SEDIMENT REDUCTION PLAN

LAKE EAU CLAIRE

EAU CLAIRE COUNTY, WISCONSIN

PREPARED FOR:

LAKE EAU CLAIRE ASSOCIATION

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SEDIMENT REDUCTION PLAN

LAKE EAU CLAIRE

EAU CLAIRE COUNTY, WISCONSIN

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EXECUTIVE SUMMARY

The goal of the Association is to return the lake bed to its 1937 contours, restoring the lake surface and depth to its original condition. Components to the plan are to include sediment maps, operation and maintenance of the traps, and development of a coherent database for future reference.

The purpose of this study and report is to investigate sedimentation in Lake Eau Claire and provide information for use in future lake management planning and project implementation.

Sediment samples were obtained and laboratory tests were performed to determine chemical and physical properties. Generally, sediment consists of medium to fine sands with some silt. Traces of arsenic, chromium, and copper were found in the sediments, however, the concentrations are so low that no special handling of dredged sediment is anticipated.

Sedimentation rates were estimated. Based on a comparison of the 1960 and 1995-97 hydrographic lake maps, three million cubic yards of sediment have accumulated in the lake during this period. Stream bank erosion is a major source of sediment.

Dredging alternatives, along with sediment trap construction, were evaluated. Sub-projects were developed to give a "shopping list" of smaller projects that may be more manageable than a single large project. Alternative projects include:

DREDGING PROJECTS

	Limited Project	Full Project
Southeast Boat Landing	$736,000	$900,000
Hay Creek Estuary	$443,000	$893,000
Muskrat Creek Estuary	$563,000	$1,380,000
Upstream of SE Boat Landing	$1,600,00	---
Total Lake	$17,000,000	---

Funding sources include the Recreational Boating Facilities program, Federal Aid in Sport Fish Restoration Act, Lake Protection grant and loan programs through the State Trust Fund and Farmer's Home Administration.

The study and report has identified a wide range of projects for sediment reduction. Sediment traps should be constructed during the first phase of any one of the projects presented to protect your investment. Financial resources will be the limiting factor in completing lake restoration. County participation, and identifying the source of the local share, whether or not through formation of a District, are challenges facing the Association.

INTRODUCTION

Since the completion of the dam construction and filling of the reservoir in 1937, Lake Eau Claire has experienced significant sediment deposition. The inlets on the east end of the lake, including the Eau Claire River, Muskrat Creek, and Hay Creek, have seen the greatest impact. Sediment deposits have resulted in navigational restrictions and a loss of lake surface area. Accumulated sediment has resulted in loss of lake access for several property owners.

The purpose of this report is to provide the Lake Eau Claire Association with data for use in future planning and project implementation. We developed a range of alternatives for restoring or partially restoring the lake to its original shoreline configuration and depth. The report includes alternatives and costs for restoring the lake, sediment analyses, and potential funding opportunities for the projects.

FIELD INVESTIGATION

Ayres Associates toured the lake with Lake Eau Claire Association members on June 15, 1996. We viewed the areas of concern by boat and from the shoreline. In the Hay Creek and Muskrat Creek estuaries, we observed sand bars reaching out from the mouth of the streams as well as sand flats and deltas. The steep, sandy shoreline in some areas are eroded with exposed unvegetated slopes. Navigation into the estuaries was limited by the sand bars and shallow water. Portions of Hay Creek and Muskrat Creek upstream of their outlets have also filled in with sediment and grown over with grasses and brush.

Navigation at the Eau Claire River estuary is also limited by sediment deposition. For most boats, navigation is limited to the river channel. The Skid Row boat landing is limited to small rigs because of the shallow depth created by the accumulated sediment. Access to and from the landing is nearly cut off by a sand bar. Upstream of the boat landing, the river channel is bordered by small islands and sand bars created by sediment deposited when the Eau Claire River widens and slows.

Aside from the Eau Claire River, Hay Creek, and Muskrat Creek estuaries, there are several other areas that have limited recreational use as a result of sedimentation. Many open water areas at the east end of the lake are so shallow that navigation is nearly impossible. The shallow water also limits the habitat for fish in the lake.

LAKE SEDIMENTATION

The Lake Eau Claire Association estimated that the lake surface area had been reduced by 137 acres in 23 years based on comparison of maps of 1937 (aerial photo) and 1960 (contour map). Sediment filling in the Hay Creek, Muskrat Creek, and Eau Claire River estuaries is extending into the main body of the lake. In June of 1993, a flood resulted in a noticeable increase of sediment deposits at these areas. This type of flood event transports huge volumes of sediment which is deposited in the lake. The sediment deposited consists mainly of sand, while finer grained sediment passes through the lake.

Approximately 20 lots and cottages that once had lake frontage and boat access are now cut off from the lake. Many other areas once accessible by boat are no longer accessible by most boats.

Ayres Associates obtained aerial photos, maps, and other data to estimate the volume of sediment that has accumulated, and the area of lake surface that has been lost since the reservoir was filled. Figure 1 shows the location of Lake Eau Claire. A 1937 map showing the

lake boundary is included as Figure 2. We used two hydrographic maps, one produced by the Wisconsin Department of Natural Resources (1960, Figure 3) and the other developed by the Augusta High School Science Club (1995 and 1997, Figures 4a and 4B). Aerial photos used to assess the loss of lake area are listed in Table 1.

TABLE 1
LAKE EAU CLAIRE AERIAL PHOTOGRAPHS

Year	Source
1938-1939	Wisconsin Department of Transportation
1958	Eau Claire County Planning and Development
1965	Eau Claire County Planning and Development
1974	Eau Claire County Planning and Development
1992	Wisconsin Department of Transportation

We compared the aerial photographs and hydrographic maps to estimate sediment delivery rates and loss of lake area. Based on aerial photographs and maps, we estimate that approximately 6 acres of the lake were lost to sediment in the Hay Creek estuary. Approximately 70,000 cubic yards of sediment has been deposited here. For a period of 56 years (1938 to 1994), the sediment delivery rate is approximately 1,250 cubic yards per year.

Sediment has filled approximately 2 acres at the Muskrat Creek estuary. Approximately 120,000 cubic yards of sediment has been deposited from Muskrat Creek, or about 2,150 cubic yards per year.

Based on differences in water depths between 1960 and 1995-1997, three million cubic yards of sediment have been deposited in the lake. Of the three million cubic yards, 163,000 cubic yards were deposited in the lake upstream of the Southeast Boat Landing during this period. Table 2 summarizes sedimentation volumes.

TABLE 2
LAKE EAU CLAIRE SEDIMENT VOLUMES AND RATES

	Volume (CY)	Rate CY/Year
Hay Creek Estuary (1938-1995)	70,000	1,250
Muskrat Creek Estuary (1938, 1995)	120,000	2,150
Upstream of S.E. Boat Landing (1960-1997)	163,000	4,400
Total Lake System (1960-1995, 1997)	3,000,000	80,000

The sediment delivery rates are averages based on calculated sediment accumulation. The actual sediment deposited in a given year will vary from year to year. Significant volumes of sediment are delivered during flood events. A large flood event, such as the flood in June of 1993, will result in noticeable increases in sediment deposits.

SEDIMENT CHEMICAL AND PHYSICAL PROPERTIES

Ayres Associates and a volunteers from the Lake Association and Augusta High School collected sediment samples on August 14, 1996. One core sample at each of the four sampling sites was obtained. The sampling site locations, shown in figure 1, Appendix A, are located at:

1. Hay Creek estuary
2. Muskrat Creek estuary
3. Southeast boat landing (Skid Row)
4. Eau Claire River estuary

We separated each core into three segments for chemical and physical analyses: (A) two foot depth, (B) four foot depth, and (C) five to six foot depth. We discussed the sampling and testing requirements with the Wisconsin Department of Natural Resources (DNR) and agreed on obtaining grain size analyses for each of the 12 samples. Based on the results of the grain size analysis, the DNR suggested chemical analyses for the sample at the boat landing, four feet deep (3B).

All of the samples collected were medium to fine sands with some silt. The University of Wisconsin - Stevens Point (UWSP) performed chemical analyses for sample 3B. The UWSP lab tested for pollutants based on known land uses in the watershed. Tests were performed to detect pollutants such as heavy metals, organics (PCB's, pesticides, herbicides), and nitrogen.

The chemical analyses detected small amounts of arsenic, chromium, and copper. The concentration of these heavy metals is below pollution standards. There were no chemical concentrations above pollution thresholds. A detailed description of the tests and the results are included in Appendix A. Based on test results, no special dredging disposal methods will likely be required.

SEDIMENT REDUCTION

The Lake Association faces two issues with respect to sedimentation. The first issue is the sediment that has already been deposited. Dredging would be required to remove the sediment that has been deposited in the lake. The second issue is continued sediment deposits from the Eau Claire River, Hay Creek, and Muskrat Creek. Sediment traps should be constructed to collect sediment before it enters the lake, reducing future dredging requirements. We investigated lake dredging for removing existing sediment and constructing sediment traps to collect future sediment.

Streambank erosion is evident in many reaches of the Eau Claire River. These raw stream banks are contributing heavily to the sediment load in the river. Streambank stabilization is beyond this study scope, but warrants further investigation in the future. A first step in the process would be an inventory of stream bank condition and an investigation of stabilization measures. This, along with sediment trap construction may be effective in controlling sediment delivery rates.

DREDGING

We identified several dredging projects to be evaluated:

1. Southeast boat landing
2. Hay Creek estuary
3. Muskrat Creek estuary
4. Upstream of southeast boat landing
5. Total lake dredging

We computed the volume of sediment to be removed for each of the projects listed. We considered full scale dredging to restore the areas to their original configuration and limited dredging to provide navigation channels for the southeast boat landing, Hay Creek and Muskrat Creek. We considered dredging in the area upstream of the southeast boat landing to restore it to the 1937 as well as the 1960 condition. We also investigated restoring the total lake to the 1937 and 1960 condition. We identified potential dredge disposal sites and considered both mechanical and hydraulic dredging.

Southeast Boat Landing

Dredging in the area of the southeast boat landing is approximately 3 acres to a maximum depth of 6 feet. The total volume to be dredged would be 18,500 cubic yards. Alternatively the Lake Association may consider dredging a channel from the boat landing to the Eau Claire River channel. The proposed channel would be 100 feet wide with a maximum depth of 6 feet. The volume to be dredged for the channel is approximately 5,000 cubic yards. Figures 5 and 6 show the two dredging alternatives for the southeast boat landing.

Hay Creek

To restore the Hay Creek estuary to its original configuration, we estimate that approximately 70,000 cubic yards of material would have to be removed. This project would involve restoring approximately 6 acres of sand flats back to water and dredging the surrounding area to a depth of 6 feet. An alternative would be to dredge a channel from Hay Creek into the lake along the west shore of the Hay Creek estuary. The channel would vary from a 6-foot-deep triangular channel in Hay Creek to a 100-foot-wide trapezoidal channel in the estuary. The channel would be greater than 100 feet from shore where possible to keep boat traffic away from the shoreline. This alternative would involve dredging approximately 24,000 cubic yards. The dredging alternatives for the Hay Creek estuary are shown in Figure 7 and 8.

Muskrat Creek

Restoring the Muskrat Creek estuary to its original form would require dredging approximately 120,000 cubic yards of sediment. The full-scale dredging alternative would restore the Muskrat Creek channel, remove the sand bar at the mouth of Muskrat Creek, and provide a depth of 6 feet in the estuary. Alternatively, a trapezoidal channel could be dredged to a 6-feet depth and 100-foot width along the west shore of the estuary. This would allow property owners access and navigation near their lakefront. The total volume of dredged material for this alternative is 33,000 cubic yards. Figures 9 and 10 show the alternative dredging scenarios for the Muskrat Creek estuary.

Eau Claire River Upstream of the Southeast Boat Landing

To estimate the extent of dredging to match the 1937 condition would be very difficult because little 1937 water depth data is available. Hence, we developed a dredging plan that would restore this area to the 1937 as well as the 1960 condition, when navigation was very good. The 1960 hydrographic map was used to define water depths at that time. The total volume to be dredged for this alternative would be 163,000 cubic yards. To restore this area to 1937 conditions would require dredging approximately 300,000 cubic yards.

Total Lake Restoration

The volume of sediment deposited in the lake, comparing the 1960 contour map to the 1995-1997 map, is about 3 million cubic yards. This is nearly 25% of the lake's 1960 volume. To restore the lake to its original depth would require dredging a projected 6 million cubic yards.

TABLE 3
DREDGING VOLUMES IN CUBIC YARDS

	Total Restoration	Limited Project
Total Lake Restoration*	6,000,000	3,000,000
Southeast Boat Landing	18,500	5,000
Hay Creek Estuary	70,000	24,000
Muskrat Creek Estuary	120,000	33,000
Eau Claire River Upstream of S.E. Boat Landing	300,000	163,000

* Includes dredging all lake areas, including the sub-projects below, to the 1937 condition and the 1960 condition.

Disposal Sites

We performed a site reconnaissance in order to identify potential dredge disposal sites. We located five potential sites, all of them located on County land. All of the sites are within a mile of Lake Eau Claire. Two of the sites are adjacent to Muskrat Creek and one adjacent to Hay Creek. The remaining sites are on the southeast side of the lake, one near the southeast boat landing and one in a gravel pit near the Eau Claire River. Each of the five sites have road access near them. The potential disposal sites are shown in Figure 11.

SEDIMENT TRAPS

We evaluated the construction of sediment traps to collect sediment before it reaches Lake Eau Claire. The sediment traps would be constructed upstream of the stream's mouth where it may be easily accessed and maintained. The sediment traps would consist of an excavated pool in the stream that is wider and deeper than the stream channel. The wider and deeper portion results in lower velocities that allow sediment being carried by the stream to settle to the bottom. Periodic dredging would be necessary to clean the sediment trap, particularly after large flood events. These operation and maintenance costs may be significant, depending upon river flows.

We computed the volume of material that would have to be excavated to construct an effective trap for the Eau Claire River, Hay Creek, and Muskrat Creek. The excavation volumes are given in Table 3. We sized the sediment trap for a 10-year flood event. The sediment traps will be less effective during larger flood events, but would still collect much of the sediment. Potential sediment trap sites are shown in Figure 11.

TABLE 4
SEDIMENT TRAP EXCAVATION VOLUMES

Location	Volume (cubic yards)
Eau Claire River	60,000
Hay Creek	9,000
Muskrat Creek	14,000

PROJECT COSTS

We developed cost estimates for eight dredging project scenarios and three sediment traps. The eight dredging projects include two projects for the southeast boat landing, Hay Creek, and Muskrat Creek; the Eau Claire River upstream of the boat landing; and for total lake dredging. The purpose of the dredging alternatives is to provide a range of costs for projects that the Lake Association may consider. The costs provided in this report are for 1997 prices and do not reflect changes in costs that may occur between now and the time the project is undertaken. The estimated costs of the projects describe in the above sections is summarized in Table 5. A detailed breakdown of project cost estimates is included in Appendix B.

TABLE 5
ESTIMATED PROJECT COSTS

	Limited Dredging	Full Dredging
Total Lake*	$17,000,000	$34,000,000
1. Southeast Boat Landing	$736,000	$900,000
2. Hay Creek	$443,000	$893,000
3. Muskrat Creek	$563,000	$1,380,000
4. Areas 1, 2, and 3	$1,550,000	$2,070,000
5. Eau Claire River Upstream Southeast Boat Landing*	$1,600,000	$3,200,000

Note: Above costs include sediment traps.
* Cost reflects dredging to the 1960 and 1937 depths

The costs provided in Table 5 may be used for planning purposes. The Lake Association may wish to undertake a project less than the full dredging but more than the limited dredging. The costs listed in Table 5 give a range so that the Lake Association may scale each project to their needs and budget.

Operation and maintenance costs for dredging sediment traps would vary year to year, however, based on the delivery rates estimated and shown in Table 2, average annual operation and maintenance costs are presented below. These costs are based on a nominal per cubic yard cost of $5.00.

TABLE 6
ANNUAL OPERATION AND MAINTENANCE COSTS

Total Lake System*	$400,000
Hay Creek Estuary	$6,250
Muskrat Creek Estuary	$10,750

*Includes Hay Creek and Muskrat Creek Estuary O&M Costs

The above costs reflect collecting all of the sediment entering the lake, therefore the costs are conservative. In reality, if 50% of the sediment is collected, the traps will be effective, hence operation and maintenance costs realistically will be up to 50% less than shown, depending upon river flows, variability, and consistency of sediment trap maintenance.

Based on historic sediment delivery rates, had sediment traps been in place and property maintained from 1937 to 1997, accumulated maintenance costs based on 1997 dollars would be 12 to 24 million dollars, depending on trap efficiency and consistency of maintenance.

FUNDING SOURCES

We investigated several state and federal grant sources that the Lake Association may be able to obtain funding from for the dredging projects. The best possibility for funding through grants would be from the Recreational Boating Facilities program sponsored by the State of Wisconsin. Table 6 lists some grant sources, their limits, and the required local share for matching funds. Appendix C provides background on the grant programs and includes information on other programs that currently are not funded.

TABLE 6
STATE AND FEDERAL GRANTS/LOANS

Program	Sponsor	Limit	Local Share
Recreational Boating Facilities	State	None	50%
Federal Aid in Sport Fish Restoration Act	Federal	None	75%
Lake Protection Grant	State	$50,000	75%
Wisconsin Trust Fund (Loan)	State	None	---
Farmer's Home Administration (Loan)	Federal	None	---

All of the grant programs require a significant financial participation by the local sponsor. At present, the Lake Association has very limited financial resources, thus a project sponsor, such as the County, would most appropriately provide local participation. To establish equitable financial participation by lake property owners, formation of a Lake District should be strongly considered. This, coupled with County participation, may provide the local participation funds.

RECOMMENDATIONS

Sedimentation in Lake Eau Claire has greatly reduced the potential recreational opportunities at the east end of the lake. A sediment reduction plan is necessary to help restore the areas described in this report. This report should be used for planning purposes to determine the sequence and magnitude of sediment reduction projects.

We recommend constructing the sediment traps as part of each of the individual or total projects undertaken. The sediment traps will greatly reduce the future volume of sediment that will reach the lake. If the dredging is performed without a sediment trap, sedimentation will continue to create problems in the lake. The need for future dredging would be reduced significantly by constructing a sediment trap on each of the major inlets to the lake. Streambank erosion appears to be supplying large volumes of sediment to the Eau Claire River. Many reaches of shoreline are actively eroding and supplying sand for the lake. A streambank inventory and consideration of stabilization should be evaluated in the future.

The costs provided in this report should be used for planning future projects. The Lake Association should prioritize the projects and obtain funding as necessary to complete the projects. A range of costs has been provided to allow the Lake Association to determine the extent of dredging necessary to meet local needs.

State and federal grants and loans are available as given in Table 4. The Department of Natural Resources and local, state, and federal officials should be able to assist the Lake Association in applying for these funds. The lake property owners should carefully evaluate the benefits of farming a lake district and pursue obtaining support from Eau Claire County.

APPENDIX A

SEDIMENT SAMPLING AND ANALYSES

APPENDIX B

DETAILED COST ESTIMATES

APPENDIX C

FUNDING SOURCES