2015

Otter Creek Lake Watershed Plan

The development of the Otter Creek Lake Watershed Management Plan was a cooperative effort among:

Tama County Conservation Board

Tama County Soil & Water Conservation District

Iowa Dep't of Agriculture & Land Stewardship

Iowa Dep't of Natural Resources

Plan Revised January 22, 2020

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EXECUTIVE SUMMARY

Otter Creek Lake is a significant recreational resource that provides opportunities for swimming, boating, fishing, camping, and outdoor education activities. Otter Creek Lake is the largest and most heavily used facility managed by the Tama County Conservation Board (Tama CCB). The 66.1-acre lake was constructed in 1968 and is the center of the 522 acre county park, which is an important recreation site in Central Iowa. The park also serves as the headquarters for the office and maintenance operations of the Conservation Board and the home of the Tama County Nature Center.

Unfortunately, water quality at Otter Creek Lake has been in decline for a number of years. The lake is experiencing excessive algal growth, which has negatively affected the recreational value of the lake. In addition, the lake is being threatened by a rapid rate of siltation. Siltation of the northern one-third of the lake has reached a point to negatively impact use of that portion of the lake. Cattail beds have encroached on the electric camp section blocking views of the lake. Areas of the north end of the lake which were 3' deep in 1979 are now less than 6" and boats have a very difficult time reaching the camp section to be docked.

According to the Tama CCB 2010 Annual Report, the protection of the Otter Creek Lake watershed is an extremely high priority. The CCB has undertaken numerous activities to address water quality issues of Otter Creek Lake, including the construction of siltation ponds and conversion of row crops to grassland and timber within park boundaries. This Otter Creek Lake Watershed Management Plan (WMP) is the next step in identifying additional opportunities to improve water quality. It is a cooperative effort between the Tama CCB, the Tama SWCD, Iowa Natural Resource Conservation Service (Iowa NRCS), the Iowa Department of Agriculture and Land Stewardship IDALS), and the Iowa Department of Natural Resources (IDNR). The plan identifies the sources of water quality problems and develops a management strategy for improving the lake's condition to be carried out over the next ten years.

Otter Creek Lake appears on Iowa's 303(d) List of Impaired Waters in the 2008, 2010, and 2012 reporting cycles. The Primary Contact Recreation designated use has been listed as 'not supporting' due to nuisance algae blooms. Phosphorus is considered the primary pollutant of concern in this plan due to its direct connection to algae blooms in Otter Creek Lake, as described in the Total Maximum Daily Load (TMDL) report (IDNR, 2013). Phosphorus is a nutrient that is essential to plant growth, and when excessive amounts are present in a lake, it can contribute to algal blooms. While is a naturally-occurring element that exists in soils, the TMDL attributes most of the phosphorus load to row crops in the watershed, particularly those on highly erodible lands. The TMDL calls for a 69% reduction in total phosphorus loading to the lake, which amounts to 1,033 pounds per year.

Sediment is a secondary pollutant of concern in the Otter Creek Lake watershed due to its impact on lake levels and because it can be a source of phosphorus. In the Otter Creek Lake watershed, the majority of sediment loading to the lake is from rill and sheet erosion off farm fields, estimated at 1,703 tons of sediment per year. This constitutes 89% of the annual sediment load to the lake.

The plan sets out the following goals for watershed improvement:

- Goal 1: Implement watershed improvement measures to increase water clarity and enhance the lake aesthetics
- Goal 2: Enhance public awareness and understanding of the Otter Creek Lake watershed
- Goal 3: Implement in-lake restoration measures to improve aquatic habitat and recreational opportunities

The watershed management plan will be implemented over the course of 4 phases, with a total project length estimated at 10 years.

- Phase 1 (*Year 1*): The primary activities of Phase 1 will be to initiate the watershed project, conduct outreach to relevant stakeholder groups, and begin the investigations of Best Management Practices on public and private land within the Otter Creek Lake watershed.
- Phase 2 (*Years 2-3*): The primary activities for Phase 2 will be to continue the public outreach, and begin working with watershed landowners to make improvements on private lands.
- Phase 3 (*Years 3-4*): This phase will focus on building a sediment trapping structure on public ground, and continuing to provide incentives to watershed landowners to reduce erosion and nutrient loss from farm fields.
- Phase 4 (*Years 5-10*): Once sediment and phosphorus loading from the watershed have been controlled, the project will seek to partner with the IDNR Lake Restoration Program to implement in-lake restoration measures.

Watershed plan implementation will be administered through a cooperative effort between the Tama County Conservation Board and the Tama Soil & Water Conservation District, with direct input from the Advisory Committee representing all stakeholder groups within the watershed. The project will hold annual meetings with the advisory committee, IDNR Lake Restoration staff, and other stakeholders to discuss progress made in implementing the watershed plan goals.

1. INTRODUCTION

Otter Creek Lake is a significant recreational resource that provides opportunities for swimming, boating, fishing, camping, and outdoor education activities. The lake is part of a park owned and managed by Tama County Conservation Board (Tama CCB) and is widely used in all seasons by the citizens of Tama County. Unfortunately, water quality at Otter Creek Lake has been in decline for a number of years. The lake is currently listed on the state's 303d list of Impaired Waters due to algae, which has negatively affected the recreational value of the lake. In addition, the lake is being threatened by a rapid rate of siltation.

This Otter Creek Lake Watershed Management Plan (WMP) has been initiated by the Tama CCB and the Tama County Soil & Water Conservation District (Tama SWCD) in order to identify the sources of water quality problems and to develop a management strategy for improving the lake's condition. This plan utilizes a watershed approach to addressing water quality concerns and makes recommendations for land management and lake restoration to be carried out over the next ten years.

The WMP is a cooperative effort between the Tama CCB, the Tama SWCD, Iowa Natural Resource Conservation Service (Iowa NRCS), the Iowa Department of Agriculture and Land Stewardship IDALS), and the Iowa Department of Natural Resources (IDNR). A Technical Advisory Committee (TAC) made up of representatives from these agencies helped to develop the plan, and feedback was also sought from the lake's stakeholders. Much of the technical information used in developing the plan comes from the Otter Creek Lake Water Quality Improvement Plan (WQIP), which is a Total Maximum Daily Load (TMDL) document developed by Mindy Buyck of IDNR. A complete list of the Technical Advisory Committee members that helped to develop the plan is shown in Table 1.

Name	Affiliation	Role
Bob Etzel	Tama CCB	Director
Larry Jones	Iowa NRCS	District Conservationist
Melody Bro	Tama SWCD	District Coordinator / Planner
Mindy Buyck	Iowa DNR	TMDL modeler
Michelle Balmer	Iowa DNR	Water Monitoring
Jeff Tisl	IDALS-DSC	Regional Basin Coordinator
Mary Beth Stevenson	Iowa DNR	Iowa-Cedar Basin Coordinator

Table 1. List of Technical Advisory Committee members.

2. WATERSHED DESCRIPTION

The Otter Creek Lake Watershed (IA 02-IOW-O2095-L_O) is the 1,030-acre area of land that drains to Otter Creek Lake in central Tama County. It is six miles northeast of Toledo, the county seat for Tama County, in Sections 30 & 31, Carroll Township.

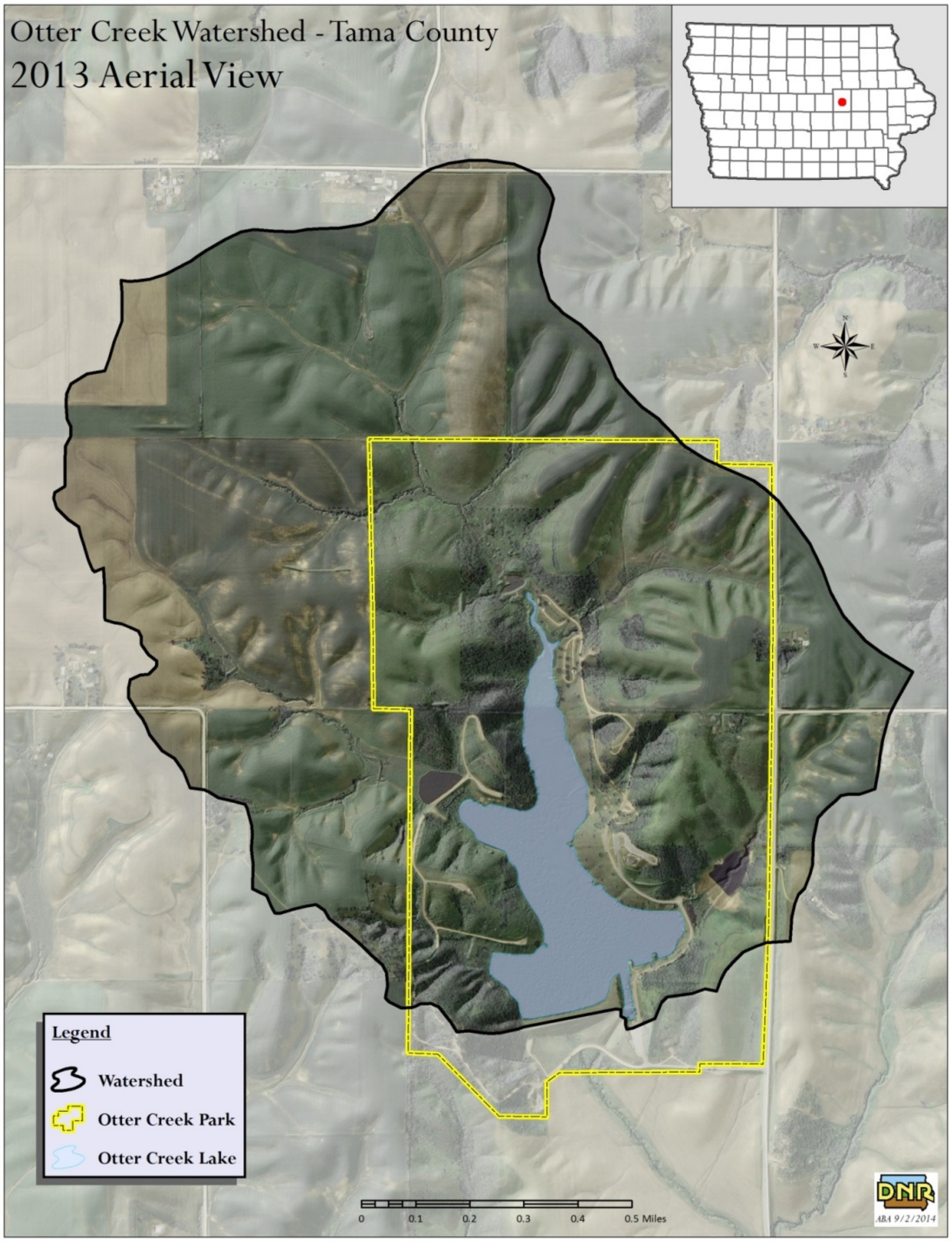


Figure 1. Aerial view of Otter Creek Lake and Park.

2.1 PHYSICAL AND NATURAL FEATURES

2.1.1 ECOREGION / LANDFORM REGION. The Otter Creek Lake watershed lies in the Rolling Loess Prairies ecoregion. In this region, the loess is not as thick as in the western part of the state. The lake is bordered with timber and grassland and is surrounded by rolling hills.

Otter Creek Lake is located on the transitional area between the Iowan Surface and Southern Drift Plain landform regions. The Iowan Surface was last covered by glaciers from 2.2 million to 500,000 years ago, then heavily eroded during the last glacial period from 21,000-16,500 years ago. The Iowan Landform Region today is characterized by gently rolling topography and low relief land.

The Southern Drift plain region is dominated by glacial deposits left by ice sheets that extended south into Missouri over 500,000 years ago. The deposits were carved by episodes of stream erosion so that only a horizon line of hill summits marks the once-continuous glacial plain. Numerous rills, creeks, and rivers branch out across the landscape creating steeply rolling hills and valleys. The uplands and upper hill slopes are loess covered.

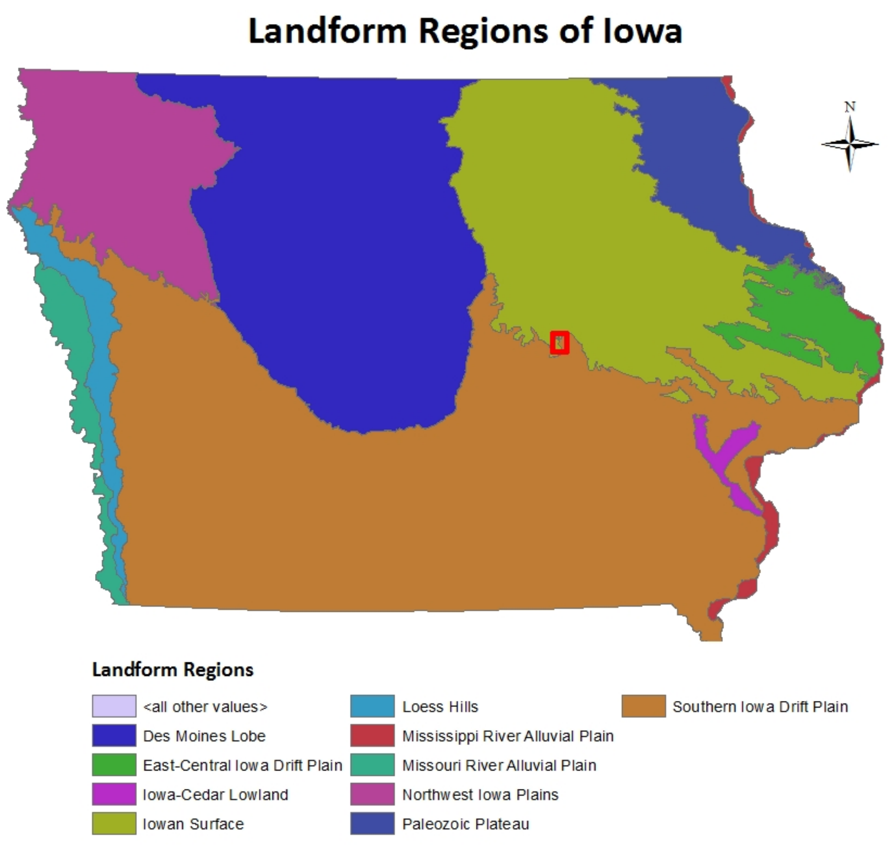


Figure 2. Map of Iowa's landform regions, showing the location of Otter Creek Lake.

2.1.2 HYDROLOGY & BATHYMETRY. Otter Creek Lake is a 66.1-acre lake fed by Otter Creek, a tributary to the Iowa River that originates in central Tama County (Middle Iowa watershed, HUC-07080208). With a watershed area of 1,030 acres, the watershed to lake ratio is 14.5:1. This is generally considered to be a favorable ratio for lake restoration possibilities, as it suggests the lake is appropriately sized to its watershed and will respond well to restoration activities.

A bathymetric map of the lake is below (Figure 3). The lake's shallowest areas are found in the northern arm, and the deepest reaches are present in the southwestern lobe of the lake. Considerable sedimentation has occurred since the creation of the map in 1979; the map shows the lake's deepest point as being in the range of 26' although recent monitoring has documented the lake's deepest point at 25'. The mean depth of the lake is 10' (ISU CARD 2008) and the lake volume is estimated to be 661 acre-feet.

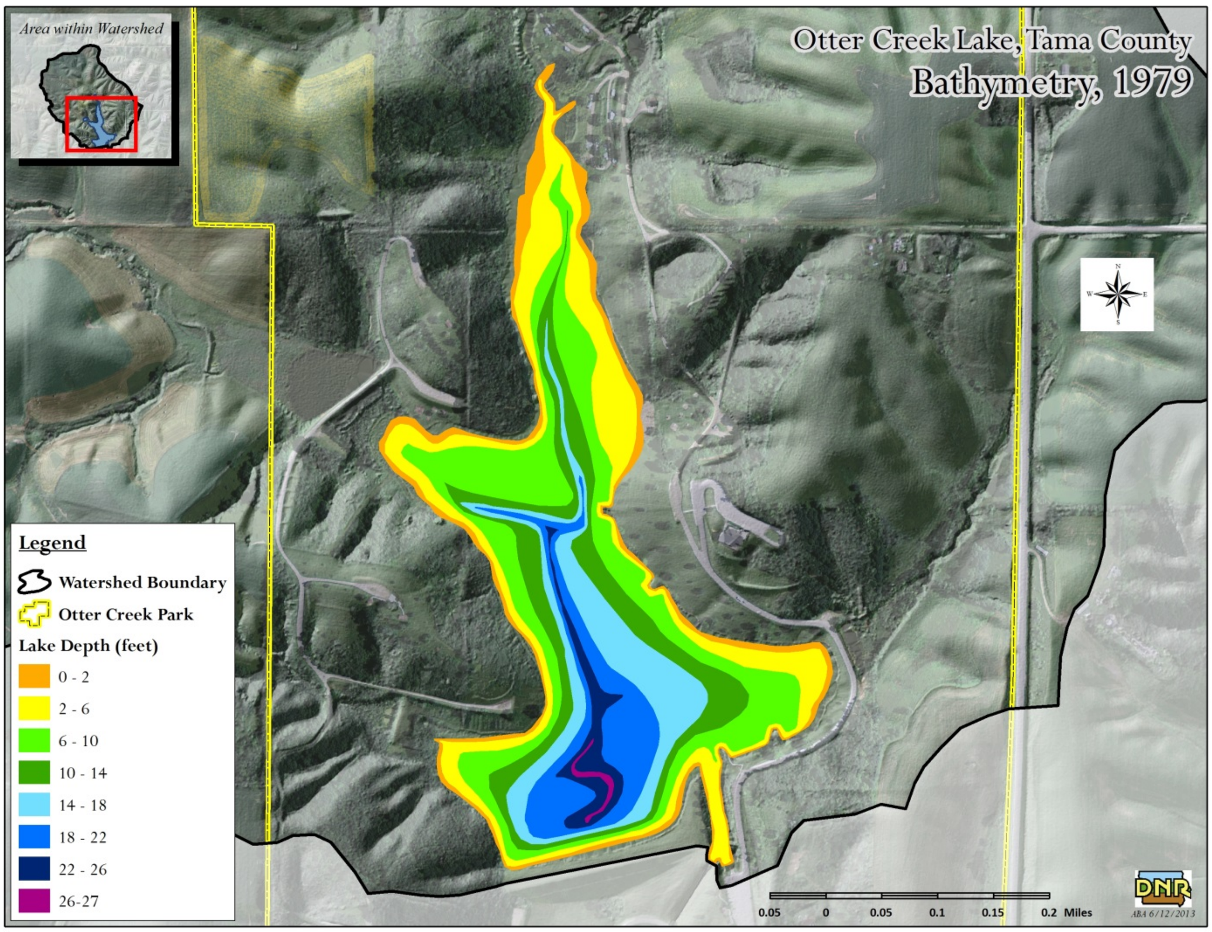


Figure 3. Bathymetric map of Otter Creek Lake.

2.1.3 SOILS. Soils throughout the watershed are typically Fayette-Downs Association (Figure 4). Soils in this group are gently sloping to very steep, well drained, silty upland soils formed in loess. They are typically found on broad to narrow, convex ridge tops and long, convex side slopes which are dissected by numerous waterways. The landscape varies from undulating to very steep. These soils are generally well suited or moderately well suited to row crop, small grain, and hay production. The association's steeper slopes are unsuitable for crops but well suited for pasture and trees. Main management concerns in this association are controlling erosion, preventing gully formation, maintaining fertility, and managing pasture and timber.

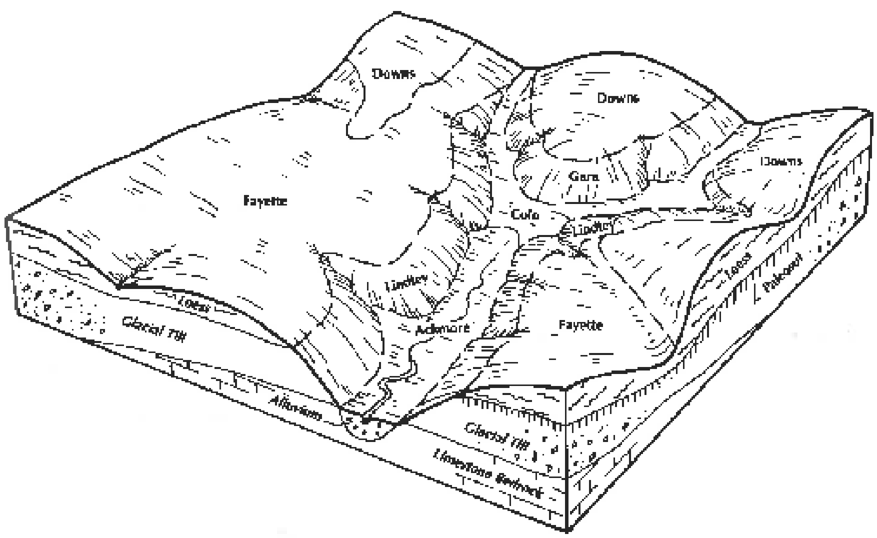


Figure 4. Otter Creek Lakes Soils

Within the watershed, 76% of the soils are considered highly erodible. As of 2015, 325 acres of HEL in watershed are currently in row crop production.

2.1.4 TOPOGRAPHY. The Otter Creek Lake watershed has a mean basin slope of 6.3%. The high point of the watershed is 1,040 ft and the low point is 920’ (Figure 5).

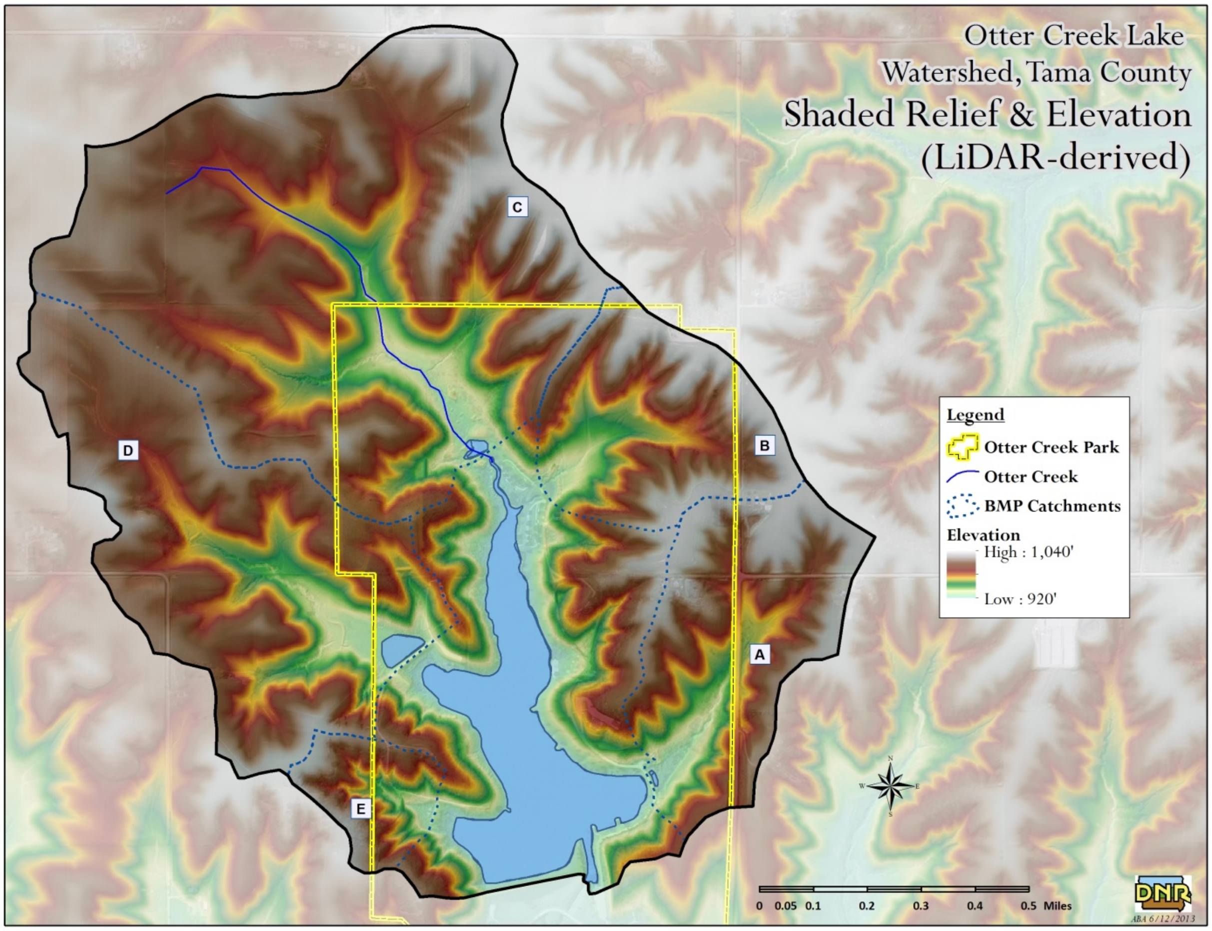


Figure 5. Otter Creek Relief Map.

2.1.5 CLIMATE. The climate of the Otter Creek Lake watershed is typical of central Iowa and the humid continental climate zone. This climatic zone is characterized by dramatic seasonal swings in temperature and precipitation occurring throughout the year.

The Otter Creek Lake WQIP provides an overview of precipitation patterns over a 10-year period. The mean annual precipitation for the watershed from 2002 – 2011 was 33.1 inches per year with a growing season average of 24.3 inches occurring between April and September. The driest month is January, averaging less than an inch of precipitation and the wettest month is June with an average of 4.9 inches of precipitation. The lowest mean temperature occurs in January at 21 degrees Fahrenheit and the highest mean temperature occurs in July with a mean of 75 degrees F.

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
2000	1.03	0.9	1.05	1.07	3.71	9.88	8.38	2.53	1.89	1.23	2.17	1.85	**35.69**
2001	1.33	1.51	1.05	4.09	5.39	4.05	2.09	2.29	3.95	3.32	1.23	0.6	**30.9**
2002	0.32	0.88	0.58	3.04	3.43	4.1	5.51	4.77	1.18	3.23	0.27	0.18	**27.49**
2003	0.44	0.42	0.81	3.6	5.19	5.53	5.42	1.21	3.77	0.98	5.9	1.11	**34.38**
2004	1.01	1.65	3.07	2.69	8.34	2.85	2.24	5.32	0.73	2.01	3.13	0.59	**33.63**
2005	0.93	1.3	0.81	3.31	4.67	6.47	4.02	3.99	3.44	0.38	1.24	1.32	**31.88**
2006	0.52	0.18	2.82	3.69	3.58	1.55	3.94	7.42	4.98	1.93	1.84	2.17	**34.62**
2007	0.82	2.66	3.13	6.38	5.08	4.39	4.64	6.32	2.07	5.23	0.18	2.3	**43.2**
2008	0.43	1.73	0.77	8.11	6.79	11.07	8.42	1.69	3.51	2.9	1.79	2.04	**49.25**
2009	0.79	0.23	3.48	5.25	3.36	6.46	3.02	6.37	3.66	7.48	0.92	2.28	**43.3**
2010	1.18	1.06	0.75	4.35	5.53	7.93	6.29	5.92	8.02	0.5	1.73	0.75	**44.01**
2011	0.78	0.6	1.38	4.09	5.11	4.62	3.26	1.23	2.71	1.43	2.28	2.73	**30.22**
2012	0.57	0.93	2.21	4.42	2.06	1.34	2.21	2.68	2.05	2.4	1.21	1.65	**23.73**
2013	1.15	1.35	2.31	6.33	15.93	4.39	1.57	0.17	2.18	2.36	2.45	0.78	**40.97**
2014	0.22	1.9	0.88	6.17	3.49	8.84	5.57	5.5	4.73	2.97	0.84	1.53	**42.64**
MEAN 1893 - 2014													
	1.04	**1.09**	**2.11**	**3.28**	**4.38**	**4.87**	**3.96**	**3.78**	**3.73**	**2.43**	**1.74**	**1.18**	**33.39**

Table 2. Mean monthly precipitation at the Marshalltown, Iowa weather station (http://mesonet.agron.iastate.edu/climodat/index.phtml#ks, accessed 4/27/15).

2.2 LAND USE AND LAND COVER

Prior to the 1968 construction of Otter Creek Lake, the land in the watershed was either cultivated or grazed. Currently, about half of the watershed (45.7%) is used for row crop production, 30.3% grassland (ungrazed and hay), 13.9% timber, and 3.2% roads and farmsteads. The map below illustrates these percentages.

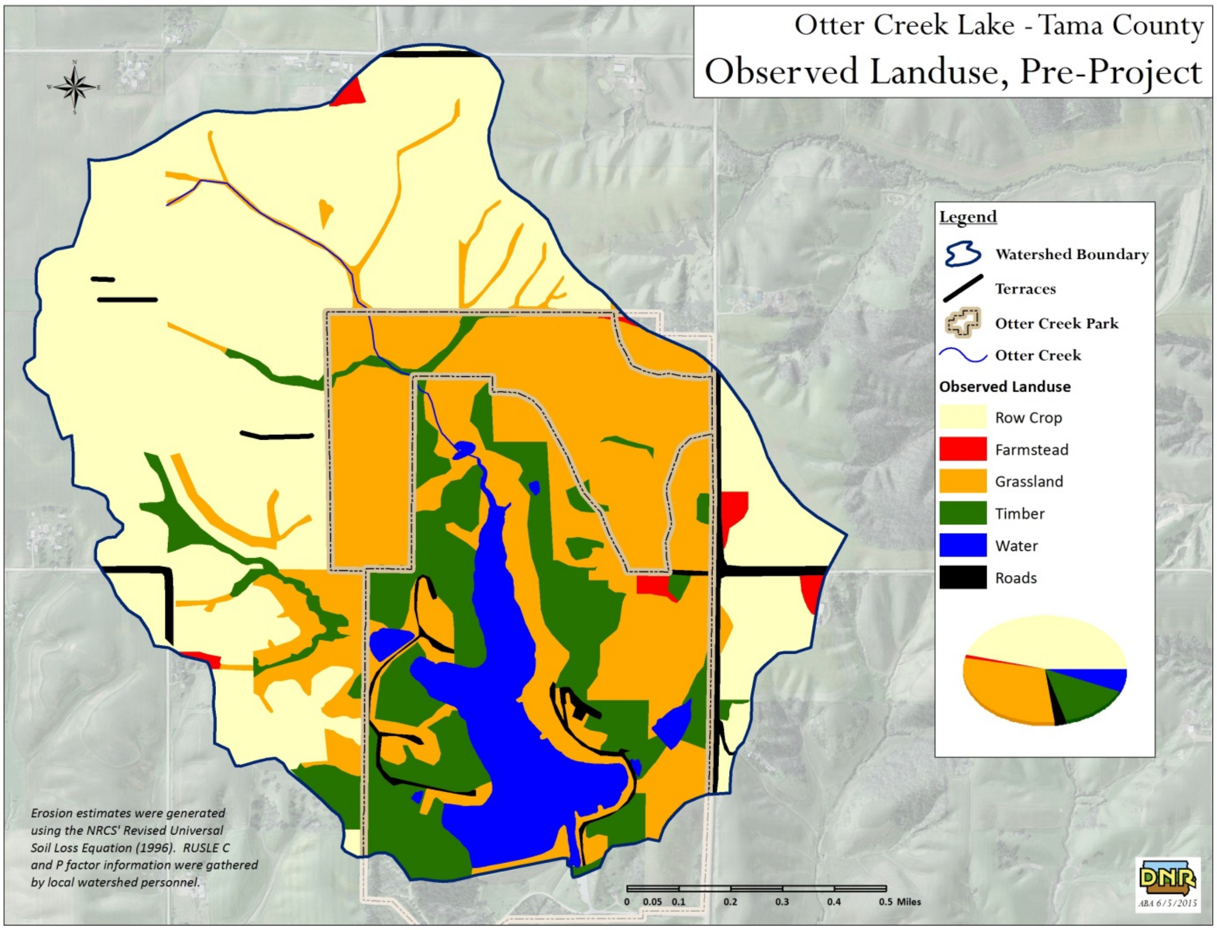


Figure 6. Land use in the Otter Creek Lake Watershed (2015)

The watershed currently benefits from a number of conservation practices designed to reduce sediment loads to the lake. Some terracing is occurring in the eastern part of the watershed on private lands. A number of sediment control basins have also been constructed, most of which are within park boundaries. Some of these structures are older and are likely not trapping at 90% efficiency.

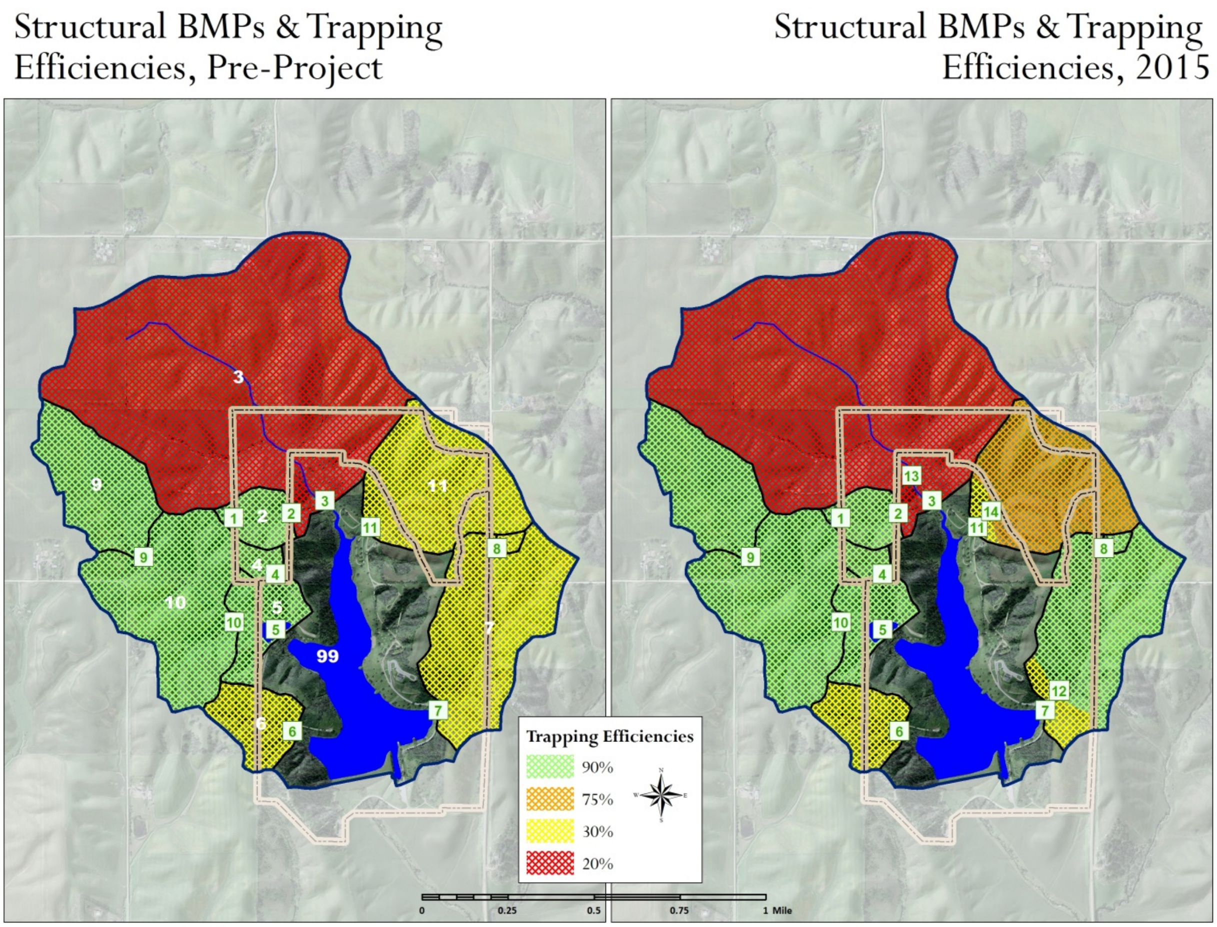


Figure 7. BMP locations in the Otter Creek Lake watershed.

2.3 DEMOGRAPHIC CHARACTERISTICS

As mentioned above, Otter Creek Lake is located in Tama County and is an important resource for the local residents. The population of Tama County is 17,536 (US Census estimate for 2012). About 7% of the Tama County population is American Indian, which is significantly higher than the State of Iowa's overall American Indian population of 0.5%. This difference is due to the fact that Tama County is home to the 8,000-acre Meskwaki settlement, where about 800 people reside. Another 7% of Tama County's population is Hispanic or Latino, which is slightly higher than the state's total of about 5.3%. About 89% of the Tama County population is white. About 12% of the population lives at or below the poverty level, which is consistent with the statewide percentage of 12.2%. The unemployment rate is about 6.4%.

2.4 OTTER CREEK LAKE PARK

2.4.1 RECREATIONAL OPPORTUNITIES.

Otter Creek Lake is the largest and most heavily used facility managed by the Tama County Conservation Board. The 66.1-acre lake was constructed in 1968 and is the center of the 522 acre county park. Fishing, swimming and boating are permitted in the lake. Otter Creek Lake is managed by Tama CCB staff based at the lake year round. The lake and park have been upgraded and expanded in its more than 40 years of existence to become a destination point for campers, fishermen, picnickers, hikers, birdwatchers, prairie enthusiasts and more to take advantage of the park's 65 RV sites with electricity, 18 unimproved tent sites, shower house, boat ramp, shelter houses, playgrounds, picnic areas, beach and hiking trails.

A list of activities and amenities available at the park is below.

- Two open air shelters with approximate capacity of 72 persons each
- Electric camp section with 80 unit capacity
- Tent section with 18 sites, 45 tent capacity
- Swimming beach offered at no charge
- Picnicking (Tables to entertain up to 400 persons)
- Concrete boat ramp providing safe and convenient access to lake
- Fish cleaning station located next to boat ramp (completed during FY '91)
- 3.2-acre siltation pond with fishing opportunities
- Sanitary dump station for trailer units using campground
- Modern showerhouse (for campers)
- Six vault latrines scattered throughout park
- Two acre native prairie (never tilled)
- Two play areas with assorted play equipment
- 2.5 mile loop scenic hiking trail around lake
- Spillway footbridge completed during FY '91 located near boat ramp
- Handicap access ramp constructed during FY '91 provides safe and easy access to beach play area
- Nature Center, a handicap accessible building which houses main office

- Handicap access improvement projects including parking and access via concrete walkway to a fishing jetty, two restrooms and the showerhouse/restroom in the electric camp section.

The most recent IDNR fish survey data yielded the following information.

Table 3a. Results from electrofishing survey completed 5/27/14. Results show number of fish caught in each size category (inches).

Fish	0-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	>15
Black Crappie	0	0	0	1	24	5	1	0	0	0	0	0	0
Bluegill	9	59	35	55	64	10	0	0	0	0	0	0	0
White Crappie	0	0	0	0	2	5	0	1	0	0	0	0	0
Yellow Bullhead	0	0	0	1	0	0	0	0	0	0	0	0	0
Yellow Bass	0	0	0	71	41	43	56	2	0	0	0	0	0

Table 3b. Results from electrofishing survey completed 5/27/14. Results show number of fish caught in each size category (inches).

Fish	0-6	6-8	8-10	10-12	12-14	14-16	16-18	18-20	20-22	22-24	24-26	26-28	>30
Channel Catfish	0	0	0	0	0	0	0	0	1	0	1	0	0
Common Carp	0	0	0	1	1	0	0	0	0	0	0	0	0

Largemouth Bass	0	0	17	16	16	3	2	1	1	0	0	0	0

Table 4. Results from fyke netting survey completed 9/16/14. Results show number of fish caught in each size category (inches).

Fish	0-4	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	>15
Black Crappie	0	0	8	18	9	13	0	0	0	0	0	0	0
Bluegill	21	53	25	12	5	1	0	0	0	0	0	0	0
White Crappie	0	0	0	0	1	4	1	0	0	1	0	0	0
Yellow Bass	0	0	8	0	1	0	2	0	0	0	0	0	0

2.4.2 ANNUAL PARK USAGE / VISITORS. In 2014, it is estimated there were 7,188 camper days in the season. Day use totals for 2014 included over 43,000 yearly visitors annually with 4,000 individuals using the nature center in the past year. This makes the lake an important recreation site in Central Iowa. The park also serves as the headquarters for the office and maintenance operations of the Conservation Board and the home of the Tama County Nature Center.

Many diverse activities are held at Otter Creek Lake Park, such as the NRCS Conservation Field Day, scouting day camps, school field trips, and youth fishing seminars. It will be the host site for ongoing environmental education activities as construction is completed on the Nature Center and on-site environmental education curriculum is developed.

2.4.3 OTTER CREEK LAKE HISTORY & FUTURE DEVELOPMENT PLANS.

The original park property, purchased during the late 1960s, measured 277 acres. Otter Creek Lake and Park's expansion project, which includes the Hansen Addition and property immediately adjacent to the park to its east, north and partially down its west side has been added bringing the current park acreage to 529 acres.

The Tama CCB believes that recent investments in acquisition of lands surrounding the park, coupled with establishment of large blocks of native vegetation and wetlands, will help extend the life of the lake. The acquisition of the final two of four total parcels completed the Hansen Addition Project-Acquisition Phase in FY2010. The acquisition of these last two parcels (C and D) was made possible through a $296,832 REAP grant which paid 100% of the acquisition cost. A summary of these acquisitions is provided in the table below.

Parcel	Acreage	Date Acquired
A	71.28	December 2007
B	51.82	December 2008
C	69.25	February 2010
D	59.97	December 2009
TOTAL	**252.32**	

Table 5. Summary of land acquisitions made through the Hansen Addition to Otter Creek Lake & Park. Total acreage of the park currently stands at 522.32 acres.

3. HISTORY OF WATERSHED IMPROVEMENT ACTIVITIES

According to the Tama CCB 2010 Annual Report, the protection of the Otter Creek Lake watershed is an extremely high priority. Siltation of the northern one-third of the lake has reached a point to negatively impact use of that portion of the lake. Cattail beds have encroached on the electric camp section blocking views of the lake. Areas of the north end of the lake which were 3' deep in 1979 are now less than 6" and boats have a very difficult time reaching the camp section to be docked.

The following section describes the activities that have occurred to help improve Otter Creek Lake.

3.1 OTTER CREEK LAKE WATERSHED PROJECT (1998-2002)

Problems with decreasing water quality and increased siltation have been observed by park staff since the 1980s. A silt survey was conducted in 1996, which concluded the depth in the northern reaches of the lake decreased from 2'-3' to 6"-12" in just the last decade. The rapid decline of water quality has negatively affected recreational opportunities at the lake. A project to address the problems with siltation and algae blooms was developed in cooperation with the Tama SWCD in 1998 to address these concerns.

The objectives of the initial project were as follows:

Objective 1: Implement nutrient & pest management and livestock waste management systems

- Develop Nutrient & Pest Management Plans on 510 acres
- Implement Manure Management Plans on 200 acres
- Implement Management Intensive Grazing systems on 45 acres
- Install 2 manure management systems

Objective 2: Implement practices to reduce soil loss and sediment delivery rate to the lake

- Install 4 sediment basins across 4 primary inlets into the lake
- Encourage a variety of BMPs in the cropland portions of the watershed

Objective 3: Demonstrate management intensive grazing using improved forages

- Encourage producers to adopt management intensive grazing systems
- Offer pasture forage improvement to grazers in the watershed

Objective 4: Conduct whole farm resource management planning on farms in the watershed

- On-farm evaluations of individual farm practices
- Conduct I & E campaign on the use of resource management systems

A primary challenge of this earlier project was the loss of a watershed project coordinator. This impeded the project's ability to make progress on several of the key objectives. While progress was made in reducing soil loss and sediment loading through structural measures, only limited success was achieved in targeting nutrient reductions and pest management due to the lack of staff. The following table summarizes the accomplishments of Phase 1 of the Otter Creek Lake project.

Practice	Goal	Implemented
Management Intensive Grazing	45 ac.	0 ac.
Pasture Planting	45 ac.	0 ac.
Manure Management	200 ac.	0 ac.
Manure Storage Units	2 no.	0 no.
Nutrient/Pest Management	510 ac.	0 ac.
Drainageway Stabilization	8,200 ft.	6,100 ft.
Grassed Waterways	23 ac.	15 ac.
No-Till	300 ac.	103 ac.
Sediment Basin Impoundments	4 no.	3 no.
Wetlands	8 ac.	4 ac.
Grade Stabilization Structures	2 no.	2 no.
Sediment Control Basins	9 no.	7 no.
Terraces	0 ft.	200 ft.

Table 6. Practice targets identified in Phase 1 of the Otter Creek Lake watershed project.

3.2 OTTER CREEK LAKE PARK ENHANCEMENTS

The Tama County Conservation Board has undertaken numerous activities to address water quality issues of Otter Creek Lake. Below is a timeline of these projects.

- Late 1980's: Tama County Board of Supervisors, realizing the cost of protection and eventual restoration of Otter Creek Lake begin to earmark $14,400 annually to be placed into the LAD (Land Acquisition and Development) Account to be used for "silt related project work for Otter Creek Lake"
- Early 1990's: Board decides that to help protect Otter Creek Lake they should focus their initial efforts on protective work in the watershed. Restoration/renovation of the lake and its fishery would follow after significant changes and improvements are made in the watershed.
- Early 1990's: CCB, realizing problems exist in the lake (siltation, algae blooms, declining fishery), initiates discussion with Emil & Louisa Hansen family regarding possible future acquisition of the Hansen ground adjoining the park property on its east, north, and partially down its west boundary. The Hansen ground is HEL and CCB feels it is a contributor to issues observed in lake basin.
- 1996: Silt survey conducted by CCB and SWCD staff in 1996 show an increasing level of silt in the lake
- October 1998 till June 2002, the Tama SWCD and CCB cooperate on a watershed effort on Otter Creek that invested an estimated $142,099 in WSPF/WPF/319 and other public funding into the watershed.
- Early 1990's – 2007: Continue communication with Hansen family touching base every twelve months or so. The intent was to remind them of CCB's interest in their property when it becomes available. Also, share with the family the important role the property will have on Otter Creek Lake & Park in the future.
- 2002 Construct 1.5 acre wetland in northern portion of park property adjacent to an existing silt pond
- 2007
    - July- CCB staff meets with Hansen family at the family's request. Family indicates they are interested in selling the 252 acres adjoining Otter Creek Park in four parcels. They would like to sell the first parcel by the end of 2007.
    - August- Realizing the significant role the Hansen ground will have on future water quality in the lake the board unsuccessfully applies for a REAP grant to acquire Parcel A.
    - December- Being unable to secure a grant and realizing the significance of the Hansen Addition Project to the long term viability of Otter Creek Lake the CCB utilizes some of the funds the county had been saving for two decades to acquire Parcel A- Hansen Addition. (71.28 acres)
- 2008
    - Spring- Parcel A- plant 6 acres to native grasses and forbs

- December- Combining funds secured through a successful DNR Wildlife Habitat Stamp Grant application with county funds the CCB acquires Parcel B- Hansen Addition. (51.82 acres)

- 2009
    - June- Plant 28.0 acres in Parcel to three different mixes of prairie forbs and grasses.
    - October- **Tama County Economic Development selected** the Otter Creek Lake and Park Expansion Project (which includes the Hansen Addition to Otter Creek Lake and Park) as one of five premier projects in the county included in a successful campaign seeking Iowa Great Places designation. Tama County was one of six Great Places chosen this fall. (This was the only natural resource project in the Tama County application.)
    - November- meet w/Jeff Tisl to discuss need to perform watershed management plan for Otter Creek Lake and determine if a watershed development grant should be pursued.
    - December- Using funds secured through a successful REAP grant application in combination with county funds acquire Parcel D- Hansen Addition. (59.97 acres)
- 2010
    - Spring- Combining funds remaining from the REAP grant secured to acquire Parcels C & D with county funds the CCB acquires Parcel C-Hansen Addition. This is the final parcel of the Hansen Addition project. (69.25 acres)
    - June- Plant 15.0 acres in Parcel D- Hansen to a savanna mix of prairie forbs and grasses
- 2011
    - June- Plant 45.0 acres in Parcels B & C to prairie grasses and forbs.
    - Fall- Wetland mitigation project located in Parcels B & C- Hansen Addition is constructed. Goal to establish 3.2 acres of forested wetland and 2.5 acres of adjacent prairie.
- 2012
    - Parcel A- plant 18.0 acres to Savanna mix of native forbs & grasses
    - Construct 3.2 acre silt/fishing pond feeding SE bay of Otter Creek Lake
- 2014 Repair existing control structures, grass spillways of wetland mitigation site and construct small rock water control structure in Parcels B & C- Hansen Addition
- 2015
    - April- Plant 9.0 acres, Parcel B- Hansen Addition to pollinator mix of prairie flowers and forbs
    - April- Plant 10.0 acres, Parcel C- Hansen Addition via direct seeding including

Figure 8. Future plan for Otter Creek Lake park.

3.3 WATER QUALITY IMPROVEMENT PLAN (TMDL)

A Total Maximum Daily Load (TMDL) developed by Iowa DNR for Otter Creek Lake was approved by the United States Environmental Protection Agency (US EPA) in 2014. The Iowa DNR is required to develop a TMDL, also known as a Water Quality Improvement Plan (WQIP) for certain impaired waters. These TMDLs provide an overall roadmap for how to improve water quality so that the water body can be restored to its designated use. The WQIP was critical to the development of this Watershed Management Plan, and the sections on Pollutant Source Identification and Reduction draw heavily from the WQIP. More information on the TMDL is provided in the Pollutant Source Assessment & Loading chapter of this WMP.

4. WATERSHED CONDITIONS

4.1 OTTER CREEK LAKE – DESIGNATED USES & IMPAIRMENTS

Otter Creek Lake Designated Uses:

Aquatic life (Class B)

Fish Consumption (Class HH)

Primary Contact Recreation (Class A1)

Otter Creek Lake appears on Iowa's 303(d) List of Impaired Waters in the 2008, 2010, and 2012 reporting cycles. The Otter Creek Lake Watershed (IA 02-IOW-O2095-L_O) is the 1,030-acre area of land that drains to Otter Creek Lake in central Tama County. It is six miles northeast of Toledo, the county seat for Tama County, in Sections 30 & 31, Carroll Township.

The Primary Contact Recreation designated use has been listed as 'not supporting' due to nuisance algae blooms. The Aquatic Life designated use is listed as 'Fully Supporting.' The Fish Consumption designated use is listed as 'Not Assessed' due to the lack of fish contaminant monitoring at the lake.

Impairment Causes	Designated Use Support	Cause Magnitude	Sources	Source Magnitude
Algal growth / Chlorophyll a	Primary Contact Recreation	Moderate	*Agriculture *Internal nutrient cycling (Primarily lakes) *Source unknown	*Moderate *Moderate *Moderate

Table 7. Overview of the causes and sources of impairment leading to a 303d impairment listing. (*Adapted from IDNR's Water Quality Assessment Database)*

4.2 WATER QUALITY MONITORING

The water quality data used for Otter Creek Lake's impairment listing are from three sources: a statewide survey of Iowa lakes conducted from 2006 - 2010 by Iowa State University, the statewide ambient lake monitoring program conducted from 2006 – 2008 by State Hygienic Laboratory (SHL), and information from the IDNR Fisheries Bureau.

The Iowa DNR used the Carlson Trophic State Index (TSI) scoring system to evaluate water quality in Otter Creek Lake. The Carlson Trophic State Index (1977) aggregates several types of water quality data in order to evaluate 'trophic state,' or the level of ecosystem productivity of a lake, typically measured in terms of algal biomass. TSI scores may range between 0 and 100, where higher scores indicate poor water quality. The TSI scores are based on three water quality parameters: secchi depth, chlorophyll *a*, and total phosphorus.

The table below is modified from the Otter Creek Lake WQIP, and ties TSI values to corresponding impacts on the lake system, recreation and aquatic life. Otter Creek Lake's scores ranged from 65 – 70 during the 2006 – 2010 sampling period.

TSI	Effects on Recreation	Aquatic Life
50-60	None	Warm water fishery only; percid fishery (walleye, some species of perch); bass may be dominant
60 – 70	Weeds, algal scums, and low transparency discourage swimming and boating	Centrarcid fishery (crappie, bluegill, bass)
70-80	Weeds, algal scums, and low transparency discourage swimming and boating	Cyprinid fishery (e.g., common carp and other rough fish)
>80	Algal scums, and low transparency discourage swimming and boating	Rough fish dominate, summer fish kills possible

Table 8. Characteristics of lakes exhibiting eutrophic conditions (from the Otter Creek Lake WQIP).

In Iowa, a lake is added to the Section 303(d) list when the median summer chlorophyll-a or Secchi depth TSI values exceed 65 (IDNR, 2008). According to the Iowa DNR's water quality assessment for Otter Creek Lake, TSI scores for Secchi depth, chlorophyll a, and total phosphorus were 67, 70, and 65 respectively for the 2006 – 2010 sampling period. These values suggest very high levels of chlorophyll a and suspended algae in the water, poor water transparency, and high levels of phosphorus in the water column. These conditions are less than favorable for most water-based recreation activities.

Secchi Depth. A Secchi disk is a simple device used to measure water clarity in a lake or stream. It consists of a disk with black and white triangular markings, which is lowered into the water. The depth at which the disk can no longer be seen from above water is measured. The greater the depth at which the disc can be seen, the clearer the water. Between 2000 – 2014, Secchi depth TSI scores exceeded 65 40% of the time.

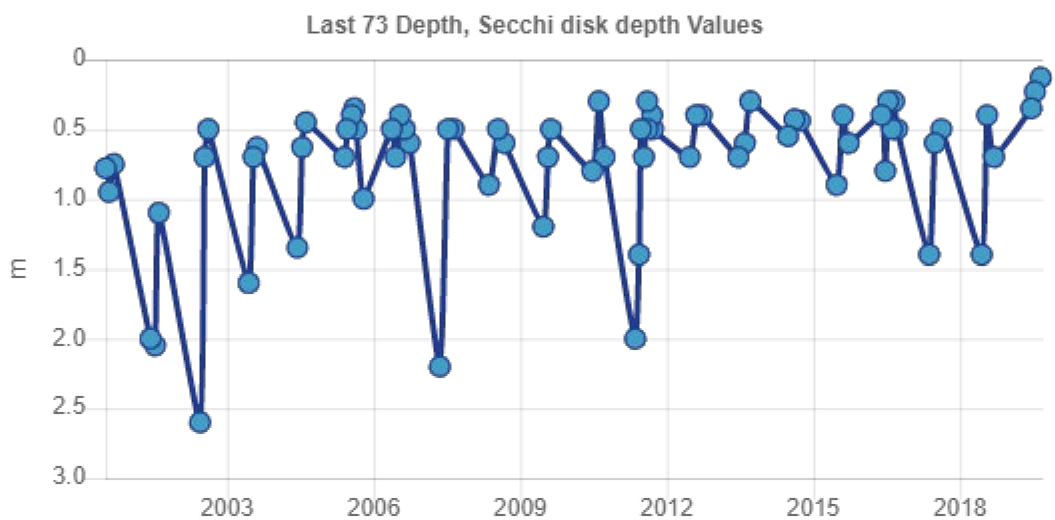


Figure 9. Secchi Depth, 2000 - 2019(Source: IDNR AQuIA)

Chlorophyll a. Chlorophyll is a green pigment found in plants and cyanobacteria (blue-green algae) that is essential for photosynthesis. The amount of chlorophyll in the water is a measure of algal biomass present in the lake. Between 2000 – 2014, chlorophyll TSI scores exceeded 65 67% of the time. A TSI value of 65 or below has not been observed in the lake since 2010. In order to de-list Otter Creek Lake, the median growing season chlorophyll-a TSI must not exceed 63 (maximum chlorophyll *a* concentration of 27 micrograms per liter (µg/L) in two consecutive listing cycles, per IDNR de-listing methodology.

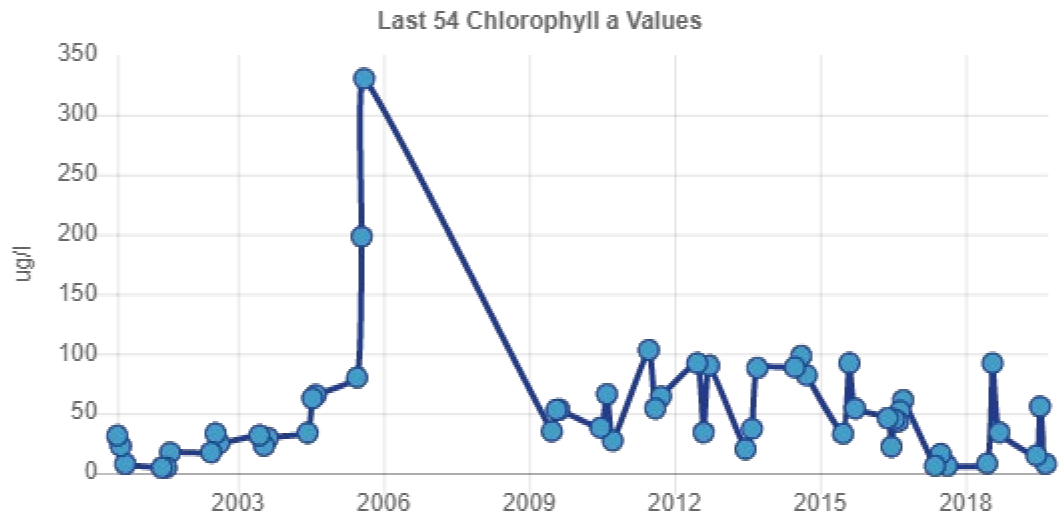


Figure 10. Chlorohpyll-a concentrations (Source: IDNR AQuIA)

Total Phosphorus. Phosphorus is a nutrient that is critical to plant growth. In freshwater ecosystems it is often a limiting nutrient, and so excessive phosphorus in the water can trigger algae blooms. Between 2000 – 2014, total phosphorus TSI scores exceeded 65 73% of the time. A TSI value for total phosphorus of 65 or below has not been observed in the lake since 2010.

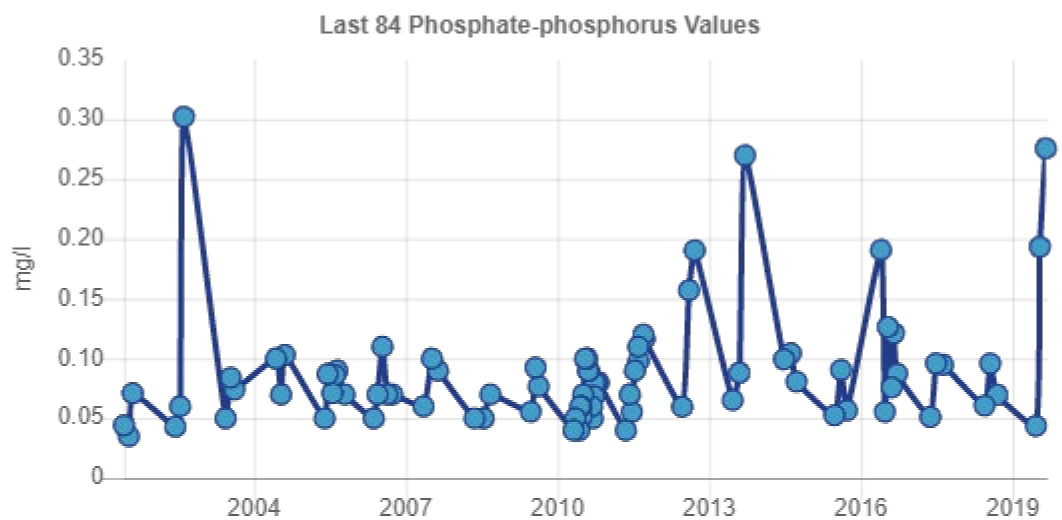


Figure 11. Total Phosphorus concentrations, 2000 - 2019 (Source: AQuIA)

Cyanobacteria also contribute to the lake's impairment. In high-nutrient conditions cyanobacteria can rapidly reach bloom conditions, often appearing as a bright green scum coating the water surface. These blooms lower the aesthetic value of the water and also can pose a threat to human and animal health. Some forms of cyanobacteria contain cyanotoxins, which can be toxic to the nervous system or the liver. According to the Iowa DNR's assessment report for Otter Creek Lake, during the period of 2006-2010 cyanobacteria "comprised 96% of the phytoplankton wet mass at this lake. The median cyanobacteria wet mass (50.0 mg/L) was the 25th highest of the 134 lakes sampled."

The chart below further illustrates the Trophic State Index values over time compared to the Iowa Impairment Trigger Level.

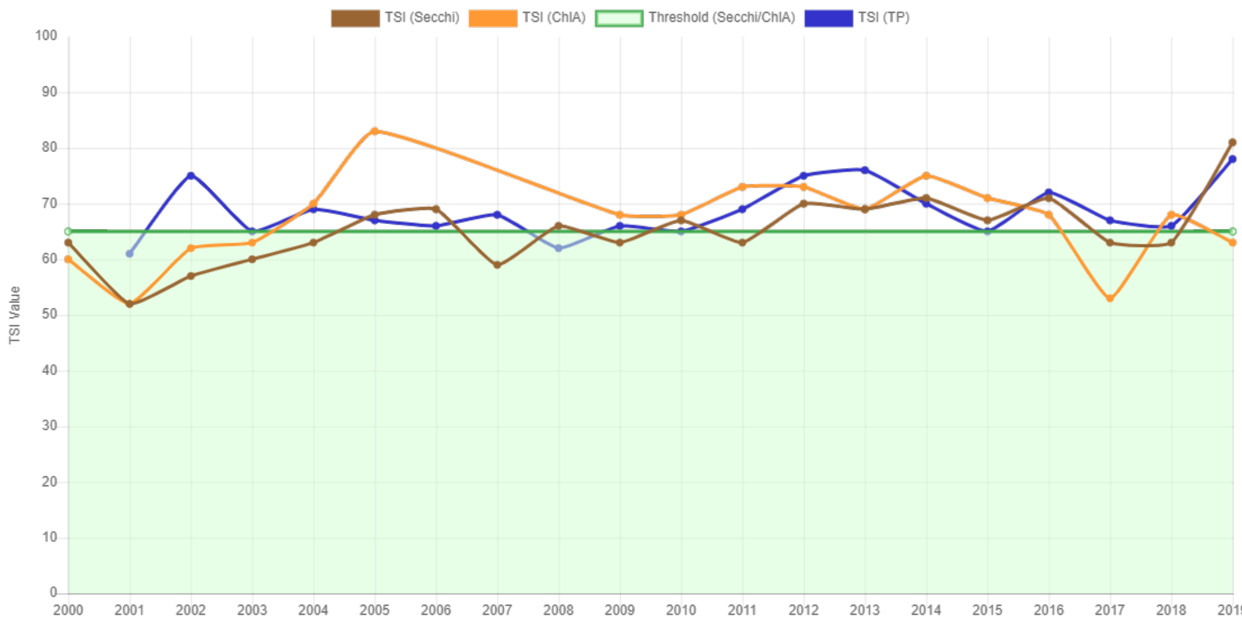


Figure 12. TSI values, 2000 - 2019 (Source: AQuIA Database)

4.3 IOWA DNR LAKE CLASSIFICATION

The Iowa Lakes Classification was developed in 2005 as a method to prioritize Iowa lakes for conservation and restoration activities. The classification report ranks 132 lakes across the state of Iowa based on data collected through the Iowa State Limnology Laboratory. The lakes are ranked according to criteria in three overall categories: water quality, benefit to public, and restoration potential. The lakes are also ranked for restoration priority. While Otter Creek Lake ranks overall as 'medium' for restoration priority, the lake ranks as high priority for three of the individual criteria. The 'high priority' designation was assigned to Otter Creek Lake for its dredging potential, for the potential effectiveness of a restoration effort, and for having high restoration potential.

- **Dredging potential**: Dredging is a cost-prohibitive option for many lakes, but in shallow lakes with small areas it may be a viable option. The Iowa Lakes Classification report ranked the dredging potential inversely with mean depth in lakes deeper than 3 m (9.8') on average. With a mean depth of 26' in 1980, Otter Creek Lake was given a high priority for restoration with respect to dredging potential.
- **Potential effectiveness of a restoration effort**: Several features of the Otter Creek Lake watershed contributed to a high priority ranking in this category. First, Otter Creek Lake has a favorable watershed-to-lake ratio of 13.1, which suggests the watershed area compared to the

size of the lake is not so large as to contribute an unmanageable amount of sediment to the lake. Second, Otter Creek Lake has a relatively low percentage of highly erodible land in the watershed, which again indicates a manageable amount of sediment delivery to the watershed. In addition, excessive wind mixing of sediments (a factor of relatively longer effective lake length and shallower depths) was not seen as a barrier to sustaining a restored condition in Otter Creek Lake.

- **Restoration Potential**: Otter Creek's lake ranking as having high restoration potential was based on the average ranking of each component within the overall category of restoration potential. The priority designation for dredging and the effectiveness of a potential restoration effort both contributed to the overall ranking of high restoration potential.

The table below summarizes the findings of the Iowa Lakes Classification report specific to Otter Creek Lake. The lower the percentile rank (out of 100), the higher the priority.

Component	Percentile Rank	High Priority	Medium Priority	Low Priority
Nutrients and eutrophication	59		x	
Silt and siltation	63		x	
Water clarity	51		x	
Plankton and planktonic biota	57		x	
Hypoxia and oxygenation	35		x	
All water quality considerations	53		x	
Public perceptions of	64		x	

water quality				
Socio-economic value	42		x	
Potential public health risks	49		x	
Potential public benefit of restoration	56		x	
Morphometric constraints on lake restoration	41		x	
Dredging potential	2	x		
Temporal trends in water quality	58		x	
Likelihood of restoration effectiveness	32	x		
Potential for fisheries restoration	55		x	
Attainment and exceedence of standards for designated use	43		x	
Restoration potential	17	x		
Priority for restoration	NA		x	

Inter-annual variation	60		x	

Table 9. Iowa Lakes Classification report rankings for Otter Creek Lake. The lower the percentile rank (out of 100), the higher the priority. Rankings in the 'high priority' column are highlighted in blue.

5. POLLUTANT SOURCE ASSESSMENT & LOADING

This section of the plan provides information on the source of phosphorus and sediment in Otter Creek Lake, and the quantity of each that is currently delivered (the pollutant load). This information is critical for setting measurable pollutant reduction goals in the watershed management plan.

5.1 PHOSPHORUS

Phosphorus is considered the primary pollutant of concern in this plan due to its direct connection to algae blooms in Otter Creek Lake, as described in the Total Maximum Daily Load (TMDL) report. Phosphorus is a nutrient that is essential to plant growth, and when excessive amounts are present in a lake, it can contribute to algal blooms. While is a naturally-occurring element that exists in soils, it is also present in fertilizers, manure, and human excrement. When these contaminants enter the lake via polluted runoff, the phosphorus they contain allows algae to grow quickly and multiply, resulting in bloom conditions.

A TMDL is calculated through a formula that identifies the point sources, nonpoint sources, and a margin of safety. The Otter Creek Lake TMDL for total phosphorus in the lake is 451 lbs / yr. This number represents the maximum amount of phosphorus the lake can receive without experiencing excessive algae blooms. A 69% reduction (1,033 lbs / year) in the existing phosphorus load to the lake is required in order to meet the TMDL. There are nonpoint sources in the watershed.

The WQIP utilized the STEPL and BATHTUB models to simulate average annual hydrology and pollutant loading. The models estimated the total phosphorus load to Otter Creek Lake to be 1,497 lbs/year.

The load can be broken into two categories of potential phosphorus sources to the lake. First is the external load, which is the phosphorus that enters the lake from the upland areas of the watershed. In general, phosphorus enters the lake attached to sediment, and therefore the phosphorus load is influenced by erosion rates and sediment loads. Phosphorus is also present in fertilizers and is a component of animal waste / manure. When runoff events occur in the watershed, phosphorus from these sources will also contribute to the external total phosphorus load. Tile outlets are another potential source for phosphorus. The external load of total phosphorus to Otter Creek Lake from the surrounding watershed is 1,205 lbs / year. A combination of BMPs to address both sediment-bound P as well as nutrient loss (P & N). Sediment control structures are a big part of the strategy. Cover crops will help with nutrient loss specifically, as well as reducing erosion. Wetlands are also being implemented, one is currently being completed on private land.

The lake's internal load is the phosphorus that has accumulated over time in the sediment at the lake bottom. Left undisturbed, this pool of phosphorus is relatively benign. However, certain rough fish species disturb bottom sediments in search of food and can cause the phosphorus to resuspend in the water column, making it available to algae. The internal load of total phosphorus within Otter Creek Lake is estimated to be 292 lbs/year.

Parameter	**Value**	**Unit**
Phosphorus	1497	Lbs/year
External	1205	Lbs/year
Internal	292	Lbs/year
Chlorophyll-a	54.4	ug/l
Secchi	0.8	m
TSI (TP)	69	NA
TSI (Chl. a)	70	NA
TSI (Secchi)	63	NA

Table 10. Average annual TP input and corresponding water quality parameters (Source: *Otter Creek Lake 2014 Water Quality Improvement Plan*).

Based on modeling, the WQIP attributes most of the phosphorus load to row crops in the watershed, particularly those on highly erodible lands. There are no livestock facilities in the watershed, and the TMDL did not identify septic systems as a significant source of phosphorus. There are no point sources of pollution in the Otter Creek Lake watershed. Therefore, all of the phosphorus load to the lake is from nonpoint sources, primarily in the form of agricultural runoff.

The following chart breaks down the percentage of phosphorus entering the lake from each land use.

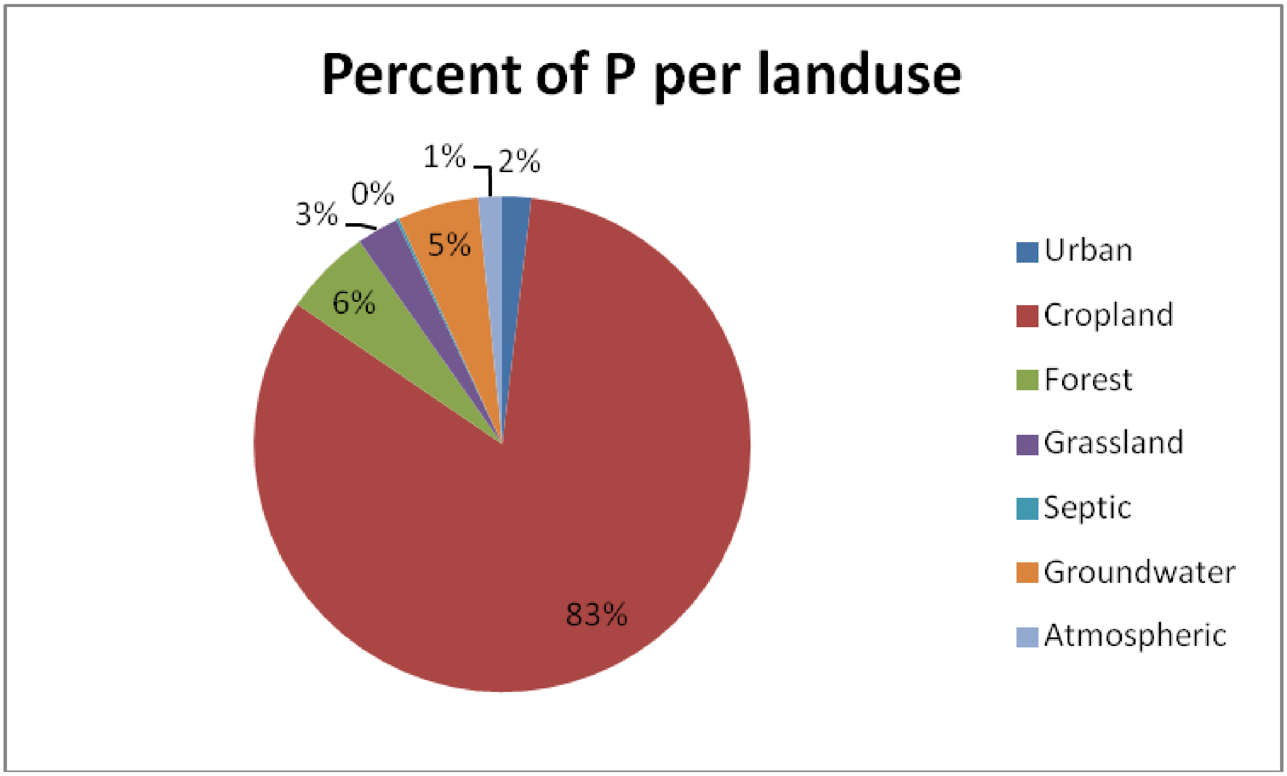


Figure 13. Percentage of the TP load per land use (Source: Otter Creek Lake 2014 Water Quality Improvement Plan).

Existing TP Load: 1,497 lbs/yr
External: 1205 lbs/yr
Internal: 292 lbs/yr

Target TP Load: 451 lbs/yr

Load Reduction Required to Meet Target TP Load:

69% Reduction (1,033 lbs/yr)

5.2 SEDIMENT

Sediment is a pollutant of concern in the Otter Creek Lake watershed due to its impact on lake levels and because it can be a source of phosphorus. The annual rate of sediment eroding from the surrounding watershed into the lake is highly variable and strongly influenced by weather conditions. Intense rain storms can cause erosion on farm fields, vulnerable slopes, and other areas where the ground lacks vegetation to hold the soil in place. Erosion rates are influenced by factors such as the amount of land under cultivation, the types of tillage methods being employed by producers, and the presence of cover crops. Sediment loading rates are calculated using averages (such as average precipitation, average soil losses, and average runoff) and information on specific land uses in the watershed in order to estimate annual loads.

In the Otter Creek Lake watershed, the majority of sediment loading to the lake is from rill and sheet erosion, estimated at 1,703 tons of sediment per year. This constitutes 89% of the annual sediment load to the lake. Ephemeral gullies constitute another 10% of the total load. Classic gully erosion and shoreline / streambank erosion make up the remaining 1%.

Source	Total Erosion (tons/year)	Sediment Delivery Rate	Total Delivery (tons/year)
Rill & Sheet Erosion	4,913	35%	1,703
Ephemeral Gully Erosion	259	70%	181
Classic Gully Erosion	8	90%	7
Shoreline Erosion	0	0%	0
Streambank Erosion	13	100%	13
Totals	**5,193**		**1,904**

Table 11. Erosion sources in the Otter Creek Lake watershed

The map below shows where the highest rates of sheet and rill erosion are occurring in the watershed.

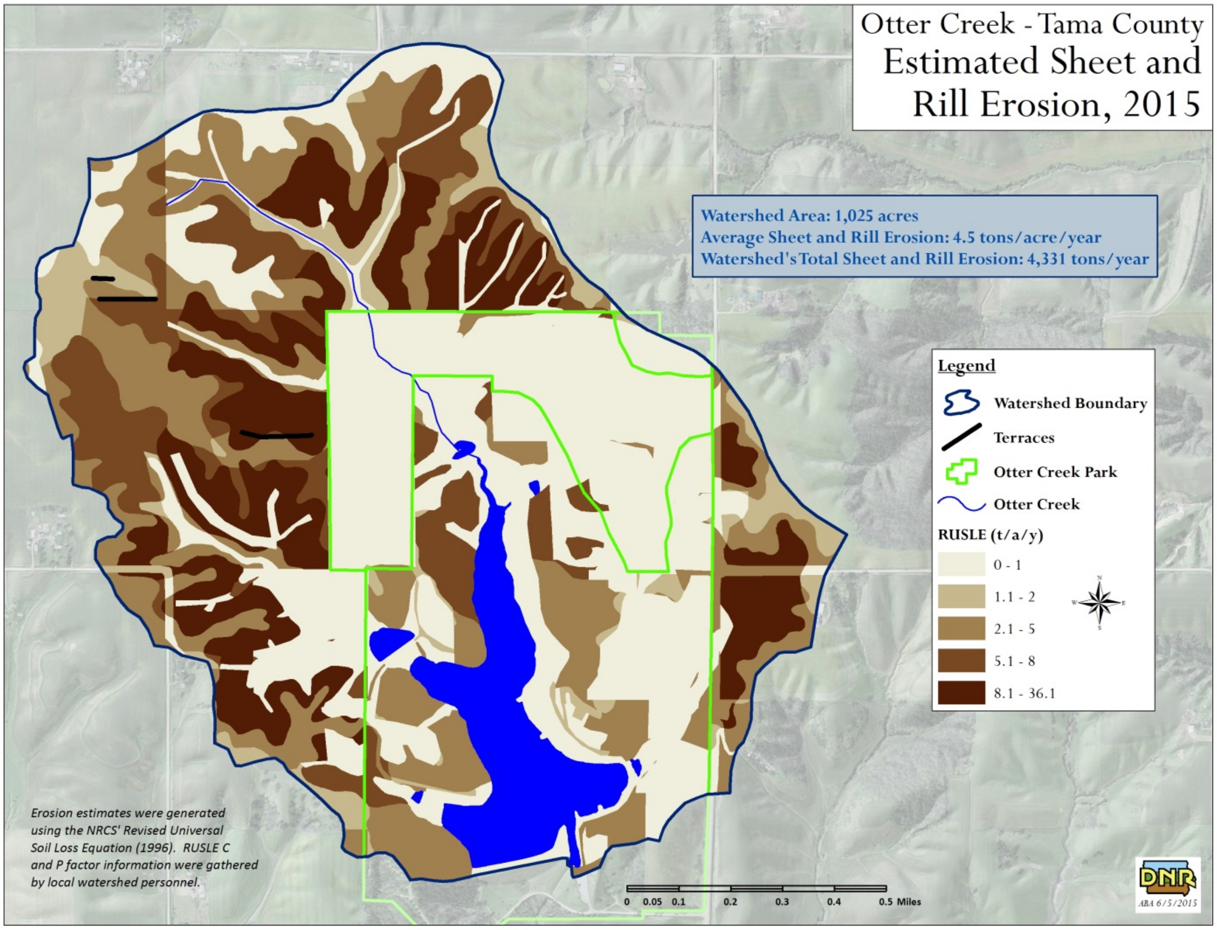


Figure 14a. Estimated sheet and rill erosion in Otter Creek Lake Watershed.

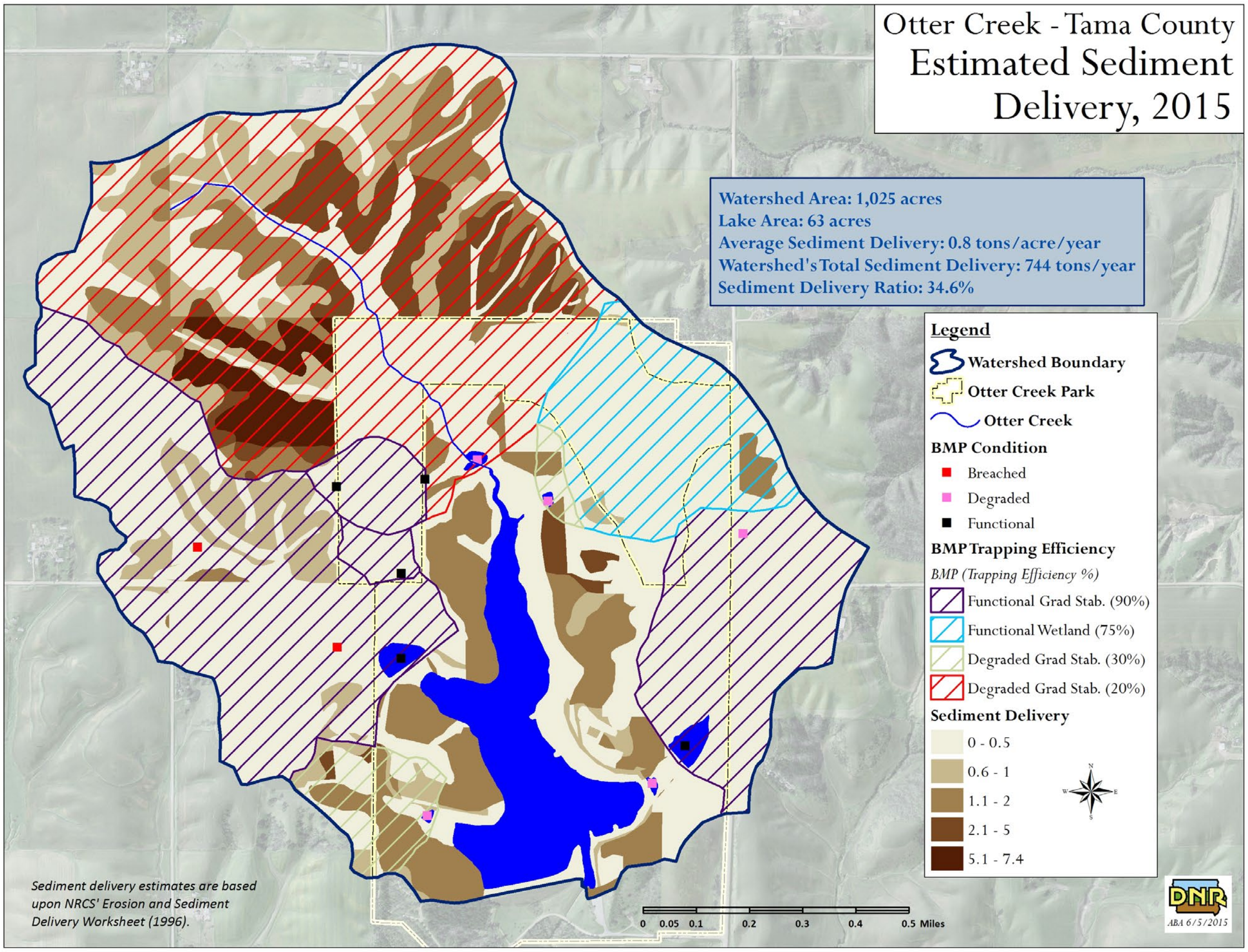


Figure 14b. Estimated Sediment Delivery to Otter Creek Lake

In summary, row cropped areas of the watershed are the most significant source of phosphorus and sediment loading to the watershed. In particular, row cropped areas on highly erodible lands are a problem for both pollutants of concern. Areas with the highest sediment delivery will also contribute the highest phosphorus loading to the lake. Areas with sediment delivery above 1 ton/ac/year, degraded structures, and active gullies will be considered a priority for sediment and phosphorus.

6. MANAGEMENT STRATEGIES

In order to achieved the phosphorus load reduction targeted by the TMDL and substantial reductions in sediment loading to the lake, a combination of structural and in-field management strategies will be needed on agricultural land along with improved stormwater management in Otter Creek Lake Park. In-lake practices and shoreline improvements are also needed. The practices that have been identified through this planning process are outlined below. Note these are simply recommendations on possible strategies; the project will employ an adaptive management strategy and will revisit achievements and water quality improvements on a yearly basis. If certain strategies are proving to be more or less effective in the field, the Technical Team will work with landowners and other stakeholders to revise the plan so that maximum efficiencies are gained. This will be accomplished by reviewing the progress made each year (through reporting and annual meetings) and adjusting the implementation schedule as needed based on progress made in the previous year.

6.1 STRUCTURAL PRACTICES – AGRICULTURAL LAND

Built either as part of the previous watershed effort, or at the discretion of the Tama County Conservation Board (Tama CCB), several sediment trapping structures already exist within this watershed. An analysis was performed to estimate the loading reductions (both in terms of sediment & phosphorus) of these existing structures as well as a significant proposed wetland structure at the north end of the lake. The entire report is included as Attachment 4, and a summary is provided below.

Estimating sediment reductions due to BMP implementations is not an exact science, but helps to compare the impact various structural practices can have based upon their existing condition and should they be rebuilt according to NRCS standards.

Existing & Potential Sediment & Phosphorus Reductions by Structural BMPs

Structure	1	2	3	4	5	6	7	9	10	11	12	13	14	Totals
Existing														
Sediment Reductions	4	9	70	1	465	12	6	24	100	4	108	NA	28	831
Phosphorus Reductions	5	12	91	1	605	16	8	31	130	5	140	NA	36	1,080
With Improvements														
Sediment Reductions	4	9	25	1	15	37	6	108	450	4	108	225	28	1,020
Phosphorus Reductions	5	12	32	1	20	48	8	140	585	5	140	293	36	1,325

Sediment reductions in tons/year. Phosphorus reductions in pounds/year.

Since the watershed already has several structural BMPs already in place, installing only a few more will only have a limited impact. However, due to the aggressive phosphorus goals outlined in the TMDL, for this effort to be successful, increasing the efficiency of every practice installation will be necessary for the partners to achieve success.

The analysis identified a few practices where alternative designs could be considered to maximize their potential sediment and phosphorus load reduction benefits. The numbers of the structures coincide with the numbers on the map below (Figure 15).

6.1.1 STRUCTURES #5, #9, AND #10

Of all the existing structures, #5 may have the single largest impact on the lake. With a drainage area that is largely cropland, this structure traps an estimated 465 tons of sediment each year. While some of this sediment is trapped in the drainageways, breached structures #9 & #10, swales and grassland areas upstream of the structure, this structure provides significant environmental benefits.

Unfortunately, of all the structures located in the watershed, the long-term functionality of #5 may be the most threatened. Within #5's drainage area, Structures #9 and #10 have been breached, whether by design or damage by storms. While #9 and #10 still provide some limited sediment trapping, the bulk of what they once collected now flows downslope and into #5.

The watershed that drains into the breached Structure #9 comprises mainly cropland, and is located along the western margins of the watershed. Structure #10 is located downstream of #9, and is also a breached structure on private lands. Being breached, the trapping efficiency of both structures drops from an estimated 90% to 20%.

For as long as Structure #5 stays functional, the importance of rebuilding #9 and #10 is somewhat muted. However, for as long as #9 and #10 stay breached, the capacity of #5 to trap sediment & phosphorus, as well as the life-span of the structure itself will continue to decrease.

Even breached, runoff is still somewhat restricted and some sediment will settle out. Therefore, #9 still traps 24 tons/year while #10 will collect 100 tons/year. However, if rebuilt (and to NRCS Standards) with a 90% trap efficiency, the resulting sediment reductions will increase to 108 tons/year for #9 and 450 tons for Structure #10. However it is important to note, the impact of these improvements will not be in the lake itself since Structure #5 ultimately catches sediment bypassing #9 and #10 before it reaches the lake. Rather, the benefit of rebuilding these structures will increase the lifespan of Structure #5.

Since #9 and #10 are both located on private lands, the decision on whether to rebuild them (hopefully this time to NRCS standards) rests with private landowners, and not the CCB. Regardless, any subsequent organized watershed efforts must make it a priority to partner with these landowners and rebuild these structures, otherwise the long-term functionality of #5 will be greatly impaired.

6.1.2 STRUCTURE #13 (PROPOSED)

If built, Structure #13 would improve on the benefits already being generated by #3. Almost all the other drainageways contributing sediment & phosphorus to the lake have been addressed, at least to a certain degree. However the pollutant loading from the subwatershed extending towards the northwest has yet to be effectively addressed.

Due to the flatness of the area and the current boundaries of the land owned by the CCB, any design will most likely be consistent with CREP-like wetlands, which are more commonly built in north-central Iowa. If the structure is built on public land only, the trapping efficiency would likely be 75%, or maybe even slightly lower. Should some of the adjoining land be purchased or at least the land rights secured through some form of easements with neighboring landowners, then it may be possible to build a taller structure, possibly improving the trapping efficiency towards 90%. Should it possible to build a structure with a 90% trap efficiency, the resulting sediment loading reductions could approach 270 tons/year, with a phosphorus reduction of 351 lbs. per year.

6.1.3 STRUCTURE #6

Though well situated, the existing structure #6 lacks the capacity to be an even greater sediment/phosphorus trap. While the structure currently traps an estimated 12 tons of sediment each year, its current design limitations allow an estimated 29 tons of sediment and 38 lbs. of phosphorus to pass through the site each year. Rebuilding this structure could increase its trapping efficiency from an estimated 30% to 90% and improve sediment loading reductions from 12 to 37 tons/year and phosphorus loading from 16 to 48 lbs. per year.

6.2 MANAGEMENT STRATEGIES – AGRICULTURAL LAND

Managing crop fields to reduce soil and nutrient loss is an important part of improving water quality. As stated above, the Otter Creek lake watershed is 76% Highly Erodible Land, with 325 acres of HEL currently in row crop production in 2015. The map below identifies opportunities for different agricultural conservation practices to be implemented based on slopes, soil type, and current land use.

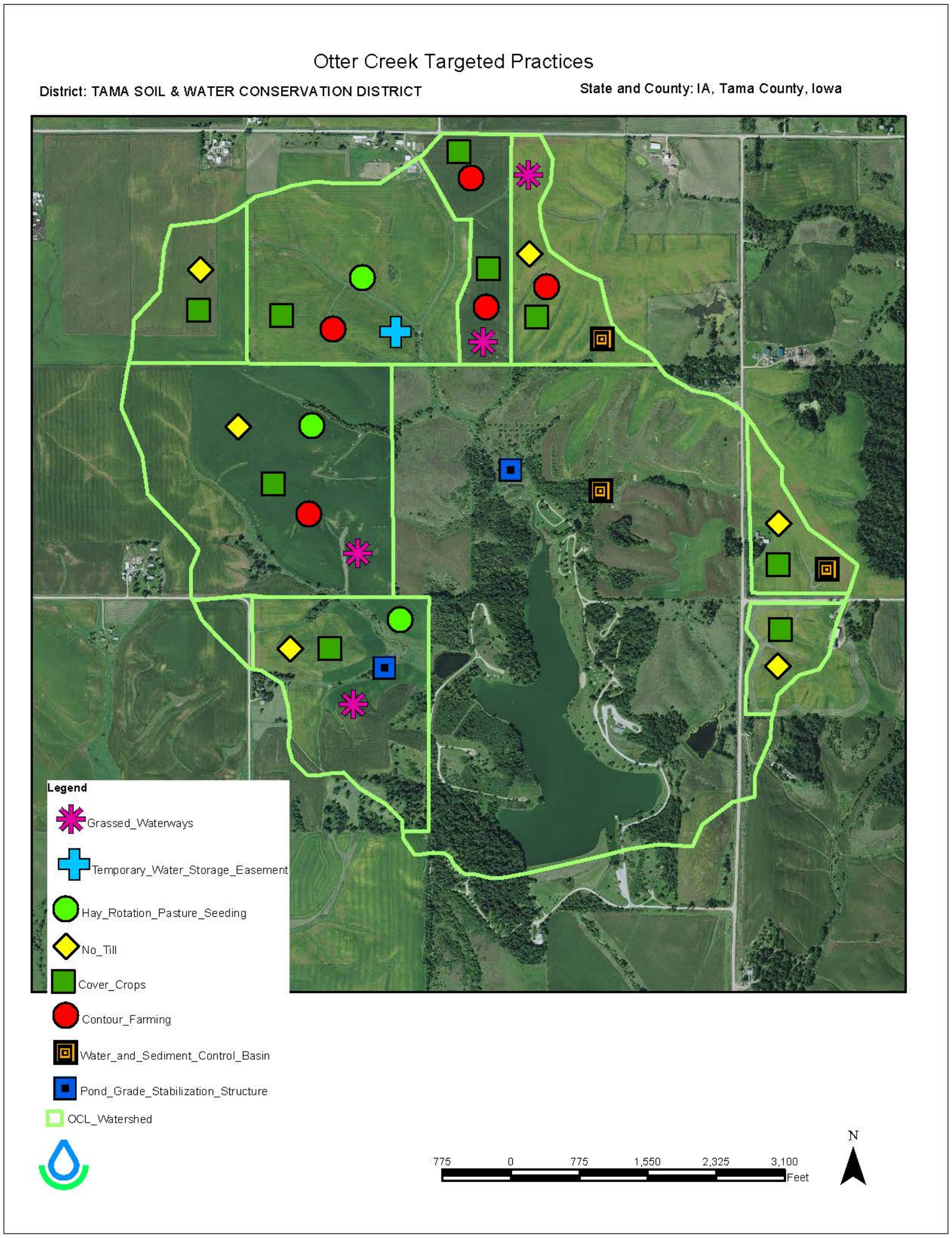


Figure 15. Otter Creek Lake Watershed Targeted Practices

6.3 WATER QUALITY IMPROVEMENT – PUBLIC LAND

In July 2019, an assessment of stormwater management and lake improvement opportunities was conducted by Tama CCB and Iowa DNR staff. The priority projects are listed below. Private engineering assistance will be sought in the fall of 2019 to develop conceptual designs and cost estimates for these priority projects.

Beach Area

Around the beach, there are numerous issues with drainage / overland flow leading to ponding in some areas. Runoff from the lawn area is leading to concentrated flow running over some places on the beach. An existing waterway conveys drainage, but the culvert is in disrepair and the channel below it is also experiencing some erosion and may contribute sediment loading to the lake. Possibilities for improvement at this site include:

- Use spoil from dredging activities to raise up the lawn area to reduce ponding and redirect runoff towards the existing waterway
- Improve the waterway, and repair culvert, possibly utilizing a bioswale with native vegetation (or other method to infiltrate / slow the flow through the waterway)
- Investigate the potential for a wetland or rain garden / bioretention cell feature to capture the flow / associated sediments from the existing waterway
- Investigate the potential of improving the parking area, either through permeable paving or incorporating stormwater practices such as rain gardens / bioretention cells to reduce runoff from the parking area
- Investigate the possibility for a sloped beach area
- Opportunity to incorporate Item #12 from wish list (re-route road near beach)

Figure 1 – Culvert draining to the north of the beach.


Figure 2. Poor condition of waterway / ditch draining along north side of beach.


Figure 3. Outlet of the ditch along beach. This area could be repurposed to a wetland or LID feature to better treat water and improve drainage of this area.

Figure 4. Example of runoff to beach

Figure 5. The beach / playground are down slope from the parking area.

New Picnic/ Camping Area (possibly the South Loop Campground?)
The CCB would like to do cattail mitigation in this area to open up the water for better access to fishing.


Figure 6. Example of an area where the CCB would like to reduce cattails.

North Siltation Pond above main arm of lake
Renovation of the existing silt pond would enable additional sediment trapping. The outlet of the pond has a broken culvert that needs to be repaired (?). This area also has potential for spoil storage. An additional structure above the existing ponds could also be possible for enhanced treatment.


Figure 7. Broken culvert at outlet of silt pond.


Figure 8. North silt pond, in need of renovation.

SE Silt pond along entrance road
There is limited ability to renovate this pond because of a pipeline that runs through it. Across the road, adjacent to the lake, the shoreline dips down and could be raised (using dredge spoil) to minimize ice damage.

West side siltation pond
This pond needs renovation to enhance sediment trapping capacity.

Playground area on the west side of the lake
This area is very damp, spoil storage could help to raise the area up. The CCB hopes for an additional fishing jetty here, where there are some decent depths that make good habitat. Timber stand improvement on the west side of the lake is needed.

7. WATERSHED GOALS, OBJECTIVES, & ACTION STEPS

The following Goals and Objectives have been developed by the Technical Advisory Team, based on the results of the TMDL and watershed assessments.

Goal 1: Implement watershed improvement measures to increase water clarity and enhance the lake aesthetics

- Objective 1: Achieve a TSI value of 63 for two consecutive listing cycles
  - Action (Output):
    - Install sediment retention structures to reduce sediment load
    - Promote the use of in-field and edge-of-field management strategies (especially HEL) to reduce phosphorus and sediment loading to the lake
    - Implement improved stormwater management practices to reduce runoff and phosphorus loading to the lake
    - Stabilize eroding areas of lake shoreline
  - Environmental Improvement (Outcome):
    - Reduce sediment loading to the lake by an additional 200 tons per year through a combination of new or rebuilt structures, and management practices
    - Reduce external TP load by 69% (832 lbs) through a combination of structures and management practices
  - Measurements of success:
    - Estimated pollutant load reduction: Water quality monitoring will be continued in the lake, following the monitoring plan outlined in the section below
    - Number of practices installed on critical ground (HEL and public lands)
    - Increased use of the lake for swimming, boating, or other recreational activities

Goal 2: Enhance public awareness and understanding of the Otter Creek Lake watershed

- Objective: Educate Otter Creek Lake park visitors and area residents / landowners about the connection between land management and water quality
  - Actions:
    - Develop signage throughout park to educate about watershed improvement
    - Install watershed boundary signs at road crossings
    - Develop a poster about the watershed for the nature center
    - Continue to distribute newsletter twice per year
  - Environmental Improvement:
    - Watershed farmers and landowners have increased knowledge about how their land management practices affect Otter Creek Lake
    - Park users have increased knowledge about potential threats to water quality in Otter Creek Lake
  - Measurements of Success:
    - Number of farmer, landowner, resident, and / or park user contacts
    - Number of landowner commitments to install practices
    - Number of newsletters distributed

Goal 3: Implement in-lake restoration measures to improve aquatic habitat and recreational opportunities

- Objective: Partner with the IDNR Lake Restoration Program to reduce the internal phosphorus load in Otter Creek Lake
    - Actions: Conduct targeted and / or in-lake dredging to remove sedimentation within the lake
    - Enhance the lake's fishery by improving shoreline habitat
    - Retrofit Dam for a control structure that allows for lake drawdown
- Environmental Improvement:
    - Reduce internal phosphorus loading by 69% (201.48 lbs)
    - Increase populations of desirable fish species
- Measurements of Success:
    - Estimated pollutant load reduction: Water quality monitoring will be continued in the lake, following the monitoring plan outlined in the section below
    - Population estimates of desirable (and undesirable) fish species
    - Increased use of lake for fishing

8. OTTER CREEK LAKE WATERSHED PROJECT

8.1 PROJECT IMPLEMENTATION SCHEDULE & MILESTONES

The watershed management plan will be implemented over the course of 4 phases, with a total project length estimated at 10 years. At the end of each of the first three phases, a meeting will be held with the project advisory committee, IDNR Lake Restoration staff, and other stakeholders to discuss progress made in implementing the watershed plan goals.

According to EPA, establishing interim milestones provides those involved with the means to periodically conduct an internal evaluation to determine if the identified project measures and planned BMPs are being adopted by stakeholders in a timely fashion. This evaluation will be conducted by the TCCB and TSWCD and the Advisory Committee (including but not limited to CCB, SWCD, Tama Supervisors, county engineer, and any other local stakeholders or technical advisors). This same group will collectively discuss alternatives and evaluate potential changes should progress be less than anticipated. The project will use the evaluation strategy currently in place for all our 319 projects: quarterly reports, an annual in-person meeting. The reports will include # BMPs, load reductions, outreach activities, etc. The annual meeting is a chance for project partners to provide in-depth feedback on the progress made the previous year

<u>Phase 1 (*Year One*)</u>

The primary activities of Phase 1 will be to initiate the watershed project, develop contacts with relevant stakeholder groups, and begin the investigations of practices on public land within Otter Creek Lake Park.

Watershed Improvement Measures (Goal 1):

- Sites for potential sediment trapping structure(s) evaluated in the watershed
- Application submitted to at least one potential funding source (such as Publicly Owned Lakes)
- Water quality monitoring program initiated
- Maintenance strategy developed
- Current land cover evaluated and strategies to reduce negative land cover conversions in order to maintain positive land cover developed.

Information & Education (Goal 2):

- Watershed Plan Open House conducted; all landowners in the watershed invited, as well as park users and citizens of Tama County
- Facebook page created
- Newsletter distributed to all landowners in watershed (two per year)
- Place signage explaining watershed concepts and efforts in strategic areas around the park.

Lake Restoration Measures (Goal 3):

- Preliminary meeting with IDNR Lake Restoration staff and watershed stakeholders about potential future partnership

<u>Phase 2 (A*pproximately Years 2 – 3*)</u>

The primary activities for Phase 2 will be to continue the public outreach, and begin working with watershed landowners to make improvements on private lands.

Watershed Improvement Measures (Goal 1):

- Work with adjacent landowners to reduce sheet and rill erosion, particularly in the area draining to the proposed sediment trapping structure planned on park property (practice targets for Phase 2 listed in Table 13)
- Water monitoring conducted at designated sites, April - October

Information & Education (Goal 2):

- Continue newsletter (two per year)
- Educational sign installed in park explaining watershed improvement concepts
- Preliminary meeting held to discuss multi-use trail system to accommodate educational and recreational opportunities in newly purchased lands demonstrating and explaining watershed science.

Lake Restoration Measures (Goal 3):

- Update meeting held with DNR Lake Restoration Staff and watershed stakeholders to share progress on watershed plan implementation

<u>Phase 3 (*approximately 3-4 years*)</u>

This phase will focus on building one or sediment trapping structures in the watershed, and continuing to provide incentives to watershed landowners to reduce erosion and nutrient loss from farm fields.

Watershed Improvement Measures (Goal 1):

- Design and construct sediment trapping structure in Otter Creek Lake Park
- Conservation practices installed on private land, especially on highly erodible land currently engaged in row crop production (targets for Phase 3 practice implementation listed in Table 13)
- Water monitoring conducted at designated sites, April - October

Information & Education (Goal 2)

- Host field days on cover crops or other agricultural conservation practices for watershed landowners

- One teacher workshop hosted demonstrating the relationship between the landscape and water quality – tied to Iowa Core Curriculum.

Lake Restoration Measures (Goal 3):

- Update meeting held with DNR Lake Restoration Staff to share progress on watershed plan implementation

<u>Phase 4 (*approximately 5-10 years*)</u>

Once sediment and phosphorus loading from the watershed have been controlled, the project will seek to partner with the IDNR Lake Restoration Program to implement in-lake restoration measures.

Watershed Improvement Measures (Goal 1):

- Continue working with landowners to implement agricultural BMPs (targets for Phase 4 practice implementation listed in Table 13)
- Evaluation and maintenance of existing practices

Information & Education (Goal 2):

- Create a watershed model demonstrating management process in nature center

Lake Restoration Measures (Goal 3):

- Work with IDNR's Lake Restoration Program and other partners to secure funds for in-lake improvements
    - Conduct partial dredging
    - Retrofit Dam so that drawdown is a possibility
    - Conduct habitat improvements and fish stocking as needed

Table 13. Practice targets according to phase of the Otter Creek Lake watershed project.

Practice	**Acres**	**Phase**			
		1	*2*	*3*	*4*
Cover Crops	460 ac	0	100	200	160
No-till	320 ac	0	100	120	100
Grass Waterways	6 ac	0	2	2	2
Structure	3 no	0	1	1	1
Water & Sediment Control Basin	12 no	0	4	4	4
Hay in rotation	300 ac	0	100	100	100
Terraces	1000 ft	0	0	500	500
Contour farming	280 ac	0	100	100	80
Pasture seeding	10 ac	0	0	0	10
Prescribed grazing	10 ac	0	0	0	10
Alternate watering source	2 no	0	0	0	2
Livestock exclusion	4 ac	0	0	0	4

9. INDICATORS TO MEASURE PROGRESS

Since most of the following critical water quality parameters are tracked as part of the IDNR's Lake Monitoring Program, this project will use their median values based upon the 5 most recent years of data in order to measure progress. Success will be achieved when the following conditions are met:

	Indicator	Phase 1	Phase 2	Phase 3	Phase 4
Watershed	Sediment Load Reductions		160 tons / year	385 tons / year	95 tons / year
	Phosphorus Load Reductions		208 lbs / year	501 lbs / year	325 lbs / year
In-Lake	Median Secchi depth	0.5 m	0.8 m	1.0 m	1.3 m
	Median Chlorophyll *a*	80 µg/L	70 µg/L	50 µg/L	27 µg/L
Education**	Direct Contacts	20	40	60	80
	Indirect Contacts	1,000	1,250	1,500	2,000

Table 14. Indicators to measure progress toward watershed plan goals. **Direct contacts include face-to-face meetings with individuals, such as at landowner meetings, field days, or educational programs. Indirect contacts include number of people who are reached through means such as signage, newsletters, or social media posts.

Once achieved, such numbers will generate sufficient improvements in the Carlson Trophic State Index values for both Secchi depths and Chlorophyll a for the de-listing of this waterbody based upon the current impairments.

10. MONITORING PROGRAM

The TCCB has developed a very cooperative relationship with various staff & departments within the IDNR to conduct a thorough monitoring effort, the results of which were used as a foundation for this document. The charts, tables, and summaries of water quality data used throughout this watershed management plan originiated either from IDNR's Ambient Monitoring Program or through monitoring conducted during the development of the TMDL. Completed datasets can be found in Appendix 2.

Water quality monitoring is critical for assessing the current status of water resources as well as historical and future trends. Furthermore, monitoring is necessary to track the effectiveness of water quality improvements made in the watershed and document the status of the waterbody in terms of achieving Total Maximum Daily Loads (TMDLs) and Water Quality Standards (WQS).

Future monitoring in the Otter Creek Lake watershed can be agency-led, volunteer-based, or a combination of both. The Iowa Department of Natural Resources (IDNR) Watershed Monitoring and Assessment Section administers a water quality monitoring program, called IOWATER, that provides training to interested volunteers. More information can be found at the program web site: http://www.iowater.net/Default.htm.

It is important that volunteer-based monitoring efforts include an approved water quality monitoring plan, called a Quality Assurance Project Plan (QAPP), in accordance with Iowa Administrative Code (IAC) 567-61.10(455B) through 567-61.13(455B). The IAC can be viewed here:

http://search.legis.state.ia.us/NXT/gateway.dll/ar/iac/5670___environmental%20protection%20commission%20__5b567__5d/0610___chapter%2061%20water%20quality%20standards/_c_5670_0610.xml?f=templates$fn=default.htm. Failure to prepare an approved QAPP will prevent data collected from being used to assess a waterbody's status on the state's 303(d) list – the list that identifies impaired waterbodies.

10.1 MONITORING PLAN TO TRACK TMDL EFFECTIVENESS

Future data collection in Otter Creek Lake to assess water quality trends and compliance with water quality standards (WQS) is expected to include monitoring conducted as part of the IDNR Ambient Lake Monitoring Program. Unless there is local interest in collecting additional water quality data, future sampling efforts will be limited to these basic monitoring programs.

The Ambient Lake Monitoring Program was initiated in 2000 in order to better assess the water quality of Iowa lakes. Currently, 137 of Iowa's lakes are being sampled as part of this program, including Otter Creek Lake. Typically, one location near the deepest part of the lake is sampled, and many chemical, physical, and biological parameters are measured. Sampling parameters are reported in Table 5.1. At least three sampling events are scheduled every summer, typically between Memorial Day and Labor Day.

Table 15. Ambient Lake Monitoring Program water quality parameters.

Chemical	**Physical**	**Biological**
• Total Phosphorus (TP)	• Secchi Depth	• Chlorophyll a
• Soluble Reactive Phosphorus (SRP)	• Temperature	• Phytoplankton (mass and composition)
• Total Nitrogen (TN)	• Dissolved Oxygen (DO)	• Zooplankton (mass and composition)
• Total Kjeldahl Nitrogen (TKN)	• Turbidity	
• Ammonia	• Total Suspended Solids (TSS)	
• Un-ionized Ammonia	• Total Fixed Suspended Solids	
• Nitrate + Nitrite Nitrogen	• Total Volatile Suspended Solids • Specific Conductivity	
• Alkalinity	• Lake Depth	
• pH	• Thermocline Depth	
• Silica		
• Total Organic Carbon		
• Total Dissolved Solids		
• Dissolved Organic Carbon		

10.2 EXPANDED MONITORING FOR DETAILED ASSESSMENT AND PLANNING

Data available from the IDNR Ambient Lake Monitoring Program will be used to assess general water quality trends and WQS attainment. More detailed monitoring data is required to reduce the level of uncertainty associated with water quality trend analysis, better understand the impacts of implemented watershed projects (i.e., BMPs), and guide future water quality modeling and BMP implementation efforts.

Figure 12 depicts where the ambient lake monitoring site and additional samples will be gathered. As data from the limbs of the lake is gathered and analyzed, additional tributary sites may be added if these would be helpful in monitoring the effectiveness of BMPs and the water quality entering the upper portion of the lake.

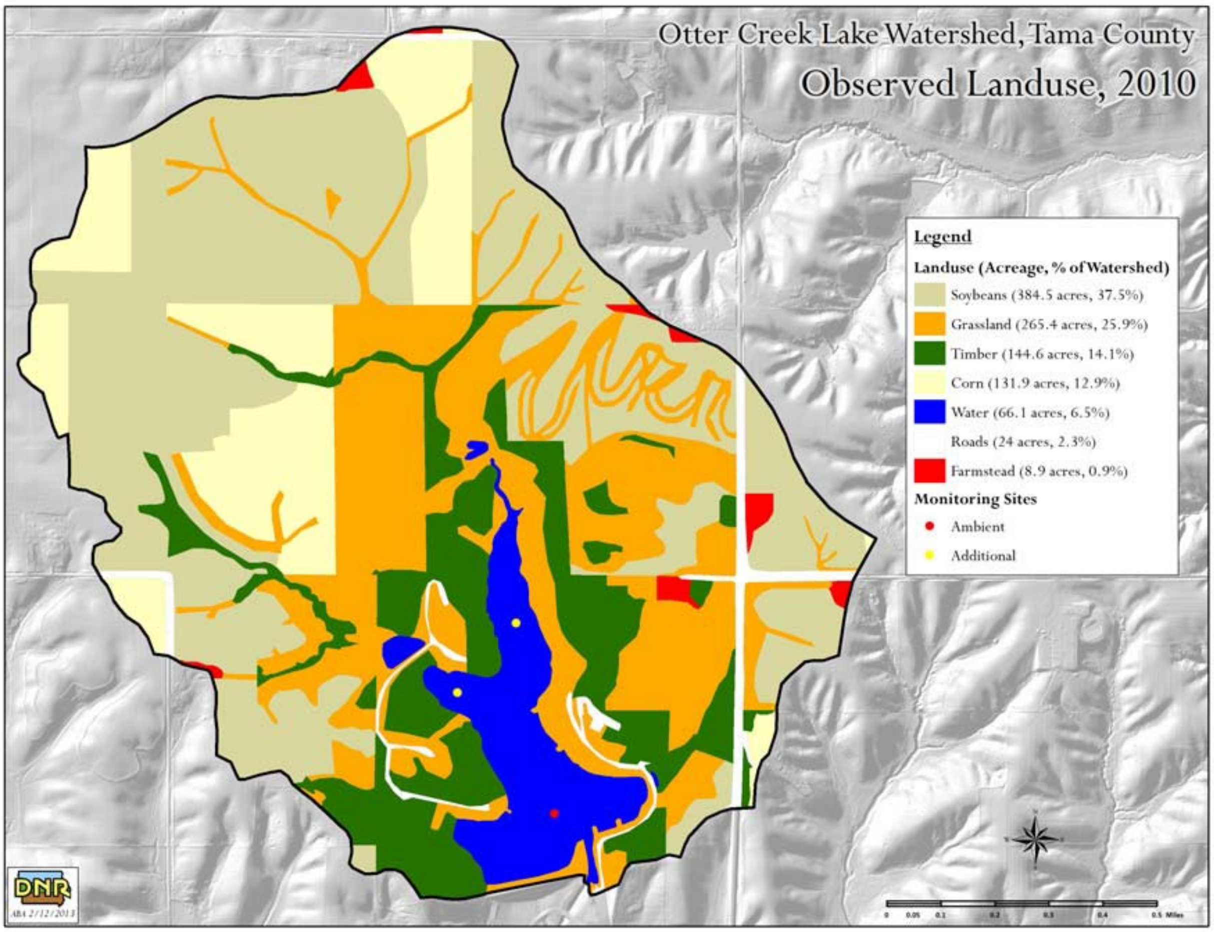


Figure 16. Sample locations for Otter Creek Lake monitoring. (Source: Otter Creek Lake TMDL)

10.3 IDEALIZED PLAN FOR FUTURE WATERSHED PROJECTS

Table 16 outlines the detailed monitoring plan by listing the components in order, starting with the highest priority recommendations. While it is unlikely that available funding will allow collection of all recommended data, this expanded plan can be used to help identify and prioritize monitoring data needs.

Table 16. Expanded monitoring plan.

Parameter(s)	Intervals	Duration	Locations[1]
Routine grab sampling for flow, sediment, and P	Every 1-2 weeks	April through October	Ambient and Tributaries
Continuous pH, DO, turbidity and temperature	15-60 minute	April through October	Ambient and Tributaries
Runoff event flow, sediment and P	Continuous flow, composite WQ	3 events between April and October	Tributaries

[1]Final location of tributary sites should be based on BMP placement, landowner permission, and access/installation feasibility.

Routine weekly or bi-weekly grab sampling with concurrent in-lake and tributary data (ambient location and tributaries in Figure 5.1) would help identify long-term trends in water quality and nutrient loading. Particularly, grab samples both upstream and downstream of BMPs to assess efficiency of each structure would be helpful in assessing the overall watershed. Data collection should commence before additional BMPs are implemented in the watershed to establish baseline conditions. This data could form the foundation for assessment of general water quality trends; however, more detailed information will be necessary to evaluate loading processes, storm events, and reduce uncertainty. Therefore, routine grab sampling should be viewed only as a starting point for assessing trends in water quality.

Continuous flow data in the tributaries and at the outlet (i.e., spillway) of the lake would improve the predictive ability and accuracy of modeling tools, such as those used to develop the TMDL for Otter Creek Lake. Reliable long-term flow data is also important because hydrology drives many important processes related to water quality, and a good hydrologic data set will be necessary to evaluate the success of BMPs such as reduced tillage, sediment control structures, terraces and grass waterways, riparian buffers, and wetlands. If funding is available, lake managers should consider deploying a data logger at the ambient monitoring location and possibly in tributaries to measure pH, temperature, and dissolved oxygen (DO) on a continuous basis. This information will help answer questions about the causes and effects of algal blooms and will provide spatial resolution for evaluation of water quality in different areas of the lake. Routine grab sampling, described previously, should be coordinated with deployment of data loggers.

The proposed expanded monitoring information would assist utilization of watershed and water quality models to simulate various scenarios and water quality response to BMP implementation. Monitoring parameters and locations should be continually evaluated. Adjustment of parameters and/or locations should be based on BMP placement, newly discovered or suspected pollution sources, and other dynamic factors. The IDNR Watershed Improvement Section can provide technical support to locally led efforts in collecting further water quality and flow monitoring data in the Otter Creek Lake watershed.

11. PUBLIC ENGAGEMENT

Watershed planning for the Otter Creek Watershed to this point has been the domain of the Tama County Conservation Board, Tama County Board of Supervisors, Conservation Board Employees, and representatives from the DNR, NRCS and IDALS_DSC. Through the efforts of these groups and individuals, land has been purchased and designated to protect the watershed as well as to provide recreational opportunities for the residents of the Tama County area as well as those of the state at large. Watershed planning is a frequent discussion point in the Conservation Board meetings and those discussions are reflected in the meeting minutes of that organization.

11.1 NEWSLETTER

A newsletter was distributed to landowners in the watershed twice a year beginning in 2013. The newsletter will continued to be distributed to keep landowners and stakeholders informed of progress towards achieving the watershed plan goals.

11.2 STAKEHOLDER SURVEY

As a part of this Watershed Management Plan process, an in-person survey of lake users was conducted in early fall of 2013 by Otter Creek Lake park staff. A total of 55 surveys were collected. Park users were interviewed by staff, and the responses were documented by the interviewer on individual survey sheets. A complete summary of the surveys is included as Appendix 1. The individuals that were surveyed were also given the opportunity to become involved in the watershed plan development process.

11.3 OPEN HOUSE

To roll out the Otter Creek Lake WMP, the TCCB and TSWCD will co-host a meeting with representatives from all stakeholder groups within the watershed, especially those representing the private-sector agricultural interests to outline how the various partners will meet periodically and work together to react to future changes in agriculture and land cover, as well as chemical and biological changes within the lake itself.

11.4 TECHNICAL ADVISORY COMMITTEE

The Technical Advisory Committee will continue to meet to evaluate progress in reaching the watershed plan goals. The committee will periodically review all existing monitoring data, as well as on-going changes in land use or land cover, and then develop alternative approaches to address emerging threats to water quality.

12. PROJECT ADMINISTRATION

The project will be administered through a cooperative effort between the Tama County Conservation Board and the Tama Soil & Water Conservation District, with direct input from the Advisory Committee representing all stakeholder groups within the watershed. The ultimate decisions as to what happens within the park will be the purview of the TCCB, while private landowners will make decisions for the surrounding watershed with input from the TSWCD.

In time, additional financial assistance may be sought via the TCCB and/or the TSWCD to support various water quality-related efforts within the watershed. Different sources have different eligibility requirements. As a result, certain streams of financial assistance may be secured via the TCCB while others may come through the TSWCD. Regardless, both entities will work in tandem with the project's Advisory Committee to ensure cooperation & participation.

13. BUDGETS

Determining a project budget is an important part of the planning process to provide partners with an overall picture of what level of investment will be needed to restore the lake. That said, project costs can vary greatly from year to year. The budget numbers provided below are simply projections, and will need to be refined as the project moves into the implementation stage. Lake Restoration Program will be investing heavily in the project (state funds) on public land. Publicly Owned Lakes funds will continue to be used for work on private land. Section 319 funds will be used as supplement for the public and private lands work as needed in addition to funding of project coordination, and public outreach.

A. Project Coordinator: The coordinator would help with the educational efforts, working with landowners on implementing conservation practices, and helping with planning the sediment trapping structures. Depending on the phase of the project, this person could be either full- or half-time. A staff person shared between the District and the County is also a possibility.

   Estimated Annual Cost for Staffing: $45,000 per year (average)

B. Structures: The costs below are very general, based on the estimated size, compared to similar structures in similar landscapes in Iowa. The costs could very easily be more or less than what is put forward here. The structures are most likely going to built in Phase 3, so most of the costs for the structures will be associated with Years 3-4 of the project.

   a. Structure #13 (Small size, 75% Trap) - $70,000
   b. Structure #13 (Larger size, 90% Trap) - $150,000
   c. #6 - $40,000
   d. #9 - $20,000
   e. 10 - $40,000

   Estimated Cost for Structures: $170,000 - $250,000

C. Agricultural Management Practices: It is difficult to predict the exact dollar amount that will be invested in providing incentives to landowners for conservation practices. The accepted cost-share rates under federal programs such as EQIP or state programs such as IFIP will be utilized. It is anticipated that an estimated $150,000 will be needed to achieve the plan goals of

Table 13. Practice targets according to phase of the Otter Creek Lake watershed project.

Practice	**Acres**	**Estimated Payment Rate**	**Phase**				**Estimated Total Project Cost**
			1	*2*	*3*	*4*	
Cover Crops	460 ac	$25 / acre	0	100	200	160	$11,500
No-till	320 ac	$10 / acre	0	100	120	100	$3,200
Grass Waterways	6 ac	TBD	0	2	2	2	TBD
Structure	3 no	$5,000 each	0	1	1	1	$15,000
Water & Sediment Control Basin	12 no	TBD	0	4	4	4	TBD
Hay in rotation	300 ac	TBD	0	100	100	100	TBD
Terraces	1000 ft	$5/ft	0	0	500	500	$5,000
Contour farming	280 ac	TBD	0	100	100	80	TBD
Pasture seeding	10 ac	TBD	0	0	0	10	TBD

Prescribed grazing	10 ac	TBD	0	0	0	10	TBD
Alternate watering source	2 no	$2,250 each	0	0	0	2	$4500
Livestock exclusion	4 ac	TBD	0	0	0	4	$6,000

D. Information & Education: Outside of staffing costs, which are estimated above, the primary costs for I&E activities will include distributing a newsletter, signage around the park, providing food and materials for field days or other educational workshops, and posters / flyers. The project anticipates spending an average of $2,000 per year on I&E activities for the watershed project.

Estimated Project Cost for I&E: $20,000

E. Lake Restoration: The costs for lake restoration are unknown at this time. Once the project is ready to move into the lake restoration phase, following construction of structures in the watershed, this will be revisited and the watershed plan updated with a tentative budget and implementation schedule.

14. Appendices

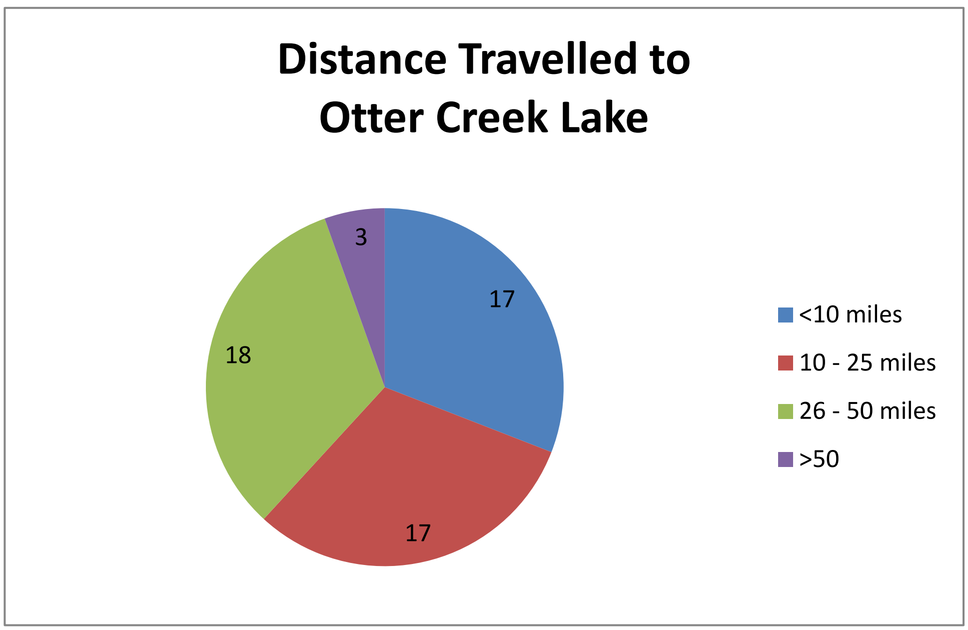
Appendix 1: Park User Survey Results

Appendix 2: Structure Analysis of Existing and Proposed Structures in Otter Creek Lake (Report)

Otter Creek Lake
Park User Survey

Methodology:
This survey was developed by the Otter Creek Lake Technical Advisory Committee to provide information for the Watershed Management Plan. Park users were interviewed by Otter Creek Lake park staff, and their responses were recorded.

What city and state do you live in? (n=55)
Over half the respondents were from 5 communities: Belle Plaine, Marshalltown, Tama, Toledo, Gilman (31/55, or 56%). 17 drove less than 10 miles to reach the park; 17 drove between 10-25 miles; 18 drove 26-50 miles; 3 drove 50 miles or more. One came all the way from Texas (>1200 miles)!



County	*Number*
Tama	29
Marshall	14

Benton	5
Black Hawk	2
Linn	2
Jones	1

Do you know which watershed you live in? (n=8)
Most said no; only 7 responded yes. Of those, the following watersheds were named: Deer Creek, Salt Creek, Cedar Valley. One person responded ‘no clue.’ One simply responded ‘yes.’

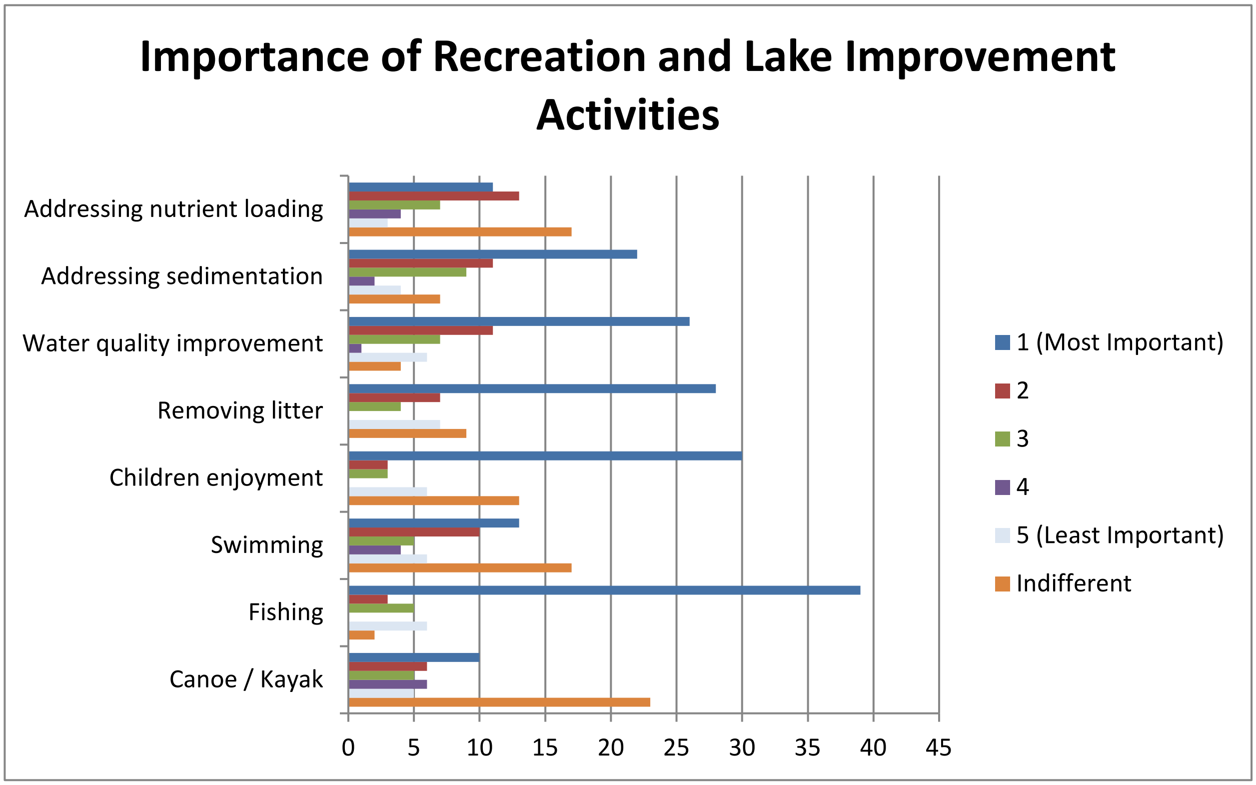
In what seasons do you visit Otter Creek Lake?
Winter _2__ Spring _31__ Summer _48__ Fall _47__

Please indicate the types of activities you do in/around Otter Creek Lake and how often you do them:

a. Biking 6
b. Camping 45
c. Running/jogging/walking 19
d. Playgrounds/picnics 18
e. Fishing/hunting 45
f. Kayaking/canoeing 12
g. Swimming 19
h. Nature enjoyment 31

Fishing / hunting, and camping were by far the most popular activities, with nature enjoyment coming in third. The least popular activity was biking.

Please indicate on a scale from 1 - 5 how important the following issues are to you. If an issue does not matter to you, do not rank it. (*1=Extremely important, 5=Not at all important) (n=55)*



Do you have any concerns about Otter Creek Lake you would like to share with us?

need 2nd boat ramp

lake needs cleaning out

more campgrounds by water

more campground by lake

We love camping at county parks over state. County parks are better cared for and rules are enforced.

lake needs to be deeper

need another boat ramp

better care of lake
better flood water control
when are you going to clean out lake
improve electrical boxes, more fish, clean out lake
need to clean out the lake more fish
no
no
not at this time
fishing could improve
more trails
like trail closer to lake

How many years have you been coming to Otter Creek Lake?

Range	Number
<1	8
2 - 10	15
11 - 25	18
>25	14

TOTAL	55

What is your age?

Range	Number
<18	0
18 - 30	4
31-50	24
>50	27
TOTAL	55

How frequently do you visit Otter Creek Lake with children?

Range	Number
Never	15
Sometimes	15
Frequently	22
Blank	3
TOTAL	55

The Tama County CCB will be developing a Management Plan for Otter Creek Lake. Would you like to be informed of opportunities to participate?

Phone	Email
319-234-1878	auntym50158@yahoo.com
319-239-9671	bruce_3750158@yahoo.com
319-329-6822	cookie25_50158@yahoo.com
319-365-0590	csduden@iowatelecom.net
319-429-0183	gltaylor04@yahoo.com
319-476-7983	jtclean4@yahoo.com
319-929-6200	kbjordan@mchsi.com
319-988-3767	mudminnow06@yahoo.com
484-2328	patdicus@netins.net
641-485-7895	su.pals@diamondvogel.com
641-485-9158	sylclemm@yahoo.com
641-499-2323	tmlamos@mediacombb.net
641-691-6098	
641-751-2184	

Trapping Efficiency of Existing and Proposed Structures in Otter Creek Lake

Built either as part of the previous watershed effort, or at the discretion of the Tama County Conservation Board (Tama CCB), several sediment trapping structures already exist within this watershed. This analysis will attempt to estimate the loading reductions (both in terms of sediment & phosphorus) of these existing structures as well as a significant proposed wetland structure at the north end of the lake.

Estimating sediment reductions due to BMP implementations is not an exact science. But how we applied it as part of this analysis enables us to compare the impact various structural practices can have based upon their existing condition and should they be rebuilt according to NRCS standards.

Existing & Potential Sediment & Phosphorus Reductions by Structural BMPs

Structure	1	2	3	4	5	6	7	9	10	11	12	13	14	Totals
Existing														
Sediment Reductions	4	9	70	1	465	12	6	24	100	4	108	NA	28	831
Phosphorus Reductions	5	12	91	1	605	16	8	31	130	5	140	NA	36	1,080
With Improvements														
Sediment Reductions	4	9	25	1	15	37	6	108	450	4	108	225	28	1,020
Phosphorus Reductions	5	12	32	1	20	48	8	140	585	5	140	293	36	1,325

Sediment reductions in tons/year. Phosphorus reductions in pounds/year.

Since the watershed already has several structural BMPs already in place, installing only a few more will only have a limited impact. However, due to the aggressive phosphorus goals outlined in the TMDL, for this effort to be successful, increasing the efficiency of every practice installation will be necessary for the partners to achieve success.

The following are brief descriptions of the existing structural practices around the lake. In a few cases alternative designs were considered when possible, again to maximize their potential impacts. The numbers of the structures coincide with the numbers on the attached maps.

Structure #1

A smaller, fenceline structure near the northwest corner of the lake. With a small drainage area, the amount of sediment trapping is low. The main benefit of this structure is that it protects the much larger Structure #2 located further downslope.

Drainage Area	1.8 acres
Trapping Efficiency	90%

Sediment Reduction	4 tons/year
Phosphorus Reduction	5 lbs/year

This structure appears to be adequately addressing the sediment & phosphorus issues at this site at this time. Emphasis needs to be placed on maintaining the functionality of this structure for the foreseeable future.

Structure #2

Located further downslope than #1, this structure receives runoff from a 19 acre drainage area. While most of the drainage area above #1 was cropland, most of the drainage area between #1 and #2 is grassland, keeping the overall erosion/sedimentation low and protecting the longevity of Structure #2.

Drainage Area	18.8 acres
Trapping Efficiency	90%

Sediment Reduction	9 tons/year
Phosphorus Reduction	12 lbs/year

Like #1 this structure appears to be adequately addressing the sediment & phosphorus issues at this site at this time. Emphasis needs to be placed on maintaining the functionality of this structure for the foreseeable future.

Structure #3

A self-built structure by the CCB, this structure spans the primary drainageway entering the northern end of the lake. While the structure may be under-designed according to NRCS standards, the design does provide some trapping, especially heavier sediment particles.

Drainage Area	363.2 acres
Trapping Efficiency	20%

Sediment Reduction	70 tons/year
Phosphorus Reduction	91 lbs/year

Increasing the trapping efficiency of the existing structure would be difficult. A better option may be to start new and construct a structure a little further upslope. The benefits of this option are outlined in the description of Structure #13.

Regardless of whether #13 is built, maintaining the functionality of #3 would be beneficial. Though the trapping efficiency is somewhat limited, is does provide a net reduction. In addition, if disturbed, the site could generate a flush of phosphorus attached to sediment that was trapped behind the structure.

Structure #4

A smaller structure along the northwest margins of the lake, the primary benefits of this structure may be the prevention of gully erosion and the protection of Structure #5

Drainage Area	8.0 acres
Trapping Efficiency	90%

Sediment Reduction	1 ton/year
Phosphorus Reduction	1 lb/year

Since the entire drainage area of this BMP is grassland & timber, the smaller structure appears to be adequately addressing the sediment & phosphorus issues at this site at this time. Emphasis needs to be placed on maintaining the functionality of this structure for the foreseeable future.

Structure #5

Of all the existing structures, #5 may have the single largest impact on the lake. With a drainage area that is largely cropland, this structure traps an estimated 465 tons of sediment each year. It is important to note, that some of this sediment is trapped in the drainageways, breached structures #9 & #10, swales and grassland areas upstream of the structure. However, there is no denying the importance of this structure.

Drainage Area	205.3 acres
Trapping Efficiency	90%

Sediment Reduction	465 ton/year
Phosphorus Reduction	605 lb/year

Unfortunately, of all the structures, the long-term functionality of #5 may be the most threatened. Within #5's drainage area, Structures #9 and #10 have been breached, whether by design or damage by storms. While #9 and #10 still provide some limited sediment trapping, the bulk of what they once collected now flows downslope and into #5.

Since #9 and #10 are both located on private lands, the decision on whether to rebuild them (hopefully this time to NRCS standards) rest with private landowners, and not the CCB. Regardless, any subsequent organized watershed efforts must make it a priority to partner with these landowners and rebuild these structures, otherwise the long-term functionality of #5 will be greatly impaired.

Structure #6

Though well situated, the existing structure lacks the capacity to be an even greater sediment/phosphorus trap. While we estimate the structure traps 12 tons of sediment each year, it's current design limitations allow an estimated 29 tons of sediment and 38 lbs. of phosphorus to pass through the site each year.

Drainage Area	30.0 acres
Trapping Efficiency	30%

Sediment Reduction	12 tons/year
Phosphorus Reduction	16 lbs/year

Rebuilding this structure could increase its trapping efficiency from an estimated 30% to 90% and improve sediment loading reductions from 12 to 37 tons/year and phosphorus loading from 16 to 48 lbs. per year.

Structure #7

Similar in design & function to #6, Structure #7 is functional, yet underdesigned according to NRCS standards. However, with the recent construction of structure #12 immediately upslope, # 7 is more than adequate to treat the remaining 13.5 acres of the watershed between #12 and #7, as well as the flow outletting from the principle spillway of #12.

Drainage Area	13.5 acres
Trapping Efficiency	30%

Sediment Reduction	6 tons/year
Phosphorus Reduction	8 lbs/year

Having such a structure immediately downstream of #12 may be fortuitous for the project. With #12 taking the hit from larger, sediment-laden flows, phosphorus in soluble form exiting #12 can be further treated in the wetland environment provided by #7.

Therefore, this structure appears to be adequately addressing the sediment & phosphorus issues for the re-designed watershed at this site at this time. Emphasis needs to be placed on maintaining the functionality of this structure for the foreseeable future.

Structure #9

Comprised mostly of cropland, the drainage area of this watershed flows into a breached structure along the western margins of the watershed. Being breached, the trapping efficiency drops from an estimated 90% to 20%.

Drainage Area	61.5 acres
Trapping Efficiency	20%

Sediment Reduction	24 tons/year
Phosphorus Reduction	31 lbs/year

For as long as Structure #5 stays functional, the importance of rebuilding #9 is somewhat muted. However, for as long as #9 and #10 stay breached, the capacity of #5 to trap sediment & phosphorus, as well as the life-span of the structure itself will continue to decrease.

As stated earlier, both #9 and #10 are on private lands, and not under the direct control of the CCB. So efforts to partner with the appropriate landowners to encourage their voluntary reconstruction will be necessary.

Structure #10

The situation with #10 is almost identical to #9, in that it's a breached structure on private lands. As a result, the trapping efficiency decreases from an estimated 90% to 20%. Even breached, runoff is still somewhat restricted and some sediment will settle out. We estimate #9 still traps 24 tons/year while #10 will collect 100 tons/year.

Drainage Area	167.0 acres
Trapping Efficiency	20%

Sediment Reduction	100 tons/year
Phosphorus Reduction	130 lbs/year

However, if rebuilt (and to NRCS Standards) with a 90% trap efficiency, the resulting sediment reductions will increase to 108 tons/year for #9 and 450 tons for Structure #10. However it is important to note, the impact of these improvements will not be in the lake itself since Structure #5 ultimately catches sediment bypassing #9 and #10 before it reaches the lake. Rather, the benefit of rebuilding these structures will be on increasing the lifespan of Structure #5.

Structure #11

The situation with #11, and its relationship to #14 is very similar to Structures #7 and #12. Though originally underbuilt, with the addition of a larger capacity structure immediately upslope, their original configuration now appears to be adequate.

Drainage Area	5.9 acres
Trapping Efficiency	30%

Sediment Reduction	4 tons/year
Phosphorus Reduction	5 lbs/year

Therefore, this structure appears to be adequately addressing the sediment & phosphorus issues for the re-designed watershed at this site at this time. Emphasis needs to be placed on maintaining the functionality of this structure for the foreseeable future.

Structure #12

Built within the past couple years, this structure, to a large degree replaces Structure #7. This pretty much effectively treats the entire 110.6 acre subwatershed draining into the southeast corner of the lake.

Drainage Area	97.1 acres
Trapping Efficiency	90%

Sediment Reduction	108 tons/year
Phosphorus Reduction	140 lbs/year

Therefore, this structure appears to be adequately addressing the sediment & phosphorus issues for the re-designed watershed at this site at this time. Emphasis needs to be placed on maintaining the functionality of this structure for the foreseeable future.

Structure #13

As #12 improves on #7, Structure #13 (if built) should improve on the benefits already being generated by #3. Almost all the other drainageways contributing sediment & phosphorus to the lake have been addressed, at least to a certain degree. However the pollutant loading from the subwatershed extending towards the northwest has yet to be effectively addressed.

Drainage Area	336.6 acres
Trapping Efficiency	75%

Sediment Reduction	225 tons/year
Phosphorus Reduction	293 lbs/year

Due to the flatness of the area and the current boundaries of the land owned by the CCB, any design will most likely be consistent with a CREP-like wetland, which are more commonly built in north-central Iowa. As a result, our trapping efficiency may drop from 90% to more like 75%, or maybe even slightly lower. Should some of the adjoining land be purchased or at least the land rights secured through some form of easements with neighboring landowners, then it may be possible to build a taller structure, possibly improving the trapping efficiency towards 90%. Should it possible to build a structure with a 90% trap efficiency, the resulting sediment loading reductions could approach 270 tons/year, with a phosphorus reduction of 351 lbs. per year.

Structure #14

Installed immediately upslope from #11, these Iowa DOT Mitigated Weltands not only improve habitat for various wildlife species, they provide an estimated 75% trap efficiency for both sediment & phosphorus.

Drainage Area	86.2 acres
Trapping Efficiency	75%

Sediment Reduction	28 tons/year
Phosphorus Reduction	36 lbs/year

These structures appear to be adequately addressing the sediment & phosphorus issues for the re-designed watershed at this site at this time, especially since most, if not all of the watershed above is in grass and/or trees. Emphasis needs to be placed on maintaining the functionality of this structure for the foreseeable future

Appendix 2: Structure Analysis