Rosemount Greenway Restoration Plan

Spring Lake Park Reserve Unit

Resilient Communities Project

By

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ESPM 5071 – Ecological Restoration

Professer Susan Galatowitsch

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1. MISSISSIPPI RIVER GREENWAY (LANDSCAPE) ASSESSMENT

1.1 INTRODUCTION

Motivation for Restoration

In 1973, Minnesota passed The Critical Areas Act which provided for planning and management of a 72 mile stretch of the Mississippi River and adjoining lands. In 1976, the Governor of Minnesota designated this area along the river as a Critical Area and it was established as such to preserve and protect this natural environment and to provide a set of guidelines for development along the river. In 1979, this designation was made permanent by the Metropolitan Council. Local governments like Dakota County and the City of Rosemount, together with other state and regional agencies, have a requirement to develop plans and regulate according to what are referred to as Tier 1 standards. These standards are outlined within Executive Order 79-19. In response to this, the City of Rosemount, receiving assistance and resources from Dakota County, the Department of Natural Resources, the Met Council and other agencies, adopted a Critical Area Plan and established ordinances in 1980 to comply and to help protect and preserve the portion of the river and adjacent land that fell within its jurisdiction (City of Rosemount 2008).

In 1988, the Mississippi National River and Recreation Area (MNRRA) was created and became part of the National Park System. Its mission recognized the environmental, recreational, cultural, historic and scientific value the river provided to the Twin Cities Metropolitan Area. It was designed to protect and preserve the corridor by encouraging coordinated efforts of federal, state and local governments to ensure orderly public and private development in this area. In 1995, the National Park Service adopted a Comprehensive Management Plan (CMP) for the MNRRA and established Tier II standards, requiring even greater protection and encouraging inter-community cooperation. Dakota County, the City of Rosemount, the City of Inver Grove Heights, Nininger Township, City of Hastings, Ravenna Township, and key leaders in industry worked together to identify common issues and priorities for the Mississippi River Corridor. The National Park Service (NPS) provided funding for cities like Rosemount to revise their plans and adopt the Tier II standards. Plan approval was undertaken by the DNR and Met Council (City of Rosemount 2008).

The city also recognized the long standing river-dependent industries that pre-dated the City's incorporation in 1972, namely CF Industries Sales LLC, a chemical fertilizer company, and Flint Hills Resources, an oil refining company. Both of these industries have been significant contributors to the economy of Rosemount and surrounding area. As part of the community, these companies have a vested interest in helping to protect and maintain the

integrity of the river and the surrounding area. This is not only for their own economic well-being but also because they recognize the importance the river corridor holds for citizens of the area and the State of Minnesota.

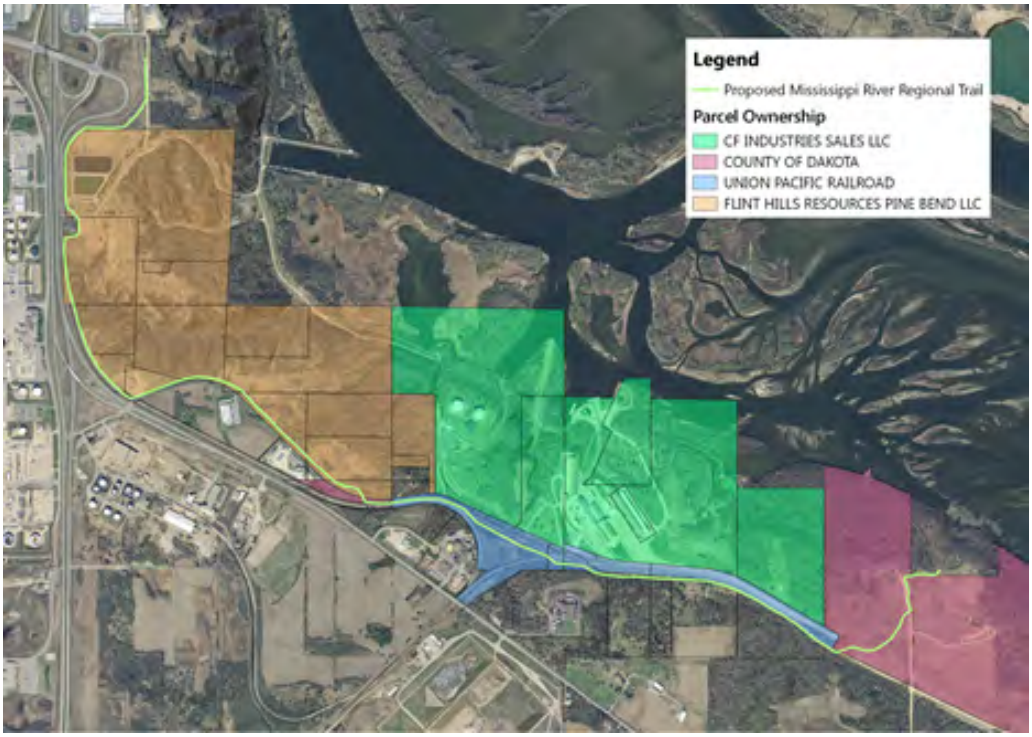
Another key partner in the restoration has been the Friends of the Mississippi River (FMR), a social advocacy group that works hard towards a river and surrounding area "where the water is clear and clean and safe to swim in, where fish and wildlife are healthy and abundant, and where scenic bluffs and cultural treasures are protected" (FMR 2013).

Dakota County has a long standing tradition of collaboration with county residents, cities, and other public and private organizations. Continuing this tradition, they have made a commitment and secured funding through organizations like the EPA, the Legislative-Citizen Commission on Minnesota Resources, and the Outdoor Heritage Fund to implement their preservation, restoration and protection plans of one of the state's most valuable assets, the Mississippi National River and Recreation Area (MNRRA).

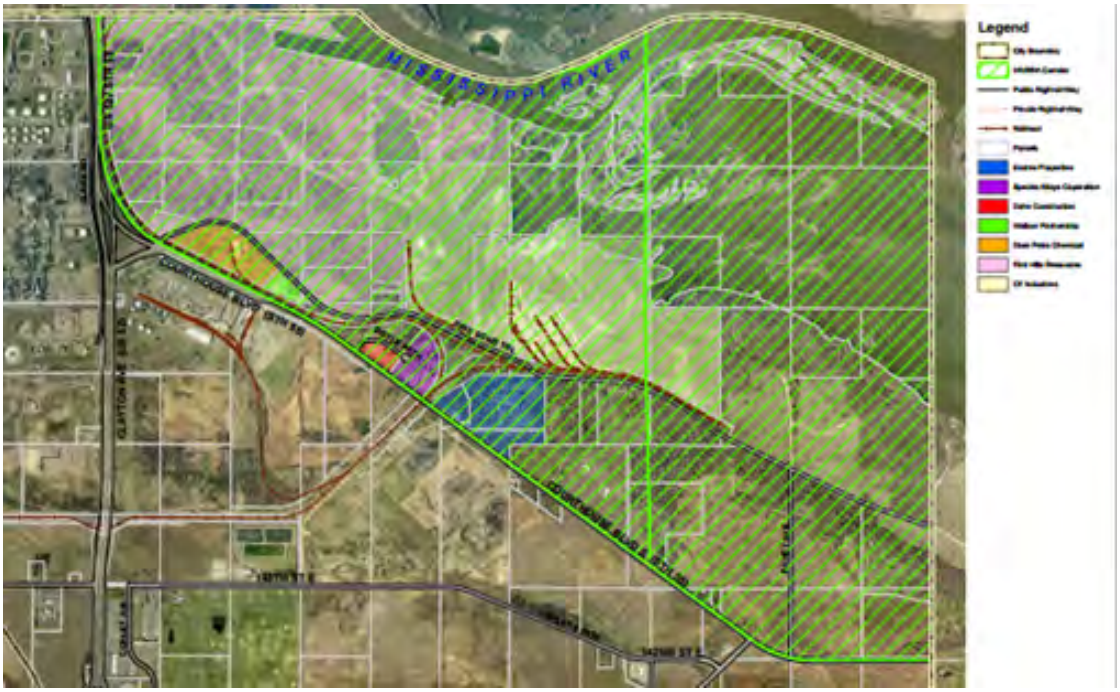
Greenway location

The portion of the greenway area that is within the scope of this project, shown on the map below (Map 1.1), runs parallel with the Mississippi River, east of Highway 52 and north of Pine Bend Trail. It is entirely encompassed within Dakota County and also falls within the limits of the City of Rosemount. It is part of the critical area previously mentioned that is referred to as the Mississippi National River and Recreation Area (MNRRA)(Map 1.2). The total MNRRA within city limits is about 2080 acres land mass, and the targeted project area is about 60% of this, or 1250 acres. Approximately 600 acres is owned by Flint Hills Resources, 380 acres by CF Industries, and the remaining 270 acres belong to Dakota County and is part of Spring Lake Park Reserve. The remainder of Spring Lake Park Reserve lies within Nininger Township outside of the project area.

Map 1.1: Project Area, Land Ownership and Proposed MRRT



Map 1.2: National River and Recreation Area (MNRRA)



Historic and Current Land Use

In 1937 the area along the Mississippi consisted of wetlands and prairies. There was sparse forest beyond that moving into dense forest the further you get from the river. To the south was almost entirely agricultural land.

By 1953, the north harbor was built and there was substantial development in the area along the river, close to where CF industries is now located. The river was rerouted to easily access the new harbor and marsh dock. This area near the river is under jurisdiction of the United States Coast Guard, adding complexity to any restoration attempts. By 1964, a large amount of industrial growth had occurred, which prompted the addition of the railway which is there today. Several new industries also popped up on the previous agricultural land south of Pine Bend Road. In 1967 a ski run was made toward the west end of the corridor.

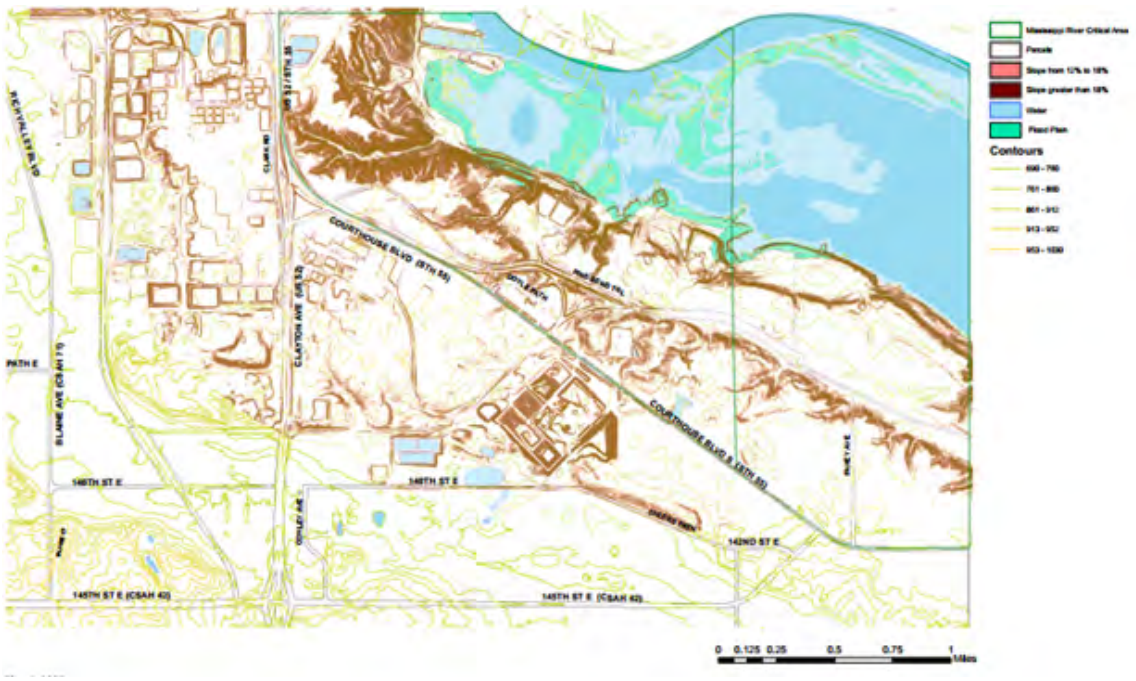
The shape of the river has changed drastically over the years. The harbor was widened and roads pass through to accommodate industries that have expanded across the shoreline (including the US Coast Guard). Forests have become more isolated but more scattered trees have been planted around the commercial businesses. Many crops have been abandoned and turned to prairie land and some of the northern crop land is now forested. In recent years CF Industries has added a retention pond at the bottom of the Pine Bend Bluff to assist with excessive stormwater runoff and has aimed at substantially increasing their native grass ground cover to reduce soil erosion.

Current land uses, in order of prevalence, are industrial, agricultural, floodplain, waste management, and parkland/open space (City of Rosemount, 2009). To the north is the Mississippi River and its floodplain. Agricultural uses and a golf course are prevalent to the south. To the east, along the river, is more parkland. And to the west, industrial and waste management uses dominate, to include the Flint Hills oil refinery.

1.2 REGION AND GEOLOGY

The proposed extension of the Mississippi River Regional Trail (MRRT) is planned within the greenway to run along Pine Bend Trail **(*Map 1.1 trail in yellow*),** bridges a gap in the trail system. This section, when completed, will allow uninterrupted trail access through the Rosemount Greenway connecting it to the Mississippi River corridor and the trail to the City of Rosemount.

Topographic elevation near two treatment ponds on the northwest side of the greenway is about 940 feet near the intersection of Highway 52 & 55. Moving towards the river, elevation drops to about 250 feet. From the ponds, and going east along Pine Bend Trail the elevation slopes downward to about 850 feet at the most easterly end of the greenway and from Pine Bend trail to the river edge it drops to about 690 feet in the Mississippi Outwash plain (Map 1.3).



Map 1.3: Topography of the Rosemount Greenway

Geologically, the greenway is situated in an outwash plain of the terminal moraine of a glacier. The northernmost point of the site may be near the edge of the moraine. A terminal moraine is a landform consisting of boulders, sand, and gravel, which formed as the glaciers in the region melted. It marks the maximum extent of the glacier. The greenway is situated in the moraine's outwash plain, which explains the occurrence of gravel resources and sandy soils (MN River Basin Data Center, 2011).

Soils in the greenway are dominantly Hapludolls, likely formed under prairie or savanna plant communities (United States Department of Agriculture, 1960). Some of the soils have likely been modified to some degree through fire suppression, leading to forest growth. Also, some areas have been farmed and plowed, resulting in modified soils. Industry, road and railways in the greenway indicate the possibility of contaminated soils. Extraction of

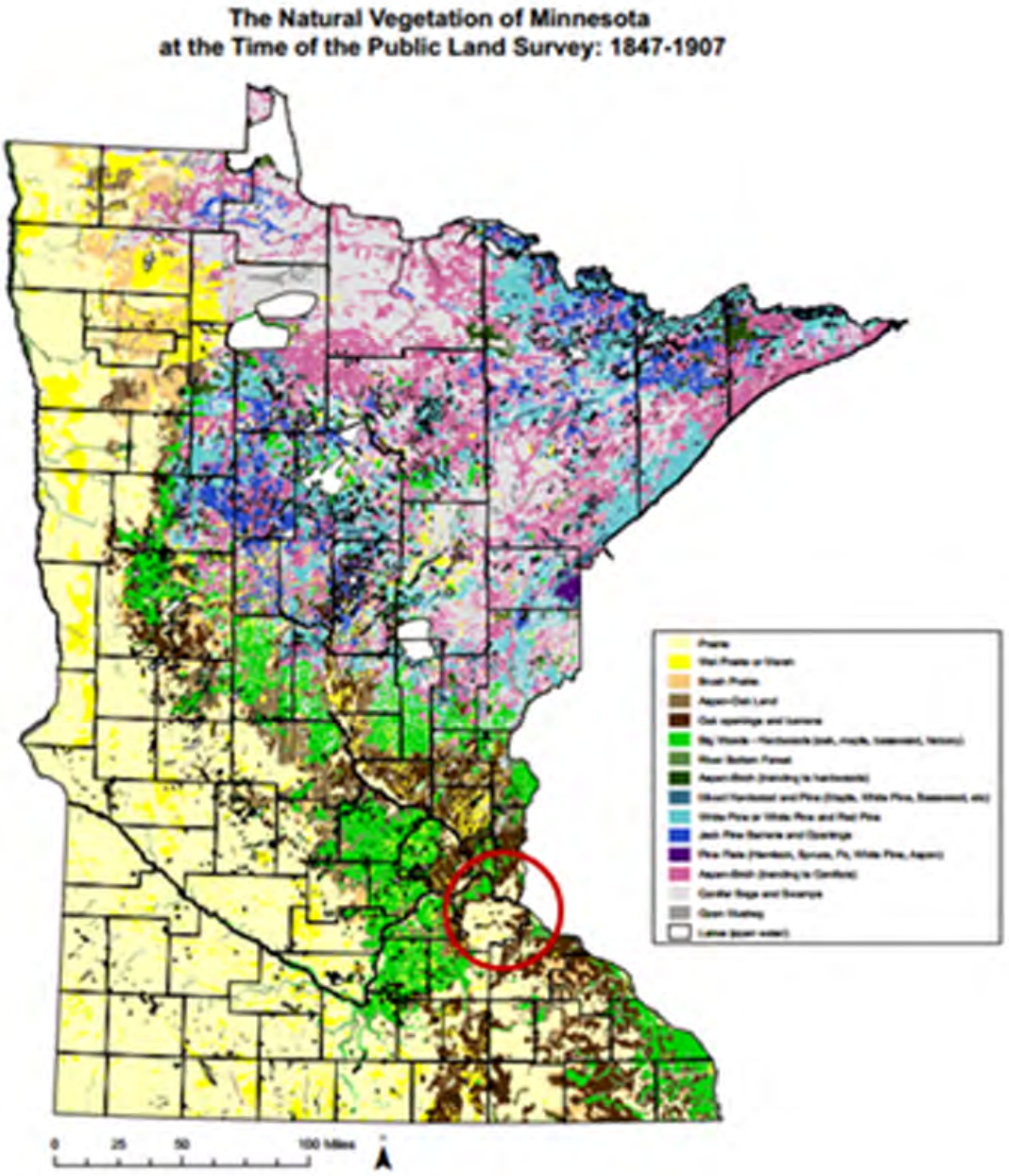
aggregate materials, such as sand and gravel, has removed soils in some areas. Even with these activities, the land throughout the greenway is relatively intact with good potential for restoration project success.

1.3 VEGETATION

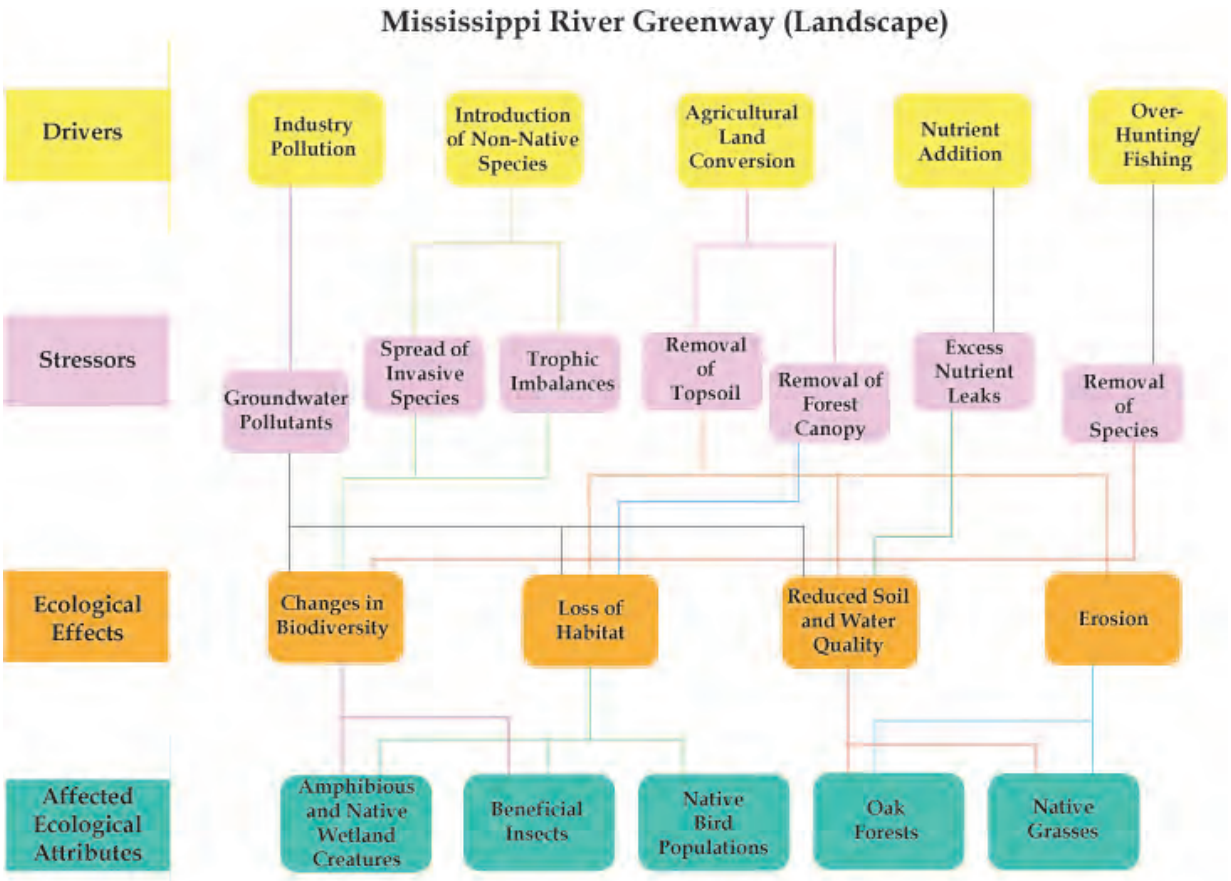
Pre-settlement and current vegetation

Mesic prairies were once the dominant vegetation type in southern and western

Minnesota, but since the time of European settlement they have been largely replaced by agriculture as discussed in the Land Use Section (DNR 2012). The term mesic refers to a normal moisture content of the prairie soil, which in this case is somewhere between wet and dry (DNR 2012). The site within Dakota County in the vegetative map from the Public Land Survey of 1847 to 1907 shows that the primary vegetation was dry to medium-dry prairie. This was surrounded by oak openings and barrens leading to deeper hardwood forests of Oak, Maple, Basswood and Hickory. *Table 1 in the appendix* shows that some of the current species of vegetation are still consistent with early settlers time, but are sparsely populated.


The Natural Vegetation of Minnesota
at the Time of the Public Land Survey: 1847-1907
Prairie
Wet Prairie or Marsh
Brush Prairie
Aspen-Oak Land
Oak openings and barrens
Big Woods - Hardwoods (oak, maple, basswood, hickory)
River Bottom Forest
Aspen-Birch (trending to hardwoods)
Mixed Hardwood and Pine (Maple, White Pine, Basswood, etc)
White Pine or White Pine and Red Pine
Jack Pine Barrens and Openings
Pine Flats (Hemlock, Spruce, Fir, White Pine, Aspen)
Aspen-Birch (trending to Conifers)
Conifer Bogs and Swamps
Open Muskeg
Lakes (open water)
0
25
50
100 Miles
N

1.4 CONCEPTUAL ECOLOGICAL MODEL



There are many drivers of ecological change across the greenway. Perhaps the most prevalent being human drivers of ecological change, largely land conversion. Initially, the land along the corridor was cleared of naturally occurring prairie and forest vegetation to make way for agricultural crop production. The ecological effect was a reduction of naturally occurring native woody and herbaceous plants. This resulted in a reduction of habitat for many native animal species and an increase in erosion of the sandy or sandy-loam soils in the area. The application of fertilizers, pesticides, and herbicides commonly used in farming during this time are now known to have adverse effects on native plants, wildlife, rivers, lakes and streams.

Land conversions took place a second time as agriculture in the area gave way to more industrial uses. These industries heavily on the river, railways and road systems to transport their raw materials in and finished goods out of the area. Changes to the river waterway to facilitate industrial transportation have included the infrastructure build and implementation of a dam and three barge terminals. Areas cleared previously for cropping were allowed to fallow as large tracts of land were purchased simply to meet industrial

surrounding land area regulations. Native woody and herbaceous plant habitats that still existed where industry-appropriate rail and roadway systems were introduced. These areas were cleared and large landscape digs, called borrow pits, were utilized as fill for the new infrastructures.

The ecological effects of this secondary and equally massive conversion are significant. The reduction of wetland areas from flooding and drainage and clearings for rail and road resulted in further reduction of specialized and unique native plant and wildlife habitats. Fallow lands and lands depleted of nutrient dense prairie top soils allowed for the introduction and proliferation of invasive species. Heavy industrial production, the transportation of chemicals, and heavy use of expanded roadways may have resulted in noise, air, and water pollution.

2. SPRING LAKE PARK RESERVE ASSESSMENT

2.1 INTRODUCTION

PARCEL INFORMATION:

Owner, mailing address:

County of Dakota

Parks Department

14955 Galaxie Avenue

Apple Valley, MN 55124

Property address:

13690 Pinebend Trail

Rosemount, MN 55068

Township, range, section: T115N, R22W, 21

Major watershed: Mississippi River

Watershed Management Organization, mailing address:

Vermillion River Watershed Joint Powers Organization

14955 Galaxie Avenue

Apple Valley, MN 55124

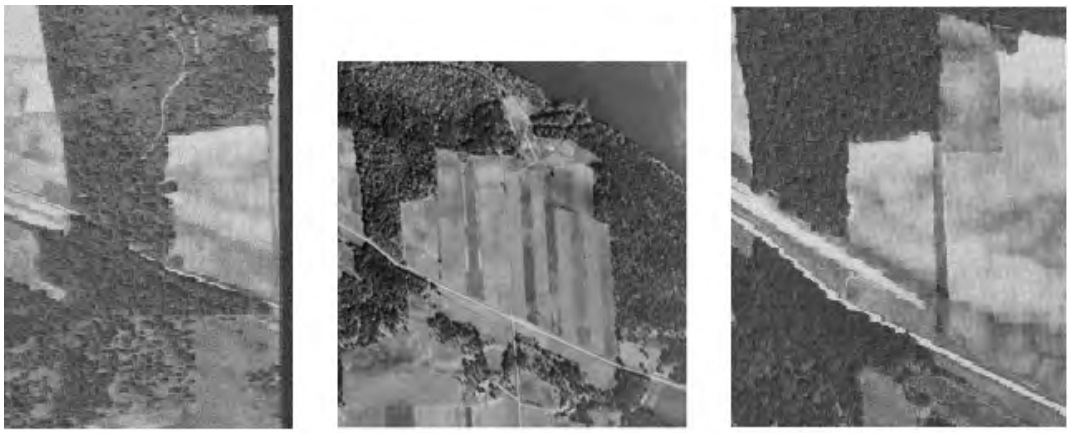
i. Site location

The restoration site, within Spring Lake Park Reserve, is located at the corner of Pine Bend Trail and Fahey Ave S. The site is adjacent to Spring Lake Archery Trail.

ii. Historic and current land use (How has the site changed over time?)

Map 2.1 shows our site in 1940, 1953, 1964, 1970, and 2012. The site was under agricultural use for most of its history. From 1940 to at least 1970, the site was a farmed field. At some point between 1970 and 2012 the site became more of an herbaceous cover area and more trees were planted along the south and west borders. In 1995 a portion of our site, as shown in map 3 was used as a borrow pit for the archery area. While visiting our site we found evidence of recent burns and the removal of several black walnut trees. During the panel discussion in class we learned that part of our site was recently used as a borrow pit for the adjacent archery area. There was also a point where they sprayed pesticides and planted a large number of oats.

Map 2.1 Historic and Current Land Use



1940 1953 1964

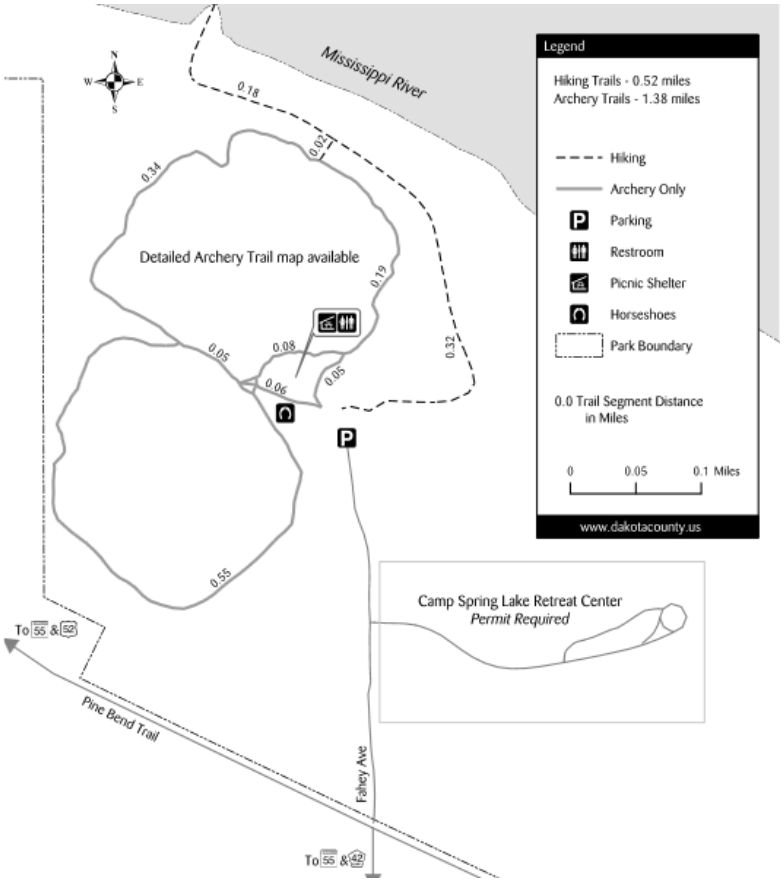
1970 2012

2.2 LANDSCAPE AND GEOLOGY

Landscape context

The area adjacent to our site (along the northwest edge) is used as an archery park where the public can practice their hunting skills (Map 2.2). North of the site is a hiking path with restrooms, horseshoes and a picnic area. To the east is an all ages retreat center that is available for rent throughout the year. The property to the west is owned by CF Industries, where Anhydrous Ammonia is received via barge and transferred to rail and truck. The property to the south, across Pine Bend Trail is owned by Burger Family Limited Partnership and consists of forest and agricultural fields.

Map 2.2. Spring Lake Park Reserve - Archery Trail and Retreat Center



Geologic History

For a general description of the geology in the greenway, see section 1.2. The site was formed as a glacier melted and deposited material into its outwash plain. In particular, this area is relatively flat compared to areas nearer the river. In addition, the site is situated on the largest area of flat ground in the greenway. The majority of our site's elevation is between 800 and 850ft. The northern portion of our site, nearest the river, has the lowest elevation (marked in gray on Map 6). The highest elevation points are along the southern border. All slopes on site are less than 10% with most being less than 5%. South of the site, further from the river, the elevation continues to increase, beyond 850ft.

2.3 SOILS

Map 2.3: Soils

According to the Dakota County Soil Survey, there are three types of soil on site. The most prevalent being 7B - Hubbard loamy sand, 1-6% slopes, followed by 8B - Sparta Loamy fine sand, 1-6% slopes, and least prevalent, along Pine Bend Trail, is 27A - Dickinson sandy loam. All soils onsite were deposited from glacial outwash. Soils are Hapludolls, being compatible for both Dry and Mesic Prairie restoration. Soil composition field tests were performed on-site and were consistent with the soil survey data. This area was farmed and plowed, likely affecting the soils differently than the less disturbed, forested areas.

2.4 VEGETATION

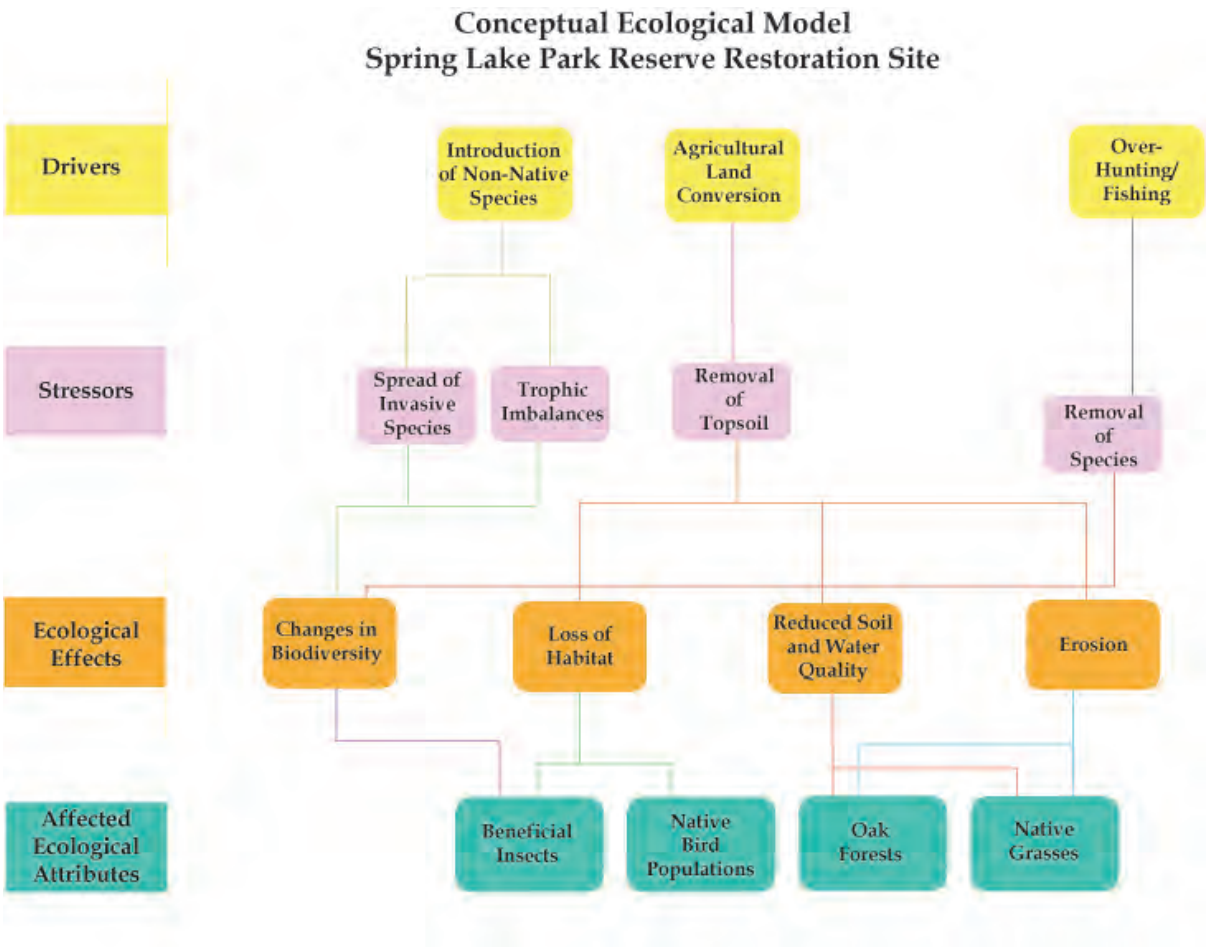
Pre-Settlement Vegetation

According to Griffis and Baker with the MN Board of Soil and Water Resources, vegetation before settlement was likely Upland Dry Prairie.

Current Vegetation

See Appendix A for a list of the current vegetation within the restoration site. While most of these species are consistent with a mesic prairie or oak clearing or barrens type terrain, they are sparsely populated. The growth however is young as the landowner reported there was a clearing, some stump grinding and a burn performed. With time, most species present will have a good chance of filling in somewhat and a cover of seed mix will help. One might expect that without the land use disturbances this site would have had some heavier populations of Little blue Stem, Indian Grass, and more flowering perennials that would bring color well into fall. The vegetation is very light in some areas with exposed sandy soils that could be subject to some erosion.

2.6 CONCEPTUAL ECOLOGICAL MODEL



On the Spring Lake Park Reserve Restoration site, the biggest driver of ecological change was agricultural activity and its associated drivers. Fields which were cultivated and plowed limited species diversity, removed habitat, caused reduction in soil and water quality and resulted in loss of soil. The introduction of non-native species also has contributed, at a low level, to changes in biodiversity on the site. Removal of species through hunting has likely had an effect as well. The site is currently in a state of self-regeneration and has a relatively wide variety of species given its history.

3. RESTORATION GOALS

3.1 ROSEMOUNT GREENWAY

Greenway Goal 1: Reduce prevalence of invasive species, (as defined by the MN DNR) to less than 10% plant species composition in five years.

This goal is meant to assist in the eradication of invasive species in the state of Minnesota.

Greenway Goal 2: Create an aesthetically pleasing environment for Mississippi River Recreational Trail users in three years

Although this goal is hard to measure (probably by trail user surveys), it is a key component of the overall greenway restoration as the trail will likely be highly travelled. Both the restorationists working on these projects and the clients will benefit from an enhanced public image if this goal is met

3.2 SPRING LAKE PARK RESERVE UNIT (SLRPRU)

Site Goal 1: Establish at least a 60% composition of plant species, by ground cover, characteristic of a Mesic or Dry Prairie (as defined by MN DNR) in 3 years.

The 60% mark is established so that there is flexibility in plant composition. This is to increase biodiversity and to allow existing species to continue to exist onsite as long as they are not a problem ecologically.

Site Goal 2: Establish Northern Pin Oak and Bur Oak at a rate of 10-12 trees per acre (combined and including selected established trees) in 10 years.

Oak trees are high quality, highly edible (by many species) trees which will be an important keystone species in this ecosystem and help create an

aesthetically pleasing environment. The 10-12 tree per acre mark has been described as ideal savanna landscape by many forward thinking experts on the topic.

Site Goal 3: Establish 15-25% composition, by ground cover, of flowering plant species known to be excellent forage for pollinators such as bees and butterflies in 3 years.

The benefits of pollinators are well understood.

Site Goal 4: Achieve less than 5% composition of plant species, by ground cover, on the MN invasive species list.

To help establishment of native species and assist in invasive species eradication in Minnesota.

4. SOIL AND LANDFORM MODIFICATION

The Spring Lake Park Reserve Restoration Unit has had no significant modifications in the past and has soils which are in relatively healthy condition. No landform modifications or soil amendments should be needed.

4.1 TRAIL CONSTRUCTION CONSIDERATIONS

Trail alignment

The most appropriate route for the Mississippi River Regional Trail (MRRT) will be along Pine Bend Trail and Fahey Avenue South (**Map 4.1**). The trail will be a bituminous, 10 foot wide path which is similar to the rest of the MRRT in the area. Also, a gravel, 1.5-2 foot wide foot path will be built as a scenic route through the restored prairie. This path will include interpretive signage. The alignment is placed this way because it will contribute the least to disturbance to and segregation of the restoration site and because it links up well with the greater Mississippi River Regional Trail alignment. The foot path will be built to provide access to the interior of the restoration and to limit the erosive forces of uncontrolled foot traffic by curious wanderers. It can be built by shovel and a golf cart to haul the gravel. This small width should have a minimal effect on the ecosystem and should not need to be maintained, except by the feet of trail users. To minimize disturbance to the surrounding restoration areas and to limit erosion, construction will be completed using small construction equipment and by working from the existing roads as much as possible.

As the soils are very sandy, trail construction is not close to any bodies of water, and the footprint is small, a minimal amount of erosion control will be necessary during construction. This will consist of bale barriers and silt fencing as outlined on page 139 of MNDOT's Erosion Control Handbook II. A Stormwater Pollution Prevention Plan (SWPPP) will be created and approved before construction begins per National Pollutant Discharge Elimination System (NPDES)/State Disposal System (SDS) Construction Stormwater (CSW) permit requirements. The tentative configuration is shown on **Map 4.1**.

Map 4.1 - Trail Alignment

Construction/Restoration timeline

As the trail alignment is along the outer edge of the restoration site, trail construction and restoration actions can happen concurrently as they should not interfere with each other except at the fringes. This being said, the trail construction is planned to begin after the first season of restoration actions have been completed. The trail corridor will be marked for restorationists to see and they will simply not plant or seed that area. This will allow the restoration to be underway before trail users arrive. The construction of the foot path will happen at the same time as the main path and should cause minimal disturbance to the overall restoration.

4.2 SOIL EROSION

Soil erosion is not a pressing issue on this site. There already exists much vegetative cover, the terrain is gently rolling, and trail construction will be temporary and is not expected to have any lasting impacts. The only soil erosion concern would be from foot traffic in the sandy soils, which will be mitigated by providing a small foot path through the restoration. Signage will also be placed asking users not to step off of the trail and will explain the risks to the ecosystem.

4.3 SOIL CONDITION AND AMENDMENTS

In the past, the entire site was cleared and plowed for agricultural use. Although this was a major alteration ecologically, it will not require soil amendments to restore. There have been no difficult alterations approximating massive soil removal, toxic additions, or dumping. The soil is intact and should take well to a Mesic Prairie/Oak plant composition. Soil hand cores taken in the field showed 8-10 inches of black topsoil with intact horizons at greater depths.

5. SITE MONITORING AND EVALUATION PLAN

5.1 MONITORING PARAMETERS

Parameter 1(Site Goals 1,3,4): Composition of plant species by percentage of ground cover.

The main strength of Parameter 1 is in its ability to monitor three goals with one sampling protocol. Another strength involves being able to catalog all plant species that end up in the survey areas. This could provide diagnostic information in the event of unforeseen events related to project goals and this plan. Limitations would include the variability in sampling by different technicians.

Parameter 2(Site Goal 2): Total number of Northern Pin Oak and Bur Oak on site divided by number of acres.

A strength of Parameter 2 is that it can be done quickly and accurately, especially once the trees are taller than the surrounding vegetation. Another is that it is simple and can be done during other sampling, creating little extra work.

5.2 MONITORING PROTOCOLS

Transect Surveys (Parameter 1) involve walking established transects through the site and documenting the plant species to estimate cover. Transects are shown on **Map B.1.**

Invasive Species Walkthroughs will involve a walkthrough of every grid square on the sampling map, notation of any invasive species, and the approximate prevalence notated as "dominant, interspersed, or minimal." (**Figure B.4**)

Oak Counts (Parameter 2) involve counting the number of Northern Pin Oak and Bur Oak individuals in each grid square on the sampling map. Individuals in poor health will also be noted. (**Figure B.4**)

Timing, frequency and duration

The three monitoring protocols will be conducted together, in June or July, when the greatest number of flowers are in bloom in the area.

Spatial considerations

Data collected from the Plot, Quadrat, Transect Surveys will be collected from 4 established locations shown on **Map B.1** in Appendix B. Although the SLPR site is relatively homogeneous, these sampling locations were strategically placed to sample a variety of conditions; for example the top of a hill or proximity to the forest on the west side of the site. Permanent markers will be installed to delineate monitoring points, subplots, and quadrats.

Data collected from the Invasive Species Walkthroughs and Oak Counts will be accomplished more loosely following a grid pattern on **Map.B.1**. This will result in a general idea of where invasive species may be starting to establish and the rough distribution of Oak trees.

Interpretation of monitoring data

Data from the Plot, Quadrat, Transect Surveys will be entered into a spreadsheet after collection. This spreadsheet will be setup to perform necessary calculations and can be analyzed, by looking at percentage cover of mesic prairie species, invasive species, and flowering species, to determine success of site goals.

Data from Invasive Species Walkthroughs and Oak Counts can be tabulated by grid and placed on a map to visualize results for analysis.

5.3 OVERALL DATA INTERPRETATION

Data will be compared to goals and determinations will be made to adjust methods based on results. For instance, if after 2 years, there is only a 30% ground cover of Mesic Prairie species, methods may need to be adjusted to meet goals. This would include an investigation as to why certain species are not establishing. Having the Plot, Quadrat, Transect Survey data of the totality of plant species may give some indications of what steps to take to correct the problem as it would allow the project manager to view trends in species composition. Another example would be the detection of a significant number of invasive species during an Invasive Species Walkthrough. Steps may need to be taken to eliminate the species before they spread and become a problem. A final example involves a lack of establishment of Oak individuals on site at year 7. More trees may need to be planted to meet the 10-12 per acre goal and have a stabilized ecosystem by year 10.

5.4 LOGISTICS

Monitoring should be conducted once in the spring and once in June or July when the greatest number of plants are flowering. The exact timing is at the discretion of the project manager and can be estimated by viewing flowering plants whatever area he may be in. The sampling should be scheduled as to not coincide with road construction, public events, or any other proceedings that could interfere with data collection.

Monitoring Program Cost Estimate

Installation Costs			
Equipment	**Man Hours**	**Rate/hour**	**Cost**
Plant ID field guide x2			$65.00
Monitoring point (Markers, etc)			$200.00
Measuring Tape x2			$40.00
Measuring Stick x2			$45.00
Labor	15	$50.00	$750.00
Total Installation Cost			**$1,100.00**
Monitoring Event Costs			
Misc (pencils, notebooks, etc)			$30.00
Plot,Quadrat, Transect Labor (consultant)	30	$50.00	$1,500.00
Invasive Species/Oak Count Labor (consultant)	5	$50.00	$250.00
Total Monitoring Survey Event Cost			$1,780.00
Yearly Monitoring Event Cost (x2)			**$3,560.00**

5.5 DATA MANAGEMENT

Competent technicians with background in botany or plant sciences will be hired for sampling. Training will be provided to all technicians on what species to expect and common mistakes in identification. All unknown species will be collected, labeled, and carried off-site for proper identification.

Field datasheets are included in this plan (**Figures B.2, B.3, B.4**) for field survey use. These sheets will reduce sampling error and allow the technician to concentrate on plant identification. These sheets can then be easily entered into a spreadsheet and the field sheets scanned and saved in the project folder as backup and verification.

6. REVEGETATION

6.1 OVERALL REVEGETATION STRATEGY

Only one ecological zone has been delineated for this site. This will allow the same methods to be applied to the entire site, reducing complexity. Also, due to the nature of the goals of this plan, there is flexibility in how the restoration will turn out. This will allow the whole site to have ecological similarities but also have variability.

Oak Savanna, for the purposes of this project, is defined as a mixture of Northern Pin and Burr Oak at 12 mature trees per acre with an understory of species characteristic of a Mesic Prairie. The figure of 10-12 trees per acre will include existing, established trees of other species that may be allowed to exist on-site. This route to revegetation was chosen because Oak Savannas tend to be quality, biodiverse, edible (by many species) ecosystems with aesthetic value to human users. Although the overall strategy is to create an Oak Savanna, there is flexibility built into the site goals to allow much of the existing vegetation to remain. This will reduce effort and should result in a more stable ecosystem as the species that currently exist on-site are already established. The established vegetation is sparse, so there should be no problem establishing new species. This approach is feasible on this particular site due to the composition of existing native vegetation. It also allows a more passive approach to revegetation, providing many benefits as discussed below.

6.2 EXTANT VEGETATION CONDITIONS

Existing vegetation is mostly native (Appendix A). Smooth Sumac (Rhus glabra), White Dogwood (Cornus alba), and Black Walnut (Juglans nigra) are woody species which may not be compatible with the desired savanna endpoint. Although this is notable, these woody species will not likely be a problem due to their relatively low prevalence in most areas of the site. As Site Goal 1 specifies a Mesic Prairie species composition at 60% of total species, some woody vegetation is tolerable. Also, the site has bare soil throughout as vegetation has not fully colonized the site. This will be a benefit as there is space for broadcast seed to colonize.

6.3 SITE PREPARATION

Site preparation will consist of:

- **Mowing or chipping of woody shrub species**

The removal of existing woody shrub species in the spring is to allow prairie vegetation to better gain a foothold in areas with a higher prevalence of these species. This will not incur a huge cost and will be done mainly to allow more sunlight to reach the ground to aid in establishing seedlings. The shrubs will be mowed or chipped in-place and allowed to add organic matter back to the soil. There is not a large biomass of woody vegetation on-site and chippings will be spread thin, which will mitigate interference with establishing seedlings and eliminate costs of disposal. Personnel will seek out and mow any areas with obvious shrub prevalence. Resprouting of woody vegetation is welcome as there is not currently an overgrowth of woody vegetation on-site and it adds biodiversity and texture to the site.

- **Felling selected existing tree species**

  In areas with existing tree prevalence of over 5 trees per acre, trees will be felled until there are only 5 trees per acre and left on the ground to provide habitat for insects and eliminate removal costs. Branches and foliage will be removed from the site. Trees will be selected for removal in order of desirability, with most desirable being cut last. The most desirable species, in order, existing on-site are Red Oak (Quercus rubra), Black Cherry (Prunus serotina), and Black Walnut (Juglans nigra). These species are most desirable mainly due to their value to humans as a food source, but also for their other ecological attributes. Trees will be marked for removal under direction of the project manager before site preparation actions begin.

Site Preparation Costs			
Equipment and Labor	**Hours**	**Rate/Hour**	**Cost**
Brush Hog/Mower	6	$15.00	$90.00
Brush Hog/Mowing Labor	7	$25.00	$175.00
Tree Removal and Cleanup	12	$40.00	$480.00
Project Management/Tree Marking Labor	8	$75.00	$600.00
Total Site Prep Cost			$1,345.00

6.4 REVEGETATION ACTIONS

Revegetation actions will consist of:

- **Seeding**

The *Dry Prairie Southeast Minnesota State Seed Mix* (Appendix C) will be broadcast over the entire site by hand. This should be done immediately before a significant rain event. The rain will help set the seed into the soil and prevent disturbance by wind. Hand seeding will result in a variable spread of seed, adding randomization and variability to seed growth. Seed will be broadcast in the fall before frost. The particular seed mix was chosen because it is readily available, high quality if purchased from a reliable source, and is tailored to this area.

- **Planting**

  Northern Pin and Bur Oak saplings will be planted at a rate of 12 trees per acre, randomly spaced and trees at least 20 feet apart, with 6 trees per acre planted in year one and 1 more tree per acre planted per year for the next 6 years. This time spacing is to allow trees with different ages to exist on the same site, adding to site variability. More trees will be planted if some fail to succeed with the goal of 10-12 trees per acre by year 10. They will be protected from browsing by using the most locally sourced tree tubes available. Oak trees are quality trees, being edible by many other species and being mutualists with many other species.

Site Seeding and Planting Costs					
Plant Materials and Equipment	**Acres**	**Rate/Acre**		**Cost/Unit**	**Cost**
State Seed Mix 35-641	25	12	lbs	$58.33	$17,500.00
Northern Pin Oak Saplings	25	8	each	$10.00	$2,000.00
Bur Oak Saplings	25	8	each	$10.00	$2,000.00
Tree Tubes	25	16	each	$0.30	$120.00
Total Planting Materials Cost					$21,620.00

Labor	**Hours**	**Rate/Hour**	**Cost**
Seeding	20	$40.00	$800.00
Planting	80	$40.00	$3,200.00
Total Labor Cost			$4,000.00

*Labor costs may be offset by organizing a volunteer effort

6.5 REVEGETATION TIMELINE

Year One (2015)

August 10th	Conduct assessment of current trees and mark trees for felling.
August 15th	Fell selected tree species.

October 15th	Broadcast seed.

Year Two (2016)

May	Mow/chip woody plants.
June	Plant Oak saplings at 6 trees/acre.
October	Broadcast seed in any areas where seeding failed or established weakly.

Year Three (2017)

June	Plant 1 more Oak sapling/acre and replace any failing trees. Total goal of 7 trees/acre.

Year Four (2018)

June	Plant 1 more Oak sapling/acre and replace any failing trees. Total goal of 8 trees/acre.

Year Five (2019)

June	Plant 1 more Oak sapling/acre and replace any failing trees. Total goal of 9 trees/acre.

Year Six (2020)

June	Plant 1 more Oak sapling/acre and replace any failing trees. Total goal of 10 trees/acre.
October	Broadcast seed in any areas where prairie vegetation is poorly established.

Year Seven (2021)

June	Plant 1 more Oak sapling/acre and replace any failing trees. Total goal of 11 trees/acre.

Year Eight (2022)

June	Plant 1 more Oak sapling/acre and replace any failing trees. Total goal of 12 trees/acre.

Year Nine (2023)

June	Plant Oak saplings to replace any that have failed. Total goal of 12 trees/acre.

Year Ten (2024)

June	Plant Oak saplings to replace any that have failed. Total goal of 12 trees/acre.

7. VEGETATION MANAGEMENT

7.1 ESTABLISHMENT MANAGEMENT

As this site does not currently have a major inundation by invasive plant species, they are not foreseen to be a problem that requires much management. In order to allow slower growing species to have access to sunlight, mowing down to 3 inches will be conducted once vegetation grows to 6 inches tall. This will also help reduce any fast growing weedy species that may emerge. When vegetation is well established, likely by year 3, a burn will be conducted to mimic natural processes with the added effect of continued control of woody species.

Year Two (2016)

Early Summer	Mow once vegetation reaches 6 inches tall, repeat every month through July to allow enough fuel to grow for the spring 2017 prescribed burn.

Year Three (2017)

Spring	Burn entire site. Mow around establishing Oak trees beforehand to protect from fire.

7.2 LONG-TERM VEGETATION MANAGEMENT

Burn in the spring and graze with cattle in late summer every 4-5 years. A patch-burn grazing method has been shown to perpetuate high diversity of grassland species as the cattle are selective in which plants they decide to consume. This can be particularly helpful for forbs. The cattle will also add manure to the soil and leave cowpies, which can be hotspots of invertebrate activity. Broadcast seed every 5-6 years where Mesic Prairie vegetation has poorly established.

Year Seven, Eleven, Fifteen, etc (2021, 2025, 2029, etc)

Spring	Burn entire site. Mow around establishing Oak trees beforehand to protect from fire.
Fall	Graze site with cattle until they have eaten all of their preferred vegetation.

Year Five, Ten, Fifteen, etc (2019, 2024, 2029, etc)

October	Broadcast seed in any areas where prairie vegetation is poorly established.

APPENDIX A - PRE-RESTORATION VEGETATION

Type	Species	Genus	Common Name	location	Status	% cover
Ground Layer	Abrosia	artemisifolia	Common Ragweed	borrow pit	native	50
Ground Layer	Monarda	fistulosa	Bee balm	borrow pit	native	20
Ground Layer	Panicum	virgatum	Switchgrass	borrow pit	native	15
Ground Layer	Sorghastrum	nutans	Indian Grass	borrow pit	native	15
Ground Layer	Asclepius	syriaca	Common Milkweed	ground	native	5
Ground Layer	Oenothera	biennis	Evening primrose	ground	native	10
Ground Layer	Parthenocissus	quinquefolia	Virginia Creeper	ground	native/ naturalized	40
Ground Layer	Rumex	crispus	Yellow doc	ground	europe naturalized	25
Ground Layer	Solidago	canadensis	Canadian goldenrod	ground	native	15
Ground Layer	Verbascum	thapsus	Mullein Weed	ground	europe naturalised	5
Ground Layer	Rhus	glabra	Smooth Sumac	ground/wood	native	25
understory	Ageratina	altissima	White snakeroot	understory	native	25
understory	Prunella	vulgaris	Self heal	understory	native	5
understory	Ribes	sp.	Gooseberry	understory	native or naturalized	5
Ground Layer	Rubus	sp.	Raspberry	understory	native	15
understory	Slphium	laciniatum	Compass plant	understory	native	5
understory	Solidago	flexicalus	Zig Zag Goldenrod	understory	native	10
understory	Symphiotrichum	ericoides	Daisy Fleabane	understory	native	10
understory	Diervilla	lonicera	Honeysuckle	wooded edge	native	25
Canopy	Juglans	nigra	Black Walnut	wooded edge	native	15
understory	Rosa	arkansana	Prairie Rose	wooded edge	native	10
Ground Layer	Vitis	riparia	Wild Grape	wooded edge	native	50
Canopy	Fraxinus	sp.	Ash Tree (dead)	woods	signs of EAB	10
Canopy	Prunus	serotina	Black cherry	woods	native	15
Canopy	Quercus	rubra	Red Oak	woods	native	35
Canopy	Cornus	alba	white dogwood	woods	native or naturalized	40

APPENDIX B - VEGETATION MONITORING PROTOCOL

Transect Surveys

Tansect Surveys will be conducted by walking the transects shown on **Map B.1** and filling out all plants that cross the transect on **Figure B.1**

Equipment: Survey forms, notebook, camera, plastic bags, 1 sq meter PVC square, measuring tape, measuring rod, survey grid and point map, pen/pencil, plant ID field guide.

	Date:		Monitoring Point:							
	Time:		Weather Conditions:							
Subplot Towards	Distance From Center	Latin Name	Common Name	Height	Photo?	Notes				

Figure B.1 – Transect Survey Data Sheet

Invasive Species Walkthrough

This method is used to gain an understanding of the types of invasive species present in the SLPR restoration site without necessarily knowing, with precision, the prevalence of each species. This method also covers a large area without much time investment. Each grid on **Map B.1** is walked through and any invasive species are noted, with their approximate prevalence categorized as dominant, interspersed, or minimal. Surveyor will use a handheld GPS to ensure that they are in the appropriate grid square. Record data on the Invasive Species/Oak Count Data Sheet (**Figure B.4**)

Equipment: Survey forms, notebook, camera, plastic bags, measuring tape, measuring rod, survey grid and point map, pen/pencil, plant ID field guide.

Oak Count

This method is used to count the Northern Pin Oak and Bur Oak populations on the SLPR restoration site. This method also covers a large area without much time investment. Each grid on **Map B.1** is walked through and Northern Pin Oak and Bur Oak individuals are counted. Record data on the Invasive Species/Oak Count Data Sheet (**Figure B.4**)

Equipment: Survey forms, notebook, camera, plastic bags, measuring tape, measuring rod, survey grid and point map, pen/pencil, plant ID field guide.

Invasive Species/Oak Count Data Sheet - Spring Lake Park Reserve Restoration Site

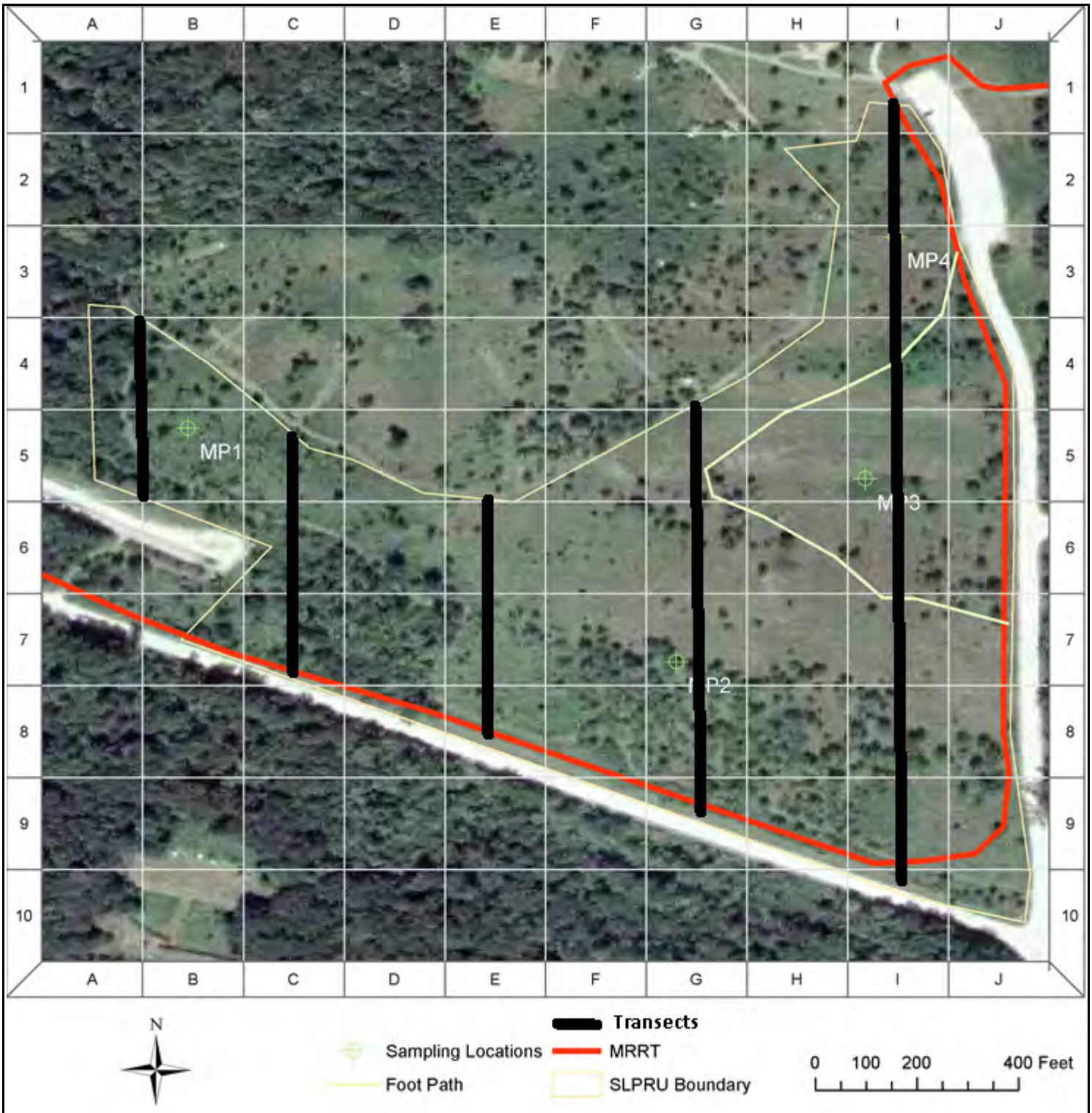
Technician Name: _____

Date: _____

Time: _____

Grid	Latin Name	Common Name	Prevalence	Northern Pin Oak	Bur Oak	Notes

Figure B.2 – Invasive Species/Oak Count Data Sheet



Map B.1 – Survey Grid and Points

APPENDIX C - SEED MIX SPECIFICATIONS

35-641 **Mesic Prairie Southeast**

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
big bluestem	*Andropogon gerardii*	1.01	0.90	7.49%	3.30
side-oats grama	*Bouteloua curtipendula*	1.54	1.37	11.38%	3.01
nodding wild rye	*Elymus canadensis*	1.18	1.05	8.77%	2.01
slender wheatgrass	*Elymus trachycaulus*	1.01	0.90	7.50%	2.28
switchgrass	*Panicum virgatum*	0.24	0.21	1.78%	1.10
little bluestem	*Schizachyrium scoparium*	1.42	1.27	10.59%	7.00
Indian grass	*Sorghastrum nutans*	2.24	2.00	16.68%	8.82
	Total Grasses	**8.63**	**7.70**	**64.19%**	**27.52**
butterfly milkweed	*Asclepias tuberosa*	0.07	0.06	0.53%	0.10
whorled milkweed	*Asclepias verticillata*	0.01	0.01	0.10%	0.05
Canada milk vetch	*Astragalus canadensis*	0.18	0.16	1.33%	1.00
partridge pea	*Chamaecrista fasciculata*	0.67	0.60	5.00%	0.60
white prairie clover	*Dalea candida*	0.01	0.01	0.07%	0.06
purple prairie clover	*Dalea purpurea*	0.10	0.09	0.76%	0.50
Canada tick trefoil	*Desmodium canadense*	0.17	0.15	1.24%	0.30
ox-eye	*Heliopsis helianthoides*	0.06	0.05	0.43%	0.12
rough blazing star	*Liatris aspera*	0.03	0.03	0.21%	0.15
great blazing star	*Liatris pycnostachya*	0.03	0.03	0.29%	0.14
wild bergamot	*Monarda fistulosa*	0.01	0.01	0.06%	0.18
stiff goldenrod	*Oligoneuron rigidum*	0.02	0.02	0.17%	0.31
gray-headed coneflower	*Ratibida pinnata*	0.02	0.02	0.15%	0.20
black-eyed susan	*Rudbeckia hirta*	0.06	0.05	0.38%	1.54
heath aster	*Symphyotrichum ericoides*	0.01	0.01	0.05%	0.40
smooth aster	*Symphyotrichum laeve*	0.06	0.05	0.41%	1.00
bracted spiderwort	*Tradescantia bracteata*	0.04	0.04	0.34%	0.15
blue vervain	*Verbena hastata*	0.04	0.04	0.37%	1.50
hoary vervain	*Verbena stricta*	0.11	0.10	0.85%	1.05
golden alexanders	*Zizia aurea*	0.08	0.07	0.60%	0.29
	Total Forbs	**1.79**	**1.60**	**13.34%**	**9.64**
Oats or winter wheat (see note at beginning of list for recommended dates)		3.03	2.70	22.47%	1.20
	Total Cover Crop	**3.03**	**2.70**	**22.47%**	**1.20**
	Totals:	**13.45**	**12.00**	**100.00%**	**38.36**
Purpose:	Regional mesic prairie reconstruction for wetland mitigation, ecological restoration, or conservation program plantings.				
Planting Area:	Eastern Broadleaf Forest Province excluding Hardwood Hills subsection. Mn/DOT Districts Metro & 6.				

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