A Model Program
for
Mitigating the Spread of Glossy Buckthorn
in
Great Lakes Wetlands

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Model Program Plan for Mitigating the Spread of Glossy Buckthorn in Great Lakes Wetlands

Healthy wetland systems are vital to the health and water quality of the Great Lakes. Glossy buckthorn, *Frangula alnus* Mill. (Syn: *Rhamnus frangula*), Rhamnaceae, is a serious threat to the native plant communities of many Great Lakes wetlands. Common buckthorn (*Rhamnus cathartica*) will also grow in wetlands and is a serious invader of a wide variety of upland habitats. Glossy buckthorn is less frequently an aggressive invader in the uplands, but a more serious pest of wetlands. The UWM Field Station, Wisconsin DNR, and the Friends of Cedarburg Bog have almost 30 years of experience controlling buckthorn in parts of the Cedarburg Bog since 1991. This document presents the outlines of a model control plan based on some of that experience.

General considerations for control of glossy buckthorn, including some considerations for planning a control program are presented in an excellent resource available online:
Michigan Department of Natural Resources, Michigan Natural Features Inventory, Invasive Species – Best Control Practices, Glossy buckthorn, *Frangula alnus*:
https://mnfi.anr.msu.edu/invasive-species/GlossyBuckthornBCP.pdf
Details of control methods presented in that publication will not be repeated here.

In fire-adapted wetland communities, regular prescribed burning will prevent the establishment of glossy buckthorn. When a fire-adapted community is already badly infested with buckthorn, the mature buckthorn will first have to be removed in order to encourage the growth of the sedge and grass fuel that will carry a fire sufficient to top-kill the buckthorn. Fire can then be an important part of an integrated management plan. Spring burns, when root carbohydrate levels are low, are most effective since they do not stimulate as many resprouts as do fall burns. Once burning can be conducted regularly and adequate fuel is present, fire will kill seedlings and help exhaust the seedbank.

Since regular burning can be all that is necessary to control buckthorn in sedge and grass meadow wetland communities, and since our experience in the Cedarburg Bog is not in a fire-adapted community, we will not give further consideration to management of glossy buckthorn in sedge meadow communities here. This document presents a model control plan for wetlands in which fire is not an appropriate or available management tool.

Inspect the wetland for buckthorn – Begin control at first appearance

The fruits of buckthorn are dispersed widely by birds. Initial colonization of a wetland takes place slowly over a relatively long period, and depends on long-distance dispersal from surrounding upland areas where buckthorn is planted or has established. In the plant communities of the Cedarburg Bog where the age of first fruit production has been determined, buckthorn begins to produce fruits at 11 to 12 years of age (Reinartz and Kline 1988). Once fruits begin to be produced by plants growing in the wetland, the growth of the population becomes logarithmic as does the cost of control and management. In consideration of these few basic facts, the most important plan for mitigating the spread of glossy buckthorn in Great Lakes wetlands can be summarized as follows:

- Inspect/survey your wetland to find out if glossy buckthorn is present. As with any invasive plant, prevention, or early-detection and rapid-response, is often the only really feasible way to prevent or control an infestation.
- Glossy buckthorn leafs-out early in spring and retains its leaves late in fall. It can be easiest to survey for buckthorn in early spring or late fall when the leaves of native vegetation are absent or have changed color.

- Inspect/survey the uplands in the vicinity of your wetland. Find out if glossy buckthorn occurs in the area. This is especially important if glossy buckthorn is not found, or is present only in small numbers, in the wetland.
- If glossy buckthorn is present, but uncommon, in the upland, and especially if it is present primarily as planted horticultural hedges, do everything that you can to eradicate it from the uplands in the vicinity. Going to considerable expense to work with property owners to remove and replace a buckthorn hedge in the area, will be way less costly than subsequent control in the wetland. Control work in the uplands is also substantially less costly than working in wetland. If glossy buckthorn is relatively new to the area or uncommon, eliminating it from the surrounding uplands is well worth the effort.
- If glossy buckthorn is present, but uncommon, in the wetland, do a thorough and systematic survey of the wetland to map its locations. Find the resources to eradicate fruiting-sized buckthorn plants and continue that program until buckthorn has been eliminated.

Controlling glossy buckthorn in a wetland with a substantial existing infestation

There are almost never sufficient resources to consider eradicating a well-established population of an invasive species. It is important to prioritize sites for treatment and plan carefully. Assessing both the scope of the problem and any available resources is a critical first step:

- Conduct a thorough and systematic survey of the wetland to map the buckthorn. Relative density or dominance of the buckthorn can be formally quantified by measuring cover at sample points using a line intercept method, or measuring density by counting individual stems in quadrats. Or relative density can be assessed on a ranked data scale by recording a number of classes or ranges of density.
- Map the different plant communities present in the wetland. Determine whether some plant communities have higher natural area values than others, or if some communities have critical species that are of particular conservation concern.
- Determine whether buckthorn density varies among the plant communities present.

Given this information, develop a strategy for control. First select areas that will receive control first:

- Prioritize high-value communities.
- Prioritize areas with the lowest buckthorn densities.
- Work in representative examples of the high-value areas where success can be achieved. If there are areas with relatively few buckthorn trees, start management there and keep the nice areas nice. Then work towards the areas that are more heavily infested.
- Preserve examples of all plant community types if practical.
- Treat larger core infestations of lower value as resources permit.

Once work areas have been chosen and prioritized:

- Remove fruiting-sized buckthorn and those that are nearing that size first. In practice, this means treating plants that are more than 1.5m tall and have a basal diameter greater than 1 to 1.5cm.
- Do not attempt to treat all of the seedlings.
- Continue to follow-up in the areas where you have previously removed buckthorn.

In a wetland with a well-established buckthorn infestation, it is likely that small seedling buckthorn are present at a high density under the mature trees, and it is not feasible to treat all of the small buckthorn plants present. Even if time allowed treatment of smaller individuals, there would be too much risk of damage associated with the higher level of herbicide application required, or the disturbance to the ground would be too great if the seedlings were pulled. One situation in which it may be worthwhile to treat

smaller size classes is where buckthorn is at a very low density and killing some smaller individuals will nearly eliminate buckthorn from the area.

The strategic goal for the work should be to eliminate fruiting of buckthorn within the treated areas. This approach recognizes that the same areas will need to be treated repeatedly. Treatments must continue until the small plants have grown to the size where they are controlled, and the population is eventually exhausted because the lack of local fruit production nearly eliminates new recruitment of seedlings. As the small, high-density, plants grow, their density is reduced through a self-thinning process. Tens, or even hundreds, of plants per square meter are reduced to a much lower density as they grow. This approach requires that control efforts be repeated every 4 to 6 years to prevent fruit production as the small plants in the population grow.

A corollary of this control strategy is that previously treated areas should be prioritized for follow-up control whenever buckthorn is reaching fruiting size before the control work is expanded to as yet untreated areas. It is most important to be able to sustain the effort to keep eliminating fruit production in all of the areas chosen for treatment.

Control planning references:
Michigan Department of Natural Resources, Michigan Natural Features Inventory, Invasive Species – Best Control Practices, Glossy buckthorn, *Frangula alnus*: https://mnfi.anr.msu.edu/invasive-species/GlossyBuckthornBCP.pdf

The Nature Conservancy's Weed Control Methods Handbook: Tools and Techniques for Use in Natural Areas: http://www.invasive.org/gist/handbook.html

Control method

Use the "cut-stump" method to kill fruiting-sized buckthorn. Stems are cut and herbicide is applied to the cut stump to prevent resprouting. Basal bark treatment should not be used for glossy buckthorn. It is not much more efficient than the cut stump method since the herbicide in oil must be applied to completely encircle the stem, and the basal bark method is considerably less selective, using much more herbicide than the cut-stump method. For the cut-stump treatment, cut stems at 15cm (6in.) or lower, and apply herbicide to the cut stumps within minutes. Apply the herbicide carefully and selectively to the surface of the cut stump.

Most glossy buckthorn can be cut with hand pull-saws or loppers. In areas where large buckthorn are common, a chain saw may be needed to cut the large stems. A substantial number of large buckthorn (> 5cm, 2in., diameter) must be present to make hauling a chain saw into the wetland (and listening to it run) worth the effort. Where a high density of desirable vegetation is growing near the base of the buckthorn stems, selective cutting with a chain saw is very difficult. A girdling cut can also be made around very large stems and herbicide applied to the girdle incision to kill the plant, in order to eliminate the need for a chain saw.

In general, brush cutters are not useful for this work since there are very few locations where native species such as bog birch, winterberry, willows, or dogwoods are not also interlaced with the buckthorn clumps. Considerable effort should be expended to protect any native shrubs that might compete with the buckthorn seedlings.

Timing of control

Winter, when the wetland is frozen, can be a good time (the best time) to control buckthorn. It can be easiest to move in the wetland when it is frozen, and work conditions can be more pleasant than in the summer. However, workers must be thoroughly trained to identify buckthorn without leaves, and that ability should be tested and periodically reviewed. Do not trust a new worker's word for her/his ability to identify buckthorn. The herbicide recommended for control is effective at killing buckthorn with the cut-stump method at any time of year, except during the early spring around the time of leaf-out when the upward flow of sap will expel the herbicide from the stump.

Herbicide used for control

Whenever air temperatures are high enough that water-based herbicide can be kept from freezing use the "3A" (Amine) formulation of triclopyr (e.g. Garlon 3A®) mixed in water. Mix Garlon 3A®, or equivalent, 1:1 (50% solution of the concentrate) in water, and add blue marker dye. The "3A" (Amine) formulation of triclopyr is commonly sold as ~44% active ingredient, so the herbicide as applied will be 22% active ingredient.

When air temperatures are well below freezing use the Ester ("4") formulation of triclopyr (e.g. Garlon 4®) mixed in agricultural oil (e.g. Bark Oil Blue®) as a 20% solution (1 part herbicide to 4 parts oil) of the concentrate. Common forms of triclopyr concentrate are ~60% active ingredient, so the herbicide as applied will be ~15% active ingredient.

The cut-stump method as applied should be very selective, resulting in very little herbicide coming in contact with water in the wetland. However, the "3A" (Amine) formulation of triclopyr is safer to use if there is any chance of having herbicide come in contact with water. There is a possibility that the "4" (Ester) formulation of triclopyr could be mobile and taken up by non-target plants in water. The Garlon 4® in Bark Oil Blue® mix must be used at temperatures well below freezing because it does not freeze as the water (3A) herbicide mixture does.

Herbicide application equipment

The best, most efficient, and most selective, herbicide applicator will depend on season, the structure of the plant community in which the buckthorn is growing, and worker preference. In general effective and recommended application equipment includes:

1. 8 oz./250mL Nalgene™ Wide-Mouth Unitary™ Wash Bottles with 24mm Cap (www.usplastic.com). Excellent for very selective application to buckthorn growing in dense desirable vegetation. Drawbacks of these bottles include: a) The squirt tip is a separate part that tends to get lost, and cannot be purchased separately, b) Workers can expect to get herbicide on their gloves from the bottles, c) Herbicide should not be stored, even over-night, in the bottles because changes in temperature will cause continual pumping of herbicide out of the nozzle and make a mess.
2. Buckthorn Blasters™ (https://landscape-restoration.com/product/buckthorn-blaster/), a small sponge-tipped applicator with a spring-loaded valve between the reservoir and sponge. An excellent, efficient, and selective applicator. Drawbacks of the Buckthorn Blasters are: a) They do not easily apply enough of the more viscous oil-based herbicide and are therefore only used for the Garlon 3A in water herbicide, b) The bottles are thin and can easily be punctured by the sharp hand saws, c) The sponge tips wear out and need to be replaced frequently.
3. High quality (i.e. expensive), 2 Quart Heavy Duty Pump-Up Sprayer with Adjustable Brass Tip Nozzle. Available from "4-Control" (http://4-control.com/model-942-pump-up-sprayer/). Over

the years Cedarburg Bog crews have tried many less-expensive pump-up sprayers purchased from garden centers and have never found one that would last more than a day or two. The advantage of a pump-up sprayer is that with just a couple pressurizing pumps the nozzle will produce many gentle squirts of herbicide. The disadvantages of these sprayers include: a) They are somewhat large and cumbersome for selective control work in dense vegetation. Their bulk renders them less selective, i.e. there is more over-spray and off-target spray, b) They need to be kept nearly full of herbicide to work with the nozzle pointed down toward the stump. If they are not full, the take-up tube will not contact the herbicide in the reservoir.

Applicators that are not recommended include common trigger-pump garden spray bottles. Applicators of this style never last for long, and the trigger-pump invariably leaks a lot of herbicide onto the workers' gloves. Sponge applicators home-made of PVC parts and valves have been found to be a mess, prone to spills and leaks. They are of very limited use, although they may initially seem to be quite efficient.

Record keeping

As with all invasive plant control projects, good record keeping is important. Many model control project record forms are available on-line. Any of these forms will suggest the variables that it will be most important to record for your project and can be modified for your use. Good records will make assessment of the methods and modification to improve effectiveness possible. Records are also essential to know when it is time to re-treat previously treated areas. Ideally these records can be kept in a GIS for the control and management project.

Retreatment scheduling

Since the control strategy is to repeatedly remove fruit producing plants until the population has been exhausted by preventing recruitment, it is important to determine when a treated area should be scheduled for retreatment. If stems are removed to a diameter of 1 or 1.5cm, how long does it take for the remaining stems to grow to begin fruit production?

In parts of the Cedarburg Bog where formal sampling has been conducted, glossy buckthorn begins to flower and set fruit at 11 to 12 years old. The age of first reproduction is easy to determine by collecting a sample of the smallest/youngest stems that are flowering by cutting them at the base, and determining their age by counting annual rings. The age of the stems that are left after all stems greater than 1.5cm are cut is also simple to determine by counting the age of a sample. Since the size and age at which buckthorn first begins to fruit can vary from site to site, these ages should be determined to calculate the retreatment interval that will be required to prevent fruit production. On average in the Cedarburg Bog we plan for a retreatment interval of 6 years.

Quality Assurance Activities

Starting with the end in mind is an important component of successful projects. A quality assurance plan will help all team members understand the goals and objectives, and how they are going to be accomplished in the course of a project. A sample Quality Assurance Project Plan is attached for consideration.

Quality Assurance Project Plan (QAPP)

Cedarburg Bog: Invasive Control in a High Quality Wetland

Grant Number GL-00E01433-0

Submitted to:
USEPA Region V
Chicago, IL

Prepared by:
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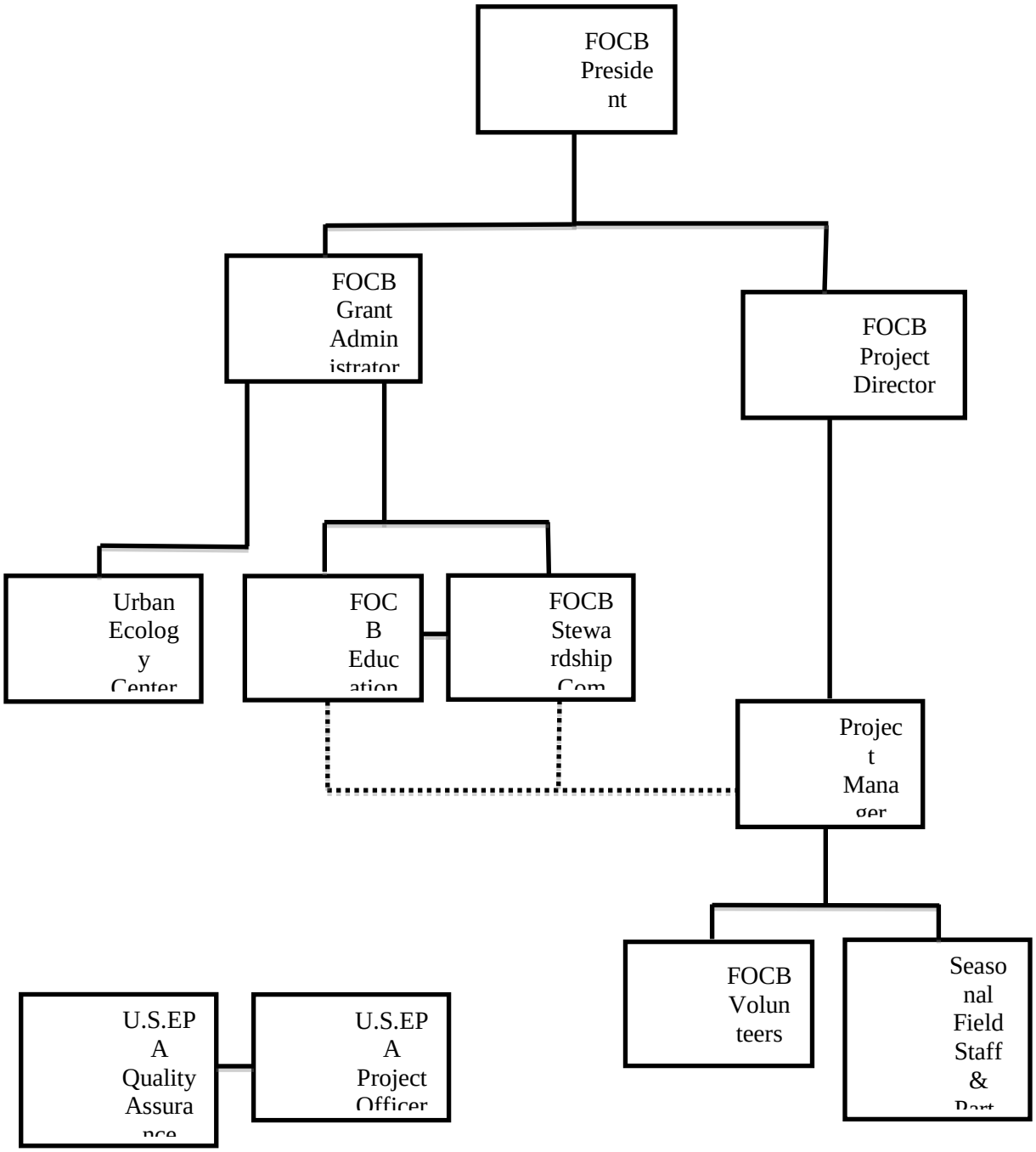
Version 3, Effective Date May 6, 2015

A2. Table of Contents

A4. Project / Task Organization

The Friends of the Cedarburg Bog (FOCB) will hire field staff and recruit volunteers to control invasive glossy buckthorn (*Rhamnus frangula*) in 680 acres of the bog, implement private landowner awareness and control programs, conduct educational programs to nearby urban populations, and enhance the organizational capacity of FOCB and partners to generate funding sources to continue long-term glossy buckthorn management throughout the Bog.

Organization of Project Participants



Name	Organization	Roles/Responsibilities
Grant Administrator	FOCB Board President	Grant administration, budget management, review and submit grant reports, conduct employee evaluations, assist with design and implementation of education programs and Invasives Control Sustainment Plan
Project Director	UWM Field Station Director	QA management and project direction, supervise Project Manager, review grant reports, design and implement invasive control workshops
Project Manager	FOCB Staff	Project management under the supervision of the Project Director, recruit, screen, hire, train and supervise seasonal field staff and Part-time Field Assistant, draft Landowner Outreach & Education Program and implement final design, prepare and submit reports to Project Director, recruit volunteers and schedule volunteer work days
	FOCB Volunteers	Control buckthorn under supervision of Project Manager
Seasonal Field Staff & Part-time Field Assistant	FOCB Staff	Control buckthorn under supervision of Project Manager
	U.S.EPA-GLNPO Quality Assurance Manager	Facilitate the development of the QAPP and provide expert assistance to project participants on quality assurance and quality control issues
	U.S.EPA Project Officer	Programmatic management and oversight of the assistance agreement; monitoring project progress, annual review of the project

The Friends of the Cedarburg Bog (FOCB), as the grant recipient, will be responsible for all aspects of project completion. FOCB is a nonprofit 501(c3) organization that supports preservation, stewardship, appreciation and scientific study of the Cedarburg Bog in cooperation with the Wisconsin Department of Natural Resources (WDNR) and the University of Wisconsin-Milwaukee Field Station (UWMFS). The Cedarburg Bog is one of the largest and most biologically interesting wetlands in southern Wisconsin. The Bog Friends seek to make the public more aware of the Bog's uniqueness by creating opportunities to visit it. FOCB plans projects and organizes volunteer workdays for invasive species control in an effort to preserve the ecosystem for educational and scientific programs, and supports long-term monitoring and research.

FOCB is a small non-for-profit with only one permanent part-time administrative staff member who does not possess the expertise to oversee QA issues related to this project. The Project Director will not be generating data, but rather, he will oversee the quality of that work, and as such, is only nominally involved with the process. It is beyond the resources and budget of this project to hire a separate QA Manager.

Name, FOCB Board President, will serve as Grant Administrator. He will manage the grant budget, review and submit grant reports to the Great Lakes National Program Office (GLNPO) and conduct employee evaluations. Mr. Ross will also coordinate with partners and FOCB Education and Stewardship Committee Chairpersons to design and implement the educational and landowner outreach programs as well as the Invasives Control Sustainment Plan.

Name, will serve as Project Director and quality assurance (QA) manager, and will supervise all work performed by the Project Manager as well as design and implement the invasive control workshops.

Name, Project Manager, will oversee project management under the supervision of the Project Director. She will recruit, screen, hire, train and supervise the seasonal field staff and the Part-time Field Assistant. The Project Manager will draft the Landowner Outreach & Education Program and implement the final design, prepare and submit project reports to Project Director, recruit volunteers, and schedule volunteer work days.

The FOCB Volunteers will be recruited and trained to control buckthorn under the supervision of the Project Manager.

A Part-time Field Assistant will be hired and trained to control buckthorn under the supervision of the Project Manager.

Seasonal Field Staff will be hired and trained to control buckthorn under the supervision of the Project Manager.

A5. Problem Definition/Background

Healthy wetland systems are vital to protect the Great Lakes. The 2,190-acre Cedarburg Bog contains the southernmost, high-quality, intact examples of the wetland communities once common to the region, and is a key reference wetland for the southern Lake Michigan Watershed. Still an excellent example of a healthy pre-settlement wetland system for the region, the Bog is threatened by a growing population of invasive glossy buckthorn (GB). Using maps of the Bog's plant communities and data on the distribution of GB densities developed through extensive sampling by the UWMFS in 1991 and 2006, FOCB, the UWMFS, and the WDNR have conducted planning sessions to identify the areas that are the highest priority for buckthorn control to preserve examples of all of the Bog's major plant communities; 212 acres of that area have already been cleared of fruiting-sized buckthorn over the past three years and this project will continue those efforts to clear fruiting-sized GB in another 680 acres of high-priority communities.

During this project, FOCB will: 1) control GB in 680 acres of the Cedarburg Bog to preserve reference examples of wetland communities, 2) implement private landowner invasive species control programs to extend the protected area and generate support to sustain the control program.

Glossy buckthorn control:

From its incorporation in 2005, FOCB has been building partnerships with the WDNR, University of Wisconsin-Milwaukee, The Natural Resource Foundation of Wisconsin (NRF), and Southeastern Wisconsin Invasive Species Consortium, Inc. (SEWISC). In 2011 in collaboration with these partners, FOCB developed a plan to control GB and protect the biodiversity of the Cedarburg Bog and began implementing that strategy. FOCB secured funding from NRF, We Energies Foundation, and the Wisconsin Knowles-Nelson Stewardship fund to clear GB from the Bog, and WDNR field crews have conducted additional control efforts in the State Natural Area. These efforts have resulted in 212 acres of protected native wetland plant communities to date. Through this work we have gained valuable experience in the efficient and effective management of a large-scale control effort for buckthorn in the wetland. This project will continue these efforts and control GB across a larger landscape, using individuals specifically hired/trained to carry out the work, and learning/adapting our methodology along the way, with the ultimate hope that this unique approach can become a template that can be adapted and used for targeted buckthorn control efforts across other similar areas within the Lake Michigan Watershed.

Enhance organizational capacity:

Invasion by invasive species has been identified as one of the greatest threats to species biodiversity. Introduction of these species is one of the most unrecoverable and permanent injuries to native biodiversity and the integrity of ecosystem processes. Once established, invasive species control and management comes at a high cost financially and ecologically. Even after successful recovery, the intricacies of the original ecosystem are often lost indefinitely.

To continue protection of the Cedarburg Bog beyond the project period, will develop an Invasive Control Sustainment Plan in coordination with our stewardship partners, including UWMFS and the WDNR. This plan will provide the roadmap for the continued protection of the bog beyond the grant period

A6. Proposed Work

Buckthorn control:

FOCB will hire a two-year, full-time, Project Manager (PM) who will learn the Bog and the GB distribution, implement tactical attack plans, and direct field crews effectively. A Part-time Field Assistant will also be hired to assist the PM in periods of time when the water level is low in the bog and greater access to GB-infested areas is possible. We will hire, or sub-award to an experienced Wisconsin DNR crew, for a large (3-4 member) seasonal field staff full-time during the months when the Bog is most accessible (i.e., winter). Limited and difficult accessibility to the Bog's interior forces us to primarily conduct control work during periods when the Bog is frozen, or at least when water levels are low in the late fall. This limits the most efficient control

activities to only 3-4 months of the year and we must manage an intensive project during that short period.

The only method that is sufficiently selective for controlling GB in the Bog is to cut stems within 4" of the ground and treat the cut stumps with herbicide. While basal-bark treatments are effective for killing GB, and in some situations require less labor than cut-stump treatments, we have found basal-bark treatment to use substantially more herbicide and to not be selective enough to protect the dense growth of desirable native species in the wetland. We use Triclopyr herbicide in an agricultural oil carrier because we have achieved more consistent kill rates with that treatment than with Glyphosate. Additionally, because much of this work is best accomplished in the winter, the Triclopyr in oil has the added advantage of not freezing as would the Glyphosate in water.

The GB control work is most easily done in remote parts of the wetland in the winter when the Bog is frozen. Winter treatment also minimizes any potential for collateral damage to native vegetation from the herbicide application. Control work on the project when the Bog is not frozen will be done by the PM, PTFA, and FOCB volunteers, including urban youth experiential learning opportunities through a collaboration with the UEC, in the more accessible parts of the project area (e.g. those parts of the Bog that are most easily reached by the UWMFS boardwalk to the center of the Bog, areas at the wetland margin, and areas at the extreme southern end of the Bog near Mud Lake).

All paid and volunteer workers engaged in this project will be given extensive training on very selective application of the cut-and-treat methods by the PM before they work in the Bog in order to ensure correct identification and that herbicide is used carefully. Volunteers will need to sign the Wisconsin State "Volunteer Stewards Agreement" and documentation that indicates that they have been given and understand training in herbicide application. The PM will supervise and monitor the work by other staff and volunteers to make sure that they are using appropriate methods.

Based on our past experience controlling GB in the Cedarburg Bog, this project will provide sufficient funding to clear fruiting-sized GB from 680 of the wetland. We have already completed an initial clearing of fruiting-sized buckthorn from 212 acres in the past four years, so this project will increase the controlled acreage in the Cedarburg Bog "wilderness" to 892 acres. Our strategy, which will be continued through this project, is to remove buckthorn from the best examples of all the major plant communities contained in the Bog that currently have the lowest levels of existing buckthorn infestation. The rationale for this approach is to minimize the impact of GB in examples of the Bog's plant communities in areas that, up to now, have been least impacted by GB. Many of these least-impacted areas are concentrated at the northern end of the Bog where we have already cleared 212 acres. Most of the 680 acres to be cleared during this project will be contiguous with that cleared area, but some work areas will be located farther south in the Bog to represent all the best examples of the wetland's plant communities. All areas where we work will be blocks of at least 40 acres in size to minimize the number of separate areas for continuation of follow-up control in the future.

Enhance organizational capacity:

To continue protection of the Cedarburg Bog beyond the project period, will develop an Invasive Control Sustainment Plan in coordination with our stewardship partners, including UWMFS and the WDNR. This plan will provide the roadmap for the continued protection of the bog beyond the grant period. It will include an overall assessment of invasive control goals and strategies to accomplish them, detailed maps of buckthorn densities and controlled areas, expected costs, funding strategies, and potential sources of that funding and specific approach strategies, define the roles of engaged and potential partners, establish timelines and schedules required to efficiently continue the protection of this wetland while maintaining already controlled areas. This plan will be useful as a model for similar protection projects.

Project Outputs:

1) Protection of 680 acres of native plant communities in the Cedarburg Bog State Natural Area by removal of fruiting-sized glossy buckthorn. Acreage cleared will be measured by obtaining daily coordinates of the boundaries of areas cleared with a GPS. The project will be successful when over 90% of all fruiting-sized stems are cut and treated from 680 acres in the Bog. We will periodically sample the cleared areas to ensure that at least 90% of the stems are detected and cut. This sampling protocol is described below.
2) An Invasives Control Sustainment Plan to guide continued protection of the Cedarburg Bog beyond the grant program.

Project Outcomes:

1) Protection of a vital reference Great Lake watershed wetland from its invasive plant threat.
2) Protection of an important headwaters wetland for the Lake Michigan Watershed.
3) A well-documented example of how to manage an invasive plant in a Lake Michigan wetland that can accelerate similar programs around the Great Lakes.

A7. Data Quality Objectives

The compilation of invasive plant management records will meet or exceed any standards set by the Wisconsin Department of Agriculture Trade & Consumer Protection's ATCP 29: Pesticide Use and Control (http://datcp.wi.gov/Plants/Pesticides/ATCP_29/). In order for management data to be comparable over time, particularly regarding the acres treated and the effort of management, the PM will use standardized field forms (see Appendix B). Those forms, completed for each work day, will provide a consistent method of tracking the acreage managed by the field staff.

The information recorded daily on field forms will be transcribed to a Microsoft Excel file for summary and storage of data pertaining to acreage and location of areas cleared, and the person-hour time cost of that work (Appendix B). We will note if any precipitation fell during the work session, and depth of snow cover to 5 centimeters. Any more detailed observations of weather conditions or temperature are not necessary since the Field Station maintains a digital weather station to US Weather Service standards (http://www4.uwm.edu/fieldstation/) and those records will be available for the project. Start and end times of the work session will be recorded to within 5 minutes as will an estimate of the total time spent traveling to and from the work area (which can be substantial in remote parts of the wetland).

The Project Manager is responsible for complete and accurate records on field forms, and for entering those data into the field work log spreadsheet. During the first 3 months of the project the Project Director will review the field forms weekly to ensure that the data recorded are complete and correct. For example, an error in a recoded coordinate of the work area will almost always map as a work area that is obviously incorrect. After the first three months of the project the Project Director and Manager will have clearly established the expectations for completeness and accuracy of work records and the Project Director will review field forms monthly thereafter. The Project's Director and Manager will recruit and train a volunteer to proof-read entry of the field form data into the field work log.

Areas worked each day will be rectangular and the coordinates of either the northern and southern, or eastern and western boundaries of the work area will be determined with the project GIS before work begins. We have a great deal of experience using this method of establishing our work areas with a GPS in the remote, relatively featureless, parts of the Cedarburg Bog. Workers move back and forth either in a north-south or east-west direction removing all fruiting-sized GB within strips or transects of set width. The width of that cleared transect is approximately 8 meters for each crew member working. For example, if the work is progressing from east to west within a rectangular area bounded by northern and southern latitudes set before the work session, then the work might start at that set northern latitude and move south until the set southern latitude is reached, following a line having a constant longitude along the transect (Appendix C). This line is normally followed using a compass rather than the GPS. Once the southern line is reached the work party moves a set distance west along that southern boundary to a new longitudinal line. Then the work progresses north along that longitudinal line until the northern latitudinal boundary is again reached. Buckthorn is dense enough in almost all of the Bog that it is also pretty easy to "see where you have been" where the current transect strip meets the one that has been completed.

At the end of the work session an area is cleared that has a uniform northern and southern latitude and extends east and west from the starting (eastern) longitude to the ending (western) longitude. By recording only two latitudes and two longitudes with the GPS in the field, the area cleared can be mapped and calculated with accuracy. This process of clearing strips, north to south, south to north, continually progressing east to west, is continued throughout the work session, and from day to day until a large, map-able, rectangular area has been cleared. It is simple for the work crew to resume work exactly where the work was halted in a previous session by navigating to the known GPS coordinate and finding the edge of the previously cut area. The summary over an extended period of 100 worker-hours or longer provides records of area cleared that will be accurate to within 5% and person-hours worked per acre cleared that will be accurate to within 5%.

The purpose of the field form is to record data daily so that they can be entered in the permanent record for the project. Permanent records will be kept in an Excel file. The format of that file (with some fabricated example data) is shown as an appendix to this document. Derived variables (e.g. person-hours/acre) will be calculated in Excel as in the example in the appendix. The coordinates of the work areas will be entered into the project GIS, which will be used to calculate the areas cleared. The most important data associated with this project is the coordinates of the areas cleared. Any errors in recording or transcribing those coordinates will

be immediately apparent when they are plotted on the GIS since an error would result in plotted areas that were not rectangular, that overlapped other areas, or that were of unreasonable size and out-of-range given the person-hours of labor. In addition all data transcription from field forms into the field work log data file will be proof-read by a trained a volunteer.

A summary of these field forms over time will provide at a minimum, GIS-produced hardcopy maps with labeled GB management sites, and consistent reporting of effort and materials used in specific areas. GPS boundary points will generate polygon area locations for each labeled management site, and will be accurate to within less than 10 meters (the minimum accuracy will follow the EPA National Geospatial Data Policy's Geospatial Accuracy Tier 4). Data source will include Projected Coordinate System: NAD 1983 HARN Transverse Mercator; Geographic Coordinate System: GCS North American 1983 HARN; Datum: D North American 1983 HARN.

The PM is an accomplished field botanist. GB is a very distinctive plant with several characteristics that absolutely and unequivocally distinguish it from any other shrub or tree that grows in the Cedarburg Bog (http://mnfi.anr.msu.edu/invasive-species/GlossyBuckthornBCP.pdf). The PM will train her field crews to identify GB with absolute certainty based on several characteristics that distinguish it either with or without leaves. The PM will monitor new crew members to ensure that they have learned to identify GB with 100% accuracy. Despite that ability to be able to be 100% sure of whether any given stem is GB, it is unavoidable that when working in dense vegetation an occasional non-target stem is cut. The PM will inspect the work of her crew members daily to ensure that they are not cutting an excessive number of non-target species. The PM will closely supervise all crew members until each crew member demonstrates competence in distinguishing buckthorn from all other woody species in the Bog.

We have extensive experience with this work and know that when a worker cuts the wrong species he or she knows immediately that they have done that because no other species in the Bog has yellow and orange colored wood similar to GB. Non-target stems that are cut and not herbicide-treated and all shrubby species that grow in the Bog are capable of sprouting from the stump, so cutting does not actually kill the individual. We require the crew members to count and report the number of non-target species they cut over the course of the work session. The purpose of having crew members count the number of stems other than buckthorn cut over the course of a work session is to ensure that the worker self-identifies any problems he/she is having with distinguishing buckhorn from other woody species. This number is normally in the single digits over an entire work day during which hundreds of GB stems are cut and poisoned. If a crew member is cutting more than 10 non-target stems during a work session the PM will work with him/her to ensure that the plants are more carefully examined before cutting and that accuracy of identification is improved to meet the goal.

A second component of field-work accuracy is the percentage of all fruiting-sized GB within the work area that are detected, cut, and treated with herbicide. Of course, our impossible-to-achieve goal will be 100% detection and treatment. Our minimum standard for the percentage of fruiting-sized stems that are detected and treated will be 90%. In previous work in the Bog we have found that we can consistently meet or exceed that standard.

Most work sites are divided into 20-acre blocks using the GIS, as a way to organize the work and complete areas in tractable units. As a practical matter, when possible, the 20-acre blocks are ¼ mile long and 1/8 mile wide. We have found that 1/8 mile (660 ft., approximately 200 m) is a good working length for the search and removal crew transect passes. As described above, for each of these rectangular work areas the crews removing buckthorn would have worked (i.e. walked their transects) in either a North-South or East-West cardinal direction.

For each 20-acre block that is completed the PM and Project Director will sample a 1,600 m2 area and count all cut GB stems, and all un-cut fruiting-sized GB stems in order to calculate the percentage of fruiting-sized GB that were detected and killed. This area will be sampled as a belt transect(s) 4m wide x 400 m long, which the Project Director has used in the past for similar surveys of GB removal work. The 400 m of belt transect(s) will be oriented perpendicular to the direction that the crews moved in their removal transects. If the 20-acre unit is a standard ¼ x 1/8 mile, then the 400 m of transect will be oriented down the center of the long axis of the rectangle. Any 20-acre units that are found not to have reached the 90% removal goal will receive another removal pass by the work crew to cut and kill more fruiting sized stems.

The PM will conduct frequent inspections of treated areas to ensure that our accuracy goals for both identification and detection/treatment are maintained. All aspects of field work, including location data and removal rates will be randomly spot checked by the Project Director. The PM will discuss any accuracy issues with the Project Director and problems will be rectified immediately.

The PM and field staff will be responsible for the completeness and accuracy of treatment records and maps. As described above, any collection or transcription errors with the work area coordinates will be immediately apparent when they are added to the GIS database and will be correct immediately by relocating those points in the field. Photo vouchers will be collected primarily just to document and photographically describe control methods, the work of crews in the field, and working conditions, for use in describing the program in publications and on the website, etc. The digital photos will be labeled for location and date and hyperlinked to the corresponding locations in the GIS database. GPS files will be downloaded and validated in ESRI ArcGIS software, and will be labeled with site location, date of management activities, and these labeled areas will be associated with data on weather conditions, names of crew members, time spent traveling to and from the work area, and time spent clearing GB.

A8. Special Training Requirements/Certification

A state permit is required to conduct this project in the State Natural Area. WDNR has committed the State Natural Area Manager's assistance in the completion and approval of these requirements. These requirements have been met before in previous Bog control projects and will not be an impediment to the project.

All paid and volunteer workers engaged in this project will be given extensive training on very selective application of the cut-and-treat methods by the PM before they work in the Bog in order to ensure correct identification and that herbicide is used carefully. Volunteers will need to

sign the Wisconsin State "Volunteer Stewards Agreement" and the herbicide training documentation. The PM will supervise and monitor the work by field staff and volunteers to make sure that they are using appropriate methods.

A9. Documentation and records

The records to be kept to meet the project goals include the following:

1. Lists of mapped and labeled GB management areas treated during this project.
2. Geospatial data in the form of hard-copy maps and ArcGIS shapefiles of polygons showing the areas searched and treated for GB.
3. GB management field records of efforts by paid and volunteer field staff including spreadsheets of acres checked and treated, and hours spent on GB management.
4. Records of equipment and material purchases for the GB management and all financial payments made with grant monies
5. Copies of publicity and public outreach materials developed for the project.
6. Summaries of the educational programs, control workshops, and written plans.

Hard (paper) copies of field records will be compiled by the PM, and the original versions will be managed and archived by the FOCB at the UWMFS. Hard-copy maps and electronic spreadsheets in Microsoft Excel format of the data to be reported by FOCB (date of work sessions, person-hours worked, coordinates of daily work sites, and calculated acres searched and treated, see Appendix B) will be compiled by the PM. Geospatial shapefiles will be compiled into a single map. The attributes for the point and polygon shapefiles will be determined by the PM and Project Director. A common template for the shapefiles and spreadsheets will help ensure accurate reporting.

This project is neither designed nor intended to be a geospatial project. The collection of point or polygon data allows for efficient relocation of treatment sites, as well as comparison of treatment costs per acre.

SECTION B: DATA GENERATION OR ACQUISITION

B1. Rationales and Methods for Data Collection or Use

This project is focused on buckthorn removal, rather than on ecological condition monitoring or geospatial modeling. The data collected for GB population locations, management efforts, and collaborative projects will center on the accomplishment of the objectives for the project, and for the reporting requirements for herbicide applications and other land management activities.

Results of the GB removal efforts, private landowner and public education programs, and sustainability planning activities will be compiled into annual reports to be distributed to EPA and the wider community in the Great Lakes watershed.

B5. Quality Control Requirements/Data Management

Quality control requirements for this project include meeting all applicable Wisconsin state regulations for pesticide certification, training, and for all pertinent federal regulations. In Wisconsin, pesticide uses in natural areas are addressed under Administrative Rule ATCP 29.

Summary data from the outputs listed in Section A6 will be entered into spreadsheets by the PM, and verified by the Project Director. A trained volunteer will proof-read all of the data for transcription errors, consistency, completeness, and conformance to the project procedures. This review will ensure that the data forms are complete and that the data are accurately entered to be summarized. The Project Director will review the summary of field work records (acres and location of areas cleared over time and worker-hours per area cleared) and will verify that those summary statistics are accurately calculated over appropriate time periods.

As described previously, because the data for this project is geospatial any errors in coordinate recording or transcription will be immediately apparent when the data is plotted/mapped in the GIS. Hard copies of the work products described Section A6 will be permanently filed with the FOCB in the UWMFS office and will be distributed to all project partners. Electronic copies of all reports and data sheets will be archived on UWMFS cloud-based server and distributed to the project partners.

The supervision of field crews will ensure that management records are timely and accurate, including daily work record forms and maps showing areas searched and areas treated. The original records will be archived by FOCB at the UWMFS and copies or summaries of the information will be compiled in spreadsheets or a database maintained by FOCB staff. Electronic copies of the records and any reports generated from them will be backed up onto the UWMFS cloud-based server and removable storage media, such as compact disc or flash drives.

B6, B7, B8. Instrument Testing, Maintenance and Calibration; Inspection of Supplies

The PM and Field Staff will be responsible for applying herbicide as a part of the project work activities. The PM will oversee all aspects of safe herbicide use. According to the State of Wisconsin law, herbicide may only be applied according to label directions. The PM will be required, as specified by State of Wisconsin law, to apply herbicide with strict adherence to label directions. This includes using herbicides by their expiration date. It is outside of the project's budget, and the technical ability and resources of FOCB volunteers and staff members to test, analyze or evaluate the quality of herbicide used in the GB control activities. However, FOCB will purchase all herbicides via a qualified and reputable vendor.

B9. Data Acquisition Requirements / Benefits of Previous Experience with this Work

This GB control is a continuation of the efforts employed from 2011 to date by FOCB and partners WDNR, UWMFS, NRF, and SEWISC. Those efforts have resulted in 212 acres of protected native wetland plant communities to date. Through this work we have gained valuable experience in the efficient and effective management of a large-scale control effort for buckthorn

in the wetland. This project will control invasive species across a larger landscape, using individuals specifically hired/trained to carry out the work, and learning/adapting our methodology along the way, with the ultimate hope that this unique approach can become a template that can be adapted and used for targeted buckthorn control efforts across other similar areas within the Lake Michigan Watershed.

SECTION C: ASSESSMENT AND OVERSIGHT

C1. Assessment and Response

The PM and Field Staff must follow all State of Wisconsin protocols when using chainsaws and applying herbicide. Audits of these activities is not necessary as these procedures have been used for decades and are protocols that the field staff must follow in order to perform these activities. All field staff members will be checked in the field by the Project Director to ensure they have the experience to perform all the activities. It is outside the power of FOCB QA Project Officer to change State Law or change protocols as required by the owner of the land, the State of Wisconsin. The overall work will be checked each month to ensure GB is identified correctly and treated with herbicide.

The electronic database with all monitoring data, progress reports and treatment site notes will be stored on the UWMFS cloud based server which is backed up automatically. Project Director is responsible for any corrective actions as needed. The aim of this project is to remove fruiting-sized buckthorn from 680 acres of a large wilderness wetland. The Project Director will keep that focus in mind when directing his project manager and field crews. The data will also be delivered to at least one project partner for archival purposes, see section A9.

C2. Reports to Management

In accordance with the grant agreement, FOCB will submit the following reports to the EPA Project Officer or relevant federal agency as required by the assistance agreement notice:

- Quarterly reports to the GLAS system
- Semi-annual reports to EPA Project Officer
- Final Project Report, including spreadsheet of acres managed, number of workers, and hours spent on management.
- Geospatial data including latitude and longitude of work locations and data described in Section A7. The data will be submitted in electronic format, including GIS shapefiles and maps.

In addition, the Project Director will evaluate work activities completed by the PM and Field Staff and include this information in the quarterly, semi-annual and final reports. Any data quality issues or significant QA/QC problems will be identified and discussed in the quarterly, semi-annual and final reports.

SECTION D: DATA VALIDATION AND USABILITY

D1, D2. Data Review, Validation, Verification

Summary data from the outputs listed in Section A6 will be entered into spreadsheets by the PM and verified by the Project Director. The criteria for accepting, rejecting, or qualifying the data will include the following elements:

1. Maps of management areas will be named consistently with work dates and accomplishments on the report forms, electronic attribute tables, and other references.
2. Acreage of management sites will be calculated using standard electronic means, such as the Calculate Geometry Tool in ArcGIS.
3. Maps will be spot-checked by Project Director who is familiar with the management sites to ensure that the areas marked are the areas named.
4. Management records, especially herbicide application records, will be checked by the PM for completeness on the data sheets and in the electronic records entered from them.

Data which is incomplete or which cannot be independently verified will be noted in project reports, with accompanying comments about the need for further review or field checks. Any data that cannot be verified will be excluded from any summary tallies or calculations included in reports and that missing data, should any exist, will be noted. The PM will be responsible for validating the accuracy of any maps compiled for the project reports, and data entry errors or quality control issues will be discussed and addressed by the Project Director before the issuance of final reports.

D3. Reconciliation with Data Quality Objectives

It is not the intention or claim of the monitoring data to accurately represent site conditions across the entire project site. Rather, the data will provide a quantitative measure of the GB control activities conducted at the site over the course of the project.

The project will have met our data quality objectives when we have the following:

1. Accurate maps and a list of GB managed sites covering the 680-acre target treatment area including number of hours worked at each site.
2. Geospatial project files containing those GB managed areas and work site attributes.
3. Purchase records, inventories, and supplies for invasive plant removal.
4. Trained volunteers who can identify and remove invasive plants from natural habitats.
5. A template that can be adapted and used for targeted buckthorn control efforts across other similar areas within the Lake Michigan Watershed.

APPENDIX A

Project Phases and Estimated Project Schedule

Major work phases:

- 2-year Project funding period begins – 1 APR 2015
- Project approval and initial mobilization (1 FEB 2015 - 10 APR 2015)
- Phase 1 Field Work (10 APR 2015 – 31 MAR 2016)

- Landowner Outreach and Education Program (LOEP) (JUN 2015 – FEB 2017)
- Phase 2 Field Work (1 APR 2016 – 28 FEB 2017)
- Invasives Control Sustainment Plan (ICSP) (APR 2015 –FEB 2017)
- Workshops: Wetlands and Invasives Control (MAY 2015 – JAN 2017)
- Reporting and clean-up (MAR - JUL 2017)

Estimated Project Schedule:

Milestone Date	***Responsible party***	***Action to be completed***
1 February 2015	FOCB	Complete / approve job description and commence 30-day solicitation period for 1 FTE Project Manager
12 March 2015	FOCB	Submit Initial QAPP to GLNPO QA Team
23 March 2015	GLNPO QA Team	Review Initial QAPP and provide feedback to FOCB
31 March 2015	GLNPO	Approve Project and authorize funding
5 May 2015	FOCB	Update and submit Revised QAPP
30 May 2015	GLNPO QA Team	Approve Revised QAPP
10 April 2015	FOCB	Hire Project Manager
April – August 2015	PM	• Orientation and plan refinement with Stewardship Committee • Purchase required supplies • Ensure quality management expectations of grant are built into Phase 1 Action Plan • Orient to the Bog • Contact adjacent landowners and gain permission for crews to access the Bog across private land for control work. • Draft Landowner Outreach and Education Program (LOEP) and submit to FOCB Stewardship & Education Chairpersons • Organize and conduct 4 Volunteer work days (160 volunteer hours = 10 acres cleared) • Spend a minimum of 200 hours (25% of time) controlling buckthorn • Interview, select, and hire a Part-time Field Assistant to control buckthorn.
1 May 2015	FOCB	Approve Phase 1 Action Plan (including Volunteer effort)
15 May 2015	Project Director	Design Workshops for Invasive Control Methods and Inland Great Lakes Wetlands
1 June 2015	WDNR	Field Work Permits Approved
15 June 2015	FOCB	Approve LOEP
15 June 2015	FOCB	Approve Urban Ecology Center partnering plan
30 June 2015	PM	Submit online quarterly report to GLNPO GLAS
1 July 2015	PM	Hire Part-time Field Assistant
1 August 2015	PM & Com. Chairs	Implement LOEP
Milestone Date	***Responsible party***	***Action to be completed***
September 2015	Project Director	Conduct one-day workshop on Invasive Control Methods
30 September 2015	PM	Submit online quarterly report to GLNPO GLAS
Sept. – October 2015	PM	Spend a minimum of 300 hours controlling buckthorn
15 October 2015	Grant Administrator	1st employee performance review (for PM)
30 October 2015	PM	Submit Semi-annual Progress Report to GLNPO
Sept. – November 2015	PTFA	Full-time (est. 400 hrs. accounting for weather) controlling buckthorn in the Bog under supervision of Project Manager

1 November 2015	PM & Committee Chairs	Implement LOEP
November 2015	PM	Interview Seasonal applicants for winter work
27 November 2015	PM	Select and hire Winter Seasonal field staff
1 December 2015	PM, Field Staff & Volunteers	Goal = 80 acres cleared by this date (900 person hours worked / 13 hours/acre) + (10 acres cleared with volunteers)
30 Nov. – 4 Dec 2015	PM	Winter Seasonal Field staff orientation, training, & control work
15 December 2015	Stewardship Co. Chair	Develop ICSP
31 December 2015	PM	Submit online quarterly report to GLNPO GLAS
Dec 2015 – Feb. 2016	PM & Field Staff	Phase 1 Winter Control work. Estimate 300 acres to be cleared.
26 February 2016	PM	Winter Seasonal field staff released
31 March 2016	PM	Submit online quarterly report to GLNPO GLAS
31 March 2016	Grant Administrator	2nd employee performance review (for PM)
2 April 2016	PM	Phase 1 control report completed and submitted to FOCB Stewardship Chair, (which includes recommendations for implementing changes/improvements = Phase 2 Control Action Plan)
2 April 2016	Educ. Com. Chair	Develop Educational Materials
12 April 2016	PM	ICSP Draft submitted to FOCB Committee chairs
30 April 2016	PM	Submit Semi-annual Progress Report to GLNPO
May 2016	PM & Project Director	Hold one-day workshop on Wetlands importance to Great Lakes Watershed
2 May 2016	Stewardship Co. Chair	Approve PH 1 Control report (which contains Phase 2 Control Action Plan)
April – August 2016	PM	• Purchase required supplies • Organize and conduct 6 Volunteer work days (240 volunteer hours = 15 acres cleared) • Spend a minimum of 400 hours (50% of time) controlling buckthorn Interview, select, and hire a Part-time Field Assistant to control buckthorn.
10 June 2016	Educ. Com. Chair	Develop interpretive materials
30 June 2016	PM	• Submit online quarterly report to GLNPO GLAS
September 2016	Project Director	Hold Invasive Control Workshop
30 September 2016	PM	Submit online quarterly report to GLNPO GLAS
1 October 2016	Grant Administrator	3rd employee performance review (for PM)
31 October 2016	PM	Submit Semi-annual Progress Report to GLNPO
November 2016	PM	Interview Winter Seasonal applicants for winter work
1 November 2016	PM	Submit Interpretive Materials draft to FOCB Ed Chair
25 November 2016	PM	Select and hire Winter Seasonal field staff
28 Nov – 2 Dec 2016	PM	Field staff orientation, training, & control work
Nov 2016 -15 Feb 2017	PM	Develop Invasives Control Sustainment Plan (ICSP) and submit to FOCB Committee chairs for approval
1 December 2016	PM, Field Staff & Volunteers	Goal = 425 acres cleared by this date (80 previously + 300 Phase 1 Winter work + 30 acres by PM April-August 2016 + 15 acres with volunteers)
Milestone Date	***Responsible party***	***Action to be completed***
Dec 2016 – Feb 2017	PM & Field Staff	Phase 2 Winter Control work. Estimate 255 acres to be cleared.
1 February 2017	PM	LOEP evaluation report submitted to FOCB chairs for review
15 February 2017	Stewardship Co. Chair	Approve final ICSP
28 February 2017	PM	Seasonal Field Staff released

15 March 2017	PM	Submit draft GLRI Final report for FOCB Grant Manager
31 March 2017	FOCB	PROJECT COMPLETED – 680 acres cleared of buckthorn
15 May 2017	PM	Submit Draft Final Project Technical Report to GLNPO
1 June 2017	GLNPO	Provide feedback on Draft Final Technical Report
30 June 2017	PM	Final Technical Report submitted to GLNPO

APPENDIX B

Cedarburg Bog GLRI Buckthorn Project - Daily Field Work Log									
					GPS boundaries (N-S & E-W) **Area Cleared**				
Date	Names of workers	Start hr/min	End hr/min	Travel hr/min	**N** Lat. (43.12345)	**S** Lat. (43.12345)	**E** Long. (-8x.12345)	**W** Long. (-8x.12345)	Dens. 1 - 4
		Weather, notes:							
		Weather, notes:							
		Weather, notes:							
		Weather, notes:							
		Weather, notes:							
		Weather, notes:							
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		Weather, notes:							
		Weather, notes:							
		Weather, notes:							
		Weather, notes:							
		Weather, notes:							

Cedarburg Bog GLRI Buckthorn Project Work Log - Crew member names and weather notes are kept on the daily paper data forms and are maintained in the project file.

Date	# Crew	# Paid	# Vol.	Start Time	End Time	Est. Travel	Hours	Person Hours	N Latitude	S Latitude	E Longitude	W Longitude	Calc. Acres	Hours:Min. per Acre
4/3/15	1	1	0	8:00	16:30	0:30	8:00:00	8:00:00	43.4003	43.3985	87.9956	87.9965	0.73	10:57:32
4/4/15	2	2	0	8:00	16:30	0:35	7:55:00	15:50:00	43.4003	43.3985	87.9965	87.9975	1.20	13:11:40
4/5/15	3	3	0	9:30	14:30	0:10	4:50:00	14:30:00	43.4003	43.3985	87.9975	87.9985	1.35	10:44:27
4/6/15	7	7	0	7:00	13:30	1:05	5:25:00	37:55:00	43.4003	43.3985	87.9985	87.9995	3.47	10:55:37
4/7/15	2	2	0	7:15	16:20	0:20	8:45:00	17:30:00	43.4003	43.3985	87.9995	88.0006	1.10	15:54:33
Totals								93:45:00					7.85	
Average														12:20:46

APPENDIX C


Previously
Cleared
Longitude session beginning
Longitude session end
Pre-set Northern Latitude