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I. Introduction

Purpose and Use of This Management Plan

The purpose of this plan is to present the results of a natural resource inventory and to provide recommendations and a plan for managing the city owned bluff lands along Saint Paul's East River Road in an ecologically sound, socially acceptable, and economically feasible manner. The plan includes recommendations regarding the roles of a variety of organizations and volunteers in carrying out the management plan.

History of the Mississippi Bluffs Management Project and LCMR grant

The Friends of the Parks and Trails of St. Paul and Ramsey County and the City of Saint Paul created a partnership to improve the ecological health of the Mississippi River Bluffs from Emerald Street to Highway 5. The Friends developed the Mississippi Bluffs Management Project, and sought state funding to support this effort. The Project was funded with a Legislative Commission on Minnesota Resources (LCMR) grant from the State of Minnesota. The work under this grant began in July 1999.

The partners understood that appearances could be deceiving. Although the view along Mississippi River Boulevard was spectacular to the untrained eye, invasive exotic plants, such as European buckthorn and Tartarian honeysuckle, had entered the bluff's ecosystem. The invasive species were overwhelming and displacing native species, and reducing the quality and function of the native communities. The Bluffs Management Project has focused on restoring the bluffs through the eradication of exotic flora by cutting, digging, careful and conservative use of herbicides, and prescribed burning. The management plan also includes replanting native vegetation and long-term management practices were identified to enable the native species to out-compete exotic species.

Community volunteers participated in removal of exotic vegetation and homeowners adjacent to the bluff natural area were encouraged to adopt volunteer conservation practices to use on their private property near the bluff. As part of the grant, a concerted public education process was employed to help the public understand the problem, the process and the purpose of the work.

Public education activities included the following:

- Brochures delivered at meetings and through local newspapers
- Local newspaper articles
- City-wide newspaper articles
- Presentations at local community meetings
- Volunteer events

This management plan provides baseline data about the conditions of the bluffs. This data was gathered in field inventories and mapped at the start of the project. It also documents project restoration activities, and provides a long-term management plan to ensure that these efforts will continue to improve and maintain the health of the bluffs in the future.

About The Management Plan

There is much current interest, community support, and volunteer activity related to the Mississippi Bluffs along East River Road. This long-term natural resource management plan was developed to enhance the capacity of the city and its partners to restore the bluffs area to a healthy condition. It will help to guide and coordinate the activities of interested groups to make the best use of available resources. This management plan is based on ecological science, integrated with the social consideration of the site. The plan will help to guide current management activities to help achieve the goals for the bluffs ecosystem. This document is meant to be adaptive, and is based on the best information of the current and historic conditions of the site. As the plan is implemented and additional information becomes available, the plan may be refined or revised, based on the new information.

The first step in developing the management plan was a comprehensive ecological inventory of the site's current and historic conditions. This data was the basis for developing the management plan and recommendations specific to the site.

The inventory and management plan will help the City and its partners:

- Identify specific problems and issues of the project area
- Prioritize areas for management
- Match management methods to the conditions on the site
- Estimate the costs of management and resources needed to complete the management tasks
- Provide a basis for monitoring progress.

II. Goals for Managing the Mississippi Bluffs

Project Goals

The goals for managing the bluffs in the project area are based on input from the St. Paul Division of Parks and Recreation natural resource managers, the Friends of the Parks and Trails of Saint Paul and Ramsey County, and consulting ecologists. The goals include the following:

1. Protect and enhance the native biodiversity of the area to achieve the fullest possible ecological restoration of plant communities over the long-term, similar to those that occurred in the project area at the time of Euroamerican settlement.

[The plant communities identified at settlement in the bluffs area include Oak Forest (mesic subtype), Maple-Basswood Forest, Floodplain Forest, and Dry Prairies. *Minnesota's St. Croix River Valley and Anoka Sandplain* (Minnesota DNR, 1995) provides descriptions and species lists for each of these plant communities in the Metro Area. This information may be used as a guide for ecological restoration of plant communities on the bluffs. Existing remnants of these communities are described on Figure 3 and associated text in the Appendices.]

2. Control woody exotic and invasive species within the project area. These include buckthorn, Tartarian honeysuckle, Russian olive, Siberian elm, and Amur maple. Control the spread of boxelder by removing young plants (1" dbh and smaller).
3. Restore native shrub and herbaceous communities through replanting.
4. Control erosion caused by running water, foot traffic, and lack of vegetation.
5. Work with surrounding neighborhoods to control populations of exotic and invasive plant species on private property.
6. Educate the community about the bluffs ecosystem, and proposed management activities.
7. Involve volunteers appropriately in ongoing management efforts.

Ecological Basis for the Management Goals

This management plan suggests that the park's natural resources be managed on an ecosystem basis. The blufflands ecosystem is the interacting group of plants, animals (including humans), and physical elements (slope, soil, climate, water) that occur at the site. All of these elements, and their interactions, need to be considered in developing goals for managing the blufflands.

An ecosystem approach to management acknowledges that people are part of the natural system and that maintaining a healthy and diverse ecosystem is the best way to meet the needs of park users as well as those of all the other organisms living on the site. Managing on an ecosystem basis integrates current scientific knowledge with human values towards a general goal of protecting the health of the ecosystem for the long term. Following are general principles that the partnership has agreed will guide us as stewards of the blufflands.

1. **Our management efforts should protect or enhance the health of the bluffland ecosystem and the native biological diversity of its habitats.** This means giving first priority to protecting and restoring high quality natural areas, along with the ecological process needed to maintain that quality. Once high quality areas are protected, attention should be given towards buffering and connecting these areas and restoring lower priority areas.

The health and survival of native plants and animals are emphasized in this plan because they form communities that have evolved together for thousands of years, and are particularly suited to surviving and thriving on the East River Road bluffs. Over the long term, native communities will maintain a healthy system that can adapt to disease, drought, flood, fire, wind, and other natural disturbances. In the long run, these communities should require less of our efforts to maintain and manage than degraded or exotic communities. These native communities offer us a varied and interesting environment and opportunities to learn about our natural heritage. Finally, high quality natural areas are increasingly rare worldwide. They are worth protecting because they are rare and are difficult, in some cases impossible, to restore. The longer they are protected the more valuable they will become.

2. **Planning should recognize that species are interdependent.** Individual plant and animal species in a community depend on each other for survival. Many of the inter-species relationships and processes within native communities are still little understood, so “saving all the parts” of a community ensures long-term viability and should be a priority of management goals.
3. **Planning should acknowledge that people are part of nature.** The actions of humans have been influencing the river valley for thousands of years. Prior to European settlement, American Indians burned bluff vegetation in the region to stimulate new growth and attract wild game. The values and needs of turn-of-the-century loggers, farmers, and city residents have altered the ecology of these bluffs for many years. Natural resource management strategies should consider the activities and needs of human communities in the surrounding area in developing the management plan for the bluffs.

4. **Planning should be based on ecological boundaries (not ownership) and on long time frames.** The natural communities and systems that make up East River Road blufflands have existed for thousands of years and extend across public/private property boundaries. Developing common management goals with surrounding landowners will ensure long-term health of the bluff's important natural resources. For example, efforts to control exotic species such as buckthorn in surrounding neighborhoods will benefit the bluff ecosystem, too.
5. **Management should be based on good information and monitoring.** Baseline assessments of natural communities and their species are critical to evaluating the condition of the bluffland's natural resources and determining appropriate management strategies. Management is a learning experience and should be modified as new information becomes available. Ongoing monitoring is critical to success.
6. **Exotic species should be excluded, if possible, or carefully controlled.** Introduction of exotic species can reduce native diversity, the quality of habitat, and the general health of the park's natural resources. Therefore, exotics should be excluded or controlled.
7. **Management should be based on cooperative efforts.** Besides the City of Saint Paul there are many other interested persons, organizations, and agencies that can and do have an impact on the park's natural resources. Decisions made by surrounding landowners and agencies affect the blufflands. For example, planting of undesirable invasive, exotic species by neighbors leads to invasion and degradation of adjacent city-owned natural areas. Critical area designation by the State of Minnesota limits management options. Activity by the Ford Motor Company, the major private owner of bluffland, can impact the integrity and connectivity of a contiguous natural area. Therefore, management plans should not be developed in isolation.

III. Project Area and Organization

The Project Area and Its Seven Priority and Secondary Areas

The Mississippi River Bluff project area extends from the river's edge to the top of the bluff, from Emerald Street to Highway 5. There are two property owners in the project area: the City of Saint Paul (Division of Parks and Recreation) and the Ford Motor Company. The Ford Motor Company property is the only area within the project boundaries that was not included in the initial buckthorn removal activities completed during years 2000-2001. The project area is divided into seven priority and secondary areas based on key geographic features and prioritization of restoration work. Priority areas will have restoration work done first, secondary areas will have work done as time and funding permits after the completion of work in the priority areas. All areas except the Ford Plant Secondary Area are composed of City of Saint Paul property, and extend from the river's edge to the City of Saint Paul's property boundary along the bluff top. From north to south, these are the areas:

Desnoyer Park Priority Area – From Emerald Street to Marshall Avenue.

Shadow Falls Priority Area – From Marshall Avenue to Goodrich Avenue.

Goodrich to Randolph Priority Area – From Goodrich Avenue to Randolph Avenue.

Randolph to Ford Parkway Priority and Secondary Area – From Randolph Avenue to Ford Parkway. (The priority area is located along the walking path and the secondary area is below the walking path between Randolph and Ford Parkway.)

Ford Plant Secondary Area – From Ford Parkway to the Hidden Falls streambed. The Ford Motor Company owns the bluff-top edge throughout the unit, and approximately the northern half of the unit down to the river's edge.

Hidden Falls North Priority Area – From the Hidden Falls streambed to a narrow point along the bluff, approximately where Sheridan Avenue would intersect the river, if it were extended to the west. This is the narrowest point along the bluff and divides this area and Hidden Falls South Secondary Area roughly in half by acreage.

Hidden Falls South Secondary Area – Extends from the border of the Hidden Falls North Priority Area to Highway 5.

IV. Restoration and Management Plan

Management Approach

The management approach outlined in this plan is often described as “adaptive management.” The approach includes the following steps:

- Set clear goals
- Determine management actions
- Implement actions
- Monitor effectiveness of management action
- Revise management actions based on results of monitoring
- Continue monitoring, and base management actions on results identified

Management Activities Before and During the LCMR Grant Period

Management activities within the project area started at the beginning of the LCMR grant period, and were ongoing while the management plan was developed. Management activities during the LCMR grant period included control measures such as cutting large buckthorn and honeysuckle by crews in some priority areas, herbicide treatment of stumps by crews, hauling of brush by volunteers, and removal of seedlings by volunteers. Figures 10a-10C in the Appendix indicate the management activities completed during year 2000.

The management recommendations begin with activities that will occur in Fall 2001.

Management Goals

The City of St. Paul Division of Parks and Recreation will bear most of the responsibility for implementing this plan. The Division understands that a commitment to the ongoing management activities identified in this plan is critical, to ensure that the exotics-removal efforts completed under the LCMR effort in 2000-2001 have been worthwhile, and the health of the bluffs is maintained and improved. The Division may work with volunteers and other organizations to implement some aspects of the plan. The ability to fully meet the goals and carry out the management activities recommended in this plan will be dependent on the resources available to the Division of Parks and Recreation. Goals for the Management Plan include the following:

1. Protect and enhance the native biodiversity of the area to restore native plant communities similar to those that occurred in the project area at the time of Euroamerican settlement.

[Plant communities identified at settlement in the bluffs area include Oak Forest (mesic subtype), Maple-Basswood Forest, Floodplain Forest, and Dry Prairies. Minnesota’s St. Croix River Valley and Anoka Sandplain (Minnesota DNR, 1995) provides descriptions and species lists for each of these plant communities in the Metro Area. This information may be used as a guide for ecological restoration of plant communities on the bluffs. Existing remnants of these communities are described on Figure 3 and associated text in the Appendices.]

2. Control woody exotic and invasive species within the project area. These include buckthorn, Tartarian honeysuckle, Russian olive, Siberian elm, and Amur maple. Control the spread of boxelder by removing young plants (1”dbh and smaller).
3. Monitor the effects of controlling exotic species on the plant communities in the project area, to determine the capacity of existing communities to regenerate. Restore native shrub and herbaceous communities through seeding or planting if needed.
4. Minimize erosion caused by running water and foot traffic.
5. Work with surrounding neighborhoods to control populations of exotic and invasive plant species on public and private lands.
6. Educate the community about the bluffs ecosystem, and proposed management activities.
7. Involve volunteers appropriately in ongoing management efforts.

Recommended Management Activities: General Approaches

The tables that follow this section, detail specific management actions recommended for each priority and secondary area within the Bluffs project area. The City of St. Paul Division of Parks and Recreation will implement these actions. Factors such as weather conditions, community cooperation, contractors’ schedules, budgets, and other circumstances will influence the time schedule for implementation. In general, each management plan includes the following elements:

1. Remove woody exotics.

Buckthorn, Tartarian honeysuckle, Russian olive, Siberian elm, and Amur maple should be cut or pulled, and the cut stumps immediately treated with herbicide, such as Garlon™. Box elder of 1” dbh or smaller should also be removed. This work may be done by hired crews or Sentence-to-Serve crews from Ramsey County. It is often easiest to complete this task (particularly buckthorn removal) in the late fall (October to November) after a heavy freeze. Buckthorn will be the only plant with green leaves at this time, and will be easily identifiable. Other exotic shrubs may be identified throughout the year, but probably are most easily removed at the same time as buckthorn. Sentence-to-Serve crews may also be easier to schedule at this time, as there is less demand for them than in the spring and summer.

In subsequent years, volunteers or hired crews may easily pull any buckthorn seedlings. Crews should also cut and spray resprouts from stumps cut the previous year.

2. Use prescribed burns where possible to control exotic resprouting and reseedling, and to control exotic species on steep slopes.

Prescribed burns can be an efficient, economic method for controlling exotic species. Fires were a normal occurrence in the project area before European settlement, and helped to maintain the quality of oak woods and oak openings in the project area. Prescribed fire maybe the best management option available to control exotic species on the steepest slopes in the project area.

Prescribed burns should always be planned, managed, and implemented by experienced staff with training and experience in conducting prescribed burns. The use of prescribed burns will require careful coordination of all project partners, including the City's Fire Marshall. It will require communication with surrounding neighborhoods about the need for this strategy, and how it will be implemented.

This strategy could be implemented first in portions of the project area where adjoining neighborhoods are most receptive. Early successes may allow for wider implementation throughout the project area.

A number of private firms offer controlled burn services. In some communities, fire departments are willing to conduct the burn as a practice fire. In any case, the local Fire Marshall will require a burn permit, and experienced professionals should direct the burn.

Burns are often successful both in removing exotic species and in encouraging native plants to sprout.

3. Monitor the effects of the removal of exotic species on plant communities in the project area, to determine their capacity to regenerate. Seed or plant areas where exotics have been removed if needed to restore diversity or control erosion. Use appropriate mulch or erosion control blanket.

City staff should monitor areas where exotic species have been removed, to determine whether native plant communities are able to regenerate from existing seed banks when the competition from exotic species has been reduced. If needed, volunteers or work crews may hand-broadcast native seed to restore additional diversity to the project area, and establish ground cover to reduce erosion on bare areas.

New seedlings should be protected by mulch or erosion control blankets. Slopes that are 3:1 or less should be mulched with a clean grain straw or native grass mulch and disc anchored following seeding (if possible). Mulching should attempt to achieve 90% coverage of the exposed soil surface. This generally requires about 2 tons per acre of straw

mulch. Specifications should identify “a high quality weed free mulch, such as MCIA Certified Weed Free mulch or native grass (prairie) mulch”, as recommended by the Minnesota Department of Transportation for native plantings. Mulches derived from pasture hay often contain reed canary grass, smooth brome, and other exotic forage grasses and weeds. These can ruin native plantings, and are not recommended for use in this situation.

On slopes that are steeper than 3:1, the seeding should be covered by an erosion blanket, such as a straw blanket or coconut fiber blanket. Blankets should also be used on swales that will receive low to moderate water flows while the seed is becoming established. More severe situations such as very steep slopes or channels exposed to high water velocities will need more intense bioengineering methods to prevent erosion. Natural resource professionals and/or engineers with familiarity with these techniques should be consulted for site-specific analysis and design.

Native shrubs may also be planted in some areas after exotics have been removed. Shrubs may be particularly useful to control foot traffic, and to stabilize eroding slopes.

Figure 7 identifies priority areas for erosion control.

4. Control erosion on pathways and slopes.

The project area includes many informal footpaths. Some are eroding badly, particularly in areas with steep slopes. Buckthorn cuttings and brush may be piled on some of these trails to close them to foot traffic. While it may not be possible to close all informal trails, those with erosion problems should be prioritized for closing.

Brush bundles have been used in some areas to try to stop erosion from surface runoff. Other bioengineering methods may be explored to reduce erosion, and should be determined on a site-specific basis.

5. Provide information and education about management activities. Involve surrounding neighborhoods and organizations in management efforts.

Adjacent neighborhoods should be kept informed about management activities. City staff and the Friends may provide articles to local newspapers, neighborhood newsletters, and other media to increase awareness about project activities. City web sites may also be used to provide current information.

Some signage in project areas may also be helpful in educating neighbors and park users about restoration efforts. Signs should be small, used sparingly, and created in natural colors that blend with surroundings. Signs may be used to inform the public about trails that are closed, and areas that have been seeded or restored. Other restoration projects in the U.S. have found that signs that emphasize the need to stay out to “restore the health” of the area have been more effective than those that simply say “Keep Out”.

Volunteers may also be involved in some project activities. Later sections of this plan discuss options for using volunteers as a part of management efforts.

Step-by-Step Phases for Management Activities

The resource management activities described for each management area are divided into three categories, Phase I and Phase II of Recovery, and Maintenance (Phase III). Phase I includes activities, which could be considered ecological triage. These activities set the stage for the initial phases in substantial recovery of system diversity and function. Phase II includes those activities that bring the restoration site much closer to having the composition, structure and function of a pre-settlement community. The Maintenance period includes activities that perpetuate the community and continue to contribute to its quality.

The recommendations for management are based on local restoration experience and techniques used by restoration ecologists in similar communities across the Upper Midwest. Although these activities are strongly recommended, changes in management techniques in the future or monitoring results may necessitate that future management incorporates new ideas. To ensure the quality of the site, proposed changes in resource management activities should be scrutinized by a qualified natural resource manager to make sure they contribute to the overall improved quality of the site. Costs are estimated in year 2001 dollars.

Phase I: Initial Recovery Years 1 - 4

This phase of the restoration process is focused on recovering a substantial portion of the composition (species), structure, and function necessary for native communities to improve in quality.

Early restoration of the site will involve activities such as the removal of non-native trees and shrubs, reintroduction of appropriate understory species if necessary, and the application of prescribed fire where feasible. Trees and shrubs that are invasive should be removed before any seeding or burning is conducted. Burning the site prior to cut/treat of invasive species encourages some species to stump sprout, leaving the resource manager with many stems to manage where one existed prior to the burn.

Listed below are specific activities recommended to be carried out during the first five years within each of the Priority and Secondary Areas of the project area. Each activity has an associated time frame for completion that is based on how it fits in with other activities being carried out. The sequencing of related activities is especially important during this phase of ecological restoration. Alterations to sequencing should be reviewed by a qualified natural resource manager for possible impacts to the overall restoration of the site.

The sequence of activities may begin during any year. Costs were estimated based on similar projects completed during 2001.

Management Issues for Each Priority Area

- **Desnoyer Park Priority Area**
 - Control invasive exotic species in woodland and seep areas.
 - Protect and enhance spring ephemeral flora populations.
 - Control Russian olive in storm water swale.
- **Shadow Falls Priority Area**
 - Control invasive exotic species in woodland.
 - Control erosion at limestone bluff outcrops.
 - Manage exotics along turf edge of woodland.
 - Close informal trails and restore vegetation.
- **Goodrich to Randolph Priority Area**
 - Control invasive exotic species.
 - Control erosion from informal paths or close the paths.
- **Randolph to Ford Parkway Areas**
 - Control invasive exotic species.
 - Control erosion at limestone bluff outcrops.
- **Ford Plant Secondary Area**
 - Manage vegetation along turf/woodland edges.
 - Control erosion below Hidden Falls overlook.
 - Control erosion at Ford trailer parking area.
 - Stabilize banks of Hidden Falls stream.
- **Hidden Falls North Priority Area**
 - Control invasive exotic species.
 - Control erosion on ravine side slopes.
- **Hidden Falls South Area**
 - Control invasive exotic species.
 - Manage vegetation along turf/woodland edges.
 - Eradicate purple loosestrife near south entrance.
 - Remove berm along floodplain forest.

**Table 1. Phase I Restoration Activities--
Desnoyer Park Priority Area**

DATE	ACTIVITY	DESCRIPTION	ESTIMATED COST/HOURS*
Early Fall, 2001, or other years as needed	Neighborhood meetings	Hold neighborhood meeting(s) to inform/involve residents in activities. Coordinate with District Council or other neighborhood organizations.	8 hours
Fall, 2001	Invasive Tree and Shrub Removal	Cut invasive brush and tree species using hired crews with Sentence-to-Serve laborers. Invasives should be cut and stump treated with the safest herbicide known to be effective for the situation.	\$475/acre
Fall, 2001	Frost seeding	Frost/dormant seeding of species in areas where exotic species have been removed, if needed. (If some areas will be burned, seed these areas after prescribed burn is completed.)	Up to \$4,000 per acre
Fall, 2001	Buckthorn Roundup	Complete Buckthorn Roundup in Desnoyer Park Neighborhood.	\$6850
Spring, 2002	Prescribed burning	Discuss possibility of prescribed burn on steep slope areas with neighborhood and city departments. If feasible, plan and conduct prescribed burn using an experienced “burn boss”, with help of fire department, city staff, and others as needed.	\$4-5,000/burn
Spring, 2002	Seed burned areas	Broadcast native seed on burn areas within two weeks of prescribed burning, if needed. Use hired crews or volunteers with supervision.	Up to \$4,000/acre
Fall, 2002	Remove seedling exotics and treat resprouts	Use volunteers and/or hired crews to pull seedlings of exotic shrubs. Use hired crews or city staff to treat resprouts with approved herbicide	\$700/acre
Spring and Fall, 2003-2005	Site monitoring and management activities	Visit site and make notes on effectiveness of resource management activities as well as work to be performed. Repeat activities to remove resprouts and exotic species seedlings each year as needed, using volunteers or hired crews.	2-3 hours monitoring

**Table 2. Phase I Restoration Activities
Shadow Falls Priority Area**

DATE	ACTIVITY	DESCRIPTION	ESTIMATED COST/ HOURS*
Early Fall, 2001, or other years as needed	Neighborhood meetings	Hold neighborhood meeting to inform residents about management activities. Coordinate with District Council or other neighborhood organizations.	8 hours
Fall, 2001	Complete Invasive Tree and Shrub Removal	Cut invasive brush and tree species in areas where removal has not been completed, or for species not removed in Year 2000. Invasives should be cut and stumps treated with herbicide by hired crews.	\$475/acre
Fall, 2001	Frost seeding	Frost/dormant seeding of species in areas where exotic species have been removed, if needed. Seeding may be done by hired crews or volunteers with professional direction.	Up to \$4,000 per acre
Fall, 2002	Remove seeding exotics and treat resprouts	Use volunteers and/or hired crews to pull seedlings of exotic shrubs. Use hired crews to treat resprouts with approved herbicide	\$700/acre
Spring-Fall, 2003	Prairie knoll areas	Close paths on prairie knoll areas. Remove exotic species through cutting, herbicide application, and/or burning. Plant native seeds/plants, using erosion control fabric to stabilize.	\$6,000 per acre or more, depending on seed mix
Spring and Fall, 2003-2005	Site monitoring	Visit site and make notes on effectiveness of resource management activities as well as work to be performed. Repeat activities to remove resprouts or exotic seedlings as needed.	2-3 hours monitoring

**Table 3. Phase I Restoration Activities
Goodrich to Randolph Priority Area**

DATE	ACTIVITY	DESCRIPTION	ESTIMATED COST/ HOURS*
Early Fall, 2001, or other years as needed	Neighborhood meetings	Hold neighborhood meeting to inform residents about management activities. Work with District Council or other neighborhood organizations.	8 hours
Fall, 2001	Invasive Tree and Shrub Removal—complete	Cut invasive brush and tree species in areas where removal has not been completed, or for species not removed in Year 2000. Invasives should be cut and stump treated with herbicide by hired crews or City staff.	\$475/acre
Spring to Fall, 2002	Remove seedling exotics and treat resprouts	Use volunteers and/or hired crews to pull seedlings of exotic shrubs. Use hired crews to treat resprouts with approved herbicide	\$700/acre
2002-2003	Prescribed burn	Discuss possibility of prescribed burn on steep slope and buckthorn removal areas with neighborhood and city departments. If feasible, conduct prescribed burn that is planned and managed by an experienced “burn boss”, with help of fire department, city staff, and others as needed.	\$4-5,000 per burn
Spring-Fall, 2003	Trails and erosion problem sites	Close paths throughout area. Plant native seeds/plants, using erosion control fabric, brush bundles, or other bioengineering methods to stabilize eroding areas.	\$6,000 per acre or more, depending on seed mix and erosion control methods
Spring and Fall, 2003-2005	Site monitoring	Visit site and make notes on effectiveness of resource management activities as well as work to be performed. Repeat activities to remove reprints or exotic species seedlings as needed.	2-3 hours monitoring

**Table 4. Phase I Restoration Activities
Randolph to Ford Parkway
Priority and Secondary Areas**

DATE	ACTIVITY	DESCRIPTION	ESTIMATED COST/ HOURS*
Early Fall, 2001, or other years as needed	Neighborhood meetings	Hold neighborhood meeting to inform/involve residents in activities. Work with District Council or other neighborhood organizations.	8 hours
Fall, 2001	Invasive Tree and Shrub Removal	Cut invasive brush and tree species using hired crews with Sentence to Serve labor. Invasives should be cut and stump treated with herbicide by hired crews or City staff.	\$475/acre
Spring, 2002-3	Prescribed burning	Discuss possibility of prescribed burn on steep slope areas with neighborhood and city departments. If feasible, conduct prescribed burn that is planned and managed by an experienced burn boss, with the help of the fire department, city staff, and others as needed.	\$4-5,000/burn
Spring, 2002	Seed burned area	Broadcast native seed on burn areas within two weeks of prescribed burning, if needed. Used hired crews or volunteers with supervision.	Up to \$4,000/acre
Fall, 2002	Remove seedling exotics and treat resprouts	Use volunteers and/or hired crews to pull seedlings of exotic shrubs. Use hired crews to treat resprouts with approved herbicide	\$700/acre
Spring-Fall, 2003	Trails and erosion problem sites	Close paths throughout area. Plant native seeds/plants, using erosion control fabric, brush bundles, or other bioengineering methods to stabilize eroding areas.	\$6,000 per acre or more, depending on seed mix and erosion control methods
Spring and Fall, 2003-2005	Site monitoring	Visit site and make notes on effectiveness of resource management activities as well as work to be performed. Repeat activities to remove resprouts or exotic seedlings as needed.	2-3 hours monitoring

**Table 5. Phase I Restoration Activities
Ford Parkway Secondary Area**

DATE	ACTIVITY	DESCRIPTION	ESTIMATED COST/ HOURS*
Early Fall, 2001, or other years as needed	Neighborhood meetings	Hold neighborhood meeting to inform residents about management activities. Work with District Council or other neighborhood organizations.	8 hours
Fall, 2001	Invasive Tree and Shrub Removal	Cut invasive brush and tree species in oak woodland areas. Invasives should be cut and stump treated with herbicide by hired crews and Sentence to Serve labor.	\$475/acre
Spring, 2002	Remove exotic species in floodplain forest areas.	Discuss possibilities for management of Ford Company properties with Ford Motor company—determine whether exotics removal can be completed on all or part of their property in 2002-3. Discuss possibility of prescribed burn on steep slope areas with neighborhood and city departments. If feasible, conduct prescribed burn that is planned and managed by an experienced “burn boss”, with the help of the fire department, city staff, and others as needed.	\$4-5,000/burn
Spring-Fall, 2002	Remove seedling exotics and treat resprouts	Use hired crews or City staff to remove exotic species such as garlic mustard and creeping charlie with spot spray of herbicides. Late spring, seed areas with native mix if needed to provide cover.	Up to \$4,000/acre
Fall, 2002	Site monitoring	Use volunteers and/or hired crews to pull seedlings of exotic shrubs in oak woodland areas. Use hired crews to treat resprouts with approved herbicide	\$700/acre
Spring and Fall, 2003-2005		Visit site and make notes on effectiveness of resource management activities as well as work to be performed. Repeat activities to remove resprouts or exotic species seedlings as needed.	2-3 hours monitoring

**Table 6. Phase I Restoration Activities
Hidden Falls North and South Secondary Areas**

DATE	ACTIVITY	DESCRIPTION	ESTIMATED COST/ HOURS*
Early Fall, 2001, or other years as needed	Neighborhood meetings	Hold neighborhood meeting to inform residents about management activities. Work with District Council or other neighborhood organizations.	8 hours
Fall, 2001	Invasive Tree and Shrub Removal	Cut invasive brush and tree species in oak woodland areas using hired crews and Sentence to Serve labor. Stumps should be treated with herbicide by hired crews or City staff.	\$475/acre
Fall, 2001	Frost seeding	Frost/dormant seeding of species in areas where exotic species have been removed, if needed.	Up to \$4,000 per acre
Spring, 2002	Remove exotic species in floodplain forest areas.	Use hired crews or City staff to remove exotic species such as garlic mustard and creeping charlie with spot spray of herbicides. Late spring, seed areas with native mix, if needed to provide cover.	\$4,000/acre
Fall, 2002	Remove seedling exotics and treat resprouts	Use volunteers and/or hired crews to pull seedlings of exotic shrubs in oak woodland areas. Use hired crews to treat resprouts with approved herbicide	\$700 per acre
Spring and Fall, 2003-2005	Site monitoring	Visit site and make notes on effectiveness of resource management activities as well as work to be performed. Repeat activities to remove resprouts or exotic species seedlings as needed.	2-3 hours monitoring

Phase II (Years 6-20): Recovery Toward Stability

Management activities proposed in Phase II build on the activities completed in the Initial Recovery Phase of the Management Plan. Because activities carried out during Phase II hinge upon completion of a number of activities in Phase I, no specific dates are given for activities in Phase II. If portions of Phase I are not completed, it may be necessary to delay some of the activities listed below.

Prescribed (Rx) Fire

Prescribed burns are identified as a potential management tool in some of the priority areas, particularly where the steepest slopes make it difficult to cut and herbicide buckthorn. If this management tool is adopted, it could be used every few years to help to maintain areas that were cleared by hand, and/or maintain the steep slope areas. Prescribed burns should always be planned and managed by experienced, trained staff. Prescribed fire could be applied 4-6 times during Phase II, but may be more or less frequent depending on community conditions.

The neighborhoods adjacent to the project area may vary in their willingness to accept prescribed fire as a management tool in the project area. If some neighborhoods are resistant to burning, the area could be divided into management units, and fire applied in areas where it is needed and accepted.

A few of the positive aspects of well-timed prescribed burning include the recycling of most nutrients; improved flowering, seed production and germination for most native plants, and reduced invasion by aggressive woody plants. Also of benefit is a net loss of nitrogen from the system after 3-5 years of annual burns, which also favors native plants over non-natives.

Vegetation monitoring should also be conducted to watch for shifts in the plant community composition due to the influence of fire. Fire has the ability to increase the presence of some species at the expense of others. If changes are spotted early, burn regimes can be amended to prevent any loss in community function or shifts in composition.

Invasive Species Control

Given the urban location of the project area, intensity of human use, and proximity of sources for buckthorn and other exotic seeds, exotic species will likely be an ongoing problem in the project area. Detailed inspections should be made at least annually for early detection of problem species on the site. Some minimal ongoing removal of seedlings and resprouts may be necessary depending on the efficacy of herbicides used in stump treatment during Phase I and amount of reseeded that occurs from the surrounding area.

Volunteers may be helpful in pulling seedlings of buckthorn, honeysuckle, boxelder, and other invasive and exotic species. A cleanup could be held annual or biannually in the fall. City staff or hired crews could be used if cutting or herbicide is needed to control larger exotics.

If efforts to control invasive exotic species have been successful, managers may consider the advisability of removing additional species such as boxelder and cottonwood from woodlands in the project area during Phase II. While these are native species, they are currently present in much larger proportions than would have been typical in the woodlands of the bluffs area at the time of settlement. The use of prescribed fire may help to control these species. If not, managers may consider the possibility of removing these species to meet the project goal of restoring the native plant communities in the area.

Species Enrichment

Recovery of plant communities to greater functionality will entail the planting and/or seeding of species in addition to those planted in Phase I. This activity of species enrichment includes species generally considered to be more “conservative”. These species often require a matrix of previously established native plants to colonize.

Seeding methods for species enrichment can include frost seeding or interseeding. Frost seeding is accomplished through broadcasting the seed on a bare soil surface between mid-November and mid-February, allowing the repeated freezing and thawing of the soil to work in the seed. Raking-in seed and packing the ground generally improves the success rate of frost seeding. Interseeding involves the use of a native seed drill to cut a furrow and place the seed in the ground. On steeper slopes, seeding will require hand-broadcasting. Both of these techniques are effective and have species-specific strengths and weaknesses.

Spring ephemeral species may be added to the area by seeding or by planting small plants. However, small plants will require watering during dry periods during the first growing season. Small plants have also been subject to theft on some project sites. Project managers will need to balance the desire for particular species that may only be available as plants, vs. the additional care and cost that such plants may require.

Monitoring

As with other stages of the restoration process, monitoring should be carried out on a regular basis to provide for determining resource management effectiveness. Also important will be monitoring for excessive human disturbance such as off-trail erosion, tree cutting, dumping, etc. Please see Monitoring Section, which follows Phase III for additional details regarding this subject.

Ford Motor Company Property

The portion of the project area that is included within the Ford Motor Company property was not included in the initial buckthorn removal efforts completed in 2000-2001. The City and its partners in this project should discuss options for exotics removal with Ford Motor, and determine whether actions can be implemented during Phase II or in the future. If Ford Motor Company moves or abandons the area along the bluffs, the City should consider options for acquisition of this area.

Table 7. Phase II - Summary of Restoration Activities — All Areas

ACTIVITY	DATE	DESCRIPTION	ESTIMATED COST or HOURS*
Neighborhood meeting(s), newsletters, or other communication	At least annually	Hold at least one neighborhood meeting in the project area and/or site tours to keep local residents up-to-date and involved. Provide updates in local newsletters or other media to let area residents know about project progress, volunteer activities, and related issues.	5-20 hours/yr.
Prescribed burning	March 15 to Nov. 15	Conduct Rx burn with help of fire department, volunteers, and others as needed. Vary season of burns based on vegetation composition and community characteristics. (Optional based on community acceptance.)	Cost will vary based on size and difficulty of area to be burned.
Invasive Species Control	Various	Monitor and address invasive/nonnative species problems as they occur. Treat with appropriate method of control, such as use of volunteers to pull exotic seedlings, or spot application of herbicides by city staff.	Less than \$500/yr
Additional seed/plant purchase	November -February	Purchase of additional seed/plants to complement original seeding, if needed. Should include more “conservative” species. May include additional seeding of limestone outcroppings if erosion control efforts are successful.	\$0-\$5000/ Acre
Site work plan inspection	2-3 visits within project area each year	Visit site and make notes on effectiveness of resource management activities as well as work to be performed	8-10 hours annually

This period of management for plant community restoration in the Phase II area is the most difficult to detail because the management activities to be carried out are so dependent on the success or failure of previous activities, as well as those that were unexpectedly brought into the fold. Despite this, some reasonable recommendations can be made. At this point in the restoration, many of the activities that have been intensively carried out for the last 20 years may have their frequency reduced, such as prescribed burning. Others may be completed, such as buckthorn removal. Below are recommendations for specific activities associated with maintaining plant community restorations.

Prescribed Burning

Depending on the level of brush remaining from Phase I & II of the restoration, the burn interval may be reduced. If brush remains a persistent problem and other aspects of the plant and animal community will not be substantially impacted, burning should be continued. In an effort to maintain some type of balance between positive and negative responses exhibited by desirable species, it is recommended that managers vary seasonal timing of prescribed fire. The frequency of burns may be increased or decreased based on monitoring results.

Although there are a myriad of factors pertaining to community and individual plant species responses to fire, some generalizations can be made about the seasonal application of prescribed fire. Past research and field experience of managers suggests that early spring fires (before April 15th) tend to favor cool season grasses, most represented by the non-natives smooth brome and reed canary grass. Late spring fires tend to favor native warm season grasses over cool season grasses and forbs. Fall fires tend to maintain a balance between warm and cool season grasses and forbs, and reduce the presence of shrubs. Because there are many factors related to seasonal timing of fire, it is important to make sure that the seasonal application of fire is consistent with addressing specific problems or achieving stated goals.

If invasion by exotic species is reduced to, or below target levels, burning could be reduced to 5-15 year intervals. This longer interval would allow any oak seedlings recruited during restoration to reach a size where they would be more resistant to being top killed by fire. The recruitment of oak seedlings into mature trees will be an important part of long-term management if the goal is to keep oak as the dominant tree on the site. Because of the aging character of the oaks on the site, it will be important to allow for a window of oak seedling recruitment in the next 30 years to provide for replacement of canopy trees.

Fuel management will also be a concern in planning for prescribed fires. Shorter intervals between burns prevent accumulation of litter. Conversely, longer intervals between prescribed burns allow for substantial litter accumulation, which may pose a potential hazard for unplanned fires. Fuel loads near human structures should be monitored and weighed as a safety factor for burn frequency. Fine fuels such as grass and leaf litter, as well as downed and standing dead wood should be factored into fuel management concerns.

Prescribed fire application will always require good planning, trained personnel, and sufficient equipment on-site. Fire is a very useful tool in the management of natural areas, but always has the potential to become dangerous if not given respect and careful attention. Fire, like many other tools, requires adaptability as a key component of long-term management. Good record keeping and monitoring during the early portions of the restoration will contribute to sound decisions during the maintenance phase of the restoration.

Species Enrichment

During the early parts of Phase III, the entire site should have had at least an “early successional” native species matrix established, either by regeneration or supplemental seeding. The native species should include desirable native grasses and forbs. The entire area may also be seeded with more “conservative” species, if desired. Any areas that show poor establishment of seeded native species should be targeted for enrichment seeding. Seed gathered from appropriate sources or purchased from appropriate native seed dealers should be planted by frost seeding or drilled. Some of the more difficult to establish plants may be reintroduced as transplants. These could be native plants salvaged from construction sites, or transplants grown by a reputable native nursery. Some examples of these transplant candidates include trilliums and other spring ephemerals. Some of these species are sought by gardeners and may need to be installed in areas of low public visitation, or provided some degree of protection.

Monitoring

This activity will continue to be an integral piece in driving adaptive management for the site. More explanation is given later in this document, in the Monitoring section.

Neighbor/City Resident Involvement During Phase III

Below is a list of recommendations for creating positive public involvement in a natural areas restoration for the long-term.

Use volunteers to assist with maintenance activities.

- Volunteers may participate in a variety of restoration activities:
- Removal of exotic species and seedlings
- Planting seed and/or native plants
- Site clean-up
- Site monitoring
- Encourage citizen monitoring of animals that use the site, particularly birds.
- Provide recognition and rewards to volunteers

Educate the public.

- Offer public tours and talks for groups regarding the project area and restoration activities.
- Submit articles on project activities to local newsletters, newspapers, and radio shows.
- Integrate resource management activities with public/school environmental education. Involve local schools in planting, monitoring, and educational activities.
- Hold occasional neighborhood meetings to inform citizens of proposed management activities and time lines for implementation.

General Comments on Monitoring Techniques

Ecological Restoration is a process that involves active management by resource managers. This management often takes place on small, sometimes isolated areas of varying quality.

Management activities can influence one or more aspects of the managed community and have lasting, long-term implications. To avert any possible damages and to make sure that the best possible practices are used for restoring natural communities, it is important to monitor chosen aspects of those communities on a regular basis.

Monitoring can be an expensive, and labor-intensive process, which potentially can take valuable monetary and human resources away from the process of active management. Deciding what to monitor and how intensively to monitor is always difficult. Some aspects of management can be monitored through visual inspection with field notes recorded and shared between the park and the resource manager. Other aspects require that quantitative monitoring be undertaken, such as long-term monitoring of rare plants and animals.

A first recommended step in monitoring is keeping a large, hardcover field diary. The diary would be used by the natural resource manager(s) for the purpose of tracking observations. These observations may include species noted (exotic species and native species), resulting of cutting, herbicide applications, prescribed fires, and other management activities, unusual weather events, human disturbance, predation by deer or other species, activities of work crews in the project area and the quality of their work performed, and other qualitative observations. Although this type of information may not be quantitative, it is crucial to help with adapting management strategies in the future. This is especially true for the long-term, since personnel and policies change within organizations are inevitable. This information would give future managers the benefit of insight on daily and yearly activities within the restoration areas as they relate to resource management.

Quantitative measures may also be used to monitor the results of management. Staff, volunteers, or researchers from local colleges and universities could take quantitative measurements of exotic species, and compare this information to the quantitative measurements made at the initiation of this project. Care should be used to keep measurements and methods consistent. Such measurements can be time-consuming and costly.

Monitoring should be used to evaluate the success or failure of management efforts, and to make adjustments in management protocols.

V. Volunteer Participation in the Mississippi Bluffs Restoration Project

Early Participation by Volunteers in the Bluffs Restoration Project

Over 100 volunteers participated in the first year of the Bluffs Restoration Project. These volunteers assisted with removal of buckthorn. A number of other residents in the project area have also indicated an interest in volunteering to participate in various aspects of bluff restoration. These lists have been provided to St. Paul Division of Parks and Recreation and to the Friends of the Parks and Trails of St. Paul and Ramsey County.

A variety of organizations near the project area have provided volunteers to work on the bluffs or on similar restoration projects in the St. Paul Area. These include the private colleges in the area, local Community Councils, and public schools. Typically volunteers have been available for a day or half-day, to assist with exotic species removal or general clean up of the area. These organizations may be contacted in the future to request volunteers to work on specific tasks in carrying out this management plan.

Tasks for Volunteers

Appropriate tasks for volunteers may include the following:

- Removal of exotic species, including cutting larger shrubs and pulling seedlings. If such tasks are completed in late fall, minimal instruction will be required to help with species identification. At other times of year, volunteers will need assistance in identifying the problem species. Trained/licensed staff will be needed to work with the volunteers to apply herbicides to cut stumps. Volunteers should use manual tools only, not power equipment such as chain saws.
- General project area clean up and litter removal.
- Assisting with seeding or planting native species. Best times for seeding and planting are spring and fall. Planting plugs or seedlings should only be done if volunteers or staff can water these plantings as needed during the first year after planting.
- Assistance with buckthorn removal on private properties in the project area, if private property owners are willing to work with volunteers.
- Assistance with monitoring the project area. This will require knowledge of native plants. Project staff should identify key characteristics to be monitored, and if possible, develop standard forms for monitoring if multiple volunteers will be used for this task.

The first three tasks are appropriate for full or half-day commitments. Middle school and high school age youth and adults are able to participate in these tasks. Smaller children may not be able to handle equipment safely or help with heavy labor. Volunteers should be used on the flatter portions of the bluffs. When removal is needed on steep slopes, staff or Sentence-to-Serve crews should be employed.

Volunteers will require staff resources for recruitment, coordination, and providing direction on the site. The staff resources available will determine the number of volunteer activities that may be completed each season.

Priorities for Volunteers

During 2000-2001, the Bluffs Restoration Project made a significant investment of time and resources in removal of exotic species from the bluffs area. This effort will be of little use if these species resprout or reseed the area.

Therefore, a priority for volunteers should be ongoing removal of exotic species seedlings and resprouts in the project area. These efforts could be modeled on highway and riverway clean-up programs, and titled “Adopt a River Bluff.” A suggestion for a structure to manage this task includes the following:

- Break the project area into manageable subunits that may take a typical crew of volunteers (20-25) approximately one-half day to clear of seedlings. An area of 4-5 acres may work well.
- Recruit volunteers through local organizations or local publications.
- Assign volunteer crews to a subunit area that is close to their homes or school. Maintain this as their “territory” over time if possible, to develop ownership of the site, and volunteer familiarity with its conditions.
- Suggest at least one large-scale clean up each fall with all volunteer units participating in a Big Cleanup activity.
- Encourage groups or individuals within groups to go back to the site at other times during the growing season to remove seedlings. This ongoing care for the site is more likely if volunteers feel a sense of ownership of part of the site, and if it is easily accessible from their homes or schools.
- Volunteers who work at the site on their own should notify park staff about their activities, so that these can be accounted for in site monitoring and planning.
- Provide rewards for volunteer participation. Some “competitive” awards may be given to groups who cover the largest area, create the biggest piles of exotic seedlings, etc., but make sure all groups get rewards.

Figures 9a and 9b in the Appendix identify areas suitable for volunteer activities to control buckthorn, and the areas that will require professional work crews due to steep slopes and difficult access.

If volunteers are available to assist with other tasks, and staff time is available to coordinate activities, these resources should be used to benefit the project area.