Nuisance Aquatic Vegetation Management Plan
Caddo Lake
2011-2012

Introduction

Caddo Lake is located on the border between northeastern Texas (southern Marion County and northern Harrison County) and northwestern Louisiana (western Caddo Parrish). Caddo Lake is part of the Cypress River Basin, downstream of Lake of the Pines and is considered by many the only natural lake in Texas. Caddo Lake encompasses 25,400 acres and contains 90 species of fish. The lake is relatively shallow, consisting of primarily bald cypress swamp with abundant native aquatic vegetation. It is a popular wetland for many resident bird species and migratory waterfowl. Caddo Lake is well known for its fisheries and is a popular destination for many anglers.

Caddo Lake contains several non-native invasive aquatic vegetation species which, if left unchecked, could potentially block all access to the resource. Problematic exotic species present on Caddo include water hyacinth, giant salvinia, and hydrilla. Alligatorweed and East Indian hygrophila, although present, have yet to cause problems. In addition to the exotic species mentioned, even native species like American lotus can reach problematic proportions.

Although somewhat reduced from 2009 levels due to high water and cold temperatures, fall 2010 surveys indicate salvinia and water hyacinth remain a threat to Caddo Lake (Figures 1 and 2). Surveys suggest hydrilla is approaching levels similar to those seen in 1997 (Figure 3). Fall 2010 surveys estimated acreages for the 3 dominant invasive species present on the Texas portion of the lake to be:

Hydrilla	4,542 acres
Water hyacinth	720 acres
Giant Salvinia	605 acres

Vegetation and Vegetation Management

Water hyacinth

The most problematic aquatic vegetation species on Caddo Lake has historically been water hyacinth. Since its initial introduction to the lake in the 1940s, some active form of control has been required to keep the population in check. In spite of annual herbicide applications, water hyacinth continues to persist and expand on Caddo Lake. A series of mild winters contributed to an increase in water hyacinth on Caddo Lake for many years prior to a dramatic reduction in mature plants due to cold weather in January 2010. It is possible reductions from cold weather in 2011 occurred as well but have yet to be documented. Due to a well established seed bank, water hyacinth may be expected to be problematic on Caddo Lake for many years, perhaps forever.

Giant salvinia

Giant salvinia was discovered on the Louisiana side of Caddo Lake in May 2006. In spite of the construction of a 2.5 mile barrier by the Cypress Valley Navigation District (CVND) in the summer of 2007, salvinia was confirmed in multiple areas on the Texas portion of the lake by fall. By fall 2008, salvinia infestations on Caddo Lake had expanded to over 1,000 acres. Annual herbicide applications on Caddo Lake have targeted salvinia since 2008.

Fall surveys estimated total acres of salvinia in 2008 and 2009 to be 1,092 and 3,228 acres, respectively. High water levels and cold temperatures in late 2009 and January 2010 reduced salvinia on Caddo Lake by an estimated 90%. Spray records indicate over 977 acres of water hyacinth and salvinia were treated on Caddo Lake in FY10.

Hydrilla

Hydrilla was first reported on Caddo Lake in 1993. In 1996 hydrilla had expanded to 575 acres and by 1997 was estimated to cover over 5,000 acres. At that time, the infestation was concentrated to the deeper portion of the lake. From all records available, by 2000 a decline in hydrilla was noted and by 2001 hydrilla had been reduced to non-problematic levels. Records do not reflect any chemical treatments targeting hydrilla on Caddo Lake during this period. Surveys in 2004 documented isolated hydrilla populations in remote areas of the lake. Hydrilla has expanded dramatically in recent years. Although chemical treatment of hydrilla was discussed in 2010, no treatments targeting hydrilla were conducted in 2010.

The purpose of this document is to provide a plan for aquatic vegetation management activities in Caddo Lake during FY 2011 (9/1/10 to 8/31/11). Control of nuisance aquatic vegetation in the public waters of Texas is the primary duty of the Aquatic Habitat Enhancement office of Texas Parks & Wildlife Department (TPWD). Control efforts are governed by the State Aquatic Vegetation Management Plan.

For details of the State Plan see *Aquatic Vegetation Management In Texas: A Guidance Document* at:

http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_pl_t3200_1066_1.pdf

Associated appendices and forms can be found at:

http://www.tpwd.state.tx.us/publications/pwdpubs/media/pwd_pl_t3200_1066_2.pdf

Cooperators involved in the control of nuisance aquatic vegetation on Caddo Lake include property owners within the Cypress Valley Basin watershed (hereby referred to as the Stakeholders), CVND, the Texas Commission on Environmental Quality (TCEQ), the North Texas Water Management District (NTWMD), the Center for Invasive Species Eradication (CISE) and the Louisiana Department of Wildlife and Fisheries (LDWF).

The objectives of this plan:

- To establish sustainable, long-term control of nuisance aquatic vegetation populations on Caddo Lake
- To maintain a healthy lake ecosystem and fisheries in Caddo Lake.

Recommendations

April -October 2011

1) **Continue public information and awareness efforts through news releases, media events, and literature.**

2) **Encourage continued participation of Law Enforcement to address the potential transport of prohibited aquatic vegetation by boat trailer.**

3) **Conduct surveys to identify problem areas and appropriate control response.**

   a. Access points (boat ramps) and boat roads should be surveyed and evaluated for the installation of floating physical barriers (booms) to prevent potential transport of water hyacinth and giant salvinia to other reservoirs and protect the immediate area from further introductions. Boom placement and design should not interfere with access to the water or pose a hazard to navigation.

   b. Spring surveys should be conducted to identify key areas containing infestations of water hyacinth and giant salvinia. A formal treatment proposal, complete with required notifications, should be prepared and be submitted 14 days before control efforts are initiated. Treatment proposals should be submitted for all control efforts, including mechanical/physical removal, bio-control introductions, and herbicide applications.

4) **Herbicide treatments should be conducted to control water hyacinth and giant salvinia infestations when air temperatures reach 70^0 F or higher.**

   a. Herbicide applications should be conducted by contractors certified in the application of pesticides in aquatic environments. In the interest of overall effectiveness and consistency, the use of commercial contractors should be considered if at all possible. TPWD personnel and equipment will be available to supplement control efforts when necessary. Accurate records (spraycards) documenting all herbicide treatments should be maintained and copies provided to TPWD on a weekly basis.

b. Areas containing strictly water hyacinth should be treated with 2,4-D based herbicides and a suitable non-ionic surfactant. Salvinia infestations should be treated with a glyphosate-Diquat combination (1.0 gal and 16 oz per acre, respectively) or the maximum rate allowed per acre, as listed on the herbicide label or label supplement. Non-ionic and silicone based surfactants should be used when treating salvinia. In areas containing both water hyacinth and salvinia the glyphosate-diquat combination should be used.

c. Post-treatment surveys of treated areas should be conducted at random by TPWD personnel and compared with submitted spraycards to accurately monitor progress of control efforts and identify areas requiring additional applications.

d. Research will be conducted this growing season by the Center for Invasive Species Eradication on the effectiveness of chemical and surfactant combinations not currently in use on Caddo Lake. As information becomes available, it will be provided to the group for further dissemination and use

5) Conduct biological control treatments, and associated pre- and post-treatment surveys.

a. Salvinia weevil introductions should be established in infested areas where herbicide treatments are not possible. Sites should be geo-referenced and well marked to prevent accidental treatment with herbicide. Release sites should be monitored throughout the growing season and supplemented as necessary to maintain a viable population.

b. Release sites for hydrilla fly introduction should be geo-referenced and monitored throughout the growing season and evaluated for efficacy on hydrilla.

6) Implement nutrient reduction education and outreach measures.

Phosphorus and other nutrients widely used for rural, residential, and agricultural purposes have been identified as potential pollutants of concern in the Caddo Lake Watershed Protection Plan (WPP). Efficient nutrient use education and outreach is a primary component of the Caddo Lake WPP and its delivery will be critical in addition to other management measures geared toward reducing nutrients impacts to the lake. Outreach and education about efficient use of nutrients under these varying circumstances is an essential component in reducing nutrient concentrations in the Caddo Lake watershed.

March –October 2011

1) **Conduct lake-wide aquatic vegetation surveys as appropriate. The surveys should be a joint Texas-Louisiana effort and include all nuisance species present.**

   Results of the survey will be compared to previous and subsequent surveys to determine if vegetation coverage is increasing or decreasing, to assess the efficacy of various treatment options and to calculate the magnitude and cost of additional control efforts.

2) **Include native vegetation surveys, manpower permitting.**

   Results will be compared to previous surveys to monitor status of native plant communities.

September-November 2011

1) **Conduct lake-wide fall survey of nuisance aquatic vegetation.**
   Coordination with Louisiana LDWF will be pursued to better assess the true extent of infestations present and evaluate success of control efforts.

2) **Evaluate FY 11 management efforts and develop management plan for FY 2012.**

   Additional recommendations may be accepted and actions may be taken such as development of a re-vegetation program, use of other registered aquatic herbicides, use of additional biological controls, etc., if cooperators agree such measures are necessary.

Cooperators and their responsibilities

Cypress Valley Navigation District:

1. Coordinate non-TPWD aquatic vegetation management activities on the Texas side of Caddo Lake.
2. Complete and submit 2 treatment proposals per year complete with required notifications and any associated permit applications.
3. Contract commercial applicator or conduct applications.
4. Maintain accurate records of all herbicide applications and provide copies to TPWD on a weekly basis.

Texas Parks and Wildlife Department:

1. Oversee all aquatic vegetation management activities, including review of all treatment proposals for the Texas side of Caddo Lake.

2. Review all pertinent permit applications.
3. Conduct post-treatment surveys to verify treatments and identify areas needing attention.
4. Monitor bio- control organism populations as needed.

Center for Invasive Species Eradication:

1. Maintain weevil rearing facility.
2. Propagate Cyrtobagous weevils for release on Caddo Lake.
3. Conduct research regarding effectiveness or suitability of new herbicides as well as dispersal and overwintering capacity of salvinia weevils.
4. Contract commercial applicator to supplement FY11 control efforts.
5. Maintain accurate records of herbicide applications and provide copies to TPWD on a weekly basis

Northeast Texas Municipal Water District:

1. Coordinate efforts to reduce nutrient input to Caddo Lake.

Louisiana Department of Wildlife and Fisheries

1. Coordinate aquatic vegetation management activities on the Louisiana portion of Caddo Lake.
2. Conduct fall nuisance vegetation surveys and collaborate with TPWD counterparts.

Water hyacinth Management Options

A. Mechanical/Physical Control

1. **Mechanical harvesters -** The effectiveness of mechanical removal of water hyacinth is limited to the control of small infestations in water more than 2 feet deep with few stumps or other obstructions. Past experience with mechanized means of water hyacinth control have proven not only limited but cost-prohibitive. Due to the magnitude of the infestation on Caddo Lake and complex nature of infested areas, large scale mechanical harvest is not a feasible option for vegetation management on the lake. It may however, be employed by property owners in confined areas to control severe infestations.

2. **Mechanical shredders –** This option includes floating machines that shred vegetation near the water surface rather than cutting and harvesting it. In areas with stumps and other submerged objects both mechanical shredders and harvesters often suffer repeated damage and operations must be discontinued periodically for repairs. For this

reason, mechanical shredding is generally considered less feasible than other control options since Caddo Lake has high numbers of submerged stumps.

3. **Water level manipulations -** The purpose of water level manipulations (drawdowns) is to strand plants on the shoreline long enough to kill them by desiccation or freezing. Effective control of floating aquatic vegetation by manipulation of water levels is well documented. Since it is not possible to manipulate the water level on Caddo Lake, this is not considered an option at this time.

4. **Booms** - The use of floating booms can be useful in a floating plant control program. They can be deployed to prevent floating plants from clogging water intakes, marinas, swimming areas, or other susceptible sites. Booms can also be used to collect or contain plants in an otherwise open setting. Booms placed around a boat launch may prevent plants from interfering with ingress or egress of boats, and prevent plants that have been accidentally introduced at a boat launch from escaping into the open water body. While not practical in all situations, floating booms may help maintain access in small problem areas like boat ramps or boat houses.

B. Biological Control

1. **Water hyacinth weevils *Neochetina* spp. (*N. eichhorniae* and *N. bruchi*) -**Water hyacinth weevils are native to Central and South America. The chevroned water hyacinth weevil (*N. bruchii*) and the mottled water hyacinth weevil (*N. eichhoniae*) were introduced into the U.S. in the 1970s to help control water hyacinth. Water hyacinth weevils have been used to slow the growth of water hyacinth populations and reduce their ability to flower and produce seeds. In rare cases, water hyacinth populations have also been significantly reduced by weevil introductions. Unfortunately, the water hyacinth weevil has proven largely ineffective in reducing water hyacinth densities in Texas. This has been true on Caddo Lake where water hyacinth weevils are present and scared leaves attest to their activity, but where the water hyacinth population nevertheless continues to expand. However, weevil populations may be supplemented in Caddo Lake as a part of an integrated approach.

C. Chemical Control

Many herbicides are quick acting and show results within a matter of days. Others are systemic and kill plants over longer periods of time. Use of federally approved chemicals for the purposes of nuisance aquatic plant control is acceptable under this plan and governed under the State Aquatic Vegetation Management Plan.

A surfactant is generally used with herbicides to increase their effectiveness. Surfactants are a necessary element in any chemical treatment of aquatic vegetation and can determine the level of control achieved. The most common surfactants used are non-ionic surfactants (NIS) and silicone based surfactants. Surfactants can increase costs by as much as 10-15 percent.
The following herbicides are typically used to control water hyacinth in Texas:

1. **2,4-D –** Dimethyl amine Salt of 2,4-D Dichlorophenoxyacetic Acid (46.8% a.i.)
   In Texas 2,4-D compounds are State-restricted herbicides and are regulated by TDA. Applicators must be certified by TDA and must follow strict use restrictions based on the county of a proposed application. Treated water cannot be used for livestock or as municipal water source for 21 days after application or until tests indicate concentration levels are below 0.1 ppm. In areas where 2,4-D use is limited, and at times of the year where its use is restricted, diquat, endothall, triclopyr, and glyphosate products can be used.

2. **Diquat –** Diquat dibromide [6,7-dihydrodipyrido (1,2-a:2',1'-c) pyrazinediiumdibromide] (37.3% a.i.)
   Diquat is a contact herbicide that requires a very short contact time. However, treated water cannot be used for livestock or as public water source for 0-5 days after application depending on application rate and how the water will be used. Although effective on water hyacinth, diquat can prove expensive when used for large-scale applications.

3. **Glyphosate –** Glyphosate, N-(phosphonomethyl)glycine, in the form of its isopropylamine salt (53.8% a.i.)
   Glyphosate is a systemic herbicide and requires only 4-6 hours of contact time to be effective. Results from glyphosate applications are evident in 1-2 weeks. Repeated applications are often necessary on deeply rooted vegetation. Glyphosate carries no restrictions but cannot be used within ½ mile of a potable water intake. Glyphosate is used on floating and marginal plants only.

4. **Imazamox –** Ammonium salt of Imazamox 2-[4,5-dihydro-4-mehtyl-4-(1-methylethyl)-5-oxo-1*H*-imidazol-2-yl]-5-(methoxymethyl)-3-pyridinecarboxylic acid (12.1% a.i.)
   Imazamox is a systemic herbicide that is effective on water hyacinth, quickly absorbed by foliage, and rapidly translocated to the growing points stopping growth. There are no restrictions on livestock

watering, swimming, fishing, domestic use, or use of treated water for agricultural sprays but Imazamox is not to be used within ¼ mile of an active potable water intake.

5. **Penoxsulam –** 2-(2,2-difluoroethoxy)-6-trifluoromethyl)-N-(5,8-dimethoxy[1,2,4]triazolo-[1,5c]pyrimidin-2-yl)-benzenesulfonomide (21.7% a.i.)
Penoxsulam is a systemic herbicide with efficacy on giant salvinia, hydrilla, and water hyacinth. Contact time necessary for efficacious control is approximately 30 days.

Giant salvinia Management Options

A. Mechanical/Physical Control

1. **Booms -** The use of floating booms can be useful in a floating plant control program. They can be deployed to prevent floating plants from clogging water intakes, marinas, swimming areas, or other susceptible sites. Booms can also be used to collect or contain plants in an otherwise open setting. Booms placed around a boat launch may prevent plants from interfering with ingress or egress of boats, and prevent plants that have been accidentally introduced at a boat launch from escaping into the open water body. While not practical in all situations, floating booms may help maintain access in small problem areas like boat ramps or boat houses.

B. Biological Control

2. **Giant salvinia weevils *Cyrtobagous salviniae* -** Giant salvinia weevils are native to South America. The success of this insect on giant salvinia infestations in other parts of the world has been thoroughly demonstrated. Initially released in Texas in October 2001 for research purposes, large-scale introductions of the salvinia weevil on Toledo Bend Reservoir began in July 2004. Weevil populations may be used in areas inaccessible to spray equipment as part of an integrated approach to help control giant salvinia populations on Caddo Lake. The salvinia weevil rearing facility managed by CISE is intended to propagate sufficient numbers of weevils to release on Caddo Lake and other salvinia affected reservoirs in east Texas. Giant salvinia weevils are a long-term control option and may take 3 years or more to establish sufficient numbers to affect measurable control.

C. Chemical Control

The herbicides used to control giant salvinia consist of both contact- and systemic- herbicides. Under the State Aquatic Vegetation Management Plan, only federally approved herbicides may be used. In addition, two surfactants are necessary and significantly affect the efficacy of herbicide use on giant salvinia. Typically, both a wetting agent and a penetrant are used. Surfactants may increase costs by as much as 10-15 percent.

1. **Diquat –** Diquat dibromide [6,7-dihydrodipyrido (1,2-a:2',1'-c) pyrazinediiumdibromide] (37.3% a.i.)
   Diquat is a contact herbicide that requires a very short contact time and has proven very effective on immature salvinia. However, treated water cannot be used for livestock or as public water source for 0-5 days after application depending on application rate and how the water will be used. Although effective on water hyacinth and salvinia, diquat can prove expensive when used for large-scale applications.

2. **Glyphosate –** Glyphosate, N-(phosphonomethyl)glycine, in the form of its isopropylamine salt (53.8% a.i.)
   Glyphosate is a systemic herbicide and requires only 4-6 hours of contact time to be effective. Results from glyphosate applications are evident in 1-2 weeks. Repeated applications are often necessary on deeply rooted vegetation. Glyphosate carries no restrictions except that it cannot be used within ½ mile of a potable water intake, and is used on floating and marginal plants only.

3. **Glyphosate-Diquat** -The use of a combination of Glyphosate and Diquat, has proven very effective in the treatment of salvinia. Recent studies by Louisiana State University indicated the addition of 1 pint of Diquat to 3 quarts of Glyphosate and two surfactants (NIS and Silicone) offered 90% effectivness on giant salvinia.

3. **Penoxsulam –** 2-(2,2-difluoroethoxy)-6-trifluoromethyl)-N-(5,8-dimethoxy[1,2,4]triazolo-[1,5c]pyrimidin-2-yl)-benzenesulfonomide (21.7% a.i.)
   Penoxsulam is a systemic herbicide with efficacy on giant salvinia, hydrilla, and water hyacinth. Contact time necessary for effictive control is approximately 45 days. Effective use is limited to confined areas with little or no flow.

Hydrilla Management Options

A. Mechanical/Physical Control

1. **Mechanical harvesters -** (Includes traditional barge type harvesters with both vertical and horizontal cutting blades and a conveyor belt

that gathers cut material for later offloading or for shredding.). Most harvesters cut up to 5 feet below the surface to temporally remove the canopy of hydrilla. In areas with stumps and other submerged objects mechanical harvesters often suffer repeated damage and harvesting must be discontinued periodically for repairs. For this reason, mechanical harvest is generally considered less feasible than other control options since Caddo Lake has high numbers of submerged stumps.

2. **Water level manipulations -** The purpose of water level manipulations (drawdowns) is to strand plants on the shoreline long enough to kill them by desiccation or freezing. Drawdowns are quite effective on most submerged plants such as Eurasian watermilfoil. Drawdowns are an effective means of temporarily reducing hydrilla biomass, but are not effective as an eradication tool hydrilla has the ability to produce numerous tubers that remain dormant in the hydrosoil for up to ten years. Further, some drying seems to act as a trigger to cause increased hydrilla tuber sprouting. Since it is not possible to manipulate the water level on Caddo Lake, this is not considered a viable control option.

3. **Bottom Barriers -** Physical barriers usually consist of various types of dark silt-fence type or similar material that are spread across the bottom of the area to be kept weed-free and then anchored in place. Barriers are susceptible to damage by propellers, excess current, and dredging. Problems have also been encountered in the past with gases (i.e. oxygen and CO_2) building up under the film and buoying the barrier up from the bottom; however more modern gas permeable fabrics are designed to avoid this. Because of expense barriers are most often used to protect small areas such as boat docks or swimming areas.

B. Biological Control

1. **Triploid grass carp *Ctenopharyngodon idella* -** Grass carp, or white amur, are plant-eating fish native to Asia. They are capable of surviving at temperatures ranging from below freezing to over 100ºF, and can grow in excess of 100 pounds. Fingerlings, juveniles and adults feed almost exclusively on plant material. Typically they may eat 40-100% of their body weight per day in plant material, but feeding may be reduced greatly at low temperatures. Only sterile (triploid) grass carp are allowed in Texas and a permit is required. Grass carp are powerful swimmers and have been known to traverse hundreds of miles. Because no emigration barrier is present to prevent the escape of triploid grass carp from Caddo Lake, their use may be problematic relative to Louisiana regulations. The stocking of grass

carp would require agreement between both Texas and Louisiana, and at least one public hearing would be necessary in accordance with Texas regulations. In addition, if stocked at high enough densities grass carp may consume more desirable plant species once hydrilla has been reduced. Until further data is collected triploid grass carp will not be considered for use in Caddo Lake at this time.

2. **Hydrilla flies *Hydrellia pakistanae* –** Hydrilla flies are still somewhat experimental. They require hydrilla growing at or near the water surface to reproduce. They are generally considered a long-term option because results are variable and may take years to be realized. However, significant impacts by sustained feeding have been observed on water bodies in Texas, Florida, and Georgia within two to three years after release of high numbers of individuals. Impact typically consists of reduced viability of the hydrilla and lowered tuber production. Use of the hydrilla flies coupled with a viable re-vegetation program and other biomass reducing options (i.e., chemicals) may produce long-term and sustainable management.

C. Chemical Control

Herbicides for submersed species are best used in the littoral zone (shallow water) where appropriate concentrations are more easily and economically maintained. Treatment cost increase dramatically as water depth increases. They are best used in the spring when water temperatures rise to the point where herbicides are easily absorbed by growing plants. All herbicides are difficult to use in flowing water since some contact time is required in order to be effective. Efficacy is a function of concentration of the herbicide and contact time.

The following herbicides are typically used to control submersed aquatic vegetation in Texas:

1. **Chelated copper –** Copper as elemental (9.0% a.i.)
   Chelated copper herbicides are approved for use in drinking water. They require very short contact times (hours). However, they are not systemic and hydrilla may re-grow from roots very quickly (30-60 days under good conditions).

2. **Diquat –** Diquat dibromide [6,7-dihydrodipyrido (1,2-a:2',1'-c) pyrazinediiumdibromide] (37.3% a.i.)
   Diquat is a contact herbicide that requires a very short contact time. However, treated water cannot be used for livestock, or as public water source for 0-5 days after application depending on application rate and how the water will be used. Diquat is not systemic and hydrilla may re-grow quickly (30-60 days under good conditions).

3. **Endothall** – 7-oxabicyclo [2.2.1]heptane-2,3-dicarboxylic acid equivlant acid equivalent (28.65% a.i.)
   Endothall is a contact herbicide that requires a very short contact time. However, water cannot be used for livestock or as a public water source for 7 days after application. Endothall is not systemic and hydrilla may re-grow quickly (30-60 days under good conditions).

4. **Fluridone** – 1-methyl-3-phenyl-5[3-(trifluoromethyl)phenyl]-4(1H)-pyridinone (5% a.i.)
   Fluridone is a systemic herbicide and requires several weeks of contact time to be effective making it difficult to use in flowing water unless a drip system is used to maintain the proper concentration in the water column. Hydrilla is often very slow to recover from effective fluridone treatments and in some cases 2-4 years of control is achieved. However, it cannot be used within ¼ mile of a potable water intake at concentrations greater than 20 ppb, and treated water should not be used for irrigation for 7-30 days depending on the crop (lawns as well as crops can be affected).

5. **Penoxsulam –** 2-(2,2-difluoroethoxy)-6-trifluoromethyl)-N-(5,8-dimethoxy[1,2,4]triazolo-[1,5c]pyrimidin-2-yl)-benzenesulfonomide (21.7% a.i.)
   Penoxsulam is a systemic herbicide with efficacy on giant salvinia, hydrilla, and water hyacinth. Contact time necessary for efficacious control is approximately 30 days. Effective use is limited to confined areas with little or no flow.

Nutrient Reduction

A. Assess available information and reports

Literature and data describing the nutrient budget of Caddo Lake will be assessed, including both point source and non-point source loading. Additionally, information about the transport of nutrients into Big Cypress Creek, Lake O' the Pines, and ultimately into Caddo Lake will be evaluated. The results will be used to develop a plan to improve nutrient management within the watershed.

B. Encourage implementation of best management practices

Local state water and soil conservation boards, as well as property owners in the Caddo Lake watershed will be encouraged to properly manage the nutrients entering the lake. In all cases, the implementation of best management practices will be encouraged.

C. Advance public education

The efficient use of phosphorus and other nutrients within the watershed will be promoted. Targeted groups include, but are not limited to:
1) Commercial providers of phosphorus.
2) Residential applicators of phosphorus.
3) Agricultural producers that generate or apply phosphorus in operations.
4) Contributors of phosphorus caused by residential activities.

Implementation will include at least the following:
1) Disseminating educational components through mass communications like Internet web sites, fliers, newsletters, magazines, memos, reports.
2) Conducting conferences focused on education to achieve changes in habits.
3) Performing person-to-person communications like site visits, telephone calls.

D. Use of native aquatic and riparian vegetation

Excess nutrients entering the system contribute to the magnitude of invasive plant infestations. If these nutrients are tied up in native aquatic and riparian vegetation they are not available for use by invasive species. In some cases aquatic and riparian species plantings could be used to help reduce nutrients available to unwanted species but are not considered a viable option on Caddo at this time.

Budget

Boom materials and installation **$5,000.00**

Estimated Herbicide Costs (based on 720 acres water hyacinth, 605 acres salvinia)

2,4-D Amine	720	gallons	$16.88/gallon=	$12,153.60
Glyphos Aquatic	605	gallons	$46.75/gallon =	$28,283.75
Reward (Diquat)	75.6	gallons	$99.00/gallon =	$ 7,486.88
NIS Surfactant	331	gallons	$9.50/gallon =	$ 3,144.50
Thoroughbred	75.6	gallons	$75.50/gallon =	$ 5,707.80
		Total	**($42.83/ac)**	**$56,746.53**

Projected Contractor Costs (based on per hour)				**Projected Total Cost**
Estimated cost/hour	$100.00	2A/h =	**$66,250.00**	**$122,996.53**
		2.5A/h =	**$53,000.00**	**$109,746.53**
		3A/h =	**$44,166.67**	**$100,913.20**

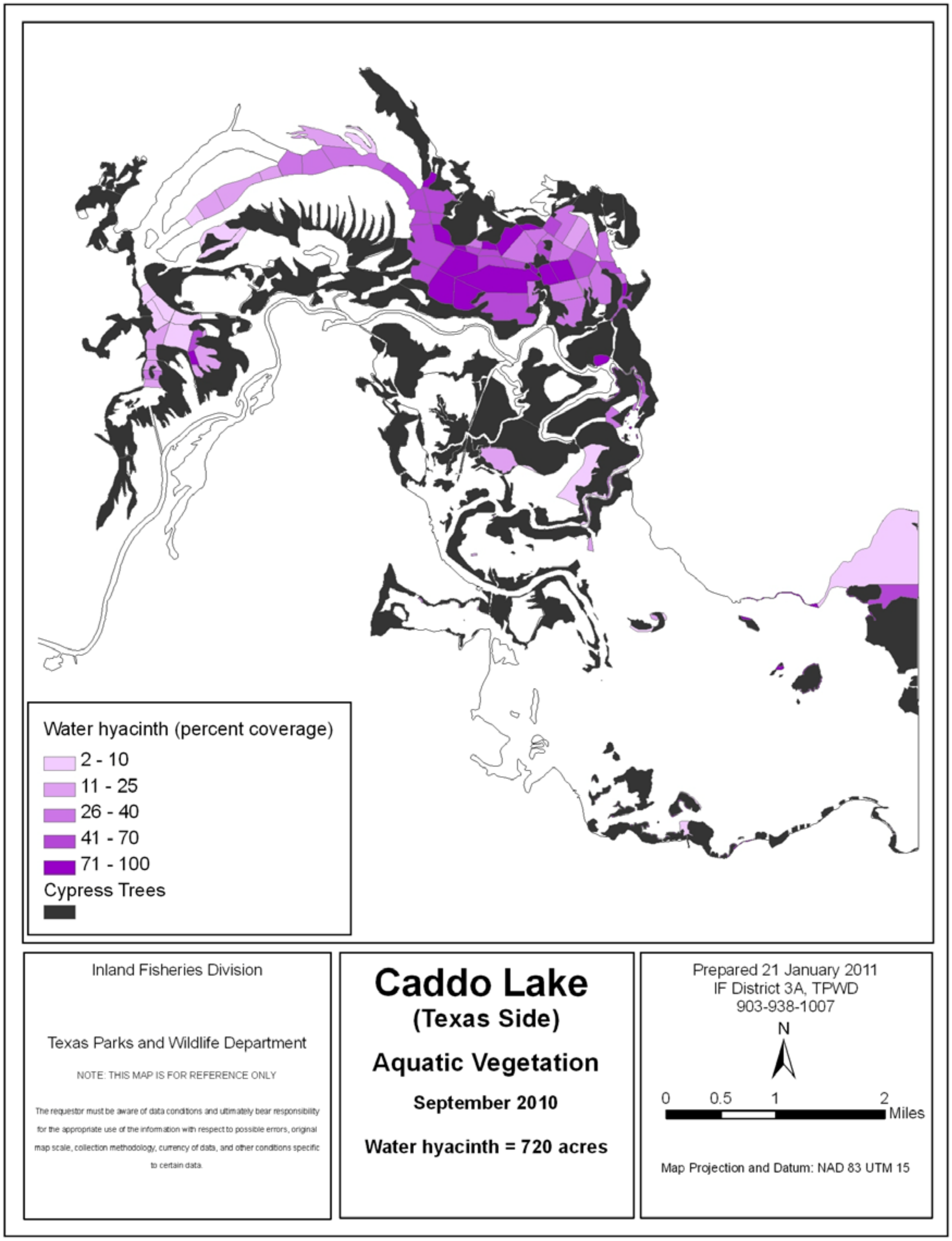

Figure 1. Water hyacinth coverage on Caddo Lake 2010 (Texas). Data is from the 2010 TPWD vegetation Survey.

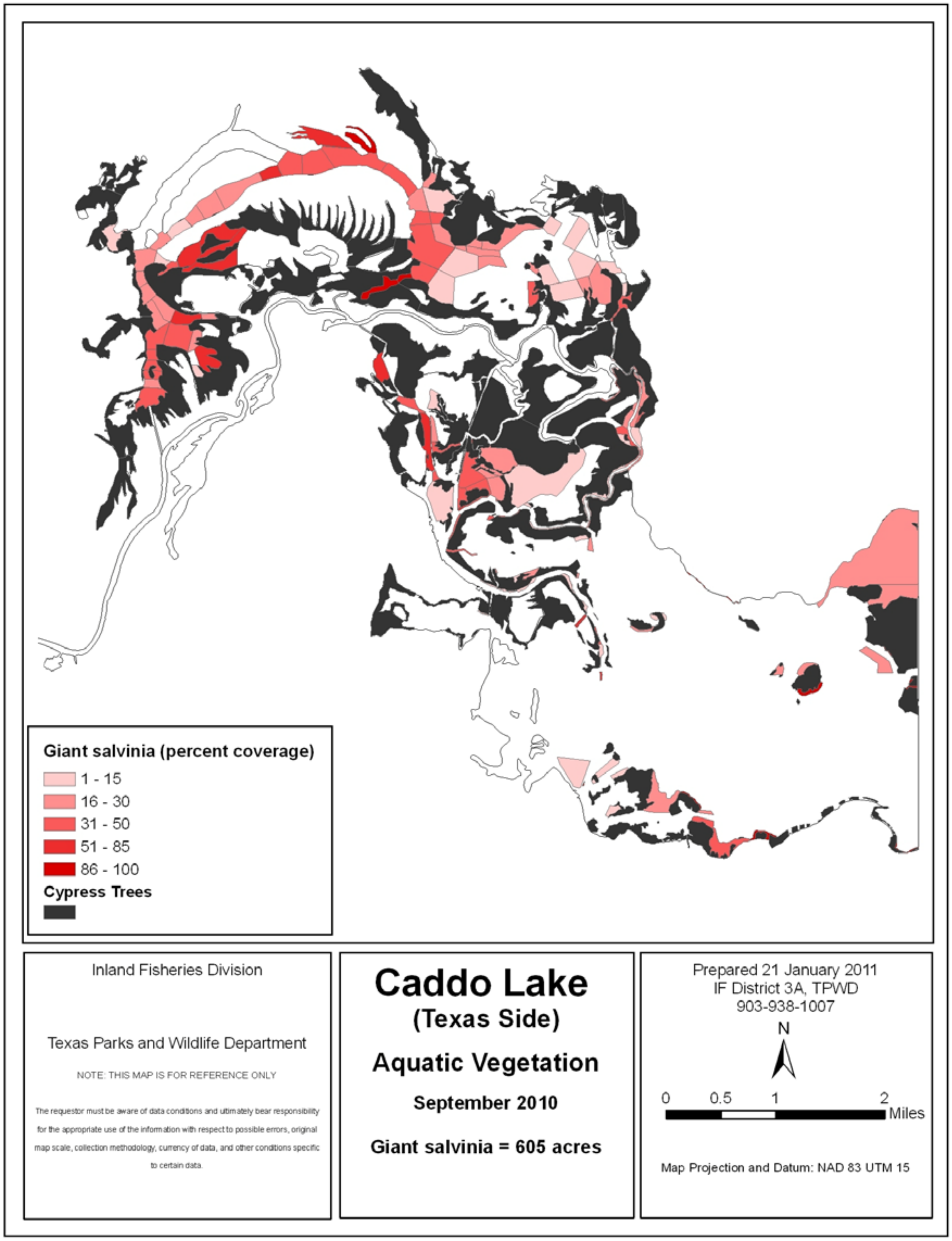

Figure 2. Giant salvinia coverage on Caddo Lake 2010 (Texas). Data is from the 2010 TPWD vegetation Survey.

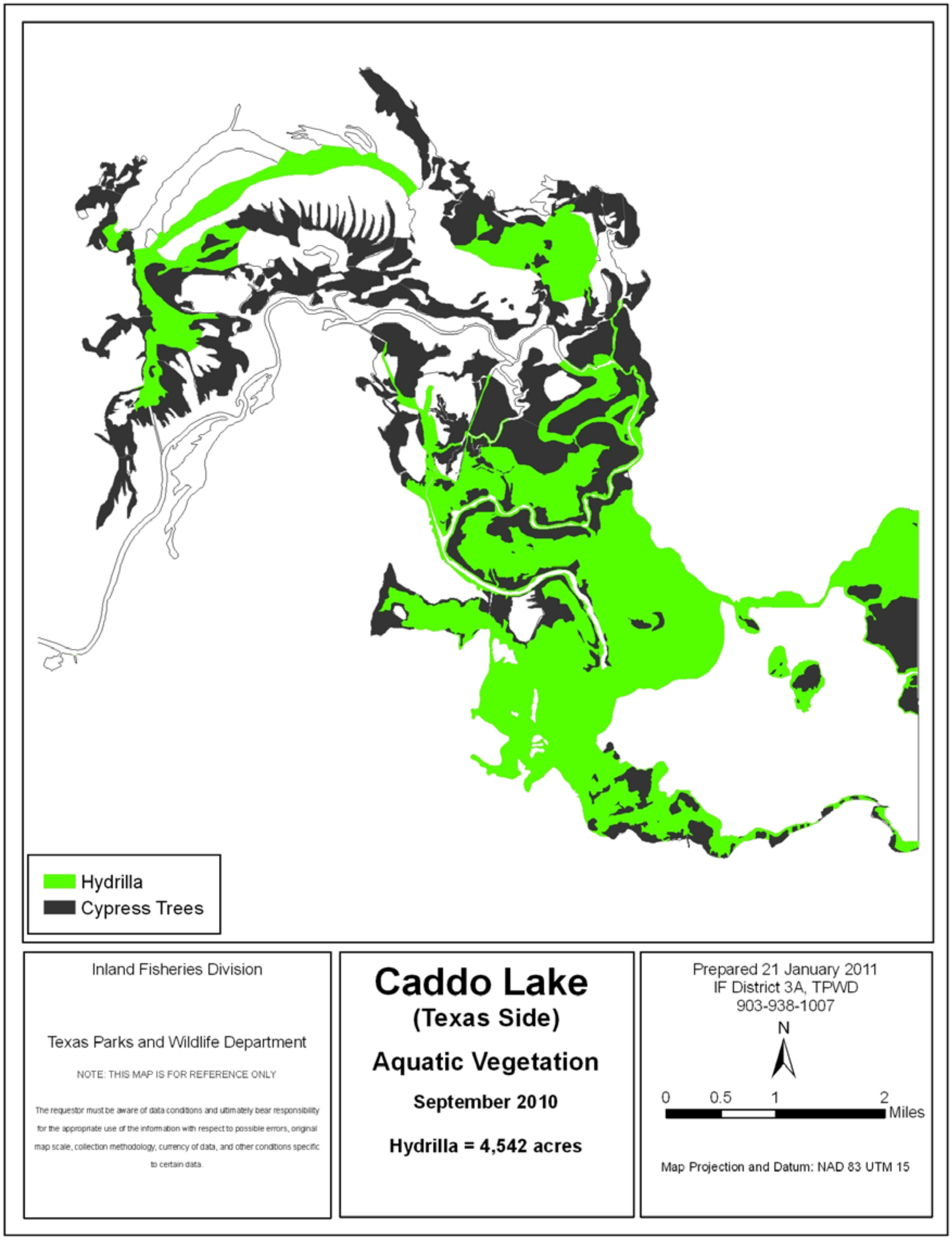

Figure 3. Hydrilla coverage on Caddo Lake 2010 (Texas). Data is from the 2010 TPWD vegetation Survey.