



# Renewing the Minnesota Landscape

## A Process for Restoration Planning

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## A Process for Restoration Planning

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### Workshop Goal:

Provide a foundation of knowledge for planning restoration projects - developing a strong restoration concept and list of strategies



# Information Resource



## “What’s Working Information Compiled from Practitioners



The screenshot shows a web browser window displaying the Minnesota Board of Water & Soil Resources website. The page is titled "What's Working" and contains the following text:

The following information has been compiled through contributions from professionals, research efforts, field trials and reporting through BWSR grant programs. Practitioners are encouraged to submit findings from their projects for the continued development of this effort. Please submit information to [dawn.shaw@state.mn.us](mailto:dawn.shaw@state.mn.us).

**Sections:**

- Conservation Project Planning and Promotion
- Vegetation Establishment and Maintenance
- Invasive Species Control

**What's Working for Conservation Project Planning and Promotion**

The following information is a continuation of a chapter that was developed in Volume II of the publication "Plants for Stormwater Design, Species Selection for the Upper Midwest" (Great River Greening, 2007).

**Categories:**

- Site Selection
- Project Design
- Partnering
- Project Promotion

**Site Selection**

-We perform a thorough pre-application site investigation of all potential wetland restoration projects, including drainage investigations such as the location, flow direction, size of intake(s), elevations, private and public systems etc. Part of the pre-application process is reviewing the site with a landowner. Good communication with the landowner and the neighboring landowner from the get-go prevents mistakes in the design and construction stage (Remember BWCD).

-When assessing funding priorities, Roadsides for Wildlife considers the following questions: which sites will provide the best grassland bird habitat (larger projects are usually better and our prime target area is within the pheasant range), which sites are publicly owned and likely to remain as long-term investments, at which sites will road construction be completed within the funding cycle.

[www.bwsr.state.mn.us/native\\_vegetation/](http://www.bwsr.state.mn.us/native_vegetation/)

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### The Restoration Process:

Step 1: Defining Goals and Outcomes

Step 2: Site Assessment

Step 3: Selecting Strategies

Step 4: Plan Development

Step 5: Implementation

Step 6: Site Monitoring and Maintenance



# Renewing the Minnesota Landscape

## A Process for Restoration Planning



### 5 Vegetation Establishment

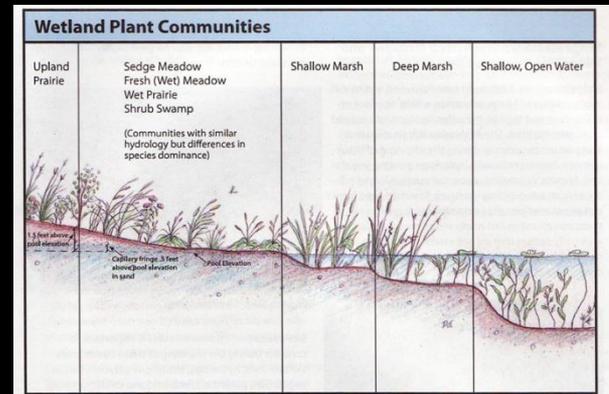
- 5-1 Vegetation Establishment Considerations
- 5-2 Developing a Vegetation Plan
- 5-3 Site Preparation
- 5-4 Establishing Upland Vegetation
- 5-5 Establishing Wetland Vegetation
- 5-6 Selecting Seed Mixes and Plant Materials
- 5-7 Vegetation Plan Implementation
- 5-8 Maintenance for Vegetation Establishment

The Vegetation Establishment Section of the Minnesota Wetland Restoration Guide provides a comprehensive approach to establishing native vegetation in restored and created wetlands and surrounding upland areas. The chapters in this section of the Guide provide detailed information about the steps involved in establishing plant communities from developing a vegetation plan to project implementation and maintenance.

The establishment of wetland vegetation has been occurring since wetland restoration became a common practice in the 1970s and 80s. Goals for many earlier projects focused on restoring hydrology and the creation of habitat for waterfowl. The restoration of vegetation typically relied on species that would establish from native seedbanks or natural colonization. In recent years, there has been an increased emphasis on establishing diverse wetland plant communities that create wildlife habitat for a larger number of species including birds, animals, and insects, increasing competition with invasive species, and providing greater plant community stability. The increased emphasis on these functional goals has led to new techniques to remove invasive species, plant wetland species, and provide long-term care.



Figure 5.1



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## A Process for Restoration Planning

### Sample Project



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### Step 1: Site Assessment

- Soils
- Historic Vegetation
- Hydrology
- Historic Landuse
- Current Landuse
- Remnant Native Plants
- Invasive species on site
- Surrounding Remnants and Habitat Corridors
- Natural Disturbance Regimes
- Human Caused Disturbance
- Sources of Pollution or Invasive Species



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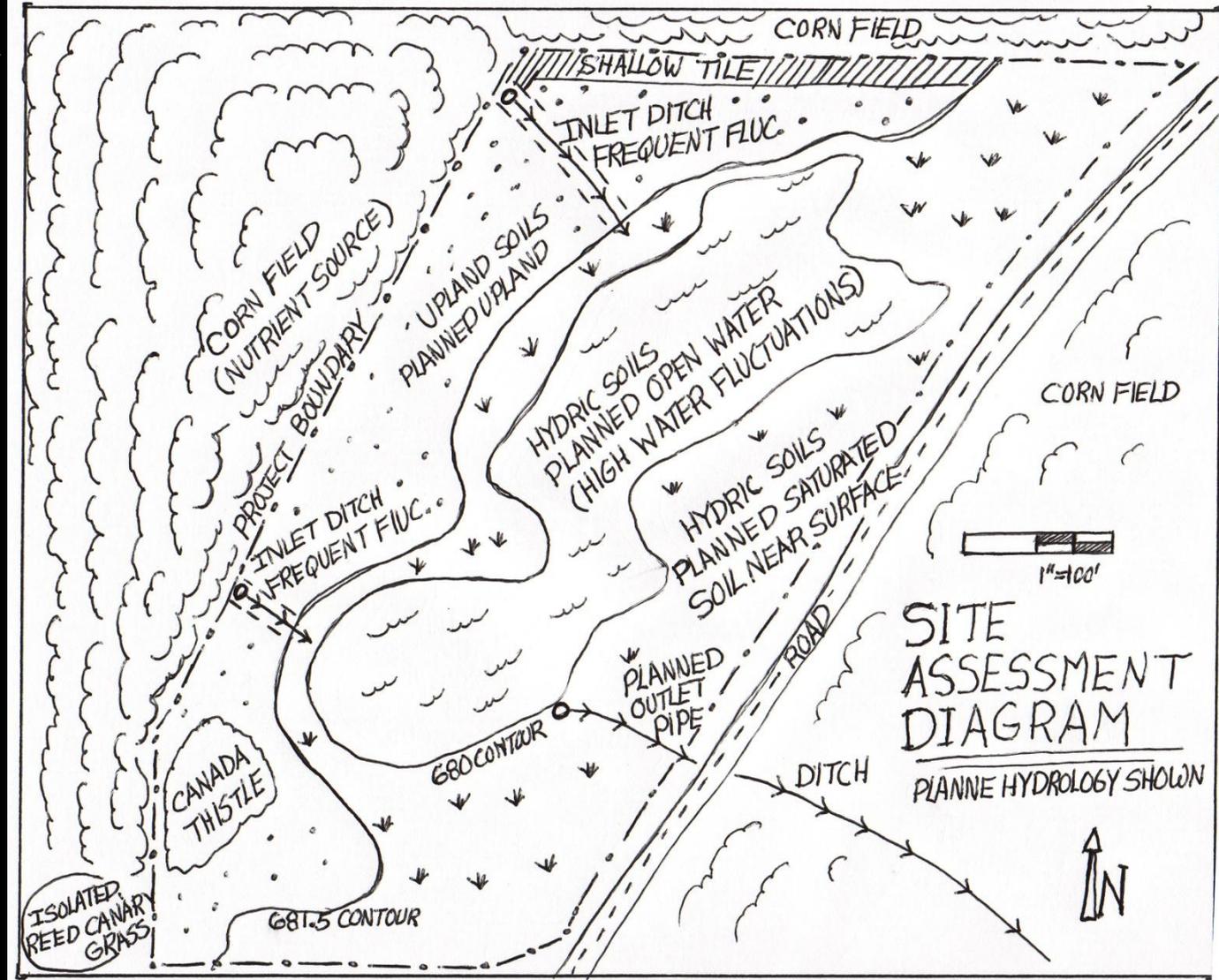
### Sample Project



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## A Process for Restoration Planning

### Sample Project



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### Step 2: Project Goals and Outcomes

- Wildlife Habitat
- Plant Community Reconstruction
- Soil Stabilization
- Water Quality
- Soil Quality
- Bio-energy
- Carbon Sequestration
- Seed Production
- Recreation
- Aesthetics



Outcomes are Quantitative Values (no. of species, pounds P reduced etc.)

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### Step 3: Project Design/ Selection of Strategies



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### Step 3: Project Design/ Selection of Strategies

#### Resources:

Wetland Restoration Guide

[www.bwsr.state.mn.us/publications/restoration\\_guide.html](http://www.bwsr.state.mn.us/publications/restoration_guide.html)

-Minnesota Wetland Plant ID Guide

[www.mn.nrcs.usda.gov/programs/wrp/plantid/about.html](http://www.mn.nrcs.usda.gov/programs/wrp/plantid/about.html)

-State Seed Mixes

[www.bwsr.state.mn.us/wetlands/vegetation/index.html](http://www.bwsr.state.mn.us/wetlands/vegetation/index.html)

-Grassland Inter-seeding Guidelines

[www.bwsr.state.mn.us/grantscostshare/native-buffer.html](http://www.bwsr.state.mn.us/grantscostshare/native-buffer.html)

-Conservation/Restoration “What’s Working” Information

[www.bwsr.state.mn.us/grants/WhatsWorking.html](http://www.bwsr.state.mn.us/grants/WhatsWorking.html)

-Project Maintenance Information

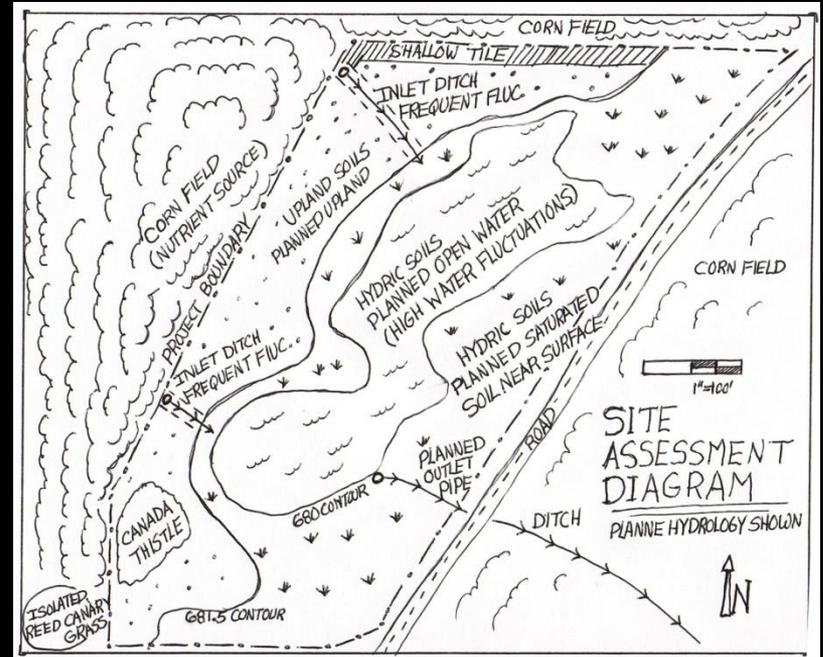


# Renewing the Minnesota Landscape

## A Process for Restoration Planning (Site Preparation)

### Site Preparation Strategies:

- Clearing and Grubbing
- Sediment Removal
- Scraping
- Crop Production
- Perennial Vegetation Removal
- Tilling for Weed Control
- Seedbed Preparation
- Temporary Cover Crops



# Renewing the Minnesota Landscape

## A Process for Restoration Planning (Site Preparation)

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### Clearing and Grubbing



#### **Benefits:**

Important to control weedy and Invasive shrubs that can become maintenance problems

#### **Limitations:**

Can cause soil disturbance and Compaction, can damage desirable trees

# Renewing the Minnesota Landscape

## A Process for Restoration Planning (Site Preparation)

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### Sediment Removal



### **Benefits:**

Can expose native seedbank

### **Limitations:**

Can cause compaction, may be difficult to find native seedbank

# Renewing the Minnesota Landscape

## A Process for Restoration Planning (Site Preparation)

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### Scraping

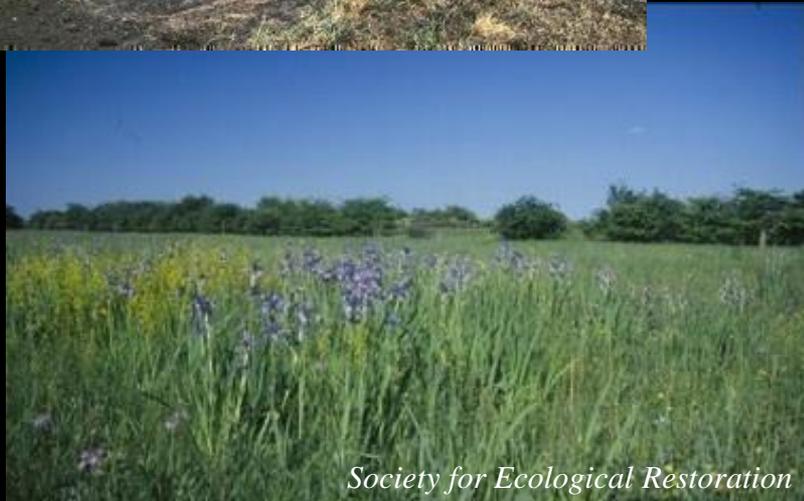


### **Benefits:**

Can remove invasive species roots/rhizomes and seed, may expose native seedbank

### **Limitations:**

May remove needed topsoil, can cause compaction



*Society for Ecological Restoration*

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## A Process for Restoration Planning (Site Preparation)

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### Crop Production



### **Benefits:**

Can produce a relatively clean seedbed with few other steps needed before seeding.

### **Limitations:**

Can disturb soil micro-organisms, may not remove all perennial Weeds such as Canada thistle.

# Renewing the Minnesota Landscape

## A Process for Restoration Planning (Site Preparation)

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### Perennial Vegetation Removal



#### **Benefits:**

Generally necessary to establish native vegetation

#### **Limitations:**

May require herbicide treatment and may take a season or longer.

[www.bwsr.state.mn.us/publications/wetland\\_restoration/Appendix-5A.pdf](http://www.bwsr.state.mn.us/publications/wetland_restoration/Appendix-5A.pdf)

# Renewing the Minnesota Landscape

## A Process for Restoration Planning (Site Preparation)

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### Tilling for Weed Control



### **Benefits:**

Can minimize herbicide use and aid in seedbed preparation

### **Limitations:**

Can disturb soil structure and lead to compaction and erosion, herbicide usually also needed for perennial weed control

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## A Process for Restoration Planning (Site Planning)

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### Seedbed Preparation



#### **Benefits:**

Necessary step in preparation of seeding

#### **Limitations:**

The right seedbed preparation strategy must be selected for the seeding equipment to be used.

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## A Process for Restoration Planning (Site Preparation)

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### Temporary Cover Crops



#### **Benefits:**

Can allow time for weed management and can be disked  
To provide mulch

#### **Limitations:**

Can add cost (though may be  
Similar to mulching costs, and  
cover crop can be harvested)

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## A Process for Restoration Planning (Upland Planting)

### Upland Planting Strategies:

Broadcast Seeding

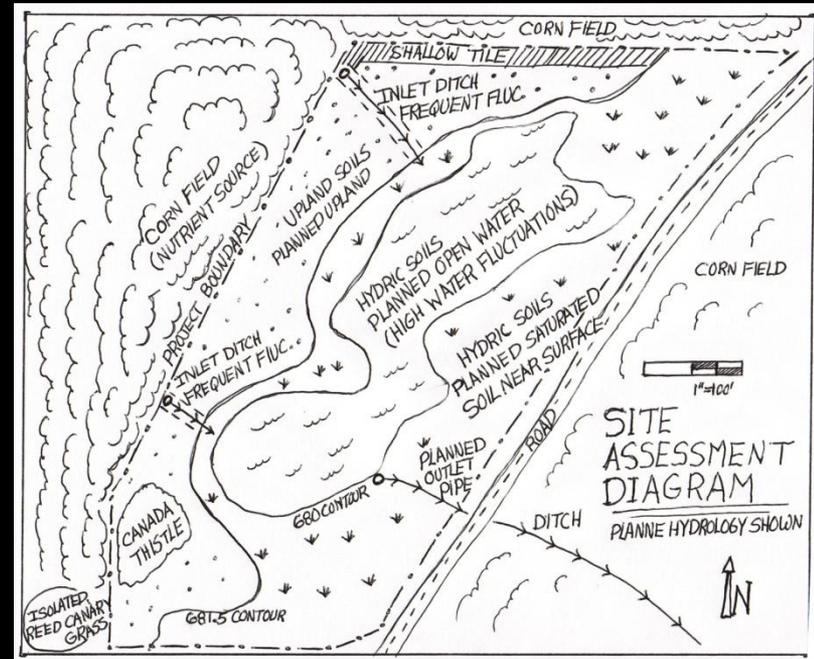
Seed Drills

Containerized Plants and Rootstock

Upland Trees and Shrubs

Bacterial and Mycorrhizal Inoculum

Stabilizing Uplands



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### Broadcast Seeding



### Benefits:

Can be conducted without smooth seedbed, seed may not require as much processing, can be conducted on frozen ground in some cases

### Limitations:

May require more seed



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### Seed Drills



### **Benefits:**

Ensures good placement of grass seed, no-till versions available.

### **Limitations:**

Specialized equipment and good seedbed preparation needed.

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### Containerized Plants and Rootstock



### **Benefits:**

Good method to add species that may not establish well from seed.

### **Limitations:**

Watering and weed control often needed.

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### Upland Trees and Shrubs



### Benefits:

Direct seeding of trees and shrub can decrease impact from deer and rodents and lead to dense stands

### Limitations:

Sufficient seed supplies are needed and some species establish better than others.

# Renewing the Minnesota Landscape

## A Process for Restoration Planning (Upland Establishment)

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### Bacterial and Mycorrhizal Inoculum



### Benefits:

Aid establishment and water holding capacity of many species

### Limitations:

May be difficult to find local sources

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## A Process for Restoration Planning

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### Stabilizing Uplands



### Benefits:

Important for any project where sediment loss is a concern, seed being covered is a common problem.

### Limitations:

It can be complex to find the right solution for site conditions and season of establishment.

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## A Process for Restoration Planning (Wetland Planting)

### Wetland Planting Strategies:

Utilizing Existing Native Seedbank

Managing Hydrology

Broadcast Seeding

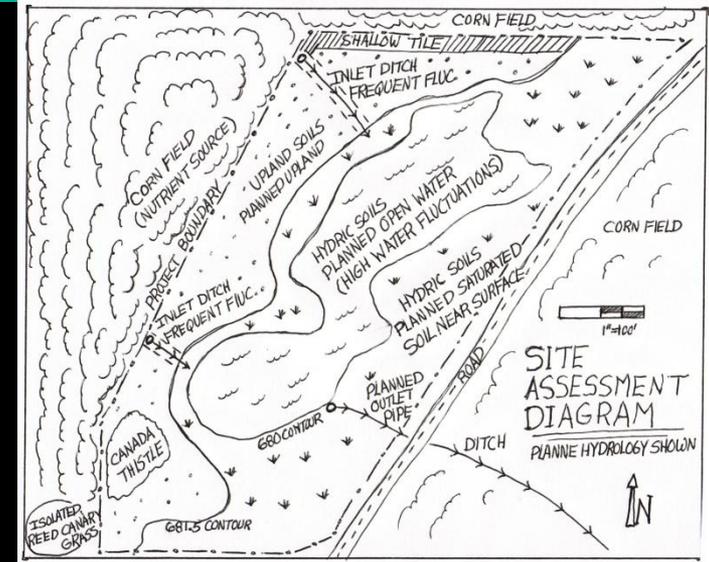
Hydroseeding Wetlands

Wetland Containerized Plants and Rootstock

Wetland Trees and Shrubs

Mulching Wetlands

Peatland Restoration



# Renewing the Minnesota Landscape

## A Process for Restoration Planning

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### Utilizing Existing Native Seedbank



### **Benefits:**

Good method to maximize the Use of local species.

### **Limitations:**

Some species are not common from seedbank. It can be difficult to find seedbank layers where sediment accumulation has occurred.

# Renewing the Minnesota Landscape

## A Process for Restoration Planning (Wetland Establishment)

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### Managing Hydrology



### **Benefits:**

Water level control can be very helpful to ensure that young plants have sufficient hydrology.

### **Limitations:**

control structures add cost and require adjustment.

# Renewing the Minnesota Landscape

## A Process for Restoration Planning

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### Broadcast Seeding



### Benefits:

Recommended method for most wetland species, and common in prairie restoration for dispersing wild harvest seed.

### Limitations:

Seeding rates often need to be increased. Grass seed may not have good seed to soil contact.

# Renewing the Minnesota Landscape

## A Process for Restoration Planning

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### Hydroseeding Wetlands



#### **Benefits:**

Useful on sites where access is difficult.

#### **Limitations:**

Application is limited by range of sprayer.

# Renewing the Minnesota Landscape

## A Process for Restoration Planning

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### Wetland Containerized Plants and Rootstock



#### **Benefits:**

Good method to add species that do not do well from seed, and to add species along the edge of open water where seedlings may not do well.

#### **Limitations:**

Changing water levels may influence survival.

# Renewing the Minnesota Landscape

## A Process for Restoration Planning

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### Wetland Trees and Shrubs



### **Benefits:**

Used for wooded forest restoration.

### **Limitations:**

Nursery grown plants often do not transplant well into wetlands. mounding may be needed when soils will be saturated

# Renewing the Minnesota Landscape

## A Process for Restoration Planning

### Mulching Wetlands



#### **Benefits:**

Protects seedling plants by holding moisture and minimizing sediment loss.

#### **Limitations:**

Adds to project cost. Mulch may windrow in wetlands.

# Renewing the Minnesota Landscape

## A Process for Restoration Planning

### Peatland Restoration



### Benefits:

New methods are being used to establish peatlands.

### Limitations:

Donor peat is needed as part of the restoration process.



Figure 5.80 Spreading Moss Fragments

Covering the reintroduced plant fragments is one of the most important steps in peatland re-vegetation. Mulch provides humid conditions that are necessary for plant establishment. Studies have shown that the use of straw mulch overwhelmingly improves Sphagnum moss establishment and survival (Quinty, 1996; Johnson, et al. 2000). Straw mulch has been successful for peatland restorations and is effectively applied to sites with a forage blower at a rate of 3000 kg per ha or 1.5 tons/acre (approximately two to three large round bales or 80 small square bales per acre) (Rochefort et al. 2001) (Quinty and Hood 1998). Shrubs and other peatland species such as Carex oligosperma may also aid in the establishment of Sphagnum by providing shade and protection from wind (Boudreau and Rochefort 1998) (Johnson et al 2000). Seed of some herbaceous peatland species may be introduced to a site along with the donor material. If the restoration site retains the acidic, low nutrient qualities of a bog or poor fen, then invasive species are usually not a significant problem. If present, invasive species such as reed canary grass should be controlled with glyphosate.

Table 5.20  
Typical Schedule for Peatland Restoration

Year 1, Fall	Site preparation.
Year 1, Fall	Initial restoration of hydrology and leveling of surface.
Year 2, March	Collection from donor site and spreading on restoration site.
Year 2, April	Application of weed-free straw.
Year 2, April	Application of phosphorus fertilizer.
Year 2, May	Final restoration of hydrology (ditch blocking).
Year 2, May-September	Spot treatment of weeds with glyphosate herbicide. Application of grass specific herbicide in areas where reed canary grass is establishing and there is no open water.
Year 3-5, May-September	Spot treatment of weeds with glyphosate herbicide. Application of grass specific herbicide in areas where reed canary grass is establishing and there is no open water.

#### Influence on Maintenance

Maintaining water levels at or just below the soil surface, providing a weed free straw mulch, and controlling invasive species are particularly important in the restoration of peatlands.

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## A Process for Restoration Planning

### 5-6 Selection and Placement of Seed and Plant Materials



Figure 5.82 Emergent Planting Zone

The information in this chapter summarizes the selection of seed and plant materials and provides guidelines for their placement on project sites. There are many types of plant materials that can be selected for a project. An increasing number of species are becoming available as seed and plants. As seed and plant material can be a significant project cost, project designers should understand options for a project, selection considerations, and where seed and plant materials can most effectively be used to provide the greatest project benefits.

The information in the previous two sections of the Guide, Sections 5-4 Upland Planting and 5-5 Wetland Planting should have already been reviewed and considered as the decisions regarding plant selections are being made.

Topics covered in this section include:

- General Seed and Plant Material Considerations
- Seed Mix Selection
- Seed Mix Standards
- Seed Mix Development
- Selecting Plants
- Seed and Plant Placement

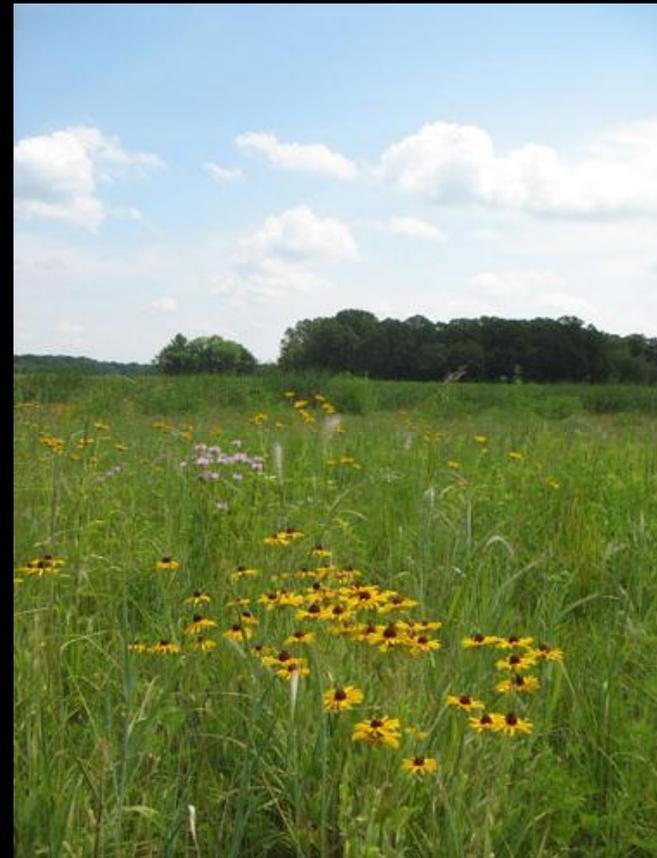
#### General Considerations

Many projects in the past have used native seedbanks or natural re-colonization for vegetation establishment. This has been successful for many projects but cannot be relied on if invasive species are present, if land use has depleted the native seedbank, or if sediment accumulation has buried the seedbank. An increasing number of projects are beginning to focus on the planting of seed for wetland plant communities in addition to upland buffers to maximize wetland functions. Wetland seed can be expensive, so it is important to select appropriate mixes for the given soil and hydrologic conditions. Plants, including containerized plants, pre-vegetated mats, bare-root plants, and transplants will jumpstart vegetation establishment, particularly in situations where fluctuating water levels or other variables related to hydrology will prevent seed from establishing.

Planting decisions should be made by a plant specialist coordinating with the site hydrologist, soil scientist and/or geotechnical engineer.



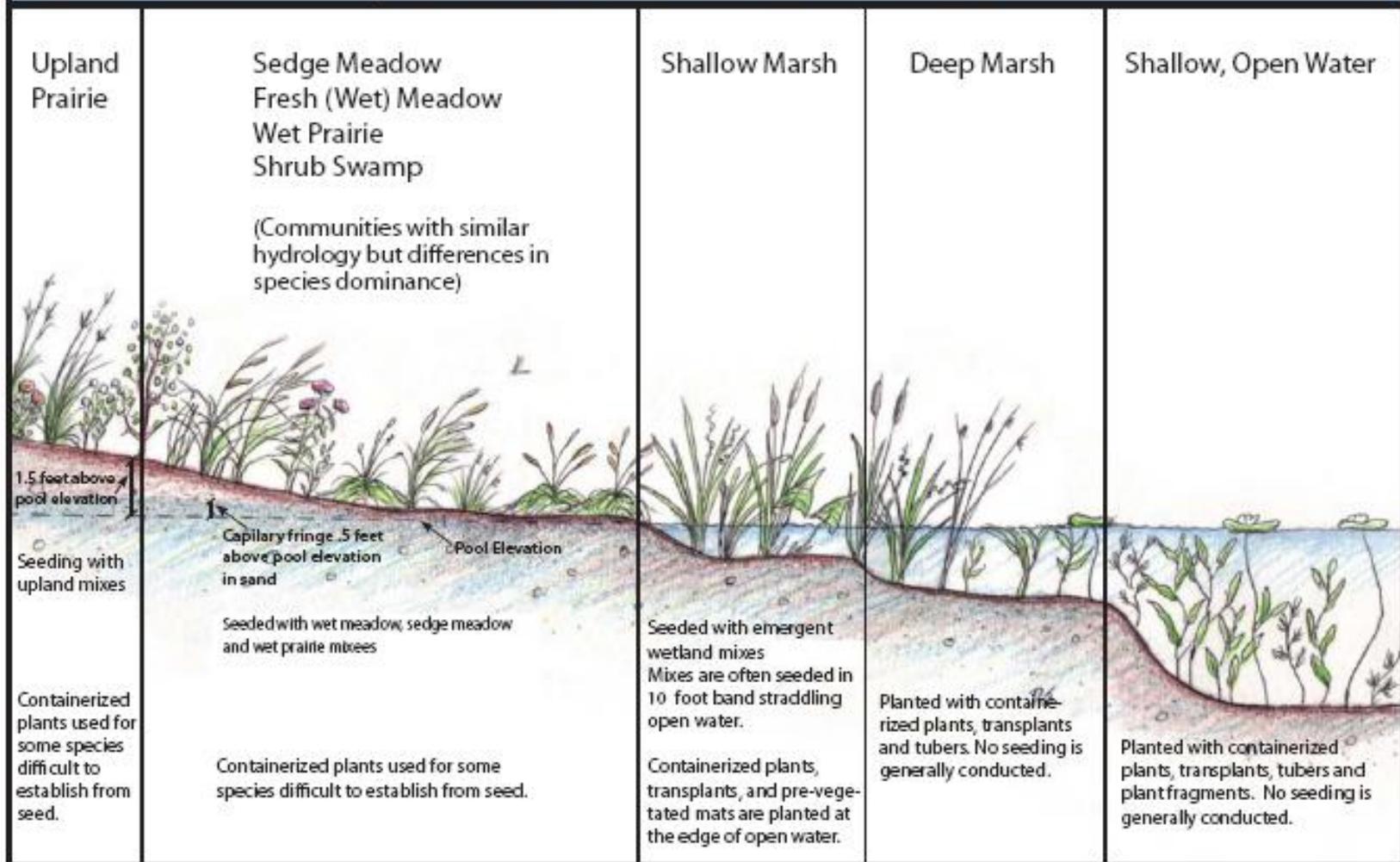
Figure 5.83 Mixing Wetland Seed



# Renewing the Minnesota Landscape

## A Process for Restoration Planning

### Plant Community Planting Recommendations



# Renewing the Minnesota Landscape

## A Process for Restoration Planning (Maintenance Strategies)

### Maintenance Strategies:

Herbivore Control

Prescribed Burning

Mowing

Tree and Shrub Care

Haying

Grazing

Biological Control

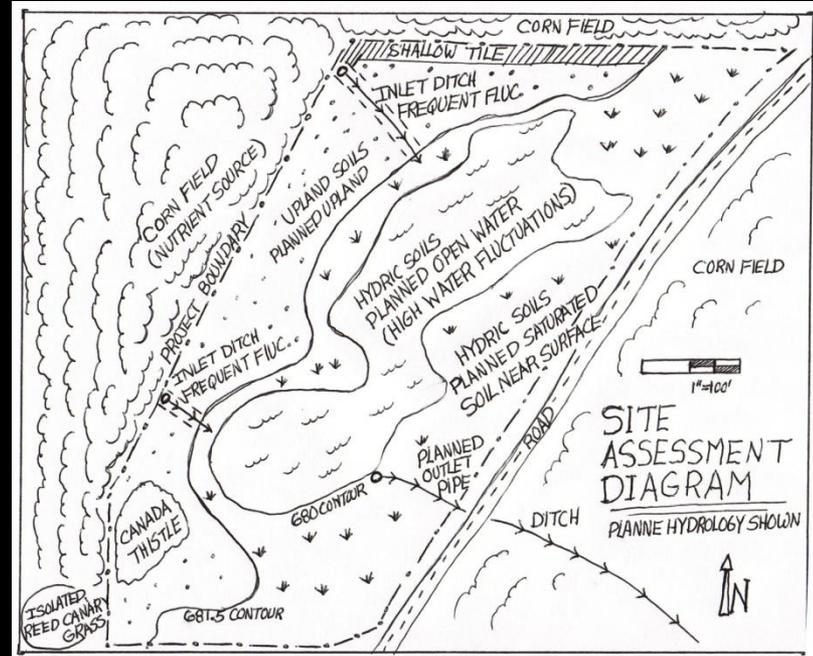
Herbicide Application

Hand Weeding

Hydrology Control

Supplemental Planting

Watering



# Renewing the Minnesota Landscape

## A Process for Restoration Planning

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### Herbivore Control



#### **Benefits:**

Herbivores can be a problem for berms and embankments

#### **Limitations:**

Solutions are generally limited to barriers or trapping.

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## A Process for Restoration Planning

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### Prescribed Burning



### **Benefits:**

Burning invigorates prairies and can aid the control of woody plants.

### **Limitations:**

Burning in wet meadow restorations can lead to spread of thistle and reed canary grass depending on timing.

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### Mowing



### Benefits:

Mowing is essential for the establishment of prairie and can aid control of species such as Canada thistle.

### Limitations:

Mowing may be limited by hydrology or steep slopes.

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### Tree and Shrub Care



#### **Benefits:**

Maintains health of forest plantings.

#### **Limitations:**

May require pesticide use, can add to project costs.

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### Haying



### **Benefits:**

Aid the removal of thatch and woody seedlings. Allows light to reach lower growing species.

### **Limitations:**

May be a temporary solution and limited by hydrology.

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## A Process for Restoration Planning

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### Grazing



### Benefits:

Can improve diversity and used for invasive species control when done well.

### Limitations:

Potential for overgrazing, and spread of invasive species.

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## A Process for Restoration Planning

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### Biological Control



#### **Benefits:**

Effective for species such as purple loosestrife and leafy spurge.

#### **Limitations:**

Less effective for scattered plants and bio-control may be lost due To flooding or fire.

# Renewing the Minnesota Landscape

## A Process for Restoration Planning

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### Herbicide Application -Spot Treatment



### **Benefits:**

Can decrease invasive species before they have a chance to spread.

### **Limitations:**

Repeated visits may be needed and care must be taken to ensure proper use of herbicides.

[www.bwsr.state.mn.us/publications/wetland\\_restoration/Appendix-5A.pdf](http://www.bwsr.state.mn.us/publications/wetland_restoration/Appendix-5A.pdf)

# Renewing the Minnesota Landscape

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### Restoration Guide Invasive Species Removal Information

#### **Species included in Appendix 5A:**

- Hybrid cattail (*Typha glauca*)
- Narrow-leaf cattail (*Typha angustifolia*)
- Purple loosestrife (*Lythrum salicaria*)
- Reed canary grass (*Phalaris arundinacea*)
- Common buckthorn (*Rhamnus cathartica*)
- Glossy buckthorn (*Rhamnus frangula*)
- Common reed grass (*Phragmites australis*, syn. *P. communis*)
- Canada thistle (*Cirsium arvense*)
- Crown vetch (*Coronilla varia*)
- Bird's foot trefoil (*Lotus corniculatus*)
- Sweet clover (*Melilotus officinalis* and *M. alba*)
- Wild parsnip (*Pastinaca sativa* L.)
- Spotted knapweed (*Centaurea maculosa*)

[www.bwsr.state.mn.us/publications/wetland\\_restoration/Appendix-5A.pdf](http://www.bwsr.state.mn.us/publications/wetland_restoration/Appendix-5A.pdf)

# Renewing the Minnesota Landscape

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### Restoration Guide Invasive Species Removal Information

<b>Reed Grass Control Strategies</b>		
Site Conditions	Recommended Strategy	Herbicide/Rate
Dense Stands, monoculture	Conduct herbicide application via sprayer, dye, and 5' wand in early fall to upper plant. Mow in fall, winter or early spring or conduct a spring burn, repeat application of herbicide to resprouts in early June. Repeat following years as necessary.	Apply 1.5% solution by volume of glyphosate or Imazapyr at label rates
Dense Stands, intermixed natives	Wick application of glyphosate in early fall. Mow or conduct spring burn, repeat application of glyphosate to resprouts in early June. Repeat following years as necessary.	Apply 1.5% solution by volume of glyphosate or Imazapyr at label rates
Small Stands	Hand cut stems near ground in July or August and drip glyphosate directly into cut stem. Drip treatment best if immediately following cutting.	Apply 25% - 50% solution by volume of glyphosate or Imazapyr at label rates.

*Note: Effectiveness of strategies may vary depending on season, weather, soils, hydrology and other environmental conditions*

[www.bwsr.state.mn.us/publications/wetland\\_restoration/Appendix-5A.pdf](http://www.bwsr.state.mn.us/publications/wetland_restoration/Appendix-5A.pdf)

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### Herbicide Application Broadcast Application



### **Benefits:**

Non-target species may be treated.

### **Limitations:**

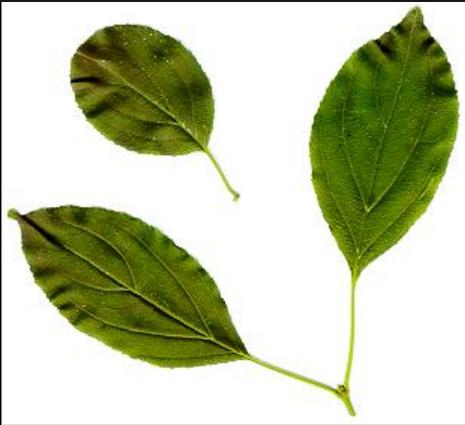
Repeated visits may be needed and care must be taken to ensure proper use of herbicides.

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### Herbicide Application Basal Treatment



### **Benefits:**

Can be an effective method to treat scattered medium to large buckthorn.

### **Limitations:**

Overspray can be a concern.  
Plants are left standing.

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### Hydrology Control



### **Benefits:**

Allows lowering of water levels for access of equipment.

### **Limitations:**

Careful control of water levels is needed as multiple wildlife species can be influenced

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### Hand Weeding



### **Benefits:**

Effective method for small populations of invasive species.

### **Limitations:**

May be too time consuming and labor intensive.

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### Supplemental Planting



#### **Benefits:**

Ensures that weeds will not become dominant in areas of poor establishment.

#### **Limitations:**

Requires access that could cause more disturbance.

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### Watering



### **Benefits:**

Important for young trees and shrubs and wetland plants that are susceptible to drying.

### **Limitations:**

May not be possible on a large scale.

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### Site Preparation Strategies

- Clearing and Grubbing
- Sediment Removal
- Scraping
- Crop Production
- Perennial Vegetation Removal
- Tiling for Weed Control
- Seedbed Preparation
- Temporary Cover Crops

### Upland Planting Strategies

- Broadcast Seeding
- Seed Drills
- Containerized Plants and Rootstock
- Upland Trees and Shrubs
- Bacterial and Mycorrhizal Inoculum
- Stabilizing Uplands

### Wetland Planting

- Utilizing Existing Native Seedbank
- Managing Hydrology
- Broadcast Seeding
- Hydro-seeding Wetlands
- Wetland Containerized Plants and Rootstock
- Wetland Trees and Shrubs
- Mulching Wetlands
- Peatland Restoration

### Maintenance Strategies

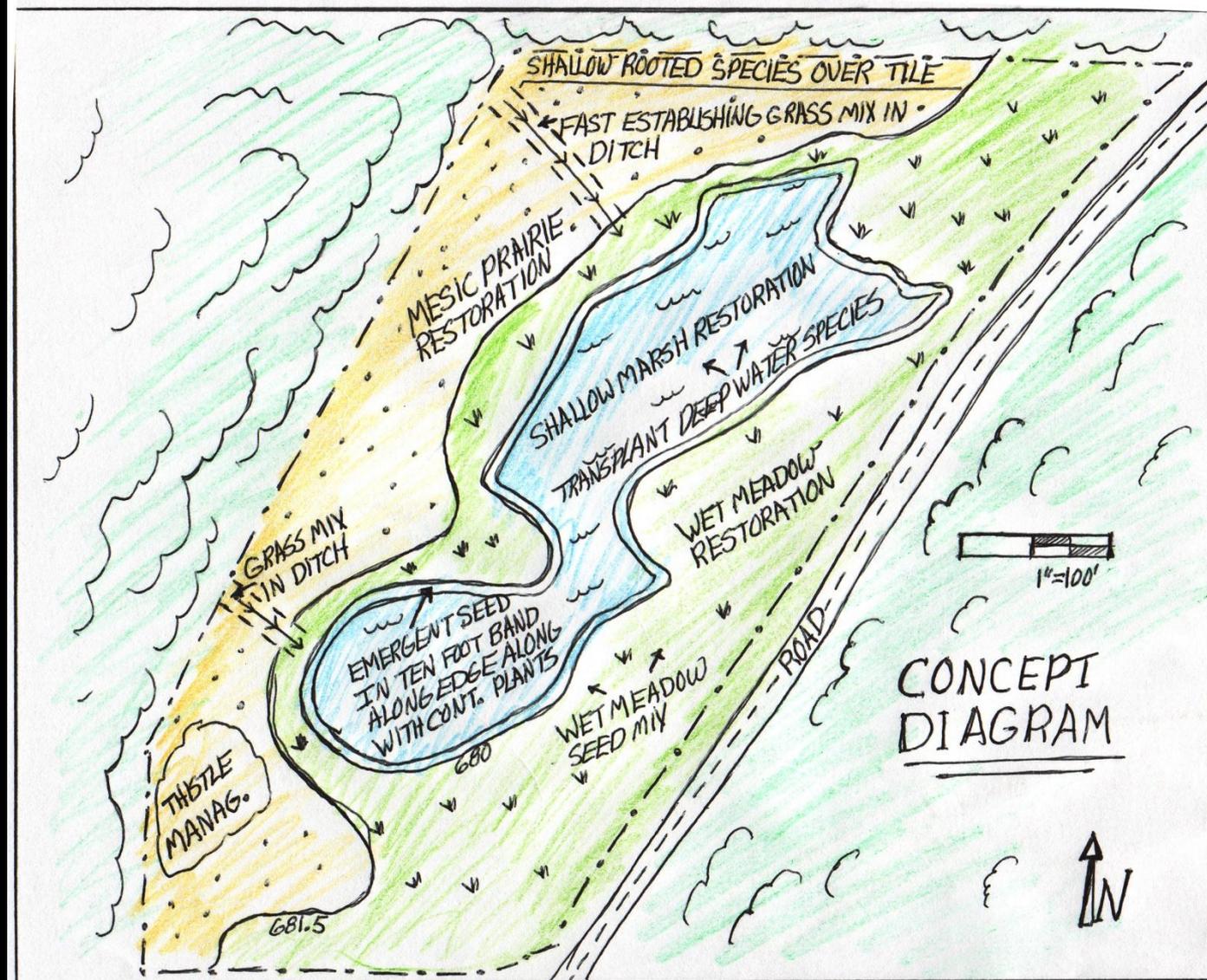
- Herbivore Control
- Prescribed Burning
- Mowing
- Tree and Shrub Care
- Haying
- Grazing
- Biological Control
- Herbicide Application
- Hand Weeding
- Hydrology Control
- Supplemental Planting
- Watering

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### Step 4: Plan Dev. Concept Plan



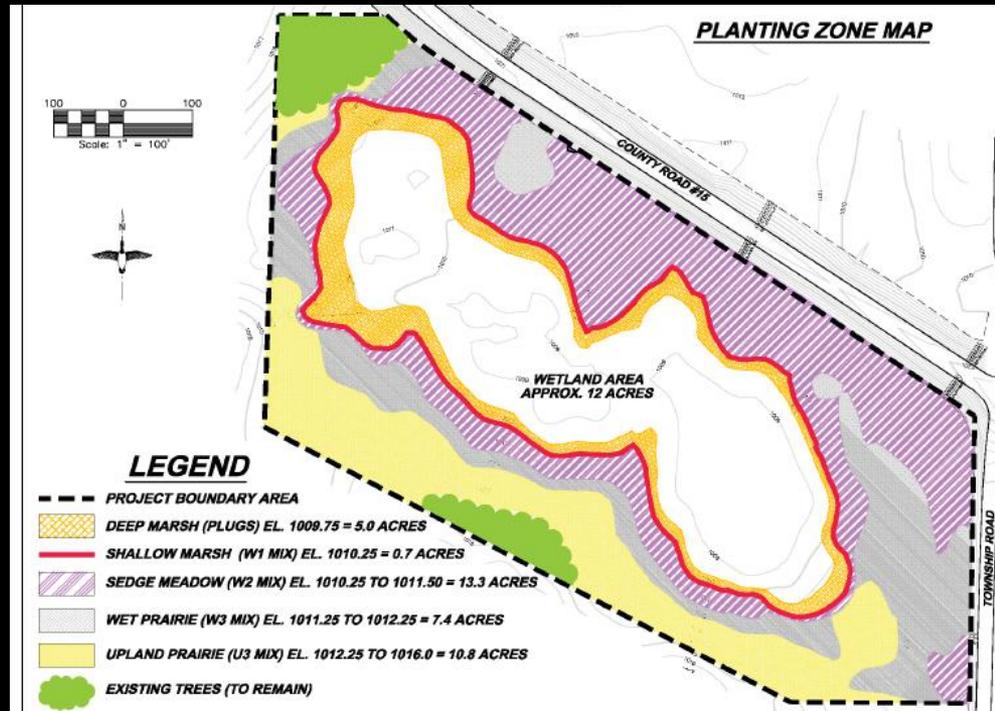
# Renewing the Minnesota Landscape

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### Step 4: Plan Development

### Final Planting Zone Map



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### Step 5: Implementation

#### 5-7 Vegetation Plan Implementation



Figure 5.103

##### Reviewing the Vegetation Plan

The final vegetation plan prepared for a project should include the project overview, planting zone map, project details, project specifications and notes, and project schedules. Time should be taken to review the vegetation plan to ensure that it is complete. It is important that all of the components are working together to provide sufficient detail for contractors to be able to conduct the installation. The vegetation plan may need additional refinement as the installation project begins, particularly if site conditions and project schedules change.

##### Pre-bid Meetings

Pre-bid meetings are recommended for larger projects to review the scope of work with contractors interested in bidding on the project. The pre-bid meeting, usually includes discussions by the project designer about the following topics:

- Submission Dates
- Permit Requirements
- Bonding Requirements
- Prequalification Requirements
- Payment and Completion Dates
- Site Access

This chapter summarizes the steps involved in preparing for project implementation. Topics covered in the chapter include the following:

- Reviewing the Vegetation Plan
- Pre-bid Meetings
- Bidding and Contractor Selection
- Measurement and Payment
- Permits and Certification Requirements
- Pre-Implementation Meetings
- Layout and Staking
- Handling Restoration Materials
- Project Coordination and Communication
- Site Inspection and Vegetation Establishment

- Project Scope
- Specifications
- Bid Information
- Project Schedules
- Property Boundaries
- Measurement and Payment
- Performance Standards.

Essentially, the pre-bid meetings are intended to help everyone understand the details of the project. The pre-bid meeting provides an opportunity for contractors to ask questions about the project before submitting a bid.

##### Bidding and Contractor Selection

If contractors will be selected through a bidding process, it is essential to develop project specifications that are clearly understood, practical, and enforceable. Performance standards aid in setting expectations for a project in preparation for bidding.

# Renewing the Minnesota Landscape

## A Process for Restoration Planning



## Step 6: Site Monitoring And Maintenance

