

Upper Lightning Lake Water Level Management  
Environmental Assessment Worksheet

Attachment E

Draft Management Plan for Upper Lightning Lake

DRAFT Management Plan for  
**UPPER LIGHTNING LAKE, Otter Tail County**

DOW# 56095700

Department of Natural Resources

Section of Wildlife

March 2014

**Summary and Background Information**

Upper Lightning Lake is a 720-acre basin located in the Rabbit River watershed in southwest Otter Tail County. The US Fish and Wildlife Service (USFWS) own a 194-acre tract of land on the east side of the lake known as the Dahler Waterfowl Production Area. This tract includes approximately 1.0 miles of shoreline and provides carry in public access. Upper Lightning Lake was traditionally known as an excellent waterfowl migration, staging, and breeding area. Large concentrations of dabbling and diving ducks historically used the lake according to local residents and past game lake surveys. In addition, the lake provided breeding habitat for furbearers and other wetland wildlife species. Past game lake surveys indicate the lake supported an abundant and diverse aquatic plant community, including dense beds of sago pondweed and large stands of hardstem bulrush. Local residents and DNR wildlife staff noted a degradation of this basin in the mid 1980's. High water levels resulted in increasing numbers of undesirable fish, poor water quality and reduced abundance of emergent and submerged vegetation. Water level management and Wildlife Lake Designation were pursued in the early 1990's and in the mid- 2000's, however local landowner concerns with downstream channel conditions and flooding prevented the project from developing. Water levels have continued to increase in recent years resulting in more shoreline erosion and further degradation of wildlife habitat.

Downstream flooding concerns have been addressed in recent years with waterfowl habitat improvement projects on Denton Slough and another unnamed basin on the Kube-Swift Wildlife Management Area in Grant County. The downstream watercourse between Denton Slough and County Ditch #5 was cleaned to remove cattail and minor sediment deposition. A high velocity fish barrier was also installed where the downstream watercourse empties into County Ditch #5. A water control structure was constructed at the outlet of Denton Slough and the basin was dewatered in 2012. Water levels in this basin had been high for years and caused damage to roadways and encroached on a building site. The Section of Wildlife also attempted

to increase water flow through the wetland on the Kube-Swift WMA with compaction and mowing of cattail in the inlet and outlet channels.

Water level management on Upper Lightning Lake is now feasible without causing downstream flooding. The goal of managing water levels on Upper Lightning Lake is to increase the abundance and diversity of aquatic vegetation to enhance migratory waterfowl habitat and improve water quality. The proposed strategy to meet this goal includes lowering water levels down to the normal run-out elevation by cleaning the cattail and minor sediment deposition in the downstream watercourse between the outlet of Upper Lightning Lake and Denton Slough. In addition, a permanent pump and lift station will be constructed to allow the lake to be drawn down further to expose bottom sediments and enhance winter fish mortality.

### **General Information**

Upper Lightning Lake is located in the gently rolling terrain of the Big Stone Moraine Complex in southwest Otter Tail County. The basin is located approximately two miles east of the Herman Beach Ridge which was once the shoreline of glacial Lake Agassiz. This area is rich with publically owned wetlands and grasslands; including nine USFWS Waterfowl Production Areas totaling 2,338 acres, and four state-owned wildlife management areas totaling 748 acres, within a three mile radius of Upper Lightning Lake. There are also six other shallow lakes within this three mile radius. A four square mile area around Upper Lightning Lake was also a target area for increasing grassland on private lands as part of the Working Lands Initiative Project.

Minnesota Rule 6115.0220 requires that projects involving water level control structures “shall be consistent with water and related land management plans and programs of local and regional governments, provided such plans and programs are consistent with state plans and programs.” The management objective to improve waterfowl habitat on Upper Lightning Lake is consistent with the DNR Shallow Lakes Program Plan and the DNR Long Range Duck Recovery Plan. Upper Lightning Lake is also a priority shallow lake as identified by Ducks Unlimited under their “Living Lakes Initiative”. The goal to improve water quality in Upper Lightning Lake is consistent with the Otter Tail County Local Water Management Plan priority goal of “Otter Tail County will maintain or improve the quality of the surface waters within their boundaries”.

### **Hydrologic Information**

Upper Lightning Lake is an alkaline, shallow basin in the upper reaches of the mostly agricultural Rabbit River watershed. It is a long, narrow basin spanning 3.3 miles north to south with a maximum width of 0.6 miles. The bottom topography is relatively complex (Figure 1). Maximum depth was 10.8 feet and mean depth was 8.5 feet in 2011. Upper Lightning Lake has a surface area of 720 acres and a direct catchment area of 9,600 acres which results in a watershed to basin ratio of 13.3 to 1.

A DNR Waters Hydrographic Survey was completed in 1987 at the request of the Section of Wildlife. The Ordinary High Watermark (OHW) was determined to be 1084.2 feet mean sea level<sup>1</sup>. The run-out elevation was also determined to be 1084.2 which was the bottom of the outlet channel just upstream from County Road 26. The surface water level was 1.5 feet higher than the OHW at the time of the survey. The surface water level in 2011 was approximately 5.0 feet above the OHW.

Upper Lightning Lake outlets through a protected watercourse on the far south end of the basin. The watercourse passes under County Road 26 through a 24-inch RCP culvert with an upstream invert elevation of 1083.30 feet. The watercourse flows south for 1.3 miles until it enters an unnamed wetland basin (26036100) on the Kube-Swift WMA. This stretch of the watercourse has become filled with narrow-leaf/hybrid cattail and minor sediment deposition. Water flows west out of the wetland basin for 0.5 miles until it enters Denton Slough (26030300) which is a Designated Wildlife Lake. Water levels can be managed on Denton Slough to improve wildlife habitat with a variable crest control structure located just downstream of the outlet. Water then flows south and southeast for about 2.0 miles until it turns west and flows through a high velocity fish barrier culvert under 300<sup>th</sup> Ave. and empties into Grant County Ditch #5. The ditch flows west for 4.0 miles into it enters an unnamed tributary of the Rabbit River, which flows north for about 2.0 miles until it enters the Rabbit River. This reach of the Rabbit River is listed on the 2008 303(d) Impaired Waters List for fish IBI, turbidity, and dissolved oxygen.

### **Present and Historical Conditions:**

#### **Water Levels**

Upper Lightning Lake was reported to be dry during the drought years of the mid 1930's. Aerial photographs from 1938 suggest that portions of the lake were either pastured or cropped (Figure 2). The lake had a mean depth of 4.3 feet and a maximum depth of 5.8 feet during the initial game lake survey in 1954. Shoreline areas and shallow bays were reported to be dry during the short-term drought between summer of 1976 and spring of 1977. High water levels and deteriorating waterfowl habitat prompted a game lake survey in 1986 and a Division of Waters hydrographic survey in 1987. Mean depth was 5.25 and maximum depth was 7.5 feet in 1986. The ordinary high water level (OHWL) was determined to be 1084.19. The water level at the time was 1.5 feet above the OHWL. Water levels were even higher between 2002 and 2011. Maximum depth ranged from 8.5 to 10.8 feet and mean depth ranged from 6.4 to 8.5

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<sup>1</sup> All elevations are in NGVD 1988 datum.

feet. These high levels have resulted in severe bank erosion and loss of shoreline around the lake.

### **Submerged Aquatic Vegetation**

A waterfowl and muskrat habitat survey completed in 1954 described a diverse submerged aquatic plant community. Nine species of submerged aquatic plants were found with sago pondweed and coontail rated as abundant. Submerged aquatic vegetation was found at all 40 sample sites. It was noted that water levels were too high for good aquatic plant growth and that abundance would increase when water levels returned to normal. Only four species of submerged aquatic plants were found during a game lake survey completed in 1986. Plants occurred at 78% of sample sites, however abundance was generally low.

Modern wildlife lake surveys were completed in 2002, 2005, 2008, and 2011. Submerged aquatic plants occurred at 11% of sample sites in 2002, 17% in 2005, 45% in 2008, and 17% in 2011. Submerged aquatic plant diversity ranged from three to seven species in those four surveys. The highest percent occurrence and species richness was found in 2008, following a suspected partial winterkill of the fish community.

### **Emergent Vegetation**

Emergent vegetation was present at 20 of 40 (50%) sample sites in 1954 and covered an estimated 5% of the surface area of the lake. Hardstem bulrush was the most common species found at sample sites and a large stand of scattered bulrush was found on the north end of the lake. There were eight other species of emergent vegetation found at sample locations and an additional fourteen species were recorded as being present on the lake.

Most of the emergent vegetation was gone by the 1986 game lake survey, likely due to extended periods of high water. Emergent vegetation was not present at any sample sites in 1986, however scattered stands of hardstem bulrush and cattail were observed. Wildlife lake surveys completed between 2002 and 2011 also documented a few scattered areas of bulrush and cattail, but no emergent vegetation at sample locations.

### **Waterfowl Use**

Early surveys support local reports that large numbers of ducks used Upper Lightning Lake for migration, staging, and breeding. The 1954 survey reported over 800 adult ducks and 7 broods of ducklings. That report also mentioned a count from July of 1951 which included 14 broods totaling 109 ducklings. Species composition of the broods was described as split equally between divers and puddle ducks in 1951. Waterfowl observed during the game lake survey in

August of 1986 included blue-wing teal (777), mallards (251), wood ducks (22), green-wing teal (17), ruddy ducks (8), redheads (3), pintails (2) and bufflehead (1). There were also 4 broods of ducklings observed.

Waterfowl observed during recent wildlife lake surveys included limited numbers of mallards, blue-wing teal and Canada Geese. Wood duck numbers have been highly variable, ranging from none observed in 2002 to over 1,100 observed in 2005. Aerial waterfowl surveys are conducted on Upper Lightning Lake during the fall migration season. Despite the decline in habitat condition over the past thirty years, the lake still attracts some migrating waterfowl. Several hundred mallards and Canada geese are frequently counted and divers, including scaup and canvasbacks, also use the lake frequently. The mallards and geese staging on the lake are likely feeding in nearby corn fields.

### **Management Objective:**

Improve waterfowl habitat and water quality by restoring water levels to the normal run-out elevation, encouraging the growth of emergent and submerged aquatic vegetation, and reducing the abundance of undesirable fish.

### **Proposed Management Actions to Achieve Objectives:**

#### **Action 1 –Clean out the downstream channel between Upper Lightning Lake and Denton Slough to maintain water levels near the original outlet elevation.**

Water levels have exceeded the run-out elevation of Upper Lightning Lake for many years. Constant high water levels have resulted in a significant reduction in submerged and emergent vegetation, increased resident fish populations, and severe bank erosion around the basin. Aerial photos reveal that the downstream watercourse has become filled with narrow-leaf/hybrid cattail over the past twenty-five years. These species of cattail tend to form denser stands and have a greater root mass than the broad-leaf species that was common to the prairie pothole region prior to the 1960's. The greater density and root mass of narrow-leaf \hybrid cattail can impede water flow through ditches and natural watercourses. Topographic surveys have also shown some minor sediment deposition within the downstream channel. Above average precipitation over the past two decades has also contributed to high water levels on Upper Lightning Lake. Annual precipitation in Otter Tail County averaged 27.40 inches\year between 2000 and 2010 and 25.31 inches\year between 1990 and 1999, compared to a historical average of 23.32 inches. The recent drawdown on downstream Denton Slough, with little effect on Upper Lightning Lake water levels, has clearly demonstrated that vegetation and silt build up in the protected watercourse is restricting water flow out of the basin.

The channel cleanout will consist of clearing a 6 to 8 -foot wide channel of cattail and sediment down to the original grade. The cleanout will extend approximately 7,200 feet downstream from County Road 26 to the open water on the Swift WMA. An additional 3,500 feet will be cleaned out from the open water on the Swift WMA downstream to Denton Slough. This work will require a Public Waters Permit from the Division of Ecological and Water Resources. Spoil will be hauled offsite or spread on adjacent upland areas.

### **Desired Outcomes – Action 1**

Lower water levels should result in some improvement to waterfowl habitat by increasing the fringe of emergent vegetation around the shoreline. Lower water levels will also reduce the severe bank erosion and sloughing that is occurring, as well as provide some relief to private property owners impacted by high water levels. Specific, measurable goals from which to measure management effectiveness include:

- A. A measurable Increase in coverage and thickness of emergent vegetation fringe around the shoreline.
- B. Stabilization and re-vegetation of steep eroding banks.
- C. A reduction in flood damage to private property around the basin.

### **Action 2 – Implement a temporary drawdown following the installation of a pump and lift station on the outlet channel.**

Temporary drawdowns on shallow lake basins enhance the abundance and diversity of aquatic vegetation. Bottom sediments hold a large, viable seed bank from the aquatic plants that the lake has supported in the past. The life history of most species of emergent aquatic vegetation requires a period of drying before seeds will germinate. Bottom sediments are consolidated and organic material is broken down during a drawdown, which can provide a more suitable substrate for a greater diversity of submerged aquatic plants. A temporary drawdown may also reduce or eliminate the existing undesirable fish community. Increased abundance of submerged aquatic plants and a reduction in fish abundance should also increase aquatic invertebrate abundance. An abundant and diverse aquatic plant community and increased numbers of invertebrates would provide quality habitat for migrating and breeding waterfowl.

A typical drawdown would begin in the late summer/early fall when surface runoff and downstream water levels are relatively low during normal precipitation patterns. The drawdown would continue during winter months to maximize the potential for winterkill of the existing fish community. The lake would remain in drawdown for the following growing season to allow for consolidation of bottom sediments and the establishment of emergent vegetation. The basin would be allowed to start refilling during the fall. Drawdowns could not occur for longer than two years as limited in Minnesota Rule (6115.0271, part C, item 4). Upper Lightning Lake will be maintained at a normal full pool elevation of 1084.19. Wildlife Lake Designation under M.S. 97A.101 is required to give the DNR Section of Wildlife the authority to control water levels as described in this management plan. See attachment for statutory language.

This drawdown plan would avoid pumping during the spring when downstream water levels are likely to be at their highest. The lake would not be drawn down during periods when the area is experiencing flooding or high water. DOW permits do not allow drawdowns to have adverse effects on downstream flooding and erosion (limitation in Minnesota Rule, Chapter 6115). Drawdowns will also be coordinated with water level management on Denton Slough to provide additional downstream storage capacity. Pumps will be operated in a manner so that discharge does not exceed 25 cfs through the water control structure on Denton Slough. In addition, pumping will be controlled or stopped when the height of water in the watercourse exceeds 24 inches above the invert of the 3 ft. by 6 ft. box culvert at the private crossing upstream of the Swift WMA. These thresholds can be revised if it is determined that downstream culverts and channel can accept more flow without causing flooding or erosion.

### **Water Control Structure and Lift Station**

The outlet of Upper Lightning Lake must be modified to allow for a temporary drawdown. The DNR Section of Wildlife, in cooperation with Ducks Unlimited, has completed a feasibility and design study that explored options to manage water levels on the basin. The DNR has chosen to pursue a pump and lift station system, which would minimize the need for significant deepening of the downstream channel. The pump system would consist of submersible non-clog pump housed in a pre-cast concrete manhole located adjacent to the outlet channel. The pump will discharge directly into a precast concrete box with a 3-foot wide stoplog bay fitted on the upstream end of the existing 24-inch RCP culvert under County Road 26.

The channel between the lake and the new pump station will need to be cleaned and deepened to allow for pumping water levels down to the desired elevation of 1079.0. The channel will have a 6 foot wide bottom and 2:1 side slopes. This channel improvement will extend approximately 1,700 feet upstream from the pump station to the lake. Excavation into the lake



bed will extend another 1,150 feet to reach an elevation of 1079.0. A perpetual easement has been secured on the private land proposed for the location of the pump station and channel work upstream to the lake.

The work described in this section will be completed under the General Waters Permit 2011-0616 for wildlife management purposes on designated wildlife lakes. The Section of Wildlife will also get approval from the U.S. Army Corps of Engineers for the work described above. The extent of the proposed excavation in the public watercourse described in Actions 1 and 2 will also require the preparation of an Environmental Assessment Worksheet by the Department of Natural Resources. The Section of Wildlife will determine and mitigate for any wetland loss under the Wetland Conservation Act through this formal environmental review process.

### **Management Thresholds - Action 2**

Prior to and following all drawdowns, the Section of Wildlife will monitor water clarity, plant abundance, and selected water quality parameters. The frequency of drawdowns would be based on the existing habitat conditions of the lake. Attempts to drawdown the lake will be considered when at least two of the following criteria are met.

- A. Average summer Secchi disk depths are less than 2.0 feet for two consecutive years.
- B. Emergent vegetation covers less than 5% of the total surface acreage of the lake. .
- C. Submerged plant species occur at less than 40% of established sample points.
- D. Submerged plant species richness < than 3.

### **Desired Outcomes – Action 2**

Temporary drawdowns are expected to shift Upper Lightning Lake from a turbid, phytoplankton-dominated state to a clear-water, macrophyte-dominated state. Drawdowns are also expected to increase the coverage of desirable emergent vegetation, which requires bare moist soil for germination. Specific, measurable goals from which to measure management effectiveness include:

- A. Average summer Secchi disk transparency > 3.0 feet.
- B. Submerged plant species richness > 4.
- C. Submerged plant occurrence at 70% of established sample points.
- D. Emergent vegetation coverage of at least 10% of the surface area of the lake.

## **Management Plan Revisions**

The management plan will be revisited every 10 years to assess effectiveness and determine if changes or updates need to be made. Landowners would be included in the revision process through notification by letter.

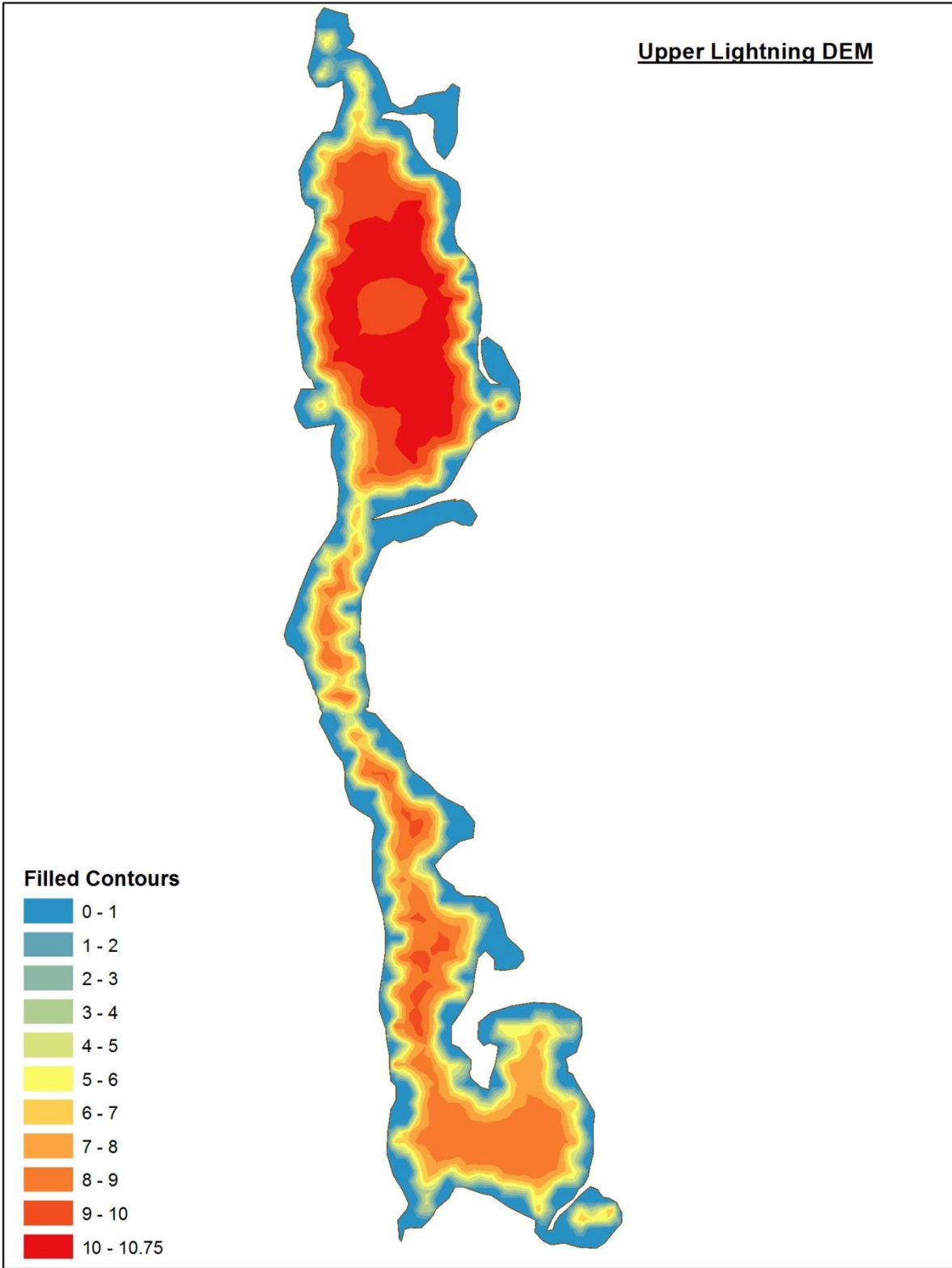


Figure 1. Bottom contours of Upper Lightning Lake.



Figure 2. Lower portion of Upper Lightning Lake in 1938.

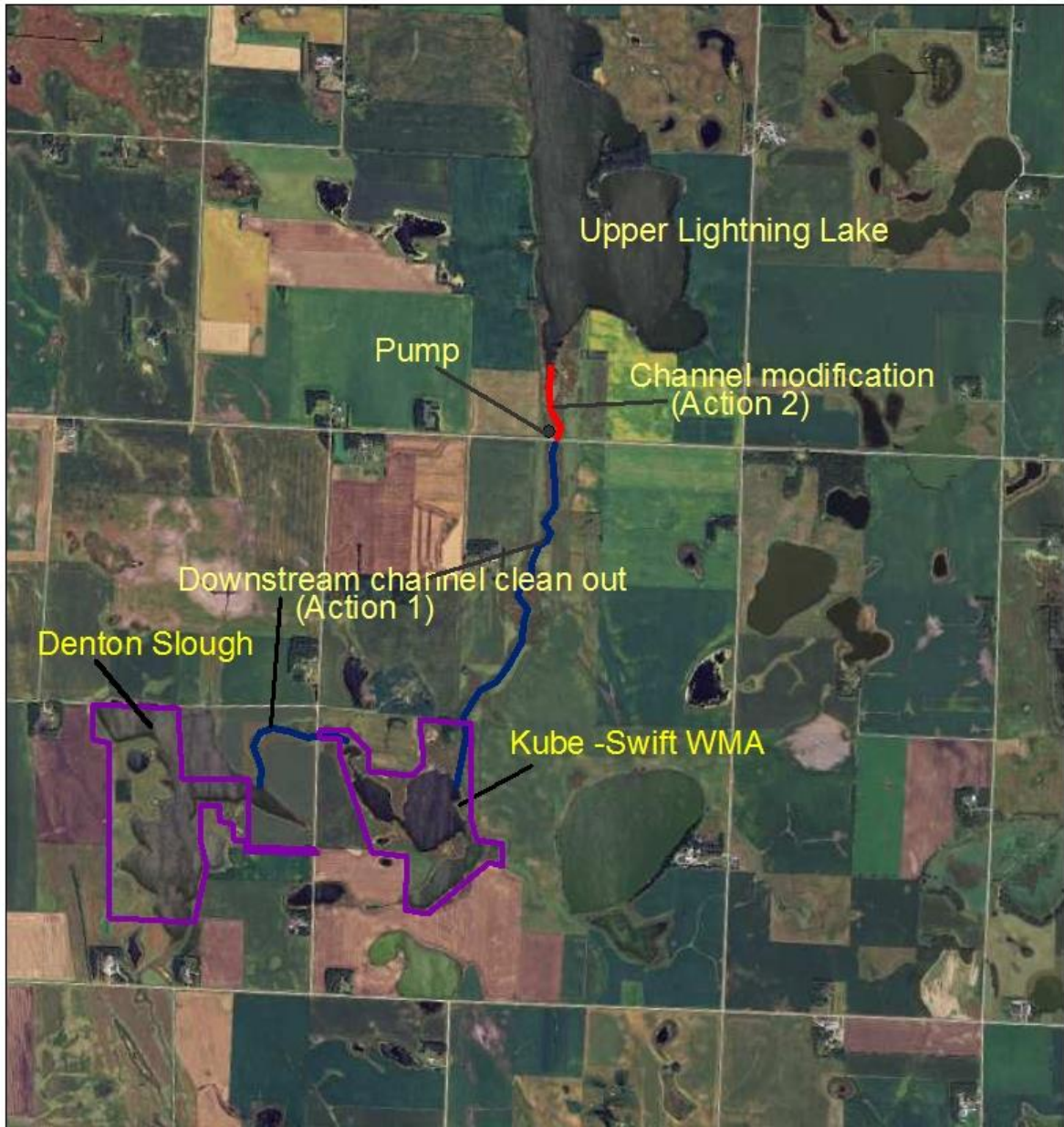


Figure 3. Downstream channel work.

## 2011 Minnesota Statutes

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### 97A.101 PUBLIC WATER RESERVES AND MANAGEMENT DESIGNATION.

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#### Subdivision 1. Reserves.

The commissioner may designate and reserve public waters of the state to propagate and protect wild animals.

#### Subd. 2. Management designation.

(a) The commissioner may designate, reserve, and manage public waters for wildlife after giving notice and holding a public hearing. The hearing must be held in the county where the major portion of the waters is located. Notice of the hearing must be published in a legal newspaper within each county where the waters are located at least seven days before the hearing. The designation by the commissioner shall be by written order published in the State Register. Designations are not subject to the rulemaking provisions of chapter 14 and section [14.386](#) does not apply.

(b) The commissioner may contract with riparian owners for water projects under section [103G.121, subdivision 3](#), and may acquire land, accept local funding, and construct, maintain, and operate structures to control water levels under section [103G.505](#) to manage designated waters.

#### Subd. 3. Fishing may not be restricted.

Seasons or methods of taking fish other than minnows may not be restricted under this section.

#### Subd. 4. Restrictions on airboats, watercraft, and recreational vehicles.

(a) The use of airboats is prohibited at all times on lakes designated for wildlife management purposes under this section unless otherwise authorized by the commissioner.

(b) The commissioner may restrict the use of motorized watercraft and recreational vehicles on lakes designated for wildlife management purposes by posting all public access points on the designated lake. To minimize disturbance to wildlife or to protect wildlife habitat, the commissioner may restrict the type of allowable motorized watercraft or recreational vehicle, horsepower or thrust of motor, speed of operation, and season or area of use. Designation of areas, times, and types of restrictions to be posted shall be by written order published in the State Register. Posting of the restrictions is not subject to the rulemaking provisions of chapter 14 and section [14.386](#) does not apply.

(c) Before the commissioner establishes perpetual restrictions under paragraph (b), public comment must be received and a public meeting must be held in the county where the largest portion of the lake is located. Notice of the meeting must be published in a news release issued by the commissioner and in a newspaper of general circulation in the area where the waters are located. The notice must be published at least once between 30 and 60 days before the public meeting and at least once between seven and 30 days before the meeting. The notices required in this paragraph must summarize the proposed action, invite public comment, and specify a deadline for the receipt of public comments. The commissioner shall mail a copy of each required notice to persons who have registered their names with the commissioner for this purpose. The commissioner shall consider any public comments received in making a final decision. This paragraph does not apply to temporary restrictions that expire within 90 days of the effective date of the restrictions.

#### History:

[1986 c 386 art 1 s 19](#); [1990 c 391 art 8 s 23](#); [1991 c 199 art 1 s 13](#); [1997 c 226 s 18](#); [2004 c 221 s 37](#); [2006 c 281 art 2 s 21](#);  
[1Sp2011 c 2 art 5 s 22](#)