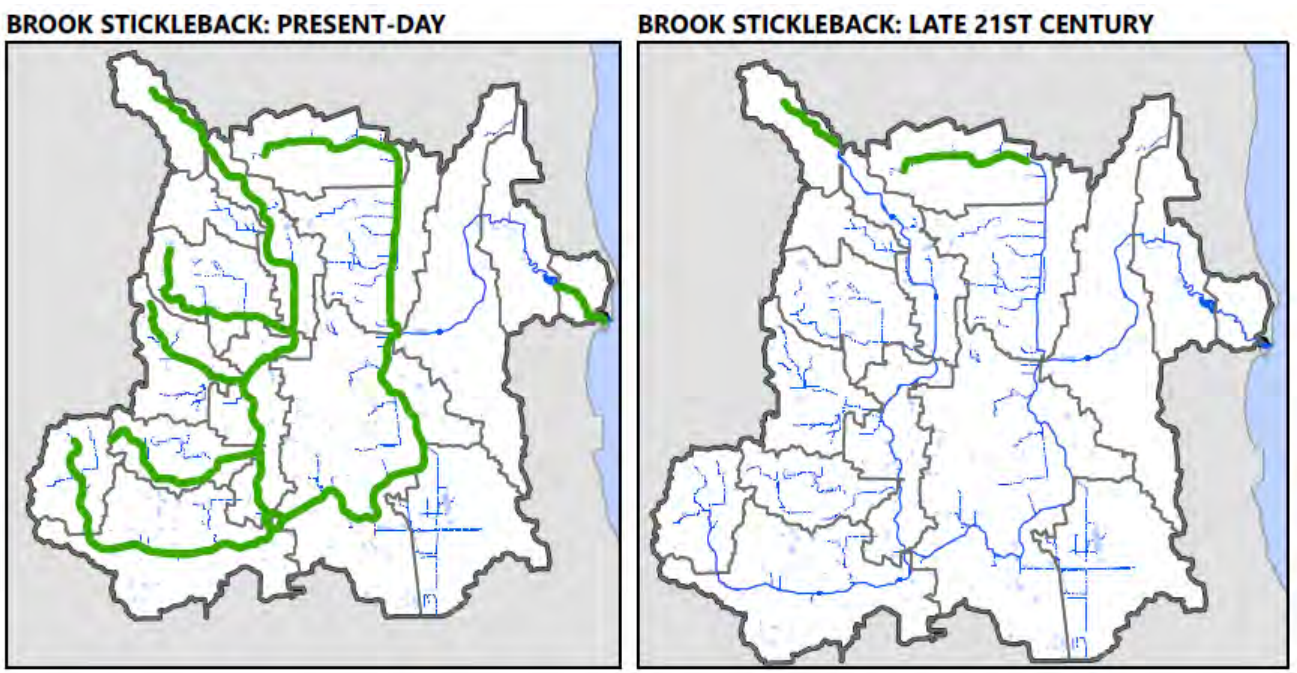
- Early 20th century surveys indicate healthy fishery
  - Condition severely declined by 1970s
- Majority of Oak Creek currently rated as fair to good
  - Predominantly cool-cold or cool-warm headwater stream
  - Fish species indicative of urban, tolerant fishery
- North Branch and Mitchell Field Drainage Ditch in poor condition
  - Elevated water temperatures and poor water quality
- Iowa Darter observed in 2015 surveys
  - Indicative of improving water quality in Oak Creek mainstem

Intolerant species – Presence may indicate improving conditions

Commonly Observed Fish in Oak Creek Watershed

Expected Climate Change Impacts

- US Geological Survey modeled present-day fish communities and stream conditions
  - Analyzed stream condition and fish distribution changes under climate change scenarios
- Anticipated increase in stream temperature and streamflow under climate change
  - Decreased distribution of coolwater fish species (e.g., brook stickleback)
  - Increased distribution of invasive common carp



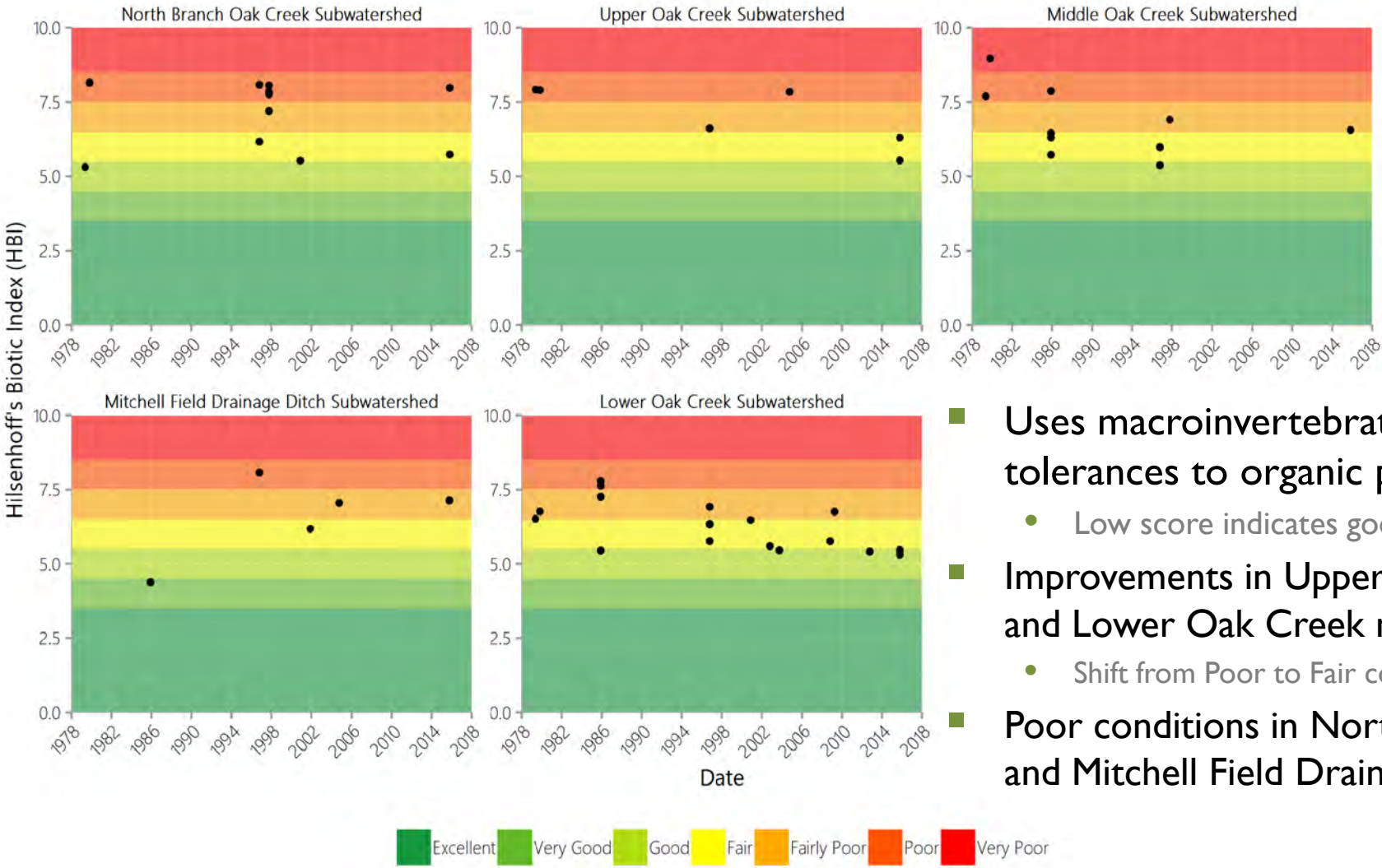
Green Line Indicates Modeled Species Distribution

Macroinvertebrates

- Organisms without backbones that inhabit streams and stream substrate
- Important roles in stream ecosystems
  - Filter, shred, and decompose algae and organic materials
  - Prey for fish, amphibians, and predator macroinvertebrates
  - Useful as water quality indicators as they are sensitive to organic pollutants
- Most commonly observed taxa in Oak Creek are Caecidotea isopods, Cheumatopsyche caddisflies, Stenelmis beetles, Hydropsyche caddisflies, and Stictochironomous midges

Commonly Observed Macroinvertebrate Taxa in Oak Creek Watershed

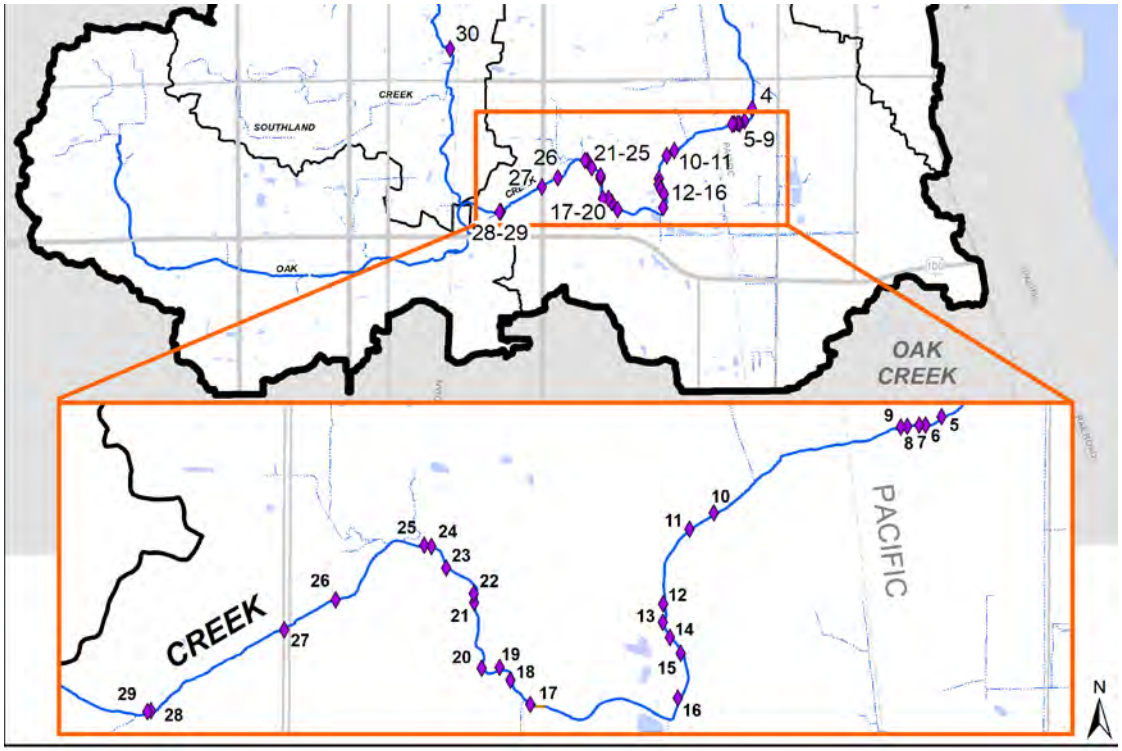
Hilsenhoff's Biotic Index



- Uses macroinvertebrate taxa tolerances to organic pollutants
  - Low score indicates good condition
- Improvements in Upper, Middle, and Lower Oak Creek mainstem
  - Shift from Poor to Fair conditions
- Poor conditions in North Branch and Mitchell Field Drainage Ditch

Freshwater Mussels

- Mussels are very sensitive to environmental pollutants
  - Presence is a potential indicator of improving water quality
- Observed at 30 locations within watershed
  - Largely in Middle Oak Creek mainstem
  - Fatmucket and White Heelsplitter only identified species



White Heelsplitter

Fatmucket

Wildlife and Natural Areas

- 172 bird species documented within watershed
  - Includes 80 breeding bird species
- Home to several mammal and herptiles species
  - Including Butler's Gartersnake, a species of special concern
- 12 Natural Areas covering 443 acres within the watershed
  - 4 of Regional Significance, 8 of Local Significance
    - Cudahy Nature Preserve, Falk Park Woods, Oak Creek Low Woods, and Rawson Park Woods are all of Regional Significance
  - Host to a number of rare and threatened plant and animal species

Examples of Rare Species Observed in Oak Creek Watershed Natural Areas

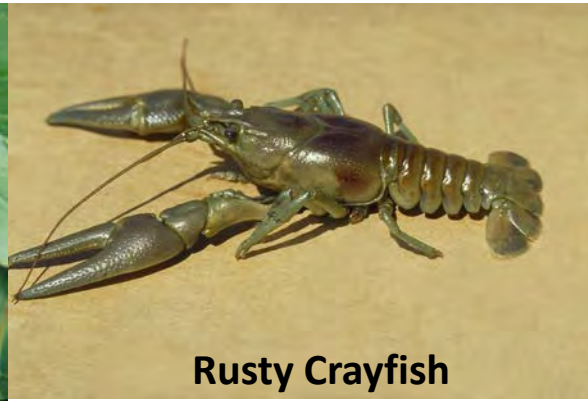
Invasive Species

- Many Natural Areas are threatened by invasive species
  - Buckthorn, common burdock, European privet, garlic mustard, honeysuckle, and reed canary grass are common invasives in watershed
  - Some natural areas lack site management plan to address threat
    - Fitzsimmon Woods, Franklin (Puetz Road) Woods, Wedge Woods
- Aquatic invasives are detrimental to stream fauna and habitat
  - Common carp, rusty crayfish, and zebra mussels observed in watershed
  - Compete with native species, decrease stream clarity, and destroy aquatic vegetation
- Emerald ash borer causing extensive ash tree die-offs
  - Higher stream temperatures with canopy loss can stress coolwater fish species


Garlic Mustard


Emerald Ash Borer


Common Buckthorn


Rusty Crayfish

Functioning Stream Ecosystems

OAK CREEK WATERSHED FUTURE

A Guide for Assessing & Restoring Stream Functions » FUNCTIONS & PARAMETERS

5 **BIOLOGY » FUNCTION:** Biodiversity and the life histories of aquatic and riparian life » **PARAMETERS:** Microbial Communities, Macrophyte Communities, Benthic Macroinvertebrate Communities, Fish Communities, Landscape Connectivity

4 **PHYSICOCHEMICAL » FUNCTION:** Temperature and oxygen regulation; processing of organic matter and nutrients » **PARAMETERS:** Water Quality, Nutrients, Organic Carbon

3 **GEOMORPHOLOGY » FUNCTION:** Transport of wood and sediment to create diverse bed forms and dynamic equilibrium » **PARAMETERS:** Sediment Transport Competency, Sediment Transport Capacity, Large Woody Debris Transport and Storage, Channel Evolution, Bank Migration/Lateral Stability, Riparian Vegetation, Bed Form Diversity, Bed Material Characterization

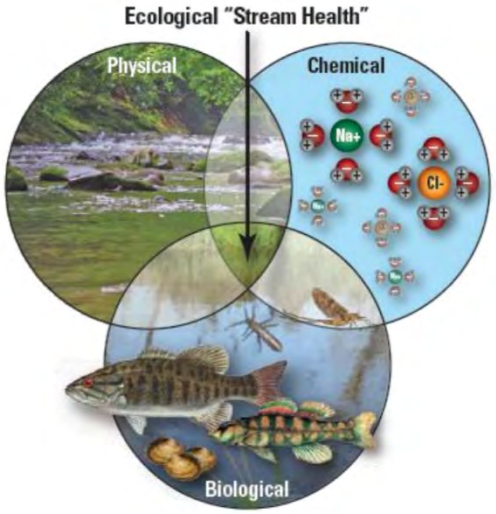
2 **HYDRAULIC » FUNCTION:** Transport of water in the channel, on the floodplain, and through sediments » **PARAMETERS:** Floodplain Connectivity, Flow Dynamics, Groundwater/Surface Water Exchange

1 **HYDROLOGY » FUNCTION:** Transport of water from the watershed to the channel » **PARAMETERS:** Channel-Forming Discharge, Precipitation/Runoff Relationship, Flood Frequency, Flow Duration

Geology

Climate

Harman, W., R. Starr, M. Carter, K. Tweedy, M. Clemmons, K. Suggs, C. Miller. 2012. *A Function-Based Framework for Stream Assessment and Restoration Projects.* US Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds, Washington, DC EPA 843-K-12-006.



StreamMechanics


Comparison of Water Quality to Water Use Objectives and Impairment Designations

Comparison to Standards

- Compared surface water quality in Oak Creek watershed to applicable water quality criteria
  - Compared available water temperature, dissolved oxygen, chloride, total phosphorus, fecal coliform bacteria, and *E. coli* data to applicable standards
  - Examined conditions 2007 through 2016
  - Evaluated conditions in
    - Oak Creek (8 reaches)
    - North Branch of Oak Creek (3 reaches)
    - Mitchell Field Drainage Ditch (3 reaches)
    - 5 small tributaries

Comparison to Standards

- Findings for streams in watershed
  - Dissolved Oxygen
    - Concentrations in Oak Creek above the confluence with North Branch are occasionally below the standard
    - Concentrations in the Mitchell Field Drainage Ditch and Unnamed Creek 5 were often below the standard
  - Chloride
    - Concentrations are occasionally above the chronic toxicity criteria, but
    - Few data are available from winter months so available data may overestimate compliance

Comparison to Standards

- Findings for streams in watershed
  - Water Temperature
    - Usually complies with acute temperature criterion
    - Occasionally higher than sublethal temperature criterion
  - Total Phosphorus
    - Often higher than standard
  - Fecal Coliform Bacteria
    - Often higher than both single sample and geometric mean standards
  - *E. coli*
    - Always higher than geometric mean and statistical test value standards

Comparison to Standards

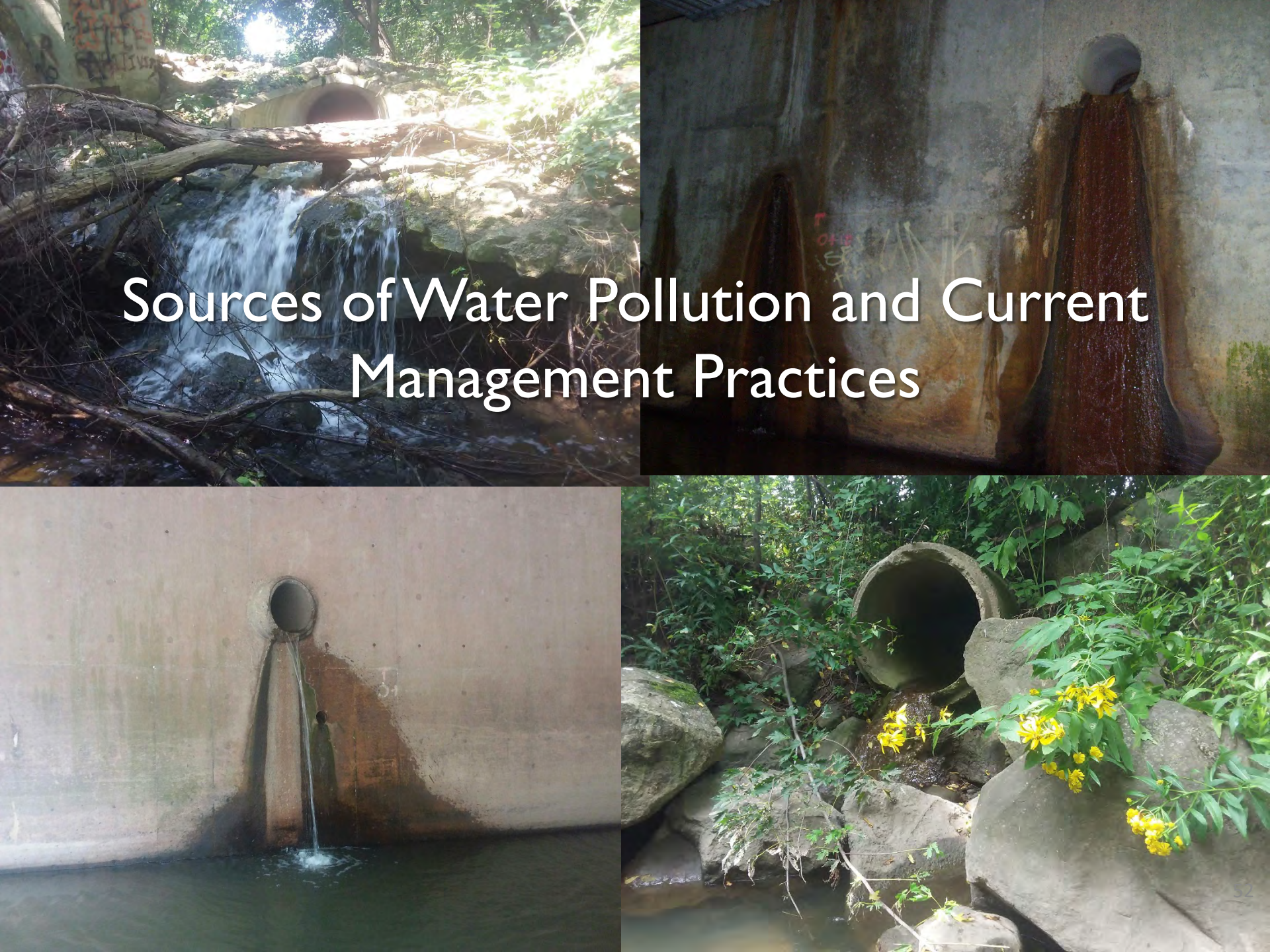
- Findings for streams in watershed
  - Compared water quality to several non-regulatory guidelines
    - Values of total suspended solids, turbidity, chlorophyll-a, and total nitrogen are higher than what is considered good water quality
  - Several impairments are present (State 303(d) list)
    - Oak Creek – Phosphorus, Chloride, Unknown Pollutant
    - North Branch of Oak Creek – Chloride
    - Mitchell Field Drainage Ditch – Chloride (proposed)

Water Quality Conclusions

- Major conclusions from water quality analysis
  - Some improvements in water quality
    - Decreases in concentration of fecal coliform bacteria
    - Decreases in concentrations of total suspended solids
    - Decreases in concentrations of some heavy metals
    - Improvement in biological community in some sections of Oak Creek
  - Existing and potential water quality problems
    - High fecal indicator bacteria concentrations indicate water is not safe for human contact
    - Low dissolved oxygen concentrations in Mitchell Field Drainage Ditch, Unnamed Creek 5, and upper reaches of Oak Creek
    - Long-term increases in chloride concentrations threaten biota

Water Quality Conclusions

- Major conclusions from water quality analysis (continued)
  - Existing and potential water quality problems (continued)
    - High concentrations of nutrients—phosphorus and nitrogen
    - Increasing concentrations of chlorophyll-*a*
    - Poor quality fish and macroinvertebrate communities
    - Exotic and invasive species threaten biological integrity
    - Presence of several toxic substances and emerging pollutants, some at concentrations that produce toxic effects in benthic organisms
    - Climate change projections show 2°C increase in average water temperature by 2100, which will cause changes in the biological communities that the watershed can support



Sources of Water Pollution and Current Management Practices

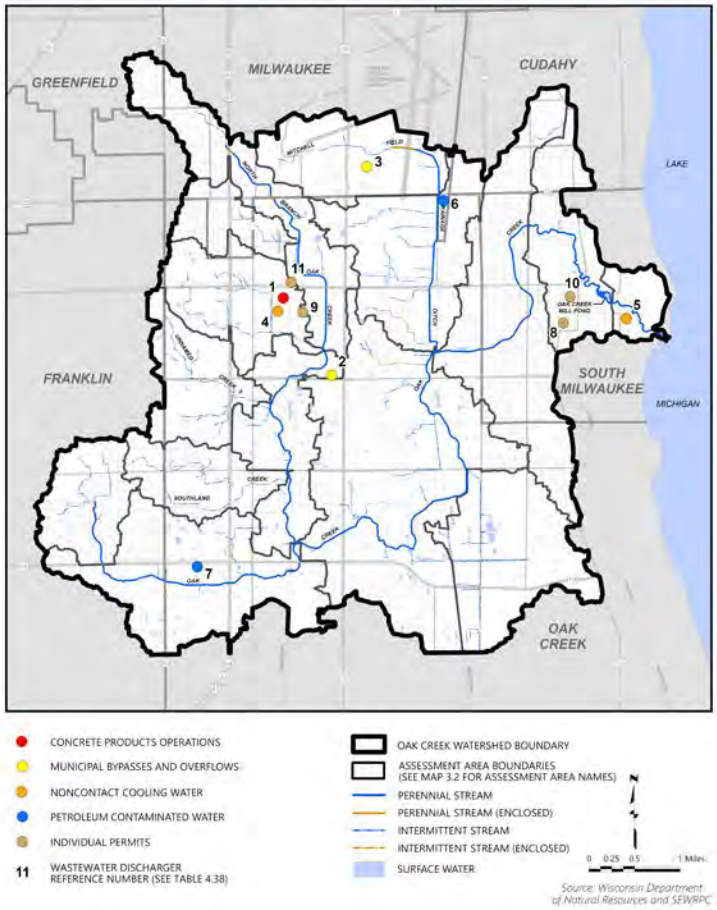
Sources of Water Pollution

- Point Sources -
  - Permitted Wastewater Dischargers
    - 4 Facilities covered by individual permits
    - 7 Facilities covered by general permits
  - Permitted Stormwater Dischargers
    - 6 Cities, Milwaukee County, and Mitchell Field covered under municipal separate storm sewer system (MS4) permits
    - 28 Facilities covered under industrial stormwater discharge permits

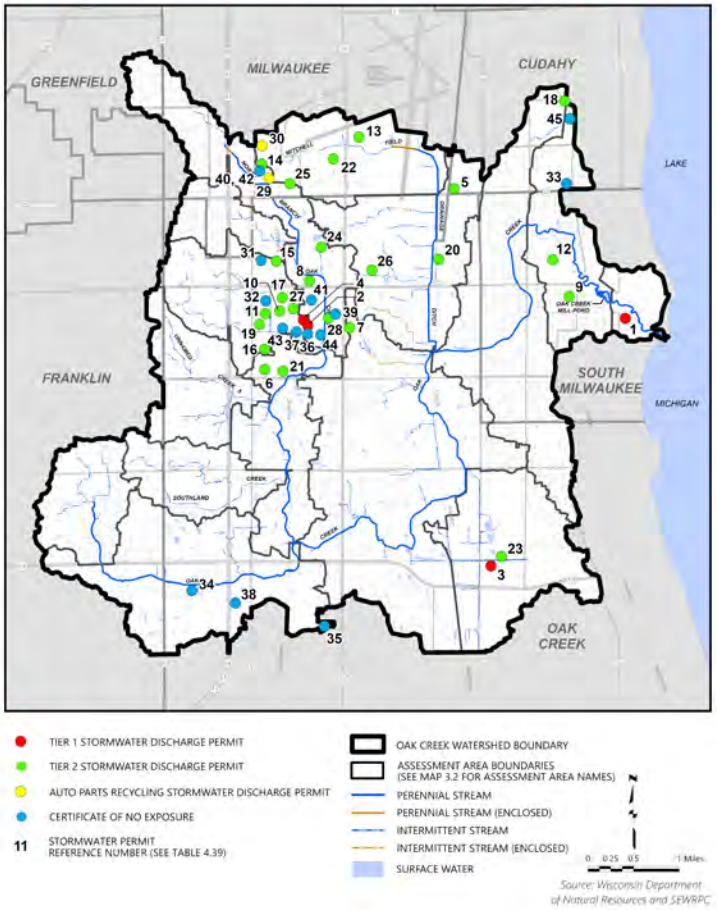
Sources of Water Pollution

OAK CREEK WATERSHED FUTURE

Map 4.42
Permitted Wastewater Dischargers Under the WPDES Program Within the Oak Creek Watershed: 2018



Map 4.43
Facilities with WPDES Stormwater Discharge Permits Within the Oak Creek Watershed: 2018

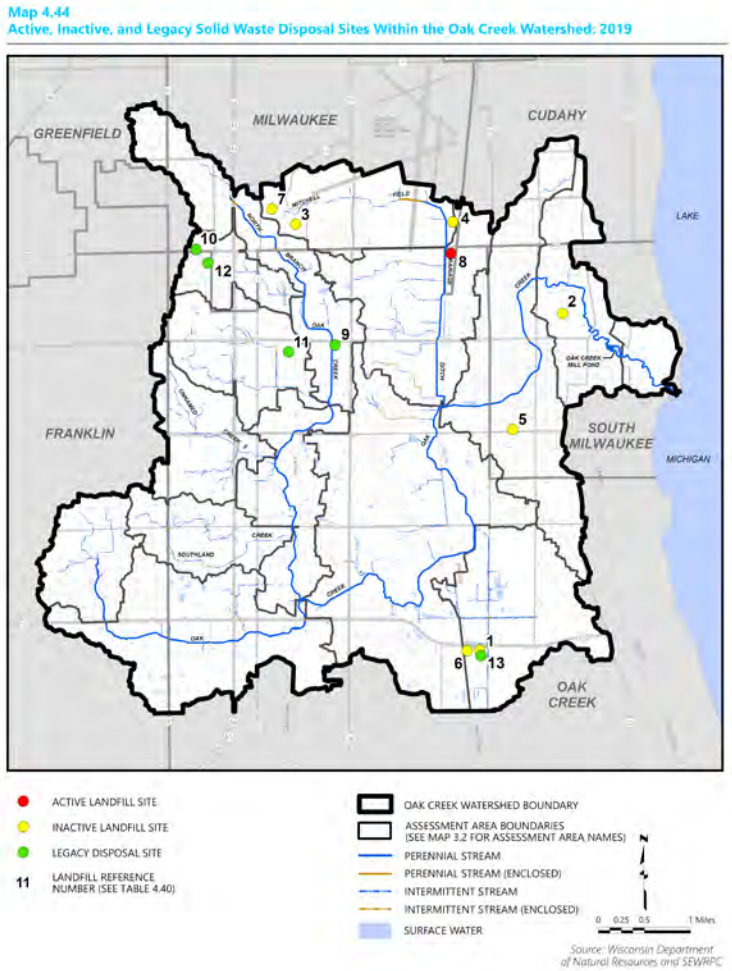


Sources of Water Pollution

- Nonpoint Sources – Examples include:
  - Vehicle exhaust, fluids, and wear and tear
  - Improper disposal of yard waste and pet waste
  - Failing and improperly maintained septic systems
  - Poor soil and water conservation practices
  - Excessive application of fertilizers and pesticides
  - Salt and sand application for snow and ice control
  - Construction and demolition activity
  - Improper storage and handling of materials
  - Improperly designed and maintained solid waste disposal

Sources of Water Pollution

- Solid Waste Disposal Sites
  - 1 Active Landfill
  - 7 Inactive Landfills
  - 5 Legacy Disposal Sites



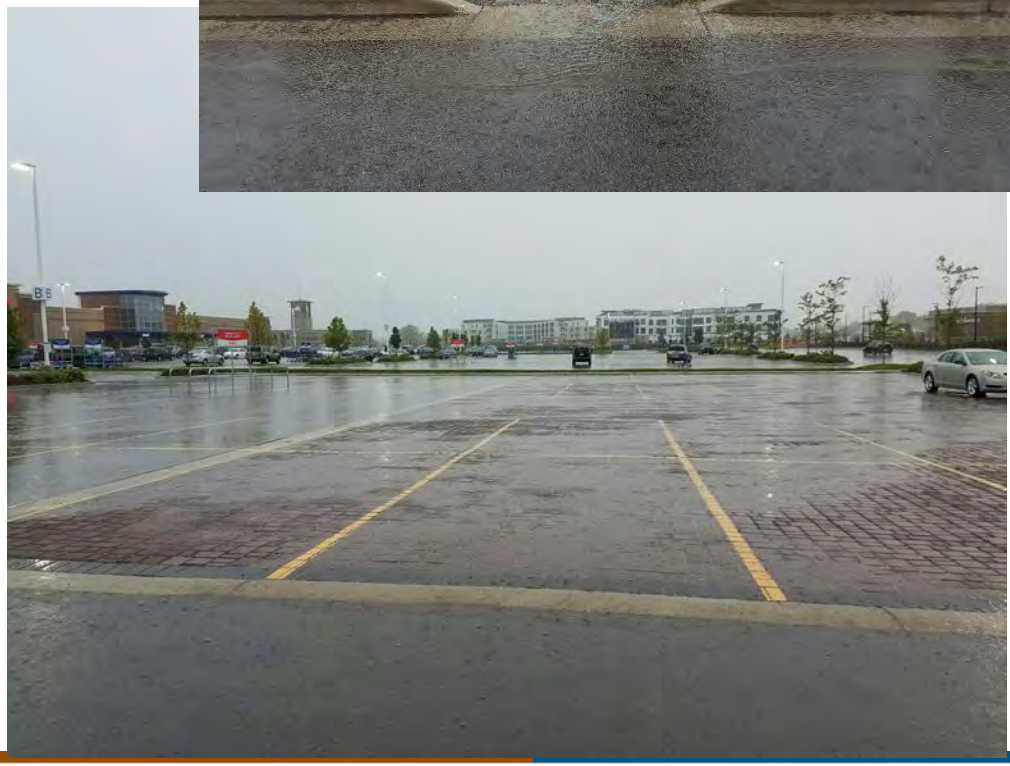
Current Management Practices

- Impervious surface impacts can be mitigated to some degree through good land use planning, implementation of traditional stormwater best management practices (BMPs), creative development site design, and emerging green infrastructure technologies

- All municipalities that make up the Oak Creek watershed have been issued municipal separate storm sewer (MS4) discharge permits from the Wisconsin DNR and are required to reduce urban pollutants entering local waterways via their storm sewer systems by implementing programs such as:
  - Construction site and long-term stormwater control
  - Illicit discharge screenings
  - Informational and educational programs
  - Improving winter road management programs
  - Inventorying and maintaining existing stormwater facilities
  - Submitting an annual report summarizing and evaluating programs

Current Management Practices

- Generally, stormwater BMPs installed in areas of the watershed developed prior to 1990 consisted of storm sewers, curb and gutter, catch basins, and grass swales.
- Development and redevelopment since 1990 continue to utilize these practices along with the addition of wet and dry stormwater detention basins and green infrastructure.
- Emerging stormwater management technologies differ from traditional practices in that they seek to better mimic the deposition of precipitation on an undisturbed landscape by retaining and infiltrating stormwater onsite.
- The most visible installations of green infrastructure within the Oak Creek watershed were installed as part of the Drexel Town Square development in the City of Oak Creek (see photos here)

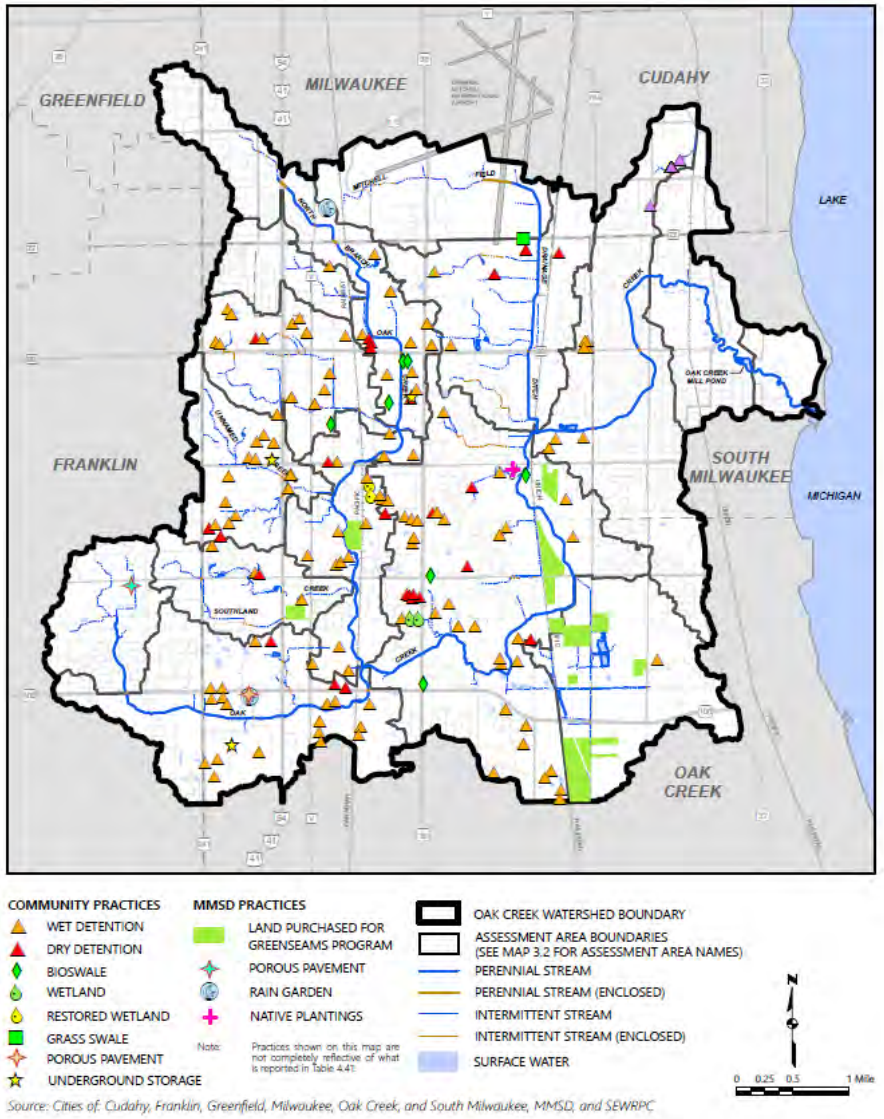


Current Management Practices

- Stormwater BMPs installed and reported by municipalities in the Oak Creek watershed include:
  - 320 miles of grass swales
  - 73 wet detention basins
  - 475 catch basins
  - 3 acres of porous pavement
  - 3 biofilter units
  - Stormwater trees
  - Rain gardens
  - Floating treatment wetlands

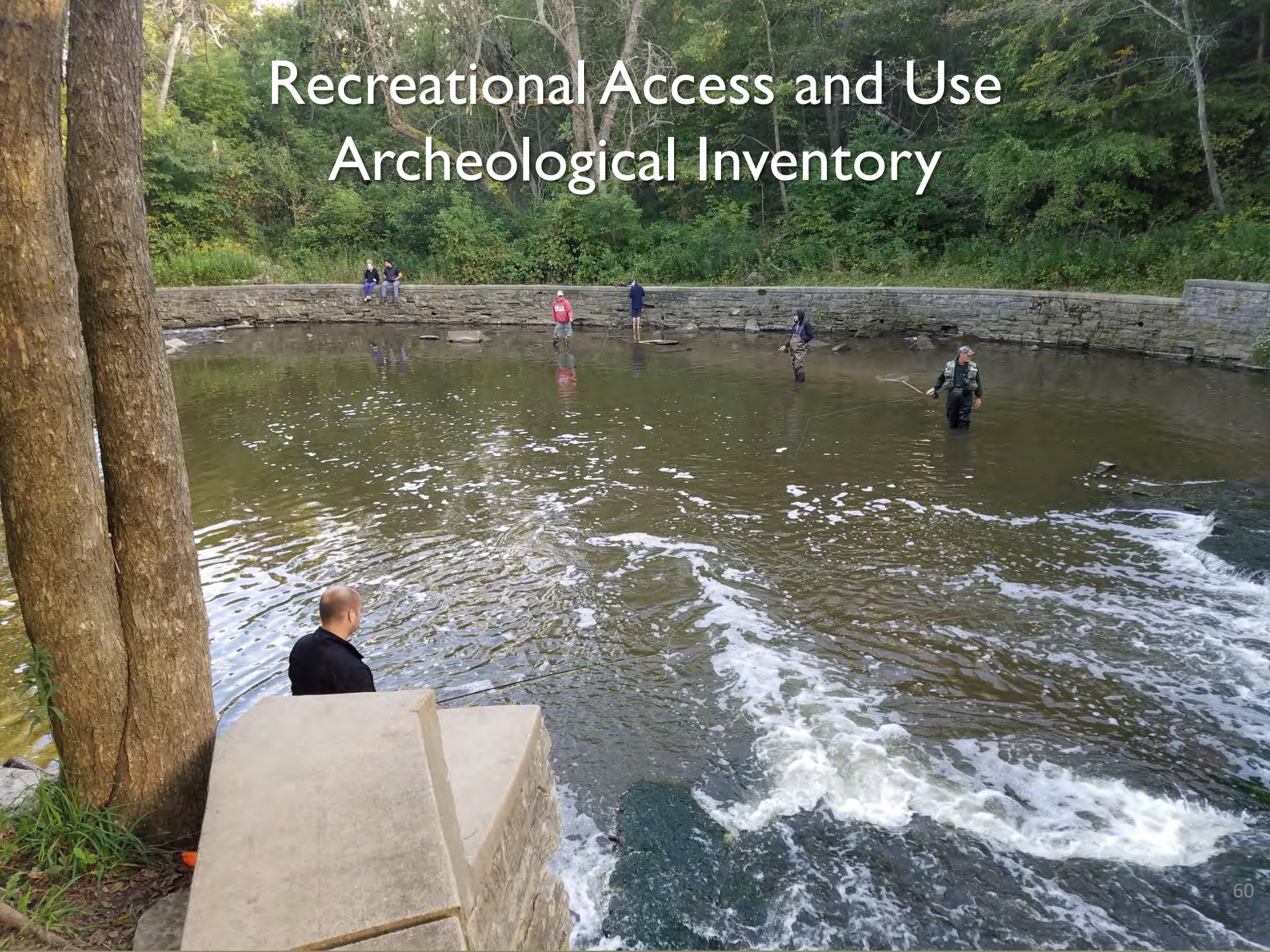
- The Milwaukee Metropolitan Sewerage District has purchased ten properties within the Oak Creek watershed (totaling 225 acres) as part of it's "Greenseams" program. This program has a flood management focus and aims to make voluntary purchases of undeveloped, privately owned properties in areas that are expected to have major urban development in the next 20 years.

Map 4.45
Stormwater Management Practices and Green Infrastructure Mapped by Communities and MMSD: 2018



Source: Cities of: Cudahy, Franklin, Greenfield, Milwaukee, Oak Creek, and South Milwaukee, MMSD, and SEWRPC

Recreational Access and Use Archeological Inventory



Recreational Access and Use

- The Oak Creek watershed contains many high-quality natural resource and recreational amenities including:
  - 15 Milwaukee County-owned park and open space sites (1,742 acres within the watershed)
  - 19 municipal park and open space sites (295 acres)
  - 16 school district parks and open space sites (376 acres)
  - 10 MMSD owned Greenseams sites
  - 11 privately owned open space sites

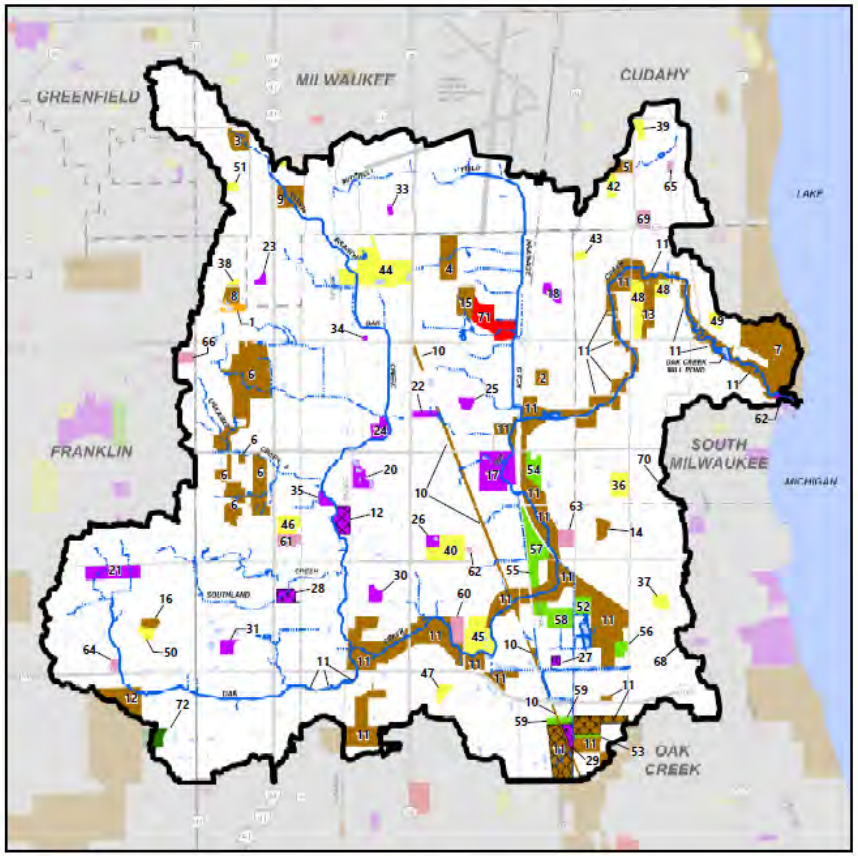
- Milwaukee County maintains 12 miles of the Oak Leaf Trail system within the Oak Creek watershed. The adopted regional land use and transportation plan proposes adding almost 6 additional miles to the Oak Leaf Trail system within the watershed.

- Milwaukee County Parks operates over 9 miles of the Forked Aster Hiking Trail System within the Oak Creek watershed. These are soft trails within County-owned parks that pass through grasslands, wetlands, and woodlands.
  - Parks that contain Forked Aster Trails include Copernicus Park, Cudahy Nature Preserve, Cudahy Park, Falk Park, Grant Park, and Rawson Park

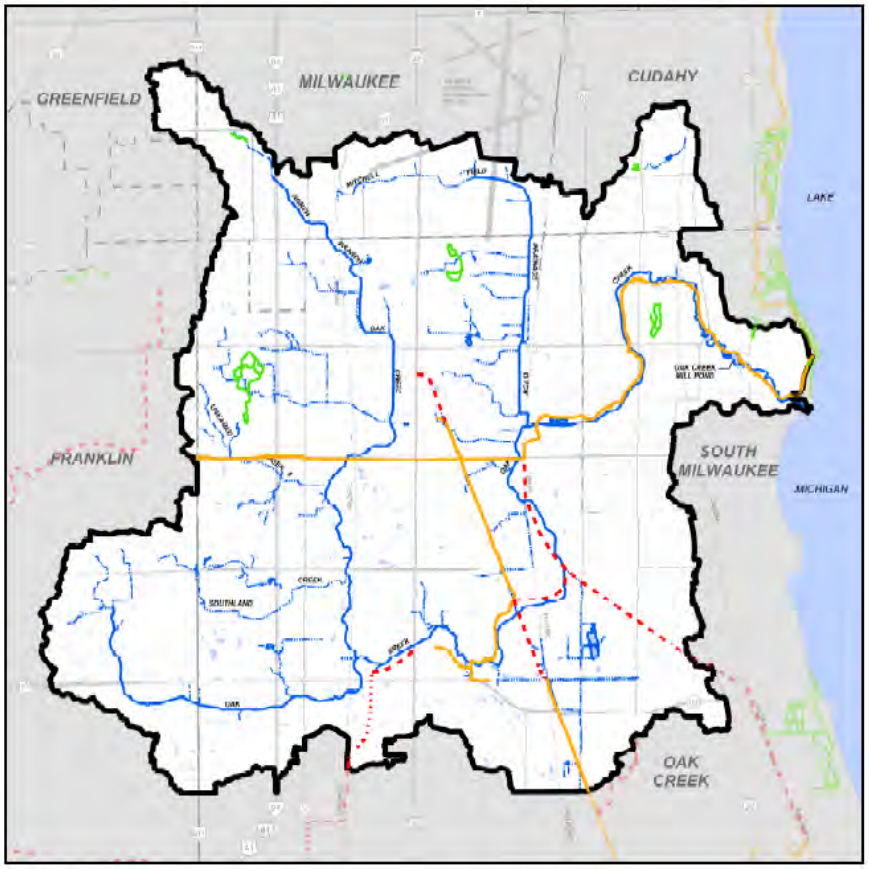
- Fishing access is available to Oak Creek and its tributaries from adjacent public lands. The most popular fishing locations in the watershed include just below the Mill Pond dam, where a large pool offers refuge for larger fish species, and the reach of Oak Creek downstream of this pool extending to the Creek's confluence with Lake Michigan.
  - These areas are especially popular for anglers during the annual salmon and brown trout runs for several weeks in the fall and the run of Steelhead (or rainbow trout) in mid- to late-February.

Recreational Access and Use

Map 4.46
State, County, Municipal, MMSD, and Private Organization Owned Park and Open Space Land Within the Oak Creek Watershed: 2020



Map 4.47
Existing and Proposed Off-Street Multi-Use Trails Within the Oak Creek Watershed: 2019



Archeological Inventory

- Archeological inventory from the State Historical Preservation Office database included 56 sites in the watershed as of August 2019. The sites were broken down as follows:
  - 28 village/campsite/cabin/workshop sites
  - 14 cemetery sites
  - 10 ten isolated finds or lithic scatter sites
  - 3 native American burial mound sites
  - 1 schoolhouse site
- The exact locations of the documented sites will not be included in this plan, but will be used to refine the recommended projects for watershed restoration

Next Steps

- Compile comments on the second half of Chapter 4 and finalize the chapter
- Complete Chapter 5 (goals) and Chapter 6 (recommendations) for Advisory Committee and stakeholder review

Materials and Comments

- Communication
  - Opportunity for written comments via the website link below or email to Laura Herrick
  - SEWRPC website for Draft documents, meeting materials, and comments

  www.sewrpc.org/OakCreekWRP
- Contact
  - Laura Herrick – Chief Environmental Engineer
    lherrick@sewrpc.org