APPENDIX E

Monitoring Program and Management Plans

Appendix E MONITORING PROGRAM AND RESOURCE MANAGEMENT PLANS

This section outlines the monitoring and implementation plan for next 10 years for each water resource, or group of water resources, in the Shingle Creek Watershed. Each implementation plan includes background information, including current water quality data and impairment status, planned projects, and the proposed monitoring schedule for the next 10 years. Projects identified in the management plans directly reflect those listed in Table 4.8 and Table 4.9 in Section 7 Capital Improvement Program. Drainage maps for each drainage area can be found in the Inventory and Condition Assessment in the Third Generation Plan.

E.1 SHINGLE CREEK AND WEST MISSISSIPPI FOURTH GENERATION PLAN MONITORING PROGRAM OVERVIEW

Minnesota Rules 8410.0100 Subp. 5 states that:

> *A. Each plan must establish water quality and quantity monitoring programs that are capable of producing accurate data to the extent necessary to determine whether the water quality and quantity goals of the organization are being achieved. The programs shall, at a minimum, include the location of sampling, the frequency of sampling, the proposed parameters to be measured, and the requirement of periodic analysis of the data.*

The Fourth Generation Monitoring Program has two organizing principles: continuation of routine flow and water quality monitoring in Shingle Creek and volunteer monitoring of lake water quality; and periodic special monitoring to evaluate progress towards meeting and maintaining TMDL goals.

Each year the Commissions will evaluate this proposed program and make modifications as necessary based on the most current data needs. The monitoring objectives guiding the Shingle Creek and West Mississippi monitoring program and the assessment of data are:

- To quantify the current status of streams and lakes throughout the watersheds in comparison to state water quality standards.
- To quantify changes over time, or trends, in stream and lake water quality in the watersheds.
- To quantify the effectiveness of implemented BMPs throughout the watersheds for the protection of water quality.
- To evaluate progress toward meeting and maintaining TMDL load reduction and other goals.

Monitoring locations are shown in Figure 3-1 in Section 3.3.2 in the Fourth Generation Plan.

E.1.1 Link to TMDLs

In each of the TMDL Implementation Plans, the Shingle Creek Commission committed to performing stream and lake monitoring to track the effectiveness of BMPs at reducing load and improving water quality. For lakes this included both CAMP monitoring and every 4-5 years more detailed lake water column profiling and aquatic vegetation surveys. The plans also included the following: “At the end of each five-year period this report [the Annual Water Quality Report] will include an assessment of progress and identification of any revisions to the implementation plan.”

Table E-1 shows the dates of TMDL Implementation Plan approvals and the year of 5-year progress evaluations completed during the Third Generation Plan. One TMDL 5-Year Review has been completed for most impaired waterbodies or group of waterbodies. In most cases, the 5-Year Review consisted of updated lake response modeling using data collected since the original TMDL. Updated models allowed for better understanding of impairments and targeting of management.

Because the Commissions' goals include achieving delisting of lakes that meet their TMDLs and water quality, the framework includes more rigorous lake monitoring sufficient to demonstrate to the MPCA and EPA that conditions have improved. The monitoring framework also includes activities such as aquatic vegetation monitoring to assist in the adaptive management process.

TMDL 5-Year Reviews will continue under this Plan but will be prioritized into tiers following the monitoring program. Tier 1 lakes will be prioritized for reviews, followed by tier 2 lakes, and tier 3. Review of Shingle and Bass Creek TMDLs will also be prioritized based on the impaired status of the streams.

Table E-1. TMDL Implementation plan approvals and 5-year progress reviews completed during the Third Generation Plan.

TMDL	EPA Approval	Implementation Plan Approval	5 Year Progress Review
Shingle Creek Chloride	February 12, 2007	March 5, 2007	2014
Twin and Ryan	November 9, 2007	November 13, 2007	2014
Crystal, (Success)	March 25, 2009	July 7, 2009	2016
Pomerleau, Bass, and Schmidt	September 25, 2009	December 3, 2009	2017
Meadow	March 23, 2010	June 14, 2010	2019
Cedar Island, Pike, and Eagle	April 14, 2010	May 18, 2010	2019
Magda	September 30, 2010	October 1, 2010	2019
Shingle and Bass Creeks Biotic Integrity and Dissolved Oxygen	November 4, 2011	January 30, 2012	ongoing
Bass Creek Chloride	Not yet started	Not yet started	2014

E.1.2 Routine Stream Flow and Water Quality Monitoring

The Commission routinely conducts continuous flow monitoring and monitors water quality data at two locations on Shingle Creek and one location on Bass Creek. Station SC-0, also referred to as the outlet monitoring site, is located upstream of the 45th Avenue crossing in Minneapolis and has been monitored since 1996. SC-0 collects drainage from about 41 square miles, or approximately 92% of the watershed. The SC-3 monitoring station, also referred to as the upper monitoring site, is located where Shingle Creek crosses Brooklyn Boulevard in Brooklyn Park, just upstream from Zane Avenue. The SC-3 drainage area covers about 17 square miles which is approximately 39% of the Shingle Creek watershed. This site has been monitored since 2007. Between 1996-2006 the upper site was monitored about 1,500 feet downstream at Zane as site SC-2. BCP is the most upstream monitoring site on Bass Creek, a headwater stream to Shingle Creek. BCP drains approximately 8 square miles, or approximately 18% of the watershed.

There is also a long-term USGS monitoring station on Shingle Creek at Queen Avenue near the border of Minneapolis and Brooklyn Center. This station was installed and operated as part of the USGS's National Water Quality Assessment Program (NAWQA). This site, which is SC-1 but referred to as the USGS site, drains approximately 31 square miles (70% of the watershed). The Shingle Creek WMC and USGS collected continuous flow and storm event samples at this location from 1996 through 1999. The USGS continued monitoring continuous flow at this site in 2001 and then began monitoring continuous conductivity at this site year around beginning in 2004. Real-time data is available through the USGS website (http://waterdata.usgs.gov/mn/nwis/uv?05288705).

Under the Fourth Generation Plan, the Commission will continue routine flow and water quality monitoring at BCP, SC-0, and SC-3 and continue to partner with the USGS to operate the USGS site. Monitored parameters may vary from year to year based on current data needs such as obtaining baseline data for upcoming new standards or collecting additional data to assist in evaluating progress towards TMDL goals. The estimated cost of this monitoring program is shown in Tables 4.6 and 4.7 in the Fourth Generation Plan.

Under the Fourth Generation Plan, the Commission will continue monitoring in the West Mississippi watershed. There is only one stream in West Mississippi that discharges to the Mississippi River, Mattson Brook. Edinbrook and Century Channels, which drain much of the central part of Brooklyn Park, flow into Mattson Brook. Mattson Brook and the storm sewer outfalls to the Mississippi River have been routinely monitored in recent years. This Plan's monitoring program proposes that Mattson Brook and outfalls be monitored on a rotating basis.

E.1.3 Lakes

There are sixteen lakes in the Shingle Creek watershed, and none in West Mississippi. It should be noted that Twin Lake is comprised of three basins and is considered as three separate lakes even though it is one chain of lakes.

The Shingle Creek Watershed Management Commission has participated in the Metropolitan Council's Citizen Assisted Lake Monitoring Program (CAMP) since 1996. The program is the backbone of lake water quality data collected by the Commission. This program is also an NPDES Phase II Education and Public Outreach BMP. CAMP was initiated by the Met Council to supplement the water quality monitoring performed by Met Council staff and to increase our knowledge of water quality of area lakes. Volunteers in the program monitor the lakes every other week from mid-April to mid-October, approximately 14 sampling events. They measure surface water temperature and Secchi depth, and collect surface water samples that are analyzed by the Met Council for total phosphorous, total Kjeldahl nitrogen, and chlorophyll-a. The volunteers also judge the appearance of the lake, its odor, and its suitability for recreation.

Under the Third Generation Plan, the Commission began more intensive lake monitoring. Intensive monitoring was planned for the year prior to performing the five-year evaluation of progress toward TMDL goals. The Commission more systematically obtained aquatic vegetation surveys, fish surveys, phytoplankton and zooplankton sampling, and collected sediment cores from lakes that did not have existing sediment core data collected. Intensive monitoring under the Third Generation Plan allowed for deeper understanding of the lake ecosystems in the watershed and has led to a multitude of management projects including the Bass and Pomerleau Lakes alum treatments, the Meadow Lake drawdown, and the Crystal Lake carp removals and alum treatment. Some additional lake data is available on the lakes because of special studies, including TMDLs, management plans, and monitoring by other agencies such as Three Rivers Park District.

For 2023-2032, the Commission will continue participating in the CAMP program to obtain lake data and will continue to those data with more intensive lake monitoring to maximize understanding for lakes with recent or planned implementation actions outlined in the CIP (see Table 4.8 in the Fourth Generation Plan). Monitoring may be planned preceding and following management to track effectiveness of implementation actions. The Commission will rely primarily on CAMP monitoring to understand changes to unimpaired, non-priority lakes for the Fourth Generation Plan. The draft lake monitoring schedule is laid out in Table E-2 and uses three tiers to guide and prioritize the monitoring:

Tier 1 – Impaired lakes with management actions planned. These lakes are priority lakes for intensive monitoring under the Fourth Generation Plan. Intensive monitoring will be used to evaluate lakes for management projects.

Tier 2 - Impaired lakes with previous management or none planned. The lakes are second priority for intensive lake monitoring under this Plan, as they are impaired
Tier 3 – Delisted lakes. These lakes are third priority and will be monitored primarily through the CAMP program unless declines in water quality are detected.

Table E-2. Draft lake monitoring schedule for Shingle Creek lakes 2023-2032.

Lake	Water Quality Monitoring									
	23	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**
Tier 1 Lakes – Impaired with management actions planned										
Cedar Island	Ci	C, Ci	Ci	C, Ci	Ci	X, Ci	Ci	C, Ci	Ci	Ci
Eagle	Ci	X, Ci	Ci	C, Ci	Ci	X, Ci	Ci	C, Ci	Ci	Ci
Pike	Ci	X, Ci	Ci	C, Ci	Ci	C, Ci	Ci	C, Ci	Ci	Ci
Upper Twin	X		X		C		X		C	
Middle Twin	X		X		C		X		C	
Tier 2 Lakes – Impaired lakes with previous management or none planned										
Crystal Lake	Ci				X				X	C
Meadow Lake	C				X					X
Lake Success			C			C				C
Lake Magda				X					X	C
Tier 3 Lakes – Delisted lakes										
Bass Lake	Ci	C	Ci				C	X		
Pomerleau Lake	Ci	C	Ci				C	X		
Schmidt Lake	Ci	Ci	C			C				X
Lower Twin Lake	C		C		C		C		C	
Ryan Lake	C			X				C		

[1]X denotes Commission monitoring, C denotes CAMP monitoring, and Ci denotes City monitoring

E.1.4 Stream and Wetland Biological Monitoring

The Commissions periodically undertakes limited stream biological monitoring of fish and macroinvertebrates, supplemented by biological data collected by volunteers through Hennepin County Environment and Energy. High school students and their teachers monitor macroinvertebrates in streams through the River Watch program, and adult volunteers led by trained leaders monitor macroinvertebrates and vegetation in wetlands through the Wetland Health Evaluation Program (WHEP). Hennepin County discontinued the WHEP program in 2022.

E.2 CEDAR ISLAND, EAGLE, & PIKE IMPLEMENTATION PLAN

The Cedar Island, Pike, and Eagle subwatershed is mostly located within the city of Maple Grove, with a portion of the Pike Lake tributary area located in the city of Plymouth. Eagle Lake is highly used for fishing, provides aesthetic values, and Three Rivers Park District plans an expansion of the Eagle Lake Regional Park to include a swimming and picnicking area on the south end of the lake. Pike and Cedar Island Lakes are smaller lakes with limited public access.

Table E-3. Characteristics of Cedar Island, Eagle, and Pike Lakes.

Lake	Area (acres)	Depth Class	Impairment Status
Cedar Island	81	shallow	Impaired
Pike	58	shallow	Impaired
Eagle	291	deep	Impaired

The subwatershed is almost fully developed. Three Rivers Park District owns and operates Eagle Lake Regional Park in the watershed, including a golf course and a significant amount of open space. MnDOT I-94 and I-694 right of way, including the Fish Lake Interchange, encompasses a significant fraction of the subwatershed. The subwatershed is almost completely developed save for a few tracts of undeveloped area, mainly wetlands, and an area within the Maple Grove Gravel Mining Area that is still in extractive use. The 2020 land use data are presented in Figure E-1.

Cedar Island Lake discharges by a pumped outlet into storm sewer, which is then conveyed to Eagle Lake. An area west of I-494 discharges into a series of wetlands which outlet into Pike Creek and then into Pike Lake. In 2001 the cities of Maple Grove and Plymouth partnered with Hennepin County to reconstruct and stabilize Pike Creek from Hemlock Lane (CSAH 61) to just upstream of Pike Lake. The Creek had been experiencing severe erosion and mass wasting from flashy flows that ranged from a few cubic feet per second (cfs) to over 600 cfs. In 2022, the City of Plymouth began additional restoration efforts on two stretches of Pike Creek between Northwest Blvd and Hemlock and further downstream near the outlet to Pike Lake to address sediment and total phosphorus (TP) loading to Pike Lake. Pike Lake is connected by a channel dredged through cattails in the wetland between Pike and Eagle Lakes. Some areas north of I-694 also discharge through storm sewer under the freeway into Eagle Lake.

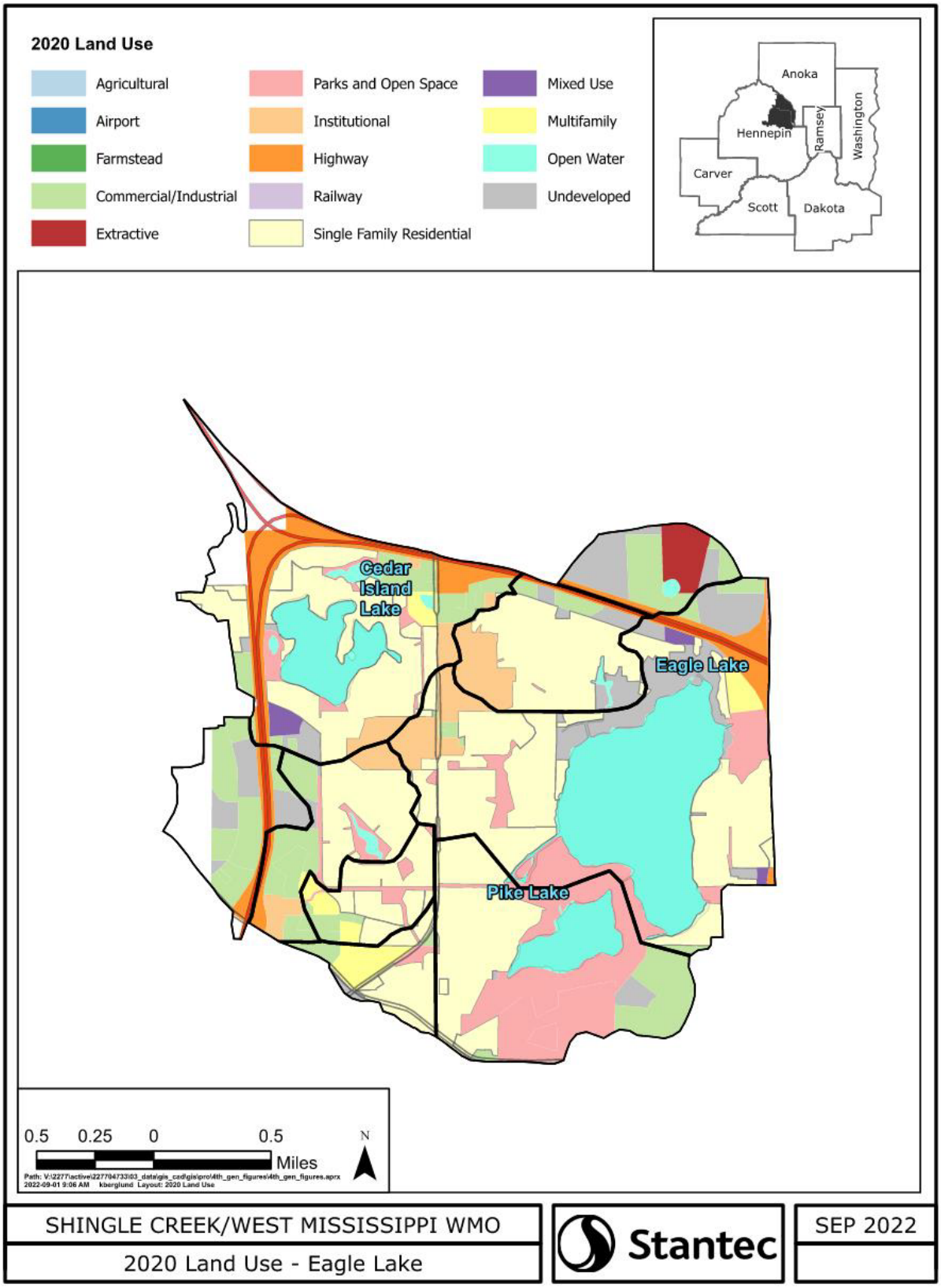


Figure E-1. Cedar Island, Pike, and Eagle Lakes subwatershed 2020 land use.

Water quality in Cedar Island and Pike Lakes is poor with frequent algal blooms while Eagle Lake has more moderately degraded water quality and is closest to unimpaired status. Both Cedar Island Lake and Pike Lake drain into Eagle Lake and influence water quality in Eagle Lake. The most severe algal blooms in Eagle Lake occur in late summer and early fall. Cedar Island is shallow and has very high TP concentrations and severe algal blooms. Cedar Island has a large internal load that is exacerbated by the presence of curly-leaf pondweed in nuisance densities and the presence of black bullhead fish that forage on the lake bottom. Pike Lake is also shallow and has high total phosphorus concentrations throughout the summer with severe algal blooms.

The TMDL concluded that a 67 percent decrease in phosphorus load would be required for Cedar Island Lake to consistently meet water quality standards. Pike Lake would require a 49 percent decrease and Eagle Lake a 40 percent decrease. Pike Lake contributes a substantial load downstream to Eagle Lake, thus improvements to that lake should result in improvement in Eagle Lake. The TMDL concluded that internal load management, biologic management, and reduction of nonpoint sources of phosphorus in the watershed by retrofitting Best Management Practices (BMPs) would have the most impact on reducing phosphorus load and improving water quality in the chain of lakes. The TMDL 5-Year review updated load reductions required for the lakes to meet their water quality goals to 80% reduction for Cedar Island, 39% reduction for Pike Lake, and 29% reduction for Eagle Lake.

The Shingle Creek WMO has identified priority implementation strategies for the Cedar Island, Pike, and Eagle watersheds in the next ten years (Table E-4). Implementation actions are focused around identifying potential BMP projects and locations through subwatershed assessments of Cedar Island and Eagle/Pike, implementing projects, and continued monitoring. An overview of the priority actions is provided in the following sections as a management plan.

Table E-4. Implementation plan for Cedar Island, Eagle, and Pike Lakes.

Action	Location	Plan Year										Estimated Cost
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Watershed Activities												
Subwatershed Study	Cedar Island Lake						x					$30,000
	Eagle/Pike Lakes	x										$30,000
Pike Creek Stabilization Project	Pike Lake	x										$395,000
In-Lake Activities												
Internal load project	Cedar Island Lake							x				$170,000
	Eagle/Pike Lake		x									$170,000
Aquatic vegetation management	Cedar Island Lake									x	x	$30,000
	Eagle Lake			x	x							$30,000
Monitoring												
Monitoring	Cedar Island Lake	Ci	C, Ci	Ci	C, Ci	Ci	X, Ci	Ci	C, Ci	Ci	Ci	--
	Eagle Lake	Ci	X, Ci	Ci	C, Ci	Ci	X, Ci	Ci	C, Ci	Ci	Ci	--
	Pike Lake	Ci	X, Ci	Ci	C, Ci	Ci	C, Ci	Ci	C, Ci	Ci	Ci	--

[1]X denotes Commission monitoring, C denotes CAMP monitoring, and Ci denotes City monitoring

E.2.1 Cedar Island Lake

Water quality in Cedar Island Lake is poor. Average growing season TP, chlorophyll-a, and Secchi depth measurements have not met State standards for decades (Figure E-2). The TMDL 5-Year review

identified a high residual load in the lake that could not be attributed to internal loading from sediment, watershed loads, or atmospheric loads. A priority for the next 10 years is identifying sources of the residual load, which may be unidentified internal sediment loading exacerbated by rough fish populations (black bullheads, carp) and the presence of curly leaf pondweed, and managing the lake for improved water quality.

Priority Concerns:

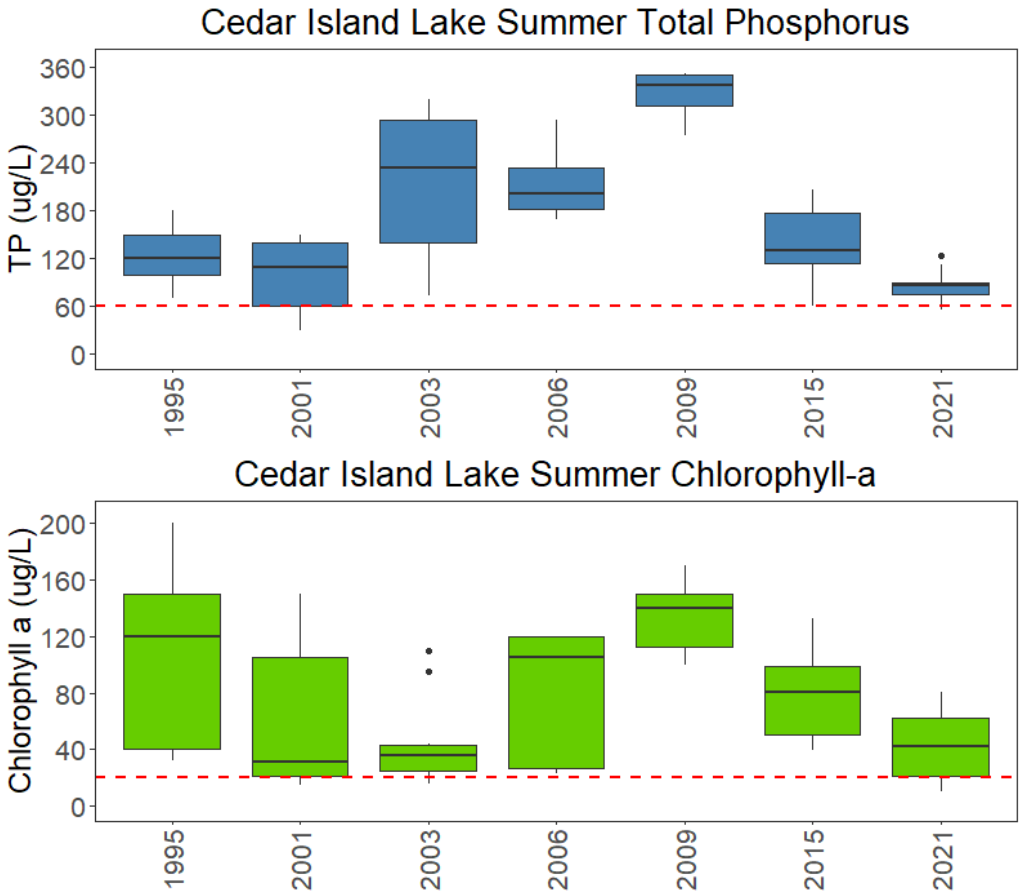
- High nutrient loading identified in TMDL and TMDL 5-Year Review
- Rough fish population (primarily black bullheads)
- Invasive aquatic vegetation (curly-leaf pondweed)

10-Year Plan Activities:

- Complete a subwatershed assessment to identify potential sources of the residual load and areas for watershed BMPs
- Monitor changes to water quality, phyto/zooplankton, fish, and submersed aquatic vegetation (SAV)

Monitoring Plan

- Monitoring in Cedar Island Lake is focused on informing and evaluating management and will rely on a combination of City of Maple Grove, CAMP, and Commission intensive monitoring. Commission intensive monitoring is planned for the same year as a subwatershed study. Monitoring will be done in tandem with Eagle and Pike Lakes, as possible, to understand relationships in the three connected lakes.



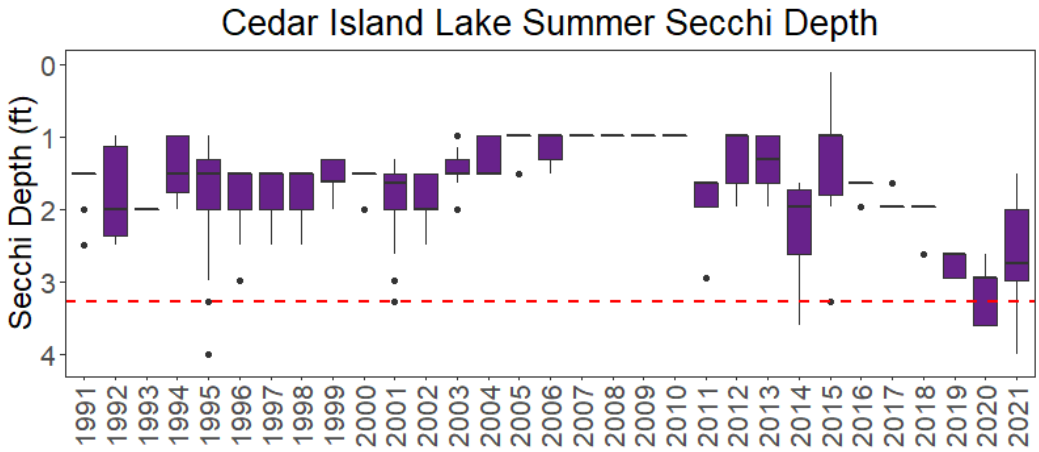


Figure E-2. Boxplots of recent growing season water quality data for Cedar Island Lake with the shallow lake standard for this ecoregion shown as a red horizontal line.

E.2.2 Eagle Lake

Water quality in Eagle Lake is generally good and near the impairment threshold (Figure E-3). Water clarity is typically good until late summer when algae blooms are most significant. TP loads identified in the TMDL 5-Year Review are similar from the watershed, upstream lakes, and internal loading from sediment. Management of these loads may improve water quality in the lake to achieve delisting from the State's Impaired Waters List. Common carp are present but controlled, and curly-leaf pondweed and Eurasian watermilfoil have been found in the lake in recent years but in relatively low abundance.

Priority Concerns:

- High watershed, upstream lake, and internal loads
- Invasive species (curly-leaf pondweed, Eurasian watermilfoil, and common carp populations)
- Harmful algae blooms

10-Year Plan Activities:

- Complete a subwatershed study encompassing the Pike and Eagle watershed to identify areas of high watershed loading to Eagle Lake. Use the planned Cedar Island subwatershed study to inform.
- Partner with the Lake Association and City of Maple Grove to continue management of invasive SAV
- Complete an internal load project on either Eagle or Pike identified in the subwatershed assessment
- Monitor changes to water quality, phyto/zooplankton, fish, and SAV

Monitoring Plan

- Monitoring in Eagle Lake is focused on informing and evaluating management and will rely on a combination of City of Maple Grove, CAMP, and Commission intensive monitoring. Commission intensive monitoring is planned for the year following a subwatershed study and a few years later to track progress. Monitoring will be done in tandem with Cedar Island and Pike Lake, as possible, to understand relationships in the three connected lakes.

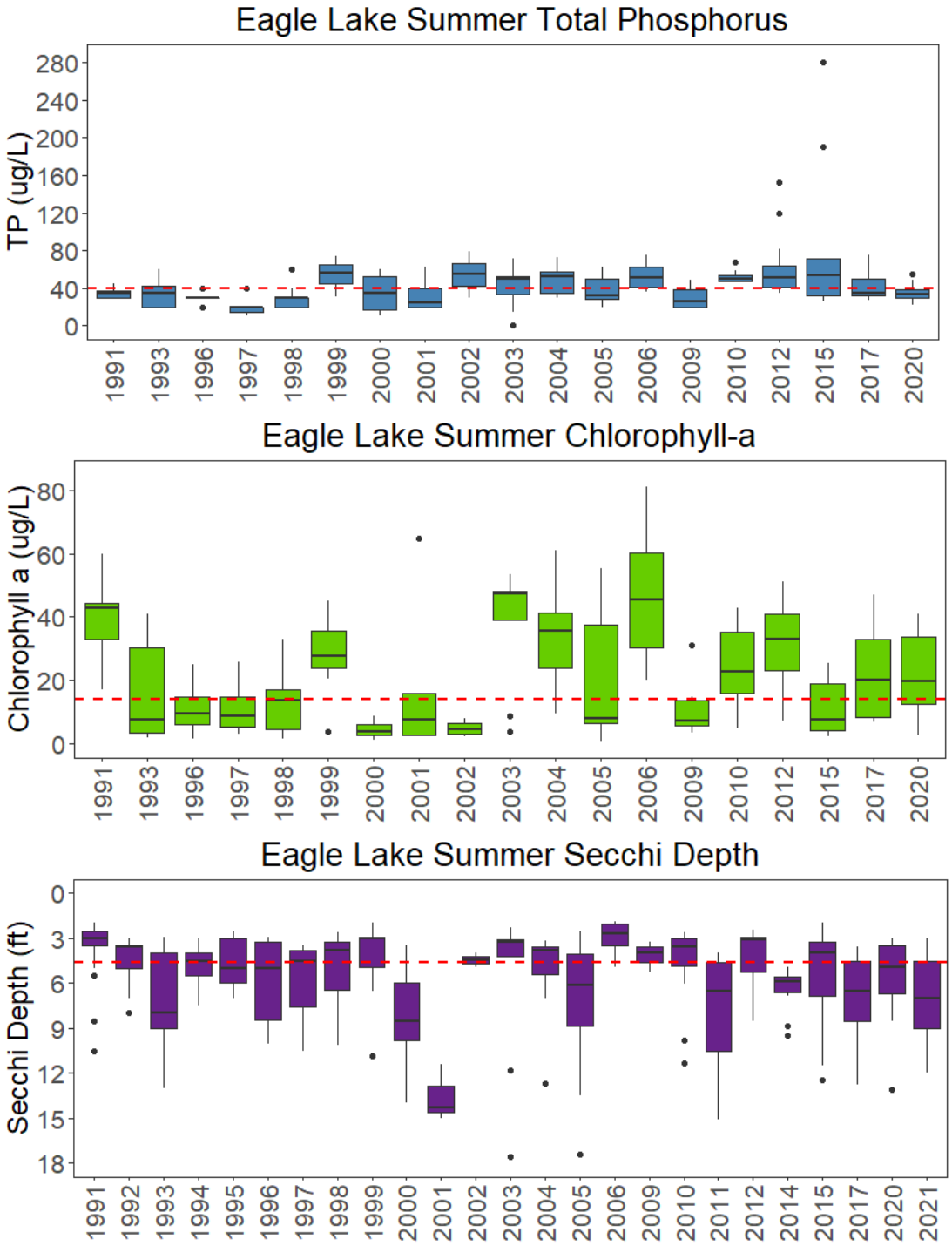


Figure E-3. Boxplots of recent growing season water quality data for Eagle Lake with the deep lake standard for this ecoregion shown as a red horizontal line.

E.2.3 Pike Lake

Pike Lake's water quality has fluctuated over time. Algae blooms are common, and deep-water TP concentrations can be extremely high (>1000 ug/L), but clarity was excellent when the lake was last monitored by the Commission in 2020 (Figure E-4). The lake has abundant aquatic vegetation, and curly-leaf pondweed and Eurasian watermilfoil are present. Pike Lake is connected to Eagle Lake through a dredged wetland channel. Lake residents have concerns about access to Pike Lake with recent low water levels preventing navigation through the channel.

Priority concerns:

- High internal and watershed TP load
- Invasive species (curly-leaf pondweed, Eurasian watermilfoil)
- Channel access through Eagle Lake

10-Year Plan Activities:

- Pike Creek Stabilization project
- Complete a subwatershed study encompassing the Pike and Eagle watershed to identify areas of high watershed loading to Eagle Lake. Use the planned Cedar Island subwatershed study to inform.

Monitoring Plan

- Commission monitoring in Pike Lake is focused on informing and evaluating management and will rely on a combination of City of Maple Grove, CAMP, and Commission intensive monitoring. Commission intensive monitoring is planned for the year following a subwatershed study. Monitoring will be done in tandem with Cedar Island and Eagle Lakes, as possible, to understand relationships in the three connected lakes.

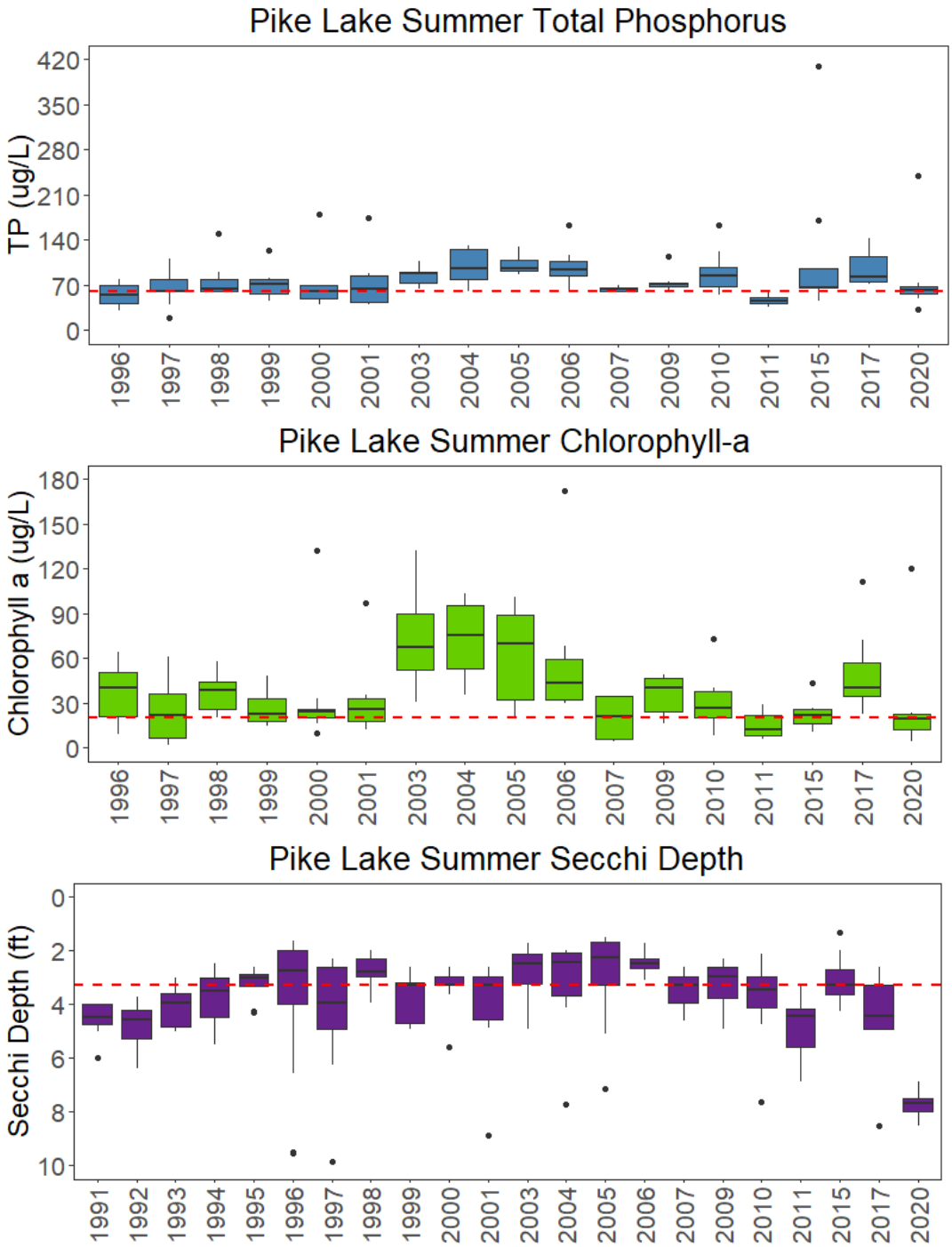


Figure E-4. Boxplots of recent growing season water quality data for Pike Lake with the shallow lake standard for this ecoregion shown as a red horizontal line.

E.3 SCHMIDT, POMERLEAU, & BASS IMPLEMENTATION PLAN

This subwatershed is almost entirely located within the city of Plymouth, with a fraction located in the city of Maple Grove. Bass and Schmidt Lakes are highly used recreational water bodies that support fishing and swimming as well as provide aesthetic values, while Pomerleau has limited public access.

Table E-5. Characteristics of Schmidt, Pomerleau, and Bass Lakes.

Lake	Area (acres)	Depth Class	Impairment Status
Schmidt	37	Shallow	Delisted
Pomerleau	30	Deep	Impaired (delisting in 2024)
Bass	175	Shallow	Impaired (delisting in 2024)

The area is almost fully developed (Figure E-5). The wetlands, woodlands, and agricultural lands around Pomerleau Lake are developing rapidly with residential and open space land uses, while the balance of the subwatershed is completely developed save for a few tracts of large lot residential and wetlands.

The Pomerleau Lake and Schmidt Lake subwatersheds drain through the Bass Lake subwatershed to Bass Lake. The area upstream of Bass Lake is drained through a series of ditches and intermittent channels that are known informally as Upper Bass Creek. The area to the west of Pomerleau Lake – the old Hampton Hills golf course and some surrounding parcels – has recently developed, and in that area Upper Bass Creek is referred to as Taylor Creek. Bass Lake outlets through Bass Creek to Shingle Creek.

All three lakes were previously designated by the MPCA and EPA as Impaired Waters and did not meet state water quality standards for nutrient concentrations. A Total Maximum Daily Load (TMDL) study was completed for this subwatershed and approved by the EPA in 2009. Since that time, management activities and land conversion have reduced nutrient and sediment loading to the lakes, all of which show improved water quality. Schmidt Lake was removed from the Impaired Waters list, or “delisted” in 2014 and Bass and Pomerleau are scheduled to be delisted in 2024.

Land use conversion can be an effective means of pollutant load reduction. For example, lands that had previously been use for agricultural purposes and drained directly to lakes and streams untreated are required during redevelopment to provide water quality treatment and manage rates and volumes of stormwater runoff. The conversion of agricultural and golf course uses around Pomerleau Lake to residential development that meets modern stormwater management standards was likely a factor in improved water quality in that lake. The City and Commission also completed alum treatments on Pomerleau and Bass Lake in 2019 and 2020 which significantly reduced internal load from sediment release.

The water quality in Schmidt Lake has been improving as a result of city implementation of BMPs such as boulevard rain gardens and enhanced street sweeping in the subwatershed and by in-lake actions taken by the active lake association.

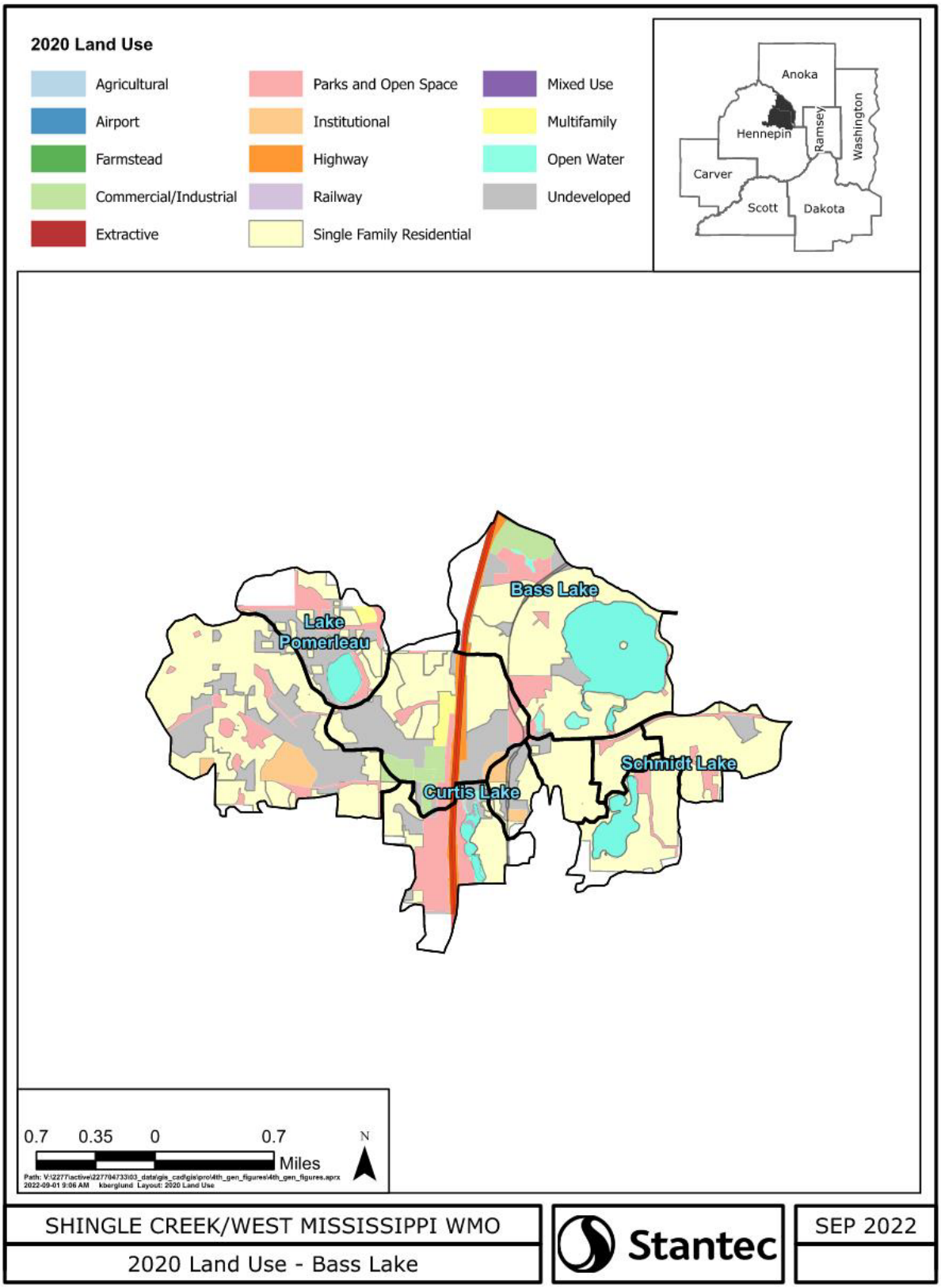


Figure E-5. Schmidt, Pomerleau, and Bass Lakes subwatershed 2020 land use

The Shingle Creek WMO has identified priority implementation strategies for the Schmidt, Pomerleau, and Bass Lake watersheds in the next ten years. Implementation actions are focused around maintaining the good water quality in all three lakes by continuing currently implemented BMPs, vegetation management, and monitoring changes. An overview of the priority actions is provided in the following sections as a management plan.

Table E-6. Implementation plan for Schmidt, Pomerleau, and Bass Lakes.

Action	Location	Plan Year										Estimated Cost
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Watershed Activities												
In-Lake Activities												
Aquatic vegetation management	Schmidt Lake								x		x	$20,000
	Pomerleau Lake				x		x					$20,000
	Bass Lake	x	x									$22,000
Monitoring												
Monitoring	Schmidt Lake	Ci	Ci	C			C				X	--
	Pomerleau Lake	Ci	C	Ci				C	X			--
	Bass Lake	Ci	C	Ci				C	X			--

[1]X denotes Commission monitoring, C denotes CAMP monitoring, and Ci denotes City monitoring

E.3.1 Schmidt Lake

Schmidt Lake was delisted in 2014 for a nutrient impairment as water quality has been consistently meeting State standards (Figure E-6). The lake has Eurasian watermilfoil and the whole lake was treated with herbicide in 2022 to control the infestation.

Priority concerns:

- Maintain current water quality
- Eurasian watermilfoil population

10-Year Plan Activities:

- Monitor changes to WQ, fish, and SAV
- Aquatic vegetation management

Monitoring Plan

- Monitoring in Schmidt Lake is focused on tracking any changes to water quality or aquatic vegetation because the lake is delisted and in good condition. The Commission will rely primarily on CAMP and City monitoring to assess water quality in Schmidt Lake. Commission intensive monitoring is planned for 2032.

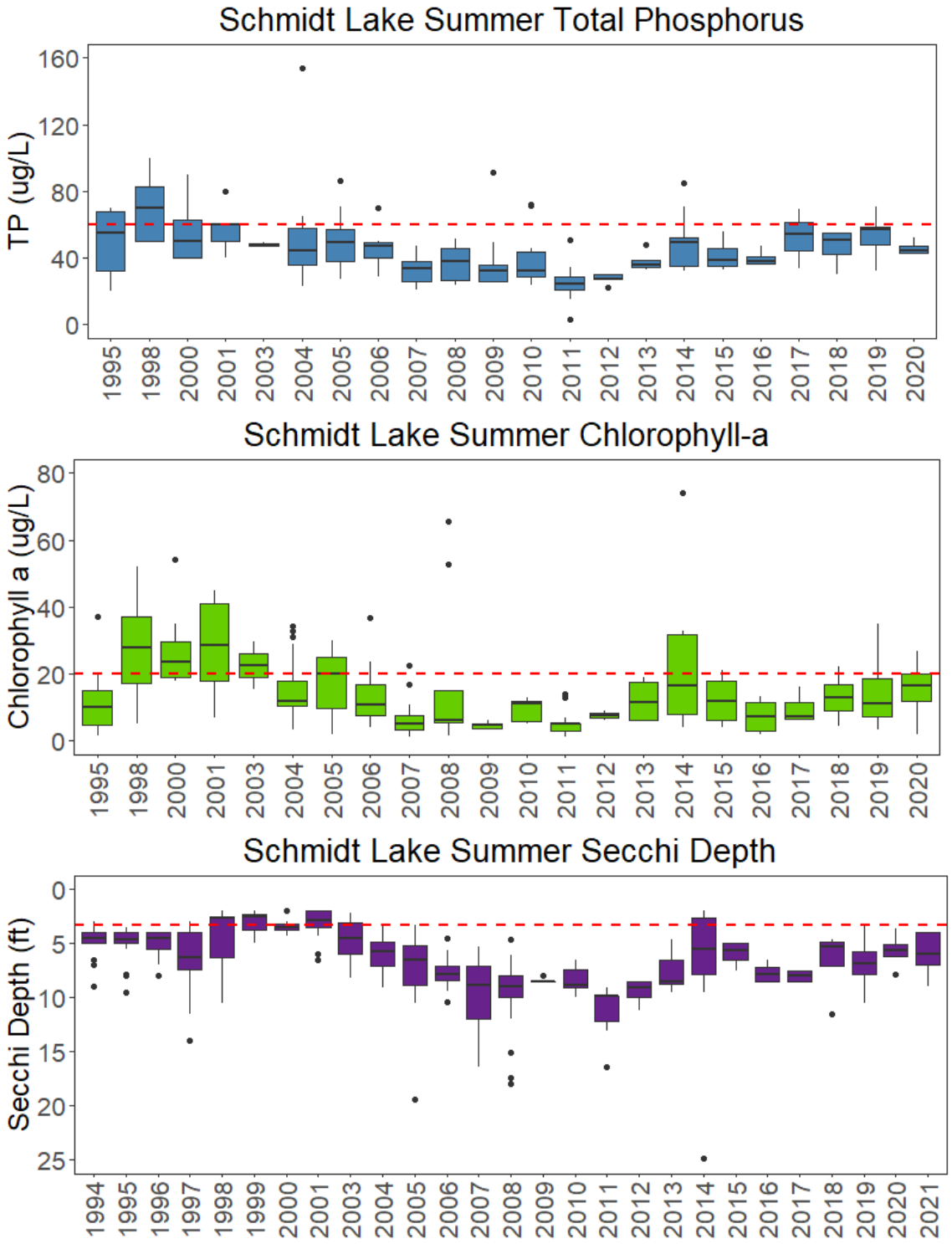


Figure E-6. Boxplots of recent water quality data for Schmidt Lake with the shallow lake standard for this ecoregion shown as a red horizontal line.

E.3.2 Pomerleau Lake

Water quality in Pomerleau Lake is excellent following the 2019 and 2020 alum treatments (Figure E-7). The vegetation community is diverse for a metro-area lake; however curly-leaf pondweed is present. In recent years, curly leaf has been under control and has not needed management. Recent conversion of land in Pomerleau's drainage area from agricultural and golf course runoff to residential development meeting Commission Rules & Standards has benefited the lake.

Priority Concerns:

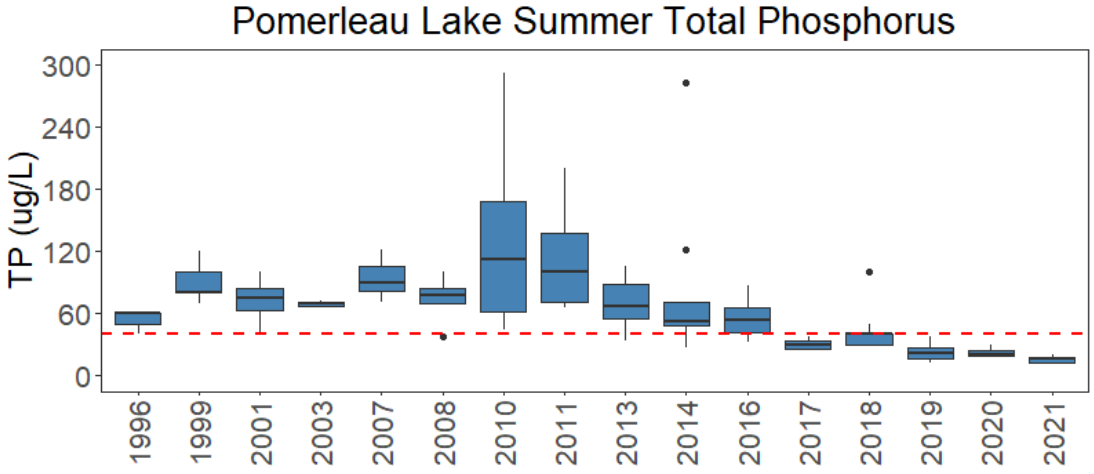
- Maintain current water quality
- Maintain diverse, native vegetation communities

10-Year Plan Activities:

- Monitor changes to WQ, fish, and SAV
- Aquatic vegetation management

Monitoring Plan

- Monitoring in Pomerleau Lake is focused on tracking any changes to water quality or aquatic vegetation because the lake is scheduled to be delisted in 2024. The Commission will rely primarily on CAMP and City monitoring. Commission intensive monitoring is planned for 2030.



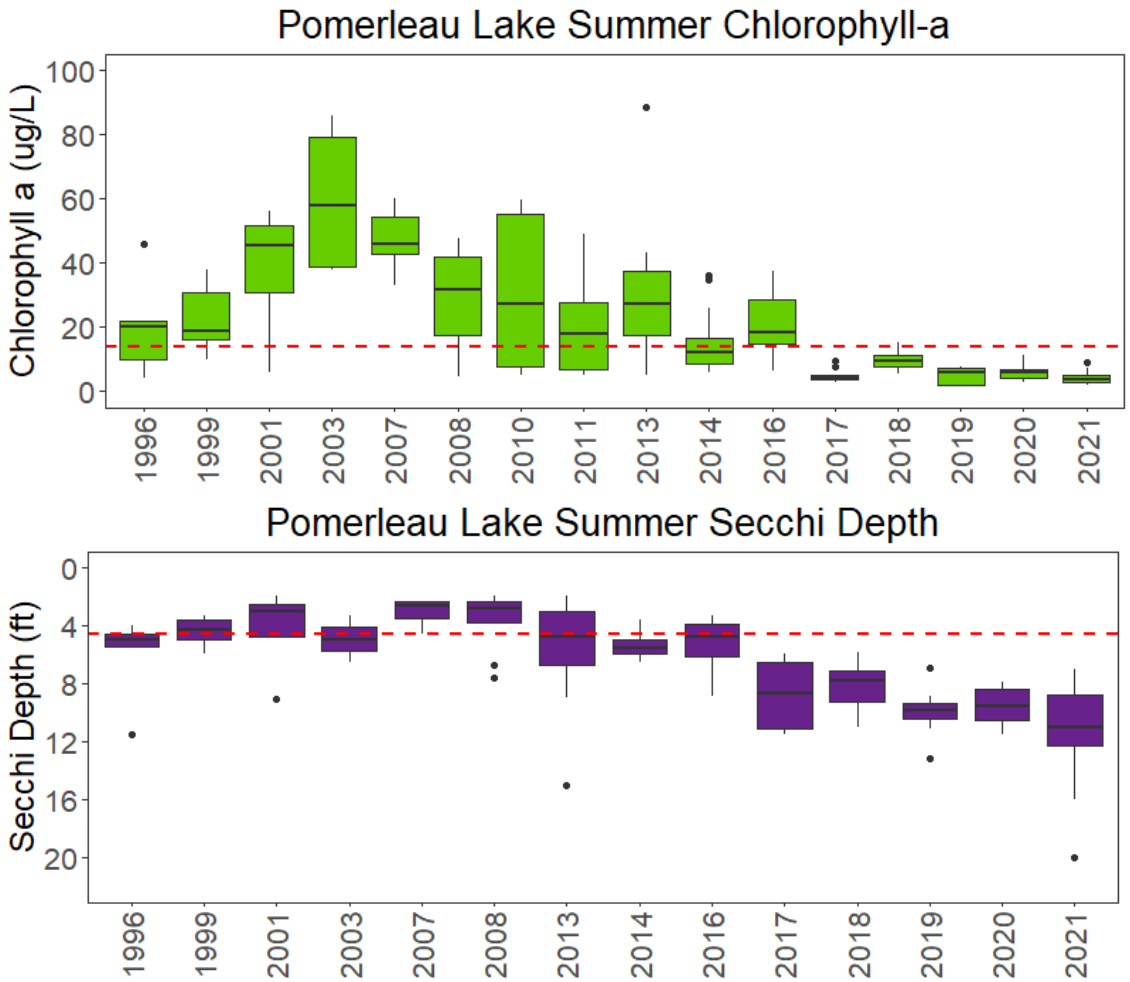


Figure E-7. Boxplots of recent growing season water quality data in Pomerleau Lake with the deep lake standard for this ecoregion shown as a red horizontal line.

E.3.3 Bass Lake

Bass Lake has excellent water quality following two alum treatments in 2019 and 2020 (Figure E-8). Curly-leaf pondweed is present in the lake and has been treated with herbicide by the Commission in recent years. The curly-leaf pondweed population has not been significantly reduced.

Priority Concerns:

- Maintain current water quality
- Control curly-leaf pondweed population
- Increase native plant diversity

10-Year Plan Activities:

- Monitor changes to WQ, fish, and SAV
- Aquatic vegetation management

Monitoring Plan

- Monitoring in Bass Lake is focused on tracking any changes to water quality or aquatic vegetation because the lake is slated to be delisted in 2024. The Commission will rely primarily on CAMP and City monitoring. Commission intensive monitoring is planned for 2030.

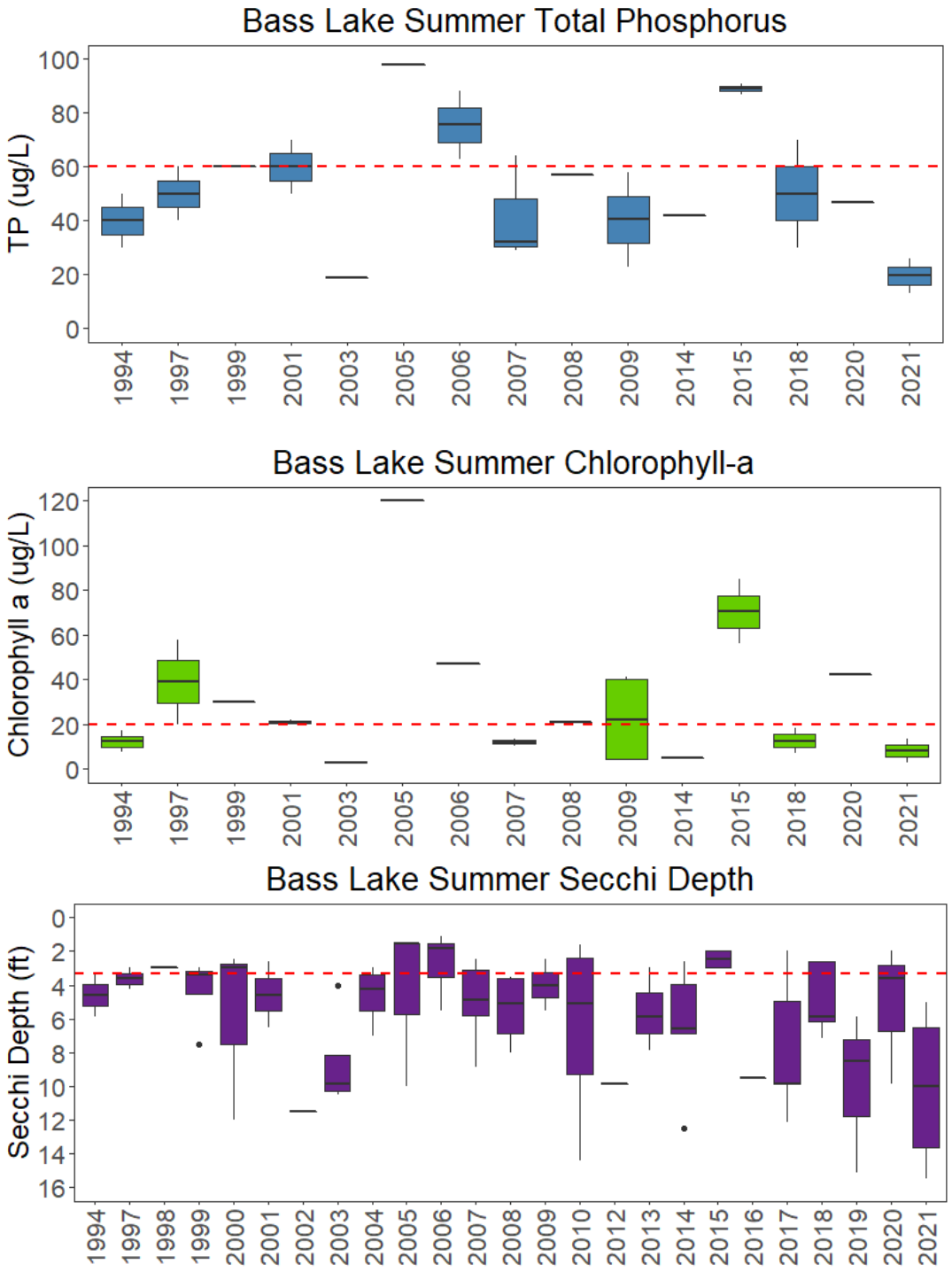


Figure E-8. Boxplots of recent growing season water quality data in Bass Lake with the shallow lake standard for this ecoregion shown as a red horizontal line.

E.4 TWIN & RYAN IMPLEMENTATION PLAN

The Twin Lake chain of lakes – Upper, Middle, and Lower and Ryan Lake – is a regional water resource located in the cities of Brooklyn Center, Crystal, Minneapolis, and Robbinsdale. The lakes are highly used recreational water bodies that support fishing and swimming as well as provide aesthetic values. The drainage area to the lake chain is 5,550 acres of fully developed urban and suburban land. Single family residences make up about half the land area in the watershed. CSAH 81 Bottineau Boulevard bisects the watershed roughly north-south, and there is a large commercial and industrial core in the watershed between West Broadway and CSAH 81, centered on Bass Lake Road in the city of Crystal. The watershed extends nearly to TH 169 to the west. The Metropolitan Airports Commission operates the Crystal Airport, which is a reliever airport serving small private planes and helicopters.

Table E-7. Characteristics of Upper Twin, Middle Twin, Lower Twin, and Ryan Lakes.

Lake	Area (acres)	Depth Class	Impairment status
Upper Twin	118	shallow	Impaired
Middle Twin	54	deep	Impaired
Lower Twin	30	shallow	delisted
Ryan	15	deep	delisted

The subwatershed is comprised of four catchment areas that extend from west to east. A northerly tier of subcatchments flows through storm sewer and by Twin Creek to Upper Twin Lake, as does a subcatchment to its south by a trunk storm sewer on Bass Lake Road. A tier of subcatchments flows through storm sewer to Middle Twin Lake. A southerly tier of subcatchments flows through storm sewer and a series of ponds to Lower Twin Lake. Lower Twin Lake outlets by a channel (Ryan Creek) to Ryan Lake, which outlets by storm sewer and Ryan Creek to Shingle Creek.

All four lakes were listed as Impaired Waters, and a TMDL and Implementation Plan were completed and approved in 2007. Upper Twin is very shallow and hypereutrophic, with frequent algae blooms and occasional winter fish kills. Middle Twin is deeper, and its water quality is degraded by the excess nutrient load in outflow from Upper Twin into Middle Twin. Lower Twin Lake water quality has improved significantly in the last decade and was delisted in 2014. Ryan Lake is the last lake in the chain. A weir at France Avenue on Ryan Creek between Lower Twin and Ryan Lake controls outflow and carp migration from Twin Lake to Ryan Lake. Water quality in Ryan has improved since the 1970s, and like Lower Twin, was delisted in 2014 from the 303(d) list.

The TMDL concluded that nutrient load reductions of 73, 9, 43, and 19 percent for Upper, Middle, Lower, and Ryan Lakes respectively would be required to consistently meet standards under average precipitation conditions. Several specific projects were identified in the TMDL Implementation Plan, many of which have been completed. Several actions have been taken to manage internal load in the system. A rough fish assessment completed in 2016 and 2017 found excessive populations of carp. In January 2018 a commercial fisherman removed 10,600 pounds of carp from the lake and 15,000 pounds of bullhead. The March 2019 commercial removal was unsuccessful when the fish migrated overnight, but during spring 2019 spawning over 1,900 pounds were removed from Ryan Creek and Upper Twin Lake. Even with those removals the population of carp in the lake system remains above the carrying capacity,. And continues to negatively impact water quality. In 2019 a fish barrier was added to the Lower Twin Lake outlet control weir at France Avenue to prevent migration from Shingle Creek and Ryan Lake into the Twin Lake system.

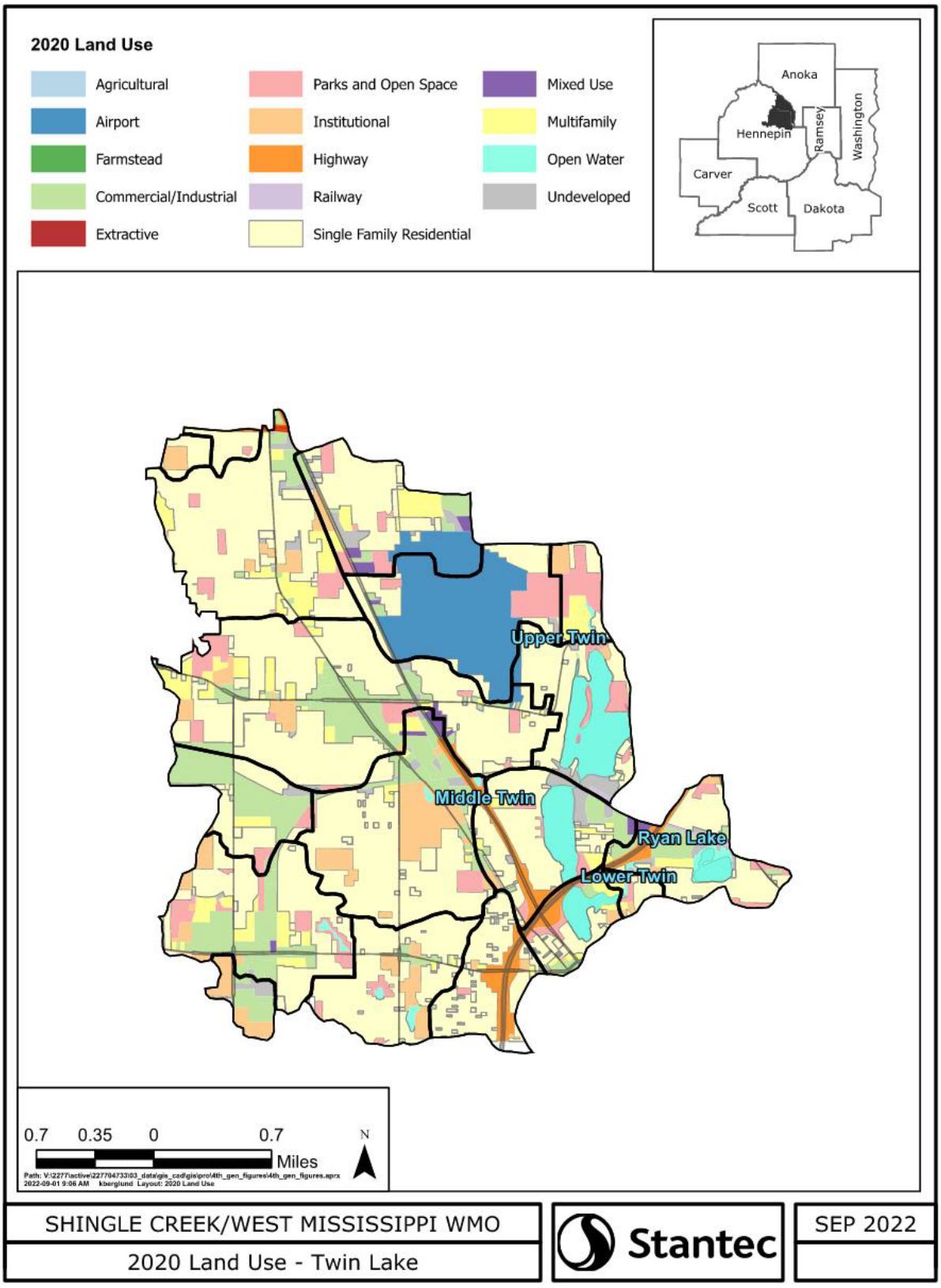


Figure E-9. Upper, Middle, and Lower Twin and Ryan Lakes subwatershed 2020 land use.

Table E-8. Implementation plan for Twin and Ryan Lakes.

Action	Location	Plan Year										Estimated Cost
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Watershed Activities												
Wetland 639W Weir Wall Enhancement	Upper Twin			x								$100,000
Modify France Ave Fish Barrier	Lower Twin/Ryan	x									x	$28,000
In-Lake Activities												
Internal load project	Upper Twin						x					$200,000
Carp management	Twin Lakes	x	x			x		x		x		$135,000
Aquatic vegetation management	Twin Lakes						x					$15,000
Monitoring												
Monitoring	Upper Twin	X		X		C		X		C		--
	Middle Twin	X		X		C		X		C		--
	Lower Twin	C		C		C		C		C		--
	Ryan	C			X				C			--

[1]X denotes Commission monitoring, C denotes CAMP monitoring, and Ci denotes City monitoring

E.4.1 Upper Twin Lake

Upper Twin Lake is hypereutrophic and has poor water quality (Figure E-10). The lake has a curly-leaf pondweed population that has been treated with herbicide by the Commission in 2018 and 2020 but appears to be robust and will require further treatment.

Priority Concerns:

- High internal load
- Winter fish kills
- Roughfish population (carp and black bullheads)
- Curly-leaf pondweed

10-Year Plan Activities:

- Upstream load reduction project (639W Wetland weir enhancement)
- Continued carp and vegetation management
- Internal load treatment project
- Monitor changes to water quality, SAV, fish

Monitoring Plan

- The Commission has planned several load reduction and improvement projects in the next 10 years, thus Commission intensive monitoring will be centered around informing projects and tracking project success. CAMP monitoring will be relied on to track water quality in years when the Commission is not monitoring.

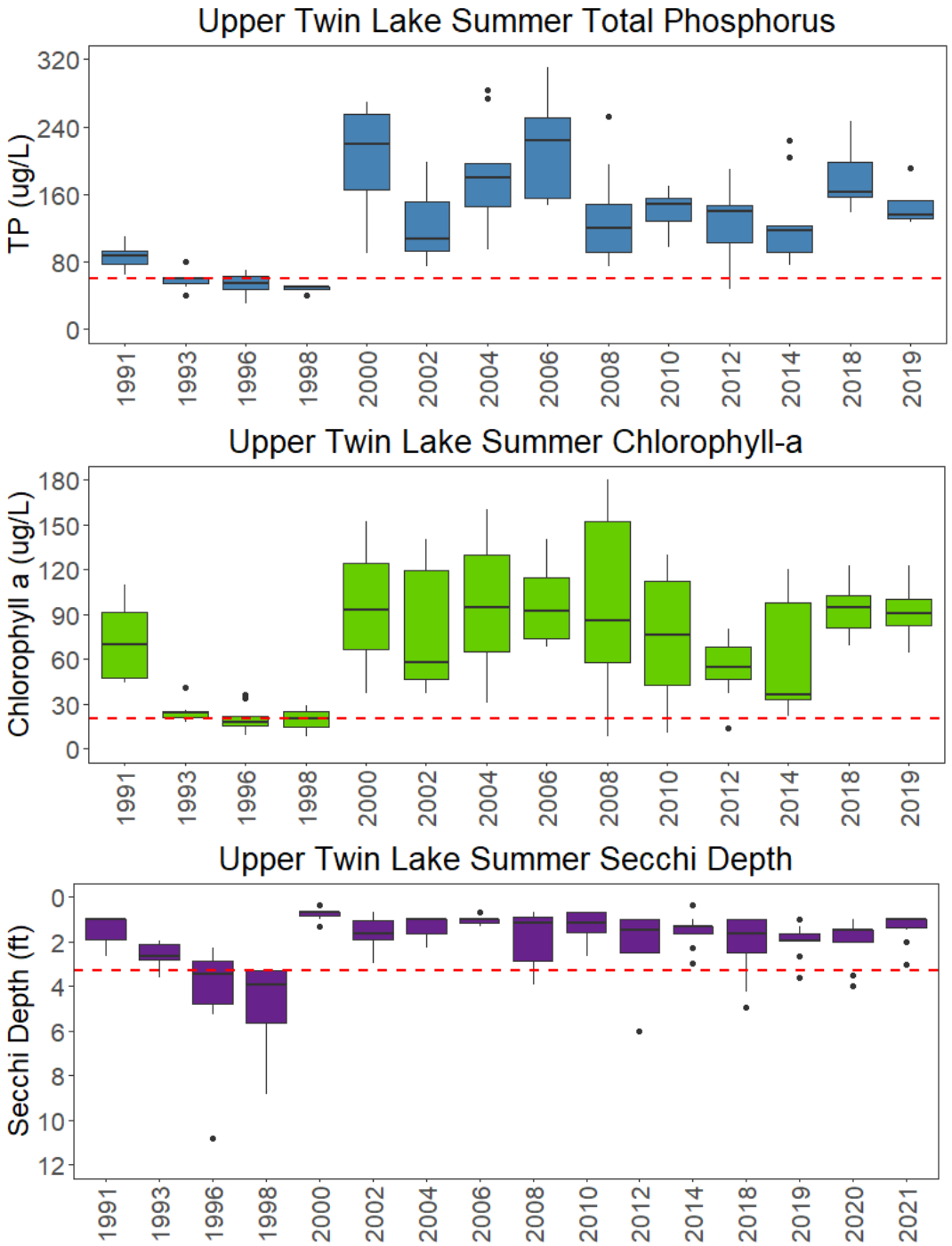


Figure E-10. Boxplots of recent growing season water quality data for Upper Twin Lake with the shallow lake standard for this ecoregion shown as a red horizontal line.

E.4.2 Middle Twin Lake

Middle Twin Lake water quality is influenced by Upper Twin's degraded water quality. TP, chl-a, and Secchi depth often do not meet standards (Figure E-11). Curly leaf pondweed is present in the lake.

Priority Concerns:

- Upstream contributions from Upper Twin
- Winter fish kills
- Roughfish population (carp and black bullheads)
- Curly-leaf pondweed

10-Year Plan Activities:

- Continued carp and vegetation management
- Monitor changes to water quality, SAV, fish

Monitoring Plan

- The Commission has planned several load reduction and improvement projects in the next 10 years, thus Commission routine monitoring will be centered around informing projects and tracking project success. CAMP monitoring will be relied on to track changes in years when the Commission is not monitoring.

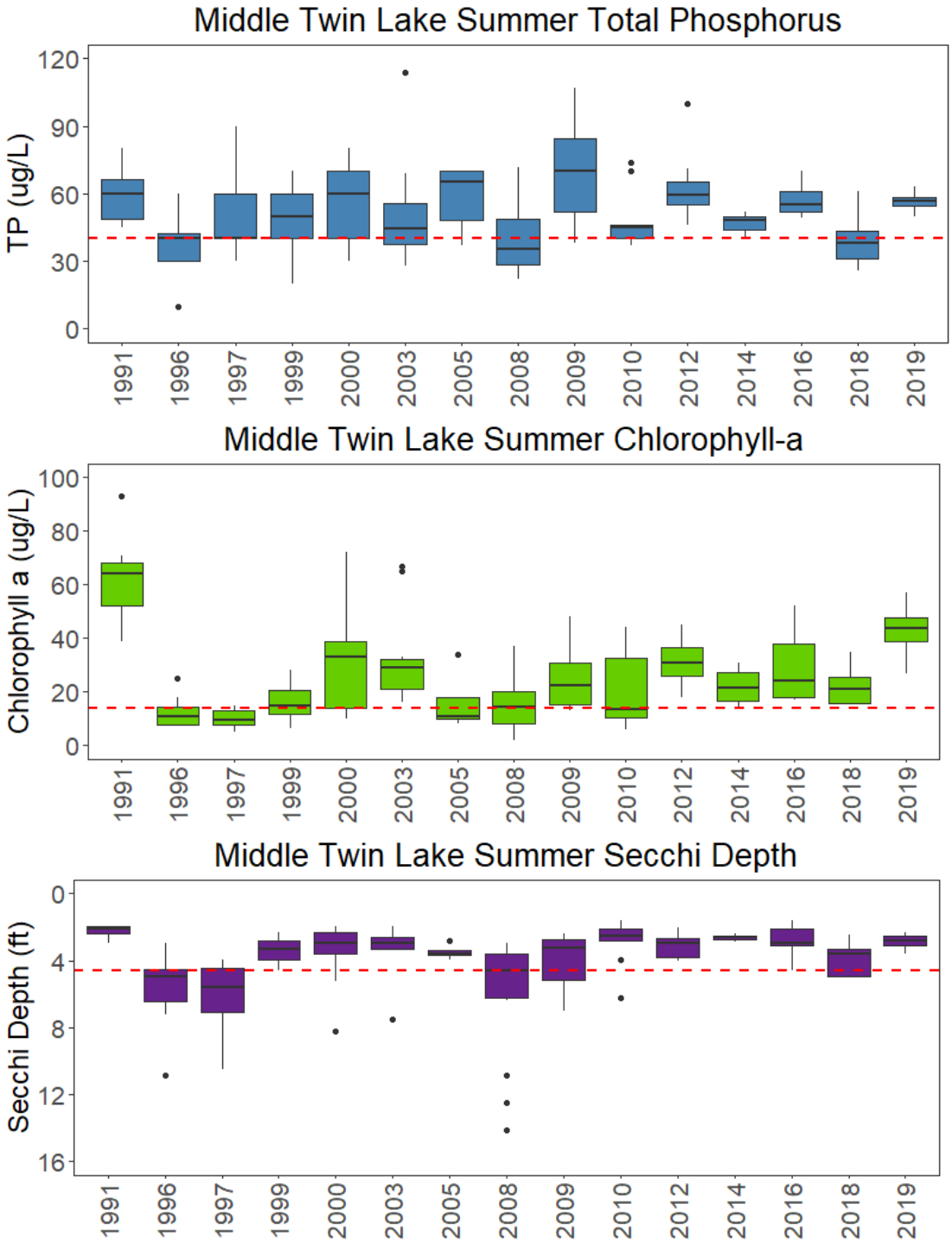


Figure E-11. Boxplots of recent growing season water quality data for Middle Twin Lake with the deep lake standard for this ecoregion shown as a red horizontal line.

E.4.3 Lower Twin Lake

Lower Twin's water quality has remained good since its delisting in 2014. There are summer algae blooms but water clarify and TP concentrations meet standards (Figure E-12). A carp barrier was installed at the weir on Ryan Creek between Lower Twin and Ryan Lake to prevent carp movement between the two lakes for spawning and migration. The barrier requires modification as it collects debris during storm events and slows passage of water.

Priority Concerns:

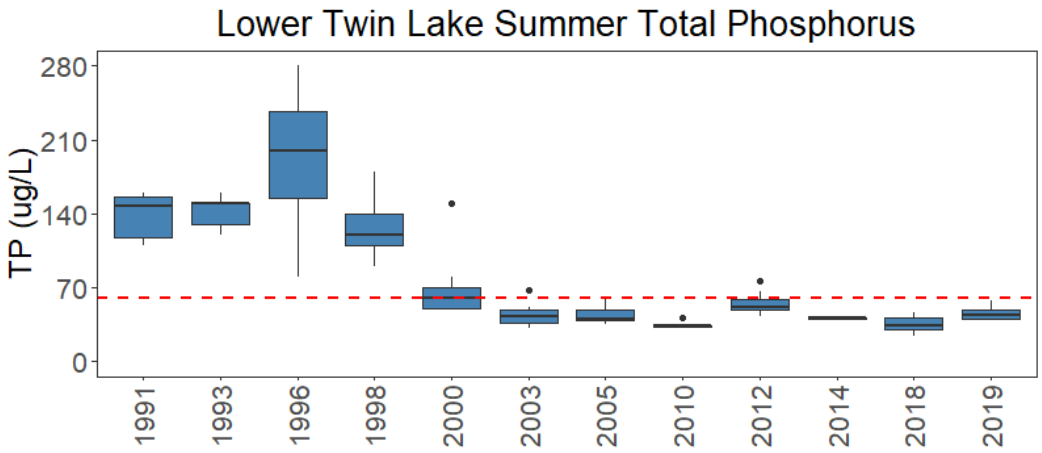
- Pollutant loading from Upper Twin
- Roughfish population (carp and black bullheads)
- Curly-leaf pondweed

10-Year Plan Activities:

- Monitor changes to water quality

Monitoring Plan

- The activities over the next 10 years in this subwatershed are primarily planned for Upper Twin. CAMP monitoring will be the primary method of tracking changes to Lower Twin Lake because the lake is delisted.



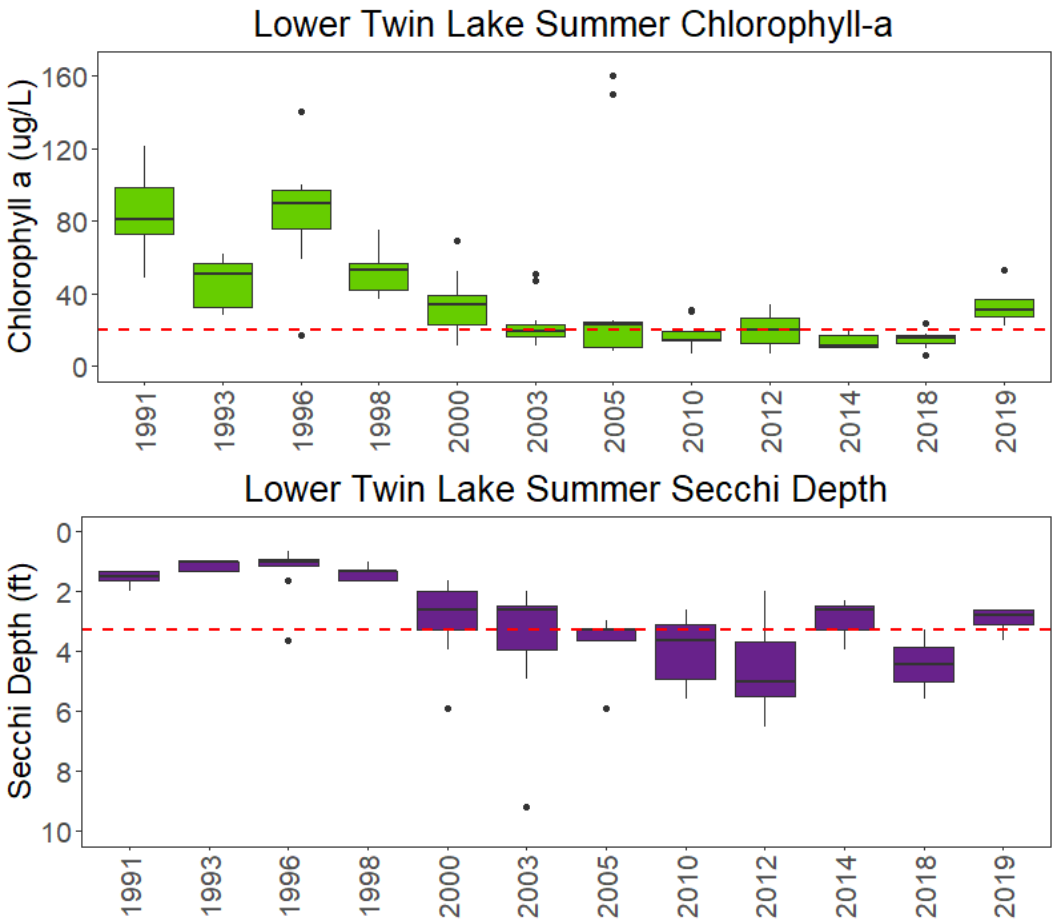


Figure E-12. Boxplots of recent growing season water quality data for Lower Twin Lake with the deep lake standard for this ecoregion shown as a red horizontal line.

E.4.4 Ryan Lake

Ryan Lake's water quality is not consistently meeting State standards, but the lake is delisted for impairments (Figure E-13). Though algae blooms are common later in the summer, the lake typically has high water clarity. The vegetation community is dominated by coontail. Curly-leaf pondweed is present in the lake but its abundance is controlled. Winter fish kills are common in Ryan Lake. Carp are present and the lake may provide spawning habitat for carp in Twin Lakes, a motivator for installing the carp barrier in Ryan Creek near France Ave between Lower Twin and Ryan Lake.

Priority Concerns:

- Maintain delisted status
- Roughfish population (Common carp) and movement between Ryan Lake and Lower Twin Lake
- Limited diversity vegetation community

10-Year Plan Activities:

- Modifying the carp barrier on Ryan Creek between Lower Twin and Ryan Lakes
- Monitor changes to water quality, SAV, and fish

Monitoring Plan

- The activities over the next 10 years in this subwatershed are primarily planned for Upper Twin. CAMP monitoring will be the primary method of tracking changes to Ryan Lake because the lake is delisted; however, the Commission will intensively monitor once to evaluate the lake health.

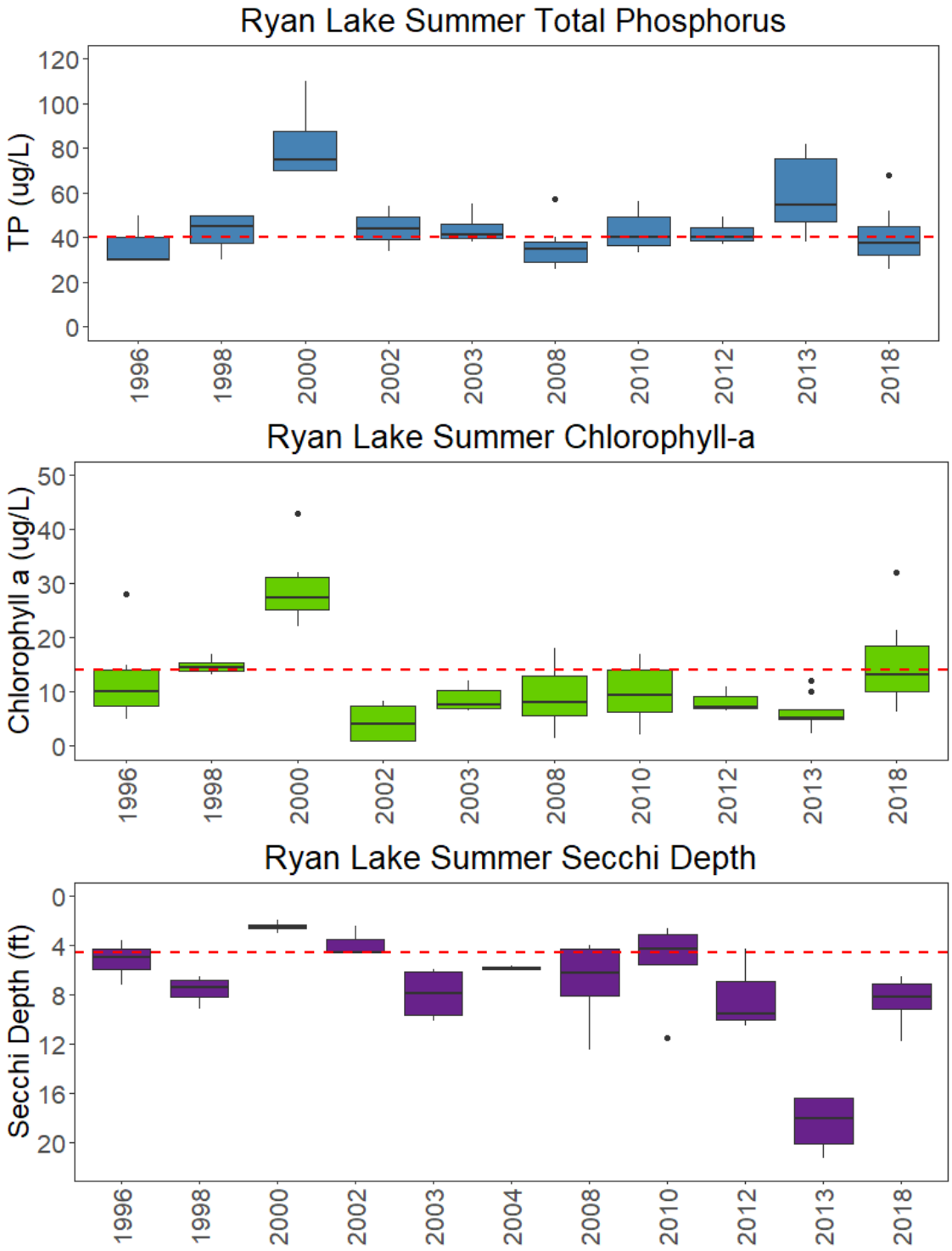


Figure E-13. Boxplots of recent growing season water quality data for Ryan Lake with the deep lake standard for this ecoregion shown as a red horizontal line.

E.5 CRYSTAL LAKE IMPLEMENTATION PLAN

Crystal Lake is located in the City of Robbinsdale, and the subwatershed includes portions of Robbinsdale and Minneapolis. Crystal Lake has no natural outlet. A lift station on the north side of the lake is used to pump outflow from the lake when it reaches a specified elevation. Drainage from Minneapolis is collected in a trunk storm sewer that discharges into Crystal Lake at 38th Avenue North. Much of the drainage area in Minneapolis has been designated by the City as "Flood Area 5." Several locations in that area experience frequent street flooding due to undersized storm sewers, and the City has an ongoing plan to upgrade the drainage system and add flood storage and water quality treatment.

The subwatershed to Crystal Lake is primarily single family residential housing (Figure E-14). Two large parks abut the lake, and a portion of Victory Memorial Drive, which is part of the Minneapolis Grand Rounds system of parkways drains to the lake. CSAH 81 Bottineau Boulevard abuts the lake on the west side. The commercial core of Robbinsdale, including several large shopping centers as well as some of the North Memorial Hospital/Clinics campus is located within the subwatershed.

Table E-9. Characteristics of Crystal Lake.

Lake	Area (acres)	Depth Class	Impairment Status
Crystal	89	deep	Impaired

Crystal Lake is an Impaired Water, and a TMDL and Implementation Plan were completed and approved in 2009. The TMDL concluded that a nutrient load reduction of 72 percent would be required to consistently meet standards under average precipitation conditions.

The City of Robbinsdale has installed a number of BMPs in the lakeshed with street improvement projects, and Hennepin County installed BMPs to treat runoff from CSAH 81 Bottineau Boulevard when that highway was reconstructed. In 2011 Robbinsdale constructed a hypolimnetic withdrawal system to treat surface and lake bottom water, which is then routed through constructed wetlands before returning to the lake. The City of Minneapolis incorporated biofiltration into a flood control project on the 37th Avenue Greenway in phase 1 of ongoing Flood Area 5 improvements. An intensive assessment to site small BMPs such as rain gardens has been completed for the Robbinsdale part of the lakeshed. In 2021 and 2022 the lake received two doses of alum treatments and underwent carp removals via box netting that removed thousands of carp from the lake.

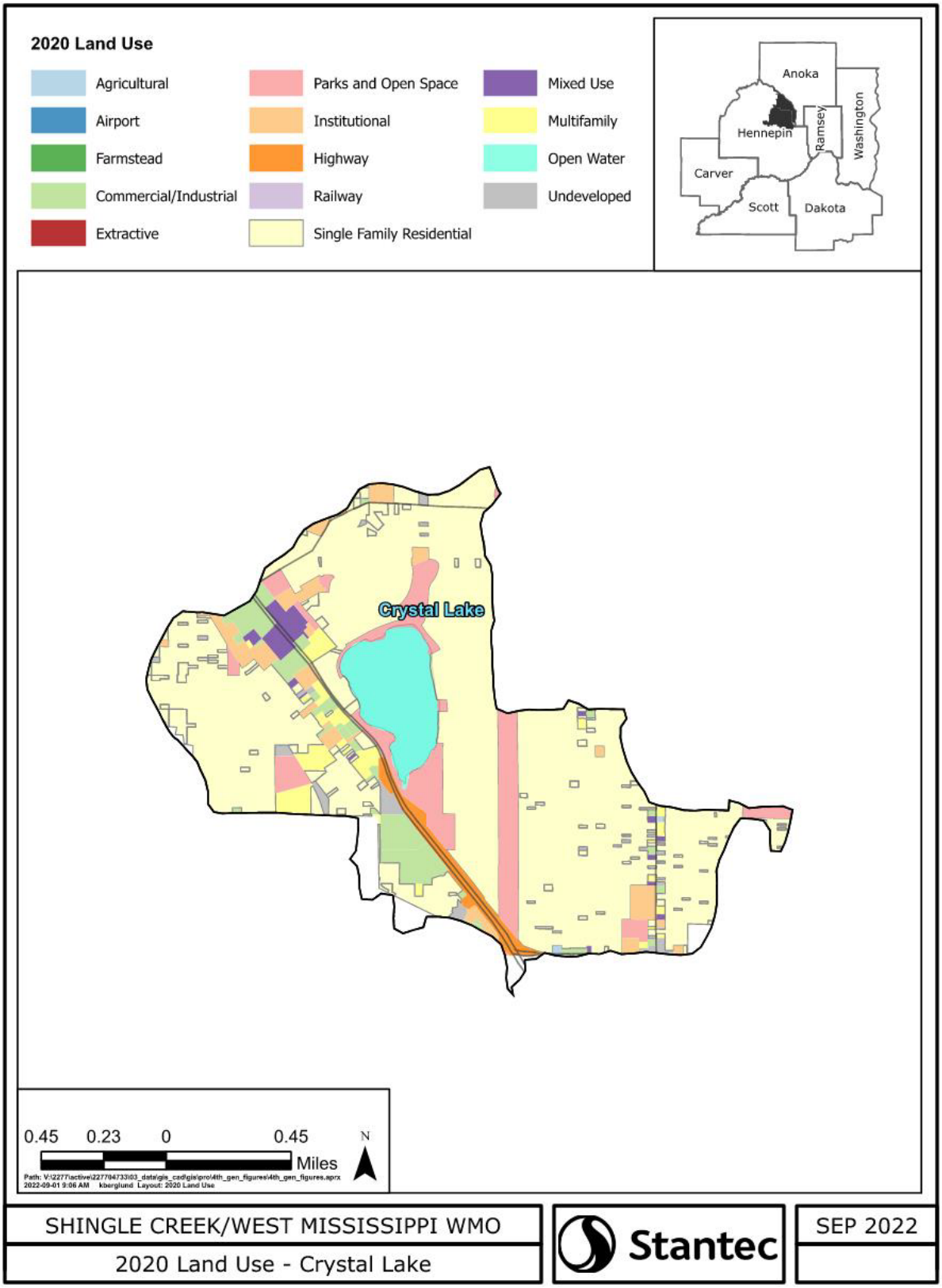


Figure E-14. Crystal Lake subwatershed 2020 land use.

Table E-10. Implementation plan for Crystal Lake.

Action	Location	Plan Year										Estimated Cost
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Watershed Activities												
In-Lake Activities												
Carp management	Crystal Lake			x		x		x	x			$100,000
Aquatic vegetation management	Crystal Lake			x	x	x			x	x		$50,000
Monitoring												
Monitoring	Crystal Lake	Ci				X				X	C	--

[1]X denotes Commission monitoring, C denotes CAMP monitoring, and Ci denotes City monitoring

Crystal Lake has poor water quality, with low water clarity and frequent algae blooms (Figure E-15). The lake has an extremely limited vegetation community, with only water lily and curly-leaf pondweed found during vegetation surveys in recent years. Algae blooms often occur earlier in the season than other Metro Area lakes and persist throughout the season. The Commission has observed harmful algae blooms (cyanobacteria) in the lake that prevent safe use by the community. Active management in 2021 and 2022 is expected to reduce internal nutrient loading in the lake through removal of carp and two alum treatments.

Priority Concerns:

- Harmful algae blooms (HABs)
- Roughfish population (Common carp)
- Limited diversity vegetation community

10-Year Plan Activities:

- Carp management: the carp population in Crystal will likely require additional removals
- Vegetation management: following alum treatments and carp removals, water clarity is expected to improve and may stimulate the curly-leaf pondweed population

Monitoring Plan

- Intensively monitor on a routine basis to track changes to water quality, SAV, and the fish community. City and CAMP monitoring will supplement Commission intensive monitoring.

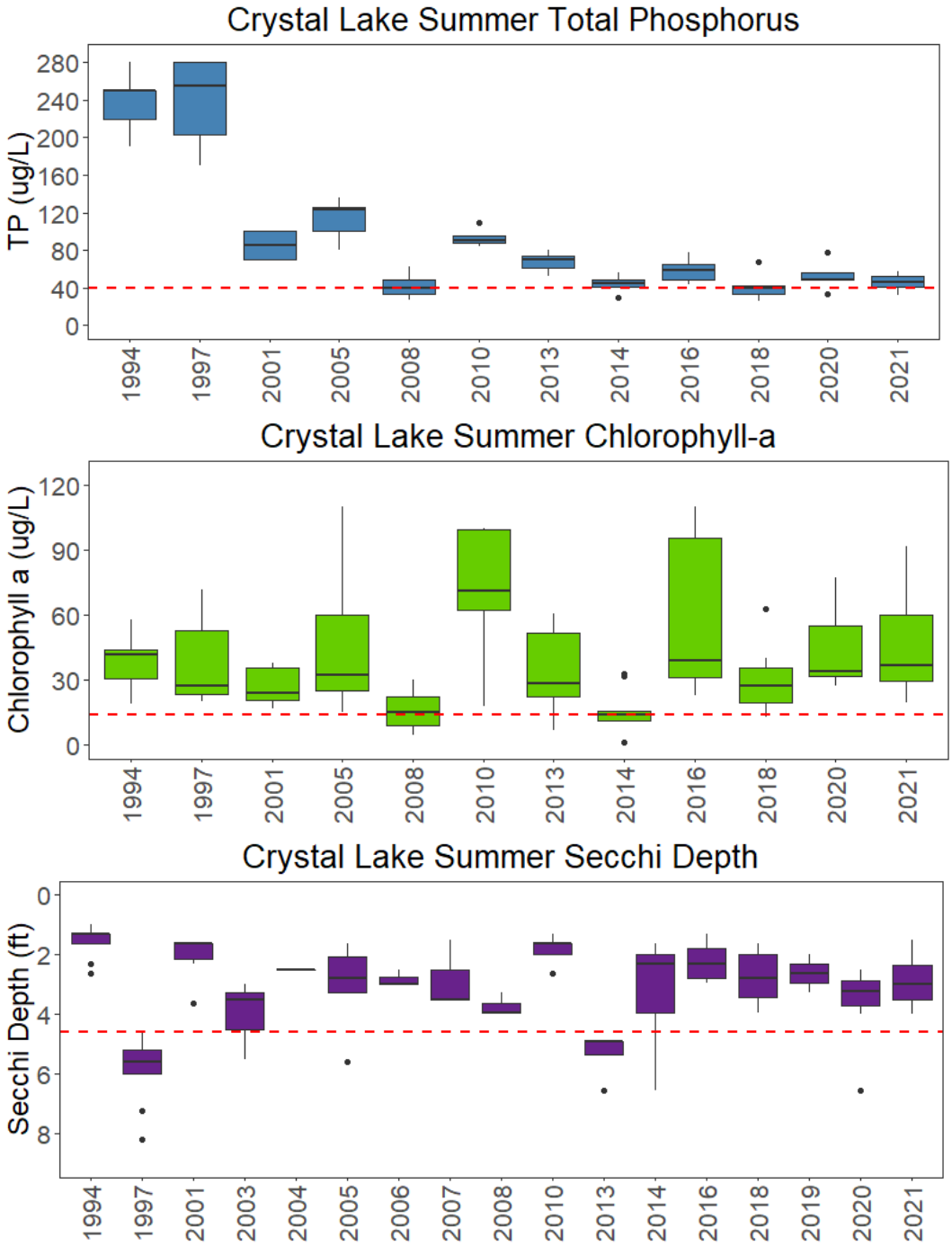


Figure E-15. Boxplots of recent growing season water quality data for Crystal Lake with the deep lake standard for this ecoregion shown as a red horizontal line.

E.6 MEADOW, MAGDA, & SUCCESS LAKES IMPLEMENTATION PLAN

Meadow, Magda, and Success Lakes are all small lakes with small drainage areas in the Shingle Creek Watershed. The lakes are not connected or in the same subwatershed but are presented here together. Meadow and Magda Lakes are both impaired for nutrients, and Lake Success has not been assessed due to insufficient water quality data.

Table E-11. Characteristics of Magda, Meadow, and Success Lakes.

Lake	Area (acres)	Depth Class	Impairment Status
Meadow Lake	12	wetland	impaired
Magda	10	shallow	Impaired
Success	8	shallow	Not assessed

Table E-12. Implementation plan for Meadow, Magda, and Success Lakes.

Action	Location	Plan Year										Estimated Cost
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Watershed Activities												
Subwatershed Study	Magda Lake									x		$30,000
In-Lake Activities												
Aquatic vegetation management	Meadow, Magda, Success			x			x					$35,000
Monitoring												
Monitoring	Meadow Lake	C				X					X	--
	Magda Lake				X					X	C	--
	Lake Success			C			C				C	--

[1]x denotes Commission monitoring, C denotes CAMP monitoring, and Ci denotes City monitoring

E.6.1 Meadow Lake

Meadow Lake is a small, shallow lake with a small, fully developed suburban subwatershed located in New Hope. The subwatershed is comprised mainly of single-family residential properties (Figure E-16). Meadow Lake School is located in the north part of the subwatershed. A small park adjacent to the lake and an overflow pond on the New Hope Golf Course also discharge to the lake.

Meadow Lake is an Impaired Water, and a TMDL and Implementation Plan were completed and approved in 2010. This very shallow lake (the mean depth is 1.5 feet) is hypereutrophic (Figure E-17), with poor clarity and frequent dense algae blooms.

There is a limited fish community in Meadow Lake, with an abundant population of fathead minnows, which thrive in turbid ponds and streams. A 2007 aquatic vegetation survey found the lake was about 90% vegetated with dense submergent vegetation growing almost to the surface over most of the lake. The vegetation was almost entirely leafy pondweed and flatstem pondweed with some coontail and water celery. Meadow Lake has in the past been invaded with nuisance levels of filamentous waternet and curly-leaf pondweed.

The TMDL concluded that a nutrient load reduction of 82 percent would be required to consistently meet state water quality standards under average precipitation conditions, and that internal load management and reduction of nonpoint sources of phosphorus in the watershed by retrofitting Best Management

Practices (BMPs) would have the most impact on reducing phosphorus load and improving water quality in Meadow Lake.

In 2006 the City of New Hope reconstructed streets in the subwatershed, and included a number of BMPs to increase water quality treatment, including grit chambers and a large boulevard rain garden. The City also performed a partial drawdown to remove sediment deltas accumulated at the storm sewer outfalls. Residents report some reduction in nuisance aquatic vegetation following the drawdown. An active lake association is promoting additional BMPs in the subwatershed as well as restoration of lakeshore. The Commission performed a full lake drawdown in Winter 2022-2023 under a Clean Water Fund grant. Management will continue into 2023 with vegetation management and possible internal load management.

Priority Concerns:

- Invasive aquatic vegetation (curly-leaf pondweed)
- High internal load
- Roughfish population (fathead minnows)

10-Year Plan Activities:

- Vegetation management: following the drawdown, water clarity is expected to improve and may stimulate the curly-leaf pondweed population
- Monitor changes to water quality, SAV, and fish communities

Monitoring Plan

- The Commission will intensively monitor Meadow Lake twice during the next 10 years to assess project success and future management. CAMP monitoring will supplement.

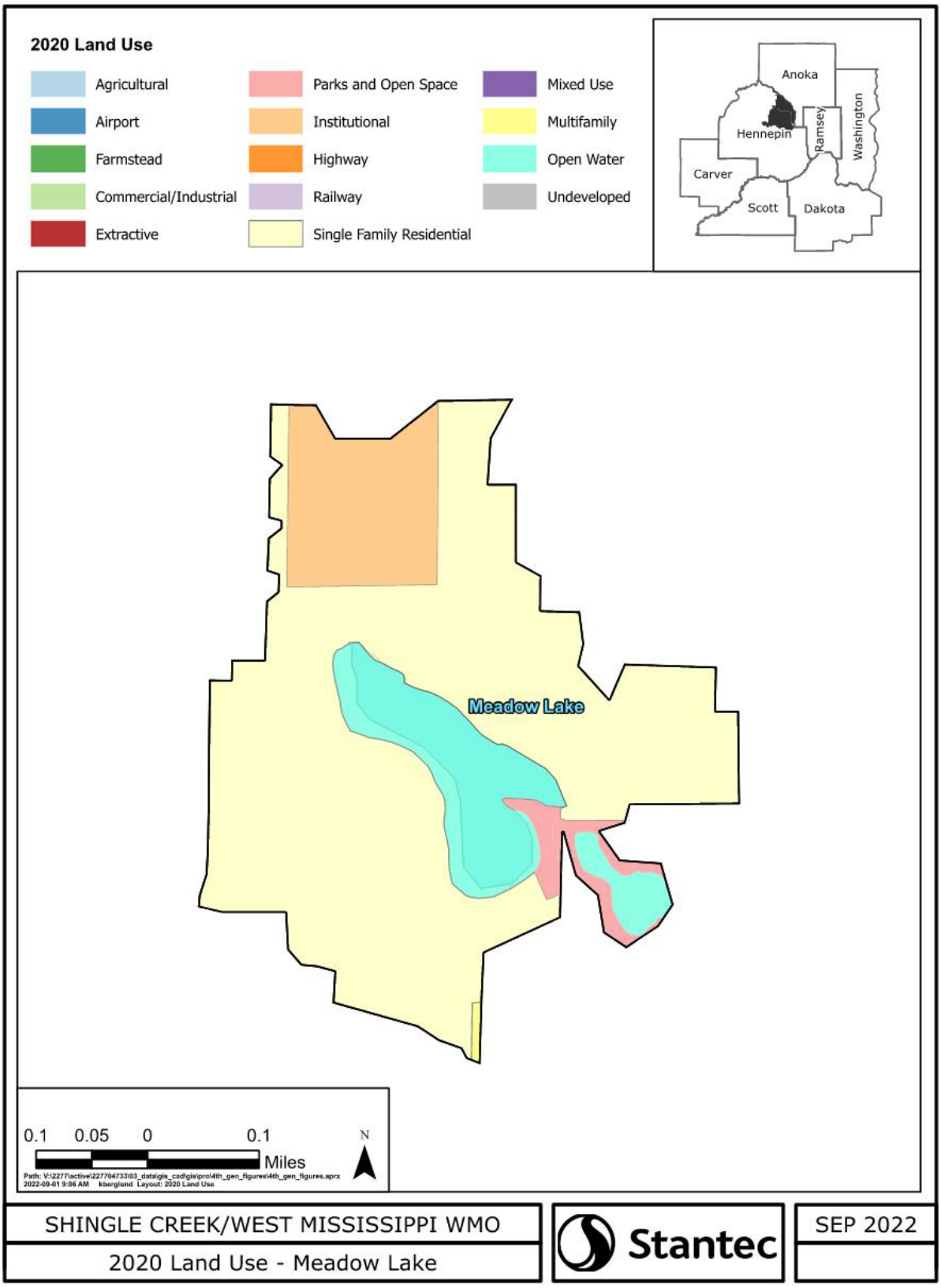


Figure E-16. Meadow Lake subwatershed 2020 land use.

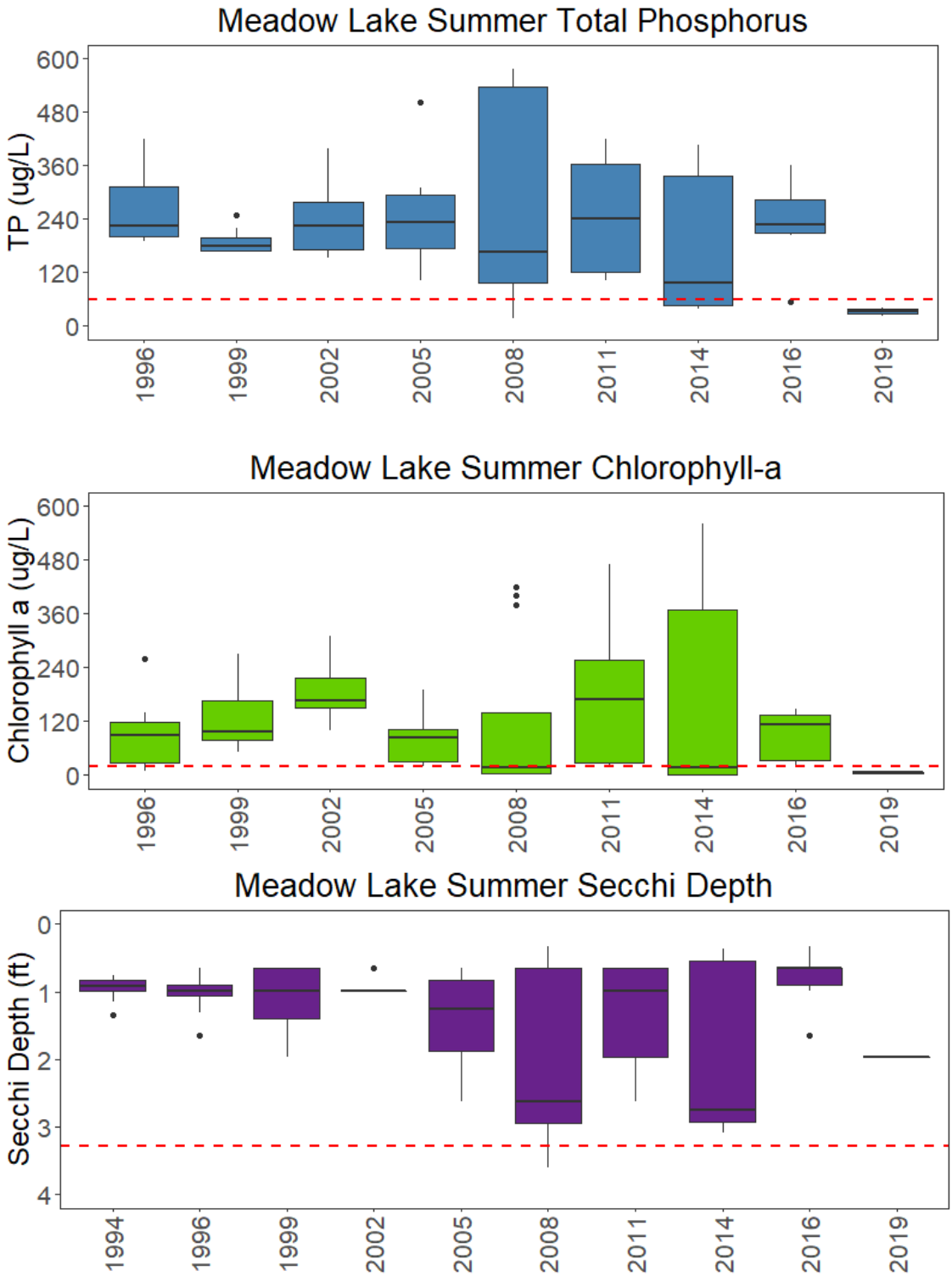


Figure E-17. Boxplots of recent growing season water quality data for Meadow Lake with the shallow lake standard for this ecoregion shown as a red horizontal line.

E.6.2 Lake Magda

Lake Magda is a small lake in a fully developed suburban residential watershed, with a state trunk highway abutting the lake on the west. The subwatershed is comprised mainly of single family residential properties (Figure E-18). Highway and right of way are the next largest land use. A small park and wetland abut the lake to the north.

Runoff from the neighborhood to the north is conveyed by storm sewer to the lake. Lake Magda outlets through a culvert under TH 169 into a wetland on the west side of the highway, then through storm sewer north to Eagle Creek. Eagle Creek joins with Bass Creek to form Shingle Creek.

Lake Magda is an Impaired Water, and a TMDL and Implementation Plan were completed and approved in 2010. This shallow lake is hypereutrophic (Figure E-19). Residents report a significant population of carp is present. In 2022, the Commission completed a fish survey on Magda. Black bullhead and fathead minnow were the only species observed. In 2017 and 2022 the Commission completed SAV surveys and observed curly-leaf pondweed, sago pondweed, elodea, coontail, and chara.

The TMDL concluded that a nutrient load reduction of 69 percent would be required to consistently meet standards under average precipitation conditions and that internal load management and reduction of nonpoint sources of phosphorus in the watershed by retrofitting BMPs would have the most impact on reducing phosphorus load and improving water quality. Because the watershed to this lake is very small, retrofit opportunities may be limited.

Priority Concerns:

- Poor water quality (stormwater inputs)
- Rough fish population (primarily black bullheads)

10-Year Plan Activities:

- Complete a subwatershed study to identify potential BMP project areas within the watershed or lake
- Monitor changes to water quality

Monitoring Plan

- The Commission will intensively monitor Lake Magda twice in the next 10 years, once to support the development of a subwatershed study in 2031.

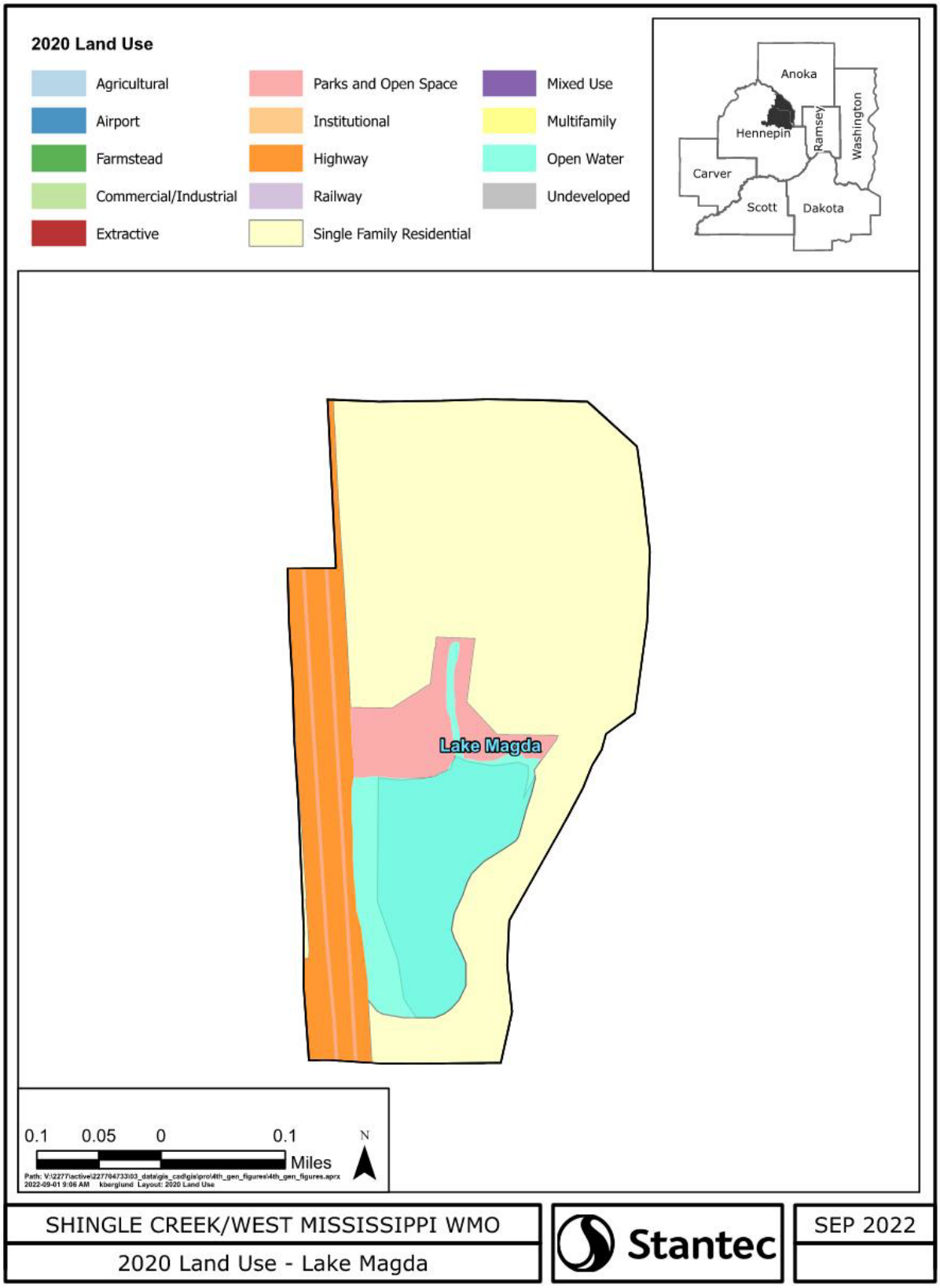


Figure E-18. Magda Lake subwatershed 2020 land use.

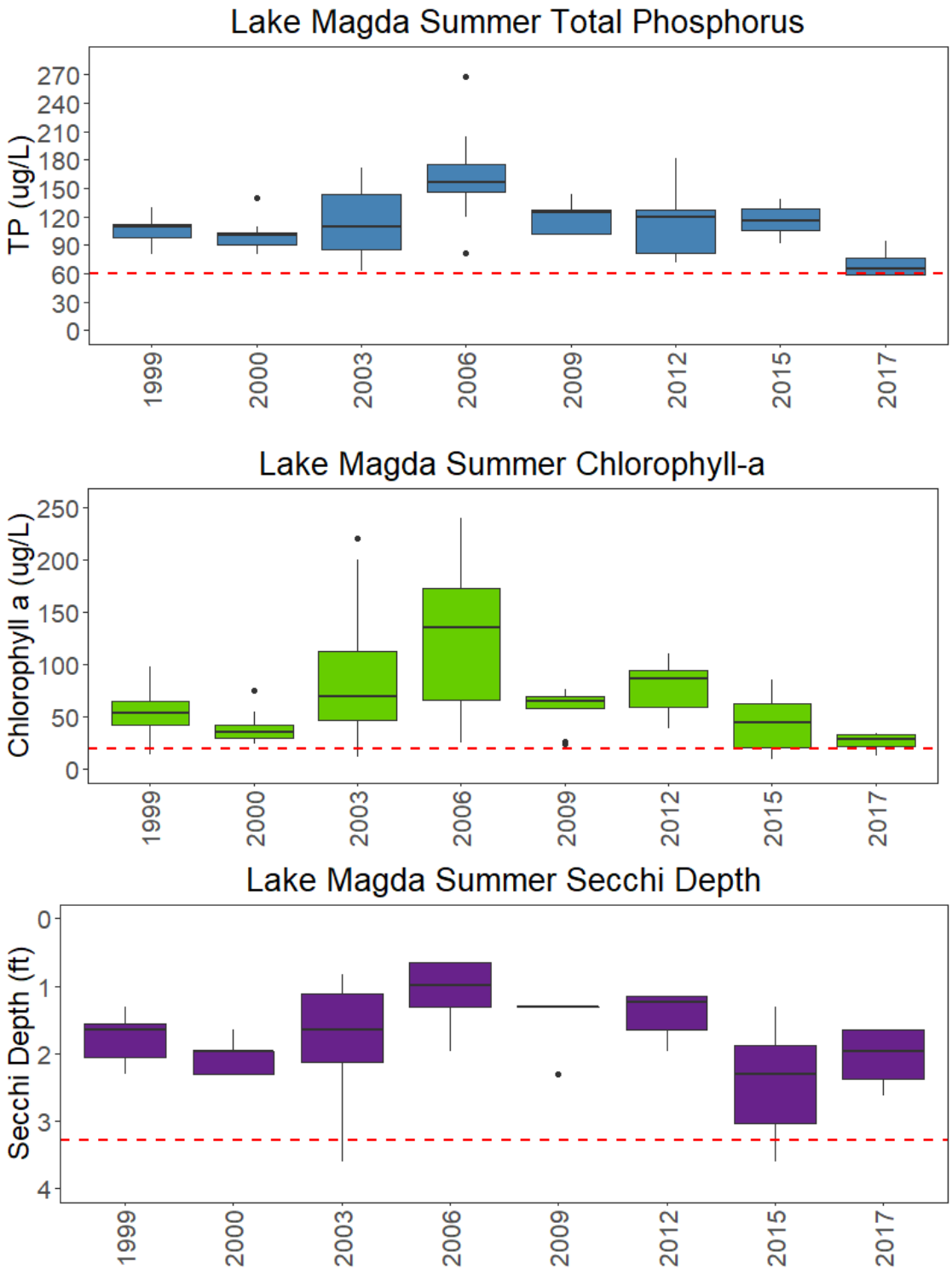


Figure E-19. Boxplots of growing season water quality data in Magda Lake shallow .

E.6.3 Lake Success

Lake Success is a small lake in Brooklyn Park. Residents report that it was originally a wetland and a small gravel borrow pit. The lake was created when the gravel mine operator hit a spring or broke through to groundwater, creating a permanent pool. The small subwatershed is primarily residential, with some commercial and industrial properties along 85th Avenue North (Figure E-20).

Lake Success has a very small watershed, and runoff is collected in storm sewers and discharged into the lake. The lake outlets south into storm sewer. Over the last several years lake levels have fallen, although since precipitation recently has been above normal the levels have risen. There is some suspicion that groundwater input to the lake has declined, and the lake is now more dependent on runoff to sustain its normal water level. Lake levels from 2013 to 2022 have ranged from about 841.5 feet to 848.5 feet. A staff gauge has been installed and lake level is now being read more frequently. The City of Brooklyn Park is working with residents and the DNR to see if lake levels may be affected by groundwater appropriations from the city's wells.

Historically Lake Success has had very good, clear water, although that has changed significantly recently, and residents report more aquatic vegetation and algae blooms (Figure E-21). This shallow lake may have "flipped" from a clear-water state to a turbid-water state, although more data are necessary to determine if that is the case and cause(s).

Priority Concerns:

- Fluctuating lake water levels
- Declining water quality

10-Year Plan Activities:

- Monitor changes to water quality

Monitoring Plan

- Monitoring will rely on CAMP volunteers, but the Commission will intensively monitor if changes are detected.

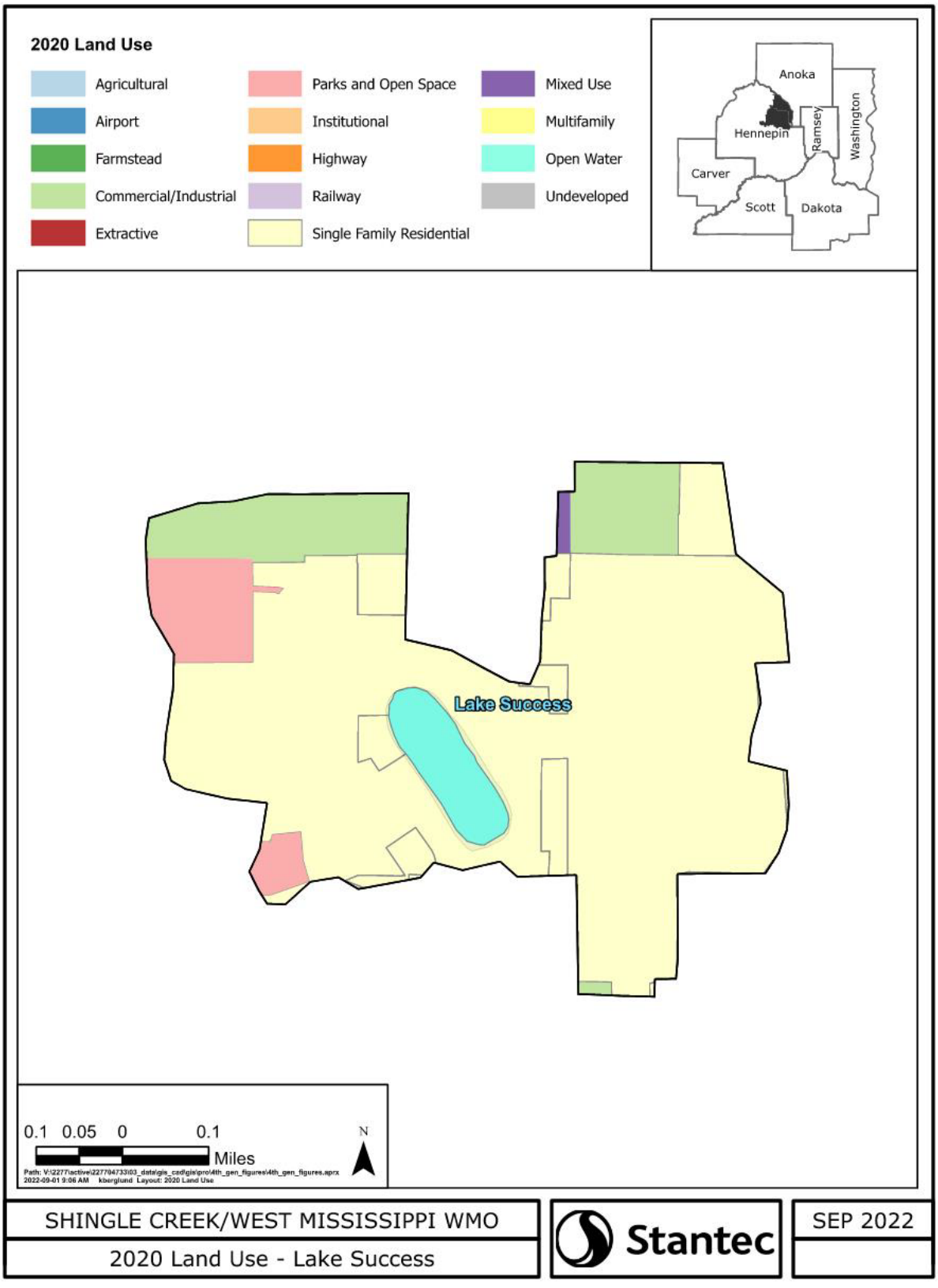


Figure E-20. Lake Success subwatershed 2020 land use.

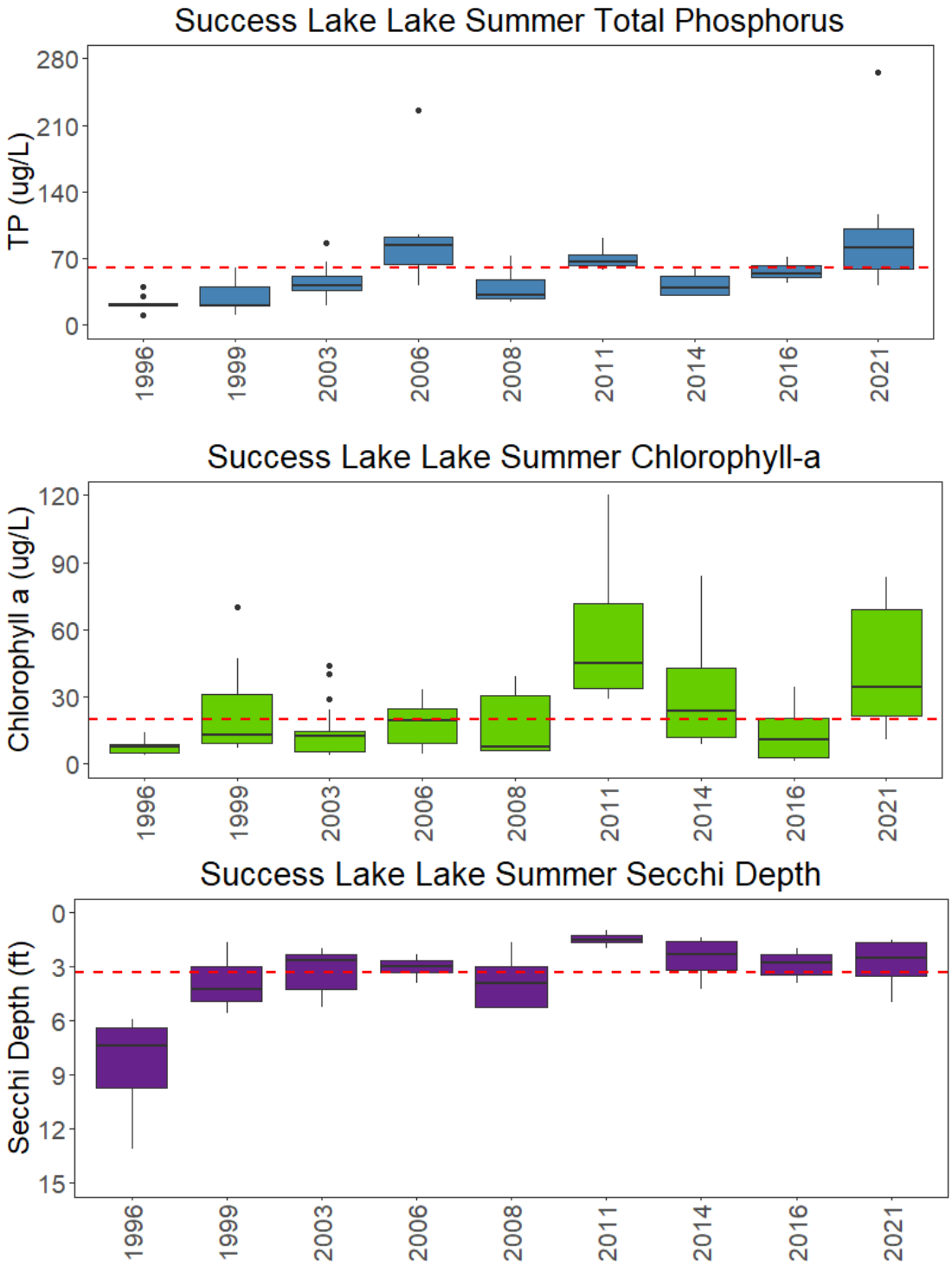


Figure E-21. Boxplots of recent growing season water quality data for Lake Success with the shallow lake standard for this ecoregion shown as a red horizontal line..

E.7 SHINGLE & BASS CREEKS IMPLEMENTATION PLAN

Bass Creek extends 2.4 miles from a wetland complex downstream of Bass Lake to its confluence with Shingle Creek; Shingle Creek then runs 11.2 miles to its confluence with the Mississippi.
There are some other small streams in the watershed conveying drainage to various lakes, including Upper Bass Creek, Pike Creek, and Twin Creek. Eagle Creek and Ryan Creek via short channels that outlet their namesake lakes to Shingle Creek. While the entire 28,682 acre Shingle Creek watershed drains to Shingle Creek or its tributaries including Bass Creek, about 15,266 acres, or about 53 percent, drain directly to Shingle Creek, and not first to a lake system. The lower Direct Watershed is primarily in single family residential use, with commercial and industrial areas, including the commercial Arbor Lakes area and the Gravel Mining Area concentrated in the upper part of the Direct Watershed (Figure E-22). Both Shingle and Bass Creeks are designated as Impaired Waters for excess chloride and *E. coli* bacteria concentrations, low dissolved oxygen (DO), and impaired fish and macroinvertebrate communities. The biotic communities are also stressed by the lack of quality stream habitat in the disturbed streams, and by highly variable stream flows. The Biotic TMDL identified altered and overwidened channels, lack of reaeration opportunities, and streambank instability as primary causes of the impairments and biotic stress. In addition, Shingle Creek discharges into the Mississippi River, which but it drains to the Mississippi River, which is Impaired for fecal coliform bacteria (*E. coli)* and nutrients as well as nutrients and TSS in downstream reaches.

The Commission routinely monitors flow and water quality at two locations on Shingle Creek and one on Bass Creek. Station SC-0, also referred to as the outlet monitoring site, is located upstream of the 45th Avenue crossing in Minneapolis. The SC-3 monitoring station is located downstream of Brooklyn Boulevard in Brooklyn Park. The Bass Creek site is located in Bass Creek Park in Brooklyn Park. Monitoring data and water quality trends are published in an Annual Monitoring Report and on an interactive map on the Commission's website. Long-term trend analysis shows improvement in nutrient and TSS concentrations in the streams, but chloride and *E. coli* remain high. There is also a long-term USGS monitoring station on Shingle Creek at Queen Avenue near the border of Minneapolis and Brooklyn Center. The USGS monitors continuous flow, conductivity, and stream temperature at this site. Real-time data is available through the USGS website http://waterdata.usgs.gov/mn/nwis/uv?05288705.

To address the impairments identified in the stream TMDLs the Commission and the cities have partnered on several stream restoration projects over the past 20 years. Over 3.4 miles of Shingle Creek has been improved, ranging from simply removing invasive vegetation from the streambanks to reestablish a native vegetative buffer to totally regrading and reshaping the channel and banks and planting a new buffer zone. These projects have stabilized banks and reduced streambank erosion and enhanced habitat to help improve biotic integrity of the fish and macroinvertebrate communities as well as other aquatic and terrestrial species. However, improvements have yet to be seen in the fish and macroinvertebrate communities. About 1,700 linear feet of Bass Creek in Bass Creek Park have also been restored.

Priority Concerns:

- Reduce chloride and bacteria concentrations to and in the streams
- Continue to stabilize and restore the streams
- Enhance in-stream habitat and make other improvements to allow the re-establish biotic integrity

10-Year Plan Activities:

- Continue to undertake priority stream restoration projects
- Continue to reduce pollutant loading to the streams, focusing on chloride and bacteria
- Monitor trends in water quality and biotic integrity

Monitoring Plan:

- Continue routine flow and water quality monitoring at two locations on Shingle and one on Bass Creeks, and periodically survey fish and macroinvertebrate populations

Table E-13. Implementation plan for Shingle and Bass Creeks.

Action	Location	Plan Year										Estimated Cost
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Watershed Activities												
Opportunistic BMPs in the watershed	Various locations as opportunities arise	x	x	x	x	x	x	x	x	x	x	Varies
In-stream Activities												
Shingle Creek Natural Channel Restoration	Brookdale Park, Brooklyn Park	x	x									$1,250,000
Shingle Creek Channel Enhancements	Creekview Park, Minneapolis		x	x								$400,000
Bass Creek	TH 169 to 63rd Avenue, New Hope and Brooklyn Park			x	x							$500,000
Other Priority Restorations	Various locations as opportunities arise					x		x		x		Varies
Monitoring												
Flow and Water Quality Monitoring	Shingle Creek and Bass Creek sites	x	x	x	x	x	x	x	x	x	x	$30,000/yr
Special Monitoring	As necessary				x				x			varies
Biotic Monitoring	Shingle Creek and Bass Creek sites			x				x				$5,000

[1]X denotes Commission monitoring

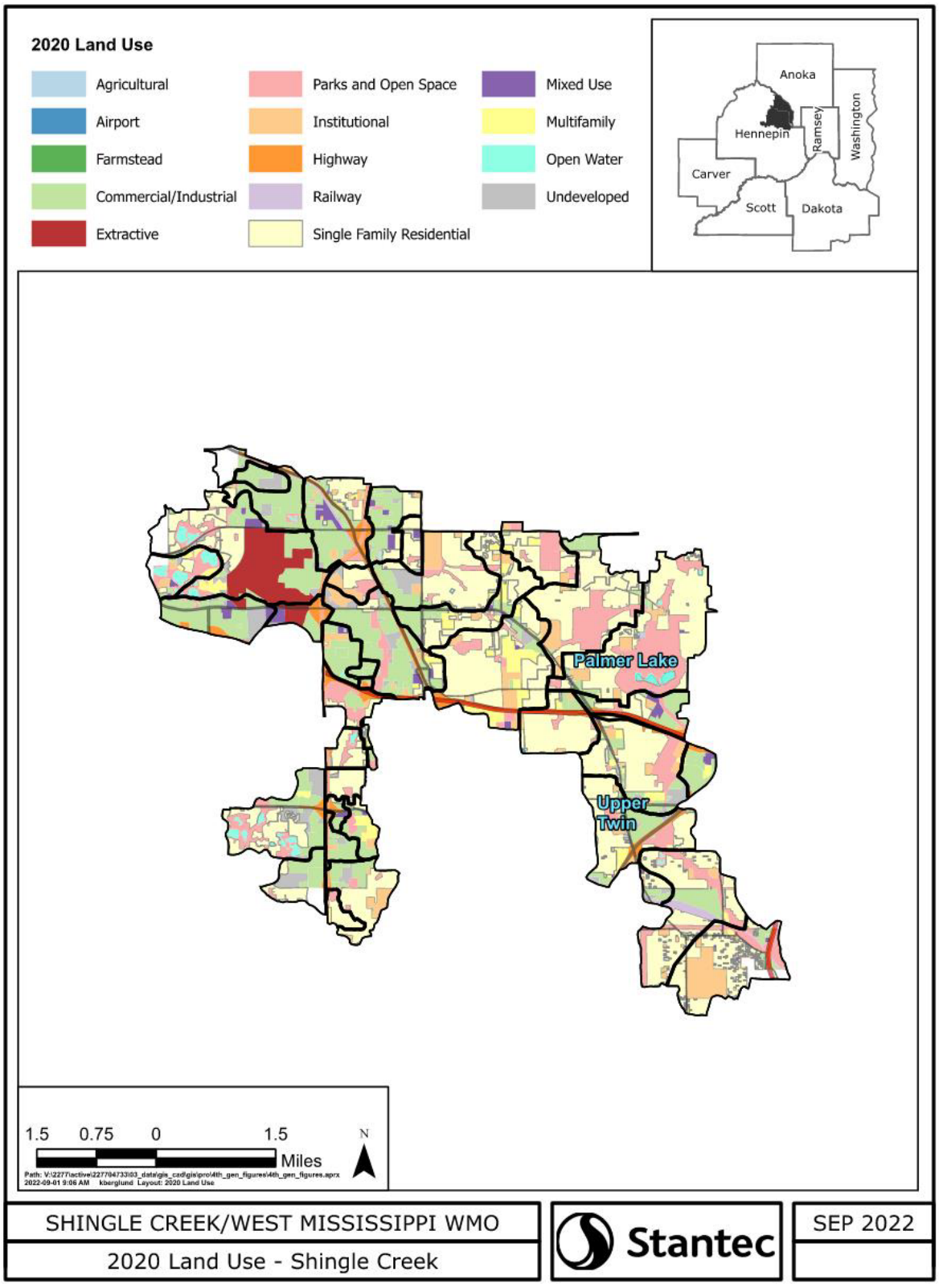


Figure E-22. Shingle Creek direct drainage area 2020 land use.

E.8 WEST MISSISSIPPI IMPLEMENTATION PLAN

The West Mississippi watershed contains just under 23 square miles of land that rains directly to the Mississippi River, mostly through storm sewer or a few natural and man-made or enhanced channels. There are no lakes in West Mississippi. Much of northern Brooklyn Park and Champlin converted from agricultural and rural land uses later than Shingle Creek, and there continues to be some ag uses along the TH 610 as that slowly develops.

There are four primary subwatershed in West Mississippi (Figure E-23): Champlin, which is the city of Champlin and a small area in Brooklyn Park; Northwest/Riverside, which includes the most of the Brooklyn Park north of TH 610, collected in storm sewer, discharged to a large wetland complex in the City's Environmental Preserve and then to the Mississippi River though a small channel; Century/Edinbrook, part of Brooklyn Park that is drained by the Century/Edinbrook Channels, which outlets into Mattson Brook and then to the River; and the Mississippi River subwatershed, which is the balance of the area that drains through storm sewer to outfalls directly on the Mississippi River.

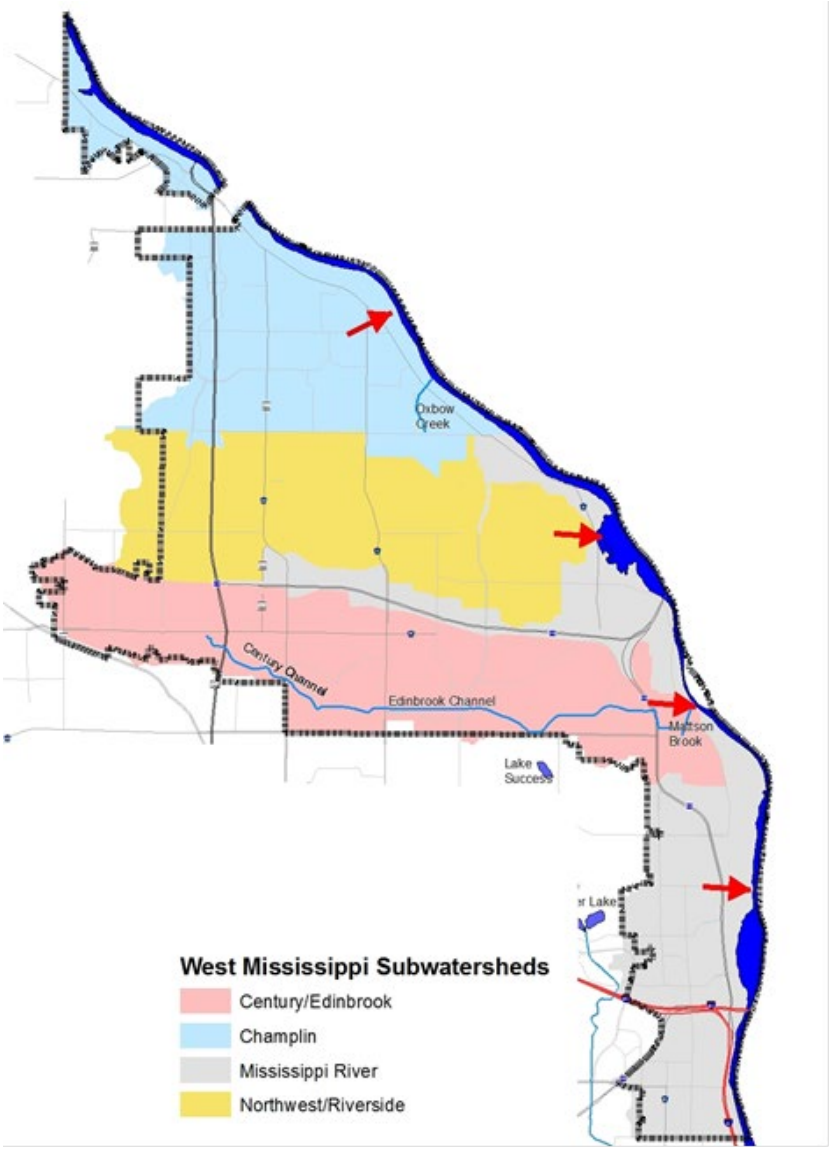


Figure E-23. West Mississippi subwatersheds.

There are no Impaired Waters in the West Mississippi watershed, but it drains to the Mississippi River, which is Impaired for fecal coliform bacteria (*E. coli)* and nutrients as well as nutrients and TSS in downstream reaches. While there are no chloride-impaired waters in West Mississippi, nor is the River impaired for chloride, the Metro chloride Management Plan encourages all watersheds within the Metro area to work toward reducing the overall amount chloride applied to the minimum necessary to protect public health and safety.

The monitoring program has focused on characterizing water quality and water yield from the primary subwatersheds, as many of the smaller outfalls only flow during storm events or snowmelt. Of particular interest to the Commission is tracking water quality discharged from the Environmental Preserve, as much of the development activity in the past decade has occurred in the Northwest/Riverside subwatershed. Similar to results found in Shingle and Bass Creeks, water quality discharged from Mattson Brook and the Environmental Preserve on average meets state water quality standards, although they do not meet the MPCA threshold for applicability of standards. During larger rain events, pollutant concentrations are elevated.

In the coming ten years the focus on the West Mississippi watershed will be on undertaking BMPs to reduce pollutant loading and runoff volumes when opportunities make them feasible and cost effective. In addition, there remains some land still in agricultural or fallow use, especially in the vicinity of the TH 610/TH 169 interchange that is slowly undergoing development. Commission Rules and Standards are in plane that require that development and land use conversion to meet strict water quality, volume management, and runoff rate control standards.

Priority Concerns:

- Reduce nutrient, bacteria, and chloride concentrations in the Mississippi River
- Continued conversion of land from agricultural/rural land uses to more intense development

10-Year Plan Activities:

- Undertake load reducing BMPs as opportunities arise
- Continue to enforce development Rules and Standards as land development occurs
- Monitor trends in water quality and biotic integrity

Monitoring Plan:

- Continue routine flow and water quality monitoring at one or two locations per year, alternating between the Mattson Brook, Environmental Preserve, and 65th Avenue outfall locations.

Table E-14. Implementation plan for West Mississippi.

Action	Location	Plan Year										Estimated Cost
		2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	
Watershed Activities												
Opportunistic BMPs in the watershed	Various locations as opportunities arise	x	x	x	x	x	x	x	x	x	x	Varies
Monitoring												
Flow and Water Quality Monitoring	Alternate between Mattson Brook, Env Preserve, and 65th Ave outfall	x	x	x	x	x	x	x	x	x	x	$22,000/yr
Special Monitoring	As necessary				x				x			Varies

[1]X denotes Commission monitoring