Fisheries Management Plan

Big Chippewa Lake, Douglas County

2016 - 2026

Minnesota Department of Natural Resources
Division of Fish and Wildlife
Section of Fisheries
Glenwood Area Headquarters

Fisheries Management Plan

Region	Area	DOW#	County	Lake	Class	Acreage
NW	Glenwood F116	21-0145	Douglas	**Chippewa**	22	SA 1,175 LA 551

Basin Morphology & Hydrology

Ecological Classification:	Walleye - Centrarchids
Management Classification:	Walleye - Centrarchids
Zoning Classification:	Recreational Development
Watershed:	Chippewa River , Minnesota River
Catchment Area:	3,916 acres (GIS)
Total Watershed Area:	12,286 acres (GIS)
Surface Area:	1,175 acres (GIS)
Drainage Area to Surface Area Ratio:	10.5:1
Littoral Area:	551 acres
% Littoral Area:	47
Shoreline Length:	13.8 miles
Shoreline Development Factor:	2.87
Maximum Fetch:	3.0 miles
Maximum Depth:	95.0 feet
Mean Depth:	24.0 feet
Ordinary Highwater Mark:	1351.6 feet MSL
Outlet Elevation:	1350.1 feet MSL

Survey and Stocking Schedule

Year	Inventory	Walleye Stocking	Special Assessment	Other
2016		Fry – 826,500	Fall electrofishing	
2017	Standard Survey/IBI		Fall electrofishing	
2018		Fry – 826,500	Fall electrofishing	
2019			Fall electrofishing	
2020		Fry – 826,500	Fall electrofishing	
2021	Standard Survey		Fall electrofishing	
2022		Fry – 826,500	Fall electrofishing	
2023			Fall electrofishing	
2024		Fry – 826,500	Fall electrofishing	
2025	Standard Survey		Fall electrofishing	
2026		Fry – 826,500	Fall electrofishing	Plan Redraft

NA-01570-01

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DNR Mission Statement: *Our mission is to work with citizens to conserve and manage the state's natural resources, to provide outdoor recreation opportunities, and to provide for commercial uses of natural resources in a way that creates a sustainable quality of life.*

Introduction and Plan Purpose

The **DNR Division of Fish and Wildlife** manages, protects, and regulates Minnesota's fish and wildlife resources. The **Section of Fisheries** is responsible for managing and sustaining the diverse fisheries in Minnesota's 5,400 game fish lakes and 15,000 miles of streams and rivers. Scope and complexity of fishery management issues, funding and administrative constraints, and mandates for efficacy and accountability necessitate a planned, systematic approach to fisheries management programming.

Area Fisheries professionals prepare fisheries plans for most, if not all, "fishable" lakes and streams with public access and active fish management allocations. Lake-specific fisheries management plans serve as a delivery mechanism for applying the DNR mission, goals, and strategic programming to field operations. The plans serve as the basis of annual work plan and operating budget development. The lake-specific fisheries management plans also ensure directed, systematic application of management programs and activities, which in turn facilitates program evaluation and accountability.

Written fisheries management plans ensure continuity in service delivery and afford customers, local units of government, and other land and natural resource management entities with an over-view of fisheries resource and habitat conditions, as well as an understanding of the actual or potential influence of land use activities on water quality and fisheries sustainability. Lastly, plan development provides a critical avenue for public input and involvement into resource issues, management strategies, and program integration.

Fisheries management plans are crafted to address key performance areas and reflect natural resource management principles and goals established in the Department's Strategic Conservation Agenda. Those guidelines include:

- Minnesota's waters, natural lands, and diverse fish and wildlife habitats are conserved and enhanced
- Minnesota's outdoor recreation opportunities meet the needs of new and existing participants so all benefit from nature
- Minnesota's natural resources contribute to strong and sustainable job markets, economies, and communities
- The DNR demonstrates operational excellence and continuous improvement in service to citizens

Long Range Goal(s)

- Protect Big Chippewa Lake and its aquatic resources from human-induced degradation in order to sustain a thriving community of native gamefishes
- Influence fish community structure and biomass to restore optimal harvestable yields of walleyes and yet, sustain quality fishing opportunities for other gamefishes
- Optimize recreational fishing opportunities afforded by the lake

Management Objectives

Desired Habitat Attributes

- Sustained water quality indices characteristic of lakes within the upper 75th percentile distribution for the North Central Hardwood Forest ecoregion (Heiskary and Wilson 1989). i.e.
  - Average summer Secchi transparency > 10.0 feet
  - Mean summer, epilimnetic total phosphorus measurements < 20 *u*g/l
  - Epilimnetic chlorophyll *a* concentrations < 6 *u*g/l over 80% of the summer
- Rooted aquatic macrophyte growth to a depth of 15.0 feet
- Absence of exotic species not already naturalized within the watershed
- Critical walleye spawning habitat identified and protected from degradation
- A more natural hydrograph and fewer instances and duration of high water periods in which water level exceeds the ordinary high water mark

Desired Recreational & Social Benefits

- Sustained recreational suitability classification of "fully supporting swimmable and fishable uses"
- Sustained appreciation of lakeshore property values
- High quality fishing opportunities, with particular emphasis on sustaining a consumptive walleye fishery
- Safe, enjoyable, fishing experiences
- Continued presence and vitality of Westwood Beach Resort in the traditional fishing resort format

Desired Gamefish Population/Fish Community Attributes

- Absence of non-native fishes or invertebrates not naturalized in the Chippewa River watershed
- 70% or more of total capture biomass in netting surveys comprised of gamefishes
- Sustained natural recruitment of walleye
- Continued presence and proliferation of northern cisco (tullibee)
- Best appropriate fish community structure to optimize energy flow, growth, and harvestable yields of walleye without excessive sacrifice of other gamefishes and fishing diversity

Species-specific management objectives and desired population attributes

Walleye: Sustain optimal yields of harvestable-sized fish. Desired population objectives for abundance, size distribution, and growth are:
- Average gill net catch rate near or exceeding 12 fish/net
- Sufficient rate of growth so that most young walleyes recruit into the quality-size category (≥ 15.0 inches) by age 4
- PSSQ and PSSP values near 60 and 10 respectively

Northern pike: Act on opportunities to minimize annual recruitment and increase angling mortality to sustain a lower population density, minimize biomass of competing predators, and increase availability of young-of-year and yearling yellow perch. Optimal population statistics would reflect:
- Gill net CPE ≤ 5-fish/net
- PSSQ of 60 or greater and at least 10% of stock-size captures exceeding 28.0 inches in length

Largemouth bass: Sustain a high quality fishery through a population comprised of medium densities of 15.0-inch and larger bass. Desired population characteristics include:
- Population densities yielding an electrofishing catch rate within the range of 50 – 80 fish/hour
- Average rate of growth such that most older captures recruit into the preferred-size category (≥ 15.- inches) at age 5 or early in the sixth growing season
- PSSQ near 70 and PSSP ≥ 20

Black crappie: Population abundance has been variable in response to irregular recruitment. Diet and habitat overlap with walleye may further influence abundance and fishing potential. There is need to more accurately describe population structure and understand community dynamics. As applicable, apply measures to sustain abundance and structural indices reflecting:
- Mean summer trap net or gill net catches of at least 1.5 fish/net
- Average growth of 10.0 inches at age 5
- PSSQ of combined trap net and gill net catches near 70 and PSSP values ≥ 10

Bluegill: Influence abundance to optimize growth, size structure, and fishing quality. Desired population characteristics would reflect:
- Mean trap net catch rate within the range of 15-30 fish/net
- Improved growth rate of at least 6.0 inches before or at age 5
- PSSQ and PSSP > 50 and 5 respectively

Yellow perch: Influence predator biomass and size structure to promote an expanded, stable preferred-prey base and maximize gamefish growth potential. Desired population characteristics my reflect:
- Gill net CPE of at least 10-fish/net
- PSSQ > 10

Operational Plan

Action Category: Habitat Protection & Enhancement

A. Monitor watershed or shoreline developmental proposals submitted through the Douglas County Board of Planning and Adjustment permit review process, and as warranted, promptly initiate action or provide recommendations to ensure that environmental concerns and aquatic resource issues are appropriately addressed.
B. Promote the Lake Association to adopt a "no net loss" policy of emergent aquatic macrophytes, particularly hardstem bulrush.
C. Seek support of the DNR, Division of Ecological and Water Resources, to investigate causes, document impacts, and address a sustained increase in lake elevation since the early 2000s. Document the extent and severity of shoreland erosion that is occurring in response to increasing surface water elevation during the 2019 survey.
D. Encourage and support local initiatives to armor or stabilize eroding shoreline. Actions might include uses of riprap, restoration of emergent vegetation, or wave-damping devices around points.
E. Monitor progress and encourage establishment and maintenance of required buffers along and around all protected waters and waterways within the Upper West Branch of the Chippewa River watershed.
F. Assess adequacy of the EAW for the Wagner feedlot expansion and promote remedial actions that would prevent greater nutrient/pollutant discharges to streams and basins adjacent to the feedlot, winter feeding areas, and manure application sites.
G. Coordinate with Douglas County SWCD staff, DU, Brandon Fins & Feathers Club, and other partners to identify opportunities to restore wetlands within the watershed area of Big Chippewa Lake to retain and slow stormwater runoff and nutrients carried downstream the lake.
H. Coordinate with Fisheries Research to confirm and geo-reference locations of important walleye spawning habitat and take measures to protect and as possible, enhance known spawning areas to increase use and natural recruitment of walleyes into the fishery.
I. Due to sustained high water, impingement of woody debris and dead plant matter on trap structures, and very limited yields of roughfish during limited operations, remove the roughfish trap structure in the outlet channel to eliminate flowage constrictions that may influence surface water elevation.
J. Work with the Lake Association to identify and catalog undeveloped shoreline parcels abutting important fisheries habitat, determine ownership, and promote actions to perpetually preserve these areas from development.

Action Category: Direct Fisheries Management

A. Act on opportunities to manage or minimize reproductive potential of northern pike and common carp. Options may include periodic restrictions to preferred spawning habitat and maintaining the fish barrier in the outlet channel of the riparian wetland on the Big Chippewa AMA.
B. Remove the roughfish trap structure in the outlet channel of Big Chippewa Lake.
C. Sustain the relatively successful walleye fry stocking schedule to supplement natural recruitment and sustain walleye population management objectives. Stocking rate will be decreased moderately in response to slowing growth and diminished yellow perch catches during standardized surveys. Retain flexibility in stocking protocol to program a walleye fingerling stocking if fall electrofishing surveys document poor natural recruitment and limited contributions from fry stockings over a three-year period. Stocking details follow:
    - Sustain walleye fry stockings in even-numbered years (2016, 2018, 2020, 2022, 2024, and 2026) at a rate of 1,500 fry/littoral acre (826,500 fry). It would be preferable to mark stocked walleye fry to differentiate stocked fish from natural recruits.

- Fall electrofishing assessments will continue on an annual basis. Based on assumptions that young-of-year walleye catches reflect density of young walleyes, probable year class strength, and annual recruitment of young fish into the population, young-of-year catch statistics will be utilized as a trigger value to program possible walleye fingerling contingency stockings. The first or 25th percentile quartile catch rate of YOY walleyes in all electrofishing surveys completed since 1992 is 14.0-YOY walleyes/hour. Should fall, electrofishing yields fall below this trigger value in three consecutive electrofishing surveys, fingerlings will be stocked at a rate up to 1.0 lbs./littoral acre (551 lbs.) immediately following the third electrofishing survey.

D. Approve or deny private walleye fingerling stocking applications only after fall electrofishing has been completed. Ground such private stocking decisions with YOY walleye densities evident from current and past fall electrofishing outcomes, walleye growth, and forage availability in the form of yellow perch catch rates.

Action Category: Angler Management, Resource Allocation, & Fishing Enhancements

A. Actively promote exploitation of 24.0-inch and smaller northern pike and 12.0-inch and smaller largemouth bass to restore predator/prey balance and enhance survival, growth and recruitment of walleyes.
B. Monitor shoreland ownership and potential sales and coordinate with DNR, Division of Parks and Trails, in acquisition and development of a larger and better public access site or a second access.
C. Engage the Big Chippewa Lake Association and Douglas County officials in discussion of surface water use activities, identify public safety or habitat disturbance concerns, and as appropriate, consider imposition of surface water zoning ordinances that may optimize enjoyment and safety of fishing experiences and minimize potential fish and wildlife habitat disturbances in shallow water.
D. Evaluate probable biological responses and angling support for pursuing harvest regulations with the greatest potential to optimize fishing quality and fish community structure. Species of interest would likely include black crappie, bluegill, and walleye.

Action Category: Education

A. Sustain awareness of undesirable exotic species through news releases, Association interactions, or countywide workshops sponsored by the Douglas County Coalition of Lake Associations.
B. Sustain and participate in cooperative educational efforts that heighten awareness of watershed management initiatives, shoreland stewardship, APM permitting requirements, Division of Ecological and Water Resources permitting requirements, and Douglas County shoreland management ordinances.
C. Work through the Douglas County Coalition of Lake Associations and individual lake association representatives to ensure awareness and understanding of the Minnesota Environmental Protection Act and its proper applications in protecting the environment.
D. Prepare "smart fishing" for the Big Chippewa Association newsletters and Echo Press newspaper to highlight the possible roles of anglers in influencing abundance and size distribution of gamefishes. Include "how to" articles in removing Y-bones from northern pike fillets to promote greater exploitation of northern pike.
E. Promote understanding of the functions and values of aquatic vegetation and encourage minimal plant disturbances or control via the APM permitting process.

Action Category: Inventory, Evaluation, & Planning

A. Sustain standardized fisheries surveys on a four-year schedule. Surveys will be programmed to occur in 2017, 2021, and 2025. Standard sampling protocol will include spring electrofishing to best define largemouth bass abundance and other population attributes.

B. Augment standard survey methodology in 2017 with IBI sampling in conjunction with MPCA WRAPS round two diagnostic monitoring of the Chippewa River watershed. Capture extent and geo-reference locations of moderate and severe shoreline erosion during the Score-the-Shore component of IBI sampling.
C. Sustain annual fall electrofishing surveys to determine densities of young-of-year and age-1 walleyes
D. As staffing and workload allow, supplement standardized netting with targeted spring or fall trap net surveys to better sample and more accurately describe black crappie population attributes.
E. Seek to understand the influence of inter-basin fish movements on fish population community structure in other basins comprising the Upper Chippewa lake complex (Big Chippewa, Devils, Little Chippewa, and Stowe lakes).
F. Explore and as feasible, act on low cost means to estimate recreational use, fishing pressure, and angling yields.
G. Support the DNR Area Hydrologist in a hydrologic assessment of the lake and runoff yields from the watershed to determine causative factors associated with a gradual, sustained increase in surface water elevation.
H. Demonstrate values of the information and encourage volunteers from the Big Chippewa Lake Association to sustain participation in the Douglas County Trophic Status water quality monitoring project and continue to read and report surface water elevations.
I. Promote and support an expanded water quality monitoring program to include collecting water samples from ditches, tributaries, and discharge pipes to better quantify runoff volumes and nutrient loading by sub-watershed levels.
J. Encourage and support any necessary training for volunteers to effectively complete biennial searches for aquatic invasive plants and animals in order to detect and effect control measures early in infestations.
K. Encourage the Big Chippewa, Devils and Little Chippewa, Stowe, and Whiskey Lake Associations to enjoin in a greater Upper Chippewa Chain of Lakes Management Group to collectively address watershed-scale lake management issues, guide decision-making, and pool each Association's political clout and funding to promote watershed and lake management initiatives.
L. Evaluate survey findings, efficacy of management programming, and redraft the fish management plan in 2026. Modify or amend the plan as compelling or new information may justify. Such justification could include implementation of harvest regulations or exotic species infestations.

Management Milestones

- √ Formation and incorporation of a Lake Improvement District or coalition of organizations or individuals comprising an Upper Chippewa River work group to address lake management issues on the Big Chippewa, Little Chippewa, Devils, Stowe, and Whiskey lakes chain of lakes
- √ Sustained northern pike catch rates at or below the Lake Class 22 25th percentile catch rate
- √ Documentation of location and effective protection of walleye spawning habitats
- √ Completion of hydrological assessments and any needed actions to restore a more natural hydrograph and reduce or stabilize surface water elevation below the OHW

Potential Plans*

A. Conduct periodic creel and recreational use surveys to assess fishing pressure, document harvest, quantify fishing satisfaction, etc. in order to assess changes attributable to management initiatives, formulate outcome-based objectives, and generate information from which to justify program expenditures. Survey design should encompass other connected basins to optimize information gained and costs.

Cost: $25,000/survey

B. Provide funding and technical assistance in a two-year comprehensive water quality monitoring program to include diagnostic evaluations of runoff volumes and total nutrient and pollutant loading from sub-watersheds and public drainage systems.

Cost: $ 20,000

C. Provide technical support and grant funding endorsements to Douglas County Soil and Water Conservation District, the Chippewa River Work Group, or local cooperatives to influence and affect protective land use changes within the watershed and shoreland management zone. Project opportunities may include ditch buffers, manure management, wetland restorations, sewer line routing, redirection or treatment of runoff waters in road ditches, shoreline buffers, etc.

Cost: $ 50,000

D. Implant transmitters into adult walleye and northern pike to assess the extent of fish movements among connecting basins. Other telemetry applications would include tracking both species to important spawning habitats to locate, describe, and protect such areas for encroachment and degradation.

Cost: $15,000

E. Commensurate with catches above management objectives and an understanding of fish movements, act on opportunities to management northern pike recruitment, density, and size structure. Options may include harvest regulation designed to increase mortality of small pike and increase numbers of large pike. There may also be potential to periodically restrict northern pike to important spawning areas.

Cost: $1,000

F. Dependent upon opportunity and manpower, conduct targeted trap net assessments in the spring or fall in those years surveys are scheduled, to effectively sample black crappie and characterize abundance, growth, and age and size distribution.

G. Form partnerships to share costs of acquiring aquatic management areas or negotiating conservation easements on undeveloped shoreland areas adjacent to essential or unique near-shore fisheries habitat.

Cost: $50,000/parcel

H. Develop a pilot project to provide landscaping assistance and funding to shoreland property owners who would are willing to ”retrofit” existing properties to protect water quality. Projects could include shoreline buffers, restoration of wetland areas to retain runoff water and trap pollutants, reduce impervious surfacing, construct infiltration trenches or temporary ponding sites, regrading, etc.

Cost: $ 10,000/project

I. If availability or condition of spawning habitat is determined to be limiting walleye recruitment, identify important areas, restore and/or create artificial spawning substrate.

Cost: $50,000

J. Should "new" and harmful exotic species such as Asian carp move into the Minnesota River watershed, rework existing barrier structures below Stowe Lake to best address potential for immigration into the upper reaches of the West Branch of the Chippewa River watershed.

Cost: $60,000

K. Utilize oxytetracycline or other methodology to mark stocked walleye in order to differentiate stocked walleye from natural recruits and gain a better perspective of the contribution of supplemental stockings.

Cost: $5,000

* *The potential plan section lists management initiatives that would be considered or implemented pending social acceptance, positive cost/benefit analyses, funding, labor requirements, and partnerships to accomplish the specific task. Project listing does not dictate or ensure action.*

Plan Prospectus

Basin Attributes

Chippewa Lake, also referred to as Big Chippewa Lake to prevent confusion with Little Chippewa Lake, is comparatively large basin with an estimated surface area of 1,175 acres. The lake has a complex morphology with shallow subsurface ridges that tend to break up the lake into three sub-basins. The irregular, elongate shape of the basin gives it 13.8 miles of shoreline and a calculated shoreline development factor of 2.87.

The deepest water occurs in the larger, central area of the lake. Maximum depth has been measured at 95.0 feet. Average depth is estimated at 24.0 feet. Only 47% of the basin area is less than 15.0 feet in depth. Most shallow area occurs on the downstream or southwest portion of the basin. Shoal water soils are largely comprised of sand and marl. Gravel and rubble deposits around an island and on long points that tend to separate the lake into sub-basins offer walleye spawning habitat.

Big Chippewa is the largest of a cluster of connected lakes located in west-central Douglas County and the upper portion of the West Branch of the Chippewa River watershed. Those managed lakes with sustained flowage connections include Whiskey Lake, Devils Lake, Little Chippewa Lake, and further downstream, Stowe Lake. Big Chippewa Lake has a relatively small catchment area estimated at 3,916 acres. The greater watershed area extends to the northeast into north central Douglas County and to the southeast. That expanded watershed area estimated at 12,286 acres is still relatively small in comparison to downstream lakes (Devils, Little Chippewa and Stowe Lake). It is interesting to note

Water quality measure describe Big Chippewa Lake as mesotrophic. Epilimnetic total phosphorus concentrations during summer months have averaged 17.2 *u*g/L over the past 18 years of monitoring. Chlorophyll-*a* concentrations during that sampling period average only 4.5 *u*g/L and have seldom approached concentration that could be classified as a nuisance algae bloom. Water transparency readings since 1997 average 11.2 feet. While not calculated as a statistically significant decrease in Secchi transparency, water clarity measure do depict a declining trend. As anticipated of deep, mesotrophic basins, the water column becomes thermally stratified during summer months. Depth of the thermocline and dissolved oxygen concentrations available to fish life in the hypolimnion have been variable among surveys completed in late-July and early-August. The top of the thermocline was documented at a depth of only 15.0 feet at time of the 2009 lake survey. Dissolved oxygen concentrations below 21.0 were too low to sustain most gamefishes.

A modest decline in water clarity coincides with a concerning and sustained increase in water level. Water level elevation reading have increasingly come to exceed the established ordinary high water mark elevation of 1351.6 feet MSL since 1994.

Despite fairly limited littoral area, Big Chippewa Lake supports a robust and diverse aquatic plant community. Sixteen submergent, emergent, and algal plant species were identified in 2013 vegetation transect survey. Submergent plants were documented to be growing to a depth of 17.0 feet.

Fish Population Assessments

Standardize fisheries survey have been sustained at a four-year frequency since 1985. Due to well documented natural reproduction and recruitment of walleyes, annual electrofishing surveys have also been completed during darkness to gain a measure of young-of-year walleye abundance from natural recruitment or a collective assessment of potential year class strength from contributions of natural recruitment and fry stockings. These targeted assessments began in 1992.

Coarse assessments of survey catch statistics provide empirical evidence of shifts within the gamefish community that likely stemmed from climatic fluxes which prompt temporary habitat changes that benefit some species and diminish recruitment or survival of other fishes. Largemouth bass and northern pike populations prospered during the wet period through the mid- and late-90s in response to expanded habitat availability and carrying capacity. Walleye, yellow perch, and bluegill sunfish recruitment diminished in possible compensatory responses to greater total predator densities and competition. Some moderation or greater irregularity in annual recruitment of Centrarchids and northern pike have become evident in recent survey information even though water level continues to increase. Limited snowmelt or timing of runoff events may have a significant impact of pike reproductive success and recruitment. Gamefish population summaries follow:

Walleyes: Primary management emphasis has long been focused on sustaining a popular walleye fishery. Walleye fishing has typically been good on Big Chippewa Lake due to elevated abundance due in part to natural recruitment. Due to popular demand and annual recruitment inconsistencies, supplemental stockings have long been programmed to sustain population management objectives and angler expectations.

Supplemental stocking records date back to 1908. Stockings records indicate walleye fry and fingerlings were stocked on a near-annual basis from 1945 through the 80s. With evidence of natural recruitment, stocking policies were adjusted to program occasional years with no stocking and stocking of known age fish, such as walleye fry, in order to gain better estimates of extent and consistency of natural recruitment. Survey catch statistics document some modest, but variable rate of natural reproduction in non-stocked years. Fall electrofishing catch rates of young-of-year walleyes captured in non-stocked years since 1992 have ranged from 4.0-fish/hour to 67.9-young walleyes/hour and average 26.7-fish/hour of effort. Fry stockings have been successful in increasing young-of-year walleye densities and catch rates during fall electrofishing surveys. Electrofishing catch rates of age-0 walleyes in stocked years have averaged 51.6 fish/hour. It is acknowledged from annual electrofishing catch rates that even with supplemental fry stockings, young-of-year walleye densities can vary greatly among years.

Fall electrofishing catch rates have generally corresponded well to year class strength and age frequency distribution of gill net captures, at least through age 6. There have been some exceptions. A good electrofishing catch rate of 45.8 YOY walleyes/hour was recorded in 1998. Cohorts of the 1998 year class were poorly represented in the 2001 gill net catch. Gill net catch rates declined during surveys completed in the early 2000s in response to three consecutive years (1998, 1999, and 2000) with poor recruitment from natural reproduction or stocking. This time period coincides with expansions of northern pike and largemouth bass populations an abrupt decrease in yellow perch catch rates. There proves to be a negative correlation ($r^2 = -.44$) between walleye and northern pike catch rates among surveys. Walleye gill net catch rates from surveys completed prior to expansion of the northern pike population in the mid-90s averaged an exceptional 18.0 walleyes/net. Walleye catches during the three surveys following expansion of the northern pike population averaged 9.2 fish/gill net. Based on declining preferred prey availability, greater competition, increasing predation of young walleyes, and similar findings on connected lakes, it is reasonable to assume that survival and recruitment of young walleyes into the population and fishery diminished with temporal environmental and habitat changes that favored expansion of northern pike and largemouth bass populations. Northern pike and largemouth bass recruitment and population density had declined in advance of 2009 and 2013 surveys. A modest and sustained increase in catch rates of age-0 walleyes has occurred since 2006. The greatest fall electrofishing catch rate of 118.6 age-0 walleyes/hour was recorded in 2008. Gill net catches increase to average 11.6 walleyes/net in 2013. Based on projected strength of 2012, 2013, 2014, and 2015 year classes from fall electrofishing catches, walleye catch rates are expected to be high at time of the 2017 survey.

Walleyes support a consumptive fishery. Population management objectives to optimize harvestable yields specify a desired growth rate of 16.0 inches at age 4. That growth objective has proven difficult to sustain at elevated densities, greater competition, indications of diminished yellow perch abundance, and modest fertility of the lake. Similarly, occasional strong year classes or consecutive years of elevated recruitment are not necessarily desirable to optimizing growth and harvestable yields. Back-calculated length at age 4 estimates among population sample have averaged 14.9 inches. Captures during the 2013 survey averaged only 13.7 inches at age 4. Age-5 walleye captured averaged only 15.5 inches at time of capture. At elevated densities and slow growth, some portion of potential harvestable yields can be projected to be lost to natural and hooking mortality before attaining 16.0 inches.

Size structure indices generated from length distributions of walleye population samples from gill nets have been variable in response to annual recruitment inconsistencies and diminished survival and recruitment from the mid-90s through mid-2000s. PSSQ values of 1980, 1985, 1989, 1993, and 1997 population samples averaged only 39 due to the elevation proportion of 15.0 inch or smaller walleye captures. PSSQ of the 2001 gill net catch increased to 78 in response to diminished recruitment. PSSQ values have moderated in recent surveys (2005, 2009, and 2013) to average 55. Whether functions of modest growth, a simple mathematical function of high numbers of young walleyes in the population, or a high rate of total annual mortality beyond age 6, the relative proportion of preferred-size (≥20.0 inches) walleyes measured during surveys has been very modest. PSSP values among surveys has seldom exceeded 10 even though age frequency distribution of population samples has extended to age 15+. At slow to modest growth rates, angler harvest may be sufficient to influence size distribution. Unfortunately, no information is available to quantify fishing pressure and yields.

Based on greater information, walleye population management objectives will be tweaked to more appropriately reflect and balance optimal density and growth potential. Supplemental walleye fry stockings will be sustained on an alternate year frequency. Annual fall electrofishing surveys will also continue. It would be desirable to record both age-0 and age-1 walleye captures to gain greater reliability of catch statistics as a predictor of future year class strength. The Big Chippewa Lake Association and Brandon Fins & Feather Club has an expressed interest in purchasing and stocking walleye fingerlings. Based on reproductive potential and documented contributions of fry stocking, any additional stocking should be delayed until the annual fall electrofishing survey is completed. Decisions and approvals to stock additional fish should be based on documentation of existing young-of-year and age-1 walleye densities and real need, particularly if growth is slow and perch abundance indices remain suppressed. If there is persistent requests to stock, it may be best appropriate to schedule those fingerling stockings to occur in years that fry are not stocked.

Rather than rely on supplemental stocking to sustain angler expectations, there may be opportunities to broaden walleye management programming to address habitat limitations and a fish community top heavy with predators. Preservation or enhancement of walleye spawning habitat may be as or more important than stocking from a long-term perspective. Walleye harvest management options are confounded by excessive variability in annual recruitment, slowing growth, and greater natural mortality. Anglers can contribute greatly to restoring desired gamefish community structure by harvesting small northern pike and largemouth bass rather than specializing on walleyes.

Northern pike: Due to direct predation and competition with walleyes for prey, a low density northern pike population is desirable to optimizing walleye abundance and fishing success. Average gill net catches in early surveys were at or below the 25th percentile quartile catch rate for Lake Class 22. During an extended wet period starting in 1993, northern pike recruitment increased in probable responses to increased water level, greater flowage connectivity and migratory access to spawning habitat, and sustain flowage connections. Gill net catches during 1997, 2001, and 2005 surveys increased to exceed the Lake Class 22, 75th percentile catch rate of 7.9-pike/net. Pike captures during the 2005 survey averaged 9.5 fish/gill net. This population prospered

in response to an extended wet weather period that extended from late 1993 through 2003. Age frequency distribution of 2001 and 2005 gill net catches suggest strong and consistent annual production and recruitment in 1997, 1998, 1999, 2001, 2002, and 2003. Rate of annual recruitment diminished through the mid- and late 2000s. In response to a decrease in natural recruitment, gill net catch rates during 2009 and 2013 surveys returned to mirror the low catches common to early surveys. A single strong year class was established in 2010. Cohorts of this year class comprised 54% of total gill net captures during the 2013 survey.

Size distribution of population samples describe a relatively poor fishery in terms of average size of fish. Even at apparent low densities, PSSQ values have averaged only 39 due to the excessive relative proportion of 21.0 inch and smaller individuals making up population samples. It is surprising given optimal habitat attributes and presence of a cisco population that few preferred-size (≥ 28.0 inches) pike have been measured among surveys. PSSP values generated from length frequencies of gill net catches has averaged only 6. While accuracy of aging northern pike aging estimates is questionable, those available age determinations suggest age structure of population samples has seldom extended beyond age 8. The largest pike captured in recent surveys measured 33.6 inches in total length.

Yellow perch: Gill net catch rates progressively increased throughout the initial five surveys. The greatest catch rate of 28.6-fish/gill net was recorded during the 1997 survey. Catch rates dropped sharply in coincidental or correlated increases in northern pike and largemouth bass abundance. Catch rates in surveys completed following the 1997 survey have been well below the Lake Class 22, 25th percentile quartile catch rate of 7.1-fish/gill net. There is some uncertainty as to whether very low catch rates reflect diminished yellow perch population density, a shift in size structure that has reduced vulnerability of perch to capture in experimental gill nets, or a combination of factors that limit size structure and catch success. Size structure of gill net catches has changed in conjunction with diminished catch rates. PSSQ values generated from gill net catches during the first five surveys averaged 17.8. No stock-size (≥5.0 inches) and larger captures have been measured during the three most recent surveys. There is speculation that yellow perch have adapted to expanded predator densities by maturing at a younger age or smaller size, thus more of their diet may now be diverted into gamete production rather than body growth. Alternative sampling methodology and age and growth determinations may be necessary to gain an understanding of population dynamics and gain accurate abundance estimations.

A moderately abundant population of young-of-year and age-1 perch is desirable to optimizing preferred prey and walleye growth. Walleye and northern pike growth rates have tended to slow with greater population abundance and reduced yellow perch catches.

Largemouth bass: The largemouth bass population expanded in the early- and mid-2000s with greater annual recruitment consistency and establishment of an exceptionally strong 2001 year class. Night electrofishing catches in early surveys (1993, 1997, and 2001) averaged 42.0 bass/hour. With recruitment of the 2001 year class, electrofishing catches during the 2005 survey increased to average 111.4 bass/hour of effort. Cohorts of the 2001 year class comprised 67% of that total catch. Electrofishing catch rates in 2009 and 2013 surveys moderated to approximately 70.0 bass/hour in response to less consistent or irregular annual recruitment through the latter half of the 2000s. Moderately strong year classes were established in 2003 and 2011. Multiple year class failures (2000, 2002, and 2004) were also evident in age structure of the 2009 population sample. Poor recruitment in the mid-2000s was evident in age frequency distribution of the 2013 electrofishing catch. Age assignments extended to only age 7.

Bass grow well in Big Chippewa Lake. Back-calculated average length at age 5 estimates have varied from 13.4 inches to 15.9 inches among population samples.
Fishing quality, in terms of size distribution and average size, improved to become very good with progression

of 2001 and 2003 year classes through the population. PSSQ of electrofishing catches during the 2009 survey increased to 90 due to an age distribution extending to age 11 and elevated catches of six- and eight-year-old captures. Forty-four percent of stock-size captures exceeded 15.0 inches in total length. Angler reports suggest 20.0 inch bass catches were not uncommon through 2012. PSSQ of 2013 catches declined to 45 with senescence of 2001 and 2003 year classes and recruitment of the strong 2011 year class. PSSP of the 2013 population sample remained elevated at 33, but it was apparent the fishing quality would diminish or be temporally inconsistent due to annual recruitment inconsistencies.

Bluegill: Similar to catch statistics for walleyes and yellow perch, bluegill catch rates were greater in early surveys. Catch rates during five surveys completed through 1997 averaged 39.1 bluegills/trap net. Catch rates during the four most recent surveys have averaged 13.9 bluegills/net. This apparent decrease in population abundance coincides with expansion of northern pike and largemouth bass populations. Survival of young bluegills may have declined in the face of greater predation, particularly with reduced availability of yellow perch as an alternative and preferred prey. Age frequency distribution of recent population samples also suggest greater annual recruitment inconsistency through the mid- and late-2000s.

Rate of growth can be qualified as "below average" and did not increase with evidence of diminished population abundance. Back-calculated length at age 5 estimates among surveys have varied from 4.5 inches to 6.0 inches. Quality of the bluegill fishery is only fair when expressed in terms of average size of bluegills making up population samples. Age assignments have seldom extended beyond age 9. Due to slow growth and total annual mortality, proportionally few bluegills measured during surveys had recruited into the preferred-size category. PSSQ values generated from trap net catches have averaged only 39. On average, only one percent of stock-size captures among surveys have exceeded 8.0 inches in total length. Eight, 8.0-inch captures were measured during the 2005 survey. These large, older individuals where likely cohorts of strong year classes established in the mid- and late-90s. These older fish had dropped out of the population before the 2009 survey was completed.

Black crappie: Poor sampling efficiency during summer months and recruitment variability undermine accurate assessments of crappie abundance, age distribution, and size structure at time of survey. Catches were very high during 1972 and 1985 surveys. Few have been captured in subsequent surveys, although trap net catch rates have been well within the interquartile range of trap net catch rates for Lake Class 22.

It is assumed that population abundance is greater than reflected in early August survey catches. Increasing population size structure indices from 1997 through 2009 surveys is suggestive of poor or reduced recruitment of young fish in the population. PSSQ of 2009 trap net catch was calculated at 91. Twenty-seven percent of the trap net catch exceeded 10.0 inches in total length. There is not much age and growth information available due to limited sample sizes. Growth can be projected to be good based on 2009 age assignments. Those 10.0 inch crappies represented in the trap net catch were only age 4+ fish.

Expansion of this population would be highly desirable in enhancing fishing diversity and quality. However, primary management emphasis will continue to be directed at walleyes, a species that may have significant prey and habitat overlap with that of black crappies.

Other Fishes: Various fish species serve as sensitive indicators of habitat conditions and trophic state of lakes. Sustained presence of **cisco**, a coldwater fish, is indicative of clean, clear lakes classified as "mesotrophic". Tullibee continue to be represented in lake survey catches from Big Chippewa Lake, but catches are very limited. Vertical gill netting will be scheduled as possible to gain a more accurate assessment of abundance and population dynamics. **Yellow bullhead** are common in lakes with good water quality. Conversely, **black bullheads** proliferate as water quality declines and gamefish diversity and abundance degrades (Schupp and

Wilson 1989). Yellow bullhead catch rates have exceeded that of black bullheads in all surveys since 1989. Black bullhead catches exceeded that of yellow bullheads in early surveys. This capture relationship over time suggests there may have been water quality and gamefish habitat improvements over time.

Ecosystem Trends or Concerns

Water quality statistics continue to describe a mesotrophic basin. Water quality monitoring records dating to 1997 document an average summer Secchi transparency average of 11.2 feet. Empirical observations of water quality data suggest a slight increase in mean epilimnetic total phosphorus concentrations during summer months and an accompanying decrease in water transparency, but due to inherent annual variabilities in measurements such water quality changes over time are not significantly significant.

Water level gauge readings depict a concerning and sustained increase in surface water elevation over time. It is probable that the sustained increase is associated with an extended wet weather period that began in late 1993. Water level readings have increasingly exceeded the established ordinary high water mark. This change in water level and habitat conditions likely favored expansion of gamefish populations, particularly northern pike and largemouth bass. Annual recruitment of these fishes proved greater and more consistent from the mid-90s through at least 2003. Expansion of these predator populations corresponded with reduced recruitment of walleyes, yellow perch, bluegills, and possibly black crappies. Related environmental impacts may include shoreline destabilization and erosion. Big Chippewa Lake Association volunteers have been vigilant in monitoring debris buildup and cleaning the roughfish trap panels at the outlet to ensure there are no constrictions to outlet capacity and outflows. All panels were removed in 2016, but supporting cross members remain intact.

Extensive and continued drainage alterations in the watershed to include pattern tiling may contribute to high water levels throughout connected basins in the upper reaches of the Chippewa River watershed.

Protection of water quality and the complex aquatic environment is critical to sustaining healthy fish resources. Protecting walleye spawning habitat to sustain natural reproduction and recruitment of walleyes is very important to maintaining this very popular fishery. Based on historical data, undesirable fish community shifts toward a greater total biomass of carp, buffalo, and black bullheads can be expected with even modest degradation of water quality (Schupp and Wilson 1993). Such environmental stress is likely with further drainage alterations and loss of stormwater runoff retention in the watershed, developmental growth, and increasing recreational pressure.

At present, zebra mussels, Eurasian water milfoil, and other recent aquatic invasive species have not been found and documented in Big Chippewa Lake and connected basins. Common carp have long been naturalized within the Chippewa River watershed. Infestation and expansion of non-native organisms could result in undesirable habitat changes or diminish carrying capacity for native gamefishes.

Limiting Factors

Early records suggest that common carp densities may have been great enough to influence water quality and plant diversity. Carp and black bullheads continue to be present, but standing stocks appear to be limited. Even modest degradation of water quality or other environmental factors influencing gamefish abundance and diversity would likely result in re-expansion of these undesirable fishes.

Fish community structure shifts occurred in the latter half of the 1990s and early 2000s in probable responses to

an extended wet weather cycle that increased surface water elevation, inter-basin connectivity, and a temporal expansion of biological carrying capacity. Those gamefishes benefitting most from habitat changes were northern pike and largemouth bass. Community responses to expanded predator densities that may be evident in survey catch data included declines in relative abundance estimates of walleyes, yellow perch, and bluegill sunfishes. Gamefish growth rates declined during this period. A disproportional density and surplus of predators with limited exploitation appeared to limit recruitment, growth, and potential yields of walleyes.

Parking space at the public access is inadequate to support existing surface water use and angling demands.

Social Considerations

The DNR, Section of Fisheries enjoys a reasonably good relationship with the Big Chippewa Lake Association. Their request for walleye harvest regulations has not been fulfilled, primarily because of the significant variability in annual recruitment of walleye and rule-making inflexibility to adjust regulations to changes in population dynamics or fishing pressure.

Interactions with Lake Association representatives were a little tenuous in the late 2000s due to polarization of opinions on support or opposition to a proposed Central Lakes Regional Sanitary District that would have extended sanitary sewer services around Big Chippewa Lake and other well developed lakes in west-central Douglas County. Both proponents and opponents were actively soliciting environmental impact input and arguments to influence public opinion and decision-making. This project ultimately failed based on projected costs and lack of administrative support of several Townships in the project coverage area.

The Lake Association, with support of the Brandon Sportsmen's Club, submitted an application to participate in the MPCA Lake Assessment Program. The Glenwood Area Office encouraged this application and forwarded an endorsement of support for the application. Unfortunately, the application was not selected from the many requests.

A petition and counter-petition have been circulated by area residents to seek development of a boat channel among the three lakes on this chain of lakes. The Little Chippewa-Devils Lake Association supported this effort, while the Big Chippewa Association demonstrated reluctance to support this request effort. That reluctance was in response to the uncertain impact on water level in mid- and late-summer.

One traditional fishing resort, Westwood Beach Resort, continues in operation. The West Publishing Family estate on the northeast shoreline was sold in 2014 and is now managed as Brentwood Estates. This exclusive resort has multiple homes for rent and offers use of watercraft for recreational boating and fishing. Business listings identify an additional resort (Acorn Acres Resort &Campground) on the west end of the lake, but there is uncertainty on aerial photos as to whether park users have access to the lake. No dock system is evident. This may have been previously operated as Chippewa Hills Resort.

The Brandon Sportsmen's Club was active for many years in fish and wildlife management enhancements. The group supported carp control efforts during the 70s and 80s. Members assisted in setting up, maintaining, and operating several roughfish trapping sites. Trapping efforts continued into the late 80's. File records indicate the group periodically assisted in rescuing and transferring northern pike from Upper Hunt Lake. A connected wetland area located of the north side of the lake was acquired and developed as a northern pike spawning area. I find no records of use and production though such information likely exists. After a period of dissolution, the old Brandon Sportsmen's Club was recently revitalized as the Brandon Fins and Feathers Club. At present, members utilize local fundraising revenues to purchase and stock walleye fingerlings in Whiskey, Moon, Devils, Stowe, Little Chippewa Lake, and dependent upon fall, YOY walleye catches, Big Chippewa Lake.

Lake files contain references to some major DOW permitting violations in development of the shoreline. Two such projects included construction of a rock pier and excavation of an inland marina. A similar proposal to create and inland marine at Westwood Beach Resort was denied.

Fishing and recreational uses are lighter than anticipated for a lake with the size, water quality, and fishery attributes of Big Chippewa Lake. Travel distance from Alexandria or Fergus Falls may partially explain the comparatively light surface water use. Lack of parking and congestion and on the undersized, substandard public access site may also reduce public use. Shoreland property owners are open in their appreciation of the quiet nature of the lake and can be projected to resist or oppose acquisition and development of an additional or larger public access.

Fisheries Management Programming

Fisheries management efforts have been relatively narrow in scope. Program activities and various achievements from previous plans include:

Roughfish removal efforts date back to 1923. Harvest records of state crews peaked in the 40s. Over 137,000 lbs. of carp and buffalo were removed from 1941-47. Yields diminished greatly in subsequent harvest efforts. The most detailed and significant harvest of common carp occurred in 1957. An estimated 33,000 lbs. of carp were removed from an early fish trap structure. A permanent roughfish trap structure was constructed in the outlet channel of Big Chippewa Lake in 1979. Approximately 18,000 lbs. of carp were removed from fish traps in 1984. Operation of the trap and yields diminished with limited harvest activities in the mid-90s. Operation of the trap ceased in 1997. With increasing water levels and outlet flows, screen panels in the trap structure became a liability due to impingement of plant material and debris. Local volunteers cleaned the panels for many years to eliminate flow blockages. At request of the Big Chippewa Lake Association, all screen panels were removed in 2016. A project proposal is in place to remove the superstructure and crossbeams from the outlet channel.

An initial fish survey was completed in 1946. A resurvey followed in 1972. Standardized netting surveys have been scheduled to occur in early August and sustained on a four-year frequency of occurrence. Standard netting surveys have been augmented with spring electrofishing surveys to better assess abundance, size structure, and age distribution of the largemouth bass population. Some sampling bias has been induced in largemouth bass catch data by inconsistency in sampling methodology such as electrofishing system configuration changes from AC to pulsed DC and time of sampling (daylight or night electrofishing). Fall electrofishing surveys were initiated and have been sustained on an annual schedule since 1992. These surveys have aided in estimating densities of young-of-year walleyes from natural reproduction or relative contributions of fry stockings in advance of programmed state or private walleye fingerling stockings.

Fisheries staff cooperated with the Brandon and Vikings Sportsmen's Clubs to construct and place fish aggregating devices (FAD's) at several locations within the lake. These structures did attract fish (Schalekamp 1988). Harvest was enhanced, particularly for black crappie. There is no current documentation of structural integrity or continued existence of these structures. Anglers occasionally requests for maps to locate and fish over these structures.

The DNR, Section of Fisheries funded a student/paraprofessional, Emily Siira, to accelerate a Division of Ecological and Water Resources initiative to develop GIS layers detailing catchment and greater watershed boundaries for basins within the West Branch of the Chippewa River. Flow delineations and connectivity corrections were completed and incorporated into GIS datasets and layers.
Fish management concerns for those managed basins in the upper reach of the West Branch of the Chippewa River Watershed are represented in discussions and planning documents of the Douglas County Local Water

Plan, Chippewa River Watershed Technical Advisory Committee, and MPCA Chippewa River Watershed WRAPS report.

Direct management programming such as supplemental walleye stocking has been reasonably successful in sustaining walleye population abundance and fishing quality, but such hands-on management actions are inadequate to ensure long-term sustainability of fisheries habitat, native fish communities, and fishing. In addition to traditional fisheries programs, management efforts must be expanded to address fish community imbalance, exotic infestation threats, increasing water level, and land use activities that have diminished stormwater retention and increased volume and rate of runoff to managed basins.

Management investments must include:

- Vigilant and comprehensive environmental review of proposed land use changes or shoreline development with a stronger emphasis on cumulative impacts.
- Identification and protection of important or unique walleye spawning habitat
- Promotion of site-specific BMP's throughout the watershed area to retain or slow runoff waters, reduce nutrient transport, and restore a near-normal hydrograph.
- Initiation or expansion of water quality monitoring efforts to include tributaries, ditch culverts, and other discharge sites to better document and address nutrient delivery and hydrologic alterations associated with drainage, road development, and impervious surfacing.
- Sustained awareness and vigilance of the Lake Association and other lake users in recognizing, preventing, and developing control strategies for infestations of harmful exotics or pathogens.
- Promotion of responsible and "smart" fishing to direct harvest to where needed, and as appropriate, expand use of harvest regulations to restore and sustain quality, fishing opportunities.
- Promotion of "retrofitting" actions to restore or correct inappropriate land and shoreland management practices associated with existing development and land uses. Preserve existing riparian wetlands and sand ridges to afford some retention and filtering of runoff.
- Preservation of some portion of the shoreline holding important or critical fisheries habitats in an undeveloped or natural state through acquisition, conservation easements, or other means.
- Discussion and public discourse on need and merits of surface water zoning restrictions to address public safety, surface water use conflicts, habitat or shoreline protection, and preservation of enjoyable fishing experiences.
- Recruitment of knowledgeable and environmentally sensitive residents from outside agricultural or pro-development communities to serve on land use planning committees and governmental positions and balance decision-making.

Inventory/Management Planning Evaluations/Planning

Standardized fisheries surveys will be sustained as possible at a four-year frequency. Survey methodology will also include spring electrofishing to describe largemouth bass population attributes. There is need to standardize bass electrofishing sampling to night or day events to address potential sampling bias induced by clear water and boat avoidance. Standard surveys will be scheduled to occur in 2017, 2021, and 2025. Sampling efforts in 2017 will be augmented with IBI sampling methodology in support of the second round of MPCA WRAPS diagnostic monitoring for the Chippewa River watershed.

Annual fall electrofishing surveys will continue indefinitely to gain estimates of young-of-year and age-1 walleye densities from which to assess relative contributions of natural recruitment and/or fry stockings to year class strength, gain a predictive indicator of annual recruitment to the fishery, and provide justification to support or restrain additional DNR or private walleye fingerling stockings.

Targeted spring or fall trap netting assessments may be completed to more accurately assess black crappie abundance and age or size distribution if angler interest and management emphasis is redirected from the walleye fishery.

Recreational use, fishing pressure, and harvest information would greatly aid in evaluating management programming successes, establishing outcome based management objectives, and justifying management investments.

Important walleye and northern pike spawning habitats and locations should be georeferenced, cataloged, and evaluated for possible enhancements or in case of northern pike, determine if potential exists to temporally restrict spawning migrations to key spawning areas.

Lake Association volunteers are encouraged to sustain participation in the Douglas County Trophic Status water quality monitoring project and as possible expand monitoring activities to collect water from natural and structural inlets to document runoff volumes and pollutant loading from sub-watersheds in order to prioritize and direct remedial actions. Volunteers should also continue to read and report water level measurements to the DNR, Division of Ecological and Waters Resources, particularly in light of a sustained increase in surface water elevation over time.

It would be beneficial to understand gamefish movements among connected basins to better understand the influence of fish movements on gamefish standing stock, fish community structure, management effectiveness, as well as, potentially locate key or critical spawning locations.

References

Heiskary, S. A. and C. B. Wilson. 1989. The regional nature of lake water quality across Minnesota: an analysis for improving resource management. Journal of the Minnesota Academy of Science 55(1): 71-77.

Larscheid, J. G. et al. 2001. The relationship of catch per unit effort to estimated density of YOY and yearling walleyes in Spirit, East Okoboji, Clear, and Storm Lakes, and an evaluation of the use of trend data for managing natural lakes in northwest Iowa. Iowa Department of Natural Resources, Natural Lakes Investigations, Project No. F-160-R.

Schalekamp, A. 1988. Evaluation of fish aggregating devices in Big Chippewa Lake. Minnesota Department of Natural Resources, Section of Fisheries Fish Management Report Series No. 29.

Schupp, D. and B. Wilson. 1993. Developing lake goals for water quality and fisheries. Lake Line, December Issue.

<table>
<tr><td>Mgmt Class
Walleye - Centrarchids</td><td>Ecological Class
Walleye - Centrarchids</td><td colspan="2">FOR CENTRAL OFFICE USE ONLY</td></tr>
<tr><td>Primary Species Mgmt
Walleye</td><td>Secondary Species Mgmt
Bass/Panfish/Nop</td><td colspan="2"></td></tr>
<tr><td>Area Supervisor's Signature</td><td>Date</td><td>Entry Date</td><td>Year Resurvey</td></tr>
<tr><td colspan="2"></td><td>_ _/ _ _ /</td><td></td></tr>
<tr><td>Regional Supervisor's Signature</td><td>Date</td><td colspan="2">Stock Species - Size - Number per Acre</td></tr>
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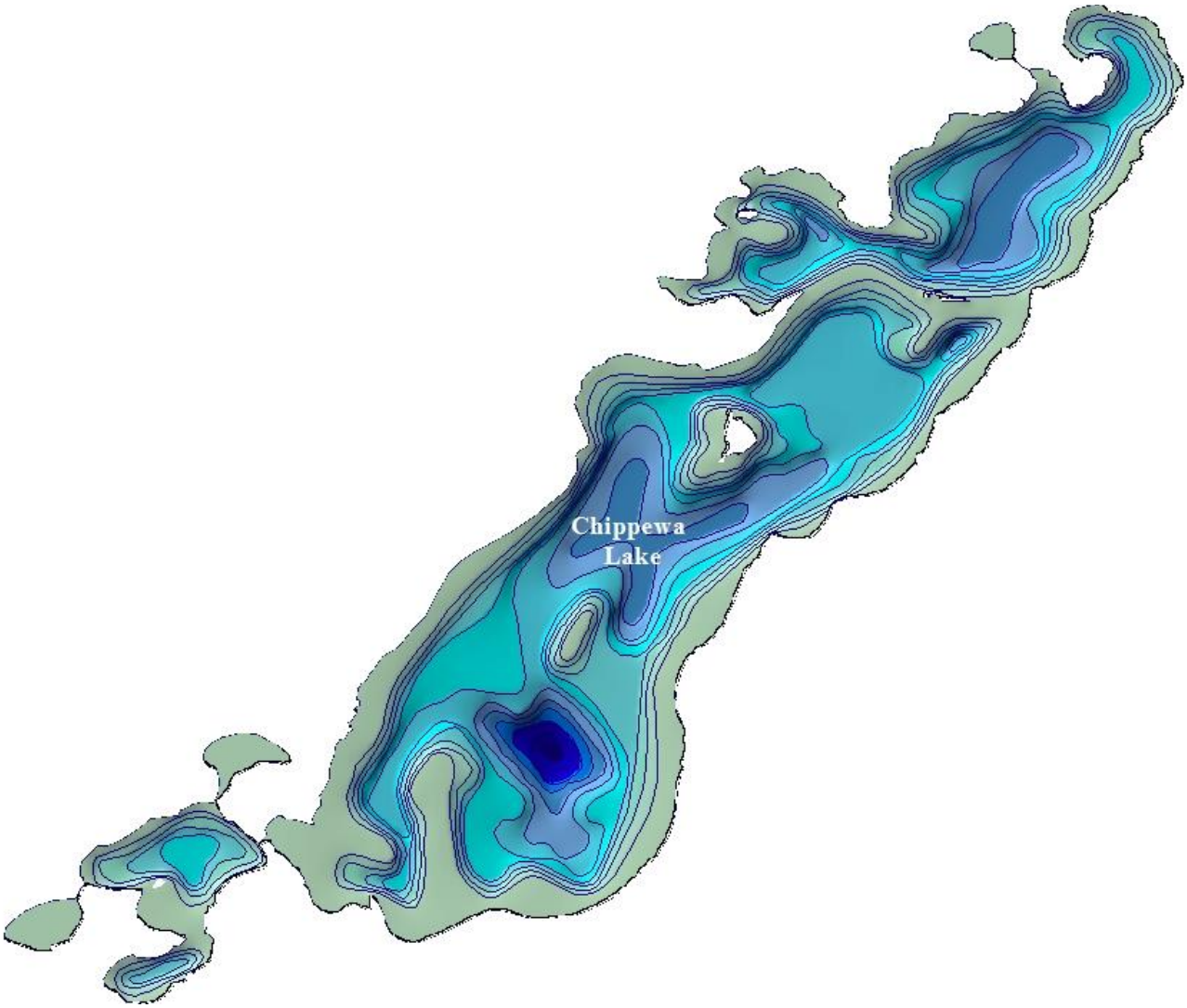
Plan Appendices

Lake: Chippewa (Big)
County: Douglas
Protected Waters Inventory No.: 21-0145
Lake Class: 22

Basin Morphology

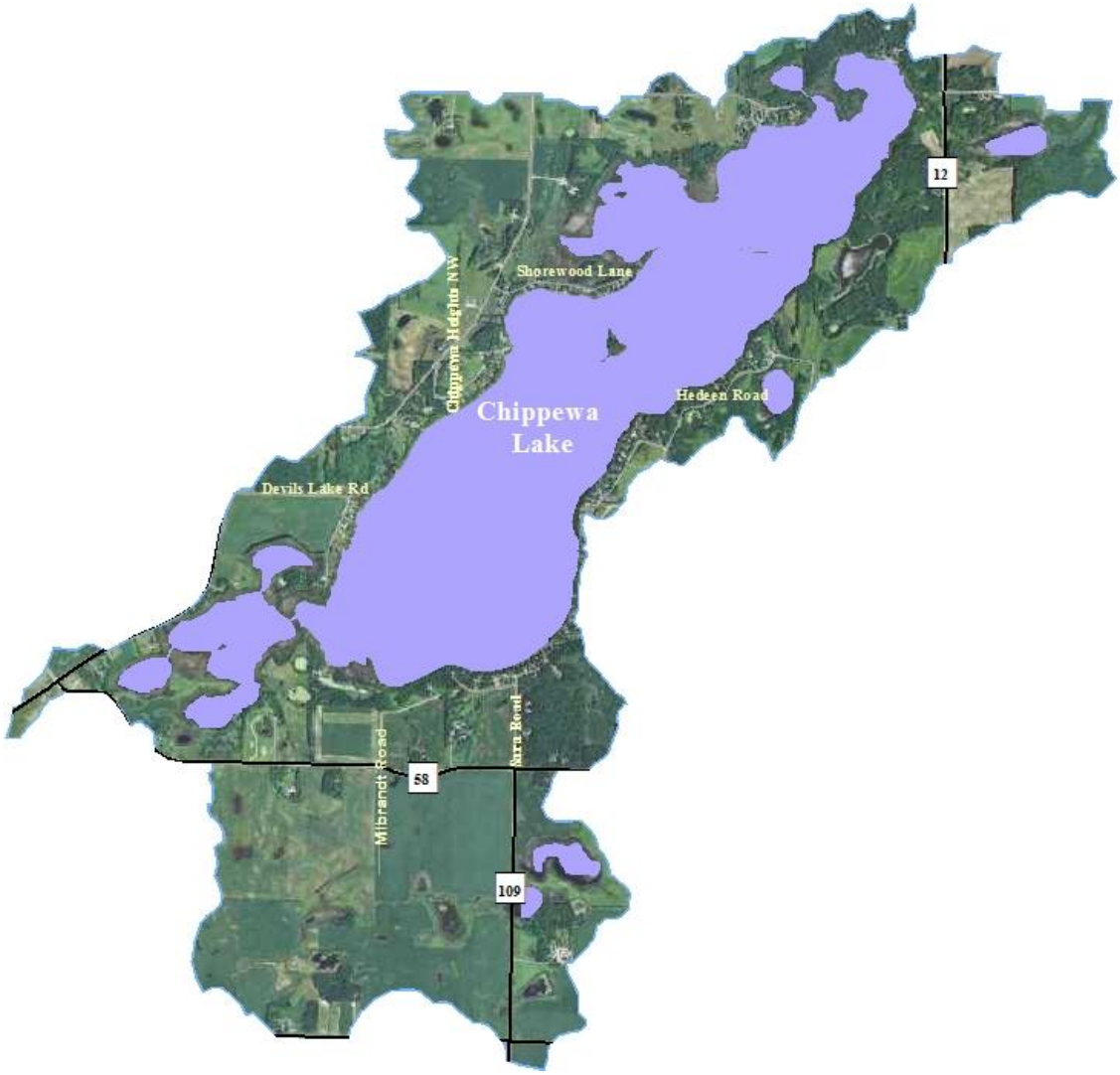
Big Chippewa Lake, Douglas County



Surface Area:	1,175 acres
Littoral Area:	551 acres
Miles of Shoreline:	13.8
Shoreline Development Factor:	2.87
Maximum Depth:	95.0 feet
Average Depth:	24.0 feet

Catchment Area

Big Chippewa Lake, Douglas County



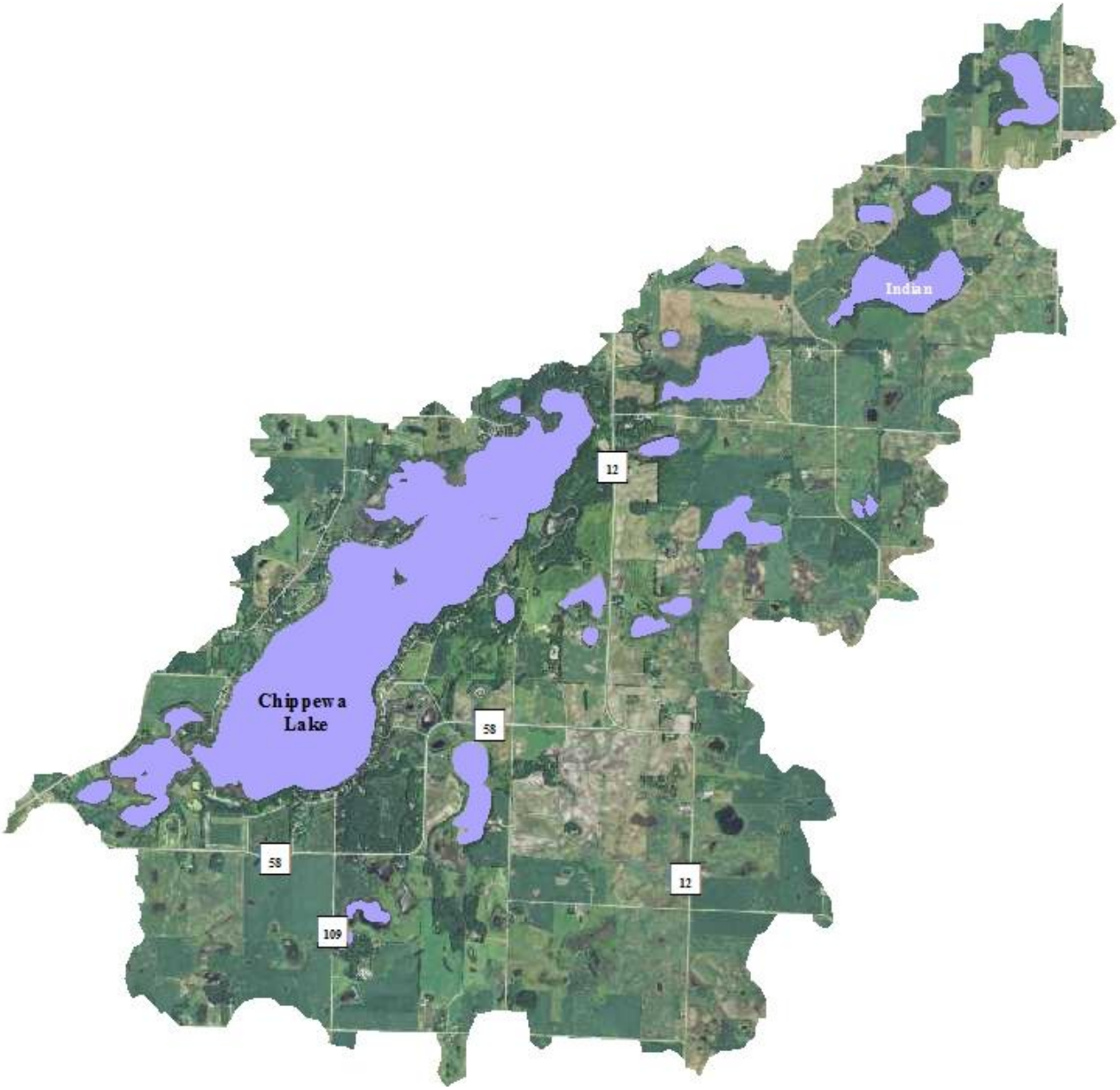
Catchment Area:	3,916 acres
Lake Surface Area:	1,175 acres
Watershed/Surface Area Ratio:	3.3:1

Catchment Topography

Big Chippewa Lake, Douglas County

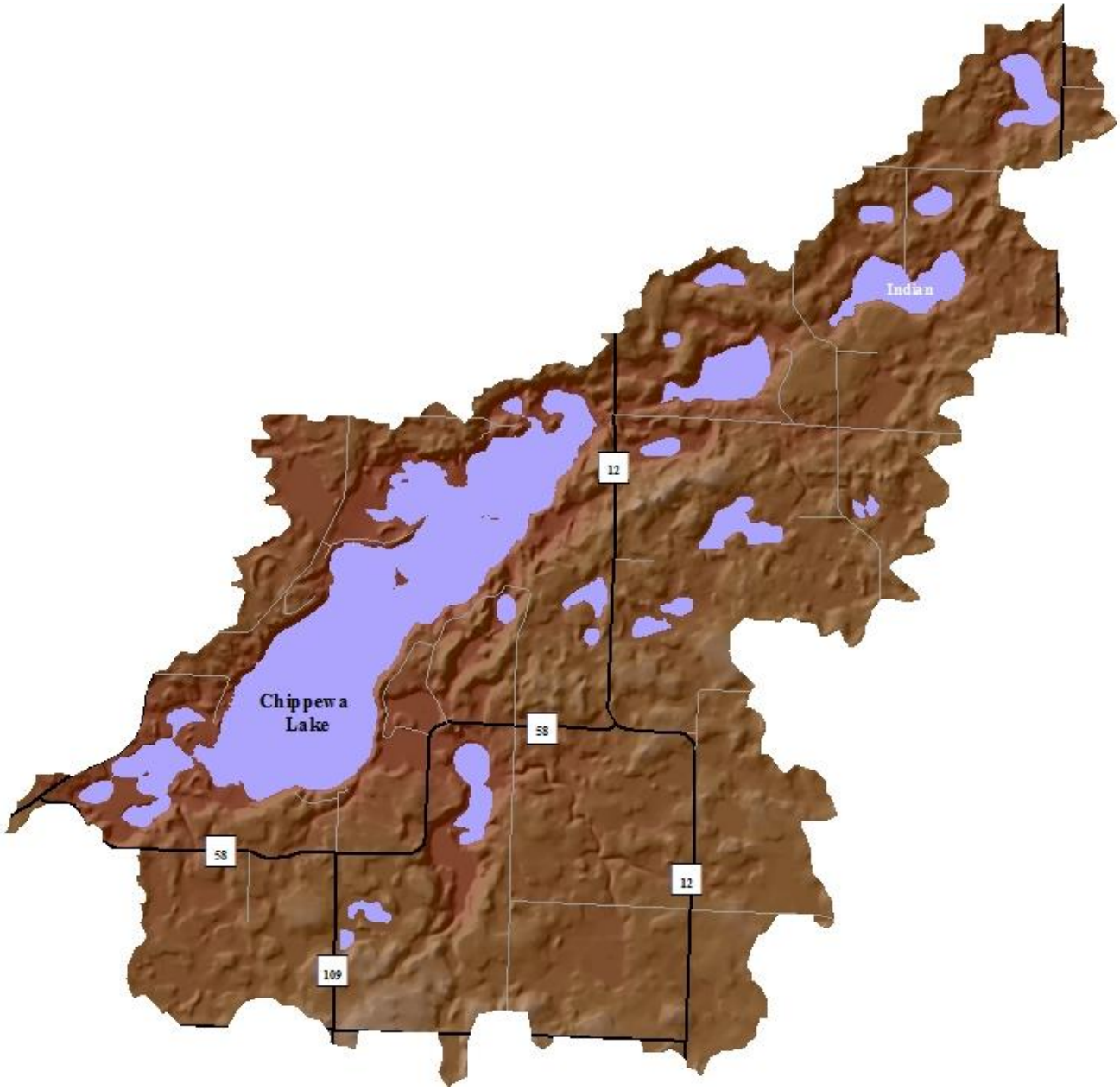
Total Watershed Area

Big Chippewa Lake, Douglas County



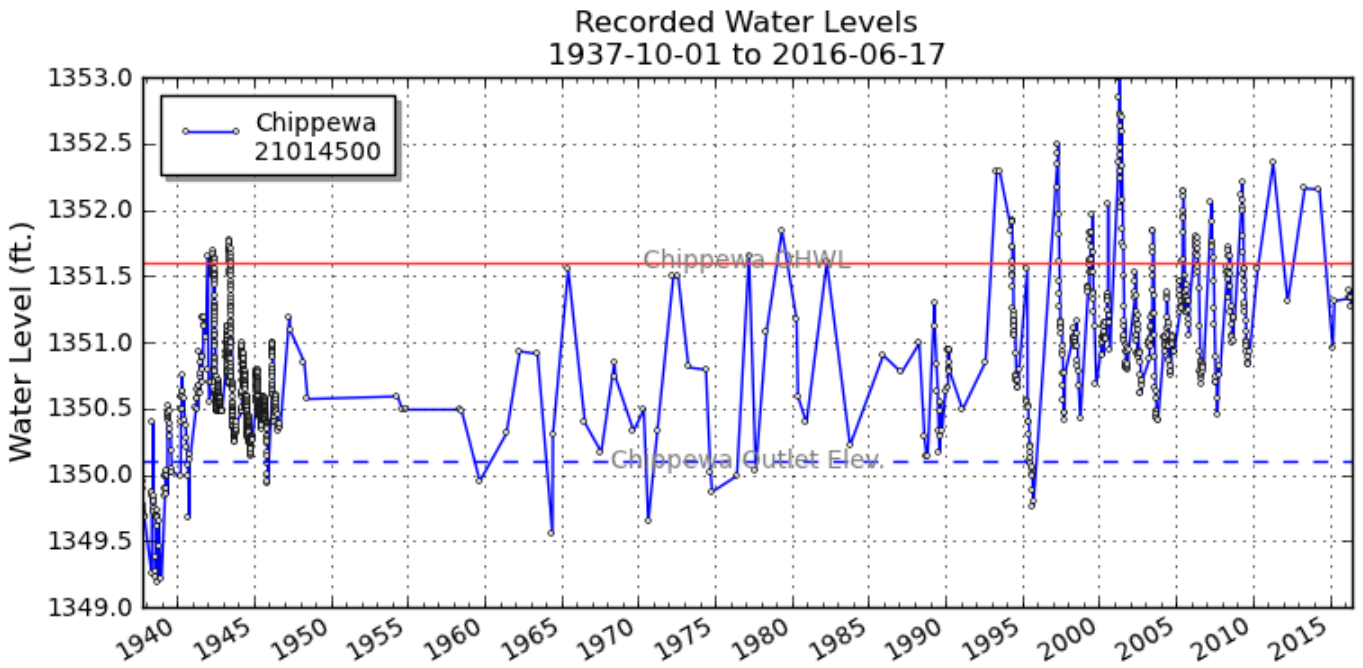
Estimated Watershed Area:	12,286 acres
Lake Surface Area:	1,175 acres
Watershed/Surface Area Ratio:	10.5:1

Watershed Topography
Big Chippewa Lake, Douglas County



Water Level Summary

Big Chippewa Lake, Douglas County



Period of record:	10/02/1937 – 6/16/2016
# of readings:	1,620
Highest recorded:	1353.00 (4/26/2001)
Lowest recorded:	1349.19 (10/19/1938)
Recorded range:	3.81 feet

Water Quality Assessments

Big Chippewa Lake, Douglas County

MN Lake ID: 21-0145
County: Douglas
Ecoregion: Northern Central Hardwood Forests
Major Drainage Basin: Minnesota River

Years monitored: 1997 - 2016 (RMB database only)

Measured Parameters	Site 202- P
Total Phosphorus Mean (ug/L):	17.2
Total Phosphorus Min (ug/L):	7.0
Total Phosphorus Max (ug/L):	45.0
Number of Observations:	61
Chlorophyll-a Mean (ug/L):	4.5
Chlorophyll-a Min (ug/L):	< 1.0
Chlorophyll-a Max (ug/L):	19.0
Number of Observations:	61
Secchi Depth Mean (ft.):	11.2
Secchi Depth Min (ft.):	5.0
Secchi Depth Max (ft.):	23.0
Number of Observations:	56

Long Term Trends*	
Total Phosphorus:	No Significant Trend Exists
Chlorophyll-a:	No Significant Trend Exists
Secchi Depth:	No Significant Trend Exists
Trophic State Index:	No Significant Trend Exists

* *A minimum of 8-10 years of data with 4 or more readings per season are recommended. Minimum confidence accepted by the MPCA is 90%*

EcoRegion Comparisons**	
Total Phosphorus:	Below Expected Range
Chlorophyll-a:	Below Expected Range
Secchi Depth:	Above Expected Range

** *Comparisons are based on interquartile range, 25th - 75th percentile, for ecoregion reference lakes*

Trophic State Index Mean: 43.6
Trophic State: Mesotrophic

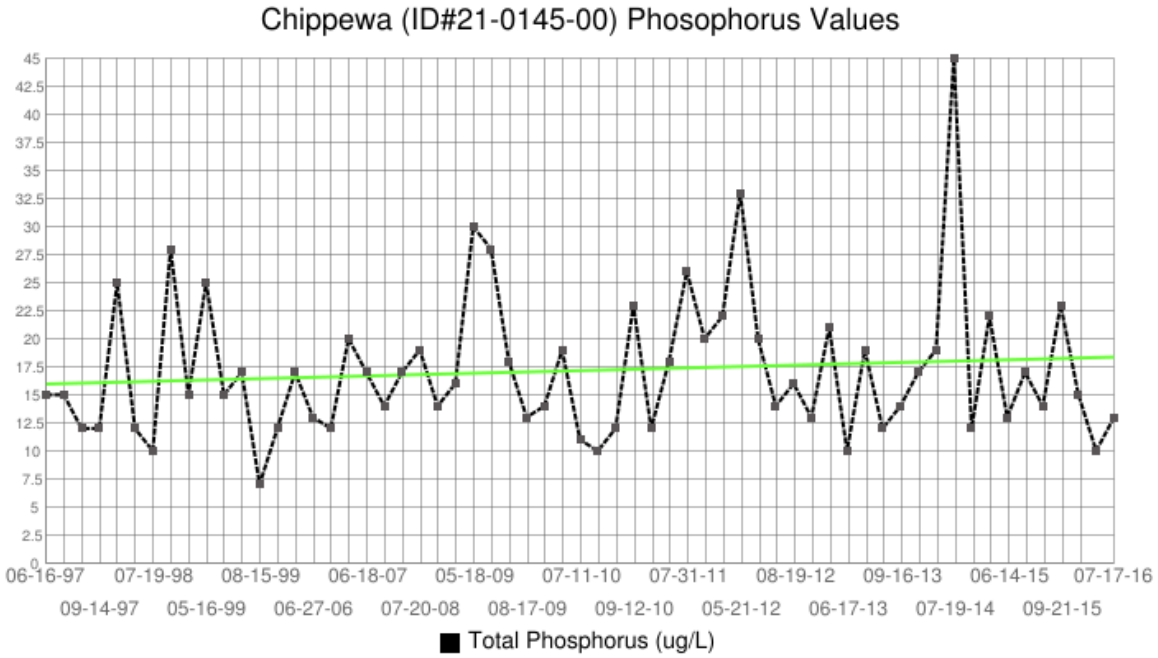
Information courtesy of:

RMB Environmental Laboratories, Inc.
22796 County Highway 6
Detroit Lakes, MN 56501
Phone: (218) 846-1465

Water Quality Analysis: Total Phosphorous

Big Chippewa Lake, Douglas County

County	MN Lake ID	Lake	Site	Data Evaluated	Date Range	Data Source
Douglas	21-0145-00	Chippewa	**202**	Phosphorus	06/16/1997 – 07/17/2016	RMB



Mann-Kendall Statistic for Trend Significance

Sample Count (n) = 61
Mann-Kendall Statistic = 99
Z = 0.6098

Probability of True Trend	Probability of Type 1 Error (alpha)	Z Critical
99.9%	0.001	3.27
99%	0.01	2.575
95%	0.05	1.96
*90%	0.1	1.645
80%	0.2	1.29
* Minimum probability used by the MPCA		

No Significant Trend Exists

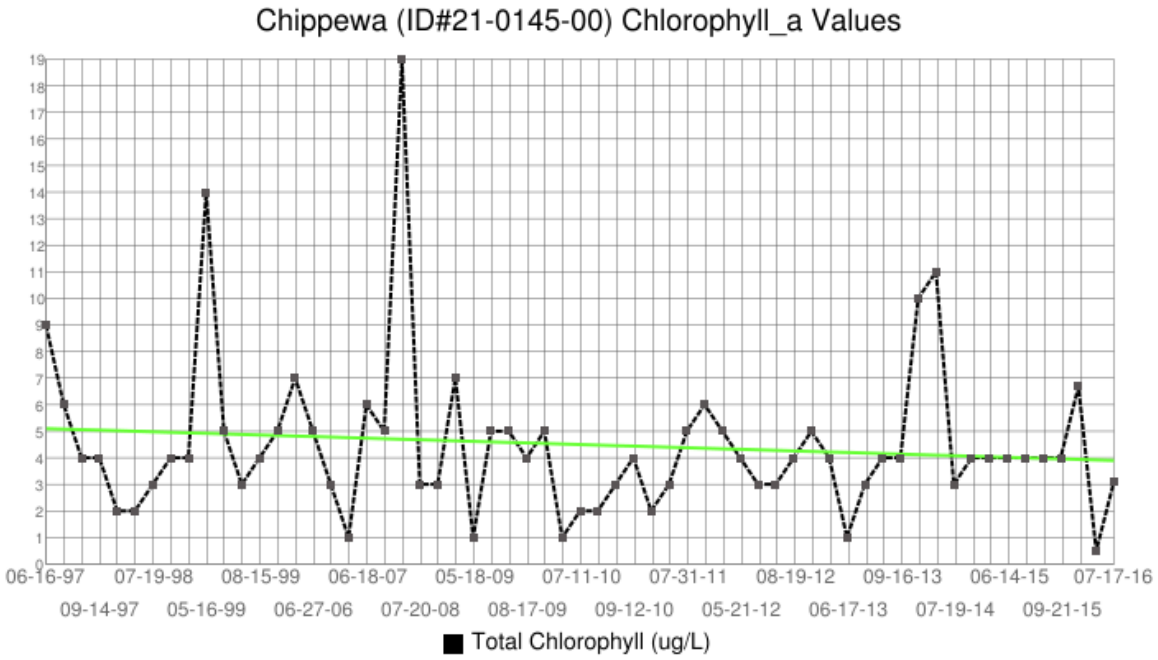
Information courtesy of:

RMB Environmental Laboratories, Inc.
22796 County Highway 6
Detroit Lakes, MN 56501
Phone: (218) 846-1465

Water Quality Analysis: Chlorophyll-*a*

Big Chippewa Lake, Douglas County

County	MN Lake ID	Lake	Site	Data	Date Range	Data Source
Douglas	21-0145-00	Chippewa	**202**	Chlorophyll-*a*	06/16/1997 – 07/17/2016	RMB



Mann-Kendall Statistic for Trend Significance

Sample Count (n) = 61
Mann-Kendall Statistic = -99
Z = 0.6098

Probability of True Trend	Probability of Type 1 Error (alpha)	Z Critical
99.9%	0.001	3.27
99%	0.01	2.575
95%	0.05	1.96
*90%	0.1	1.645
80%	0.2	1.29
* Minimum probability used by the MPCA		

No Significant Trend Exists

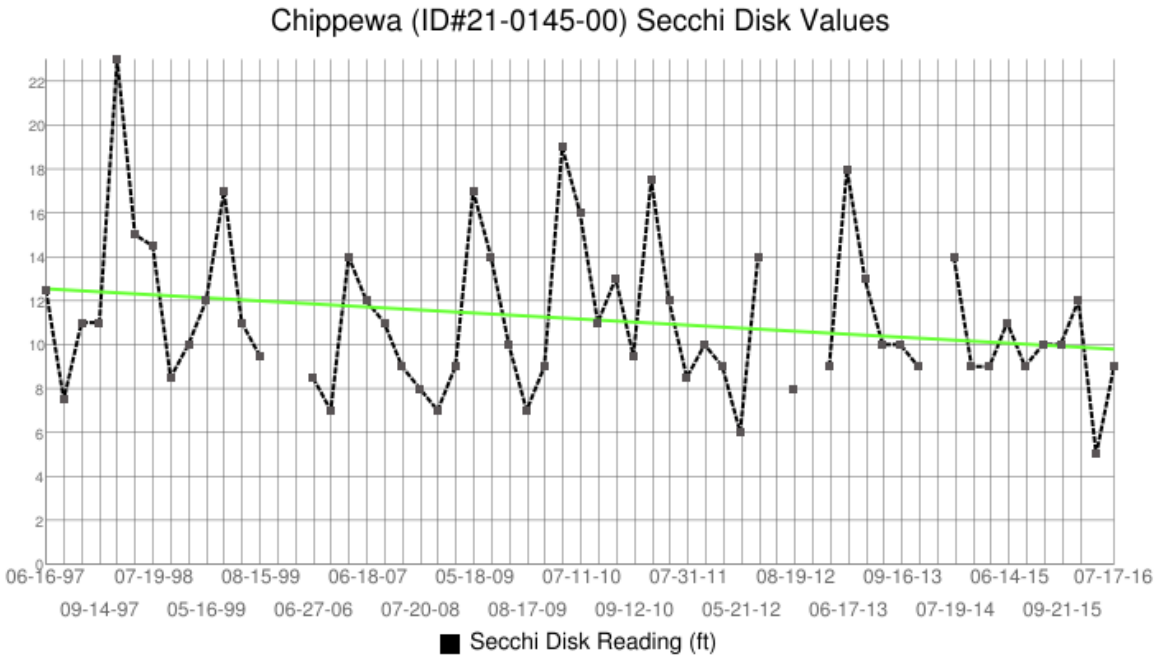
Information courtesy of:

RMB Environmental Laboratories, Inc.
22796 County Highway 6
Detroit Lakes, MN 56501
Phone: (218) 846-1465

Water Quality Analysis: Secchi Transparency

Big Chippewa Lake, Douglas County

County	MN Lake ID	Lake	Site	Data Evaluated	Date Range	Data Source
Douglas	21-0145-00	Chippewa	**202**	Secchi Transparency	06/16/1997 – 07/17/2016	RMB



Mann-Kendall Statistic for Trend Significance

Sample Count (n) = 56
Mann-Kendall Statistic = -181
Z = 1.2722

Probability of True Trend	Probability of Type 1 Error (alpha)	Z Critical
99.9%	0.001	3.27
99%	0.01	2.575
95%	0.05	1.96
*90%	0.1	1.645
80%	0.2	1.29
* Minimum probability used by the MPCA		

No Significant Trend Exists

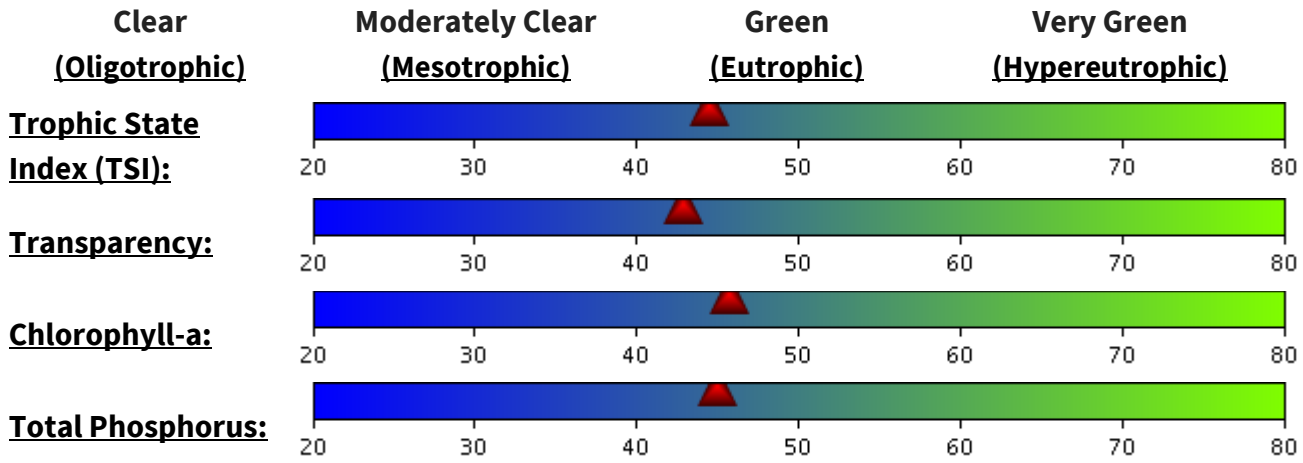
Information courtesy of:

RMB Environmental Laboratories, Inc.
22796 County Highway 6
Detroit Lakes, MN 56501
Phone: (218) 846-1465

Trophic State

Big Chippewa Lake, Douglas County

TSI calculations are based on data collected between June and September 2006 to 2015



Parameter	10-Year average of all summer samples	Parameter TSI	Expected TSI range for lakes in same ecoregion	Number of samples
Transparency (m)	3	43	**N/A**	37
Chlorophyll-a (*u*g/L)	5	46	**N/A**	38
Total Phosphorus (*u*g/L)	17	45	**N/A**	38

Overall Trophic State Index for This Lake: 45

Information courtesy of:
Minnesota Pollution Control Agency
& Citizen Monitors

Beneficial Use Assessments

Big Chippewa Lake, Douglas County

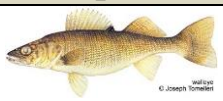
Beneficial use	Assessment year	Assessed condition	Impairment cause	Restoration project no
Aquatic consumption	2007	One or more standards not met	Mercury in fish Tissue	http://www.pca.state.mn.us/wfhy9ef
Aquatic recreation	2011	Standards Met for all Assessed Parameters		

Overall Condition:

Suitable for swimming and wading, with good clarity and low algae levels throughout the open water season. Concentrations of mercury in fish tissue exceed the water quality.

Information courtesy of:
Minnesota Pollution Control Agency

Gamefish Population Attributes: Big Chippewa Lake, Douglas County

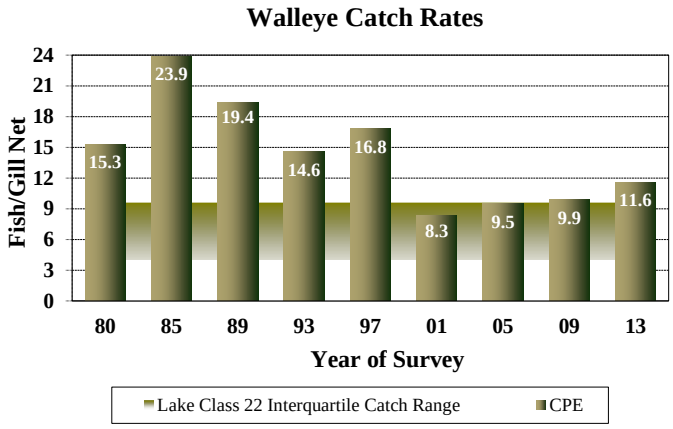


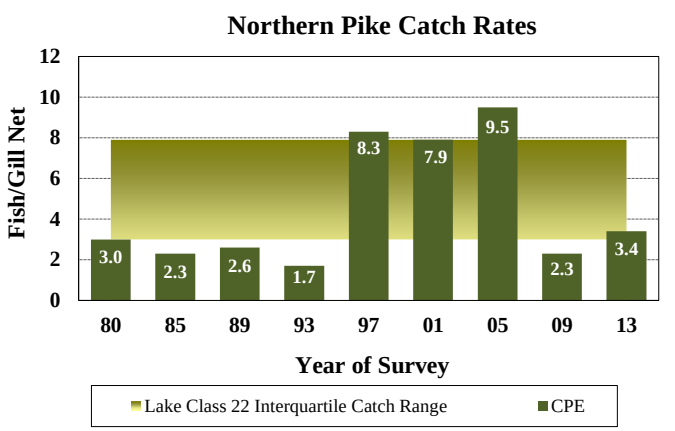
Walleye

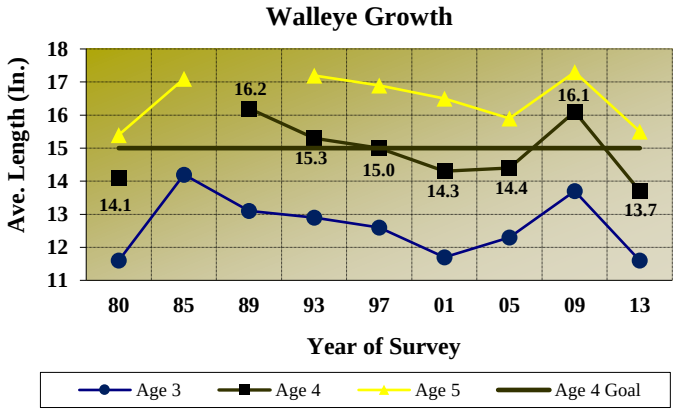
Management Objectives
Gill Net CPE: > 12/net
Average Growth: 15” at age 4
Size Structure: PSSQ ≈ 60; PSSP ≈ 10

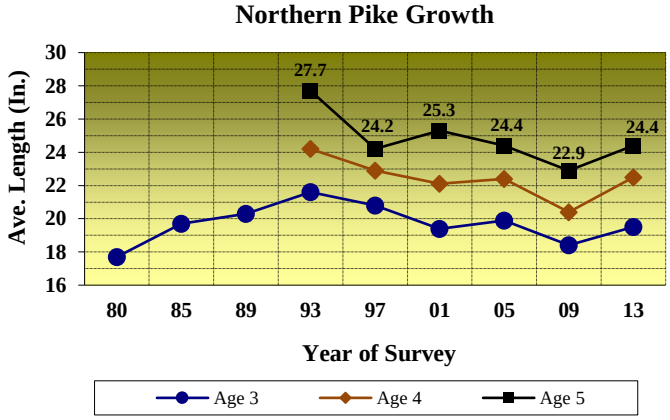
Northern pike

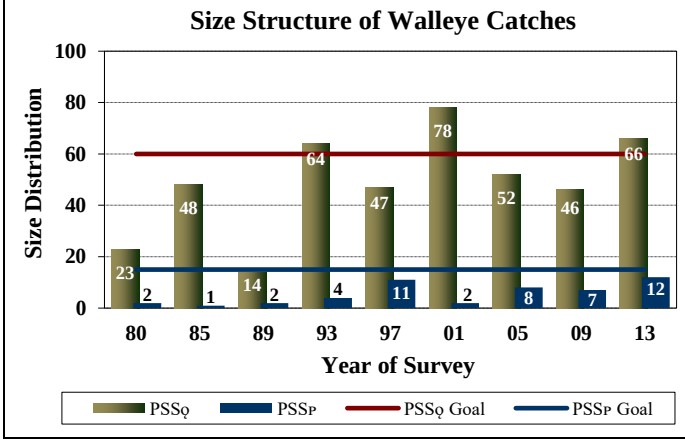
Management Objectives
Gill Net CPE: < 5/net
Size Structure: PSSQ > 60; PSSP > 10

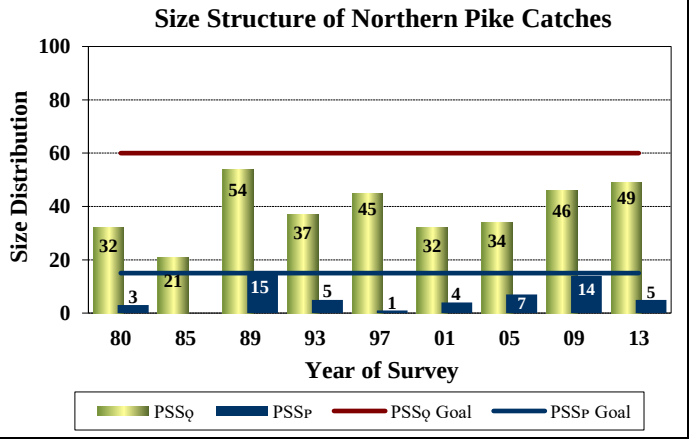












Gamefish Population Attributes: Big Chippewa Lake, Douglas County

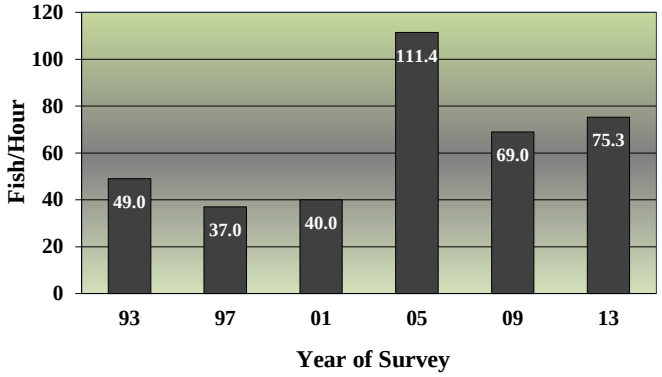
Largemouth bass

Management Objectives
Electrofishing CPE: 50 - 80/Hour
Average Growth: 15" by age 5
Size Structure: PSS$_Q$ ≈ 70; PSS$_P$ ≥ 20

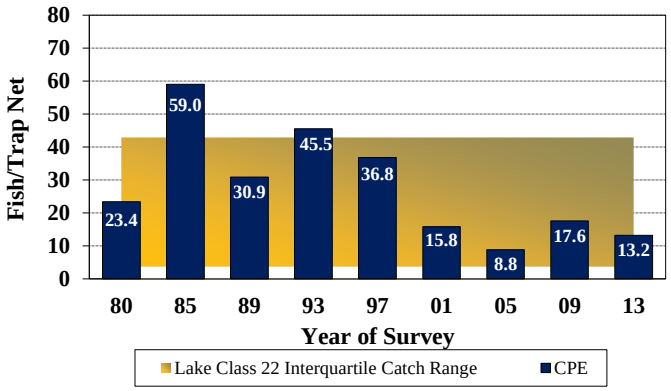
Bluegill sunfish

Management Objectives
Trap Net CPE: 15 – 30/net
Average Growth: 6" by age 5
Size Structure: PSS$_Q$ > 50; PSS$_P$ > 5

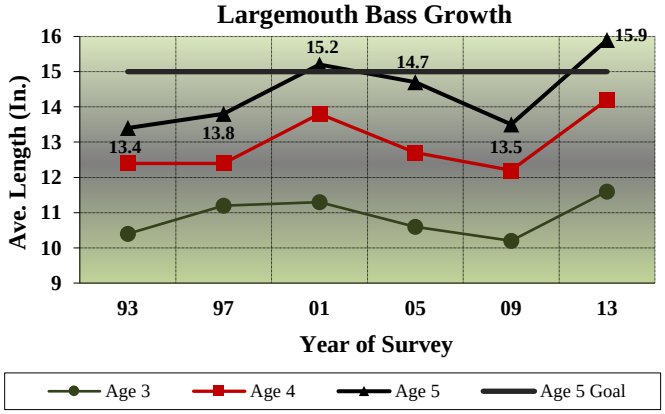
Largemouth Bass Catch Rates



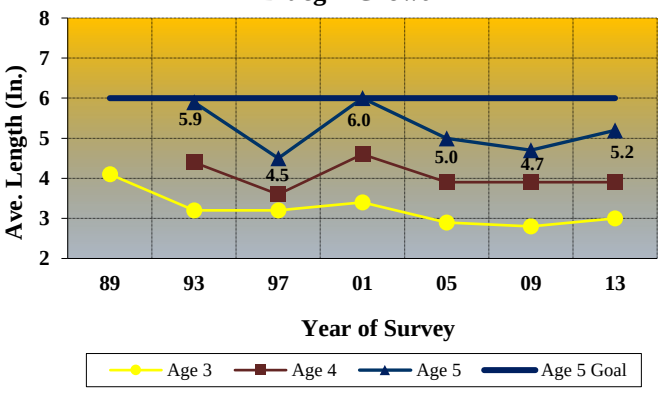
Bluegill Catch Rates



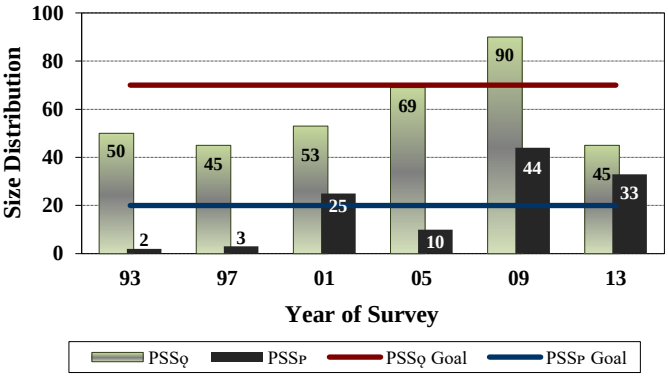
Largemouth Bass Growth



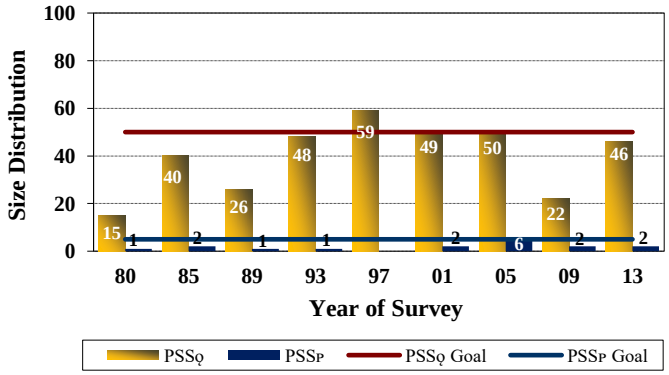
Bluegill Growth



Size Structure of Largemouth Bass Catches



Size Structure of Bluegill Catches



Gamefish Population Attributes: Big Chippewa Lake, Douglas County

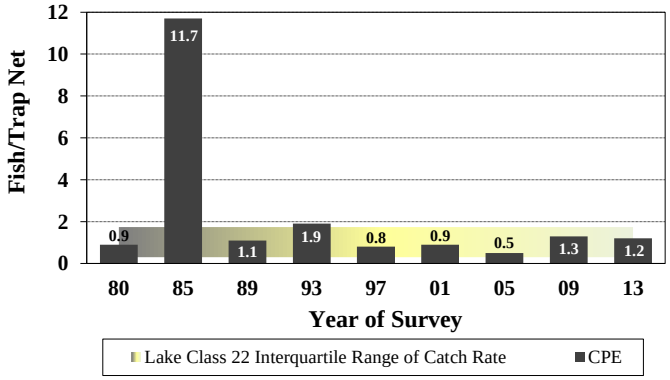
Black crappie

Management Objectives
Trap Net CPE: ≥ 1.5/net
Average Growth: 10” by age 5
Size Structure: PSSQ ≈ 70; PSSP ≥ 10

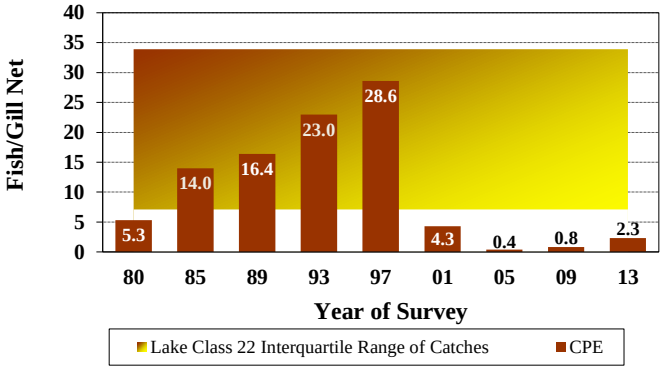
Yellow perch

Management Objectives
Gill Net CPE: >10/net
Size Structure: PSSQ > 10

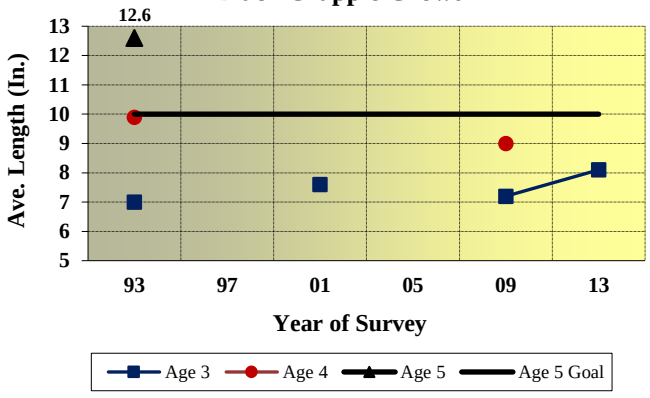
Black Crappie Catch Rates



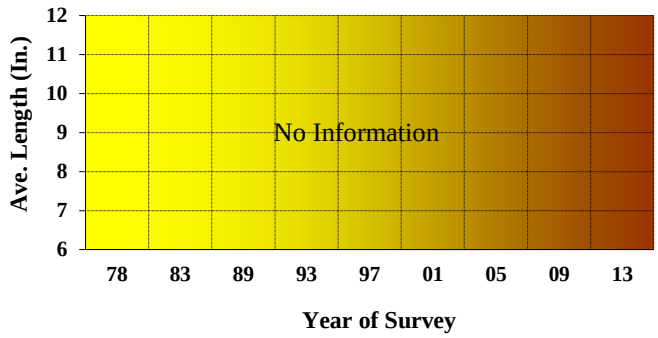
Yellow Perch Catch Rates



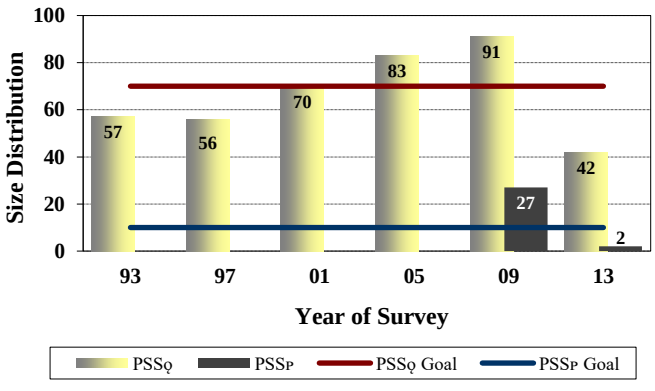
Black Crappie Growth



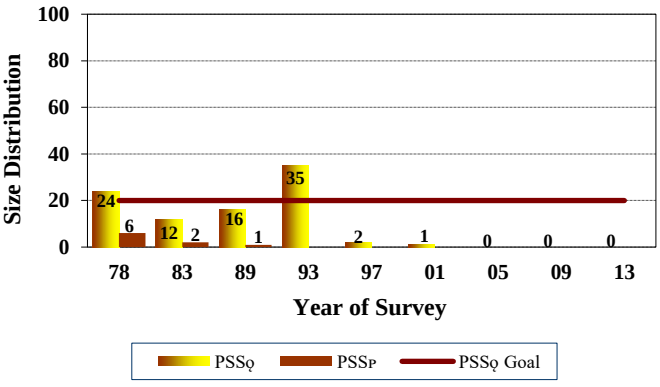
Yellow Perch Growth



Size Structure of Black Crappie Catches



Size Structure of Yellow Perch Catches

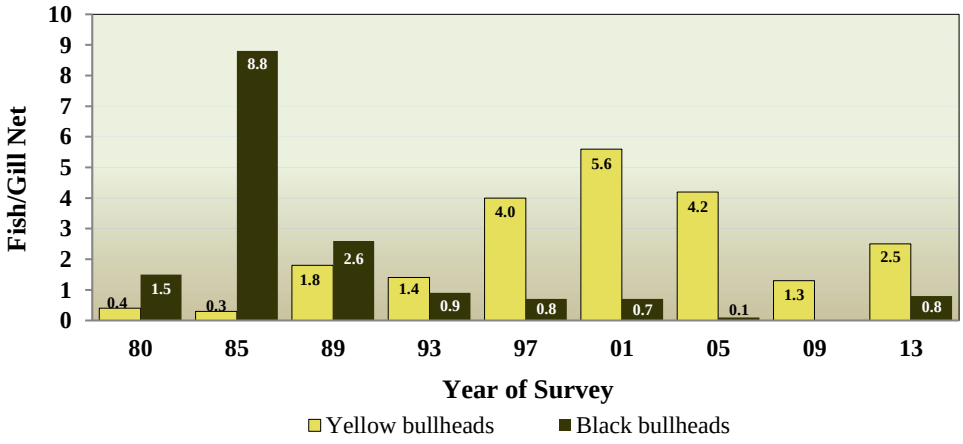


Other Fish Community Attributes: Big Chippewa Lake, Douglas County

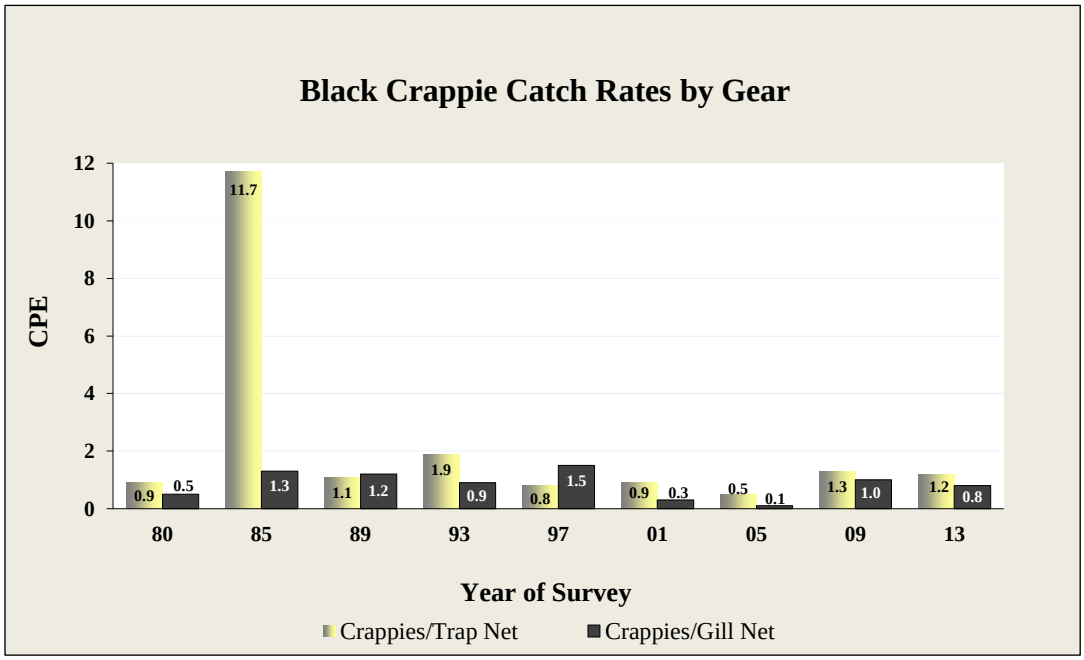
Ictalurid Abundance & Catch Differential

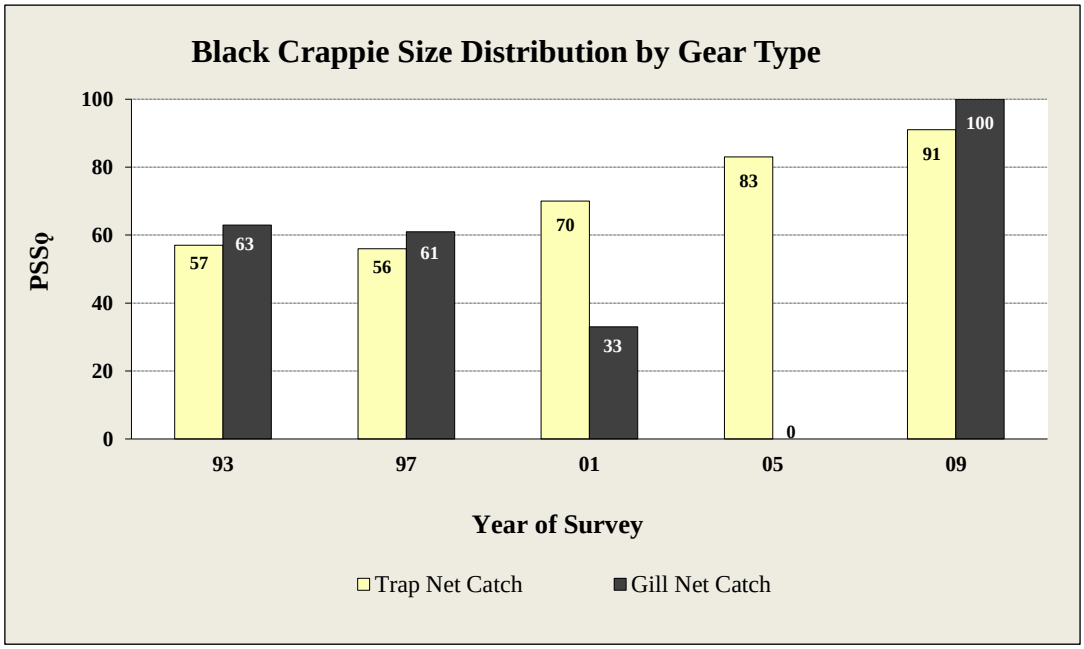
Yellow Bullhead

Black Bullhead

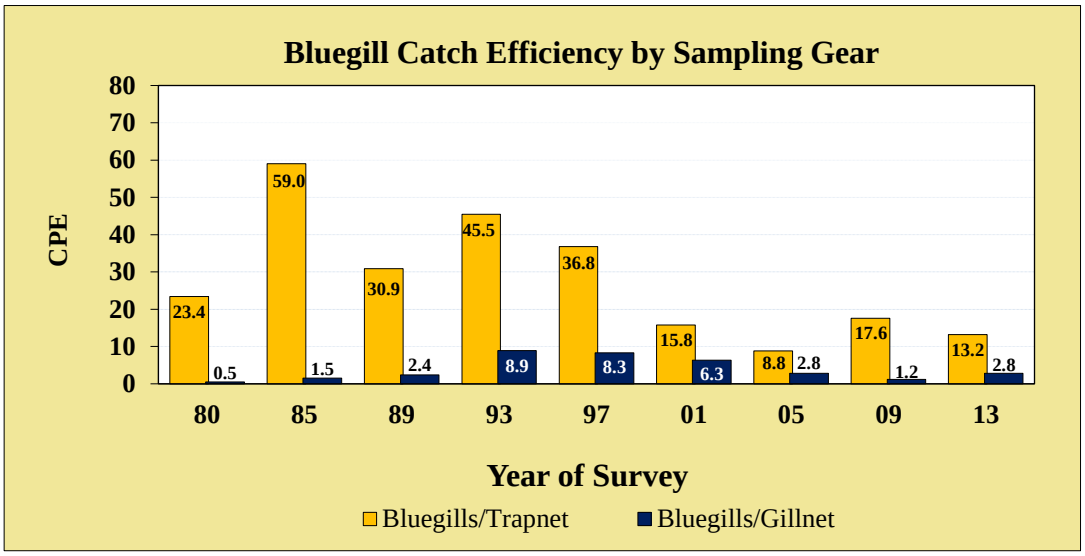


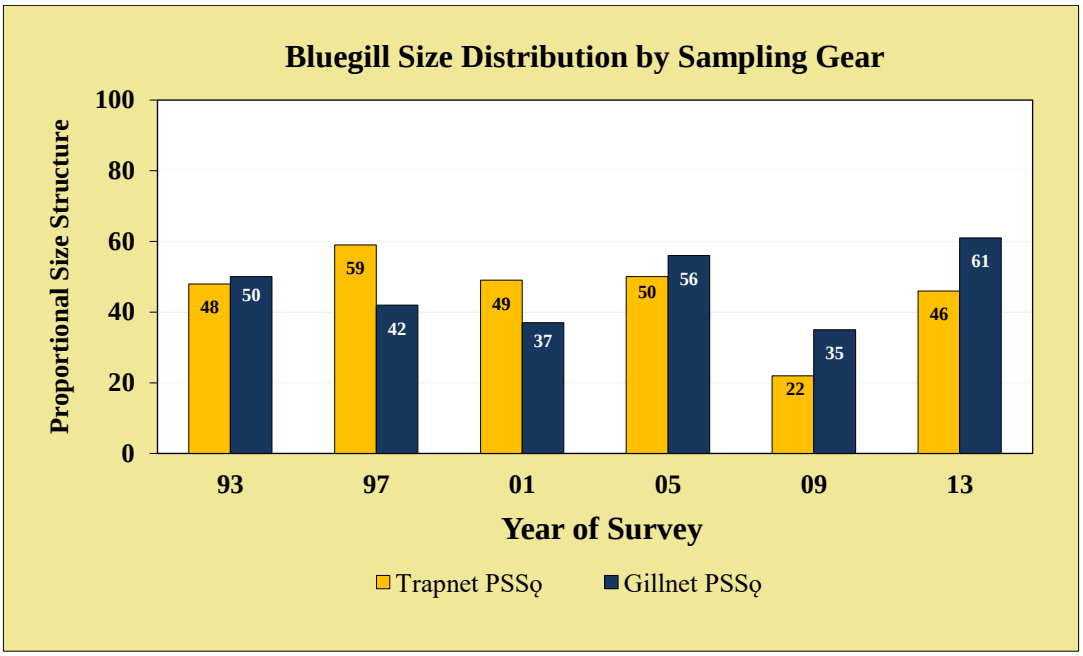
Black Crappie Catch Comparisons by Sampling Gear
Big Chippewa Lake, Douglas County





Bluegill Catch Comparisons by Sampling Gear
Big Chippewa Lake, Douglas County





Fall, Young-of-Year Walleye Catch Summary
Big Chippewa Lake, Douglas County

Year	Electrofishing CPE (walleye/hour)	Fry Stocking (Y/N)	Number Stocked
1992	5.8	N	
1993	12.7	N	
1994	32.8	N	
1995	29.0	N	
1996	101.2	Y	757,500
1997	47.5	N	
1998	45.8	Y	760,000
1999	4.0	N	
2000	<1.0	Y	760,000
2001	31.0	Y	684,000
2002	22.0	Y	1,320,000
2003	54.5	Y	759,982
2004	14.0	Y	1,186,040
2005	7.0	N	
2006	66.9	Y	1,186,000
2007	67.9	N	
2008	118.6	Y	1,194,288
2009	24.4	N	
2010	34.3	Y	1,190,804
2011	5.4	N	
2012	47.0	Y	1,178,220
2013	68.6	Y	1,175,000
2014	66.1	Y	1,300,000
2015	57.0	N	

YOY Walleye Catch Comparison:	
CPE in Non-Stocked Years:	**26.7**
CPE in Years Fry Stocked:	**51.6**

Fish Management Plan Progress/Comment Sheet

Region	Area	DOW#	County	Lake	Class	Acreage
NW	Glenwood F116	21-0145	Douglas	**Big Chippewa**	22	SA 1,175 LA 551

Action Category: Inventory	
Date	**Achievements/Observations/Comments**
2015	Fall electrofishing survey – YOY walleyes
2014	Fall electrofishing survey – YOY walleyes
2013	Fall electrofishing survey – YOY walleyes
8/5-8/2013	Re-Survey completed
2012	Fall electrofishing survey – YOY walleyes
2011	Fall electrofishing survey – YOY walleyes
2010	Fall electrofishing survey – YOY walleyes
2009	Fall electrofishing survey – YOY walleyes
8/3-6/2009	Fish community assessment completed
2008	Fall electrofishing survey – YOY walleyes
2007	Fall electrofishing survey – YOY walleyes
2006	Fall electrofishing survey – YOY walleyes
2005	Fall electrofishing survey – YOY walleyes
8/1-3/2005	Fish community assessment completed
2004	Fall electrofishing survey – YOY walleyes
2003	Fall electrofishing survey – YOY walleyes
2002	Fall electrofishing survey – YOY walleyes
2001	Fall electrofishing survey – YOY walleyes
7/30-8/2/2001	Fish community assessment completed
2000	Fall electrofishing survey – YOY walleyes

Action Category: Stocking & Other Direct Fish Management	
Date	**Achievements/Observations/Comments**
5/2016	Walleye fry stocked: 1,294,122 fry
5/2014	Walleye fry stocked: 1,300,000 fry
3/2012	Walleye yearlings stocked by Brandon Fins & Feathers Club & Lake Association: 50 lbs – 750 fish
5/2012	Walleye fry stocked: 1,178,220 fry
5/2010	Walleye fry stocked: 1,190,804 fry
10/2009	Walleye fingerlings stocked by Viking Sportsmen Inc & Lake Association: 400 lbs – 8,000 fish
5/2008	Walleye fry stocked: 1,194,288 fry
5/2006	Walleye fry stocked: 1,186,040 fry
5/2004	Walleye fry stocked: 1,186,040 fry
5/2003	Walleye fry stocked: 759,982 fry
5/2002	Walleye fry stocked: 1,320,000 fry
5/2001	Walleye fry stocked: 684,000 fry
5/2000	Walleye fry stocked: 760,000 fry

Action Category: Habitat Protection/Enhancement	
Date	**Achievements/Observations/Comments**
2015	Big Chippewa AMA posted and encroachment issues addressed. CCM crew performed some buckthorn and honeysuckle control.

Action Category: Harvest Management/Regulations	
Date	**Achievements/Observations/Comments**
Action Category: Education	
Date	**Achievements/Observations/Comments**

Action Category: Cooperation/Integration	
Date	**Achievements/Observations/Comments**

Action Category: Other	
Date	**Achievements/Observations/Comments**
2012	Central Lakes Region Sanitary District project fails after several townships pull out of project
2016	Division of Parks and Trails affect some needed ramp and parking area regarding at public access.