



Gully 30 Calcareous Fen Management Plan

Enbridge Energy, Limited Partnership • Line 3 Replacement Project

October 2020

ENBRIDGE®

TABLE OF CONTENTS

FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

Alberta Clipper	Alberta Clipper Project
Alberta Clipper FMP	Gully 30 Fen Management Plan for the Alberta Clipper Project
Alberta Clipper Monitoring Program	the ongoing Alberta Clipper Project monitoring program
ATV	all-terrain vehicle
ATWS	additional temporary workspace
BMP	best management practice
Designated Route	the Minnesota Public Utilities Commission Designated Route
Ditch Fen	Bed of a shallow ditch crossed within the Gully 30 Fen
DOC-EERA	Minnesota Department of Commerce, Energy Environmental Review and Analysis
EI	Environmental Inspector
EIS	Environmental Impact Statement
Enbridge	Enbridge Energy, Limited Partnership
EPP	Environmental Protection Plan
existing Line 3	A 282-mile, 34-inch diameter pipeline that enters Minnesota at the North Dakota border in Kittson County, and exits Minnesota at the Wisconsin border in Carlton County
FdL	Fond du Lac Band of Lake Superior Chippewa
FEIS	Final Environmental Impact Statement
FMP	Fen Management Plan
FSA	Farm Service Agency
Gully 30 Fen	Gully 30 calcareous fen
INS	invasive and noxious species
L3R FMP	Gully 30 Fen Management Plan for the Line 3 Replacement Project
L3R or Project	Line 3 Replacement Project
LSr	Enbridge's Light Sour Pipeline
MDNR	Minnesota Department of Natural Resources
mgy	million gallons per year
MPARS	MDNR Permitting and Reporting System
MPCA	Minnesota Pollution Control Agency
MPUC	Minnesota Public Utilities Commission
MPUC Applications	Enbridge applications for a certificate of need and route permit
MPUC CN Order	September 5, 2018 MPUC-issued written order granting the certificate of need as modified and required filings
MPUC FEIS Order	May 1, 2018 MPUC-issued written order finding the revised FEIS adequate
MPUC RP Order	October 26, 2018 MPUC-issued written route permit order
OBL	Obligate
PFQA	Prairie Floristic Quality Assessment
psi	pounds per square inch
ROW	right-of-way
RSA	Route Segment Alternative
Sod Storage Area	a storage area outside of the Ditch Fen, but with similar environmental conditions
Strata Mine or Mine	Strata Corporation Aggregate Mine
wC	average weighted Mean C
wFQI	average weighted Floristic Quality Index

1.0 BACKGROUND INFORMATION

1.1 LINE 3 REPLACEMENT PROJECT DESCRIPTION

Enbridge Energy, Limited Partnership's ("Enbridge") Line 3 Replacement Project ("L3R" or "Project") is a pipeline integrity- and maintenance-driven program designed to address identified mechanical integrity deficiencies on the existing Line 3 pipeline and to return the pipeline to the operating capabilities for which it was designed. L3R consists of approximately 355 miles of new 36-inch-diameter pipeline traversing the states of North Dakota, Minnesota, and Wisconsin, and terminating at the existing Enbridge Superior terminal facility near Superior, Wisconsin. The Project involves replacement of the existing 34-inch-diameter Line 3 pipeline with 36-inch[1]-diameter pipeline and associated facilities in Minnesota. Enbridge's route generally follows the existing Line 3 pipeline along the Enbridge Mainline System right-of-way from the North Dakota/Minnesota border in Kittson County to the Clearbrook Terminal in Clearwater County. Next, L3R turns south from Clearbrook to generally follow an existing third-party crude oil pipeline right-of-way to Hubbard County. The route then turns east to generally follow other existing electric transmission lines until it rejoins the Enbridge Mainline System right-of-way in St. Louis County, through the Fond du Lac Band of Lake Superior Chippewa ("FdL") Reservation to the Minnesota/Wisconsin border in Carlton County (see Figure 1.1-1).

1.2 ALBERTA CLIPPER FEN MANAGEMENT PLAN

The portion of L3R that crosses the Gully 30 calcareous fen ("Gully 30 Fen") (Fen ID No. 35382) is co-located with Enbridge's Light Sour ("LSr") and Alberta Clipper Project ("Alberta Clipper") pipelines (Lines 65 and 67, respectively)[2] (see Figure 1.2-1). LSr was constructed in 2008 prior to the Minnesota Department of Natural Resources ("MDNR") listing of the Gully 30 Fen in the State Register in 2009. Enbridge then developed a Gully 30 Fen Management Plan ("FMP") for the Alberta Clipper pipeline ("Alberta Clipper FMP") in coordination with MDNR. As required by Minnesota Statutes 103G.223, MDNR approved the Alberta Clipper FMP before Enbridge began construction of the Alberta Clipper pipeline.

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1 36-inch-diameter steel pipeline is a more standard pipeline than 34-inch in the industry and among the Enbridge Mainline System. The decision to replace with 36-inch-diameter pipeline makes pipe, pipefitting, valves, and maintenance equipment more readily available. A 36-inch pipeline is more energy efficient than a 34-inch pipeline.

2 The majority of the L3R route in Minnesota is offset 25 feet (north) of Alberta Clipper, which is 25 feet offset (north) of LSr; however, the orientation of the LSr and Alberta Clipper pipelines through the Gully 30 Fen are reversed (LSr is 25 feet offset [north] of Alberta Clipper). The L3R route through the Gully 30 Fen is offset 25 feet (north) of the LSr pipeline.

Figure 1.1-1 General Project Location Map

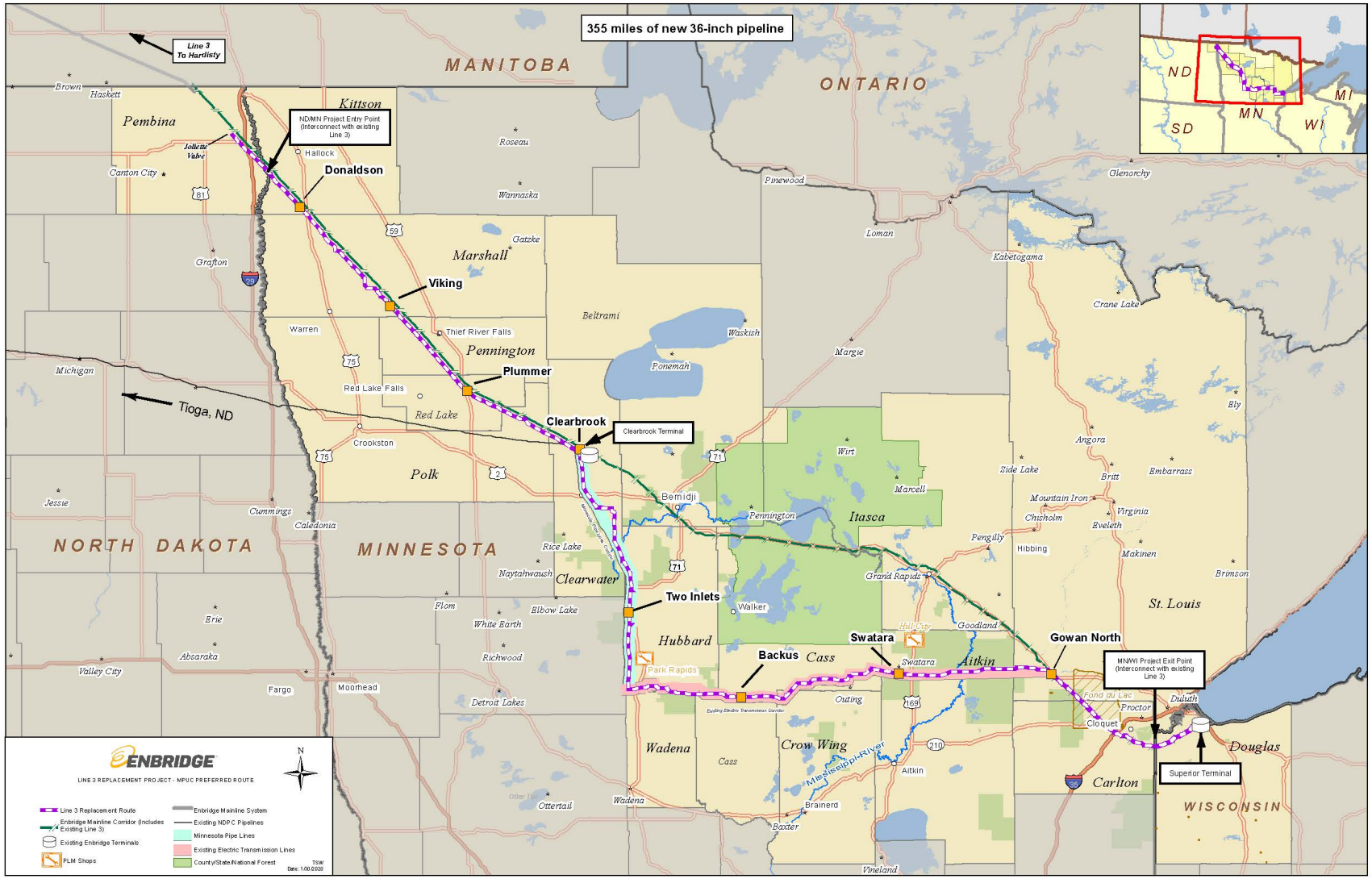
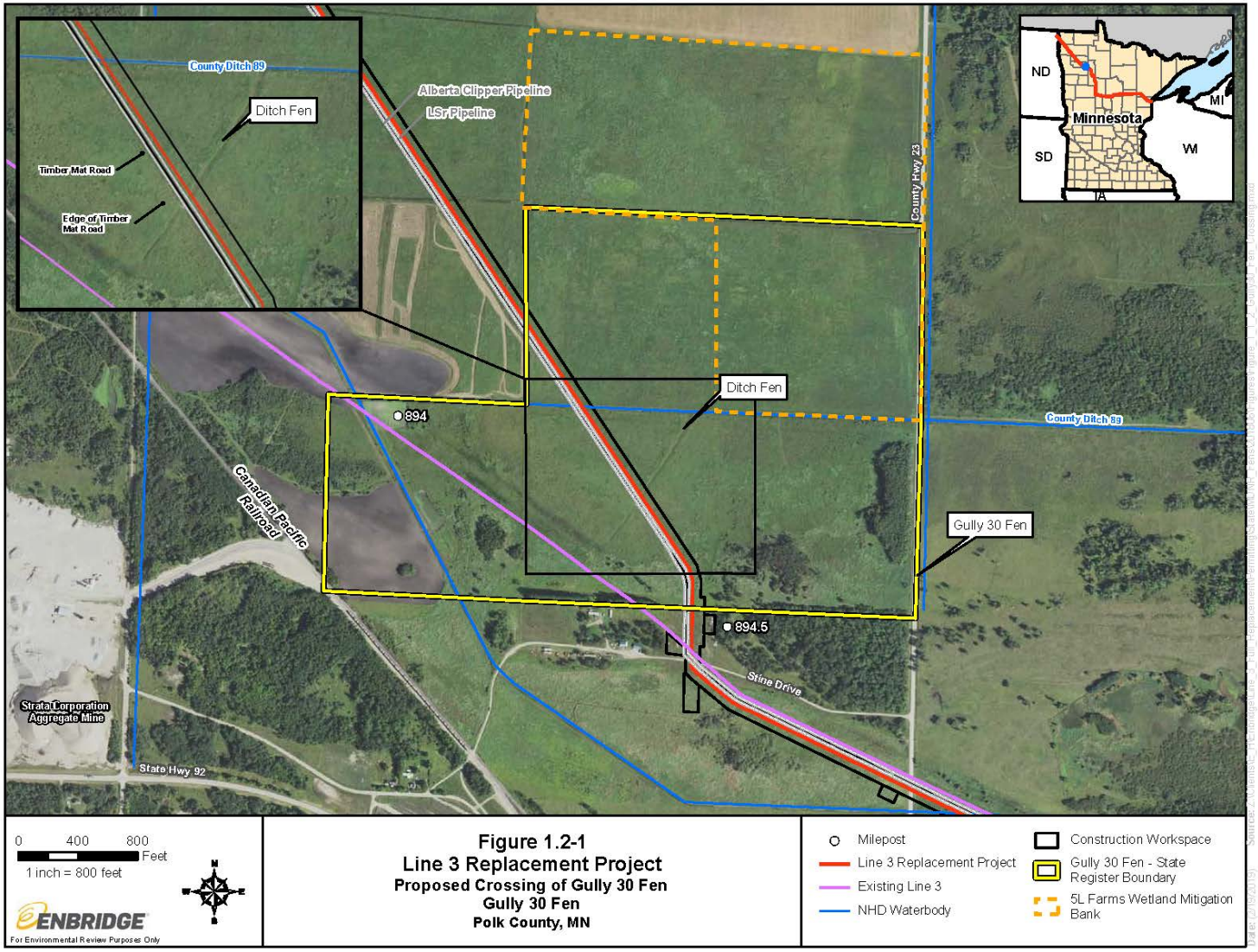


Figure 1.2-1 Proposed Crossing of Gully 30 Fen



1.3 LINE 3 REPLACEMENT PROJECT FEN MANAGEMENT PLAN

Enbridge utilized the Alberta Clipper FMP as a basis for development of this L3R Gully 30 FMP ("L3R FMP"). The purpose of this L3R FMP is to:

- characterize the current state of the Gully 30 Fen (Section 1.5);
- discuss avoidance and minimization options (Section 1.7);
- present construction procedures and best management practices ("BMPs") that minimize impacts (Sections 2.1 through 2.3); and describe post-construction restoration procedures (Section 2.4); and
- present a long-term post-construction monitoring plan and associated release criteria developed in coordination with MDNR (Sections 2.5 and 2.6).

1.4 REGULATORY AND TECHNICAL BACKGROUND

Calcareous fens are characterized by specific soils, hydrology, groundwater chemistry, and vegetation criteria as defined in Minnesota Rules 8420.0935 and expanded on in Berglund (1995) Leete et al. (2005), and MDNR (2016).

1.4.1 Calcareous Fen Criteria

Specific criteria related to the Gully 30 Fen were collected in 2009 and submitted to the MDNR in the Alberta Clipper FMP (Enbridge, 2009). Criteria observed for the Gully 30 Fen are provided in Section 1.5.

- *Chemical Criterion:* Field evidence of calcareous fen chemistry include the observation of deposits of secondary (precipitated in place) calcium carbonate at and near the soil surface and the presence of calcium carbonate within the entire soil profile as evidenced by effervescence in 2N HCl. Virtually any saturated mineral or peat soil with free calcium carbonate will meet pH, alkalinity, and dissolved solids criteria. Chemical criteria for the Gully 30 Fen are discussed in Section 1.5.4.
- *Soil Criterion:* Soils in areas meeting other fen criteria typically have a histic (peat) epipedon or are organic soils (Histosols) often referred to as muck soils. These soils are indicative of the historic presence of relatively continuous saturation with water and persistent anaerobic conditions. Soils criteria for the Gully 30 Fen are discussed in Section 1.5.5.
- *Hydrologic Criterion:* Field evidence of calcareous fen hydrology observed include: (1) the presence of a peat or organic soils in areas meeting other fen criteria; (2) the presence of small, isolated pools with calcium carbonate deposits on the sediment surface indicating active groundwater discharge; (3) the presence of water table at the surface in up-gradient sloping positions indicative of groundwater discharge; and (4) the presence of active spring heads or spring runs. Hydrology criteria for the Gully 30 Fen are discussed in Section 1.5.5.

- *Vegetation Criterion:* Plant species with the ability to grow in calcareous fens have been assigned point values ranging from 1 to 25. Species that are found primarily in calcareous fens are assigned the highest value (25), whereas species that can also be found in non-calcareous wetlands are assigned the lowest value (1). The vegetation criteria are regionalized and the point value for each species varies according to the regional location of the fen. Vegetation criteria for the Gully 30 Fen are discussed in Section 1.5.6.

1.4.2 Gully 30 Fen Features

The existing Enbridge right-of-way ("ROW") and adjacent L3R environmental survey corridor have been assessed for Minnesota sensitive flora species and calcareous fen indicators. Based on these surveys, the following fen features have been defined (Figure 1.4-1):

- Verified Calcareous Fen Components. The primary verified calcareous fen components meet all calcareous fen criteria and consist of: (1) the bed of a shallow ditch the Project crosses within the Gully 30 Fen (hereafter referred to as the "Ditch Fen"); and (2) several locations adjacent to and north of the existing Enbridge easement. Most of these areas fall within the Calcareous Fen Northwestern (OPp93a) Minnesota Native Plant Community Classification (MDNR, 2005) (Figure 1.4-1).

- Disturbed Calcareous Fen. MDNR (2016) discuss situations where reduced vegetation point criteria can result in the formal designation of a calcareous fen on the conditions that all other criteria are met:

  > *"[I]f a [disturbed][3] site has calcareous fen soil, hydrology, and water chemistry, but the calciphile point total ranges from 30 to 50, the area will be considered to meet calcareous fen criteria."*

Walkovers conducted in 2008 and 2009 of several areas within the Alberta Clipper/LSr survey corridor prior to construction indicated that low-, mid-, and high-point calciphiles were sparsely distributed outside the Ditch Fen and south of County Ditch 89. Depending on the size of the target area examined, a 30- to 50-point calciphile count is common in these areas. Many of these areas fall within the Northern Wet Prairie (WPn53) classification (MDNR, 2005). Figure 1.4-2 illustrates the results of Minnesota state-listed species presence/absence surveys conducted within the Alberta Clipper/LSr survey corridor in 2008 and 2009 (presented as Figure 1.0-3 of the Alberta Clipper FMP [Enbridge, 2009]).

Subsequently, Enbridge state-listed flora species surveys conducted in 2010 to 2011 (Gully-Trail Fen Inventory Project; Enbridge, 2012), in 2011 through 2017 (Alberta Clipper wetland monitoring; Enbridge, 2011; 2013; 2015; and 2017), and in 2014 through 2018 for the Project noted a substantial increase in the distribution and numbers of several state-listed calciphiles [species names removed] within the previously disturbed construction ROWs for Enbridge's LSr and Alberta Clipper projects.

[3] Leete et al. (2005) did not include the reference to disturbed conditions when considering areas meeting all other fen criteria but with 30-50 calciphile points to meet vegetation criteria for calcareous fens. The MDNR corrected this omission and clarified the "Disturbed Fen" category in their restatement of calcareous fen criteria (MDNR 2016), noting that disturbed areas meeting all other fen criteria and with 30-50 calciphile points are considered calcareous fens subject to regulation under MS 103G.223.

Figure 1.4-1 Gully 30 Fen Features

Figure redacted due to sensitive protected species information.

Figure 1.4-1 presents 2014-2018 flora presence/absence data collected for L3R. Points on this map represent individuals or small populations of the species and do not represent the actual number of individuals found within the survey corridor. Current protected flora population data collected for the Gully 30 Fen area through September 2018 is provided in Enbridge's Endangered Species Permit application. Portions of these areas that in 2008 and 2009 lacked calciphiles (Figure 1.4-2) and were considered partially drained non-calcareous fen and disturbed fen now likely are considered disturbed fen and calcareous fen, respectively.

- Potential Calcareous Fen. MDNR (2016) discuss disturbed areas of potential calcareous fen.

  > "*[I]f a disturbed site has calcareous fen soil, hydrology, and water chemistry, but a calciphile point total of less than 30, the disturbed area may have the potential to support a calcareous fen plant community."*[4]

  The entire area north of County Ditch 89, but within the Gully 30 Fen was historically tile drained and likely not jurisdictional wetland during 2008-2009 field inventories (Figure 1.4-2).

- Probable Upland. Historic upland exists on the northern boundary and a significant portion of the southwest corner of the Gully 30 Fen (Figure 1.4-3).

Several subsurface drain tiles were severed during construction of LSr in 2008 and Alberta Clipper in 2009 to 2010, resulting in a substantial acreage of effectively drained historic cropland returning to wetland conditions over the next 6 to 8 years. Several areas identified as non-wetland in the LSr/Alberta Clipper field wetland surveys now qualify as wetland and have been mapped as such (Figure 1.4-3). Several state-listed species characteristic of calcareous fens (e.g., [species names removed]) were observed within the survey corridor during 2014 through 2018 surveys within portions of these restored wetland areas, suggesting that portions of these wetlands may be in the process of being converted to disturbed calcareous fen and calcareous fen (Figure 1.4-1).

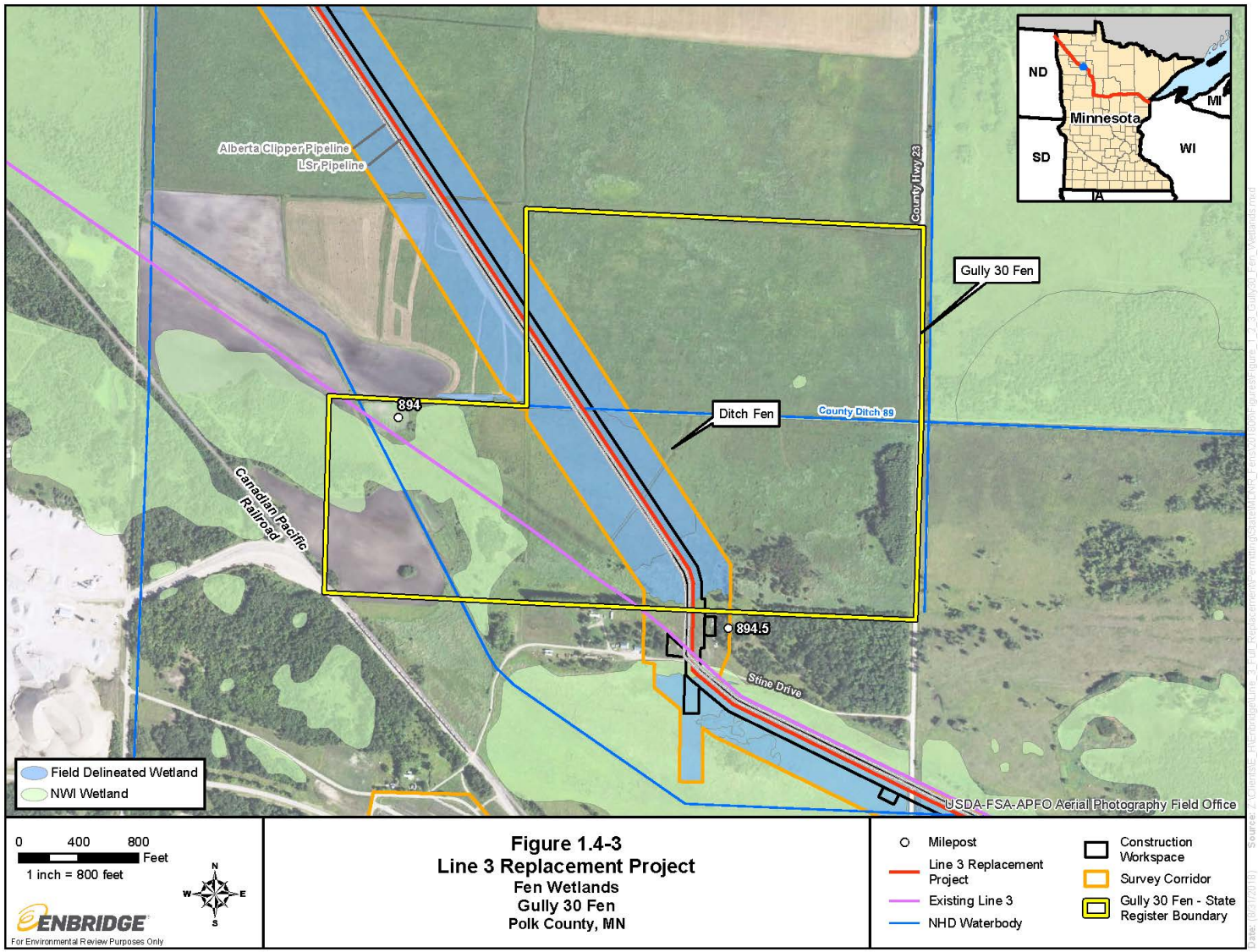
For the purposes of this L3R FMP, the portions of the Gully 30 Fen that are wetland will be considered calcareous fen even though specific information on calciphile distribution, groundwater chemistry, soils, and hydrology are not uniformly available throughout the site. The increase in the distribution and numbers of state-listed calciphiles within the previously disturbed construction workspace of the LSr and Alberta Clipper projects will be considered and noted, as applicable.

[4] If "Potential Calcareous" fen is the only fen component present within the wetland area, the wetland area is not formally considered a calcareous fen subject to regulation under Minnesota Statutes 103G.223.

Figure 1.4-2 Minnesota State-Listed Flora Species Survey Data at Gully 30 Fen

Figure redacted due to sensitive protected species information.

Figure 1.4-3 Gully 30 Fen Wetlands



1.5 RESOURCE CHARACTERIZATION

1.5.1 Regional Climate and Ecology

The area of the Gully 30 Fen is characterized by a cold and dry continental climate. The total annual rainfall at Fosston, Minnesota, approximately 20 miles south of the Gully 30 Fen, is 25.51 inches. Average annual snowfall is 39.0 inches at Fosston. Thunderstorms occur about 32 days each year in the survey area, mostly occurring in July. In summer and winter, the average temperature at Fosston is 66 and 8 degrees Fahrenheit, respectively. The highest summer and lowest winter recorded temperatures at Fosston, were 103 (1976) and -53 (1996) degrees Fahrenheit, respectively (U.S. Climate Data, 2018; Saari and Heschke, 2003).

The Gully 30 Fen lies within the Northwestern Fen Zone of Leete et al. (2005) and within the Aspen Parklands ecological province (MDNR, 2005). In general, areas within the Gully 30 Fen that meet calcareous fen plant criteria fall within the open peatland plant community (e.g., OPp93a – Calcareous Fen Northwestern) using the Minnesota Native Plant Community classification. Most partially/effectively drained areas that lack sufficient calciphiles to meet calcareous fen criteria fall within the WPn53 (Northern Wet Prairie) classification (MDNR, 2005).

1.5.2 Land Use History and Historic Disturbance Features

The Alberta Clipper FMP includes a detailed assessment of land use history within the Gully 30 Fen based on interpretation of historical aerial photography signatures beginning in 1939 and extending through 2008, including Farm Services Agency (“FSA”) photography that is continuous from 1979 to 2002. The discussion applicable to L3R is summarized below.

1.5.2.1 Agriculture and Agricultural Drainage

The hydrology of the Gully 30 Fen has been substantially impacted by: (1) the establishment of County Ditch 89; (2) associated public and private lateral ditches; and (3) the installation of subsurface drain tile. Extensive portions have been partially drained, and additional areas affected by subsurface drain tile may be effectively drained and non-wetland. Earlier FSA aerial photography suggests intermittent plowing may have been more prevalent south of the ditch containing the Ditch Fen. The area north of County Ditch 89 has been tile drained and has an extensive history of agricultural tillage and cropping to row/cereal grains beginning in 1980 and extending through 2008.

The Ditch Fen is the highest quality calcareous fen component within the Gully 30 Fen. An analysis of aerial photography from 1939 to 2002 indicates that the Ditch Fen is associated with a disturbed agricultural landscape. The private lateral ditch that includes the Ditch Fen was established sometime between 1974 and 1979 and was a component of active agricultural land use until 1992, when it appears that agricultural use of the field surrounding the ditch ceased. Several periods of probable ditch maintenance that exposed the ditch bottom are evident as light grey signatures associated with exposed soil in the ditch and on the ditch banks and dark signatures associated with ponding in the ditch prior to 1992. A review of historic aerial imagery suggests that ditch maintenance was reduced or halted around 1992, as the ditch signature becomes less distinctive after 1992. The ditch is barely distinguishable in the 1994 to 1997, 1999, and 2002 aerial photographs, and has become largely filled in.

While the ditch may have supported populations of calciphiles prior to 1992, abandonment of adjacent agricultural land use and lack of ditch maintenance has likely permitted the progressive increased establishment of calciphiles in the ditch bed, especially the [species name removed] (obligate ["OBL"] hydrophyte, threatened in Minnesota). Historic photographic evidence combined with the field assessment of calciphile distribution provided below suggests that the calciphiles in the Ditch Fen are taking advantage of the presence of wetter conditions and active discharge of calcareous groundwater that occurs within the historic ditch. The aerial photo history strongly suggests that the Ditch Fen is incidental to the legal establishment of an agricultural ditch that was excavated to convert adjacent fields to agricultural use.

1.5.2.2 Pipeline Construction

Portions of the Gully 30 Fen have also been physically impacted by soil disturbance resulting from pipeline construction. The Gully 30 Fen contains two Enbridge pipeline corridors (Figure 1.2-1). The southernmost ROW was established in the 1950s, including the existing Line 3, and presently contains five pipelines with the last installation occurring in 1999. A second Enbridge ROW was established in 2008 and approved for the construction of the LSr and Alberta Clipper projects; the proposed L3R will be co-located within this existing pipeline corridor.

Enbridge construction of the LSr pipeline was completed in 2008, and construction of the co-located Alberta Clipper pipeline was completed in 2010. The disturbance and reclamation signature of both pipelines is apparent as southeast to northwest trending linear signatures in current high-resolution aerial photography (Figure 1.2-1). These features are generally darker in phototone and have more surface water signatures than the adjacent undisturbed areas outside the construction ROW and represent the only major change in land use comparing 2008 through 2009 to current conditions.

1.5.2.3 Sand and Gravel Mining

Several active and inactive gravel mines are located on the beach terraces to the south of the nearshore sediments that contain the Gully 30 and Chester 24 fens. The Strata Corporation Aggregate Mine ("Strata Mine" or "Mine"), located west of the Gully 30 Fen as shown in Figure 1.2-1, was developed after 1954. It has the potential to affect surface and subsurface hydrology in the Gully 30 Fen. The Strata Mine is typical of aggregate mines located in coarse textured sand and gravel deposits that frequently serve as recharge areas for calcareous fens. Sand and gravel in these mines are typically mined to the water table, and if resources are sufficiently valuable, the area is dewatered and mined below the water table.

Based on current aerial photography, the Mine has an approximate 220-acre footprint, including approximately 41 acres of surface water features representing flooded areas previously excavated to an elevation of approximately 1,200 feet above sea level. The western boundary of the Gully 30 Fen is less than 0.25 mile from the eastern boundary of the footprint of the Strata Mine.

Aggregate mining operations typically require substantial amounts of water to wash and grade aggregate into uniform size classes. When groundwater floods historic excavations, the Mine may choose to appropriate all or a portion of its processing water from the pond feature. Strata Corporation has secured water appropriation permit 1999-1147 to withdraw up to 240 million gallons per year ("mgy") at 2,200 gallons per minute effective July 2013. This permit is the largest existing groundwater appropriation permit in the area of the Gully 30 Fen.

1.5.2.4 Wetland Bank

A wetland compensatory mitigation bank has been proposed by 5L Farms on a 118-acre footprint directly north of the Gully 30 Fen (see Figure 1.2-1). The proposed bank site contains one large wetland area with a relatively small component of upland. The total wetland area is approximately 114.1 acres. A Type 2, sedge meadow wetland is approximately 100.5 acres in size and extends off the parcel to the west. The wetland transitions to upland in the northeast corner of the property. Buffers will border the site along the northern, eastern, and southern boundaries and are included to account for the lateral effect of drainage ditches that remain open and functional as well as buffer the restored area from other off-site activities. Pattern subsurface drain tile, installed in spacing intervals of approximately 115 feet, will be disabled by breaking the lines close to the outlet ditches, which will also be filled to match the adjacent elevations. This will prevent the additional drainage currently occurring at the site and will enhance the hydrology of the site.

1.5.2.5 Water Appropriation

Currently there are three active groundwater appropriation permits to support either agricultural irrigation or industrial sand mining uses within 6 miles of the Gully 30 Fen. Total appropriation from the sand and gravel aquifer is 290 mgy to support sand and gravel mining (Strata Corporation; Knife River Materials) and 26 mgy for irrigation ([name removed]). Irrigation use was more significant in the past, with 3 inactive permits (industrial use and irrigation) totaling 140 mgy for permitted wells no longer appropriating water.

1.5.2.6 Climate

Northern Minnesota calcareous fens are landscape features that are specific to the Wisconsin glaciation, and more specifically the period following the final glacial recession that occurred approximately 12,000-10,000 years before present. During the approximate 10,000 years since the glacier receded, climate has been both significantly warmer and dryer, and cooler and wetter than current conditions (Wright et al., 2006). Scientists generally anticipate that climatic changes similar to or greater than the most extreme climatic shifts will occur over the next few decades. The Gully 30 Fen monitoring program for the Alberta Clipper pipeline is in its 8th year (Enbridge, 2011; 2013; 2015; and 2017), and the monitoring period has so far been characterized by substantial climatic variability that appears to be reflected in hydrographs for the climatic extremes.

1.5.2.7 Land Use Potential for Hydrologic Impacts to the Gully 30 Fen

Calcareous fens were far more extensive in the Gully 30 Fen area prior to European settlement (Enbridge, 2009). As part of the Alberta Clipper Pipeline Project in 2012, Enbridge conducted an inventory of calcareous fens within approximately 20,000 acres of contiguous, sloping, calcareous peat soils in the Gully-Trail area (Enbridge, 2012). The 2012 fen inventory determined that there were a number of high-quality isolated areas remaining in addition to known calcareous fens. These areas have persisted despite the influence of gravel mining, agriculture, and the extensive network of drainage ditches.

The large and small-scale anthropogenic disturbance factors described above have, to greater or lesser degrees, the potential to adversely impact surface and subsurface hydrology that historically supported the Gully 30 Fen and nearby listed calcareous fens.

- Agricultural land use and agricultural drainage is extensive, has affected the area for the longest period, and has had significant impacts on calcareous fens. Surface ditching and subsurface tile drainage are facilitated by the sloping nature of the peatlands that results in the potential for rapid removal of surface and subsurface water. Well-designed systems can easily keep up with groundwater discharge. Listed calcareous fens persist only in areas distant from the lateral effect of area ditches or in areas that were never ditched or where ditching was poorly designed. Though effective and applied over a very broad area, hydrologic alteration through surface and near-surface drainage primarily affects surface hydrology and has a limited effect on broad regional groundwater flow. As evidenced at the Ditch Fen, the groundwater discharge hydrology that supports calcareous fen plant communities and soils appears to return relatively quickly when the drainage system is either destroyed or lack of maintenance results in system failure.

- Pipeline construction is similar to a temporary agricultural disturbance with a smaller and less permanent disturbance footprint than agricultural use. Functionally, the disturbance is associated more with the construction of the pipeline trench than the adjacent construction workspace. Where necessary, dewatering is temporary and shallow, occurs over a period of weeks to a depth that does not exceed that of the trench itself, and the water is discharged back to the same area. Persistent impacts to surface and groundwater hydrology are avoided by backfilling the ditch to maintain soil strata in the same sequence and approximate density as that which existed prior to construction, returning topsoil to the approximate locations from which topsoil was removed, ensuring the return of the original topography, and using trench breakers to prevent preferential flow along the restored trench line. Other construction-related disturbance is avoided and/or minimized by ensuring that all equipment operates from construction mats that are designed to minimized compaction and avoid rutting.

- Sand and gravel mining have the potential to significantly affect local and regional groundwater hydrology, as well as to substantially alter surface topography and surface runoff dynamics.

  The hydrologic impact of Strata Corporation's water management program, which occurs in areas that were previously rolling to steep sandy beach terraces assumed to be groundwater recharge areas for the downslope fen features (Enbridge, 2009) is unknown. However, the sand mine represents the creation of 41 acres of significant, persistent surface pond features not present previously at elevations that could impact groundwater flow regimes. These water features have the potential to affect local and sub-regional groundwater hydrology. Groundwater flow could be captured, resulting in a groundwater divide that could reduce downslope groundwater flow to the sloping fens that are fed by discharge of calcareous groundwater. In addition to the unknown impacts of these surface water features, the MDNR has authorized Strata Corporation's appropriation of up to 240 mgy from the gravel aquifer that may have a direct connection to the fen. There will be a cone of depression associated with this appropriation, and localized water flows could be affected. There has been no fen management plan developed for the Strata Mine facilities to assess hydrologic impacts on the Gully 30 or Chester 24 calcareous fens.

- Groundwater appropriation for agricultural use generally has increased in Polk County; however, most of the irrigation water appropriation permits are inactive, indicating that irrigation is no longer being practiced extensively. The amount of irrigation varies with the weather, and active irrigation may be a significant impact to sub-regional groundwater

flow, particularly during dry periods and when the irrigation wells are in close proximity to the fen features. Based on data from MDNR Permitting and Reporting System ("MPARS"), there are four active water appropriation permits for irrigation and industrial mining use within approximately 6 miles of the Gully 30 Fen for a total yearly appropriation not to exceed 316 mgy. The short- and long-term effects of this potentially persistent appropriation of groundwater on the hydrology of the fen is unknown.

- There is currently no research investigating the effects of historic climate anomalies (i.e., wetter and cooler compared to warmer and drier compared to "normal" conditions on calcareous fens). When combined with the Alberta Clipper monitoring program data, L3R monitoring data will represent relatively long-term responses to climatic variability (see Section 2.5).

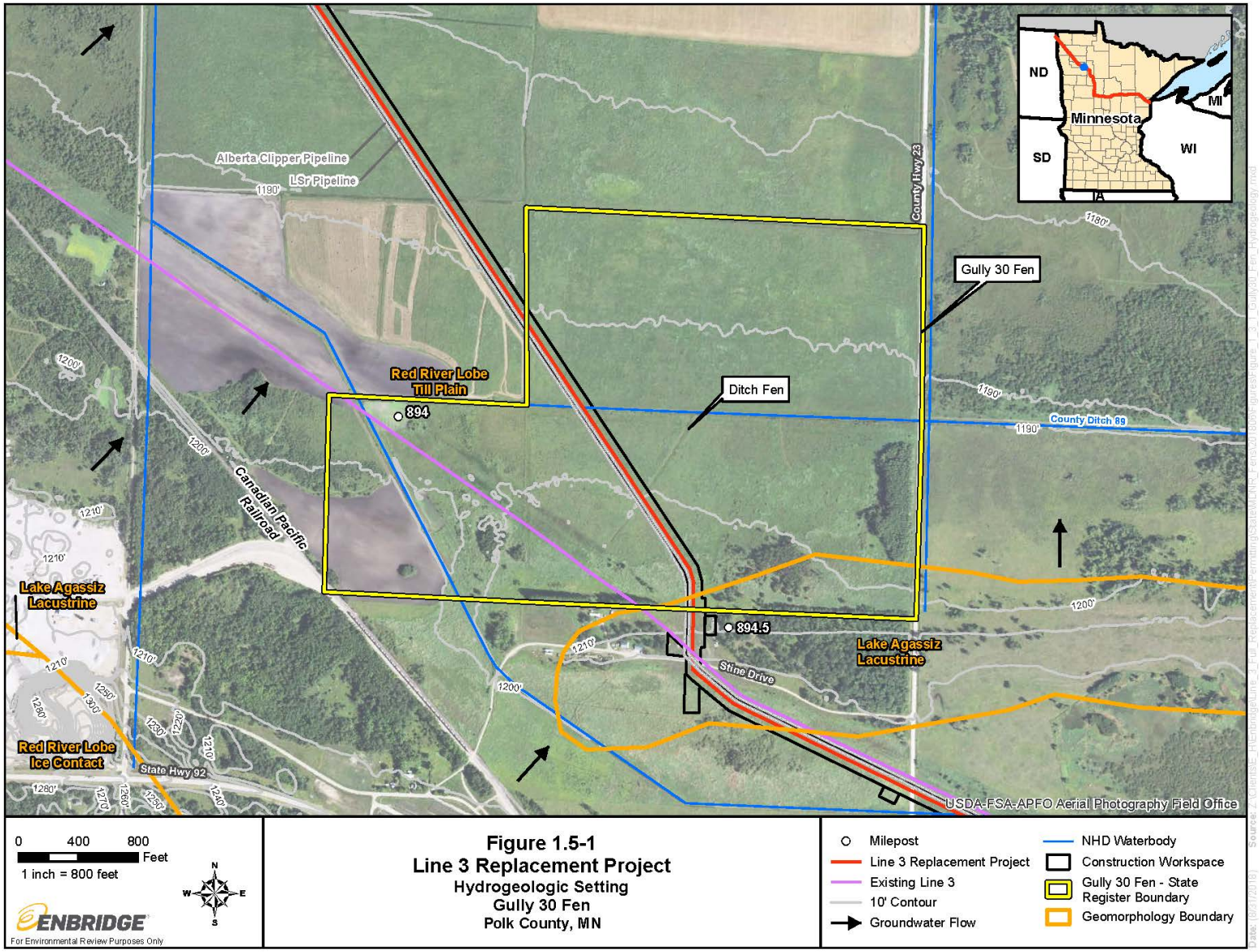
1.5.3 Hydrogeological Setting

The Alberta Clipper FMP hydrologic setting sections, including those relating to geomorphic setting, soils, topography, peat stratigraphy, and geologic cross sections, remain applicable to L3R as summarized below.

The hydrogeologic setting in the Gully-Trail area that includes the Gully 30 Fen is uniquely situated to support extensive calcareous fens (present as peat "blankets" sloping north to the deeper portion of the glacial lake) and is likely the result of the landforms produced by Pleistocene glacial ice and meltwater (Figure 1.5-1).

The data suggest that groundwater flow around the Gully 30 Fen is driven by recharge in adjacent sandy and loamy uplands. Sandy areas are characterized by coarse surface textures and high infiltration rates that will maximize recharge of precipitation as well as high hydraulic conductivity values that will result in rapid downslope water flow. Potential hydraulic gradients indicated in the County Well Index data are quite steep and could be as much as 50 to 100 vertical feet over a distance of a few miles. The presence of confining lacustrine and till layers can result in discrete areas of strong groundwater discharge where lacustrine confining layers are absent or thin and the presence of groundwater discharge in areas relatively distant from the recharge zone. Strong groundwater discharge is indicated by: (1) the presence of non-acid and calcareous peat soils on strongly sloping surfaces near the edges of the lake plain; (2) the presence of a nearby flowing well; and (3) the presence of leached mineral soils further out into the lake plain.

Figure 1.5-1 Gully 30 Fen Hydrogeologic Setting



For the purposes of pipeline construction, upwelling groundwater with water tables at or near the soil surface and the presence of non-cohesive sand under the peat complicate trench excavation because of the possibility of trench wall failure. Peat depth and the nature of the underlying mineral sediments were determined across the Gully 30 Fen (Figure 1.5-2). The following features were observed:

- Peat thickness ranges from approximately 2.5 feet (30 inches) in the south to over 10 feet (120 inches) in the north of the Gully 30 Fen, respectively.

- The peat is discontinuously underlain by a thin-to-thick layer of fine-textured lacustrine material. Where this layer is thick, groundwater discharge will be limited. The presence/ absence and approximate thickness of the lacustrine layer provides useful information and can be used to support other hydrological observations. The thickness of the lacustrine layer varied considerably across the site but ranged from not present to relatively thick (greater than 10 inches).

- The combined thickness of peat and lacustrine material within the full length of the ditch that includes the Ditch Fen ranged from 30 to 46 inches and is generally thicker than the peat in adjacent undisturbed areas. Peat and finer-textured sediments may have slumped into the ditch after it was abandoned, or peat may be accreting due to more favorable groundwater conditions within the ditch.

- Peat is thicker (8 feet, 90 to 100 inches) over the outwash sands to the north of County Ditch 89 and thins to 2 to 4 feet (24 to 40 inches) to the south where the proposed L3R trench exits the Gully 30 Fen boundary.

1.5.4 Chemical Criteria

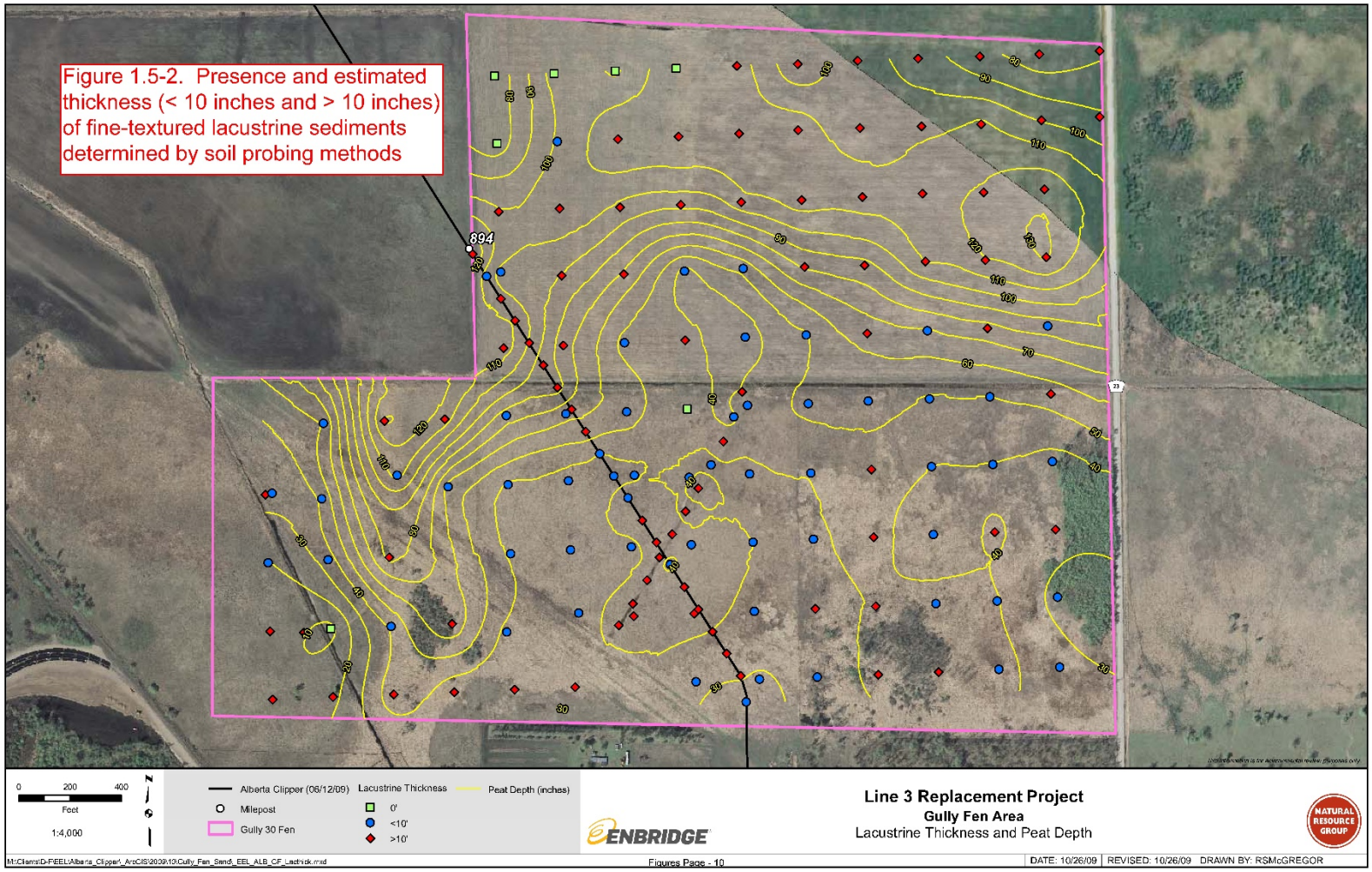
The Alberta Clipper FMP discussion of chemical criteria remains applicable to L3R as summarized below.

All hydric soils within the Gully 30 Fen contain free calcium carbonate. The flow matrix for groundwater in the area also contains free calcium carbonate and is therefore saturated with respect to pedogenic calcium carbonate (calcite). In active groundwater discharge locations, the upward hydraulic gradient maintains a high water table that is persistently at or near the surface (within 1 to 1.5 feet) in areas that are not tile drained. The resulting persistent, chemically reducing environment retards the oxidation of organic carbon to carbon dioxide and water, which historically resulted in the development of organic (peat) soils. Evapotranspiration in near-surface soil sediments results in the precipitation of large amounts of pedogenic calcite. All groundwater within the 200-acre Gully 30 Fen, and in areas extending well beyond the fen boundaries, are likely to meet calcareous fen chemical criteria.

1.5.5 Soils and Hydrology

The Alberta Clipper FMP discussion of soils and hydrologic criteria remains applicable to L3R as summarized below.

Figure 1.5-2 Gully 30 Fen Lacustrine Thickness and Peat Depth



Soils within and adjacent to the Ditch Fen are Markey soils that are characteristic of calcareous fens formed in shallow peat over outwash sands in the Gully-Trail area (Figure 1.5-3). Markey soils are common peat soils in northwestern Minnesota and do not by themselves indicate the presence of a calcareous fen, although all meet the calcareous fen soils criterion.

The soils within Ditch Fen appear to be a truncated and disturbed variant of adjacent Markey soils that are consistent with ditch excavation, subsequent sidewall collapse and infill, and ditch maintenance, consistent with the land use history described in Section 1.5.2. As noted previously, the ditch appears to be progressively filling in subsequent to the halting of maintenance of the ditch and abandonment of agricultural land use in adjacent fields in 1992. Given the discontinuous nature of the lacustrine material within the ditch, it is also likely that zones of focused groundwater discharge are also present. All physical and hydrologic conditions exhibited within the ditch feature favor the re-establishment of calciphile vegetation from seed present in the seed bank. The presence of partial drainage introduced by the ditch itself and the intact, relatively impermeable lacustrine layer in the soils away from the ditch retards the re-establishment of calcareous fen conditions that may have been present prior to the establishment of area ditches.

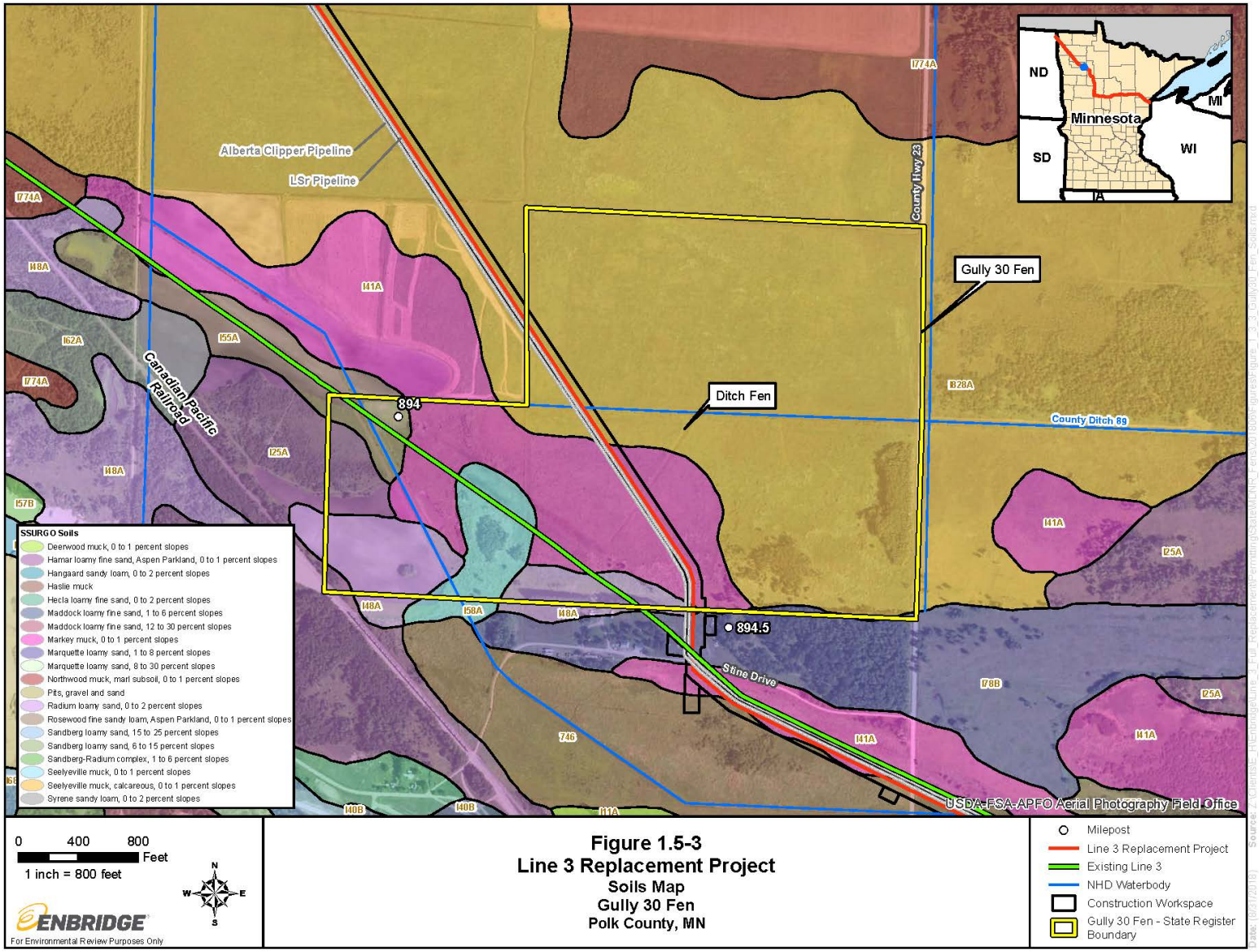
Groundwater recharge is expected to occur south of the Gully 30 Fen on coarse-textured Pleistocene terraces, a large stratified ice contact ridge immediately to the south of the near-shore lake plain, and in stratified ground moraine in upland positions south of the lake plain. Groundwater flows downslope through coarse-textured outwash to the glacial lake plain and becomes saturated with calcium carbonate because of the calcareous mineralogy of the sediments through which the groundwater is flowing. Groundwater discharge may be reduced in areas with overlying fine-textured lacustrine material with the reduction in discharge dependent upon the thickness and texture of the underlying fine-textured material. Active groundwater discharge is associated with areas where lacustrine material is thin or non-existent. Diffuse and focused groundwater discharge through the partially confining lacustrine sediments maintains a high water table and provides continuous saturation sufficient for the development of extensive peat soils although such soils are moderately sloping. The area of potential groundwater discharge is large and impractical to avoid completely by linear projects traversing the area.

1.5.5.1 Implications for Pipeline Construction Disturbance

Due to the implementation of topsoil segregation practices and the use of construction mat roads as a travel lane and work platform, which minimizes impacts on underlying soil, pipeline construction is anticipated to disturb only the soil surface in areas within the pipeline trench. Twelve inches of topsoil will be stripped from the trench line and other areas as needed and approved. Loading under spoil storage areas and mat roads may result in transient compaction and temporary reductions of a few inches of elevation in the soil surface.

Construction-related disturbance within the construction workspace outside of the L3R trench will be minor, transient, and similar to historic disturbance. As described in Section 1.5.2, active agricultural use was occurring in the fields adjacent to the Ditch Fen until 1992. Areas within the fen boundary, including areas affected by pipeline construction, have a history of plowing and other agricultural use. Surface topography and soil morphology still reflect these historic agricultural uses. For these reasons, the Gully 30 Fen lacks normal sedge hummocks observed in undisturbed nearby fen areas. These hummocks were likely destroyed during mechanized haying and plowing, which also resulted in agricultural compaction.

Figure 1.5-3 Gully 30 Fen Soils



As noted in Alberta Clipper post-construction monitoring documents (Enbridge, 2011; 2013; 2015; 2017), loading under spoil storage areas and mat roads may have resulted in shallow transient compaction and temporary reductions of a few inches of elevation in the soil surface. Soil compaction (Hillel, 1982) is defined as an increase in bulk density resulting from compressive forces reducing the volume of air- or water-filled voids. For reference, ground pressure produced by a typical 150-pound human walking is approximately 6 pounds per square inch ("psi"). Ground pressures produced by a typical 20-ton tracked piece of construction equipment operating directly on the soil is approximately 7 psi, while working off a standard timber mat road (edge-butted 16-feet long by 4-feet wide by 1-foot deep) reduces ground pressure to 1 psi (Digger Mats, 2014). Maximum compaction is produced when laying in the pipeline. The weight of the pipe plus the pipelayer (e.g., Caterpillar 587T) generates surface pressure of about 3 to 4 psi (120,000 pounds distributed over 4 timber mats) (Environmental Laboratory 1989). Soft, low-bearing capacity soils similar to the shallow, unsaturated peat soils in the Gully 30 Fen could be expected to settle up to approximately 4 inches when experiencing a load of 3 to 4 psi (Anthony Hardwood Composites 2018).

The compaction that likely occurred under the timber mat road during the construction of Alberta Clipper pipeline has not had an apparent adverse effect on plant communities in the Gully 30 Fen (see Section 1.4.2 and 1.5.6). Post-construction vegetation monitoring for Alberta Clipper and pre-construction baseline characterization performed for L3R indicate that obligate-hydrophyte calciphiles are returning to areas of the Alberta Clipper potentially affected by compaction resulting from loading under mat roads and spoil storage piles (Figure 1.4-1). Most of these areas lacked obligate-hydrophyte calciphiles prior to construction of the Alberta Clipper pipeline (Figure 1.4-2). It is likely that the hydrophytes are responding to a wetter hydrologic regime resulting from a slightly lowered soil surface and thicker capillary fringe produced by compaction during pipeline construction.

Because compaction is limited to a single construction event of relatively short duration and is minimized by limiting construction traffic to construction mat roads, persistent, deep compaction, similar to that associated with agricultural practices, is not anticipated. It is unknown how long compaction resulting from construction equipment operating during unfrozen conditions and its effect on plant communities persists; however, compaction is likely to be transient and primarily associated with low-strength peat at and near the soil surface. Because the area is partially drained by the ditch containing the Ditch Fen and County Ditch 89, seasonal water table drawdown typically extends to well below 12 inches as seen in the groundwater monitoring data (Enbridge, 2011; 2013; 2015; 2017) and reflected in pre-construction Alberta Clipper pipeline soil descriptions.

Given the sensitivity of the Gully 30 Fen plant communities, and the minor amount of compaction anticipated during L3R pipeline construction, remediation of compaction by standard deep tillage techniques is not justified. Research on compacted agricultural fields indicates that compaction in the upper 20 inches of the soil resulting from continuous agricultural use was remediated after 5 to 10 years by natural processes including plant root growth, freezing and thawing, and wetting and drying (Wortman and Jasa, 2009; Duiker, 2004). Freezing and thawing and wetting and drying are likely to remediate transient compaction occurring under spoil storage and mat roads.

Pipeline installation represents a disturbance like that of shallow ditch excavation. Minor alterations in the topographic surface; in saturated and unsaturated surface peat groundwater flow; in the near-surface sediment structure (removal of thin aquitard layers) in areas excavated

for the ditch; and exposure of underlying peat may have subtle transient-to-persistent effects on calcareous fen hydrophytic vegetation.

Land use history and field surveys suggest that the Gully 30 Fen, once part of a larger contiguous calcareous peatland, has experienced significant hydrologic disturbance from agricultural activities. Prior to construction of the Alberta Clipper and LSr pipelines, only the areas in and adjacent to the shallow agricultural Ditch Fen were most favorable to support calcareous fen vegetation, likely due to poor drainage (Figure 1.4-2). However, the distribution and numbers of state-listed calciphiles generally increased within the LSr and Alberta Clipper construction workspaces following their installation in 2008 and 2010, respectively. These results occurred over a period of 6 to 8 years and are illustrated in Figure 1.4-1, discussed in Section 1.5.6, and in Attachment A.

1.5.6 Vegetation

The Alberta Clipper FMP discussion of calcareous fen vegetation criteria remains generally applicable to L3R as summarized and updated below

1.5.6.1 LSr and Alberta Clipper Vegetation Surveys

Prior to construction of Alberta Clipper, Enbridge conducted a detailed survey of plant populations within an environmental survey corridor, which identified several populations of Minnesota state-listed and calcareous fen indicator plant species. Although vegetation surveys did not encompass the entire 200-acre Gully 30 Fen, survey results indicate that, except for the Ditch Fen area, state-listed and calcareous fen indicator plants were isolated populations and single individuals were not uniformly distributed (Figure 1.4-2). Such areas meet the disturbed-fen vegetative criteria requiring between 30 and 50 calciphile fen points. These findings are consistent with the hydrologic and physical disturbance resulting from activities described in Section 1.5.2.

The bed of the Ditch Fen feature met the criteria established for calcareous fens; and, the area outside the ditch bed met the “Disturbed Fen” vegetation criteria. This suggests that: (1) the presence of persistent saturation with calcareous groundwater within the ditch was sufficient to maintain a high-quality calciphile community in spite of historic hydrologic disturbance; (2) it is possible that the disruption of the fine-textured lacustrine layer above the outwash sands during original ditch excavation permitted a greater amount of groundwater discharge than present under undisturbed conditions; and (3) partial drainage associated with the bounding county ditches and two excavated lateral private ditches reduced the duration of persistent saturation and affected surface chemistry sufficiently that large numbers of diverse calciphiles were not present outside the Ditch Fen feature.

However, the presence of scattered high ([species name removed]) and low point calciphiles in the partially drained land adjacent to the ditch strongly suggests that the entire area was calcareous fen prior to county ditching and that there may have been a much higher calcareous fen quality prior to disturbance. The presence of a diverse calciphile community within the Ditch Fen further suggests that there is a seed bank present that can take advantage of suitable conditions to re-establish calciphiles when the opportunity presents itself.

1.5.6.2 L3R Vegetation Surveys

State-listed Species

The location of state-listed species that are also high-calciphile point indicators of calcareous fens is provided in Figure 1.4-1 based on L3R surveys conducted from 2014 through 2018. Starting in 2014, Enbridge worked with MDNR-approved botanists to document the occurrence of sensitive plant species within an environmental survey corridor that varied between approximately 300 and 600 feet wide along the proposed L3R centerline. The vegetation survey target areas included the Gully 30 Fen and areas to the north. To follow up on the findings of the occurrence surveys, Enbridge conducted systematic population counts for four state-threatened species ([species names removed]) located within the survey target areas. These population counts took place in 2015 through September 2018 and have been submitted to the MDNR as part of the Endangered Species Permit application.

Baseline Characterization

Enbridge conducted a baseline characterization of vegetation communities within the environmental survey corridor associated with L3R in 2016 and 2018 (Attachment A). This report is intended to be used as a point of reference for post-construction monitoring activities. The results of this baseline characterization are summarized below.

Areas immediately west and east of the Ditch Fen are a mosaic of native plant community types that remain strongly associated with the localized hydrology and topographic variability. The main community type is representative of the northern wet prairie community (WMn53). Northern wet prairie communities are dominated by graminoid cover with dominant species that include mat muhly grass (*Muhlenbergia richardsonis*) and slimstem reedgrass (*Calamagrostis stricta*) along with tufted hair grass (*Deschampsia cespitosa*), elliptic spikerush (*Eleocharis elliptica*), tall cottongrass (*Eriophorum angustifolium*), baltic rush (*Juncus arcticus*), autumn willow (*Salix serissima*), panicled aster (*Symphyotrichum lanceolatum*), red-stemmed aster (*Symphyotrichum puniceum*), and marsh arrowgrass (*Triglochin palustris*). Intermixed within the northern wet prairie communities are wet meadow communities dominated by aquatic sedge (*Carex aquatilis*), hardstem bulrush (*Schoenoplectus acutus*), and slimstem reedgrass.

Species such as knotty rush (*Juncus nodosus*), tall cottongrass, seaside arrowgrass (*Triglochin maritima*), marsh arrowgrass, and [species name removed] began to appear in noticeable concentrations within the Alberta Clipper/LSr construction ROWs and travel lane within a year after construction and restoration were complete. [Species name removed] also became more prevalent but was harder to detect initially because the plants were not mature and not producing flowering and fruiting parts. This increase in abundance, in particular with regards to marsh arrowgrass, [species names removed], may be explained by persistence of the historic seed bank, improved hydrology in terms of discharge, and the initial reduction of competition that allowed these species to quickly re-establish from seed.

Of interest is the absence to date of key calcareous fen vegetation indicator species beyond the main Ditch Fen and other lateral ditches in the immediate area. Species such as twig rush (*Cladium mariscoides*), Mistassini primrose (*Primula mistassinica*), hair-like beak rush, whorled nutrush, and tufted bulrush (*Trichophorum cespitosum*) are noticeably absent in the Alberta Clipper/LSr survey corridor according to the pre-construction monitoring data presented in the Pre-construction Monitoring Report (2018) (Attachment A and Figure 1.4-2). Additionally, the

vegetative quality in terms of native species cover and abundance along the LSr and Alberta Clipper corridor decreases 400 meters west and beyond the Ditch Fen feature despite the periodic appearance of [species names removed].

1.6 LINE 3 REPLACEMENT PROJECT CERTIFICATE OF NEED AND ROUTE PERMIT PROCEEDINGS

Enbridge applied for a certificate of need and a route permit from the Minnesota Public Utilities Commission ("MPUC") to construct and operate the Project on April 24, 2015 ("MPUC Applications"). The Minnesota Department of Commerce, Energy Environmental Review and Analysis ("DOC-EERA") staff prepared an Environmental Impact Statement ("EIS") in cooperation with the MDNR and Minnesota Pollution Control Agency ("MPCA") to facilitate the MPUC's review of the MPUC Applications in accordance with Minnesota Rules Chapter 4410. The EIS considered numerous certificate of need alternatives, route permit alternatives, and route segment alternatives for the Project. On December 7, 2017, the MPUC deemed the final EIS ("FEIS") inadequate solely on the basis of four specific and narrow issues, and a revised FEIS was published on February 12, 2018. On May 1, 2018 the MPUC issued a written order finding the revised FEIS adequate ("MPUC FEIS Order").

At the conclusion of contested case proceedings, the MPUC issued a written order on September 5, 2018, granting the certificate of need as modified and requiring filings ("MPUC CN Order"). On October 26, 2018, the MPUC issued a written route permit order ("MPUC RP Order") identifying the Project's Preferred Route inclusive of Route Segment Alternative ("RSA")-05 and RSA-22 through the FdL Reservation as the MPUC Designated Route (hereafter referred to as the "Designated Route" or "Project"). The Project is a 750-foot wide corridor which allows for minor adjustments to the pipeline alignment and permanent right-a-way within the Project.

On June 3, 2019, the Minnesota Court of Appeals reversed the MPUC FEIS Order upon determining the failure to address the potential impacts of an oil spill into the Lake Superior Watershed constituted an inadequacy in the FEIS. On October 28, 2019, MPUC issued a written order finding the FEIS inadequate because it did not sufficiently address the potential impact of an oil spill into the Lake Superior Watershed. The order requested DOC-EERA to revise the FEIS to include an analysis of the potential impact of an oil spill into the Lake Superior Watershed and to submit the revised FEIS to the MPUC within 60 days.

On December 9, 2019, the DOC-EERA issued the second revised FEIS. Notice of availability of the second revised FEIS and the procedures for written comments were also published in the December 9, 2019 EQB Monitor. On February 3, 2020, the MPUC found that the Second Revised FEIS was adequate and reaffirmed its previous certificate of need and route permit orders with a minor change related to the public safety escrow condition within the route permit. The MPUC's written order(s) were issued on May 1, 2020.

1.7 LINE 3 REPLACEMENT PROJECT GULLY 30 FEN CROSSING LOCATION, TIMING AND CONSTRUCTION TECHNIQUE

1.7.1 L3R Gully 30 Fen Crossing Location

L3R is co-located with the LSr and Alberta Clipper pipelines in the Gully 30 Fen. This minimizes potential additional disturbance to listed plants and environmentally sensitive features that would be associated with a greenfield crossing location.

L3R's Gully 30 Fen crossing location is consistent with the approved Alberta Clipper FMP and the Designated Route (MPUC RP Order). It minimizes wetland impacts by utilizing pastured upland and the only available, extensively disturbed agricultural land in the immediate area. This crossing location also maximizes the use of effectively drained historic wetland and partially drained, farmed wetland.

1.7.2 Season and Timing of Construction

Enbridge plans to commence construction of the new pipeline and associated facilities as soon as all construction related regulatory approvals have been obtained. As discussed with the MDNR, Enbridge will avoid spring construction (defined as the months of April through June) during normal high-water conditions at the Gully 30 Fen[5] and will construct across the Gully 30 Fen crossing between mid-August and the end of September in the year of construction. Enbridge will not begin construction unless initial water levels in the Gully 30 monitoring wells are measured to be consistently 1 foot below ground surface during the August 15 through September construction timeframe.

Construction activities within the fen will be completed within 30 days after the start of dewatering. Construction during this timeframe is anticipated to provide the following advantages:

1. Constructing from construction mats set after mid-August when water tables are at their lowest will minimize compaction and damage to wetland sod and constituent dormant plants. Modified strip, store, and replace methods will be used to minimize impacts to the Ditch Fen sod (Section 2.3.3).

2. Minimizes total construction time in the fen. Pipeline construction can proceed with maximum efficiency. Cold-related equipment breakdowns and work stoppages are reduced, and workdays are longer. Assuming dewatering to the pipe installation depth can be done in one to two weeks, it is possible to begin construction, install the pipe, and reclaim the construction workspace in three to four weeks or less.

3. Final restoration can commence immediately after construction and during a time when conditions are optimal for these activities.

If Enbridge is unable to obtain the required permits and authorizations to allow for construction between mid-August and end of September, Enbridge will construct during frozen conditions.

[5] Seven years of hydrologic data indicate that pipeline construction beginning August 15 will occur during a period when water tables are typically at their lowest, due to higher midsummer evapotranspiration rates.

Attachment B includes the Gully 30 Winter Construction Procedures for MDNR review as a contingency.

1.7.3 Construction Method

Enbridge proposes to use the open cut construction method to install the L3R pipeline in the Gully 30 Fen. The open cut method will use a construction mat travel lane, with the trench and adjacent areas dewatered using horizontal dewatering procedures, which involves the use of drain tiles and with removal of water assisted by pumps. Dewatering is discussed in greater detail in Section 2.3.4 of this L3R FMP. Enbridge proposes to cross County Ditch 89 using the dam-and-pump crossing method as described further in Section 2.3.5; this technique may also be necessary to cross the Ditch Fen if flowing water is present.

1. The open cut method will be done in accordance with accepted engineering practices and standards with dewatering as a contingency when low-strength soils and saturated conditions are encountered.

2. The method is consistent with reasonable requirements of public health, safety, and welfare. Construction workers operating heavy equipment will be working off stable construction mats installed on the soil surface, not on construction mats placed on potentially unstable sheet pile.

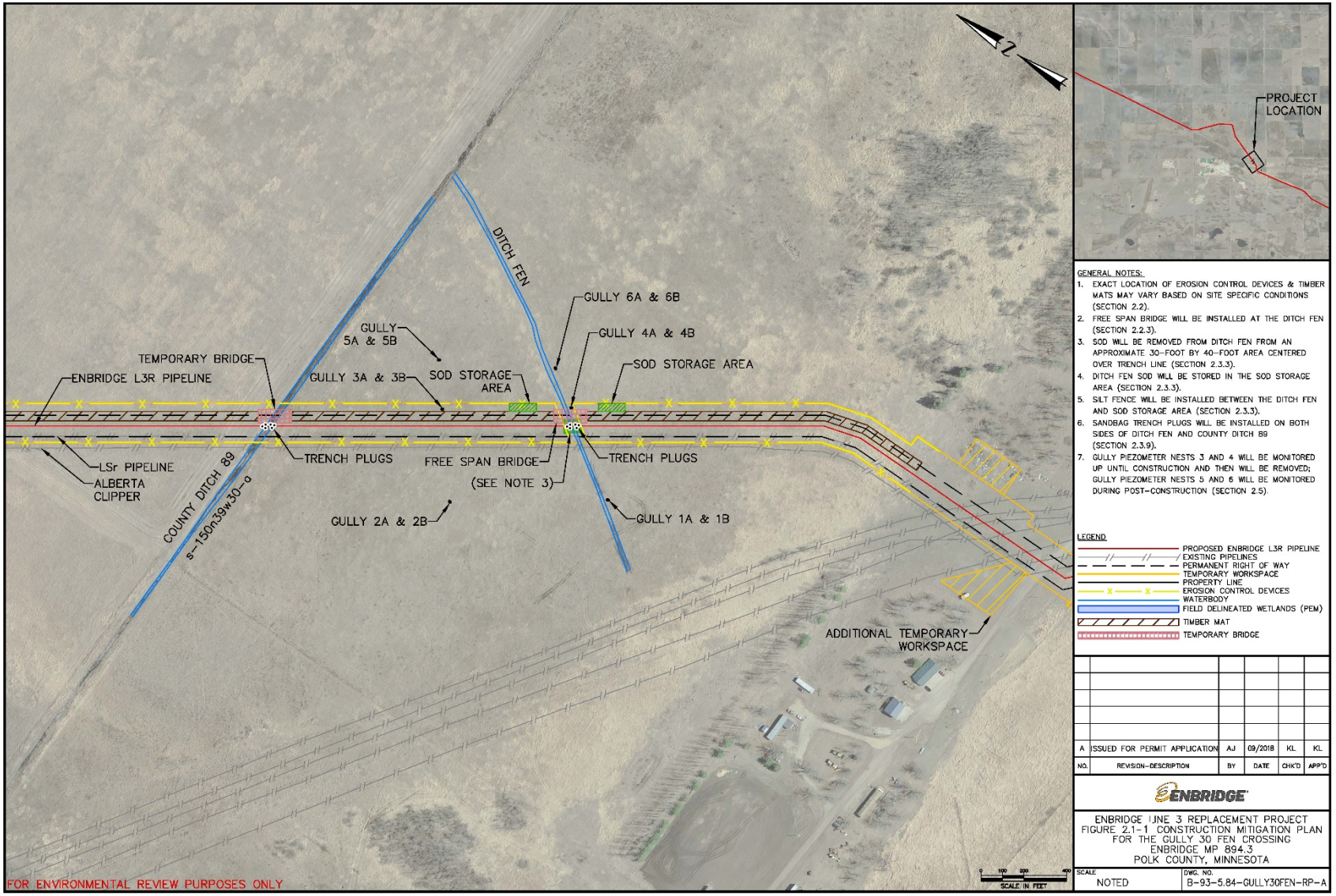
3. Special procedures described in Section 2.2.2 are proposed to minimize impacts on soils and vegetation within the construction workspace (also refer to Section 1.5.5 for further discussion of compaction).

2.0 GULLY 30 FEN CONSTRUCTION PLAN

2.1 CONSTRUCTION PROCEDURES

The construction procedures provided in this L3R FMP will apply to all wetland areas within the boundaries of the Gully 30 Fen, or approximately 2,000 feet of pipeline construction workspace. A detailed Construction Mitigation Plan identifying the construction workspace, sod removal and storage locations, locations of erosion prevention controls, trench plugs, bridges, and long-term groundwater monitoring piezometer nests is provided in Figure 2.1-1. Enbridge will utilize a free span bridge across the Ditch Fen (see Attachment C). Additional details on the bridge installation are included in Section 2.2.3.

Figure 2.1-1 Construction Mitigation Plan for Gully 30 Fen Crossing



2.2 PRE-CONSTRUCTION REQUIREMENTS

Enbridge will schedule a pre-construction meeting between Enbridge contractors, environmental staff, and agencies prior to commencing construction to review and discuss the construction techniques, schedule, sod removal, avoidance and minimization measures, dewatering, and to answer any questions regarding the L3R FMP and construction procedures.

Applicable hydrographs from piezometers installed during construction and long-term groundwater monitoring wells, and current growing season precipitation and climatic projections will provide information on the current and projected water table depths in the fen to assess potential water-related summer-construction issues. Enbridge will consider August 15 as the earliest construction start date and will not construct unless water levels in the Gully 30 monitoring wells are measured to be consistently 1 foot below ground surface during the August 15 through September construction time-frame. Construction activities within the fen will be completed within 30 days after the start of dewatering. Construction procedures for winter conditions are provided in Attachment B.

1. Environmental Inspectors ("EIs") trained on the L3R FMP are required to be on-site during any ground disturbance activities. Inspectors will document all site activity and prepare daily and weekly reports documenting compliance or non-compliance with the conditions of this L3R FMP.

2. Any deviations from the conditions of this plan must be submitted in writing as a variance request provided to and authorized by the MDNR.

3. Pre-construction site preparation traffic and site access: Light all-terrain vehicle ("ATV") or equivalent low ground pressure vehicle use will be allowed on-site at any time to perform pre-construction equipment installation and monitoring. The use of such equipment will be minimized to the extent practicable, and trafficking and the development of ATV access trails will be limited to the trench line. Installation of construction mats may proceed after August 15. No ATV, equipment, or other vehicle use will be permitted within the Ditch Fen prior to removing and reserving the sod (Section 2.3.3).

2.2.1 Construction Workspace Location and Configuration

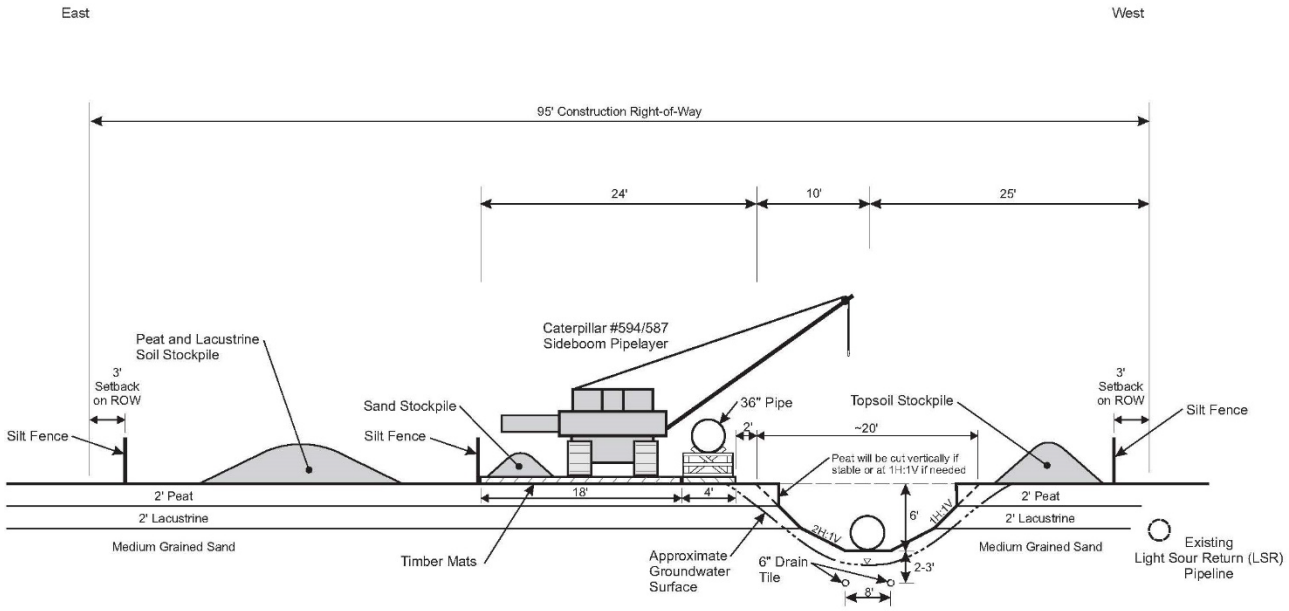
The L3R pipeline installation cross section is presented in Figure 2.2-1.

4. In accordance with the MPCA National Pollutant Discharge Elimination System/State Disposal System Construction Stormwater General Permit for the Project, Enbridge will properly install and maintain redundant control measures prior to or at the same time as ground disturbance activities (e.g., grading, topsoiling) occurring within a 100-foot buffer zone outside of the fen boundary (a state-designated "special water").

5. Construction will occur within a 95-foot-wide construction workspace configured with a 55-foot-wide working side to the north[6] of the L3R trench line and a 40-foot-wide spoil storage side to the south of the trench line.

[6] The construction ROW has been necked down from 120 feet wide in upland areas to 95 feet wide in the Gully 30 Fen to accommodate safe construction while minimizing physical disturbance to the fen.

Figure 2.2-1 Pipeline Installation Cross Section



Not to Scale

NOTE:
Topsoil storage locations are not fixed, and are at the contractors discretion depending on conditions. However, topsoil peat, subsoil peat, and subsoil sand must be stored separately and be returned to the approximate areas from which it was taken. For Alberta Clipper construction, sand was stored on the timber mat road to facilitate rapid removal of excess sand displaced by the pipe on set-on weights, and rapid replacement of the remaining sand to the trench.

Figure 2.2-1
Pipeline Installation Cross Section

6. No unapproved additional temporary workspace ("ATWS") will be staged outside of the 95-foot wide construction workspace within the boundaries of the Gully 30 Fen.

7. ATWS will be located in an upland area to the south of the Gully 30 Fen and immediately to the north of Stine Drive to stage: (1) fen crossing activities; and (2) the tie-in to connect the pipe crossing the fen with the pipe installed to the south of the fen (Figure 1.2-1).

8. Access to the main Gully 30 Fen staging area will be achieved from Stine Drive (Figure 1.2-1).

9. The construction workspace will be accessed from public roads only (Stine Drive). No temporary access roads will be required (Figure 1.2-1).

10. New construction mats are preferred for all construction use in the Gully 30 Fen. However, used construction mats may be employed if new mats are not available, provided they have been cleaned via scrape down, blow down, or power washing to ensure that no invasive or noxious plant seeds or vegetative parts are brought into the fen (Appendix B of the Environmental Protection Plan ["EPP"] [Attachment D]). Enbridge will ensure that the construction mats are sound to limit breaking and chipping. Enbridge will remove any mat chips or debris during cleanup.

11. All construction equipment will be cleaned prior to entering the Gully 30 Fen by scrap down, blow down, or power washing to ensure that no invasive or noxious plant seeds or vegetative parts (roots/rhizomes) are brought into the fen (Appendix B of Attachment D).

12. A 22-foot-wide construction mat travel lane and working surface on the working side of the construction workspace will consist of: (1) 4-foot-wide by 18-foot-long by 8-inch-deep construction mats laid lengthwise edge to edge; and (2) a pipe cribbing area consisting of 4-foot-wide by 18-foot-long by 8-inch-deep mats laid crosswise end to end, abutting the south side of the construction mat road between the road and the northern trench wall (Figure 2.2-1).

13. Enbridge proposes to use the 30-inch minimum depth of cover standard permitted by the U.S. Department of Transportation, Pipeline Hazardous Materials Safety Administration to reduce the depth of required trenching for installation of the L3R pipeline to 6 feet. Reducing trenching depth to 6 feet dramatically avoids/minimizes excavation in the sandy subsurface sediments within the Gully 30 Fen, reducing the potential for trench failure that will require a wider trench (Figure 2.2-1).

14. Trench excavation is planned to have a maximum width of 16 to 20 feet centered on the pipeline centerline to accommodate the anticipated side slopes needed to maintain sidewall stability of the dewatered trench and the installation of bag weights (Figure 2.2-1). A reduced trench slope may be required at tie-in locations, which will be located outside of the Ditch Fen, to allow workers safe entry into the trench.

15. Earthen trench plugs[7] will be left at the boundaries of the Gully 30 Fen to ensure that significant amounts of groundwater discharge originating outside the Gully 30 Fen do not preferentially flow into the site via the trench (Figure 2.1-1; Section 1.13 of the EPP [Attachment D]).

16. Enbridge will install a free span bridge over the Ditch Fen portion of the Gully 30 Fen. Further details on bridge design and installation are provided in Section 2.2.3.

2.2.2 Special Plant Community Considerations and Erosion Control

17. Attachment A provides the results of the Gully 30 Fen pre-construction baseline vegetation survey conducted along the L3R survey corridor (both within and outside of the construction workspace) and describes the location of survey plots to facilitate an assessment of post-construction restoration through monitoring (Section 2.5).

18. Prior to construction, signage will be established to identify: (1) the northern and southern boundaries of the Gully 30 Fen within which the conditions of the L3R FMP will apply; (2) the northern and southern boundary of the Ditch Fen area (bank to bank) and a 20-foot buffer to each side; and (3) locations of avoidable state-listed plant species.

19. No clearing is anticipated within the Gully 30 Fen. Silt fence and/or equivalent erosion and sediment control BMPs will be installed as indicated in Sections 1.9, 2.0, and 3.0 of the EPP (Attachment D) at the boundary of the construction workspace and at appropriate locations adjacent to the Ditch Fen and County Ditch 89 as indicated in Figure 2.1-1.

2.2.3 Matting and Bridge Installation

Installation of the construction mat road, bridges across the Ditch Fen and County Ditch 89, and the pipe fabrication area will be performed as follows:

20. Construction mats will be installed by a mat truck. The mat truck will lay mats in front, then drive across the mats to reach and lay mats on un-matted areas. The mat truck will return to the mat storage area by traveling over the partially installed mat road for additional mats as necessary. Installation of erosion and sediment control BMPs and bridges across County Ditch 89 and the Ditch Fen will occur concurrently with the mat road installation. The installation of the erosion and sediment control BMPs will use Enbridge standard methods as indicated in Section 1.9 of the EPP (Attachment D).

21. Temporary bridges will be established across the Ditch Fen and County Ditch 89 to facilitate equipment crossing with minimum impact. Based on discussions with MDNR staff and a review of bridging options, Enbridge will use a free span bridge across the Ditch Fen, which will not require in-stream supports to install (see Attachment C). Bridges will be designed and maintained to prevent soil from entering the wetland and waterbody. The exact dimensions of the portion of the Ditch Fen proposed for sod removal, storage, and replacement will be identified and flagged as an exclusion area.

[7] Earthen trench plugs consist of temporary bridges of native, undisturbed soil that remain to prevent runoff from entering the Gully 30 Fen. The earthen trench plugs will be removed during pipe installation and will be replaced by sandbag trench breakers or equivalent.

22. Temporary bridges will be equipped with geotextile fabric and sideboards to prevent sediment from entering the Ditch Fen or County Ditch 89. Soil that accumulates on the bridge decking will be removed as needed. Bridges will be removed as soon as possible during final restoration.

2.3 CONSTRUCTION REQUIREMENTS

2.3.1 Topsoil, Sod, and Substrate Handling

23. Trench-only topsoil stripping (consisting of the existing top organic/vegetative layer with roots and underlying topsoil up to 12 inches) will be employed along a strip approximately 24 feet wide centered on the pipeline centerline to minimize construction impacts on surface soils and vegetation. This method is advised within the proposed timeframe (after August 15) to take advantage of the strength of the sod knitted together with roots to support construction mats and construction traffic without substantially deforming the underlying peat.

24. Topsoil will be stripped from the trench and a two-foot buffer on the outside of each trench wall to account for potential sidewall slumping. The topsoil layer (consisting of the existing top organic/vegetation layer with roots and underlying topsoil up to 12 inches) will be stripped with a backhoe operating off the construction mats. The topsoil will be stored on the north side of the construction mat travel lane; Enbridge will use either tarps, plywood, or mats to provide a physical barrier between the undisturbed native sod and topsoil. Topsoil stripping will be completed in advance of drain tile installation.[8] Topsoil stripping ensures that intact, relatively undisturbed sod mats containing quantities of state-listed species within the Ditch Fen are restored.

25. Subsoil peat will be stored on plywood over construction mats adjacent to the construction mat travel lane, and sand may be stored on the construction mat road during the short period of time the trench is open. Excess sand (previously calculated based on pipe and bag weight displacement) can be easily loaded on dump trucks for off-site disposal when the sand is stored on the construction mat road.

2.3.2 Pipe Preparation

Pipe fabrication consists of bringing the pipe in by semitrailers (stringing), placing the pipe on pipe cribs in the lay-up area, bending the pipe to the angle of points of inflection and topography, welding the pipe, grinding and coating the welds, and jeeping[9] and x-raying the pipe to ensure weld and coating integrity. To minimize the length of time the fen is disturbed, the pipe will be fabricated to the point where it is ready to be laid into the trench immediately after completion of trenching. In addition, all chemicals and grinding residue from pipe fabrication will be collected on ground cloths for off-site disposal.

[8] Drain tile installed will consist of standard perforated flexible plastic pie encased in a sleeve of geotextile filter fabric. The resulting tile is frequently called “sock tile.”

[9] Jeeping refers to the operation of inspecting pipe coating with the aid of electronic equipment. An indicator ring is passed over the pipe which carries, an electric charge. If there is a break in the protective coating a signal is transmitted through the indicator ring to an alarm.

Pipe stringing, bending, welding, grinding, coating, and jeeping will proceed as follows:

26. All pipe fabrication will be performed in advance of trenching to minimize the amount of time the trench is open. As appropriate, pipe will be strung, bent, welded, welds ground and coated, and pipe jeeped. Stringing trucks will access the cribbing area using the construction mat road, cribbing the pipe on narrow segments of construction mat laid between the mat road and the trench. Ground cloths will retain grinding residue for off-site disposal and be used to ensure that epoxy coating does not contaminate site soils.

2.3.3 Special Plant Community Considerations: Ditch Fen

The Ditch Fen sod will be removed, stored, and replaced within the August 15 through September 30 construction period. It will be necessary to (1) create a storage area ("Sod Storage Area") outside of the Ditch Fen, but with similar environmental conditions; and (2) to remove sod, transfer it to the storage location, manage it as necessary, and return it to the locations from which it was removed. Sod will be hand cut into appropriate blocks and removed and replaced using a hoe equipped with a standard four feet by eight feet scraper blade. Figure 2.3-1 illustrates the Ditch Fen sod removal and storage procedures employed on the Alberta Clipper pipeline.

27. Ditch Fen sod removal will begin after the construction mats for sod storage are laid, prior to installation of the dewatering system and before pipe stringing and fabrication.

28. Silt fence will be established between the Ditch Fen and the Sod Storage Area (Figure 2.1-1) to prevent sediment from entering the Ditch Fen.

29. The Sod Storage Area will be prepared within the approximately 1-foot high spoil pile of topsoil stripped from the wetlands adjacent to the north bank of the Ditch Fen (refer to Section 2.3.1 and Figures 2.1-1 and 2.2-1). This topsoil spoil pile and adjacent area are higher in elevation than the bed of the Ditch Fen and surrounding wetland; this area is depauperate in state-listed species and state-ranked calciphiles based on 2017 through September 2018 flora census (count) results (refer to Enbridge's Endangered Species Application for additional information). Figure 2.3-2 presents Ditch Fen 2018 flora count data. The removed sod and topsoil from the Ditch Fen will be physically separated (e.g., plywood, tarp) from the underlying topsoil storage area. Sod will be stored in a single layer and will not be stacked. Enbridge will implement the measures identified in Invasive and Noxious Species ("INS") Management Plan (Appendix B of Attachment D) to manage the spread of terrestrial INS identified in the area during construction.

30. During excavation, if necessary due to a precipitation event or other unforeseen circumstances, the Sod Storage Area will be dewatered into a filter bag placed adjacent to the Ditch Fen. Additional silt fence will be placed between the filter bag and the Ditch Fen to prevent sediment from entering the Ditch Fen.

Figure 2.3-1 Ditch Fen Sod Removal and Storage

Part A. Sod from the Ditch Fen that contained several Minnesota State Listed plant species was removed and stored adjacent to and to the southeast of the Ditch Fen Area on December 8, 2009. The removal of sod within the Ditch Fen was initiated by using a ditch-witch trencher to inscribe a shallow trench defining the area (approximately 30 feet X 40 feet) (Photo A1). Timber mats were placed adjacent to the Ditch Fen area to provide support for a track-hoe equipped with a scraper blade attachment (Photo A2). The scraper blade cut and lifted sod in approximate 4 X 8 foot segments (Photo A3). These sod pieces were then placed on sheets of plywood nailed to timber mats (Photo A4) that were numbered and moved to a holding area just southeast of the Ditch Fen.

Part B. Sod pieces placed on numbered mats were stored in a holding area just to the southeast of the Ditch fen (Photo B1). The process continued (Photos B2 and B3) until the entire area of the Ditch Fen and an 8 to 10 foot buffer zone outside of the Ditch Fen was cleared (Photo B4) with all sod pieces held in the storage area (Photo B5). Once it became apparent that constraints imposed by cold weather on the timing of the drain tile dewatering would result in an extended period before the sod pieces could be returned to their original locations, the sod pieces were covered with clear plastic to keep the sod from desiccating in the cold and wind (Photo B6).

Figure 2.3-2 Ditch Fen 2018 Flora Count Data

Figure redacted due to sensitive protected species information.

31. The area from which sod will be removed will be identified and staked. Erosion and sediment BMPs as described in Section 1.9 of the EPP (Attachment D) will be employed across the full width of the pipeline construction ROW workspace to prevent sediment from entering the Ditch Fen (Figure 2.1-1).

32. Blocks of sod approximately 4 feet by 6 feet by 12 inches thick will be manually cut with a sod knife/hand shovel to facilitate removal by a backhoe equipped with a scraper blade. Pre-cut Ditch Fen sod will be removed using a backhoe equipped with a flat scraper-blade and operating on the construction mat road and off temporary mats laid outside the Ditch Fen, as necessary.[10] Sod pieces will be consecutively numbered and located on a field sketch to facilitate their return to the locations from which they were removed.

33. Sod pieces will be placed into the storage area in the same order removed and will be manually adjusted as necessary. During sod storage, the sod blocks will be maintained by a combination of natural irrigation (precipitation) and, if necessary, artificial irrigation. The stored sod will be inspected daily to check for desiccation and will be moistened, as needed, using water pumped from the site.

34. Once all sod from the Ditch Fen area has been removed and placed into the Sod Storage Area, pipe stringing and installation of the drain tile dewatering system will proceed.

2.3.4 Dewatering Methods

Alberta Clipper geotechnical work performed to evaluate potential trench stability issues in the Gully 30 Fen indicate that flowing groundwater and the presence of near-surface unconsolidated sands could compromise trench stability and result in trench slumping. To strengthen Alberta Clipper pipeline trench walls, shallow dewatering was employed to lower water levels to near the bottom of the trench using 8-inch drain tile installed horizontally 2 feet below the bottom of the trench (8 feet from ground surface). This procedure resulted in minimal trench failure or slumping (see illustrative photos in Figure 2.3-3).

Alberta Clipper dewatering was complicated by inefficiencies in drain tile capacity and dewatering control that could be alleviated by employing two, independently operating drain tile systems on each side of the L3R pipeline centerline. Enbridge performed additional geotechnical and groundwater drawdown modeling to evaluate trench stability issues and dewatering timing estimates. Based on the Alberta Clipper dewatering experience and this additional modeling, the proposed L3R dewatering system has been optimized (see Attachments E and F).

[10] If additional workspace is necessary due to space constraints in siting the Sod Storage Area, the MDNR will be notified and a variance request prepared. All work will be from construction mats appropriately located outside of the Ditch Fen in areas approved beforehand by the MDNR. Any temporary mats placed in approved ATWS will be removed immediately after the sod has been stripped.

Figure 2.3-3 Drain Tile Installation and Dewatering System

Part A. Drain tile segments were installed such that the end risers abutted each other and were separated by approximately 15 feet of undisturbed ground. After installation, each riser was connected to a 6-inch length of un-perforated pipe and was subsequently connected to a 6-inch pump in spill containment as specified in Enbridge's EPP (Photos A1 through A3). Water was directed through 6-inch hose to a discharge location near the County Ditch 89 ditch crossing. Energy dissipaters were designed to prevent erosion of the bed or banks of County Ditch 89 (Photo A4). Note the clarity of the discharge water in Photo A4 is the result of both the filter sock encasing the installed perforated tile combined with the presence of high natural levels of calcium in the groundwater that dramatically reduces turbidity by flocculating the sediment.

Part B. At maximum rates of pump discharge, County Ditch 89 was running well and discharge water flowed to the east and subsequently to the Lost River without flooding incident (Photo B1). Sump water from the tie-in location to the south of the Gully 30 Fen was directed to a filter bag to the south of Stine Road (Photo B2). Barr Engineering staff (Photo B3) manually monitored the piezometers (Photo B4) to determine when the water table had reached the target level where trenching could proceed. After trenching (Figure 8), groundwater discharged to the trench primarily through sand at the bottom of the trench. Because the gradient of the trench followed the ground surface gradient to the north, water flow in the majority of the trench was directed down-slope to County Ditch 89 where it was removed by 6-inch pumps and was discharged through filter-cloth hay-bale dewatering structures to County Ditch 89 (Photo B5). Water flow in the southern portion of the trench that was to the south of the Gully 30 fen flowed to the bell hole excavated to install the pipe under the existing pipelines. This water was removed by 6-inch pump (Photos B6 and B7) and was directed to the south of Stein road (Photo B2).

2.3.4.1 Piezometer Installation and Monitoring

Once the topsoil is removed, the centerline of the pipeline will be surveyed to assist with identifying the appropriate location to install the piezometers used to monitor water table drawdown during construction; distance from the centerline will vary to model the target depth that will ensure maximum stability of the trench wall during excavation of the trench. On Alberta Clipper, 19 piezometers in 8 rows were established at approximately 300-foot intervals along the area to be dewatered adjacent to the trench to monitor water levels and to determine when trenching could begin.

35. For L3R, Enbridge geotechnical engineers will develop a groundwater monitoring system similar to that used on the Alberta Clipper pipeline. Figure 2.3-4 shows approximate piezometer locations for the Project. Up to 4 piezometers will be installed at each row dependent upon field conditions. Enbridge will provide the MDNR with a final map of all piezometer locations, including Gully 1A through 6B monitoring wells, and will provide latitude/longitude, depth, screen, top of casing, and ground surface elevation of all piezometers once installed. Piezometers will be monitored hourly or as needed to evaluate the decline in water elevations. Trenching can commence when water levels in the piezometers adjacent to the centerline are 6 feet or greater from the soil surface.

36. Piezometers will consist of 8 to 10 feet of 2-inch steel pipe equipped with an 18-inch-long, 2-inch-diameter 10-slot, wound, stainless steel well screen.

37. Piezometers will be installed by using a backhoe bucket to drive the piezometer assembly into the ground such that the bottom of the well screen is no less than 8 feet below the soil surface, leaving a three-foot riser. These piezometers will be removed prior to trenching (for those adjacent to the centerline) or after construction is complete.

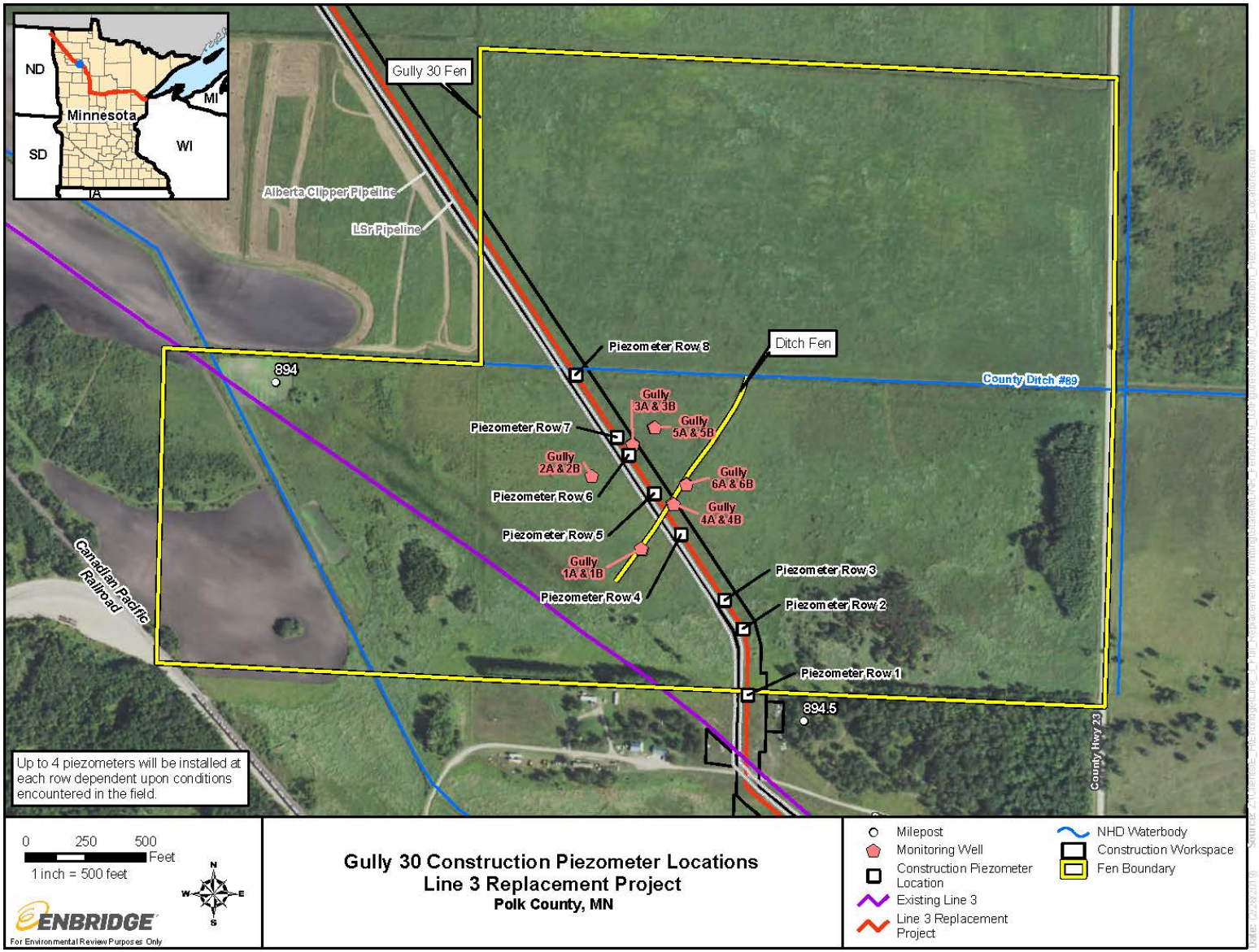
2.3.4.2 Installation of Drain Tile: General

38. During construction, trench plugs will be left at the locations where typical open cut crossing procedures cease and installation of the horizontal dewatering system commence. Trench plugs will ensure that any water flowing along the trench will not lower the efficiency of the horizontal dewatering system (refer to Section 1.13 of the EPP [Attachment D]).

39. A mechanized tile installer will be used to install two independent parallel lines of 6-inch-diameter, fabric-covered drain tile approximately 2 feet below the installed depth of the L3R pipe (installation depth approximately 8 feet below from the surface) and approximately 4 feet to either side of the pipeline centerline (8 feet of total separation). Two passes of the tile installer machine will be needed to install the two parallel tile lines (Figure 2.2-1)

40. The tile installer will operate from 4-foot by 18-foot by 8-inch end-butted construction mat strips to minimize track disturbance to the underlying soil. All disturbance resulting from the tile installation process will be confined to the 24-foot-wide area stripped of topsoil and centered on the L3R pipeline centerline.

Figure 2.3-4 Gully 30 Construction Piezometer Locations



41. Drain tile will be installed only in areas where sand is present above 6 feet in depth.[11]

42. A sequential series of up to eight flexible drain tile segments per side consisting of 6-inch perforated polyvinyl chloride pipe with a geo-textile filter casing will be installed horizontally in approximate 250- to 500-foot lengths to an 8-foot depth and 4 feet to either side of the trench centerline (Figures 2.2-1 and 2.3-5).

43. Appropriate drain tile segments will be completed with a riser connected via a pump manifold to high-capacity pumps; the number of pumps required will be determined by site-specific conditions at the time of construction (Figure 2.3-5).

44. The maximum distance between drain tile segment risers will be 12 feet to ensure sufficient drainage in the space between segments.

45. Gaps between construction mats at appropriate locations will be used to route the non-perforated drain tile across the pipe lay-up area and the construction mat road. Discharge from the south and north dewatering systems will be directed to filter bags or equivalent dewatering structures.

46. All dewatering water will be discharged through a minimum of two approved filter bag structures or equivalent to County Ditch 89 under the applicable water appropriation and discharge permits. Each parallel dewatering tile segment will have its own dewatering structure on each side of the pipeline trench. Records of pump volumes will be kept consistent with permit conditions to determine total water appropriation and discharge volumes.

47. Pumps will be operated 24 hours per day as appropriate.[12]

48. On initiation of backfilling, the risers will be cut off at a maximum of 5 feet below ground surface in dry conditions, or a minimum of 18 inches (below the sod layer) in wet conditions, by the backhoe bucket and the tile segments will be jetted full of sand and abandoned in place. Sand will be derived from the trench excavation; if in situ material cannot be used, sand may be sourced from a local aggregate mine. The cut-up tile risers will then be crushed as was done on Alberta Clipper.

2.3.4.3 Installation of Drain Tile: Ditch Fen

49. No permanent mats or construction equipment travel will be allowed within the Ditch Fen. All construction equipment will traverse the Ditch Fen area using a temporary bridge with the following exceptions only after the sod layer containing listed plant species is removed and placed in the Sod Storage Area:

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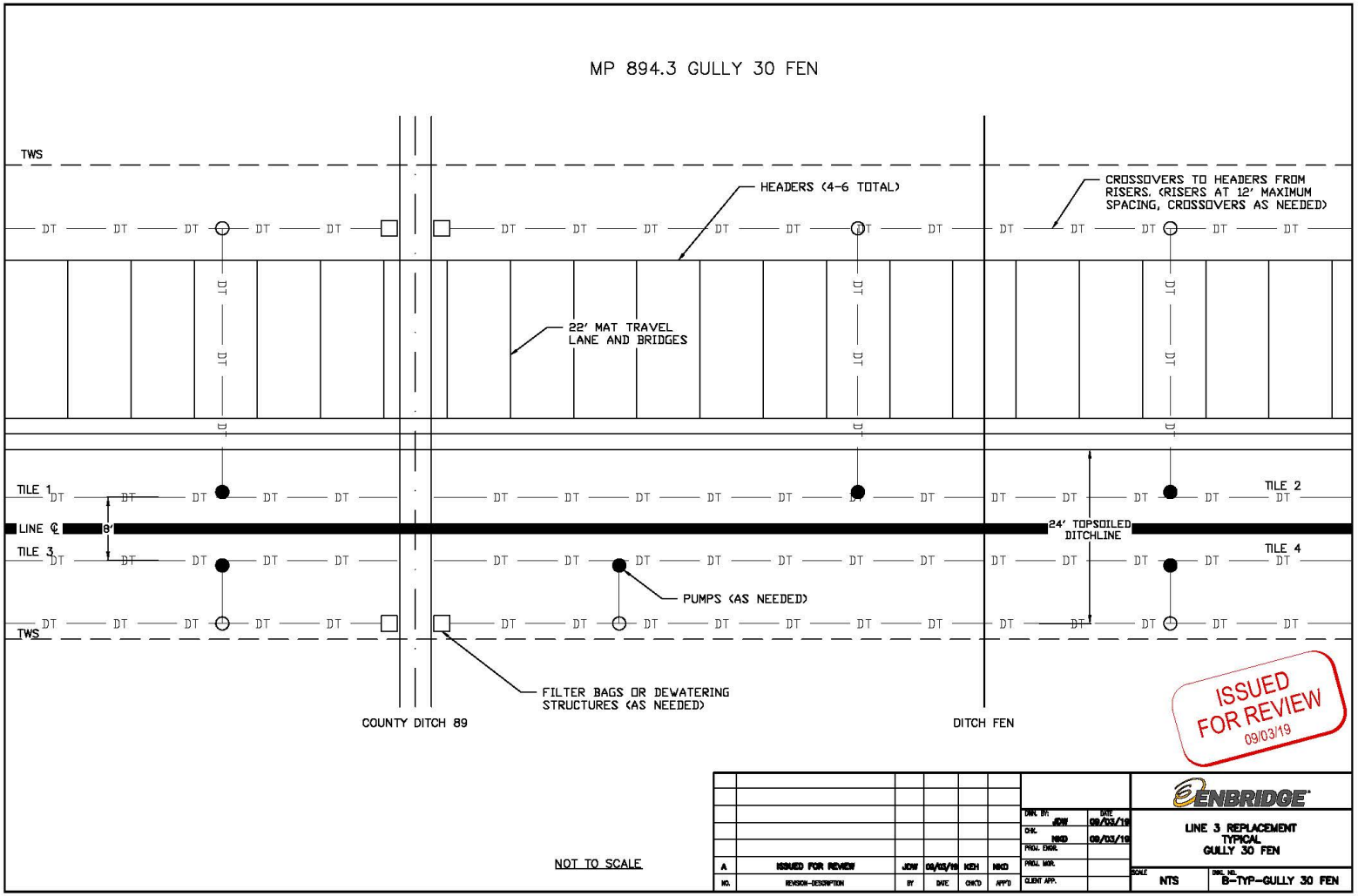
[11] The peat thickness contour map indicates that peat less than 7 feet in thickness does not extend much beyond County Ditch 89 (Figure 1.5-2). Deep peat greater than 6 feet in thickness begins approximately 380 feet south of County Ditch 89. Trenching during Alberta Clipper indicated that peat greater than 6 feet in depth has sufficient strength to maintain a trench wall. No significant trench failures or widening of the trench north of the installed drain tile occurred, and the presence of the drain tile in areas where peat was shallow to sand prevented significant trench wall failure in the locations where it was expected.

[12] Note that sufficient groundwater pressure is present such that ceasing pumping for more than a short time (i.e., a few hours) will result in a substantial increase in water levels and additional time for dewatering the segment.

Figure 2.3-5 Drain Tile Dewatering



a. The trencher installing the dewatering tile will be permitted to cross the ditch on 4-foot-wide construction mats installed at separations necessary to support both tracks of the trencher. Matting is necessary because the sod will be removed prior to installation of the horizontal dewatering system and the trencher will be operating directly on loose unconsolidated subsoil peat.

b. The trencher will be confined to the trenched area from which the sod has been stripped, and installation of the horizontal drain tile will be approximately 4 feet to either side of the L3R pipeline centerline.

2.3.4.4 Trench Dewatering

50. Concurrently, the volume of water appropriated and discharged to County Ditch 89 through the appropriate dewatering structures will be determined based on knowledge of pump volumes and time that pumps are operating. Records of discharge volumes and rates will be maintained/reported as stipulated by applicable permits.

51. Trench dewatering and dewatering for the County Ditch 89 crossing will be in accordance with all applicable state and local permits as described in Section 5.1 of the EPP (Attachment D).

2.3.5 Crossing of County Ditch 89 (and Ditch Fen as Necessary)

The crossing techniques used to cross County Ditch 89 and the Ditch Fen during Alberta Clipper are proposed for L3R.

52. The dam-and-pump (dry-crossing) method will be used to cross County Ditch 89. For Alberta Clipper, this method consisted of heavy steel sheets that were shored with sheet pile to isolate the trenched area and then dewatering and excavating the area between the two steel sheet segments. The dam-and-pump method is described in Section 2.5.2 and Figure 23 in the EPP (Attachment D).

53. The dam-and-pump method may be necessary to cross the Ditch Fen if flowing water is present; however, if the Ditch Fen is dry, the open cut crossing method described in Section 2.5.1 and Figure 22 of the EPP (Attachment D) will be used.

54. To maintain the natural flow of groundwater and to prevent capture of groundwater by the trench, sandbag trench plugs will be placed across the trench at locations coincident with the banks of County Ditch 89 and the Ditch Fen, as well as the boundaries of the Gully 30 Fen after pipe lay-in and prior to backfill (Figure 2.1-1).

2.3.6 Trenching and Spoil Handling

Trenching will proceed rapidly with peat and sand subsoil lifts kept separate. Topsoil will have been previously stripped and stored appropriately on the spoil storage side. Subsoil peat will be stored on plywood over construction mats adjacent to the construction mat travel lane. Sand may be stored on the construction mat road during the short period of time the trench is open. Excess sand (previously calculated based on pipe and bag weight displacement) can be easily loaded on dump trucks for off-site disposal when the sand is stored on the construction mat road.

If the trench line is wet and soil is susceptible to excessive disturbance and rutting the track hoe will operate off of construction mats.

55. Trenching can proceed in segments by multiple backhoes[13] once water tables have been drawn down to approximately 6 feet from the soil surface. Trenching is accomplished by backhoes travelling backwards along the trench line, digging the trench, reserving, and storing two lifts of soil: the peat subsoil layer and the sand subsoil layer.

56. The peat subsoil layer will be stored on the spoil storage side over the Enbridge's existing pipeline easement. The sand subsoil layer will be stored on the construction mat road and can be trafficked over as necessary. For Alberta Clipper, the excavated sand subsoil was stored on the construction mat road, which facilitated the concurrent removal of excess sand to an off-site location for disposal.[14]

57. If areas exist where two or three of the lifts are stored in close proximity, sediment barriers will be installed between stockpiled soil layers, as necessary, to maintain segregation and prevent mixing.

58. If sand is to be stored on the construction mat road to facilitate rapid removal of excess sand, ground cloths or equivalent will be used to cover and protect the portions of the pipe over which the backhoe bucket travels.

2.3.6.1 Trenching: Ditch Fen

59. The crossing of the excavated ditch that includes the Ditch Fen will be subject to a 48-hour limitation for an open trench. Ditch excavation, pipeline installation, installation of trench plugs, backfill, and subsequent sod replacement will occur within a 72-hour period.[15]

60. The only ground disturbance permitted within the Ditch Fen area will be within the excavated trench area.

61. The trench line and pipe installation will be conducted off construction mats and the temporary bridge.

62. If, during excavation of the crossing, it is determined that sloughing of the trench walls has the potential to impact additional sod area, further sod pieces will be removed with their original location recorded to facilitate return to the same pre-construction location.

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[13] Trenching for Alberta Clipper was accomplished by four backhoes in 1 day. Enbridge anticipates similar trenching duration for L3R under summer construction conditions.

[14] The storage location of spoil materials is not fixed. The staging of topsoil adjacent to construction mats with peat subsoil stored over the hot pipeline and sand stored on the construction mat road was the configuration used for Alberta Clipper. However, whatever configuration is used, the contractor must ensure that topsoil, peat subsoil, and sand substrate are stored such that the "lifts" are kept separate (no mixing), that the spoil can be returned to the approximate location from which it was removed, and that excess sand can be removed for off-site disposal.

[15] An additional 24 hours (72 hours total) has been added to ensure the replacement of the reserved sod to the locations in the Ditch Fen from which it was removed.

63. After pipe lay-in and prior to backfill, trench plugs consisting of sandbags will be placed across the trench at locations coincident with the banks of the Ditch Fen to maintain the natural flow of groundwater and to prevent capture of groundwater by the trench.

2.3.6.2 Removal of Excess Sand

Calcareous fens are especially sensitive to persistent changes in groundwater levels. Because large volumes of sand will be displaced by the 36-inch-diameter L3R pipe and gravel-filled bag weights (also referred to as saddlebag weights) placed on 10-foot centers, excess sand must be removed to ensure that the trench mound left after final restoration is no more than 6 inches in height after equilibration.

64. Excess sand (previously calculated for the Alberta Clipper pipeline as the volume of sand displaced by the pipe and bag weights in the area where sand is above the bottom of the trench) will be hauled off-site in dump trucks for disposal. The total volume of sand will be tracked by number of truckloads of sand removed.[16]

2.3.7 Laying In

65. As soon as trenching is complete, the previously prepared L3R pipe will be installed in the trench by sideboom pipe layers with rolling slings operating off the construction mat travel lane.

2.3.8 Placing Bag Weights for Buoyancy Control and As-built Survey

The pipeline will have positive buoyancy and can move upward even when covered with soil. Buoyancy control for pipelines traversing wetlands is typically provided by installing concrete-coated pipe or placing bag weights (i.e., saddlebag weights) on the pipe prior to backfill. Enbridge and the MDNR have agreed that negative buoyancy control for pipe installed in calcareous fens will be provided by using bag weights filled with clean, locally derived pea gravel, sealed and connected at the top so that the assembly of two bag weights can be draped over the installed pipe prior to backfill.

66. Buoyancy control for the L3R pipe installed within the Gully 30 Fen will be provided by bag weights filled with clean pea gravel (9,000 pounds total), connected at the top, and laid over the pipe on approximate 10-foot centers.

67. Prior to backfill, elevations of the top of the pipe will be surveyed to develop as-built schematics indicating exact centerline locations, installation depth, top of pipe, and depth of cover.

[16] Soil displacement by the pipe and bag weights is a fixed calculable value for the pipeline. The 36-inch-diameter pipe with 9,000-pound gravel-packed bag weights placed on 10-foot centers displaces approximately 7.07 cubic feet (12,215 cubic inches) and 6.21 cubic feet (10,725 cubic inches), respectively, per foot of pipe. Preliminary volumes established for the 36-inch Alberta Clipper pipeline indicated the removal of 74 dump truck loads of sand will be needed. These values are provided as estimates and will be modified in the field to adjust for site-specific conditions as approved by the MDNR.

2.3.9 Installation of Trench Plugs and Backfill

68. Trench plugs consisting of sandbags stacked across the trench and coincident with both sides of the Ditch Fen will be installed to prevent any capture of groundwater flow within the Ditch Fen by the trench subsequent to backfill and restoration. Trench plug locations are displayed on Figure 2.1-1.

69. Similarly, trench plugs will also be installed across the trench on either side of the County Ditch 89 crossing to prevent any preferential movement or capture of water from County Ditch 89 by the pipeline subsequent to backfill. Trench plug locations are displayed on Figure 2.1-1.

70. Sand will be replaced to the approximate location from which it was removed and to the level noted in the sidewalls of the excavated trench, with an allowance for settling.

71. Because the volume of sand displaced by the L3R pipeline and bag weights will be removed for off-site disposal, all sand and peat subsoil should be returned to the trench.

72. After the sand has been returned to the trench, peat subsoil will be returned to the approximate location of the trench from which it was removed.

2.4 POST-CONSTRUCTION REQUIREMENTS

2.4.1 Cleanup and Restoration

Final restoration will proceed immediately after backfilling minimizing the time during which the fen is disturbed as discussed in Section 2.3.9. The backfill operation will remove excess sand to an off-site location and will fill the trench with sand to the approximate level of the sand/peat subsoil contact. Sand will cover the pipe and associated gravel-filled buoyancy control bags. Inspectors will ensure that large voids are not present that could result in substantial subsidence. Peat subsoil will be returned to the approximate locations from which it was removed. The trench will be worked until the soil is not cloddy and is at a level to receive topsoil such that the final finish graded trench will be level with the adjacent undisturbed soil at the trench edge.

73. Enbridge will inform the MDNR when any work is proposed to be done around County Ditch 89 or the Ditch Fen.

74. All work will be done by track hoes operating from construction mats. No reclamation equipment will be allowed off the existing construction mats.

75. Topsoil stored on the working side will be returned to the approximate locations of the trench from which it was removed.

76. Because topsoil stripping will be only from the 24-foot-wide trench area, topsoil replacement is only applicable to the stripped area.

77. As topsoil is replaced, the soil surface will be gently tamped to ensure a firm surface soil with minimal large void space. Tamping the surface to assure a firm rooting zone and absence of significant macro voids in the peat will be done by shovel and/or backhoe bucket, depending on the scale of the restoration being completed.

78. To the extent practicable, peat surface soil will be returned after replacement of peat subsoil, with the original sod returned last, and with the top of the sod facing upwards.

79. Enbridge will remove construction mats from the 4-foot-wide pipe cribbing and lay-up area.

80. The banks of County Ditch 89 will be finish graded as necessary to restore original topographic contours. Permanent erosion and sediment control BMPs will be installed as indicated and necessary.

81. When restoration activities are complete within the Gully 30 Fen, including County Ditch 89 and the Ditch Fen, all construction debris will be removed, and the mat road will be taken out by backhoes successively removing mats. All mat removal will be accomplished from the mat road. Any remaining debris from the construction mats will be removed, as necessary.

82. As a final step, restoration crews will hand broadcast the Minnesota Board of Water & Soil Resources Wet Meadow South and West seed mix (see Appendix C of the EPP [Attachment D]) to control erosion and to supplement subsequent revegetation from the seed bank. This seed mix will be customized by removing three species that are not native to Polk County, Minnesota:

    a. Rice cut grass (*Leersia oryzoides*);
    b. Tall manna grass (*Glyceria grandis*); and
    c. Bristly sedge (*Carex comosa*).

83. Enbridge and MDNR will review the completed restoration for adequacy and compliance with the conditions of this L3R FMP. Once final restoration grades and conditions have been approved, the monitoring phase of this L3R FMP will begin.

2.4.2 Cleanup and Restoration: Ditch Fen

Final restoration will proceed immediately after backfilling minimizing the time during which the Ditch Fen remains in a disturbed state as discussed in Section 2.3.9. The backfill operation will remove excess sand to an off-site location and will fill the trench with sand to the approximate level of the sand/peat subsoil contact. Sand will cover the pipe and associated gravel-filled buoyancy control bags. Inspectors will ensure that large voids are not present that could result in substantial subsidence. Peat subsoil will be returned to the approximate locations from which it was removed. The trench will be worked until the soil is not cloddy, is firm to minimize subsidence, and is at a level to receive reserved sod such that the final grade is level with the original bed of the Ditch Fen.

84. Enbridge will inform the MDNR when any work is proposed to be done around County Ditch 89 or the Ditch Fen.

85. The entire restoration will be observed by an EI or supervising Enbridge Environment Compliance staff.

86. The crossing of the excavated ditch that includes the Ditch Fen will be subject to a 48-hour limitation for an open trench. Ditch excavation, pipeline installation, backfill and sod replacement will occur within 72 hours.

87. Enbridge will calculate and remove 100 percent of displaced soil material from the Ditch Fen area.

88. Enbridge will return sand to the same level observed in the trench. A slight excess is acceptable if the EI or supervising Enbridge Environment Compliance staff believe that additional settling will occur.

89. Peat subsoil will be returned and will be packed during replacement to ensure a firm soil bed for the sod.

90. Upon EI approval, sod from the Sod Storage Area will be returned to the same locations from which it was removed.

91. The sod pieces will be returned with each piece either directly butting the next or separated by narrow linear spaces of varying width to ensure optimal overall coverage of the stripped area. Topsoil reserved from beneath the sod should be used to fill open spaces between sod pieces.

92. Sod pieces will be leveled and brought to the appropriate contour of the Ditch Fen bed.

93. The track hoe and restoration crews will restore the original contours by filling in areas of the trench that have settled and removing or pressing down areas where excess material exists. Only native peat will be used to restore the pre-construction elevation. Restoration of the Ditch Fen is not expected to take more than 2 days. If restoration requires that sod be temporarily removed, sod will be watered down to maintain saturated conditions as necessary.

94. When the sod has been returned to the locations from which it was removed, and the replacement approved, the Sod Storage Area will be restored as described in Section 2.4.1.

95. Enbridge Environment Compliance staff and MDNR will review the completed restoration of the Ditch Fen and the Sod Storage Area for adequacy and compliance with the conditions of this L3R FMP. Once final restoration grades and conditions have been approved, the monitoring phase of this L3R FMP will begin (Section 2.5).

2.4.3 Reporting

2.4.3.1 Provide As-built Drawings and Records

96. As-built drawings of the installation will be provided, including:

- As-built elevation of the pipe;
- Depth of cover;
- Dimensions of the trench crown, centerline, and edges related to pre-construction conditions;
- Locations of pre-construction vegetation and state-listed species;
- Location and extent of the topsoil/sod storage areas;

- Location and extent of the peat/lacustrine stockpile areas;
- Location and dimensions of the working side, the trench width, the spoil storage side, and any ATWS;
- All dewatering locations, along with records of water appropriation volumes; and
- All dewatering water discharge locations.

2.4.3.2 Construction Documentation and Compliance Report

97. Once final restoration has been approved, the interim construction documentation and L3R FMP compliance report will be completed and provided to all stakeholders.

98. All reports, including final documentation and compliance report and all subsequent monitoring reports, will be transmitted electronically.

2.5 PROPOSED LONG-TERM MONITORING PROGRAM

Enbridge proposes to incorporate future monitoring for the L3R into the ongoing Alberta Clipper monitoring program ("Alberta Clipper Monitoring Program") with L3R specific modifications recommended by MDNR described below:

2.5.1 Hydrology

Four piezometer nests (Gully Nests 1 through 4) consisting of one deep sub-peat well and one water table well each, and two reference piezometer nests in the Chester 24 fen (Chester Nests 1 and 2), are monitored under the Alberta Clipper Monitoring Program. The two piezometer nests to the west of the Alberta Clipper and LSr pipelines (Gully Nests 1 and 2) and the two reference nests in the Chester 24 fen (Chester Nests 1 and 2) remain undisturbed by L3R construction and will continue to be monitored for both projects.

The two piezometer nests to the east of the Alberta Clipper pipeline (Gully Nests 3 and 4) will be disturbed by L3R pipeline construction. At the MDNR's request, two additional piezometer nests (Gully Nests 5 and 6) have been located at approved locations north and east of the proposed L3R construction workspace. All six piezometer nests were monitored in 2018 and 2019 and are anticipated to be monitored until construction begins requiring the removal of Gully Nests 3 and 4 (Figure 2.5-1).

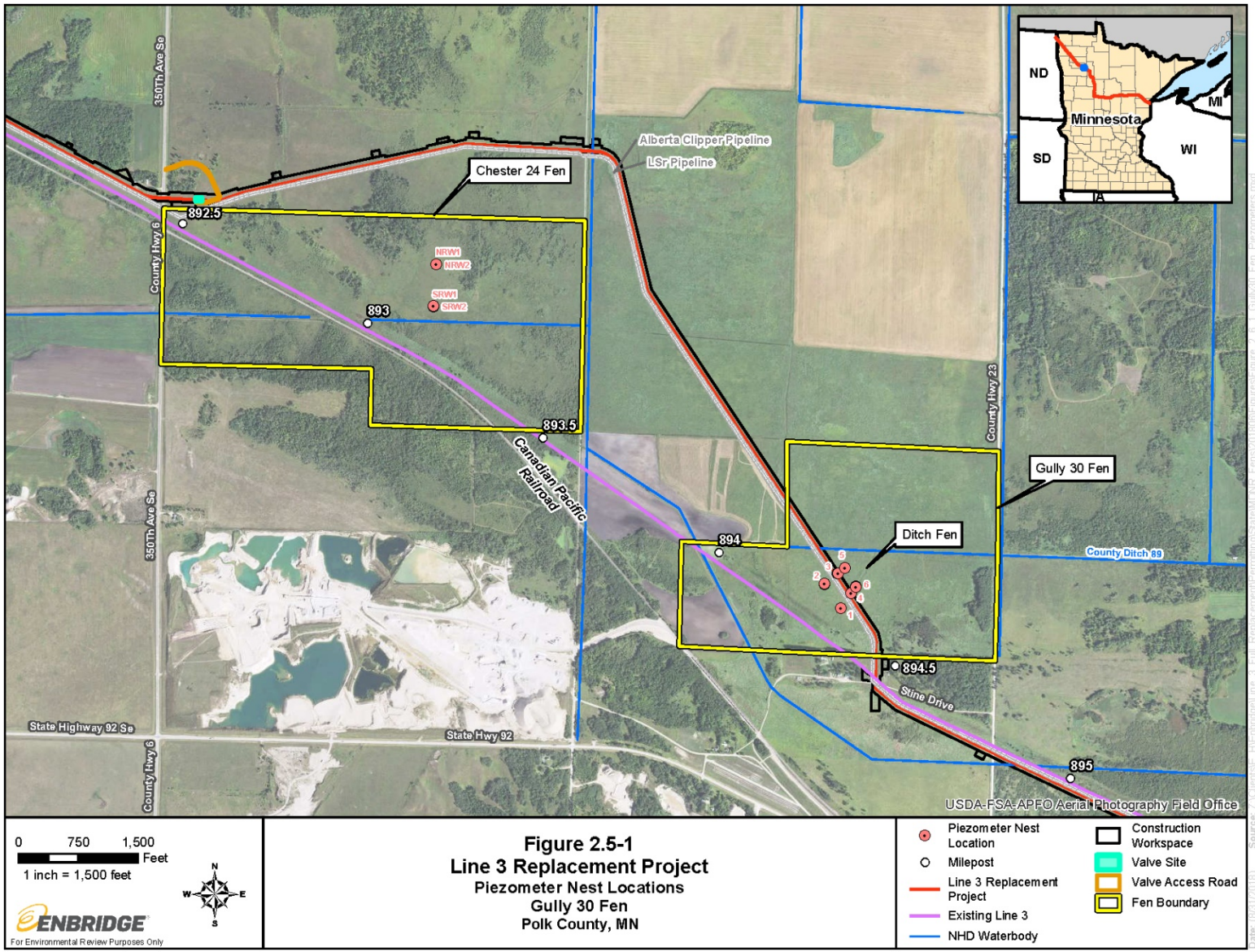
Wells are monitored using In-Situ™ dataloggers programmed to register water levels every hour. The pre-construction data will be used to establish pre-construction baseline conditions, and Enbridge proposes to continue hydrologic monitoring for a 5-year period following construction of L3R at Gully Nests 1, 2, 5, and 6 and Chester Nests 1 and 2. The Alberta Clipper Monitoring Program protocols will be used for the L3R:

- Hydrologic monitoring will be performed during the frost-free period for each of 5 consecutive post-construction years. Hydrologic monitoring results will be graphically presented and interpreted, comparing water levels in upgradient and down-gradient piezometer nests established within the Ditch Fen feature (Gully Nests 1, 4, and 6) with piezometers established outside of the Ditch Fen feature (Gully Nests 2, 3, and 5). Results will be accompanied by explanatory text and the raw hydrology data in an Excel

spreadsheet. Yearly hydrologic monitoring reports will be prepared and provided to the MDNR by December 31 of the current monitoring year through year 5.

- Enbridge will also monitor the re-establishment of pre-construction contours by noting and observing the hydrologic and vegetative conditions along the trench line where a 6-inch mound is proposed to remain to account for settling. If necessary, Enbridge will re-establish contours as approved by the MDNR by re-grading with small footprint, low ground pressure equipment.

Figure 2.5-1 Gully 30 Piezometer Nest Locations



- Enbridge and the MDNR will evaluate the need for additional hydrologic monitoring based on the previous years of hydrologic monitoring results. Hydrologic monitoring may cease earlier than 5 years if approved in writing by MDNR. However, if monitoring indicates that adverse impacts on fen hydrology as a result of L3R construction have not stabilized after a period of 5 years, additional monitoring including length of time and required procedures will be negotiated between Enbridge and the MDNR.

- If requested by the MDNR, Enbridge agrees to transfer the ownership and responsibility for the maintenance and eventual removal of wells and piezometers that are on land in Enbridge ownership to the MDNR after hydrologic monitoring ceases so that these wells and piezometers can be used in the MDNR's fen monitoring program. Enbridge also agrees to provide the MDNR access to wells and piezometers on property that is in Enbridge ownership after Enbridge monitoring ceases. This transfer will apply to the wells and piezometers only and will not apply to electronic data loggers, pressure transducers, peristaltic pumps, field laboratory equipment, or any other specific equipment used or acquired by Enbridge in support of hydrologic monitoring at the Gully 30 Fen. If MDNR does not want ownership of some or all of the wells and piezometers, or if permission is not granted by the landowner to leave the wells in place, Enbridge will be responsible for their proper removal.

2.5.2 Chemical

Based on discussions with MDNR, Enbridge does not propose additional monitoring of groundwater chemistry for L3R.

2.5.3 Vegetation

Enbridge proposes to conduct long-term monitoring of vegetation transects using the Floristic Quality Assessment developed for Minnesota wetlands in years 1, 3, 5, 7, and 10 post-construction, with a review after year 10 (see Attachment A). For Alberta Clipper, four vegetation transects were established perpendicular to the Alberta Clipper construction ROW. One of these four transects was established directly within the construction workspace of the Ditch Fen. This specific transect has six plots, two plots within the trenched area, one plot each on the working side and spoil storage side, and two plots located outside and on either side of the construction workspace, but within the Ditch Fen. The remaining three transects were established with five plots each. Each transect was on each side of the construction workspace. One of these transects was placed northwest of the Ditch Fen and the remaining transects were placed southeast of the feature.

As described in Attachment A, in 2016 and 2018 Enbridge collected vegetation data in a total of 87 plots along the proposed L3R workspace, which includes restored areas within the previous Alberta Clipper workspace. The sampling configuration consists of three transects perpendicular to the pipeline corridor including a Ditch Fen transect and two other transects spaced 8 meters to either side within the surrounding northern wet prairie community. Each 92-meter transect has 23 1-by-1-meter plots spaced 4 meters apart located within the proposed L3R workspace, the restored Alberta Clipper workspace, and within areas undisturbed by pipelines.

In addition to the perpendicular transects, three parallel transects spaced 32 meters apart with 6 1-by-1-meter plots spaced 55 meters apart have been established primarily within the northern

wet prairie community. One transect is located within the proposed L3R workspace and the other two transects are located outside of the proposed workspace (refer to Figure 9 of Attachment A).

Between the perpendicular and parallel transects, a total of 87 plots were sampled with:

- 27 plots strictly within the proposed construction corridor (L3R workspace);
- 27 plots strictly within the Alberta Clipper workspace;
- 30 control plots (outside any workspace); and
- 3 plots within both the Alberta Clipper workspace and proposed L3R workspace.

Enbridge proposes to monitor these same transects in years 1, 3, 5, 7, and 10 post-construction of L3R. The Gully 30 Fen is not located on land owned or administered by the MDNR; however, Enbridge will manage for INS plants identified on MDNR Operational Order 113 as described in the INS Management Plan (Appendix B of Attachment D), which includes reed canary grass (*Phalaris arundinacea*).

Enbridge will provide on-ground pre- and post-construction photographic documentation, including a photograph key that shows location and direction of each photograph, that clearly shows all vegetated wetlands occurring within the permitted project area. The post-construction photos will be taken at the same location and in the same direction as the pre-construction photos. Enbridge will also acquire spring leaf-off color infrared imagery[17] of the Gully 30 Fen prior to construction and during post-construction monitoring years 2 and 5, and during late summer (leaf-on) in year 5. The post-construction documentation, including photographs, will be acquired and submitted within 60 days of the end of the first full growing season following completion of the Project. Enbridge will notify MDNR of the date of completion of permitted activities within 5 working days of completion. Monitoring Reports will be provided within 60 days following the end of the in-field monitoring effort.

Enbridge will provide advance notification to the MDNR of vegetation monitoring field work each season, in the event that DNR staff would like to accompany survey crews in the field. Notification will be provided to:

- [Names and contact information removed]

2.6 RELEASE CRITERIA

Release criteria will apply only to areas with established impacts as indicated by Project-related disturbance on plant communities or hydrology observed during monitoring when compared to baseline conditions. Release criteria will be specific, realistic, and attainable. Because groundwater hydrology is variable depending on past climatic conditions, hydrologic release criteria are more general and will reflect the presence of wetland hydrology and groundwater discharge.

2.6.1 Hydrology

Release criteria will be met when calcareous fen hydrology is present without continuous or sustained reduction in water levels in the fen. Hydrologic monitoring well results establish a clear

[17] Color infrared imagery will be flown by a fixed-wing aircraft at approximately 6-inch pixel resolution.

equilibrium indicating that the up-gradient and down-gradient groundwater levels indicate no significant hydrologic alterations. Comparison of water level traces in monitoring wells on site to reference wells established at a nearby unaffected site will be evaluated to determine if hydrology is changing over time. Detailed hydrology monitoring is required and will be reported yearly or upon MDNR request.

Enbridge will meet with the MDNR at the end of each monitoring year to review the results of the Monitoring Report and to determine if additional actions are required to complete restoration.

2.6.2 Vegetation

2.6.2.1 Ditch Fen Area

Enbridge will monitor vegetation in years 1 through 10 as described in Section 2.5.3. Enbridge will be released from further monitoring if plant data within the disturbed area of the Ditch Fen (but still within the Ditch Fen) meet or exceed the floristic metrics described below. Specifically, Enbridge proposes the following vegetation release criteria for the portions of the Ditch Fen that will be stripped of sod and trenched through:

- The average weighted Mean C (“*wC”*) and average weighted Floristic Quality Index (“*wFQI”*) will meet or exceed a *wC* of 7.0 and a *wFQI* of 28 within the Ditch Fen (“OPp93”) feature. C values used here should be based on the regionalized Prairie Floristic Quality Assessment (“PFQA”). Analysis will incorporate INS into the calculations. Sampling will be conducted using 1-by-1-meter plots with sampling to occur within the window of July 24 through August 7.

- *Eleocharis rostellata* shall comprise 50 percent or greater areal cover (pre-Project conditions were 50 percent to 75 percent) directly over the trench line at the end of the 5th year of monitoring.

- Release criteria for moss species will be negotiated after collection and evaluation of moss samples.

- All INS identified on the MDNR Operational Order 113 will be managed throughout the 10 post-construction monitoring growing seasons in accordance with Enbridge’s INS Management Plan (see Appendix B of the EPP [Attachment D]). Management will consist of hand-pulling, cutting, or mowing. Spot herbicide treatments are not recommended given the presence of state-listed plant species, unless required to manage small clumps of INS. For especially aggressive INS, such as Canada thistle (*Cirsium arvense*) or reed canary grass (*Phalaris arundinacea*), Enbridge will implement a management strategy developed in consultation with the MDNR. It is expected that management strategies for these species will be site-specific, depending upon the density of the species and dispersion within or near native plant communities.

2.6.2.2 Within and Adjacent to the Construction Workspace Outside of the Ditch Fen Area

Enbridge proposes to utilize the same sampling method as proposed above to evaluate the re-establishment of native vegetation in areas adjacent to the trench outside of the Ditch Fen area.

- The average *wC* and average *wFQI* will meet or exceed a *wC* of 5.5 and a *wFQI* of 22 within the area designated as Northern Wet Prairie ("WPn53"). C values used here should be based on the regionalized PFQA. Analysis will incorporate INS into the calculations. Sampling will be conducted using 1-by-1-meter plots with sampling to occur within the window of July 24 through August 7.

- Release criteria for moss species will be negotiated after collection and evaluation of moss samples.

- All INS identified on the MDNR Operational Order 113 will be managed throughout the 10 post-construction monitoring growing seasons in accordance with Enbridge's INS Management Plan (see Appendix B of the EPP [Attachment D]). Management will consist of hand-pulling, cutting or mowing. Spot herbicide treatments are not recommended given the presence of state-listed plant species, unless required to manage small clumps of INS. For especially aggressive INS, such as Canada thistle (*Cirsium arvense*) or reed canary grass (*Phalaris arundinacea*), Enbridge will implement a management strategy developed in consultation with the MDNR. It is expected that management strategies for these species will be site-specific, depending upon the density of the species and dispersion within or near native plant communities.

2.7 MITIGATION

Persistent impacts include those adverse impacts that show a substantial, quantifiable negative impact on vegetation community dynamics and wetland hydrology for a period of at least five years, and where sufficient evidence is available to indicate that it is due to pipeline construction and maintenance. If monitoring indicates persistent impacts on the calcareous fen plant community or hydrologic function of the Gully 30 fen, Enbridge proposes to work collaboratively with the MDNR to determine appropriate corrective measures and/or compensatory mitigation.

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Attachment A

Gully 30 Pre-construction Monitoring (2018)

(Non-Public Data)

Attachment B

Gully 30 Winter Construction Procedures





Gully 30 Winter Construction Procedures

Enbridge Energy, Limited Partnership • Line 3 Replacement Project

September 2020

ENBRIDGE®

TABLE OF CONTENTS

FIGURES

ACRONYMS AND ABBREVIATIONS

Alberta Clipper	Alberta Clipper Project
ATWS	additional temporary workspace
BMP	best management practice
Ditch Fen	Bed of a shallow ditch crossed within the Gully 30 Fen
EI	Environmental Inspector
Enbridge	Enbridge Energy, Limited Partnership
EPP	Environmental Protection Plan
Gully 30 Fen	Gully 30 calcareous fen
L3R FMP	Gully 30 Fen Management Plan for the Line 3 Replacement Project
L3R of Project	Line 3 Replacement Project
MDNR	Minnesota Department of Natural Resources

1.0 PRE-CONSTRUCTION REQUIREMENTS

Enbridge Energy, Limited Partnership ("Enbridge") will schedule a pre-construction meeting between Enbridge contractors, environmental staff, and agencies prior to commencing construction to review and discuss the construction techniques, schedule, sod removal, avoidance and minimization measures, dewatering, and to answer any questions regarding the Gully 30 Calcareous Fen Management Plan for the Line 3 Replacement Project ("L3R" or "Project") ("L3R FMP") and construction procedures.

1. Environmental inspectors ("EIs") trained on the L3R FMP are required to be on-site during any ground disturbance activities. Inspectors will document all site activity and prepare daily and weekly reports documenting compliance or non-compliance with the conditions of this L3R FMP.

2. Any deviations from the conditions of this L3R FMP must be submitted in writing as a variance request provided to and authorized by the Minnesota Department of Natural Resources ("MDNR").

3. Prior to freeze-up: foot-traffic, light all-terrain vehicles or equivalent, or low-ground-pressure vehicle use will be allowed on-site to gather data and install erosion control devices and signage. Construction vehicles and equipment will operate off of construction mats or may proceed after 5 inches of persistent frost is observed within the construction workspace.

2.0 CONSTRUCTION WORKSPACE LOCATION AND CONFIGURATION

The L3R pipeline installation cross section is presented in Figure 2.2-1 of the L3R FMP.

4. In accordance with the Minnesota Pollution Control Agency National Pollutant Discharge Elimination System/State Disposal System Construction Stormwater General Permit for the project, Enbridge will properly install and maintain redundant control measures prior to or at the same time as ground disturbance activities (e.g., grading, topsoiling) within a 100-foot buffer zone outside of the fen boundary (a state-designated "special water").

5. Construction will occur within a 95-foot-wide construction workspace configured with a 55-foot-wide working side to the north[1] of the L3R trench line and a 40-foot-wide spoil storage side to the south of the trench line.

6. No unapproved additional temporary workspace ("ATWS") will be staged outside of the 95-foot-wide right-of-way within the boundaries of the Gully 30 Calcareous Fen ("Gully 30 Fen").

7. ATWS will be located in an upland area to the south of the Gully 30 Fen and immediately to the north of Stine Drive to stage: (1) fen crossing activities; and (2) the tie-in to connect

[1] The construction right-of-way has been necked down from 120 feet wide in upland areas to 95 feet wide in the Gully 30 Fen to accommodate safe construction while minimizing physical disturbance to the fen.

the pipe crossing the fen with the pipe installed to the south of the fen (Figure 1.2-1 in the L3R FMP).

8. Access to the main Gully 30 Fen staging area will be achieved from Stine Drive (Figure 1.2-1 in the L3R FMP).

9. The construction workspace will be accessed from public roads only (Stine Drive). No temporary access roads will be required (Figure 1.2-1 in the L3R FMP).

10. New construction mats are preferred for all construction use in the Gully 30 Fen. However, used construction mats may be used if new mats are not available, provided they have been cleaned via scrape down, blow down, or power washing to ensure that no invasive or noxious plant seeds or vegetative parts are brought into the fen (see Appendix B of the Environmental Protection Plan ["EPP"] in Attachment D of the L3R FMP).

    a. Based on Enbridge's experience on the Alberta Clipper Project ("Alberta Clipper"), power washing is not a practical alternative during frozen conditions. Enbridge developed a method to clean the mats that was reviewed and approved in the field by MDNR staff during Alberta Clipper. This method uses a backhoe-mounted cleaning device that employs stiff wire bristles to loosen soil and debris that is then completely removed by a simultaneous jet of compressed air.

11. All construction equipment will be cleaned prior to entering the Gully 30 Fen by scrape-down to ensure that no invasive or noxious plant seeds or vegetative parts (roots/ rhizomes) are brought into the fen (see Appendix B of Attachment D of the L3R FMP).

12. A 22-foot-wide construction mat travel lane and working surface on the working side of the construction workspace will consist of: (1) 4-foot-wide by 18-foot-long by 8-inch-deep construction mats laid lengthwise edge to edge; and (2) a pipe cribbing area consisting of 4-foot-wide by 18-foot-long by 8-inch-deep mats laid crosswise end to end, abutting the south side of the construction mat road between the road and the northern trench wall (Figure 2.2-1 in the L3R FMP).

13. Enbridge proposes to use the 30-inch minimum depth of cover standard permitted by the U.S. Department of Transportation, Pipeline Hazardous Materials Safety Administration to reduce the depth of required trenching for installation of the L3R pipeline to 6 feet. Reducing trenching depth to 6 feet dramatically avoids/minimizes excavation in the sandy subsurface sediments within the Gully 30 Fen, reducing the potential for trench failure that will require a wider trench (Figure 2.2-1 in the L3R FMP).

14. Trench excavation is planned to have a maximum width of 16 to 20 feet centered on the pipeline centerline to accommodate the anticipated side slopes needed to maintain sidewall stability of the dewatered trench and the installation of bag weights (Figure 2.2-1 in the L3R FMP).[2] A reduced trench slope may be required at tie-in locations, which will be located outside of the Ditch Fen (the bed of a shallow ditch the Project crosses within

[2] Groundwater modeling and geotechnical assessments of trench wall strength were performed for winter conditions for Alberta Clipper. Engineering estimates suggest that that a stable trench would result under winter conditions assuming that dewatering can draw the water table down to the approximate 6-foot depth of the trench (see Attachments B and C of the L3R FMP).

the Gully 30 Fen [hereafter referred to as the "Ditch Fen"]), to allow workers safe entry into the trench.

15. Earthen trench plugs[3] will be left at the boundaries of the Gully 30 Fen to ensure that significant amounts of groundwater discharge originating outside the Gully 30 Fen do not preferentially flow into the site via the trench (Figure 2.1-2 in the L3R FMP; Section 1.13 of the EPP [Attachment D of the L3R FMP]).

16. Enbridge will install a free span bridge over the Ditch Fen portion of the Gully 30 Fen. Further details on bridge design and installation are provided in Section 4.0.

3.0 SPECIAL PLANT COMMUNITY CONSIDERATIONS AND EROSION CONTROL

17. Attachment A of the L3R FMP provides the results of the Gully 30 Fen pre-construction baseline vegetation survey conducted along the L3R survey corridor (both within and outside of the construction workspace) and describes the location of survey plots to facilitate an assessment of post-construction restoration through monitoring (Section 2.5 of the L3R FMP).

18. Prior to construction, signage will be established to identify: (1) the northern and southern boundaries of the Gully 30 Fen within which the conditions of the L3R FMP will apply; (2) the northern and southern boundary of the Ditch Fen area (bank to bank) and a 20-foot buffer to each side; and (3) locations of avoidable state-listed plant species.

19. No clearing is anticipated within the Gully 30 Fen. Silt fence and/or equivalent erosion and sediment control best management practices ("BMPs") will be installed as indicated in Sections 1.9, 2.0, and 3.0 of the EPP (Attachment D of the L3R FMP) at the boundary of the construction workspace and at appropriate locations adjacent to the Ditch Fen and County Ditch 89 as indicated in Figure 2.1-1 in the L3R FMP.

4.0 MATTING AND BRIDGE INSTALLATION

Installation of the construction mat road, bridges across the Ditch Fen and County Ditch 89, and the pipe fabrication area will be performed as follows:

20. Construction mats will be installed by a mat truck. The mat truck will lay mats in front, then drive across the mats to reach and lay mats on un-matted areas. The mat truck will return to the mat storage area by traveling over the partially installed mat road for additional mats as necessary. Installation of erosion and sediment control BMPs and bridges across County Ditch 89 and the Ditch Fen will occur concurrently with the mat road installation. The installation of erosion and sediment control BMPs will use Enbridge standard methods as indicated in Section 1.9 of the EPP (Attachment D of the L3R FMP).

21. Temporary bridges will be established across the Ditch Fen and County Ditch 89 to facilitate equipment crossing with minimum impact. Enbridge has committed to using a

[3] Earthen trench plugs consist of temporary bridges of native, undisturbed soil that remain to prevent runoff from entering the Gully 30 Fen. The earthen trench plugs will be removed during pipe installation and will be replaced by sandbag trench breakers or equivalent.

free span bridge across the Ditch Fen, which will not require in-stream supports to install (see Attachment C of the L3R FMP). Bridges will be designed and maintained to prevent soil from entering the wetland and waterbody. The exact dimensions of the portion of the Ditch Fen proposed for sod removal, storage, and replacement will be identified and flagged as an exclusion area.

22. Temporary bridges will be equipped with geotextile fabric and sideboards to prevent sediment from entering the Ditch Fen or County Ditch 89. Soil that accumulates on the bridge decking will be removed as needed. Bridges will be removed as soon as possible during final restoration.

5.0 CONSTRUCTION REQUIREMENTS

5.1 TOPSOIL, SOD, AND SUBSTRATE HANDLING

23. Trench-only topsoil stripping will be employed along a strip approximately 24 feet wide centered on the pipeline centerline to minimize construction impacts on surface soils and vegetation.

24. Topsoil will be stripped from the trench and a 2-foot buffer on the outside of each trench wall to account for potential sidewall slumping. Topsoil consisting of 12 inches of frozen soil that would subsequently be excavated during trenching will be stored directly on frozen peat soil on the north side of the construction mat travel lane. Topsoil stripping will be completed in advance of drain tile installation.[4]

25. Subsoil peat will be stored on plywood over construction mats adjacent to the construction mat travel lane, and sand may be stored on the construction mat road during the short period of time the trench is open. Excess sand (previously calculated based on pipe and bag weight displacement) can be easily loaded on dump trucks for off-site disposal when the sand is stored on the construction mat road.

5.2 PIPE PREPARATION

Pipe fabrication consists of bringing the pipe in by semitrailers (stringing), placing the pipe on pipe cribs in the lay-up area, bending the pipe to the angle of points of inflection and topography, welding the pipe, grinding and coating the welds, and jeeping[5] and x-raying the pipe to ensure weld and coating integrity. To minimize the length of time the fen is disturbed, the pipe will be fabricated to the point where it is ready to be laid into the trench immediately after completion of trenching. In addition, all chemicals and grinding residue from pipe fabrication will be collected on ground cloths for off-site disposal.

Pipe stringing, bending, welding, grinding, coating, and jeeping is described as follows:

[4] Drain tile installed will consist of standard perforated flexible plastic pie encased in a sleeve of geotextile filter fabric. The resulting tile is frequently called “sock tile.”

[5] Jeeping refers to the operation of inspecting pipe coating with the aid of electronic equipment. An indicator ring is passed over the pipe that carries an electric charge. If there is a break in the protective coating a signal is transmitted through the indicator ring to an alarm.

26. All pipe fabrication will be performed in advance of trenching to minimize the amount of time the trench is open. As appropriate, pipe will be strung, bent, welded, welds ground and coated, and pipe jeeped. Stringing trucks will access the cribbing area using the construction mat road, cribbing the pipe on narrow segments of construction mat laid between the mat road and the trench. Ground cloths will retain grinding residue for off-site disposal and be used to ensure that epoxy coating does not contaminate site soils.

5.3 SPECIAL PLANT COMMUNITY CONSIDERATIONS: DITCH FEN

The Ditch Fen remains the highest-quality calcareous fen component with the largest numbers of listed species. It is characterized by the presence of [species name removed] that was removed and stored during construction of Alberta Clipper in 2009 and replaced during spring restoration activities in 2010. Figure 5.3-1 illustrates the Ditch Fen sod removal and storage procedures employed on the Alberta Clipper Pipeline, which will also be used on L3R as described below.

27. Erosion and sediment control BMPs as indicated in Section 1.9 of the EPP (Attachment D of the L3R FMP) will be employed across the full width of the pipeline construction workspace to prevent sediment from entering the Ditch Fen feature (Figure 2.1-1 of the L3R FMP).

28. To ensure that no Ditch Fen sod will be disturbed during trenching, sod will be removed from an approximate 30-foot by 40-foot area centered over the trench line. The dimensions of the sod area to be removed would be identified by a shallow trench inscribed by a ditch-witch.

29. Ditch Fen sod will be removed using a backhoe equipped with a flat scraper-blade and operating on the construction mat road and off temporary mats laid outside the Ditch Fen, as necessary. Any temporary mats will be removed immediately after the sod has been stripped. Sod pieces will be removed from the area previously identified as requiring sod removal. Sod pieces will be consecutively numbered and located on a field sketch to facilitate their replacement to the locations from which they were removed.

30. Ditch Fen sod pieces will be stacked on construction mats covered with plywood, with the sod subsequently covered with plastic. The sod will then be moved to an acceptable location on the spoil side for storage outside of the Ditch Fen. It is assumed that immediately prior to removal, the Ditch Fen sod will be frozen to a depth of a few inches, and sod will be completely frozen during storage. If sod is dry/unsaturated when removed, the sod will be wetted down prior to covering with plastic to prevent desiccation.

Because the sod is required to be removed prior to the installation of the horizontal dewatering tile, the sod from the Ditch Fen area will be in reserve for a period not to exceed 1 week. If construction conditions dictate a storage period longer than 1 week, Enbridge will cover the sod and monitor daily to check for desiccation and moisten as needed. Enbridge will also notify the MDNR and provide an estimate of the additional storage time required.

Figure 5.3-1 Ditch Fen Sod Removal and Storage

Part A. Sod from the Ditch Fen that contained several Minnesota State Listed plant species was removed and stored adjacent to and to the southeast of the Ditch Fen Area on December 8, 2009. The removal of sod within the Ditch Fen was initiated by using a ditch-witch trencher to inscribe a shallow trench defining the area (approximately 30 feet X 40 feet) (Photo A1). Timber mats were placed adjacent to the Ditch Fen area to provide support for a track-hoe equipped with a scraper blade attachment (Photo A2). The scraper blade cut and lifted sod in approximate 4 X 8 foot segments (Photo A3). These sod pieces were then placed on sheets of plywood nailed to timber mats (Photo A4) that were numbered and moved to a holding area just southeast of the Ditch Fen.

Part B. Sod pieces placed on numbered mats were stored in a holding area just to the southeast of the Ditch fen (Photo B1). The process continued (Photos B2 and B3) until the entire area of the Ditch Fen and an 8 to 10 foot buffer zone outside of the Ditch Fen was cleared (Photo B4) with all sod pieces held in the storage area (Photo B5). Once it became apparent that constraints imposed by cold weather on the timing of the drain tile dewatering would result in an extended period before the sod pieces could be returned to their original locations, the sod pieces were covered with clear plastic to keep the sod from desiccating in the cold and wind (Photo B6).

5.4 DEWATERING METHODS

Based on the dewatering and construction experience from Alberta Clipper, the proposed L3R dewatering system has been optimized, although this methodology is anticipated to be more difficult to implement under winter conditions than summer conditions (see Attachments E and F of the L3R FMP). Photos of the drain tile installation and dewatering system employed on Alberta Clipper are provided in Figure 5.4-1 below for illustrative purposes.

5.4.1 Piezometer Installation and Monitoring

Once the topsoil is removed, the centerline of the pipeline will be surveyed to assist with identifying the appropriate location to install the piezometers used to monitor water table drawdown during construction; distance from the centerline will vary to model the target depth that will ensure maximum stability of the trench wall during excavation of the trench. On Alberta Clipper, 19 piezometers in 8 rows were established at approximately 300-foot intervals along the area to be dewatered adjacent to the trench to monitor water levels and to determine when trenching could begin.

31. For L3R, Enbridge geotechnical engineers will develop a groundwater monitoring system similar to that used on the Alberta Clipper pipeline. Figure 2.3-4 of the L3R FMP shows approximate piezometer locations for the Project. Up to 4 piezometers will be installed at each row dependent upon field conditions. Enbridge will provide the MDNR with a final map of all piezometer locations, including Gully 1A through 6B monitoring wells, and will provide latitude/longitude, depth, screen, top of casing, and ground surface elevation of all piezometers once installed. Piezometers will be monitored hourly or as needed to evaluate the decline in water elevations. Trenching can commence when water levels in the piezometers adjacent to the centerline are 6 feet or greater from the soil surface.

32. Piezometers will consist of 8 to 10 feet of 2-inch steel pipe equipped with an 18-inch-long, 2-inch-diameter 10-slot, wound, stainless steel well screen.

33. Piezometers will be installed by boring a shallow access hole through the frost into the underlying unfrozen peat, placing the piezometer assembly into the hole, and using a backhoe bucket to drive the piezometer assembly into the ground such that the bottom of the well screen is no less than 8 feet below the soil surface, leaving a 3-foot riser. These piezometers will be removed prior to trenching (for those adjacent to the centerline) or after construction is complete.

5.4.2 Installation of Drain Tile: General

34. During construction, trench plugs will be left at the locations where typical open-cut crossing procedures cease and installation of the horizontal dewatering system commence. Trench plugs will ensure that any water flowing along the trench will not lower the efficiency of the horizontal dewatering system (refer to Section 1.13 of the EPP [Attachment D of the L3R FMP]).

Figure 5.4-1 Drain Tile Installation and Dewatering System

Part A. Drain tile segments were installed such that the end risers abutted each other and were separated by approximately 15 feet of undisturbed ground. After installation, each riser was connected to a 6-inch length of un-perforated pipe and was subsequently connected to a 6-inch pump in spill containment as specified in Enbridge's EPP (Photos A1 through A3). Water was directed through 6-inch hose to a discharge location near the County Ditch 89 ditch crossing. Energy dissipaters were designed to prevent erosion of the bed or banks of County Ditch 89 (Photo A4). Note the clarity of the discharge water in Photo A4 is the result of both the filter sock encasing the installed perforated tile combined with the presence of high natural levels of calcium in the groundwater that dramatically reduces turbidity by flocculating the sediment.

Part B. At maximum rates of pump discharge, County Ditch 89 was running well and discharge water flowed to the east and subsequently to the Lost River without flooding incident (Photo B1). Sump water from the tie-in location to the south of the Gully 30 Fen was directed to a filter bag to the south of Stine Road (Photo B2). Barr Engineering staff (Photo B3) manually monitored the piezometers (Photo B4) to determine when the water table had reached the target level where trenching could proceed. After trenching (Figure 8), groundwater discharged to the trench primarily through sand at the bottom of the trench. Because the gradient of the trench followed the ground surface gradient to the north, water flow in the majority of the trench was directed down-slope to County Ditch 89 where it was removed by 6-inch pumps and was discharged through filter-cloth hay-bale dewatering structures to County Ditch 89 (Photo B5). Water flow in the southern portion of the trench that was to the south of the Gully 30 fen flowed to the bell hole excavated to install the pipe under the existing pipelines. This water was removed by 6-inch pump (Photos B6 and B7) and was directed to the south of Stein road (Photo B2).

35. A mechanized tile installer will be used to install two independent parallel lines of 6-inch-diameter, fabric-covered drain tile approximately 2 feet below the installed depth of the L3R pipe (installation depth approximately 8 feet below from the surface) and approximately 4 feet to either side of the pipeline centerline (8 feet of total separation). Two passes of the tile installer machine will be needed to install the two parallel tile lines (Figure 2.2-1 in the L3R FMP)

36. The tile installer will operate from 4-foot by 18-foot by 8-inch end-butted construction mat strips to minimize track disturbance to the underlying soil. All disturbance resulting from the tile installation process will be confined to the 24-foot-wide area stripped of topsoil and centered on the L3R pipeline centerline.

37. Drain tile will be installed only in areas where sand is present above 6 feet in depth.[6]

38. A sequential series of up to eight flexible drain tile segments per side consisting of 6-inch perforated polyvinyl chloride pipe with a geo-textile filter casing will be installed horizontally in approximate 250- to 500-foot lengths to an 8-foot depth and 4 feet to either side of the trench centerline (Figures 2.2-1 and 2.3-5 in the L3R FMP).

39. Appropriate drain tile segments will be completed with a riser connected via a pump manifold to high-capacity pumps; the number of pumps required will be determined by site-specific conditions at the time of construction (Figure 2.3-5 in the L3R FMP). Two drain lines will be established to the north and two to the south of the L3R pipeline centerline.

40. The maximum distance between drain tile segments risers will be 12 feet to ensure sufficient drainage in the space between segments.[7]

41. Gaps between construction mats at appropriate locations will be used to route the non-perforated drain tile across the pipe lay-up area and the construction mat road. Discharge from the south and north dewatering systems will be directed to filter bags or equivalent dewatering structures.

42. All dewatering water will be discharged through a minimum of two approved filter bag structures or equivalent to County Ditch 89 under the applicable water appropriation and discharge permits. Each parallel dewatering tile segment will have its own dewatering structure on each side of the pipeline trench. Records of pump volumes will be kept consistent with permit conditions to determine total water appropriation and discharge volumes.

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[6] The peat thickness contour map indicates that peat less than 7 feet in thickness does not extend much beyond County Ditch 89 (Figure 1.5-2 in the L3R FMP). Deep peat greater than 6 feet in thickness begins approximately 380 feet south of County Ditch 89. Trenching during Alberta Clipper indicated that peat greater than 6 feet in depth has sufficient strength to maintain a trench wall. No significant trench failures or widening of the trench north of the installed drain tile occurred, and the presence of the drain tile in areas where peat was shallow to sand prevented significant trench wall failure in the locations where it was expected.

[7] To facilitate pumping and handling pipe during cold weather, drain tile risers abutted each other such that two risers were near each other and to the dewatering pump.

43. Pumps will be operated 24 hours per day as appropriate.[8]

44. On initiation of backfilling, the risers will be cut off at a maximum of 5 feet below ground surface in dry conditions, or a minimum of 18 inches below ground surface (below the sod layer) in wet conditions, by the backhoe bucket and the tile segments will be jetted full of sand and abandoned in place. Sand will be derived from the trench excavation; if in situ material cannot be used, sand may be sourced from a local aggregate mine. The cut-up tile risers will then be crushed as was done on Alberta Clipper.

5.4.3 Installation of Drain Tile: Ditch Fen

45. No permanent mats or construction equipment travel will be allowed within the Ditch Fen itself. All construction equipment will traverse the Ditch Fen area using a temporary bridge with the following exceptions, only after the sod layer containing listed plant species is removed and placed in the Sod Storage Area:

    a. The trencher installing the dewatering tile will be permitted to cross the ditch on 4-foot-wide construction mats installed at separations necessary to support both tracks of the trencher. Matting is necessary because the sod will be removed prior to installation of the horizontal dewatering system and the trencher will be operating directly on loose unconsolidated subsoil peat.

    b. The trencher will be confined to the trenched area from which the sod has been stripped, and installation of the horizontal drain tile will be approximately 4 feet to either side of the L3R pipeline centerline.

5.4.4 Trench Dewatering

46. Concurrently, the volume of water appropriated and discharged to County Ditch 89 through the appropriate dewatering structures will be determined based on knowledge of pump volumes and time that pumps are operating. Records of discharge volumes and rates will be maintained/reported as stipulated by applicable permits.

47. Trench dewatering and dewatering for the County Ditch 89 crossing will be in accordance with all applicable state and local permits as described in Section 5.1 of the EPP (Attachment D of the L3R FMP).

5.5 CROSSING OF COUNTY DITCH 89 (AND DITCH FEN AS NECESSARY)

The crossing techniques used to cross County Ditch 89 and the Ditch Fen during Alberta Clipper are proposed for L3R.

48. The dam-and-pump (dry-crossing) method will be used to cross County Ditch 89. For Alberta Clipper, this method consisted of heavy steel sheets that were shored with sheet pile to isolate the trenched area and then dewatering and excavating the area between

[8] Note that sufficient groundwater pressure is present such that ceasing pumping for more than a short time (i.e., a few hours) will result in a substantial increase in water levels and additional time for dewatering the segment.

the two steel sheet segments. The dam-and-pump method is described in Section 2.5.2 and Figure 23 in the EPP (Attachment D of the L3R FMP).

49. The dam-and-pump method may be necessary to cross the Ditch Fen if flowing water is present; however, if the Ditch Fen is dry or completely frozen, the open cut crossing method described in Section 2.5.1 and Figure 22 of the EPP (Attachment D of the L3R FMP) will be used.

50. To maintain the natural flow of groundwater and to prevent capture of groundwater by the trench, sandbag or equivalent trench plugs will be placed across the trench at locations coincident with the banks of County Ditch 89 and the Ditch Fen, as well as the boundaries of the Gully 30 Fen after pipe lay-in and prior to backfill (Figure 2.1-1 in the L3R FMP).

5.6 TRENCHING AND SPOIL HANDLING

Trenching will proceed rapidly with peat and sand subsoil lifts kept separate. Topsoil will have been previously stripped and stored appropriately on the spoil storage side. Subsoil peat will be stored on plywood over construction mats adjacent to the construction mat travel lane. Sand may be stored on the construction mat road. Excess sand (previously calculated based on pipe and bag weight displacement) can be easily loaded on dump trucks for off-site disposal when the sand is stored on the construction mat road.

Track hoes will be permitted to travel directly on the frozen soil because the entire area traversed by the track hoe as it moves backward will be trenched, avoiding compaction or related disturbance issues.[9]

51. Trenching can proceed in segments by multiple backhoes[10] once water tables have been drawn down to approximately 6 feet from the soil surface. Trenching is accomplished by backhoes travelling backwards along the trench line, digging the trench, reserving, and storing two lifts of soil: the peat subsoil layer and the sand subsoil layer.

52. The peat subsoil layer will be stored on the spoil storage side over the Enbridge's existing pipeline easement. The sand subsoil layer will be stored on the construction mat road and can be trafficked over as necessary. For Alberta Clipper, the excavated sand subsoil was stored on the construction mat road, which facilitated the concurrent removal of excess sand to an off-site location for disposal.[11]

53. If areas exist where two or three of the lifts are stored in close proximity, sediment barriers will be installed between stockpiled soil layers, as necessary, to maintain segregation and prevent mixing.

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[9] Track hoes will be cleaned or scraped down and inspected to ensure that no invasive species are brought in on construction equipment as described in Section 2.0.

[10] Trenching for Alberta Clipper was accomplished by four backhoes in 1 day. Enbridge anticipates similar trenching duration under summer construction conditions

[11] The storage location of spoil materials is not fixed. The staging of topsoil adjacent to timber mats with peat subsoil stored over the hot pipeline and sand stored on the timber mat road was the configuration used for Alberta Clipper. However, whatever configuration is used, the contractor must ensure that topsoil, peat subsoil, and sand substrate are stored such that the "lifts" are kept separate (no mixing), that the spoil can be returned to the approximate location from which it was removed, and that excess sand can be removed for off-site disposal.

54. If sand is to be stored on the construction mat road to facilitate rapid removal of excess sand, ground cloths or equivalent will be used to cover and protect the portions of the pipe over which the backhoe bucket travels.

5.6.1 Trenching: Ditch Fen

55. The crossing of the excavated ditch that includes the Ditch Fen will be subject to a 48-hour limitation for an open trench. Ditch excavation, pipeline installation, installation of trench plugs, backfill, and subsequent sod replacement will occur within a 72-hour period.[12]

56. The only ground disturbance permitted within the Ditch Fen area will be within the excavated trench area.

57. The trench line and pipe installation will be conducted off the construction mats and the temporary bridge.

58. If during excavation of the crossing it is determined that sloughing of the trench walls has the potential to impact additional sod area, further sod pieces will be removed with their original location recorded to facilitate return to the same pre-construction location.

59. After pipe lay-in and prior to backfill, trench plugs consisting of sandbags or foam (pending agency approval) will be placed across the trench at locations coincident with the banks of the Ditch Fen to maintain the natural flow of groundwater and to prevent capture of groundwater by the trench.

5.6.2 Removal of Excess Sand

Calcareous fens are especially sensitive to persistent changes in groundwater levels. Because large volumes of sand will be displaced by the 36-inch-diameter L3R pipe and gravel-filled bag weights (also referred to as saddlebag weights; see Section 5.8) placed on 10-foot centers, excess sand must be removed to ensure that the trench mound left after final restoration is no more than 6 inches in height after equilibration.

60. Excess sand (previously calculated for the Alberta Clipper pipeline as the volume of sand displaced by the pipe and bag weights in the area where sand is above the bottom of the trench) will be hauled off-site in dump trucks for disposal. The total volume of sand will be tracked by number of truckloads of sand removed.[13]

[12] An additional 24 hours (72 hours total) has been added to ensure the replacement of the reserved sod to the locations in the Ditch Fen from which it was removed.

[13] Soil displacement by the pipe and set-on weights is a fixed calculable value for the pipeline. The 36-inch-diameter pipe with 9,000-pound gravel-packed set-on weights placed on 10-foot centers displaces approximately 7.07 cubic feet (12,215 cubic inches) and 6.21 cubic feet (10,725 cubic inches), respectively, per foot of pipe. Preliminary volumes established for the 36-inch-diameter Alberta Clipper pipeline indicated the removal of 74 dump truck loads of sand would be needed. These values are provided as estimates and can be modified in the field to adjust for site-specific conditions as approved by the MDNR.

5.7 LAYING IN

61. As soon as trenching is complete, the previously prepared L3R pipe will be installed in the trench by sideboom pipe layers with rolling slings operating off the construction mat travel lane.

5.8 PLACING BAG WEIGHTS FOR BUOYANCY CONTROL AND AS-BUILT SURVEY

The pipeline will have positive buoyancy and can move upward even when covered with soil. Buoyancy control for pipelines traversing wetlands is typically provided by installing concrete-coated pipe or placing concrete weights or saddlebag weights (i.e., bag weights) on the pipe prior to backfill. Enbridge and the MDNR have agreed that negative buoyancy control for pipe installed in calcareous fens will be provided by using bag weights filled with clean, locally derived pea gravel, sealed and connected at the top so that the assembly of two bag weights can be draped over the installed pipe prior to backfill.

62. Buoyancy control for the L3R pipe installed within the Gully 30 Fen will be provided by bag weights filled with clean pea gravel (9,000 pounds total), connected at the top, and laid over the pipe on approximate 10-foot centers.

63. Prior to backfill, elevations of the top of the pipe will be surveyed to develop as-built schematics indicating exact centerline locations, installation depth, top of pipe, and depth of cover.

5.9 INSTALLATION OF TRENCH PLUGS AND BACKFILL

64. Trench plugs consisting of sandbags or foam (pending agency approval) stacked across the trench and coincident with both sides of the Ditch Fen will be installed to prevent any capture of groundwater flow within the Ditch Fen by the trench subsequent to backfill and restoration. Trench plug locations are displayed on Figure 2.1-1 in the L3R FMP.

65. Similarly, trench plugs will also be installed across the trench on either side of the County Ditch 89 crossing to prevent any preferential movement or capture of water from County Ditch 89 by the pipeline subsequent to backfill. Trench plug locations are displayed on Figure 2.1-1 in the L3R FMP.

66. Sand will be replaced to the approximate location from which it was removed and to the level noted in the sidewalls of the excavated trench, with an allowance for settling.

67. Because the volume of sand displaced by the L3R pipeline and bag weights will be removed for off-site disposal, all sand and peat subsoil will be returned to the trench.

68. After the sand has been returned to the trench, peat subsoil will be returned to the approximate location of the trench from which it was removed.

    a. Peat subsoil will likely be frozen. Clods would be reduced in size by backhoes to the extent practicable, with the resulting clods returned to the trench. All peat subsoil

removed will be returned to the trench.[14] If a large trench mound results because of additional void space in the cloddy backfill, the trench mound will be left for final grading and topsoil replacement to occur after spring thaw.

6.0 POST-CONSTRUCTION REQUIREMENTS

6.1 CLEANUP AND RESTORATION

Frozen topsoil and peat and sand subsoil precluded immediate topsoil replacement and final finish grading during Alberta Clipper, resulting in an interim winter restoration in preparation for final restoration to occur after spring thaw. Enbridge proposes L3R restoration to follow these two stages: interim, which would occur following completion of pipe installation in mid-winter, and final restoration after spring thaw.

6.1.1 Interim Restoration and Clean-up

69. Enbridge will remove construction mats from the 4-foot-wide pipe cribbing and lay-up area.

70. Enbridge will leave the construction mat access road and temporary bridges over County Ditch 89 and the Ditch Fen to provide access and a stable work platform for final restoration.

71. All signage, applicable erosion and control BMPs, exclusion fencing, and protective plastic covering, including that associated with County Ditch 89 and the Ditch Fen, will be checked weekly, repaired and replaced as necessary, and left for the final restoration.

72. The original grade of County Ditch 89 will be re-established, and banks stabilized using the appropriate erosion and sediment control BMPs.

73. All unnecessary construction debris will be removed. Construction materials to be used during final restoration after spring thaw will be stored off-site.

74. During subsoil replacement, excess soil on construction mats will be removed as practicable and added to the spoil returned to the trench.

75. Topsoil storage piles will remain on the spoil storage side where topsoil was originally placed.

76. During the periodic site reviews, the status of frost will be checked using steel probes: (1) in the ground adjacent to the construction mat road; (2) in the topsoil storage piles; and (3) in the trench. Subsidence of the trench mound over the pipeline will be noted, as will

[14] During backfill for Alberta Clipper, subsoil peat and to some degree sand was frozen requiring modification to the backfill and timing procedures in the Alberta Clipper FMP. Sand was replaced in the trench first, with frozen clods broken up to the extent practicable by backhoes operating off the timber mats. Peat subsoil was then replaced, again with clods broken up to the extent practicable. The presence of substantial void volumes resulted in a large mound up to 3 feet high over the trench. With MDNR's approval, it was decided to perform interim cleanup, leaving the final grading and replacement of topsoil until after spring thaw. Erosion and sediment control BMPs were established at appropriate locations and the construction area was frequently monitored to maintain the integrity of the erosion and sediment control BMPs and to evaluate the progress of thaw within the trench mound and stored topsoil.

subsidence in other areas of the construction workspace affected by ground disturbance, such as the restored bed and banks of County Ditch 89 and the Ditch Fen.

77. Final restoration will proceed when the ground is unfrozen or when frost is out over the trench line and topsoil piles can be turned and broken up to facilitate thaw.[15]

6.1.2 Final Restoration and Finish Grading

78. Enbridge will inform the MDNR when any work is proposed to be done around County Ditch 89.

79. All work will occur from construction mats. Construction traffic will not be allowed off the existing construction mats.

80. Final restoration of the Gully 30 Fen will proceed when the trench area is sufficiently thawed to grade the subsoil over the trench mound by pressing and smoothing with a backhoe bucket. If necessary, Enbridge may fluff and turn subsoil to speed thaw. The trench will be worked until the soil is not cloddy and is at a level to receive topsoil such that the final finish graded trench will be level with the adjacent undisturbed soil at the trench edge.

81. If necessary, backhoes will fluff and turn the topsoil to ensure that all topsoil is unfrozen and in a suitable condition to be returned to the trench. Soil may be temporarily stored on the construction mat road.

82. The banks of County Ditch 89 will be finish graded as necessary to restore original topographic contours. Erosion and control BMPs will be installed.

83. When restoration activities are complete within the Gully 30 Fen, including County Ditch 89 and the Ditch Fen, all remaining construction debris will be removed, and the mat road will be taken out by backhoes successively removing mats. All mat removal will be accomplished from the mat road.

84. As a final step, restoration crews will hand broadcast Minnesota Board of Water & Soil Resources Wet Meadow South and West seed mix (see Appendix C of the EPP [Attachment D]) to control erosion and to supplement subsequent revegetation from the seed bank.

85. Enbridge and MDNR staff will review the completed restoration for adequacy and compliance with the conditions of this L3R FMP. Once final restoration grades and conditions have been approved, the monitoring phase of this L3R FMP will begin.

[15] A few inches of the surface of the peat can dewater over winter, which insulates the underlying peat preventing the transfer of heat to the interior of the peat spoil pile, thus the topsoil mound would generally be the last to thaw. However, once temperatures rise and the ground begins to thaw, topsoil piles can be broken up and turned using a backhoe operating off the timber mats. Breaking up the frozen piles increases the rate of thaw, and topsoil may be able to be replaced in a matter of days or less.

6.2 CLEANUP AND RESTORATION: DITCH FEN

As observed during Alberta Clipper, frozen conditions will preclude final restoration of the Ditch Fen immediately after backfilling because frozen sod and soils preclude setting sod pieces to the optimum level and grade before thaw. Enbridge anticipates that L3R restoration will proceed in two stages similar to the Alberta Clipper Ditch Fen restoration; interim restoration activities will replace frozen sod to the locations from which it was removed and to the extent practicable, set the pieces to appropriate depths for final restoration to occur immediately after spring thaw. Enbridge will complete restoration after spring thaw, when sediments can be worked and optimum grades obtained.

6.2.1 Interim Restoration

Photos of the Ditch Fen interim restoration process employed on Alberta Clipper are provided in Figure 6.2-1 for illustrative purposes.

86. Enbridge will inform the MDNR when any work is proposed to be done around County Ditch 89 or the Ditch Fen.

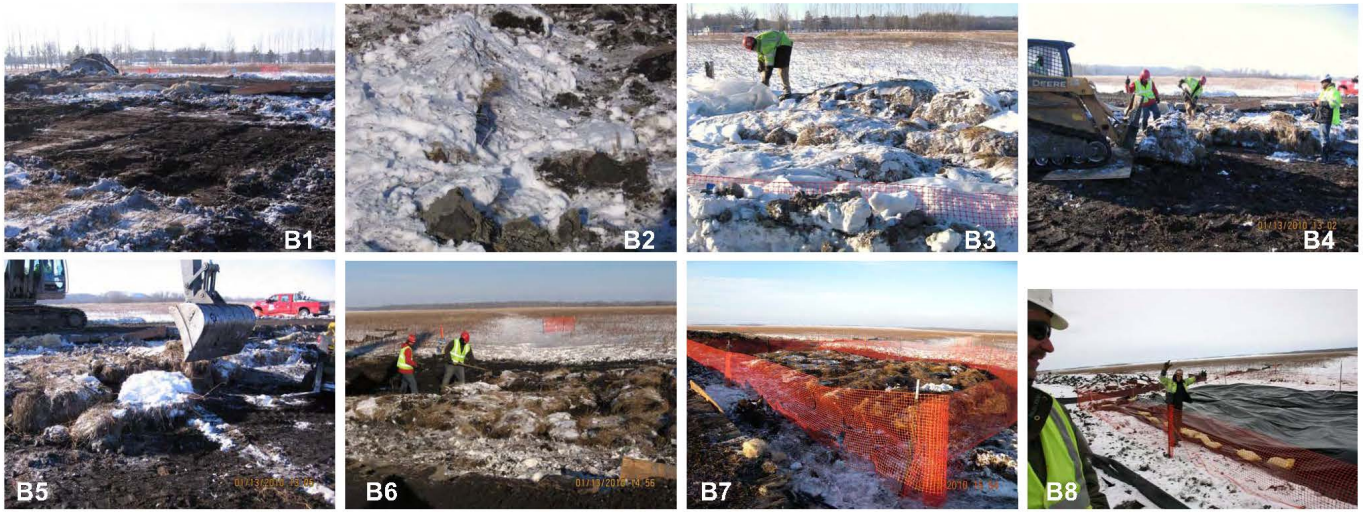
87. The entire restoration will be observed by an EI or supervising Enbridge Environment Compliance staff.

88. The crossing of the excavated ditch that includes the Ditch Fen will be subject to a 48-hour limitation for an open trench. Ditch excavation, pipeline installation, and backfill and sod replacement will occur within a 72-hour period.

89. Enbridge will calculate and remove 100 percent of displaced soil material from the Ditch Fen.

Figure 6.2-1 Ditch Fen Interim Restoration

Part A. Restoration of the Ditch Fen area began with the installation of trench plugs on either side of the Ditch Fen to ensure that preferential water flow would not reduce the normal water level in the ditch feature (Photo A1). Sand excavated from the Ditch Fen feature was returned to the feature to the approximate pre-construction level. In order to prepare a proper setting bed for the sod, Enbridge used backhoes equipped with "padder buckets" to break the frozen peat up into a finer soil that could be placed and packed without large voids (Photo A2). The restoration of the peat subsoil layer was accomplished with the padder buckets and a long stick hoe to smooth and pack the returned peat subsoil (Photo A3). After the process was complete, the disturbed area of the Ditch Fen had been smoothed, with soil brought up to a level where the sod pieces could be replaced (Photos A4 and B1).



Part B. The area from which the sod was removed was evident as a shelf of native forbs and grass that identified the originally stripped area (Photo B2). The plastic was removed from the stored sod pieces (Photo B3) which were found to be in excellent condition – present as cohesive soil units and not desiccated. A small front end loader equipped with forks and a long stick backhoe was used to replace the sod pieces to the locations from which they were taken (Photos B4 through B6). Photo B7 shows the restored ditch fen sod. A perfect fit with the sod pieces was not possible because the sod pieces were frozen solid. Spaces between the pieces were filled in with ground-up peat (Photo B6), and a few pieces of sod removed from the buffer outside the ditch remained. The completed restoration is in Photo B7. A few days after the replacement, the MDNR requested that the restored area be covered with plastic to prevent desiccation until conditions were suitable to finalize the setting of the sod and complete the restoration of the original topographic contours the following spring.

90. Enbridge will replace sand to the same level observed in the trench. If the sand is frozen, Enbridge will pulverize the sand such that it can be returned and tamped to approximate pre-construction density. A slight excess is acceptable if the EI or supervising staff believe that additional settling will occur.

91. Following replacement of the sand, peat subsoil will be replaced to the approximate locations from which it was removed. Peat subsoil is likely to be frozen into clods of various sizes. To facilitate the replacement of the optimum amount of peat subsoil with minimal excess void space, Enbridge will break the clods to the extent practicable with the backhoe bucket, and will reduce clod size further using a "padder bucket."[16] Enbridge will then replace the ground peat subsoil in the trench, packing it with hand tools and the backhoe bucket as needed to bring the surface to the level where sod pieces can be returned to the approximate original elevation of the bed of the Ditch Fen (refer to Figure 6.2-1). Locally derived certified-weed free peat will be used to provide fill.

92. Frozen sod pieces, previously numbered, covered in plastic, and stored at an appropriate location near the Ditch Fen (see Section 5.3), will be transported to the Ditch Fen and returned in the exact location from which they were removed. Sod will be generally placed by a track hoe operating off the temporary bridge. Contractor staff equipped with pry bars and shovels will adjust the locations as necessary to obtain optimum placement of each individual sod piece.

93. The sod pieces will fit together similar to a jigsaw puzzle with each piece either directly butting the next or separated by narrow linear spaces of varying width. In addition, the frozen pieces will be of slightly different thickness, precluding the setting of the sod to match the exact elevations of the adjacent undisturbed ditch bottom.

94. Sod pieces will be leveled and brought to the appropriate contour to the extent practicable, with the interstices between sod pieces filled with locally obtained ground peat.

95. To prevent desiccation, the entire 30- by 40-foot sod replacement area will be protected by covering with black plastic mulch.

6.2.2 Final Restoration

After interim restoration and covering of the Ditch Fen has been completed, the Ditch Fen will be left for final restoration concurrent with final restoration of the Gully 30 Fen. Based on Alberta Clipper experience, some sod pieces are likely to be elevated above and below the original, pre-construction grade. Final restoration will ensure that the original grade is returned and all sod pieces are appropriately set in the bed of the Ditch Fen. Photos of the Ditch Fen final restoration process employed on Alberta Clipper are provided in Figure 6.2-2 for illustrative purposes.

96. Enbridge will inform the MDNR when any work is proposed to be done in the Ditch Fen.

[16] A padder bucket is a backhoe accessory that uses rotating grinders to coarse aggregates to fine material suitable to act as a protective pad for sensitive pipeline. Enbridge used two padder buckets to crush frozen peat subsoil clods to a relatively fine texture suitable to replace to the trench, using backhoe buckets to apply moderate pressure to compact the replaced peat subsoil.

Figure 6.2-2 Ditch Fen Final Restoration

Part A. Because some sections of the sod replaced in January were above the pre-construction elevation, a long-stick backhoe with an 8-foot wide bucket operating off of the timber mats was used to gently press the sod down to the pre-construction elevation.

Part B. The sod portion of the Ditch Fen area after the pieces of sod that were above the pre-construction grade had been pressed down to the pre-construction level.

Part C. Because some of the sod pieces had subsided to below the pre-construction contour and were very fragile because they were covered with water, a thin layer of peat was used to raise the ground surface elevation. Plants are expected to grow through the thin peat layer.

Part D. Restoration staff continuing to spread a thin layer of local peat topsoil in areas where the sod has subsided to below pre-construction contours.

Part E. The Ditch Fen area after restoration of the pre-construction elevations was completed by the restoration crew. The restoration process was observed by agency staff, Jim Arndt, Keith Lane, and Andrew Lane.

Part F. Removal of the timber mat bridge that was used to span the Ditch Fen area without disturbing the components of the fen that were under the bridge.

97. The track hoe and restoration crews will restore the original contours by filling in areas of the trench that have settled and removing or pressing down areas where excess material exists (Figure 6.2-2). Only native peat will be used to restore the pre-construction elevation. Sod pieces will be restored such that the contours match the adjacent, undisturbed areas. Restoration of the Ditch Fen is not expected to take more than 2 days. If restoration requires that sod be temporarily removed, sod will be watered down to maintain saturated conditions as necessary.

98. Enbridge and MDNR staff will review the completed restoration for adequacy and compliance with the conditions of this L3R FMP. Once final restoration grades and conditions have been approved, the monitoring phase of this L3R FMP will begin.

6.3 REPORTING

6.3.1 Provide As-built Drawings and Records

99. As-built drawings of the installation will be provided to the MDNR, including:

    - As-built elevation of the pipe;
        - Depth of cover;
        - Dimensions of the trench crown, centerline, and edges related to pre-construction conditions;
    - Locations of pre-construction vegetation and state-listed species;
    - Location and dimensions of the working side, the trench width, the spoil storage side, and any ATWS;
    - All dewatering locations, along with records of water appropriation volumes; and
    - All dewatering water discharge locations.

6.3.2 Construction Documentation and Compliance Report

100. Once final restoration has been approved, the interim construction documentation and L3R FMP compliance report will be completed and provided to all stakeholders.

101. All reports, including final documentation and compliance report and all subsequent monitoring reports, will be transmitted electronically.

Attachment C

Gully 30 Ditch Fen Bridge Design

(Non-Public Data)

Attachment D

Environmental Protection Plan





Environmental Protection Plan

Enbridge Energy, Limited Partnership • Line 3 Replacement Project

October 2020

ENBRIDGE®

TABLE OF CONTENTS

TABLES

FIGURES

APPENDICES

ACRONYMS AND ABBREVIATIONS

ATWS	additional temporary workspace
BMP	best management practices
BWSR	Minnesota Board of Water & Soil Resources
CLL	Construction Line List
CRP	Conservation Reserve Program
DOT	Department of Transportation
ECD	erosion and sediment control device
EI	environmental inspector
EMCP	Environmental Monitor Control Plan
Enbridge	Enbridge Energy, Limited Partnership
EPP	Environmental Protection Plan
FdL	Fond du Lac Band of Lake Superior Chippewa
HDD	horizontal directional drilling
IEM	independent environmental monitors
INS	invasive and noxious species
L3R or Project	Line 3 Replacement Project
MDNR	Minnesota Department of Natural Resources
MPCA	Minnesota Pollution Control Agency
OHWL	ordinary high water level
OHWM	ordinary high water mark
PHMSA	Pipeline and Hazardous Materials Safety Administration
pig	pipeline inspection gauge
PLS	Pure Live Seed
ROW	right-of-way
SPCC	Spill Prevention, Containment, and Control
SWPPP	Stormwater Pollution Prevention Plan
TWS	temporary workspace
USDA APHIS	U.S. Department of Agriculture, Animal and Plant Health Inspection Service
VMP	Post-Construction Vegetation Management Plan for Public Lands and Waters
WQC	Section 401 Water Quality Certification

INTRODUCTION

CONTROLLING REQUIREMENTS FOR CONSTRUCTION AND OPERATION

This Environmental Protection Plan ("EPP") prepared by Enbridge Energy, Limited Partnership ("Enbridge") includes statements, policies, procedures, and protection measures regarding the construction of the proposed Line 3 Replacement Project ("Project" or "L3R") in the states of Minnesota, North Dakota, and Wisconsin. This EPP was developed based on Enbridge's experience implementing Best Management Practices ("BMPs") during construction as well as the Federal Energy Regulatory Commission's Upland Erosion Control, Revegetation, and Maintenance Plan (May 2013 Version) and Wetland and Waterbody Construction and Mitigation Procedures (May 2013 Version). The federal government, Tribal Nations, State of Minnesota, State of North Dakota, State of Wisconsin, and local governments will issue multiple regulatory permits and Clean Water Act Section 401 water quality certifications ("WQCs") to Enbridge for construction and operation of the proposed Project. The EPP is a component of the Construction Environmental Control Plan developed to comply with the conditions of right-of-way ("ROW") preparation, construction, cleanup, and restoration and to meet or exceed federal, Tribal, state, and local environmental protection and erosion control requirements, specifications, and practices. The EPP and the regulatory permits and WQCs must be read together; they do not exist separate from one another. There may be discrepancies between the content of the EPP and the requirements of the regulatory permits and WQCs. For any discrepancy, particularly regarding construction conditions, protection measures, and required notifications, the regulatory permits and WQCs are controlling and supersede EPP content.

If there are discrepancies between contract specifications and Project-specific permit conditions and/or landowner agreements, the more stringent condition will apply. Any doubt as to which condition is more stringent will be resolved by Enbridge in consultation with the applicable regulatory authority and/or landowner, as appropriate.

<u>BMPs that differ from the standard BMPs described in this EPP and that will be implemented on public lands[1] and/or at public waters[2] as required by Minnesota Department of Natural Resources ("MDNR") licenses and leases are underlined.</u>

This document includes the following sections:

- Section 1.0 describes general mitigation measures, including soil erosion and sedimentation control BMPs to be implemented during construction and restoration;
- Section 2.0 describes practices for stream and river construction, crossings, and restoration;
- Section 3.0 describes practices for wetland construction, crossings, and restoration;
- Section 4.0 describes highway, road, and rail crossings;

[1] All tracts or lots of real property belonging to the state and under the control and supervision of the commissioner of natural resources.

[2] Public waters as defined in Minnesota Statutes 103G.005, Subd. 15 and depicted in Public Waters Inventory maps authorized by Minnesota Statutes 103G.201.

- Section 5.0 describes construction and hydrostatic testing dewatering;
- Section 6.0 outlines water appropriation practices;
- Section 7.0 addresses revegetation measures;
- Section 8.0 addresses winter construction issues;
- Section 9.0 addresses waste management issues;
- Section 10.0 addresses construction equipment-related spill prevention, containment, and controls; and
- Section 11.0 addresses containment, response, and notification procedures for inadvertent releases of drilling fluid.

Alternative construction procedures implemented in lieu of this EPP will provide an equal or greater level of protection to the environment and will be approved in writing by Enbridge in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing the activity.

Enbridge and its Contractors (collected referred to as "Enbridge" unless otherwise noted) are responsible for implementing the requirements of this EPP.

Enbridge has developed an Environmental Monitor Control Plan ("EMCP") to ensure that appropriate systems are in place to achieve compliance with the various permits and plans that have been developed for the Project during the construction phase. The EMCP includes:

- definitions of the roles and responsibilities of the personnel involved with implementing the various environmental requirements;
- the reporting structure and electronic system that will be employed to document compliance during construction; and
- a series of training events to communicate the environmental requirements to the construction personnel.

Enbridge will provide appropriate construction oversight to confirm and document compliance with the measures of this EPP and requirements of applicable federal, Tribal, state, and local permits. Enbridge's Environmental Inspectors ("EIs") will assist in interpreting and implementing the requirements of the EPP and verify compliance with these procedures for Enbridge. The roles and responsibilities of the EIs are described in more detail in Section 2.4 of the EMCP.

Enbridge has also committed to applicable agencies to fund a comprehensive third-party monitoring program to be deployed during Project construction. The roles and responsibilities of the independent environmental monitors ("IEMs"), including Tribal Monitors, are described in more detail in Section 3.0 of the EMCP.

1.0 GENERAL MITIGATION MEASURES

1.1 IDENTIFICATION OF AVOIDANCE AREAS

Prior to the commencement of clearing activities, civil survey crews will flag or stake the boundaries of the construction workspace and improved access roads[3] in a manner that ensures all individuals can readily identify the boundaries of the authorized construction limits and to ensure that construction activities will only occur in areas authorized. In addition, Enbridge will post signs or flagging for the following environmental features along the construction workspace and access roads so they can be easily identified by Project personnel and managed as described in applicable permit applications:

- wetland[4] boundaries and waterbody[5] crossing locations;
- drainages/drain tiles as identified by counties and landowners;
- hiking and hunter walking trails, snowmobile and all-terrain vehicle trails, winter access roads, canoe routes and water access sites, or other recreational areas as required by permit conditions;
- buffer zones for environmentally sensitive features, including archaeological and historic sites, bald eagle nests, rare plant or ecological communities, and other sensitive wildlife species and/or habitat per agency consultations (note that the signs will not disclose the specific location and/or species or feature type where federal, Tribal, or state laws require data protection);
- areas where typical construction sequence may be delayed due to permit restriction, such as timing restrictions or clearing restrictions (e.g., hydrotest water infiltration areas); and
- invasive and noxious species locations, including infested waters[6] as identified in Enbridge's Invasive and Noxious Species ("INS") Management Plan (Appendix B).

Enbridge's Rare and Sensitive Environmental Resources Plan will include additional mitigation and conservation measures to be implemented near sensitive biological resources. Enbridge's NHIS Review and Avoidance Plan will include Project required mitigation and conservation measures to be implemented near sensitive biological resources on public lands. Federally or state-listed species observations within the construction workspace will be reported to the appropriate agency(ies).

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[3] Improved access roads refer to new greenfield roads, or existing linear disturbances such as trails, utility corridors, and narrow or unmaintained roads that will be widened to 30 feet as described in Section 2.1 of the Summary of Construction Methods and Procedures (Appendix A).

[4] Wetlands are those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

[5] Lakes, rivers and streams.

[6] Infested waters means waters of the state listed by the commissioner under Minnesota Statutes Sections 84D.03, subdivision 1, and 84D.12.

1.2 ALIGNMENT SHEETS, CONSTRUCTION LINE LIST AND PERMITS

Enbridge will prepare detailed alignment sheets for the Project. The alignment sheets will depict the plan and profile of the construction ROW, tract (property) boundaries, and environmental features such as wetlands, waterbodies, and buffer zones for sensitive features as listed in Section 1.1. Notations will be included in the alignment sheets to direct the personnel to the appropriate environmental plans/or permit conditions that stipulate the activities, restrictions, and/or BMPs to be employed at each environmental feature.

In addition, Enbridge will prepare detailed Environmental Plan Sheets that accompany the Stormwater Pollution Prevention Plan ("SWPPP") required under the Minnesota Pollution Control Agency ("MPCA") National Pollutant Discharge Elimination System/State Disposal System Construction Stormwater General Permit (MNR100001). The Environmental Plan Sheets will identify the temporary and permanent erosion and sediment control and stabilization measures for the Project along the construction workspace and access roads. Refer to the Soil Erosion and Sediment Control Plan (which incorporates SWPPP by reference) for additional information.

Enbridge will also maintain a Construction Line List ("CLL") for each tract (property) that describes special requirements (e.g., clearing, timber salvage, topsoil segregation, restoration measures, herbicide use, fencing requirements) as agreed upon with landowners, provided the special requirements conform to Project permits.

The CLL identifies requirements and comments provided by landowners; however, it is not a comprehensive list of construction requirements. The CLL will be considered in conjunction with other Project documents and permits.

1.3 WET WEATHER SHUTDOWN

During construction, certain activities may be suspended in wet soil conditions, based on consideration of the following factors:

- extent of surface ponding;
- potential for rutting, defined as the creation of linear depressions made by tire tracks of machinery 6 inches or greater in depth,[7] that results in the mixing of topsoil and subsoil;
- extent and location of potential rutting and compaction (i.e., can traffic be rerouted around wet area); and
- type of equipment and nature of the construction operations proposed for that day.

Enbridge will cease work in the applicable area until Enbridge determines that site conditions are such that work may continue. Enbridge Construction Management, in collaboration with Enbridge Environment, will ultimately decide if wet weather shutdown is necessary in a given location in conformance with the required regulatory authorizations and all applicable federal, state and local

[7] MDNR State Land Rutting Guidelines and Erosion and Sediment Control Decision Tree.

regulations governing this activity. Refer to Section 1.18 for a discussion of the measures to alleviate soil compaction.

Enbridge will monitor upcoming weather forecasts to determine if significant rainfall is anticipated during construction. Enbridge will be responsible for appropriately planning work, considering the potential for wet conditions, and being prepared to implement mitigation measures in the event of wet weather conditions and/or excessive waterflow. Enbridge will be responsible for implementing any and all such corrective measures deemed necessary should conditions subsequently worsen where the above described criteria cannot be met. Additional details on this procedure are described in the Project SWPPP.

1.4 RIGHT-OF-WAY ACCESS

Enbridge will utilize the following three main types of travel corridors to obtain access to the construction workspace:

- Haul Routes: Existing public roads will typically be used as haul routes, which are used to deliver equipment and materials to the workspace during construction.

- Access Roads: Access roads to the construction workspace may be private or public roads along existing roads or trails, or they may be new greenfield roads on private or public land that are constructed for the purpose of the Project.

- Shoo-flies: In some cases, Enbridge proposes to construct a “shoo-fly,” which is a short detour off the main access road or construction workspace used to avoid impacts to sensitive features, such as wetlands.

Enbridge is responsible for posting signs or other methods to identify approved haul routes and access roads in the field and to ensure that access is confined to only the approved roads.

To provide temporary access to the construction workspace, Enbridge will maintain existing roads, improve existing trails or roads, or build new roads as needed and as approved through applicable permits and leases, and as described in the Summary of Construction Methods and Procedures (Appendix A). Construction mats will be used in wetlands at all temporary access roads. Gravel will only be added to maintain existing roads that have an existing gravel road base, or to develop permanent access roads, if needed. If gravel is installed on a road that is not permanently maintained for the Project, it will be removed and the area will be restored to pre-construction conditions following construction. Enbridge may use construction mats or rock on top of geotextile fabric, with or without a flume/culvert as appropriate depending on site conditions, to construct or widen access roads at intersections with other roads or the construction workspace as illustrated in Figure 47. Gravel on top of geotextile fabric will only be used on approaches to construction workspace and not within construction workspace as illustrated in Figure 47. Mats, rock, geotextile fabric, and flume/culverts will be removed after construction and the area will be restored to pre-construction conditions following construction.

Vehicle tracking of soil from construction sites will be minimized by implementation of BMPs such as installing rock access pads or construction mats, reducing equipment/vehicle access to the construction workspace where practicable (off-ROW parking), or equivalent. Installation of rock or construction mat access pads will be in accordance with applicable permits and federal, Tribal, and/or state specifications. Typical drawings for rock and construction mat approaches are

provided in Figures 1 and 2. If such BMPs are not adequately preventing sediment from being tracked onto paved public roads, self-contained street sweeping, or other equivalent means of collecting sediment, will be used. If soil is tracked onto a paved roadway, Enbridge will remove accumulated material from the road and return it to the construction workspace within an upland area as soon as possible, but in no circumstances more than 24 hours after discovery. In addition, soil on paved roadways cannot be broomed, washed, and/or graded into the road ditch or onto the shoulder.

Permanent access roads will be limited to the roads to mainline valve sites and pump station facilities as further described in the Summary of Construction Methods and Procedures (Appendix A).

1.4.1 Bridges and Culverts

Generally, the bridges and culverts associated with existing roads will be sufficient to allow the passage of construction equipment and vehicles. However, in some cases, improvements to existing infrastructure may be required, or new bridges or culverts may be installed as described in Section 2.1.1 of the Summary of Construction Methods and Procedures (Appendix A). Figures 3 and 4 provide typical drawings of the bridge types that may be implemented on the Project; Figure 1 illustrates a rock flume/culvert that may be used at road/construction workspace intersections. Ice bridges are described in Enbridge's Winter Construction Plan. Enbridge will obtain the appropriate permits for new and improved infrastructure, as required, and will comply with the conditions associated with those permits, including in-stream timing restrictions for any work proposed within the ordinary high water mark ("OHWM") (refer to Section 2.1). Refer to Section 2.4.2 for additional discussion on bridge and culvert design and maintenance and restoration.

1.4.2 Temporary Access Road Restoration

After construction, Enbridge will return improved roads to their pre-construction condition unless the road authority, landowner, or land-managing agency requests that the improvements be left in place, and the applicable permits, certifications, and authorizations are obtained. Revegetation of temporary access roads will proceed as described in Section 7.0. Decompaction can be accomplished using tillage radish on public lands as described in Section 1.18. No temporary infrastructure in wetlands or waterbodies (e.g., bridges, construction mats) will be permanently left in place without the appropriate regulatory permits, authorizations, and certifications.

1.5 RIGHT-OF-WAY REQUIREMENTS

All construction equipment and vehicles will be confined to the approved construction workspace and additional temporary workspace ("ATWS"), except where landowners or land managing agencies have given permission for construction dewatering activities outside of the construction workspace (see Section 5.0).

The width of the construction workspace for the Project will vary and is co-located with Enbridge's existing corridor, third-party (foreign) utilities, roads, railroads, or highways along the majority of the route. The construction workspace is inclusive of the permanent ROW, permitted temporary workspace ("TWS"), and site-specific extra workspaces (referred to as ATWS) as defined below and shown in Figure 5. The construction workspace width will be reduced (i.e., necked down) in selected locations (e.g., wetlands, waterbodies, in/near sensitive features), as indicated on the

Project construction alignment sheets and in the field by the use of staking. The typical TWS and permanent ROW dimensions are described in Section 2.3 of the Summary of Construction Methods and Procedures (Appendix A).

(a) ROW (Permanent)

The new permanent ROW will be located entirely within the construction workspace and is co-located with Enbridge's existing corridor along portions of the route. The permanent ROW is the legally acquired land that is used to install, maintain, operate, and access the pipeline system. The permanent ROW is maintained to facilitate access and aerial inspection of the pipeline system in accordance with U.S. Department of Transportation ("DOT") regulations.

(b) TWS

Construction will require TWS to install the pipeline, which will be located adjacent to and contiguous with the permanent ROW.

(c) ATWS

Site-specific ATWS locations (construction work areas beyond the permanent ROW and TWS previously described) will be required at select locations such as steep slopes; road, waterbody, railroad, and some wetland crossings; and, where it is necessary to cross under existing pipelines or foreign utilities. ATWS will typically be located in uplands adjacent to the construction workspace and set back at least 50 feet from sensitive resource boundaries where site-specific field conditions allow. However, to complete work safely, Enbridge may need to locate ATWS within a wetland or within the 50-foot setback from a wetland or waterbody based on site-specific conditions. ATWS adjacent to waterbodies and/or wetlands is addressed further in Sections 2.0 and 3.0, respectively.

1.6 MANAGEMENT OF UNDESIRABLE SPECIES

Enbridge will minimize the potential for introduction and/or spread of undesirable species (i.e., INS along the construction workspace and temporary access roads due to pipeline construction activities. The measures that Enbridge will implement to manage the spread of terrestrial and aquatic INS are described in more detail in Enbridge's INS Management Plan provided in Appendix B. Enbridge's INS Implementation Plans for Public Lands, and for Private and County Lands, which are attachments to the INS Management Plan, prioritize INS sites, and provide site- and species-specific management strategies to be selected in the field based on timing, activities, and species phenology, among other factors.

1.7 POTHOLING/HYDROVAC SLURRY

Appropriate safety measures will be implemented before excavation begins, including notification through the One-Call system to ensure third-party utilities and adjacent pipelines are properly

marked. Four-way sweeps[8] will also be conducted to positively locate any existing underground utilities.

Potholing is the act of using pressurized water to excavate the soil over pipelines and utilities identified through the One-Call and four-way sweep process. Hydrovac slurry is made up of clean water and subsoil excavated from the area over the utility to positively identify the utility lines and prevent line strike during construction. Enbridge will construct an unlined but bermed containment area or identify comparable containment (e.g., open-top tank) to hold the hydrovac slurry in an Enbridge- and landowner-approved upland area within the construction workspace or dispose of the material at an approved off-site location. The containment area/structure will be sized appropriately to contain the amount of hydrovac slurry material to be generated at that site. Once the slurry is drained and dry, it may be incorporated with the subsoil in an Enbridge- and landowner-approved upland area within the construction workspace in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity. Discharging hydrovac slurry onto topsoil is not permitted as the material will degrade the quality of the topsoil and potentially affect revegetation. Once construction activities are complete, the potholes will be backfilled, graded, and revegetated as described in Sections 1.15, 1.16, and 7.0.

1.8 UPLAND CLEARING

The initial stage of construction involves the clearing of brush, trees, and tall herbaceous vegetation from the construction workspace. Clearing may be accomplished with chain saws, mowers, and hydraulic tree-cutting equipment. Clearing over horizontal directional drills (“HDD”) paths will be limited to the 30-foot-wide construction workspace.

On public lands, retain roughly 1/3 tree tops, branches, and small, non-merchantable trees that will be lop and scattered in place in select locations that will not impede safe access and construction of the Project (e.g., ATWS, along the edge of the construction ROW) to aid in natural reforestation following construction, unless there is insufficient construction workspace to store the material. The material will be dispersed uniformly to the site of origin to permit natural regrowth of the existing vegetation and will not be spread greater than 2 feet in depth; remaining material will be hauled off public lands or to an approved location or used in stabilizing erodible slopes or construction entrances. Lop and scatter from uplands is not permitted in seasonal ponds or open water/emergent wetlands. Lop and scatter is permitted to be returned to the site of origin in forested and scrub-shrub wetlands only.

1.8.1 Disposal of Non-Merchantable Timber

Unless otherwise agreed upon between Enbridge and the applicable landowner or land-managing agency, non-merchantable timber and slash will be disposed of by mowing, cutting, chipping, mulching and left in upland areas, and/or hauling off-site to an approved location or used in stabilizing erodible slopes or construction entrances. In non-agricultural, non-wetland areas,

[8] A four-way sweep is a method of locating underground utilities that involves scanning the ground with electromagnetic induction or ground-penetrating radar equipment to detect the presence of buried features; it does not involve digging or other ground-disturbing activities. The term “four-way sweep” comes from the fact that an area typically is scanned (or swept) in at least four directions.

chips,[9] mulch,[10] or mechanically cut woody debris[11] may be uniformly broadcast across the construction workspace in a manner that avoids inhibiting revegetation. Chipping is not allowed on public lands. On public lands, mulch and mechanically cut woody debris must be uniformly broadcast to less than 2-inch thickness and in a manner that maintains visible ground. An EI will proceed with the clearing crews to monitor these activities on public lands. Should an accumulation of mulch or mechanically cut woody debris occur on public lands, Enbridge will remove the material and haul off-site to an approved location. However, woody debris or mulch that scatters during normal use of clearing equipment is acceptable, provided it does not accumulate as described above. This material may also be incorporated into the topsoil layer during grading activities, with landowner approval (coordinated through Enbridge Lands agents). Chips, mulch, or mechanically cut woody debris shall not be stockpiled in a wetland. Non-merchantable timber shall not be disposed of by placing it off the construction workspace; however, it may be temporarily stored off the construction workspace in upland areas at the request of the landowner.

Burning of non-merchantable wood may be allowed only where the applicable permits and approvals (e.g., agency, Tribal, and landowner) have been acquired and in accordance with all Tribal, state, and local regulations. Burning is not allowed in wetlands or peatlands. Burning within 100 feet of a wetland or waterbody is prohibited without site-specific approval in advance from an EI and in accordance with applicable permits and/or approvals.

1.8.2 Disposal of Merchantable Timber

All merchantable timber will be managed in accordance with Enbridge contract specifications and applicable permits and licenses. All merchantable timber cut down on public lands must be salvaged in accordance with MDNR policies. The MDNR defines merchantable timber as any species greater than 3 inches in diameter. Each species must be utilized down to a minimum merchantable top diameter inside the bark as follows:

- 4 inches for cordwood and pulpwood material, except 3 inches for spruce;
- 6 inches for bolts; and
- 10 inches for saw timber.

No merchantable timber will be disposed of on public lands.

1.8.3 Upland Grading and Stump Removal

Stumps within the trench line will be completely removed, ground, and/or hauled off-site to an approved location. Tree stumps outside the trench line will be ground below normal ground

[9] Wood chips are small- to medium-sized pieces of wood formed by cutting or chipping large pieces of wood such as trees, branches, logging residue, stumps, roots, and wood waste utilizing a chipper or shredder. Sizes vary from approximately 1-inch by 1-inch by 1/8-inch thick to 2 1/4-inch by 2 1/4-inch by 1/4-inch thick.

[10] Wood mulch consists of shredded wood chips and bark of fairly uniform size, generally approximately 2 inches long and 1 inch in diameter. The hydro-ax uses a rotating blade to shred small saplings and brush less than 3 inches in diameter into mulch. It is not possible to collect this debris as the equipment is operating; however, upon completion Enbridge will ensure uniform dispersal of the mulch across the construction workspace to avoid inhibiting revegetation.

[11] Mechanized cutting of woody vegetation may include saws, shears, or chainsaws. Woody debris left on-site will be less than 1.5-inch diameter and/or 12 inches in length.

surface to facilitate a safe work area and to allow topsoil removal, if necessary. In some circumstances, tree stumps outside the trench line may be completely removed to allow for a safe work area and hauled off-site to an approved location. Additional clearing will be needed where free-span engineered bridges will be installed. No grading or stump removal will occur along HDD paths except at limited locations where bridges will be installed, or as needed to assist with staging to respond to an inadvertent release of drilling mud. Bridge headers will be set back 10 feet from the top of bank and some limited grading may be required to allow for the safe installation of the bridge.

1.9 TEMPORARY EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES

Temporary Best Management Practices ("BMPs") to minimize erosion and control sediment, also referred to as erosion control devices ("ECDs"), include but are not limited to sediment barriers (silt fence, certified weed-free straw or hay bales,[12] bio-logs, etc.), filter socks (refer to Figures 6 through 9), mulch (Section 1.9.2), upslope diversions (Figure 48), slope breakers (earthen berms) (Section 1.9.4), and revegetation subsequent to seeding of exposed soils (Section 7.0).

Enbridge will maintain erosion and sediment control BMPs as required in the Project construction documents and as required by all applicable permits, including SWPPPs. Enbridge requires inspections of temporary ECDs at least once every 7 calendar days and within 24 hours after a rainfall event of 0.5 inch or greater in Minnesota and Wisconsin, or 0.25 inch or greater in North Dakota. A "rainfall event" is the total amount of rainfall recorded in any continuous 24-hour period. Non-functional ECDs will be repaired, replaced, or supplemented with functional materials within 24 hours after discovery, or as otherwise specified in project permits.

Temporary ECDs will be installed prior to or at the same time as ground disturbing activities (e.g. grading, topsoiling) at the base of sloped approaches to streams, wetlands, water conveyances (e.g., ditches, swales) and roads. Temporary ECDs will also be installed at the edge of the construction workspace and improved temporary access roads as needed, and/or in other areas determined by the EI to slow water leaving the site and prevent siltation of waterbodies and wetlands downslope or outside of the construction workspace (e.g., swales and side slopes). Temporary ECDs will be placed across the entire construction workspace and temporary access roads at the base of slopes greater than 3 percent and at site-specific locations identified in the SWPPP until the area is revegetated and there is no potential scouring of, or sediment transport to surface waters. Adequate room will be available between the base of the slope and the sediment barrier to accommodate ponding of water and sediment deposition. Temporary ECDs will be maintained until permanent cover[13] is established.

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[12] Minnesota Department of Transportation 3882 Type 3 specifications: http://www.dot.state.mn.us/pre-letting/spec/2018/2018-spec-book-final.pdf.

[13] Permanent cover means surface types that will prevent soil failure under erosive conditions. Examples include: gravel, concrete, perennial cover, or other landscaped material that will permanently arrest soil erosion. Permittees must establish a uniform perennial vegetative cover (i.e., evenly distributed, without large bare areas) with a density of 70 percent of the native background vegetative cover on all areas not covered by permanent structures, or equivalent permanent stabilization measures. Permanent cover does not include temporary BMPs such as wood fiber blanket, mulch, and rolled erosion control products (Minnesota Rules 7090).

If silt fence is used, when the depth of sediment reaches about one-third of the height, the sediment will be removed. Non-functional ECDs will be repaired, replaced, or supplemented with functional structures within 24 hours after discovery, or as otherwise specified in Project permits.

Temporary ECDs installed across the travel lane or temporary access roads may be removed during active daytime construction; however, ECDs will be properly reinstalled after equipment passage, or activities in the area are completed for the day. These ECDs will also be repaired and/or replaced prior to inclement weather when forecasted. Enbridge is responsible for monitoring weather conditions and adjusting resources as needed to address pending and/or existing weather conditions.

Additional erosion and sediment control BMPs may be installed as exclusionary fencing to protect other sensitive features, such as archaeological, cultural, or historic sites. These measures will be described in the applicable permit conditions and resource protection plans.

1.9.1 Temporary Stabilization

Stabilization[14] of all exposed areas, including spoil piles, must be initiated immediately[15] to limit soil erosion when construction activity has permanently or temporarily ceased on any portion of the site and will not resume for a period exceeding 14 calendar days. Stabilization must be completed no later than 14 calendar days after the construction activity has ceased.

In areas within 1 mile of, and draining to, a special or impaired water (refer to Section 2.2.2), stabilization measures will be initiated immediately and completed within 7 calendar days whenever construction activity has permanently or temporarily ceased on any portion of the site. Areas of the Project where this timing restriction applies will be clearly defined on the Environmental Plan Sheets accompanying the SWPPP.

On portions of the Project where work will be occurring during applicable “work in water restrictions” for Public Waters (refer to Section 2.1), all exposed soil areas within 200 feet of the water’s edge, and that drain to that water, will be stabilized within 24 hours during the restriction period. Stabilization of all exposed soils within 200 feet of the public water’s edge, and that drain to that water, will be initiated immediately and completed within 7 calendar days whenever construction activity has permanently or temporarily ceased on any portion of the site outside of the restriction period. These areas will be identified on the Environmental Plan Sheets accompanying the SWPPP.

Enbridge may require that temporary stabilization materials be installed sooner based on site conditions, or as required in Project permits.

[14] Stabilization means that the exposed ground surface has been covered by appropriate materials such as mulch, staked sod, riprap, erosion control blanket, mats or other material that prevents erosion from occurring. Grass seeding, agricultural crop seeding or other seeding alone is not stabilization. Mulch materials must achieve approximately 90 percent ground coverage (Minnesota Rules 7090).

[15] Initiated immediately means taking an action to commence soil stabilization as soon as practicable, but no later than the end of the work day, following the day when the land-disturbing activities temporarily or permanently cease (Minnesota Rules 7090).

1.9.2 Mulch

Enbridge will stabilize exposed ground surfaces within the timeframes described in Section 1.9.1. In most cases, Enbridge will utilize mulch (certified weed-free hay or straw,[16] wood fiber[17] hydromulch, or a functional equivalent) to disturbed areas (except for actively cultivated land and most wetlands) as required by the applicable permits, certifications, or licenses, or as required by Enbridge, and as approved by the landowner or land-managing agency. Mulch will specifically be used on:

- slopes greater than 5 percent; and
- dry, sandy areas that can blow or wash away, as determined in the field.

Only certified weed-free mulch will be utilized on this Project. Sources will be approved by Enbridge prior to purchase. Other stabilization methods, such as staked sod, erosion control blanket, mats or other material that prevents erosion from occurring may be used as appropriate based on site-specific conditions.

Mulch will be applied to cover at least 90 percent of the ground surface unless otherwise stipulated by permit conditions. Mulch will be uniformly distributed by a mechanical mulch blower, or by hand in areas not accessible to the mulch blower. Strands of mulch shall be sized to allow proper anchoring. Mulch will be anchored/crimped using a mulch-anchoring tool or disc set in the straight position to minimize loss by wind and water, as site conditions allow and as approved by Enbridge in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity. In areas not accessible to a mulch-anchoring tool or too steep for safe operation, the mulch may be anchored by liquid tackifiers with advance written approval from Enbridge. The manufacturer's recommended method and rate of application will be followed.

Hydro-mulch and liquid tackifier can be used in place of certified weed-free straw or hay mulch with prior approval from Enbridge. All hydromulch and liquid tackifier products used will be on the applicable state DOT product list. Hydro-mulch and liquid tackifier products containing plastic/ polypropylene fiber additives and Malachite Green (colorant) will not be utilized on this Project. Application rates will be at the manufacturer's recommended rate. Enbridge will avoid the use of hydromulch on public lands; however, Enbridge may use hydromulch on steep slopes to prevent erosion until permanent cover has been established.

1.9.3 Cat Tracking

Cat tracking, also known as horizontal slope grading, may be implemented based on site conditions (sandy or silt soils) to reduce erosion potential. Cat tracking is achieved by driving a

[16] Minnesota Department of Transportation 3882 Type 3 specifications: http://www.dot.state.mn.us/pre-letting/spec/2018/2018-spec-book-final.pdf.

[17] Wood mulch consists of shredded wood chips and bark of fairly uniform size, generally approximately 2 inches long and 1 inch in diameter. The hydro-ax uses a rotating blade to shred small saplings and brush less than 3 inches in diameter into mulch. It is not possible to collect this debris as the equipment is operating; however, upon completion Enbridge will ensure uniform dispersal of the mulch across the construction workspace to avoid inhibiting revegetation.

bulldozer vertically up and down the slope which results in the tracks being oriented horizontally; creating small speed bumps for water (refer to Figure 10).

1.9.4 Temporary Slope Breakers

Temporary slope breakers will be installed to minimize concentrated or sheet flow runoff in disturbed areas in accordance with the following maximum allowable spacing unless otherwise specified in permit conditions.

Slope (%)	Approximate Spacing (ft)
3-5	250
5-15	200
15-25	150
>25	<100

If the length of the slope is less than the distance of the required spacing, slope breakers are not required unless a sensitive resource area (e.g., wetland or public roadway) is located immediately down slope, or as determined to be needed by the EI. Temporary slope breakers may be constructed using earthen subsoil material, silt fence, certified weed-free straw or hay bales, or in non-agricultural land, rocked trenches may be used. On highly erodible slopes, slope breakers in the form of earthen berms will be used whenever possible.

Temporary slope breakers will be constructed according to the following specifications (refer to Figure 11):

- certified weed-free straw or hay bales used as slope breakers will be trenched in and staked so as to not allow spacing between bales or allow flow underneath the bales;

- the outfall of temporary slope breakers will be directed off the construction workspace into a stable well-vegetated upland area or into an appropriate energy-dissipating sediment control device (e.g., filter sock, silt fence, straw bales, rock aprons, sumps) to prevent the discharge of sediments (refer to Figure 11) and the area will be inspected to ensure stabilization;

- proper slope breaker outfalls will be established where topsoil segregation and/or grading has created a barrier at the edge of the construction workspace;

- J-hook sediment traps will be installed at the perimeter of the erosion control zones on the downslope side of the construction workspace; and

- gaps will be created through spoil piles where necessary to allow proper out-letting of temporary berms.

1.10 TOPSOIL SEGREGATION AND STORAGE

Areas where topsoil will be stripped includes cropland, hay fields, pasture, residential areas, and other areas as requested by the landowner or as specified in the Project plans, commitments, and/or permits.

1.10.1 Topsoil Segregation Methods

The following topsoil segregation methods may be employed during construction:

- Full Construction Workspace (refer to Figures 12 and 13)
- Trench-Line-Only (refer to Figures 14 and 15)
- Modified Trench-Plus-Spoil Side (refer to Figures 16 and 17)

The Full Construction Workspace topsoil segregation technique will typically be used in agricultural areas, including active cropland, pasture, and hayfields, and will consist of stripping topsoil from the spoil storage area, trench line, and the primary travel lane.

The Trench-Line-Only topsoil segregation method will be used in wetlands, forested vegetation communities, and where requested by the landowner or land-managing agencies. Topsoil is not typically segregated in standing water wetlands unless specifically requested by the landowner or managing land agency in accordance with applicable permit conditions.

Alternative topsoil segregation methods may be used on a site-specific basis or as requested by the landowner or land-managing agency.

1.10.2 Topsoil Storage

Gaps will be left and erosion and sediment control BMPs installed where stockpiled topsoil and spoil piles intersect with water conveyances (i.e., ditches, swales) to maintain natural drainage. A minimum 1 foot of separation will be maintained between the topsoil and subsoil/spoil piles to prevent mixing. Where the 1-foot separation cannot be maintained, the EI may approve the use of a physical barrier on a site-specific basis, such as a thick layer of mulch or silt fence, between the spoil and topsoil piles to prevent mixing.

1.10.3 Depth of Upland Topsoil Stripping

In deep soils (more than 12 inches of topsoil), topsoil will be stripped to a minimum depth of 12 inches, unless otherwise specified/requested by other plans, permit conditions, or the landowner. If less than 12 inches of topsoil are present, Enbridge will attempt to segregate to the depth that is present. In the Red River Valley, Enbridge will strip topsoil in accordance with the Agricultural Protection Plan.

1.11 UPLAND TRENCHING

Trenching in uplands is typically accomplished with a backhoe excavator or a rotary wheel trenching/ditching machine. The trench width excavation requires an average of 20 feet depending on topography and soil conditions. The trench will be excavated to a depth that complies with the minimum depth of cover requirements described in the Summary of Construction Methods and Procedures (Appendix A) (Figure 18). Enbridge may implement additional depth of cover within or adjacent to surface waters required by the agencies; the extent of these areas will be depicted on the Alignment Sheets and corresponding crossing plans. Following installation of the pipeline, Enbridge will confirm that the pipe depth meets federal and state requirements through civil survey.

Excavated material will be side cast (stockpiled) within the approved construction workspace separate from topsoil and stored such that the area subject to erosion is minimized. Enbridge will coordinate with landowners to minimize disruption of access caused by the trench during construction. Where deemed appropriate, Enbridge will leave subsoil in the trench or will construct temporary access bridges across the trench for the landowner to move livestock or equipment; temporary bridges may also be utilized by wildlife. Where trenches are left open overnight, trenches will also be sloped (less than 45 degrees) where started and ended to allow wildlife egress. Spacing of ramps will be determined in the field. Enbridge will inspect the trench and construction area for presence of animals every day before initiating construction activities and prior to backfilling the trench. If an animal is located, it will be relocated outside of the active construction workspace. If the animal is a federally or state-listed species, the appropriate agency(ies) will be notified. In the event that a large mammal such as a deer, moose, or bear becomes entrapped in the trench, Enbridge will contact the IEM to coordinate with the U.S. Department of Agriculture, Animal and Plant Health Inspection Service ("USDA APHIS"), Wildlife Services Program to assist with removal. The IEM will also notify the MDNR through its 24-hour hotline (1-888-646-6367).

In areas with shallow bedrock, blasting may be required to excavate the trench. Enbridge will follow the procedures outlined in its Blasting Plan wherever blasting may be required.

1.11.1 Timing

The length of time a trench is left open will be minimized to ensure that installation of the pipe and restoration of the construction workspace occurs in a timely fashion. Generally, Enbridge will minimize the length of trench and amount of time that the trench is left open in wetter conditions to minimize water-management issues (e.g., construction dewatering) associated with high groundwater tables or precipitation events. Therefore, unless otherwise specified by regulatory permits or WQCs issued for this Project's construction, Enbridge will limit the cumulative amount of excavated open trench to a maximum of 3 days of anticipated welding production rate or 14,000 linear feet per spread. Within each spread, site-specific activities, such as HDD, bores, valve work and pump station construction may be performed independent of open trench work. This timeframe or length may be decreased at the discretion of Enbridge based on field conditions including topography, soils, weather conditions, hydrology, presence of sensitive resources, and the construction technique being utilized.

1.12 TRENCH PILLOW INSTALLATION

Pillows are placed under and around the pipe where needed to take stress off the pipe as a result of incidental variabilities in trench depth, or to protect the pipe coating in rocky conditions. For this same reason, the trench pillows are left in the trench. Trench pillows will be composed of either closed cell polyurethane foam or sand bags. Foam pillows are rectangular blocks measuring approximately 3 feet by 2 feet. The foam components are mixed either at an off-site location or on-site on a protective sheet of plastic in an upland area to create the foam pillows. Cured foam pillows are then transported to the construction site for installation within the trench or the foam is applied directly into the trench line. Sand bags will be filled with clean rock-free subsoil or sand; topsoil will not be used to construct trench pillows. Enbridge will take measures to minimize the materials used in sand bags are free of pollution and contaminants and do not contain invasive propagules. Enbridge will install pillows composed of closed cell polyurethane foam or sand bags within the external boundaries of the Fond du Lac Band of Lake Superior Chippewa ("FdL") Reservation in Minnesota, and in Wisconsin and North Dakota. Outside of the FdL Reservation

in Minnesota, Enbridge will utilize sand bags. Enbridge will also utilize sand bags on public lands, within the Aquatic Management Area managed by the MDNR, and at public waters located within the external boundaries of the FdL Reservation.

1.13 TRENCH BREAKERS

Trench breakers are installed in sloped areas after the pipe has been lowered into the trench to protect against subsurface water flow along the pipe after the trench is backfilled. Trench breakers will be composed of either closed cell polyurethane foam or sand bags. Sand bag trench breakers will be constructed with bags filled with clean rock-free subsoil or sand. Topsoil will not be used to construct sand bag trench breakers. Enbridge will take measures to minimize that the products used in sand bags are free of pollution and contaminants and do not contain invasive propagules. The foam trench breakers will only be used under dry conditions where no groundwater is present, or where the trench has been effectively dewatered. Enbridge will not backfill the trench until foam is completely cured (i.e., finished foam). Enbridge will install trench breakers composed of either sand bags or closed cell polyurethane foam within the external boundaries of the FdL Reservation in Minnesota, and in Wisconsin and North Dakota. Outside of the FdL Reservation in Minnesota, Enbridge will utilize sand bags. Enbridge will also utilize sand bags on public lands, within the Aquatic Management Area managed by the MDNR, and at public waters located within the external boundaries of the FdL Reservation.

Trench breakers will be placed from the bottom of the trench to near the top of the trench, completely surrounding the pipe and will be properly keyed into the undisturbed trench walls (refer to Figure 19). The approximate spacing of trench breakers will be 250 feet (3-5 percent slope), 200 feet (5-15 percent slope), 150 feet (15-25 percent slope) and less than 100 feet (>25 percent slope). The location of trench breakers will be selected based on field conditions at the time of construction and will consider the degree and length of slope, presence of down-slope sensitive resource areas such as wetland and waterbodies, and proximity to other features such as roads and/or railroads. The following conditions apply to the placement and installation of trench breakers unless otherwise directed by Enbridge:

- Trench breakers will be installed on slopes greater than 5 percent adjacent to streams, wetlands, or other waterbodies.

- Where the pipeline exits a wetland towards areas of lower relief, trench breakers will be installed (within the upland) where there is a potential for underground drainage along the pipe in order to prevent wetland or waterbody drainage.

- At all waterbody crossings, as necessary, to prevent diversion of water into upland portions of the pipeline trench and to keep accumulated trench water out of the waterbody.

- Adjacent to Minnesota public watercourses with poorly defined bed and banks located within wetland complexes.

The general location of trench breakers will be identified on construction alignment sheets with a note to “Field Verify,” the precise location through coordination between Enbridge’s EIs, Enbridge’s Craft Inspectors, and the Contractor’s Foreman. The trench breaker may be moved short distances in either direction from the location identified on the construction alignment sheets to more stable soils, or to avoid other site-specific conditions. Additional trench breakers may also be added depending on site-specific conditions. Enbridge will require Contractors to have

additional materials on hand to install additional trench breakers as needed. The pipe will then be marked with paint near the location that the trench breaker is needed to alert the trench operators to key the banks for breaker placement.

1.14 DRAIN TILE INLET PROTECTION AND TILE REPAIRS

Enbridge will attempt to locate existing drain tile inlets that are located near the construction work area prior to construction. Drain tile inlets will be marked using flags. Enbridge will protect located drain tile inlets with the potential to receive stormwater from construction of the Project using the appropriate erosion and sediment control BMPs until sources with the potential to discharge have been stabilized. The determination of the specific erosion and sediment control BMP will be made based on the location of an inlet with respect to the Project area, drainage area from the construction workspace to the inlet, topography, vegetation, soils, and accessibility to the inlet. Where drain tile inlets are located off of Enbridge's construction workspace, Enbridge may not have authorization to install erosion and sediment control BMPs at the inlet site. In these cases, sediment control measures (typically silt fence) will be installed along the edge of the construction workspace that drains to the inlet structure to minimize sedimentation.

If underground drain tile is damaged by pipeline construction, it will be repaired in a manner that assures proper tile line operation at the point of repair in accordance with the Agricultural Protection Plan.

1.15 UPLAND BACKFILLING

Backfilling follows pipe installation and consists of replacing the material excavated from the trench. Prior to backfilling, the trench will be dewatered in accordance with the methods discussed in Section 5.0 if water obscures the trench bottom, except for certain site-specific conditions.

1.16 CLEANUP AND ROUGH/FINAL GRADING

All waste materials, including litter generated by construction crews, will be disposed of daily. Initial cleanup and rough grading activities may take place simultaneously. Cleanup involves removing construction debris (including litter generated by construction crews and excess rock) and large woody debris and repairing/replacing fences or other infrastructure removed or damaged during construction as agreed upon with the landowner or land-managing agency.

Rough grading includes restoring disturbed subsoil to as near as practicable to pre-construction conditions and decompacting subsoil (where applicable) (Section 1.18). Final grading consists of returning the topsoil where topsoil has been stripped and final contouring to near as practicable to pre-construction conditions. Enbridge will backfill the trench to an elevation similar to the adjacent area outside the trench line and will add a slight crown of approximately 3 to 6 inches (depending on soil type) over the backfilled trench to allow for subsidence. Generally, excess subsoil displaced by the pipe installation will be spread across the portion of the construction workspace where topsoil removal has occurred (see Section 1.10). Any remaining excess subsoil will be removed and disposed of at an approved off-site location as needed to ensure contours are restored to as near as practicable to pre-construction conditions. Periodic breaks in the crown will be implemented to allow for normal hydrologic flow across the backfilled trench. Crowning will not extend beyond the previously excavated trench limits. As the backfill material settles, there is potential that the original crown may not completely recede to pre-construction contours. Additional (final) grading may occur when conditions allow to ensure the disturbed area has been

returned to pre-construction conditions. Enbridge will then prepare the seedbed (Section 7.1.1) and install or repair erosion control measures (Sections 1.9 and 1.17).

1.16.1 Timing

Enbridge will begin cleanup and rough grading (including installation of temporary erosion and sediment control BMPs) as soon as practicable, but not later than the end of the following workday after backfilling the trench (refer to Section 1.9.1 for temporary stabilization timing requirements). Enbridge will attempt to complete this rough cleanup within 1 week. Enbridge will initiate final grading, topsoil replacement, seeding, and installation of permanent erosion and sediment control BMPs as described in Section 7.0. If seasonal or other weather conditions prevent compliance with these timeframes, temporary stabilization and erosion and sediment control BMPs will be maintained until conditions allow completion.

1.17 PERMANENT EROSION AND SEDIMENT CONTROL BEST MANAGEMENT PRACTICES

During final grading, slopes in areas other than cropland will be stabilized with erosion and sediment control BMPs (i.e., ECDs). With exception for actively cultivated areas, permanent berms (diversion dikes or slope breakers) will be installed on all slopes, according to the following maximum spacing requirements unless otherwise specified in permit conditions (Figure 20):

Slope (%)	Approximate Spacing (ft)
5	250
>5-15	200
15-25	150
>25	<100

Permanent berms will be constructed according to the following specifications:

- Permanent berms will be installed with a 2 to 4 percent out slope.
- Permanent berms will be constructed of compacted earth, stone, or functional equivalent as approved in advance by Enbridge in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity.
- The outfall of berms will divert surface water flow to a stable area, or in the absence of a stable area, to appropriate energy-dissipating devices. Berms will be extended slightly beyond the edge of the construction workspace if possible; however, only with the appropriate sediment capturing device. Outfalls will be inspected to ensure stabilization.
- Permanent berms will be inspected and repaired as deemed necessary by Enbridge to maintain function and prevent erosion.

1.17.1 Erosion Control Blanket

The appropriate class of erosion control blanket will be installed in accordance with manufacture recommendations and/or state DOT specifications on slopes greater than 33 percent that drain to surface waters (refer to Figure 21), and at other locations based on site-specific conditions. Installation of erosion control blankets and additional erosion and sediment control BMPs may

occur after first snowfall depending on construction progress, seasonal weather, and site conditions. Erosion control blankets will be installed running parallel (up and down) with the direction of the slope (not perpendicular). On public lands, Enbridge will utilize wildlife-friendly erosion and sediment control BMPs that contain biodegradable netting (Category 3N or 4N natural fibers[18]) and will avoid the use of plastic mesh.

1.18 SOIL COMPACTION TREATMENT

After rough grading and before topsoil replacement, Enbridge will decompact the subsoil in actively cultivated areas (as directed by Enbridge) to relieve soil compaction and promote root penetration. Decompaction may also occur on improved upland temporary access roads as appropriate. To alleviate soil compaction, Enbridge will decompact the area prior to topsoil replacement with a deep tillage device or chisel plow if agreed to by the landowner or land-managing agency. Soil conditions must be dry enough to shatter the compacted soil between the points of a subsoiler or chisel plow to lower the bulk density of soil and reduce compaction. Soil at the compacted depth must not be wet and plastic at the time of tilling, otherwise it will not reduce compaction. If subsequent construction and cleanup activities result in further compaction, the measures described above will be completed a second time to alleviate the soil compaction. Additional details on soil decompaction in agricultural areas is described in Enbridge's Agricultural Protection Plan.

On public lands and MDNR-administered temporary access roads, Enbridge will use tillage radish either as a temporary cover crop prior to permanent seeding, or as part of the permanent seed mix (see Section 7.5) to assist with decompaction as appropriate depending on site conditions and timing. Tillage radishes do not do well in poorly drained soils prone to water logging or during extended wet periods. Enbridge will not utilize deep tillage devices or chisel plows on public lands.

1.19 STONE REMOVAL

After soil decompaction, a diligent effort will be made to remove excess stones equal to or larger than 4 inches in diameter and other debris brought to the surface from decompaction efforts or as specified in permit conditions, contract documents, or landowner agreements. After the topsoil is replaced, stone removal efforts will cease when the size and density of stones on the construction workspace are similar to undisturbed areas adjacent to the construction workspace as determined by the EI. Excess rock will be piled in upland areas where landowner permission has been obtained or will be hauled off-site to an Enbridge approved disposal location.

With prior approval from the MDNR, rocks encountered during construction will be stockpiled at an accessible and agreed upon location for future use by the MDNR on public lands.

1.20 REPAIR OF DAMAGED CONSERVATION PRACTICES

Enbridge will restore all soil conservation practices (such as terraces, grassed swales, etc.) that are damaged by the pipeline construction to pre-construction conditions to the extent practicable.

[18] Category 3N or 4N as described in Table 3885-2 (3885.2A Erosion Control Blanket Requirements) in Minnesota Department of Transportation Standard Specifications for Construction, 2018 Edition (http://www.dot.state.mn.us/pre-letting/spec/2018/2018-spec-book-final.pdf).

1.21 LAND LEVELING FOLLOWING CONSTRUCTION

Following the completion of the pipeline, the construction workspace will be restored to its pre-construction conditions as practical. Should uneven settling or documented surface drainage problems occur following the completion of pipeline construction and restoration, Enbridge will take appropriate steps to remedy the issue.

Additional monitoring and corrective measures are described in:

- Post-Construction Wetland and Waterbody Monitoring Plan;
- Gully 30 Fen Management Plan;
- Spring Brook Construction and Restoration Plan;
- LaSalle Creek Construction and Restoration Plan; and
- Post-Construction Vegetation Management Plan for Public Lands and Waters ("VMP").

1.22 OFF-ROAD VEHICLES

To reduce the potential for members of the public to access public lands with off-road vehicles or other recreational equipment along the cleared permanent ROW, Enbridge will incorporate barriers to restrict access within the operational ROW as practicable where requested and approved by the land-managing agency, and where these barriers will not restrict or impede access for maintenance and emergency response activities. The type of barrier will be selected in consultation with the landowner and/or land-managing agency.

2.0 STREAM AND RIVER CROSSING GENERAL REQUIREMENTS

The procedures in this section apply to public watercourses, streams, rivers, and other waterbodies such as jurisdictional ditches, ponds, basins, and lakes. These procedures require that judgment be applied in the field and will be implemented under the supervision of Enbridge.

Stream crossing requirements, including construction methods, timing, erosion and sediment control BMP usage, and restoration are described in this section and in the stream crossing permits, licenses, and certifications issued by state and federal agencies and by Tribal authorities (as applicable). Requests to change the proposed crossing method will follow the process outlined in Section 6.0 of the EMCP. Written approval from Enbridge and the applicable agency(ies) must be obtained prior to implementing an alternative crossing method.

Enbridge will monitor upcoming weather forecasts to determine if significant rainfall is anticipated during construction and plan work accordingly.

2.1 TIME WINDOW FOR CONSTRUCTION

All in-stream work activities (installation of dams, sheet piling, etc.) will be minimized to the extent practicable on an area and time duration basis. In-stream trenching will be conducted during periods permitted by the appropriate regulatory agencies and applicable permits and certifications.

Enbridge will not conduct certain construction activities in known wild rice waters or in areas up to 25 miles upstream of wild rice waters from April 1 through July 15 as required by the MPCA Section 401 WQC.

Enbridge will adhere to the following work-exclusion dates for Minnesota Public Water Inventory cool- and warm-water fisheries that require in-channel work,[19] or will seek a waiver with the MDNR:

- Region 1 (Northwest) Non-Trout Streams: March 15 – June 30;
- Region 1 Lakes: March 15 – June 30; and
- Region 2 (Northeast) Non-Trout Stream and Lakes: March 15 – June 30.

In addition, Enbridge will adhere to the following work-exclusion dates in designated Minnesota trout streams and their designated tributaries that require in-channel work to allow for spawning and migration, or will seek a waiver with the MDNR:

- Region 1 (Northwest): September 1 – June 30;
- Region 2 (Northeast): September 15 – June 30; and
- Region 2 within the Lake Superior watershed: September 15 – June 30.

[19] In-channel work that results in the alteration of the course, current, or cross-section of the public water; this restriction does not apply to the trenchless crossing method or water appropriation activities (see Section 6.0), except where explicitly identified by the MDNR.

In addition, Enbridge will not execute the HDD crossing method at waterbodies during frozen conditions (i.e., ice-covered waterbody), unless otherwise approved by the MPCA and MDNR on a case-by-case basis.

Special waters (including trout waters), impaired waters, and public waters will be identified on the Environmental Plan Sheets accompanying the SWPPP. Unless otherwise specified in applicable permits or certifications and with exception to blasting and other rock breaking measures and HDD, in-stream construction activities (specifically trenching, pipeline installation, backfill, and restoration of the streambed contours) for open cut (non-isolated) crossing methods will occur within the following timeframes:

- Minor Waterbodies (all waterbodies less than or equal to 10 feet wide at the water's edge at the time of crossing): 24 hours.

- Intermediate Waterbodies (all waterbodies greater than 10 feet wide but less than 100 feet wide at the water's edge at the time of crossing): 48 hours.

- Major Waterbodies (all waterbodies greater than 100 feet wide at the time of crossing): As specified by Enbridge or in the applicable permits.

These timeframes apply regardless of the presence or absence of flow. These timeframes also apply to dry (isolated) crossing methods as a guideline and can be extended based on site-specific conditions with approval from Enbridge Environment, Construction Management, and the EI in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity. Enbridge will contact the MDNR if a crossing of a public water watercourse feature will take longer than 24 hours to complete.

Stream crossings have been designed to be as close to perpendicular to the axis of the stream channel as engineering and routing constraints allow, creating the shortest crossing length.

2.2 CLEARING AND GRADING

For trenched crossings of waterbodies, the construction workspace width will consist of a 25-foot-wide neck down beginning 20 feet from the OHWM on the working side of the construction workspace (refer to Figures 22 through 24). Enbridge will properly install and maintain redundant sediment control measures immediately after clearing and prior to initial ground disturbance at surface waters[20] located within 50 feet of the Project and where stormwater flows to the surface water (refer to the Environmental Plan Sheets in the SWPPP). Enbridge will install perimeter sediment controls at least 5 feet apart unless limited by lack of available space. Redundant controls will not be installed adjacent to road ditches, judicial ditches, county ditches, stormwater conveyance channels, storm drain inlets, and sediment basins. Sheet piling is a redundant perimeter control if installed in a manner that retains all stormwater. Sheet piling will be removed using an excavator upon completion of construction activities, unless otherwise authorized by the applicable agencies. Sheet piling may be cleaned and reused or returned to a materials yard. Clearing, topsoil segregation, and trenching of an upland approach to the surface water will occur

[20] "Surface water" or "waters" means all streams, lakes, ponds, marshes, wetlands, reservoirs, springs, rivers, drainage systems, waterways, watercourses, and irrigation systems whether natural or artificial, public or private, except that surface waters do not include stormwater treatment systems constructed from upland (Minn. R. Ch. 7090).

as described in Sections 1.8.3, 1.10, and 1.11. If it is a wetland approach to the surface water, clearing, topsoil segregation, and trenching will occur as described in Sections 3.2 and 3.6. Refer to Section 2.2.2 for a discussion of erosion and sediment control BMP installation at special and impaired waterbodies.

Enbridge will clear a 30-foot-wide corridor over the HDD path to allow vehicle and equipment to access the waterbody for appropriations and/or to monitor for inadvertent releases (refer to Section 11.0). Additional clearing will be needed where free-span engineered bridges will be installed. No grading or stump removal will occur over the HDD path except at limited locations where bridges will be installed, or as needed to assist with staging to respond to an inadvertent release of drilling mud. Bridge headers will be set back 10 feet from the top of bank and some limited grading may be required to allow for the safe installation of the bridge.

2.2.1 Beaver Dam Removal and Prevention of Dam Rebuilding

Beaver dams will be removed once all required permits and authorizations, including landowner approval, are obtained. Enbridge will conduct dam removal activities carefully to prevent downstream sedimentation and scouring impacts. The following BMPs will be implemented during removal of all beaver dams:

- Enbridge will obtain landowner permission and will contact downstream landowners prior to removal activities;
- Enbridge will monitor weather conditions prior to removal;
- Removal will be limited to the removal of the debris that comprises the dam structure;
- Waterbody bed and bank material will not be removed or disturbed during debris removal;
- Materials will be removed incrementally by hand using hand tools to minimize the adverse effects of sudden water release on downstream waters/landowners;
- Ponded water will be released slowly to minimize potential downstream sedimentation. After each drop in dam height, Enbridge will allow the water level and sediment plume to stabilize;
- Downstream conditions will be monitored by construction staff to ensure incremental release of water;
- No mechanized removal will occur outside of the construction workspace when activities could impact public waters;
- In areas where multiple dams are located, Enbridge will remove the dam farthest downstream first;
- Work will be halted, and the situation reassessed should removal result in unexpected conditions (e.g. ponding); and

- Due to Enbridge's plan to remove only material necessary and to do it gradually to maintain water quality, Enbridge does not anticipate the need for any additional contingency measures to manage water flow.

Should Enbridge discover a new beaver dam in public waters during construction that must be removed, or identify the need to trap a beaver, activities will not commence until all required permits and authorizations, including landowner approval, are obtained.

2.2.2 Special, Impaired, and Infested Waters

Enbridge will comply with the construction and mitigation measures identified in the applicable permits for special waters, such as trout streams, canoe waters, and other waters designated by state rules and statutes. Additional applicable erosion control and stabilization measures are described in the Project SWPPPs. Enbridge will properly install and maintain redundant sediment control measures immediately after clearing and prior to initial ground disturbance at special waters located within 100 feet of the Project and where stormwater flows to the surface water (will be reflected in the Environmental Plan Sheets in the SWPPP).

Where discharges of stormwater may occur to waters designated under Section 303(d) of the Clean Water Act as Impaired Waters for phosphorus (nutrient eutrophication biological indicators), turbidity, total suspended solids, dissolved oxygen, or aquatic biota (fish bioassessment, aquatic plant bioassessment and aquatic macroinvertebrate assessment), additional erosion and sediment control BMPs will be implemented as specified in the Project SWPPP and other applicable Project permits. Enbridge will properly install and maintain redundant sediment control measures immediately after clearing and prior to initial ground disturbance at all relevant impaired waters located within 50 feet of the Project and where stormwater flows to the surface water (will be reflected in the Environmental Plan Sheets in the SWPPP).

During Project construction and restoration, Enbridge plans to appropriate water from local sources, such as lakes, streams, and groundwater wells for construction activities such as dust control, make-up of HDD drilling mud, and hydrostatic testing. The Project will follow applicable permit and lease conditions for appropriation and discharge and the BMPs described in the INS Management Plan (Appendix B) to prevent the spread of aquatic invasive species.

2.3 ADDITIONAL TEMPORARY WORKSPACE

ATWS includes work areas outside the boundary of the typical construction workspace. These spaces are typically used to assemble pipe segments and for temporary spoil storage. Clearing of forested and brushy areas for ATWS will be avoided as much as possible. Woody vegetation in wetlands and riparian areas will typically not be cleared for the purpose of ATWS unless approved by appropriate regulatory agencies as stipulated in permits issued for the Project. ATWS will be constructed as follows:

- ATWS will be located at least 50 feet away from the OHWM/ordinary high water level ("OHWL") if topographic or other physical conditions such as stream channel meanders allow, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land (refer to Figures 22 through 24).

- If safe work practices or site conditions do not allow for a 50-foot setback, ATWS should be located no closer than 20 feet from the OHWM/OHWL, subject to site-specific approval

by Enbridge in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity.

- ATWS will be limited to the minimum size needed to construct the stream crossing.

2.4 BRIDGES

Temporary equipment bridges will be used on most waterbodies (upon approval by the appropriate agency(ies)), including small waterbodies such as ditches and intermittent streams, where there is a potential for stormwater runoff or rain events to transport sediment downstream from equipment crossing the waterbody. Some bridges may be used on waterbodies crossed using the HDD method, where approved by regulatory agencies. Bridges will be constructed as described below during clearing and will be removed as soon as possible during final restoration of waterbody contours once the bridge is no longer required to complete and monitor restoration activities.

Fording of waterbodies is prohibited (i.e., civil survey, potholing, or other equipment are not permitted to ford waterbodies prior to bridge placement).

2.4.1 Types of Bridges

Bridge crossing methods associated with the travel lane of the construction workspace are described in detail in Section 2.4.2 of the Summary of Construction Methods and Procedures (Appendix A). Ice bridges are described in Enbridge's Winter Construction Plan. Equipment bridges will be constructed using one of the following techniques (Figures 1, 3, and 4):

- Clear span bridge;
- Non-clear span bridge (in-stream support); or
- Culvert/flume.

2.4.2 Bridge and Culvert Maintenance

Equipment bridges and culverts will be maintained in accordance with the applicable permits. Debris or vegetation that becomes lodged on the bridge support will be removed and disposed of in an upland area. Bridges will be maintained to prevent soil from entering the waterbody (refer to Figure 3 and 4). Soil that accumulates on the bridge decking will be removed daily, or as deemed necessary by the EI. Bridge removal is described in Section 2.6.3.

2.5 STREAM AND RIVER CROSSING CONSTRUCTION METHODS

Section 4.0 of the Summary of Construction Methods and Procedures (Appendix A) describes the different waterbody crossing techniques that Enbridge intends to utilize during construction, the site-specific conditions required for the method to be feasible, and the advantages and disadvantages associated with each technique. Procedures that differ in frozen conditions are discussed in Enbridge's Winter Construction Plan. The following sections describe the stream and river crossing methods that are typically used, subject to further restrictions by Enbridge and applicable permits and subject to modifications as approved by appropriate regulatory agencies and Tribal resource specialists (as applicable) during construction. Generally, depth of cover under waterbody crossings is a minimum of 48 inches unless otherwise specified in applicable permits or authorizations. The trench width excavation requires an average of 20 feet depending

on topography and soil conditions. For those waterbodies that require buoyancy control, the trench will need to be wider. Following installation of the pipeline, Enbridge will confirm that the pipe depth meets federal and state requirements through civil survey (Figure 18 and Appendix A).

2.5.1 Open Cut (Non-Isolated) Trench Method

Crossing of waterbodies when they are dry or frozen to the bottom and not flowing may proceed using the open cut (non-isolated) trench crossing technique described below, provided that the EI verifies that water is unlikely to flow between initial disturbance and final stabilization of the feature. This also applies to features that have been permitted as waterbodies, but field delineations determined were wetlands based on conditions at the time of survey. If unanticipated flow conditions develop during construction of a given waterbody, Enbridge's EIs will be notified immediately to determine the extent of the flow and Enbridge will install additional erosion and sediment control BMPs, as necessary. If flows are significant, and sedimentation is likely to occur, work will be stopped, or Enbridge will switch to a dry (isolated) crossing technique (see Sections 2.5.2 and 2.5.3), with Enbridge and agency approval.

There are also a limited number of locations where due to surrounding saturated wetlands, it is not feasible to isolate the flow and the open cut trench method, such as the push-pull technique (see Section 3.7.1), may be used.

2.5.1.1 Installation

The following procedures will be used during open cut trench crossings (Figure 22):

- Sediment control measures will be installed before initial ground disturbance at the waterbody. Spoil containment structures will be installed back from the stream bank so that spoil does not migrate into the stream.

- Grading will be directed away from the waterbody to minimize the potential for sediment to enter the stream. Grading of stream banks will be restricted to the trench line and areas necessary for safe bridge installation.

- After grading, backhoes or draglines will be used to excavate the trench. Where possible, excavating equipment will operate from one or both banks, or a temporary bridge, without entering the stream. If equipment must encroach into the stream, it will operate on clean construction mats. The upper streambed material (e.g., up to 12 inches of streambed material such as gravel, sand, cobble) will be segregated and stored separately from the remaining trench spoil within the construction work area limits. Storage of streambed spoil within the stream is prohibited unless expressly approved in the applicable permits.

- Earthen trench plugs (hard plugs) between the stream and the upland trench will be left undisturbed during excavation of the in-stream trench to prevent diversion of the stream flow into the open trench and to prevent water that may have accumulated in the adjacent upland trench from entering the waterbody. Trench plugs will be removed immediately prior to pipe placement, and then replaced when the pipe is in place. Trench water accumulated upslope of trench plugs will be dewatered appropriately prior to trench plug removal. Water within the trench will be managed in accordance with Section 5.0.

- A series of pipelayers will place the pipe in the trench at the appropriate depth, with any required buoyancy control measures to maintain depth of cover (refer to Section 3.7.3 for a discussion of buoyancy control measures). Enbridge will also install trench breakers as appropriate at the waterbody edge(s) to prevent diversion of water from the waterbody to flow preferentially down the trench as described in Section 1.13.

- Backfilling will begin after the pipe is positioned in the trench at the desired depth. Backfill material will consist of the spoil material excavated from the trench and parent streambed unless otherwise specified in state, Tribal, or federal permits. The in-stream trench will be backfilled so that the stream bottom is as near as practicable to its pre-construction condition, with no impediments to normal water flow.

- Stream bank and bed restoration will proceed immediately after the installation of the crossing as described in Section 2.6.

2.5.1.2 In-Stream Best Management Practices

To minimize downstream sedimentation, Enbridge will install in-stream BMPs (e.g., silt curtains [Figure 25], bladder dams, or water gates) downstream of open cut crossing locations where there is water prior to the initiation of crossing, and where site-specific conditions allow access for BMP installation. The type of in-stream BMP utilized will depend on waterbody conditions (flow velocity, water depth, and the width of the waterbody) and will be selected depending upon the site-specific conditions at the time of crossing.

2.5.2 Isolated Trench: Dam and Pump Method

2.5.2.1 Installation

The dam and pump method is an isolated dry crossing technique that is suitable for low flow streams and is generally preferred for crossing meandering channels. The dam and pump method involves damming of the stream upstream and downstream to isolate the trench before excavation (refer to Figure 23) and pumping water around the construction area. Procedures for conducting dry crossing techniques in frozen conditions are described in Enbridge's Winter Construction Plan. The following procedures will be used for dam and pump crossings:

- The first step will be the installation of pumps to start pulling water from upstream of the construction workspace and reintroducing the water downstream of the construction workspace. By pumping the water around, Enbridge avoids interrupting the stream flow and also lowers the water flow at the crossing location to facilitate dam installation.

- Stream flow will be pumped across the construction area through a hose and will be discharged through an energy-dissipating device, such as plywood boards, filter bags, large rock or bricks, or any other material that reduces the concentrated flow of a water pump such that stream bed or banks scouring will not occur, at the downstream reach of the waterbody. These devices are placed within the channel or on the banks of waterbodies to ensure that stream water being pumped around a crossing will not cause erosion or scouring and that the water will not be inadvertently discharged outside of the feature.

- The pump intake will be installed in a manner to prevent sediment from being sucked from the bottom of the stream and will be installed with mesh screens[21] to prevent fish entrainment.

- The pumps and fuel containers will be located on the upstream side of the crossing and will be placed in impermeable, sided structures that will act as containment units (refer to Section 10.0). The pumps used for this crossing method will not be placed directly in the stream or on the streambed. Pumps will have a capacity greater than the anticipated stream flow. Pumping will be monitored throughout operations and adjusted as necessary to maintain an even flow of water across the work area and near-normal water levels upstream and downstream from the crossing. Backup pumps are required on site for each crossing.

- Dams will be installed upstream and downstream of the crossing location within the construction workspace. Dams may be constructed of sandbags, inflatable dams, aqua-dams, sheet piling, and/or steel plates. The dams will prevent the stream from flowing into the construction area. The dams will be continuously monitored throughout the pipe installation process for seeping or leaks and repaired or reinforced as needed.

- Where possible, excavating equipment will operate from one or both banks, or a temporary bridge, without entering the stream. If equipment must encroach into the stream, it will operate on clean construction mats (free of soil and plant material prior to being transported onto the construction workspace). Streambed material will be segregated as stated in the open cut (non-isolated) trench method and will be placed within the construction workspace. Storage of streambed spoil within the stream will only be allowed if expressly approved in the applicable permits.

- Earthen trench plugs (hard plugs) between the stream and the upland trench will be left undisturbed during excavation of the in-stream trench to prevent diversion of the stream flow into the open trench and to prevent water that may have accumulated in the adjacent upland trench from entering the waterbody. Trench plugs will be removed immediately prior to pipe placement, and then replaced when the pipe is in place. Trench water accumulated upslope of trench plugs will be dewatered appropriately prior to trench plug removal. Standing water that is isolated in the construction area by the dams will be managed in accordance with Section 5.0.

- A series of pipelayers will place the pipe in the trench at the appropriate depth, with any required buoyancy control measures to maintain depth of cover (refer to Section 3.7.3 for a discussion of buoyancy control measures). Enbridge will also install trench breakers as appropriate at the waterbody edge(s) to prevent diversion of water from the waterbody to flow preferentially down the trench as described in Section 1.13.

- Backfilling will begin after the pipe is positioned in the trench to the desired depth. Backfill material will consist of the spoil material and parent streambed excavated from the trench unless otherwise specified in state, Tribal, or federal permits. The in-stream trench will be

[21] Mesh screens will be sized to 3/16-inch in Minnesota, 0.25-inch in North Dakota, and 1-inch or less in Wisconsin.

backfilled so that the stream bottom is similar to its pre-construction condition, with no impediments to normal water flow.

- Enbridge will then restore the stream bed and banks as described in Section 2.6 while the water is continuing to be diverted around the work area. The dams will not be removed until after the pipeline has been installed, the trench has been backfilled, and the banks have been stabilized. Once the dams have been completely removed, the pumps will be shut off to allow normal flow through the restored area.

2.5.2.2 Isolated Trench: Modified Dam and Pump Method

In situations where the stream banks are stable, but conditions are too saturated to effectively dewater from the construction workspace, Enbridge will conduct a modified dam and pump crossing. The only difference from standard dam and pump method and this modified technique is that Enbridge will not dewater the trench and will utilize buoyancy control methods (refer to Section 3.7.3) as appropriate to sink the pipe to the bottom of the trench. Enbridge will install in-stream BMPs downstream of these crossing locations prior to initiating the crossing to mitigate the potential for elevated sedimentation (refer to the discussion in In-Stream BMPs under Section 2.5.1). The exact location of in-stream BMPs will be determined on-site prior to initiating the crossing by Enbridge's EIs in conformance with the required regulatory authorizations and all applicable federal, state, and local regulations governing this activity.

2.5.3 Isolated Trench: Flume Method

2.5.3.1 Installation

The flume method is an isolated dry crossing technique that is suitable for crossing relatively narrow streams that have straight channels and are relatively free of large rocks and bedrock at the point of crossing (refer to Figure 24). This method involves placement of flume pipe(s) in the stream bed to convey stream flow across the construction area without introducing sediment to the water. Procedures for conducting dry crossing techniques in frozen conditions are described in Enbridge's Winter Construction Plan. The procedures for using the flume method are described below.

- Sandbag dams with or without steel plates (or equivalent) will be used both up and downstream of the crossing location within the construction workspace. The upstream and downstream ends of the flume(s) will be incorporated into dams. The upstream dam will be constructed first and will funnel stream flow into the flume(s). The downstream dam will prevent backwash of water into the trench and construction work area. The dams will be continuously monitored for a proper seal. Adjustments to the dams will be made where necessary to prevent large volumes of water from seeping around the dams and into the trench and construction work area.

- The flume(s) will be of sufficient diameter and/or quantity to transport the maximum flows anticipated to be generated from the watershed. The flume(s), typically 40 to 60 feet in length, will be installed before trenching and will be aligned so as not to impound water upstream of the flume(s) or cause downstream bank erosion. EIs will evaluate flume discharges; if excessive flows are observed and may cause scouring, then energy dissipation devices (plywood, steel plate, etc.) can be placed within the waterbody to deflect/absorb heavy water flows.

- Where possible, excavating equipment will operate from one or both banks, or temporary bridge, without entering the stream. If equipment must encroach into the stream, it will operate on clean construction mats. Streambed material will be segregated and placed within the construction workspace. Storage of streambed spoil within the stream will only be allowed if expressly approved in the applicable permits.

- Earthen trench plugs (hard plugs) between the stream and the upland trench will be left undisturbed during excavation of the in-stream trench to prevent diversion of the stream flow into the open trench and to prevent water that may have accumulated in the adjacent upland trench from entering the waterbody. Trench plugs will be removed immediately prior to pipe placement, and then replaced when the pipe is in place. Trench water accumulated upslope of trench plugs will be dewatered appropriately prior to trench plug removal. If additional trench dewatering is necessary to complete the installation of the pipe, the discharge will be managed in accordance with Section 5.0.

- Once the flume(s) and dams are in place, Enbridge will proceed with the excavation and pipe installation. Excavators will be used to remove the sediment form the trench line under the flume(s) and will also install the pipe under the flume(s). Enbridge will also install trench breakers as appropriate at the waterbody edge(s) to prevent diversion of water from the waterbody to flow preferentially down the trench as described in Section 1.13.

- Backfilling will begin after the pipe is positioned in the trench to the desired depth. Backfill material will consist of the spoil material excavated from the trench and parent streambed unless otherwise specified in state, Tribal, or federal permits. The in-stream trench will be backfilled so that the stream bottom is similar to its pre-construction condition, with no impediments to normal water flow.

- Enbridge will then restore the stream bed and banks as described in Section 2.6 while the water is continuing to be diverted through the flume(s). The dams and flume(s) will not be removed until after the pipeline has been installed, trench has been backfilled, and the stream banks have been stabilized.

2.5.4 Trenchless Methods: Horizontal Directional Drill Method (Pressurized)

Refer to Section 3.6 of the Summary of Construction Methods and Procedures (Appendix A) for a more detailed description of the HDD method.

2.5.4.1 Installation

HDD is a trenchless crossing method that involves no direct excavation of the features being crossed; for this reason, it is often used for large waterbodies that cannot be crossed by other methods or to cross sensitive resources such as waterbodies (refer to Figure 26). An HDD occurs in multiple phases. In the first phase, a small-diameter pilot hole will be drilled under the feature along a prescribed profile. After the pilot hole has been completed, barrel reams will be used to enlarge the pilot hole to accommodate the desired pipeline diameter. Drilling mud will be necessary to remove cuttings and maintain the integrity of the hole. Water from an agency-approved source will be used to prepare the slurry of drilling mud and will be appropriated according to applicable permits. In the final phase, the pipe section will be pulled through the hole by the drilling rig (called “pullback”) and welded to the adjoining sections of pipe on each side of the feature. During the pilot hole drilling, reaming, and swabbing, pressure is applied to the

borehole as drilling fluids are pumped in. A surveying system is utilized to guide the drill path from entry to exit point.

2.5.4.2 Drilling Mud

Drilling mud (potentially mixed with additives) is used to provide hydrostatic pressure to prevent fluids from entering the bore hole, to lubricate and cool the drill bit, and return cuttings from the bore hole to the surface to clear the hole and maintain drilling operations. Maintaining drilling fluid circulation to the extent possible is the key to reducing the risk of inadvertent drilling fluid returns (also referred to as an "inadvertent release"). Drilling mud additives help control sand content and flow, water hardness, keep the bore hole open and stable, prevent groundwater inundation, and allow the bentonite to yield properly. Only Enbridge and agency-approved drilling mud additives will be used on this Project.

During drilling operations, drilling mud and slurry will be stored back from the waterbody in an earthen berm sediment control structure, mud pit, in tanks, or by other methods so that it does not flow into the waterbody, adjacent wetlands or off the workspace (refer to Section 11.0 for additional details).

Excess drilling mud may be land applied within the construction workspace or transported to an off-site land application location in accordance with federal, state, and Tribal regulations and as approved by Enbridge and the landowner. Excess drilling mud will not be land applied or disposed of on public lands. Enbridge must pre-authorize the planned action at each proposed land application location to ensure compliance with regulatory requirements and secure landowner approval. Drilling mud may also be hauled to an authorized off-site disposal facility in accordance with the requirements of that facility.

2.6 RESTORATION AND STABILIZATION

Restoration of the stream bank and bed contours will be initiated immediately after the installation of the crossing using the open cut trench method and prior to restoring flow using the standard or modified dam and pump or flume method, unless site and permit conditions delay permanent installation. Enbridge will restore the stream banks as near as practicable to pre-construction conditions unless that slope is determined to be unstable. If the slope is considered unstable, Enbridge will reshape the banks to prevent slumping. For public waters, Enbridge will return the bank to pre-construction contours, unless otherwise directed by the site-specific restoration plan. If Enbridge cannot restore to pre-construction contours at a public water, Enbridge will consult with the MDNR before proceeding further. Once the banks have been reshaped, Enbridge will commence soil stabilization activities as described in Section 1.9.1. Temporary slope breakers will be installed on all sloped approaches to streams in accordance with the spacing requirements identified in Section 1.9.4 and the outlet of the slope breaker will be directed away from the stream into a well-vegetated area.

Enbridge will clear a 30-foot-wide construction workspace along the HDD path for placement of guidewires, and to facilitate response to a potential inadvertent release and pipeline monitoring during operations. Additional clearing will be needed where free-span engineered bridges will be installed. No grading or stump removal will occur along the HDD path except at limited locations where bridges will be installed, or as needed to assist with staging to respond to an inadvertent release of drilling mud. Bridge headers will be set back 10 feet from the top of bank and some limited grading may be required to allow for the safe installation of the bridge. This reduces the

potential for erosion and sedimentation at the stream crossing. Consequently, temporary erosion and sediment control BMP measures will only be installed as needed. Enbridge will initiate restoration activities as needed immediately after the installation of the HDD crossing and demobilization of equipment. Stabilization will commence soil stabilization activities as described in Section 1.9.1.

2.6.1 Revegetation of Banks

Seed mix (refer to Section 7.8) and mulch and/or other appropriate stabilization method will be installed within the required natural buffer on either side of the stream, with exception to actively cultivated land and some wetlands. Erosion and sediment control BMPs (e.g., straw bales, filter socks [Figure 27], silt fences, erosion control blankets [Figure 28]) will be installed as described in Sections 1.9, 1.17, and 2.2 and maintained until permanent cover has been established. Wherever practicable at waterbody crossings, Enbridge will utilize wildlife-friendly erosion and sediment control BMPs that contain biodegradable netting (Category 3N or 4N natural fibers[22]) and will avoid the use of plastic mesh.

Permanent berms or other sediment filter devices will be installed at the base of sloped approaches to streams with the spacing requirements identified in Section 1.17 and the outlet of the berm will be directed away from the stream into a well vegetated area; berms will not be installed in wetlands or floodplains.

2.6.2 Supplemental Bank Stabilization

Unstable soils and/or site-specific factors such as stream velocity and flow direction may require additional restoration efforts, such as installation of woody vegetation, geotextile fabric, or tree, log, rootwad, or boulder revetments to stabilize disturbed stream banks (see Figure 29). Enbridge does not plan to install rock rip-rap on this Project, unless approved by the applicable permit, authorization or certification. Enbridge will prepare site-specific restoration plans in coordination with the applicable agencies to identify riparian areas that may require specialized seed mixes, plantings of woody vegetation, or other specialized restoration techniques. Where specialized restoration measures are required, these locations will be noted on the construction alignment sheets and supplemental restoration plans.

2.6.3 Bridge Removal

Equipment bridges will be removed during final cleanup or, if access is needed, after final cleanup and permanent seeding. Bridge decking will be removed to ensure sediment and debris are collected by geotextile fabric secured below decking during bridge construction. Subsequently, geotextile fabric will be removed to prevent debris from entering the waterbody.

Once the bridge is removed, Enbridge will conduct additional grading to restore the banks to as near as practicable to pre-construction conditions as needed. Additional seeding and/or installation of erosion and sediment control measures will also be implemented as required.

[22] Category 3N or 4N as described in Table 3885-2 (3885.2A Erosion Control Blanket Requirements) in Minnesota Department of Transportation Standard Specifications for Construction, 2018 Edition (http://www.dot.state.mn.us/pre-letting/spec/2018/2018-spec-book-final.pdf).

Enbridge will follow the restoration procedures described above in this section and the revegetation procedures described in Section 7.0.

3.0 WETLAND CROSSING GENERAL REQUIREMENTS

The various crossing techniques employed in different wetland types are described in more detail in Section 3.0 of the Summary of Construction Methods and Procedures (Appendix A). Note that the proposed crossing technique may change depending on seasonality and site-specific conditions at the time of crossing (e.g., saturation level). Procedures for wetland crossings during frozen conditions are discussed in Enbridge's Winter Construction Plan.

The procedures in this section apply to all wetlands that will be affected by the Project. These procedures require that judgment be applied in the field and will be implemented under the supervision of Enbridge and the EI. The intent of these procedures is to minimize construction-related disturbance and sedimentation of wetlands and to restore wetlands as near as possible to pre-construction conditions.

In wetlands that are being actively cultivated or hayed at the time of construction, Enbridge will construct the pipeline using standard upland methods. Most seasonally saturated farmed wetlands are used for crop production and topsoil will be segregated in the same manner as topsoil in upland agricultural lands. Pipe stringing and fabrication may occur within the farmed wetland adjacent to the trench, or adjacent to the farmed wetland in a designated ATWS.

Wetland crossing requirements, including construction methods, timing, erosion control, and restoration, are described in this section and in the wetland crossing permits issued by state, federal, and/or Tribal agencies as applicable.

Enbridge will not conduct certain construction activities in non-sensitive wetlands, as defined by the MPCA Section 401 WQC, between April 1 to June 1, and from April 1 to June 15 in sensitive wetlands, as defined by the MPCA Section 401 WQC, except for those wetlands that are permitted for permanent fill.

3.1 WETLAND ACCESS

Enbridge will use the construction workspace and only approved roads to access wetland areas. Construction mats will be placed along the travel lane within delineated wetlands within the construction workspace and along access roads (refer to Section 1.4). Section 3.1 of the Summary of Construction Methods and Procedures (Appendix A) provides a description of the various construction mats that may be utilized on the Project. Mat travel lanes are typically a single layer (Figures 30 and 31); however, there may be cases in saturated areas where more than one layer of mats must be placed to provide a stable working surface (Figures 32 and 33). Enbridge may use multiple mat configurations in inundated areas depending upon the depth of inundation and presence of channelized flow to maintain surface flow. These different mat configurations are illustrated in Figure 49. Enbridge will remove the mats during final cleanup activities. If there are multiple layers of mats, Enbridge will probe the soil after mats have been removed to verify that no additional mats remain.

3.2 CLEARING

Clearing the construction workspace in wetlands will be similar to clearing in uplands. For construction to proceed, obstructions (e.g., trees, brush, and logs) need to be removed. Vegetation and trees within wetlands will be cut off at ground level, leaving existing root systems intact.

Lop and scatter is permitted to be returned to the site of origin in forested and scrub-shrub wetlands only on public lands. On public lands, retain roughly 1/3 tree tops, branches, and small, non-merchantable trees that will be lop and scattered in place in select locations that will not impede safe access and construction of the Project (e.g., ATWS, along the edge of the construction ROW) to aid in natural reforestation following construction, unless there is insufficient construction workspace to store the material. The material will be dispersed uniformly to the site of origin to permit natural regrowth of the existing vegetation and will not be spread greater than 2 feet in depth; remaining material will be hauled off public lands or to an approved location or used in stabilizing erodible slopes or construction entrances. Lop and scatter from uplands is not permitted in seasonal ponds or open water/emergent wetlands.

Non-merchantable timber and slash will be disposed of by mowing, cutting,[23] chipping,[24] mulching[25] and left in upland areas, and/or hauling off-site to an approved location or used in stabilizing erodible slopes or construction entrances. Chips, mulch, or mechanically cut woody debris shall not be stockpiled in a wetland. Hydro-ax debris, or similar can be left in the wetland if spread evenly in the construction workspace to a depth that will allow for normal revegetation, as determined by the EI. Chipping is not allowed on public lands. On public lands, mulch and mechanically cut woody debris must be uniformly broadcast to less than 2-inch thickness and in a manner that maintains visible ground. An Environmental Inspector will proceed with the clearing crews to monitor these activities on public lands. Should an accumulation of mulch or mechanically cut woody debris occur on public lands, Enbridge will remove the material and haul off-site to an approved location. However, woody debris or mulch that scatters during normal use of clearing equipment is acceptable, provided it does not accumulate as described above. Clearing over HDD paths will be limited to the 30-foot-wide construction workspace, except where free-span engineered bridges will be installed.

3.3 ADDITIONAL TEMPORARY WORKSPACE IN WETLANDS

In general, Enbridge attempts to locate ATWS outside of wetlands wherever practicable; however, ATWS may be sited in select wetlands where the wetland is adjacent to a waterbody, road, railroads, foreign utility crossings, pipeline cross-overs, and/or where required based on site-specific conditions with prior approval from the applicable regulatory agencies. Clearing of forested wetlands for ATWS will be avoided as much as possible.

- Staging areas, additional spoil storage areas, and other ATWS will be located in upland areas at least 50 feet away from wetland boundaries (refer to Figure 34), where safe work practices or site conditions permit, except where the adjacent upland consists of cultivated or rotated cropland or other disturbed land. If site conditions do not permit a 50-foot setback, then these areas will be located as far away from the wetland as is practicable.

[23] Mechanized cutting of woody vegetation may include saws, shears, or chainsaws. Woody debris left on-site will be less than 1.5-inch diameter and/or 12 inches in length.

[24] Wood chips are small- to medium-sized pieces of wood formed by cutting or chipping large pieces of wood such as trees, branches, logging residue, stumps, roots, and wood waste utilizing a chipper or shredder. Sizes vary from approximately 1-inch by 1-inch by 1/8-inch thick to 2 1/4-inch by 2 1/4-inch by 1/4-inch thick.

[25] Wood mulch consists of shredded wood chips and bark of fairly uniform size, generally approximately 2 inches long and 1 inch in diameter. The hydro-ax uses a rotating blade to shred small saplings and brush less than 3 inches in diameter into mulch. It is not possible to collect this debris as the equipment is operating; however, upon completion Enbridge will ensure uniform dispersal of the mulch across the construction workspace to avoid inhibiting revegetation.

Vegetation will not be cleared between these areas and the wetland in any event. No construction activities including vegetation clearing or earthwork will occur between the ATWS and the wetland.

- The size of the ATWS areas will be limited to the minimum needed to construct the wetland crossing.

3.4 GRADING AND TOPSOIL SEGREGATION

Grading and topsoil segregation activities will be confined to the area of the trench and will be minimized to the extent practicable. Grading outside the trench will only be allowed where required to install a level and stable construction mat travel lane for safe operation of equipment. Grading outside of the trench area in wetlands may only proceed with prior approval from Enbridge and in conformance with the required regulatory authorizations and applicable federal, Tribal, state and local regulations governing this activity.

When constructing in wetland areas without standing water, up to 1 foot of topsoil (organic layer) will be stripped from the trench line and stockpiled separate from trench spoil to preserve the native seed stock. Topsoil will not be stockpiled in wetlands for longer than 30 days on public lands or in public water wetlands, except potentially at tie-in locations within wetlands where additional time may be required to complete construction of the pipe segment. In standing water wetlands, organic soil segregation is not typically practical because of the inability to maintain a cohesive spoil pile due to liquid nature of soil; however, Enbridge will attempt to segregate as much of the organic layer as possible based on site saturation conditions. If normally unsaturated wetlands are saturated at the time of construction, topsoil segregation will be attempted as illustrated in Figures 32 and 33 and based on recommendations from the EI and appropriate regulatory agencies.

3.4.1 Temporary Erosion and Sediment Controls

Redundant temporary erosion and sediment control BMPs will be installed:

1. across the entire construction workspace upslope of the wetland boundary, where necessary, to prevent sediment flow into the wetland;

2. along the edge of the construction workspace as necessary to prevent sediment flow into off-ROW wetlands;

3. along the downgradient edge of the construction workspace as necessary to contain spoil and sediment within the construction workspace through wetlands; and

4. at locations specified in any applicable permits.

Enbridge will identify the potential locations of these erosion and sediment control BMPs at wetland approaches and within wetlands on the Environmental Plan Sheets included with Enbridge's SWPPP. The SWPPP will also describe the procedures the Enbridge Environment will utilize to evaluate the potential location, extent, and type of erosion and sediment control BMPs to be implemented based on site-specific conditions.

Enbridge will properly install and maintain redundant sediment control measures immediately after clearing and prior to initial ground disturbance at wetlands located within 50 feet of the Project and where stormwater flows to the wetland (will be reflected in the Environmental Plan Sheets in the SWPPP). Enbridge will install perimeter sediment controls at least 5 feet apart unless limited by lack of available space. Redundant controls will not be installed adjacent to road ditches, judicial ditches, county ditches, stormwater conveyance channels, storm drain inlets, sediment basins, and agriculturally-farmed wetlands. Sheet piling is a redundant perimeter control if installed in a manner that retains all stormwater. Sheet piling will be removed using an excavator upon completion of construction activities, unless otherwise authorized by the applicable agencies. Sheet piling may be cleaned and reused or returned to a materials yard following removal. Clearing, topsoil segregation, and trenching of the upland approaches to wetlands will proceed as described in Sections 1.8.3, 1.10, and 1.11. Erosion and sediment control BMPs will be maintained in proper working order to prevent the flow of sediment into wetlands from spoil piles or sloped approaches that are adjacent to the wetlands.

As described further in the SWPPP, in non-cultivated, sloped, saturated wetland areas, filter sock, silt fence, or super silt fence will be installed along the downgradient perimeter of the construction workspace. Where concentrated water flow exists or is expected, bypass pipe and/or bridging (Figure 50), check dams (Figure 51), and perimeter filter sock will be installed. Silt fence will not be used where concentrated flow is expected. In shallow (<2 feet) inundated wetlands with no flow or sheet flow, filter sock, silt fence, or super silt fence will be installed along the perimeter of the ROW. The height of the BMPs used must be sufficient to control off-site sedimentation and allow for collection and removal of accumulated sediment. Where concentrated flow is anticipated or observed, bypass pipe and/or bridging, check dams, and filter sock or coffer dams (Figure 52) will be installed. Enbridge's SWPPP will be utilized by Enbridge's Environmental Compliance Management Team to evaluate the potential location, extent, and type of erosion and sediment control BMPs to be implemented based on the wetland saturation level.

3.5 RIGHT-OF-WAY STABILIZATION

Tree stumps, brush riprap, imported soil, and rock fill will not be brought in to stabilize the construction workspace in wetlands. Where low ground pressure equipment is not used, construction equipment will operate from construction mats or equivalent means with prior approval from Enbridge in conformance with the required regulatory authorizations and all applicable federal, state, Tribal, and local regulations governing this activity. Timber riprap (also known as corduroy road) will not be used on this Project. Corduroy roads in wetlands will be removed if discovered during construction within the construction workspace, unless otherwise requested by the landowner or land-managing agency.

Subsoil from the pipeline trench within the immediate wetland may be placed on top of equipment mats for additional stabilization. Construction mats may be placed over the trench line or on the working side to facilitate trench excavation. All construction mats, construction debris, and larger woody vegetative debris will be removed during cleanup of wetlands.

3.6 TRENCHING

Excavation of the pipeline trench in wetlands will typically be accomplished using backhoe excavators. The trench width excavation requires an average of 20 feet depending on topography and soil conditions. For those wetlands that require buoyancy control, the trench will need to be wider. The trench will be excavated to a depth that complies with the minimum depth of cover

requirements described in the Summary of Construction Methods and Procedures (Appendix A) (Figure 18), or deeper if required by specific regulatory authorizations. All wetlands should be crossed with depth of cover minimizing the impact on hydrology of the wetland. At a minimum the depth of cover in wetlands should not include open water nor floating mats and water. In these wetlands or portions of wetlands the pipe will be placed 4 feet below the top of the consolidated organic material as illustrated in Figure 18.

Enbridge will take reasonable steps to ensure that the duration of open trench in wetlands, including tie-ins, is minimized to the fullest extent possible. As described in Section 1.11, where deemed appropriate, Enbridge will leave subsoil in the trench or will construct temporary access bridges across the trench for the landowner to move livestock or equipment; temporary bridges may also be utilized by wildlife. Where trenches are left open overnight, trenches will also be sloped (less than 45 degrees) where started and ended to allow wildlife egress. Spacing of ramps will be determined in the field. Enbridge will inspect the trench and construction area for presence of animals every day before initiating construction activities and prior to backfilling the trench. If an animal is located, it will be relocated outside of the active construction workspace. If the animal is a federally or state-listed species, the appropriate agency(ies) will be notified. In the event that a large mammal such as a deer, moose, or bear becomes entrapped in the trench, Enbridge will contact the IEM to coordinate with the USDA APHIS, Wildlife Services Program to assist with removal. The IEM will also notify the MDNR through its 24-hour hotline (1-888-646-6367).

3.6.1 Trench Breakers

Trench breakers will be installed as outlined in Section 1.13. Where the EI determines that the pipeline trench has the potential to drain or partially drain a wetland, trench breakers will be installed as necessary to maintain the original wetland hydrology.

3.7 PIPELINE INSTALLATION

The following procedures are intended to minimize siltation and disturbance to wetlands during installation. Generally, depth of cover under wetland crossings is a minimum of 48 inches unless otherwise specified in applicable permits or authorizations. Following placement of the pipeline, Enbridge will confirm that the pipe depth meets federal and state requirements through civil survey.

3.7.1 Push-Pull Method

Large (greater than 200 feet) wetlands or wetland/waterbody complexes with standing water (greater than 12 inches) can generally not be crossed with typical crossing methods. In these areas, the pipeline will be pre-assembled and positioned in the trench using the “push-pull" and/or "float" techniques (Figures 35 and 36). This technique cannot be utilized in dry or certain frozen conditions where open water cannot be maintained.

Construction mats may be installed over the wetlands to provide a travel lane if conditions allow. A temporary bridge may also be installed over the waterbody feature, if present. Erosion and sediment control BMPs will be installed, as required by the MPCA Construction Stormwater General Permit prior to initiating ground disturbance activities. Enbridge will then excavate a trench using excavators operating off construction mats, or if the installation of construction mats is not feasible, using a swamphoe, which is a pontoon-mounted excavator. Topsoil segregation is typically not practical in these conditions because of the inability to maintain a cohesive spoil

pile due to liquid nature of soil. Enbridge will segregate as much of the topsoil as possible, which will be stored separately from the subsoil in the construction workspace, as illustrated in Figures 35 and 36. Once the trench has been excavated, a prefabricated section of pipe will be welded together in the adjacent upland, and barrels or "floats" will be attached to the pipe. Usually this fabrication requires use of ATWS adjacent to the construction workspace in order to stage and string (i.e., weld) the pipe, and to install the equipment, such as roller sidebooms, or excavators to push the pipe into place.

Then, the prefabricated pipe will be pushed from the edge of the wetland or pulled with a cable from the opposite bank of the wetland into the trench. For buoyancy control, the pipe will be concrete-coated (see Section 3.7.3). This helps ensure that the pipe maintains sufficient depth of cover. Once the pipe is in the appropriate position, the floats will be removed, and the pipe will sink to the bottom of the trench. Enbridge will then backfill the spoil material into the trench and will grade the disturbed area back to pre-construction conditions as described in Sections 3.8 and 3.9.

3.7.2 Temporary Erosion and Sediment Controls

Erosion and sediment control BMPs at approaches to wetlands will be installed as previously described and in accordance with Section 3.4.

Where a defined waterbody will be crossed utilizing the push-pull technique as part of a larger wetland/waterbody complex crossing, Enbridge will install in-stream BMPs (e.g., silt curtains [Figure 25], bladder dams, or water gates) downstream of push-pull crossing location within the waterbody where site-specific conditions allow access for BMP installation. The type of in-stream BMP utilized will depend on waterbody/wetland complex conditions and will be selected depending upon the site-specific conditions at the time of crossing.

3.7.3 Buoyancy Control

Enbridge will install buoyancy control in saturated environments. Enbridge calculates the amount of buoyancy control required based on an empty pipe. Buoyancy control can be achieved by utilizing one or more of the following methods:

- Concrete coating (refer to Figure 37);
- Bag weights (also referred to as saddlebag weights) (refer to Figure 38); and/or
- Sand bags.

Enbridge will select the appropriate method(s) depending on site-specific conditions at the time of crossing. Weights will be strung along the construction workspace, where necessary, until they are placed over the pipe within the excavated trench.

Concrete for the concrete-coated pipe will generally be mixed off-site and transported to the construction workspace on trucks. Limited mixing and coating activities may occur on the construction workspace for coating pipe joints, and mainline valve and pump station foundations, etc. Washing equipment used for mixing, pouring, casting, or coating will not occur within 100 feet of any wetland. Enbridge will collect and retain all the concrete washout water and solids in a leak proof containment. Wash water disposal will be limited to a defined area of the site or to an area designated for concrete washout within construction yards. The area(s) will be sufficient to contain

the wash water and residual cement and will include equipment capable of reclaiming wash water during wash out (Figure 39). No concrete washing stations are allowed on public lands.

3.8 BACKFILLING

Subsequent to pipe installation, backfilling of wetland trenches will take place immediately, or as approved by EI in conformance with the required regulatory authorizations and all applicable federal, Tribal, state, and local regulations governing this activity.

3.9 CLEANUP, ROUGH/FINAL GRADING, AND TEMPORARY RESTORATION

Cleanup activities will occur as described in Section 1.16. Rough and final grading includes restoring original conditions within the disturbed areas (i.e., trench line, spoil storage areas, and equipment travel lane). Enbridge will backfill the trench to an elevation similar to the adjacent areas outside the trench line and will add a slight crown of approximately 3 to 6 inches (depending on soil type) over the backfilled trench to allow for subsidence. Generally, excess subsoil displaced by the pipe installation will be spread across the portion of the construction workspace where topsoil removal has occurred. Any remaining excess subsoil will be removed and disposed of at an approved off-site location as needed to ensure contours are restored to as near as practicable to pre-construction conditions. Periodic breaks in the crown will be implemented to allow for normal hydrologic flow across the backfilled trench. Crowning will not extend beyond the previously excavated trench limits. As the backfill material settles, there is potential that the original crown may not completely recede to pre-construction contours. After rough grading, previously segregated topsoil (where applicable) will be spread uniformly over the trench area from which it was removed. Additional (final) grading may occur when conditions allow to ensure the disturbed area has been returned to pre-construction conditions. Enbridge will also prepare the seedbed (Section 7.1.1) and install or repair erosion and sediment control BMPs (Sections 1.9 and 1.17). Slope breakers and/or permanent berms will be installed near the boundary between the wetland and adjacent sloped approaches to prevent sediment flow into the wetland as described in Sections 1.9.4 and 1.17.

3.9.1 Timing

Cleanup, rough, and final grading (including installation of temporary erosion and sediment control BMP measures) will proceed as soon as the trench has been backfilled in wetlands. If seasonal or other weather conditions prevent compliance with these timeframes, temporary stabilization and erosion and sediment control BMPs will be maintained until conditions allow completion of cleanup.

3.9.2 Stabilization and Revegetation

Stabilization of all exposed areas, including spoil piles, will occur as described in Section 1.9.1. Where necessary and appropriate, disturbed wetland areas will be seeded with a temporary seed mix as described in Section 7.1.2. Permanent seeding of wetland areas is described in Section 7.7. Temporary erosion and sediment control BMPs will be maintained until permanent cover has been achieved.

4.0 HIGHWAY, ROAD, AND RAIL CROSSINGS

4.1 BORES (NON-PRESSURIZED)

Conventional bore methods are typically used to cross highway, road, and rail crossing features. Because watercourses, such as ditches, often occur parallel to these features, bores may be extended to bore under multiple features. Bore methods involve construction of a bore pit on each side of the feature (e.g., highway, road, railroad, watercourse) and thumping or boring a carrier pipe underneath the feature(s) without use of pressurized drilling fluid. The specific equipment utilized to execute the bore is dictated by the length of the bore and soil conditions. Water and bentonite clay can be introduced if soil conditions dictate in order to lubricate the drill head and carrier pipe and allow it to move through the ground more freely. With this construction practice at no time is pressurized water or drilling mud being used to hold the hole open as it will during an HDD, and therefore there is no risk for an inadvertent release at these locations. If drilling mud is needed at these locations, any release will travel back along the path of the pipe and into the bore pit. Typically, the length of these crossings is limited, and the bore holes must be set up relatively close to the edge of the feature, and the depth maintained just below the depth of scour for watercourses. Figures 40 and 41 provide typical examples of a horizontal bore crossing of transportation corridors.

4.2 ADDITIONAL WORKSPACE

Additional workspaces for bored road and railroad crossings and open-cut road crossings will be determined on a site-specific basis. These workspaces will be adjacent to the road or railroad and limited to the size needed to contain spoil, stage equipment, and store supplies for the crossing.

4.3 MAINTENANCE

Roadway crossings will be maintained in a condition that will prevent tracking of mud onto the roadway.

Rock/gravel or construction mat tracking pads, as required by the applicable permits, will be installed adjacent to paved public roads to prevent or minimize the tracking of soil onto the roadway. If the roadside ditch is part of a jurisdictional waterbody, a permit will be obtained prior to installing the tracking pad or culvert. Construction mat tracking pads or rock/gravel tracking pads on top of geotextile fabric will be utilized in wetlands and will be removed after construction.

4.4 TEMPORARY EROSION AND SEDIMENT CONTROLS

Temporary erosion and sediment control BMPs (e.g., silt fence and/or double-staked straw bales) will be installed on sloped approaches to road crossings where vegetation has been disturbed as described in Section 1.9.4.

5.0 CONSTRUCTION DEWATERING

5.1 TRENCH AND PIT DEWATERING

For pipeline trench and pump station pit construction dewatering, Enbridge will typically utilize portable pumps. Enbridge will vary the number and size of pumps employed in a dewatering event based on the volume of water to be removed from the trench. In addition to portable pump dewatering along the trench, Enbridge may need to employ a well point system for dewatering at some road bores, utility crossings, mainline valve excavations, and as required by site-specific conditions. A well point system will be utilized when traditional dewatering techniques cannot keep up with the rate of groundwater recharge into the excavation. This system will consist of a series of small diameter wells installed via hydro-jetting that are connected by a header pipe to a well point pump (Figure 42). The well point system will be installed within the construction workspace following topsoil segregation. Adequate temporary erosion and sediment control BMPs will be installed to prevent the migration of subsoil slurry produced during the well point installation process.

Prior to initiating dewatering activities, the EI will approve the water discharge plan to ensure that erosion and sediment control BMPs are applied in such a way as to minimize the potential for water containing sediment from reaching a wetland or waterbody. Furthermore, landowner approval is required in advance of placement of dewatering structures outside of the approved construction workspace. On public lands, these discharges will be subject to the terms and conditions of a lease. The EI will consult pre-construction environmental resource survey data for lands adjacent to and outside of the construction workspace when siting the dewatering structure. Dewatering structures will be sited to avoid environmental resources that may be affected by the discharge, such as federally- or state-listed species. If pre-construction environmental survey data is not available, Enbridge will consult Natural Heritage Information System data or other relevant resource data to determine if protected resources may be present in the area and/or conduct additional environmental resource surveys before initiating activities.

Enbridge will utilize the Environmental Plan Sheets accompanying the MPCA SWPPP in addition to site-specific conditions at the time of dewatering to assess each water discharge situation, including:

1. **Water Discharge Setting** – This includes:

    a. Soil Type – The soil type the discharged water will flow over. The management of discharged water traveling over sandy soil is more likely to soak into the ground as compared to clay soils.

    b. Ground Surface – The topography in the area that will influence the surface flow of the discharged water.

    c. Adjustable Discharge rate – The flow rate of the discharged water (which may need to vary) can be managed based on the site conditions to minimize instances of water from reaching a sensitive resource area such as a wetland or waterbody.

    d. Discharge Outfall – The amount of hose and number/size of pumps needed to attempt to discharge water at a location which drains away from waterbodies or wetlands.

2. **Pump Intake** – Use floating suction hose or other similar measures to prevent sediment from being sucked from bottom of trench.

3. **Filtering Mechanism** – All dewatering discharges will be directed through a filtering device as indicated below. Enbridge's SWPPP describes the procedures that Enbridge Environment will utilize to identify the appropriate dewatering structure.

    a. Well-Vegetated Upland Area – Water can be directed to a well-vegetated upland area through a geotextile filter bag (Figure 43). Geotextile bags need to be sized appropriately for the discharge flow and suspended sediment particle size.

    b. Straw/Hay Bale Dewatering Structure – Where the dewatering discharge point cannot be located in an upland area due to site conditions and/or distance, the discharge will be directed into a straw or hay bale[26] dewatering structure. The size of the straw or hay bale dewatering structure is dependent on the maximum water discharge rate (refer to Figure 44). A straw or hay bale dewatering structure will be used in conjunction with a geotextile filter bag to provide additional filtration near sensitive resource areas. Alternative filtration methods (e.g., sand filter) will be readily available and used as needed.

    c. Stormwater Pond – When dewatering from pump station pits, Enbridge will discharge to a stormwater pond wherever feasible and as approved by the appropriate permits.

4. **Monitoring and supplemental/alternative dewatering methods –** Discharge will be monitored to ensure it is not causing visible turbidity, material discoloration, or other nuisance conditions,[27] or violations of other applicable water quality standards beyond the treatment area. If Enbridge observes that the filtration system fails to adequately treat the discharge, Enbridge will stop the discharge and will implement alternative or supplemental filtration. Alternative/supplemental methods will be selected based on the volume and site-specific conditions to comply with regulatory authorizations and certifications and all applicable federal, state and local regulations governing this activity and as described in Enbridge's SWPPP. Alternative BMPs may include:

    a. Dewatering filter bags placed inside a natural fiber curlex bloc dewatering structures (Figure 53);

    b. In-line bag filter directed to a dewatering filter bag within a structure (Figure 54);

    c. Sand filters directed to a dewatering bag or bale structure for energy dissipation (Figure 55); and

    d. Other methods if approved by Enbridge and applicable agencies prior to use.

[26] Minnesota Department of Transportation 3882 Type 3 specifications: http://www.dot.state.mn.us/pre-letting/spec/2018/2018-spec-book-final.pdf.

[27] Minnesota Administrative Rules 7050.0210, subp. 2.

Once dewatering activities are complete in a given area, Enbridge will clean up the discharge area by removing bags and structures for disposal to an approved off-site location. Enbridge will re-seed any areas disturbed by the discharge event as described in Section 7.0.

5.1.1 Flow Measurement and Water Sampling

Enbridge will maintain logs of daily use totals at each water source and will provide logs for periodic reporting as required by the applicable agency. The volume may be determined using a timing device, flow meter, or equivalent method, as approved by Enbridge or specified by applicable permit conditions.

Enbridge will monitor dewatering throughout the duration of the dewatering activities. Samples of the water discharged will be sampled as required by Tribal permits and/or state-issued discharge permits. Enbridge will take immediate corrective actions to prevent dewatering activities from violating applicable permits and certifications.

5.1.2 Regulatory Notification and Reporting

Enbridge will notify and submit reports to appropriate Tribal, state, and federal agencies as required by all permits/authorizations.

5.2 HYDROSTATIC TEST DISCHARGES

Hydrostatic testing will be done to verify that there are no flaws in the pipe or welds. Hydrostatic testing involves filling the new pipeline segments with water acquired in accordance with applicable permits (refer to Section 6.0), raising the internal pressure level, and holding that pressure for a specific period of time per U.S. DOT Pipeline and Hazardous Materials Safety Administration (“PHMSA”) specifications. The number of mainline spread segments are governed by PHMSA specifications as well as internal Enbridge specifications (e.g., elevation differences between segments require that test sections be broken up in certain areas).

Hydrostatic pre-tests will be performed on pre-built HDD sections prior to installation. HDD segments will be tested again post-installation and tie-in as part of the mainline hydrostatic test section.

Hydrostatic testing will be conducted in accordance with applicable appropriation and discharge permits and leases obtained by Enbridge. Hydrostatic test waters will not be transferred from one waterbody to another. After the hydrostatic test is complete, Enbridge Construction Management, in collaboration with Enbridge Environment will determine if discharge activities can proceed in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity. Then the line will be depressurized and the water discharged according to applicable permits.

Procedures for winter hydrostatic testing are described in Enbridge’s Winter Construction Plan.

5.2.1 Refueling

The operation and refueling of hydrostatic test equipment will be in accordance with the conditions outlined in Section 10.0.

5.2.2 Siting of Test Manifolds

Hydrostatic test manifolds will be installed where necessary to ensure proper test pressures and incorporate changes due to topography. Where feasible, Enbridge will incorporate minor adjustments to the test manifold locations to avoid placement in wetlands and riparian areas. However, completely avoiding the placement of a test manifold in a wetland may not always be possible. Enbridge will install appropriate erosion and sediment control BMP measures where the EI determines they are necessary.

5.2.3 Water Sampling

Water discharged from hydrostatic tests will be sampled as required by federal-, Tribal- and state-issued appropriation or discharge permits. Sampling parameters and methodology are described in the applicable permits. Enbridge will be responsible for recording water volumes and flow rates.

5.2.4 Hydrostatic Testing Procedures

5.2.4.1 Mainline Hydrostatic Testing

Prior to hydrostatic testing the pipeline, Enbridge will prepare the pipe by removing accumulated construction debris, mill scale, dirt, and dust using a cleaning pig[28] that is moved by compressed air. Cleaning water and debris removed from the pipe will be disposed of off-site in accordance with applicable permits. Once the pipe has been cleaned, hydrostatic test manifolds are welded to each end of the pipeline test section. The pipeline is then filled with test water from an approved water source (see Section 6.0). Once the pipeline test section is filled, the pipeline is pressurized to a specific pressure and maintained for a minimum of 8 hours.

Once the testing procedure is complete, the hydrostatic test section will be depressurized and the water is drained from the pipeline through a pipe/hose connected to the test header to water containment tanks known as frac tanks. The water will then be run through a filtration system and discharged back to the source water or discharged to a well-vegetated, upland area with an appropriate dewatering structure such as a geotextile filter bag and/or a hay bale structure that will be lined with geotextile fabric to allow for infiltration. Enbridge has screened the soil conditions, topography, and other factors to identify areas suitable for infiltration. Direct discharges to surface waters, if allowed by permit, will be directed into an energy dissipation device such as a splash pup (see Figures 45 and 46).

After dewatering the pipe, Enbridge will conduct drying runs using foam or solid cup type pigs to remove all the free (residual) water from the pipeline as practical. The incidental volume of water collected from the drying runs will be allowed to infiltrate into the trench.

At no time will the discharge rate exceed the applicable discharge rates specified in federal-, Tribal- or state-issued or other discharge permits or leases. In the event no maximum discharge rate is identified, discharges will be monitored and adjusted as necessary to avoid scouring,

[28] A pipeline “pig” is the acronym for pipeline inspection gauge. Pipeline inspection gauges have a variety of applications including, but not limited to, cleaning the pipeline, dewatering and drying post hydrostatic testing to prepare the pipeline to accept product, and working as an in-line inspection tool to identify pipeline anomalies prior to and during in-service use.

erosion, or sediment transport from the discharge location. Visual observations will be performed for all hydrostatic test discharge events.

To minimize the potential for introduction and/or spread of invasive and noxious species due to hydrostatic testing activities, Enbridge will follow the procedures outlined in the INS Management Plan (Appendix B). If water is reused to test multiple test sections, it will be relayed back to the source water through the pipeline for final discharge or discharged to an upland area for infiltration in accordance with applicable permits. Test water will not be discharged to a waterbody other than the appropriation source.

5.2.4.2 HDD Hydrostatic Testing

HDD test sections are hydrostatically tested in much the same manner as detailed above. The primary differences between the procedures are that HDD test sections are hydrostatically tested for a minimum of 4 hours prior to the installation or pullback of the pipe and then tested again with the mainline once they are tied-in.

Frac tanks may or may not be used for HDD discharges depending on water volumes and whether or not discharge rates need to be reduced. Infiltration areas used for HDD pre-test discharges will be constructed and operated in accordance with applicable permits and licenses.

5.2.5 Flow Measurement

The total volume of water discharged will be determined with a flow meter (or equivalent), or as required by the applicable permit. The total volume of water discharged will not exceed the volume specified in the applicable permit.

6.0 WATER APPROPRIATION

6.1 GENERAL

Water may be drawn from local sources, such as lakes, streams, and groundwater wells, for construction activities such as fugitive dust control, HDD drilling mud, buoyancy control, trench dewatering, and hydrostatic testing. The Project will follow applicable permit conditions for the appropriation of water and will only utilize sources approved by the applicable agencies. Refer to Enbridge's Fugitive Dust Control Plan for a description of the procedures that will be utilized for dust suppression on the construction ROW and access roads.

For appropriation from surface waters, Enbridge will install a mesh screen sized as approved by the applicable agencies on the intake hose to prevent fish entrainment.[29] The intake hose will be managed to minimize sediment intake from the waterbody bed. During withdrawal, adequate waterbody flow rates and volumes will be maintained to protect aquatic life and allow for downstream uses. If the waterbody does not have adequate water flow, an alternative agency-approved source will be used. The volume and rate of withdrawal will be monitored to comply with applicable permit conditions.

6.2 WATER SOURCES

Water will only be withdrawn from agency-approved sources and in accordance with applicable permits. Water will not be transferred from one waterbody to another. No additives to the water are permitted unless written approval is received from Enbridge and applicable permits authorize such additives.

If surface water appropriation is scheduled to occur during possible periods of low flow, a backup source will be identified. Procedures for winter water appropriation are described in Enbridge's Winter Construction Plan.

6.3 FLOW MEASUREMENT

At no time will the withdrawal rate for the water source exceed the rate specified in the applicable permits.

Enbridge will measure and document the withdrawal rate and total volumes of water appropriated with a flow meter (or equivalent), as required by the applicable permits.

6.4 WATER SAMPLING

Where required by permit conditions, Enbridge will sample the water during appropriation. Sampling parameters and methodology are described in the applicable permits.

6.5 REGULATORY NOTIFICATION AND REPORTING

Enbridge will notify appropriate agencies of the time of appropriations if required by the state appropriations permits. Enbridge will submit reports regarding the volume and quality of the water withdrawn if required by the applicable permits.

[29] Mesh screens will be sized to 3/16-inch in Minnesota, 0.25-inch in North Dakota, and 1-inch or less in Wisconsin.

7.0 REVEGETATION

This section was developed based on the Minnesota Board of Water & Soil Resources ("BWSR") Native Vegetation Establishment and Enhancement Guidelines (2019), and the Minnesota Wetland Restoration Guide (BWSR, 2014). Project-specific permit conditions and landowner requests (with exception to wetlands) for specific seed mixes (as indicated in the Project CLL) take precedence over the measures described in this section. These measures will be applied as appropriate in areas disturbed within the construction workspace (permanent easement, TWS, and ATWS) and temporary access roads.

7.1 SITE PREPARATION

Site preparation involves the following steps:

- Seed bed preparation;
- Planting of temporary cover crops (if appropriate);
- Installation of permanent erosion and sediment control BMPs; and
- Mulching.

7.1.1 Seed Bed Preparation and Seeding Procedures

After rough grading and before topsoil replacement, Enbridge will decompact the subsoil in actively cultivated areas (as directed by Enbridge in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity) to relieve soil compaction and promote root penetration as described in Section 1.18. Decompaction may also occur on improved upland temporary access roads as appropriate. On public lands and MDNR-administered access roads, Enbridge will use tillage radish either as a temporary cover crop prior to permanent seeding, or as part of the permanent seed mix (see Section 7.5) to assist with decompaction as appropriate depending on site conditions and timing. Tillage radishes do not do well in poorly-drained soils prone to water logging or during extended wet periods. Enbridge will not utilize deep tillage devices or chisel plows on public lands.

After topsoil replacement, the soil will be tilled with a disc or rolling harrow, drag harrow, Harley rake, field cultivator, or chisel plow (or equivalent) to break up large clods and to prepare the soil surface. Suitable conditions generally include a firm soil surface that is not too loose or too compacted and will be prepared to accommodate the seeding equipment and method to be used (see Section 7.4). Enbridge will not utilize discs, field cultivators or chisel plows for seedbed preparation on public lands.

Tillage and equipment operations related to seeding and mulching will be performed parallel to ground contours as much as practicable. Fertilizer and other soil amendments, if required, will be incorporated into the soil during seedbed preparation as specified by Enbridge in the Project-specific CLL requirements and permits in conformance with the required regulatory authorizations and all applicable federal, Tribal, state, and local regulations governing this activity. No soil amendments will be applied in wetlands unless directed by the appropriate agencies. No soil amendments or fertilizers will be applied on public lands without authorization from the MDNR.

7.1.2 Temporary Revegetation

Enbridge's temporary seed mixes (refer to Appendix C) were developed based on Minnesota BWSR seed mixes. The use of short-lived temporary cover crops (refer to Table 7.1-1) helps stabilize project sites and minimize the need for additional mulch in preparation of planning native seed mixes. Unless specifically requested by landowners or land-managing agencies, Enbridge does not intend to establish temporary vegetation in actively cultivated land, standing water wetlands, and/or other standing water areas. Enbridge will only utilize MDNR-approved seed mixes on public lands. Enbridge will implement the Planting Plan included with the VMP. As discussed in Section 7.1.1, Enbridge may also utilize tillage radish as a temporary cover crop to assist with decompaction on public lands and MDNR-administered access roads.

Table 7.1-1
Temporary Cover Crops

Seed	Seeding Rate [a]
Oats	80-100 pounds/acre
Winter Wheat	75-100 pounds/acre
Soil Building Cover Crop (field pea/oats)	110 pounds/acre
Wetland Rehabilitation	5.3 pounds/acre

[a] Seed rates are based on drill seed application and will vary based on site-specific conditions.
Source: BWSR, 2019.

If temporary cover crops are being used to stabilize slopes between 5 to 10 percent, the seeding rate should be increased by 35 pounds/acre. If slopes are greater than 10 percent, the seeding rate should be increased by 56 pounds/acre.

7.1.2.1 Timing for Temporary Vegetation

Generally, oats will be used for spring or summer revegetation, and winter or spring wheat will be used in the fall. Temporary vegetation should be established at any time between **April 1 and October 15 or frozen soil**. Attempts at temporary revegetation after this date should be assessed on a site-specific basis and with approval from Enbridge in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity (refer to Section 7.3.1). Refer to Section 1.9.1 for temporary stabilization timing requirements.

7.1.3 Permanent Erosion and Sediment Control Best Management Practices

Permanent erosion and sediment control BMP measures will be installed as described in Section 1.17. These controls will be left in place permanently and will not be removed following restoration.

7.1.4 Mulch

Mulch will be applied as described in Section 1.9.2. Enbridge will avoid the use of hydromulch on public lands; however, Enbridge may use hydromulch on steep slopes to prevent erosion until permanent cover has been established.

7.1.5 Soil Amendments

Soil amendments may be applied to agricultural, pasture, and/or residential lands if requested by landowners and/or land-managing agencies. Enbridge will apply phosphate-free fertilizers to

areas within 100 feet of a waterbody if soil amendments are required. No soil amendments or fertilizers will be applied on public lands without authorization from the MDNR.

7.2 PROJECT SEED SPECIFICATIONS

Seed used will be purchased on a "Pure Live Seed" ("PLS") basis for seeding (both temporary and permanent) revegetation areas. Proposed seed sources will be submitted to Enbridge for review and approval prior to seed purchase in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity. Enbridge will arrange for the appropriate storage of the seed. Enbridge will utilize yellow tag seed, which is certified by the Minnesota Crop Improvement Association, when it is available. Seed tags will identify:

- name of mixture;
- lot number;
- weed seed percentage;
- other crop percentage;
- inert matter percentage;
- noxious weeds by name and number per pound;
- net weight; and
- labeler's name and address.

In addition, for each component in the mix the following information must be included on the label:

- kind;
- variety;
- pure seed percentage;
- germination percentage;
- hard seed percentage;
- dormant seed percentage;
- total viable percentage;
- origin; and
- test date.

Seed will be used within 5, 12, or 15 months of testing as required by applicable federal, Tribal, and state laws and regulations. The seed tags on the seed sacks will also certify that the seed is "Noxious Weed: None Found." The label must show any noxious weed seed by name and number per pound. If none were found in testing, then the label should state "Noxious Weeds: None Found." Any *Amaranthus* seeds found in the purity and/or noxious exam must be tested using a genetic test to determine if Palmer amaranth is present. If Palmer amaranth is identified in testing, the seed is not legal for sale in Minnesota. Seed rates used on the Project will be based on PLS rate, not actual weight basis. Therefore, to determine the correct application rate if not indicated on the seed tag, a correction calculation will be performed based the purity and total germination.[30] For example, a seed mix that has a specified 10 pounds PLS per acre, 95 percent total germination rate, and is 80 percent pure needs to be applied at the following rate:

[30] Percent total germination = (germination + hard seed + dormant).

(95% total germination × 80% purity)/100 = 76% PLS
10 pounds PLS per acre/.76% PLS = 13.2 pounds per acre actual seeding rate

The species components of individual mixes are subject to availability at the time of purchase. Grass species may be substituted with alternative native or non-invasive species that are included in the Natural Resources Conservation Service guidelines and subject to approval by Enbridge in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity. Any seed substitution must meet all the Project requirements as outlined. The seed tag must always reflect the species in the container and reflect any substitutions.

Seed tags will be collected during seeding activities. The tags will be reviewed by the EI prior to installation to ensure that the seed mix complies with regulatory and Enbridge specifications and that it is being applied to the correct location. Seed tags will be maintained for a minimum of 2 years after seeding along with planting records for each specific location. If bulk delivery of seed is made, the above information will still be made available to Enbridge. Off-loading/on-loading of seed will not be performed in a designated wetland area. Enbridge will notify the Minnesota Department of Agriculture, Minnesota Seed Regulatory Program Coordinator so that seed lots may be sampled and tested to confirm compliance with Minnesota Seed Law, as necessary.

Legume seed (if used) will be treated with an inoculant specific to the species and in accordance with the manufacturer's recommended rate of inoculant appropriate for the seeding method (broadcast, drill, or hydroseeding).

7.3 SEEDING PERIODS

Enbridge will typically conduct permanent seeding shortly after final grading/seed bed preparation, depending on weather conditions. On public lands and at public waters, final seeding will occur within 48 hours after final grading/seed bed preparation (weather permitting). Enbridge will delay seeding during frozen ground conditions until the ground has thawed and final grading and seed bed preparation can be completed. If conditions allow, Enbridge may complete dormant seeding (refer to Section 7.3.1). Enbridge will temporarily stabilize exposed soils and will install and maintain temporary erosion and sediment control BMPs during frozen conditions.

7.3.1 Dormant/Winter Seeding

Dormant seeding is a method used after soil temperatures have cooled to 40 degrees Fahrenheit or cooler to prevent seed germination of cool-season grasses and legumes, and 50 degrees Fahrenheit or below for native warm season grasses, forbs, and legumes (BWSR, 2019). Dormant seeding is only practicable if the soil is not frozen and is preferably done before the first snowfall as the snow cover will prevent loss of seeds from wind and birds (BWSR, 2014). Procedures for applying soil amendments, seedbed preparation, seeding, and mulching are the same as outlined for permanent revegetation in Sections 7.1 and 7.2.

Winter or snow seeding can be implemented during early or late winter when there is less than 1 foot of snow and on a sunny day when seed can move into the soil surface (BWSR, 2019). The freeze/thaw action helps to set the seed firmly in the soil to prepare for spring growth. The seed bed must have been previously prepared for winter seeding to be successful, and it is not recommended for areas prone to spring flooding or running water (BWSR, 2014).

Where dormant or winter seeding is conducted, one or more of the following temporary erosion and sediment control BMPs will be put in place over the freshly seeded area unless the local soil conservation authority, landowner, or land managing agency specifies otherwise. The temporary measures will be in place after seeding, and are as follows:

- certified weed-free straw or hay mulch, at 90 percent cover, anchored;
- hydromulch, according to supplier specifications; and/or
- erosion control blanket.

Additional erosion and sediment control BMPs will be applied as requested by the EI.

If conditions do not allow for final grading and seed bed preparation, seeding will not occur until soils have thawed. Enbridge will temporarily stabilize the area and install and maintain erosion and sediment control BMPs until conditions allow for final grading and permanent seeding.

7.4 SEEDING METHODS

Seed will be applied uniformly at specified rates across the prepared construction workspace by drilling, broadcasting, hydroseeding, or air seeding. The EI will suspend seeding activities if conditions are such that equipment will cause rutting of the surface in the designated seeding areas. Enbridge will continue to monitor construction workspace conditions to resume seeding activities as site conditions improve and as described in Section 7.3.

7.4.1 Drill Seeding

The seeding rates provided with the seed mixes in Appendix C are based on seed drill application. Seed drills are commonly used, particularly where additional soil disturbance may cause erosion or weed germination. Advantages of this method include:

- more predictable results when correctly calibrated;
- seed placement below the surface protects the seed resulting in high germination rates;
- tilling prior to seeding is not required; and
- no disturbance of the existing vegetation.

However, there are limitations to where seed drills can be used, very clean seed is needed to avoid clogging the drill, and drills cannot be used for winter seeding. Seed drills also tend to favor the germination of grasses over forbs (BWSR, 2014).

A smooth, firm seedbed is required for this method. Recently tilled sites may require additional treatment such as disc harrowing and rolling to prepare an adequate seedbed and prevent seed from being buried too deep (BWSR, 2014 and 2019). Seeding equipment will be capable of uniformly distributing the seed and sowing it at the required depth. Drills will be equipped with a feeding mechanism that will provide a uniform flow of seed at the desired application rate. Double-disc furrow openers equipped with depth bands and packer wheels to firm the soil over the seed will be used where practicable. Enbridge will not utilize discs on public lands.

7.4.2 Broadcast Seeding

Broadcast seeding can be applied to a wide range of surfaces and is the most common method of seeding wetlands. Broadcast seeding rate will increase the drill-seeding rate by approximately

10 to 20 percent depending on site-specific conditions. Seed will be uniformly distributed by a mechanical or hand operated seeder by making two or three passes at right angles to ensure the entire site has been seeded. Following seeding, cultipacking, harrowing, rolling, mulching, or hand raking will be used where conditions allow to keep the seeds in place, except when late fall or winter seeding and snow will promote seed to soil contact. Seed will not be buried deeper than one-half inch and smaller seed will be at the surface. Enbridge will allow the soil to settle after disking or cultipacking the site to smooth the seedbed. Enbridge will not utilize discs on public lands. Winter broadcast seeding may be conducted if site conditions are appropriate to ensure adequate soil moisture and minimize loss from wind, birds and rodents (BWSR, 2014 and 2019) (see Section 7.3.1).

7.4.3 Hydroseeding

Hydroseeding is a preferred option for situations where hydrology conditions do not allow for the use of broadcast seeding equipment and seed can be directed on to a site with a hydroseeder. The seedbed must be loosened to allow spaces for seed to make good contact with the soil to prevent washing. Hydroseeding rate will increase the drill seeding rate by 10 to 20 percent depending on site-specific conditions, or the same as broadcast seeding rate. Seed will be applied alone or in a seed, fertilizer, and/or hydromulch slurry. No fertilizers will be applied on public lands without authorization from the MDNR. If seeding is applied alone, the amount of hydromulch material will be adjusted to the seed slurry to show where seeding has taken place, providing a means to identify uniform cover of the construction workspace. Hydroseeders will provide continuous agitation and be capable of supplying a continuous, non-fluctuating flow of slurry. Enbridge will pre-approve all hydromulch products, which must be on the applicable state DOT product list. Hydromulch and liquid tackifier products containing plastic/polypropylene fiber additives and Malachite Green (colorant) will not be utilized on this Project. Enbridge will avoid the use of hydroseeding on public lands; however, Enbridge may use hydroseeding on steep slopes to ensure seed is maintained in place until revegetation is successfully achieved.

7.4.4 Air Seeding

Air seeding is similar to drill seeding; however, an air seeder volumetrically meters the seeds below each tank, whereas a drill seeder will singulate each seed right above the row. The air seeder uses fans that blow air into the primary tubes; the meters then drops the seed into the airflow down to the tool. From there, the seed (and fertilizer if used) travel to a tower and into secondary hoses to drop down into an opener. An opener blade opens the trench so that the seed can be placed at the bottom. A gauge wheel is used to set the depth of the seed. The seed is blown into the seed boot and then a pressing wheel pushes the seed into the soil to ensure full contact. A closing wheel follows to replace the soil back over the trench.

7.5 PERMANENT REVEGETATION

Permanent vegetation will be established in areas disturbed within the construction work area (permanent easement, TWS, and ATWS) and temporary access roads, except in actively cultivated areas and standing water wetlands. The seed mixes for permanent seeding include Minnesota state seed mixes that have been developed for a variety of habitats with the intent to increase diversity, create competition for invasive species, and promote plant community resiliency (BWSR, 2019). Enbridge's seed mixes (refer to Appendix C) were selected to augment revegetation via natural recruitment from native seed stock in the topsoil and are not intended to change the natural species composition. Rates provided are assumed for a drill application and

will be adjusted based on the selected application described in Section 7.4 and site-specific conditions (e.g., slope). Enbridge will only utilize MDNR-approved seed mixes on public lands. Enbridge will implement the Planting Plan included with the VMP.

7.5.1 Timing of Final Seeding and Stabilization

Upon final grading and seed bed preparation of the construction workspace, and upon the restoration stream banks as described in Section 2.6, seeding will occur as weather and soil conditions allow as described in Section 7.3.

7.6 UPLAND CONSTRUCTION AREAS

Appendix C includes upland seed mixes for restoring disturbed woodland and prairie (grassland) areas affected by the Project. These mixes include species that will provide for effective erosion control and revegetation of the project area. These seed mixes will be used by Enbridge as the standard upland mixes unless an alternate seed mix is specified by a landowner or land managing agency.

Enbridge will utilize the MDNR-approved seed mixes for permanent seeding of upland communities on public lands identified in Enbridge's Planting Plan within the VMP.

7.7 PERMANENT SEEDING OF WETLAND AREAS

Enbridge will utilize the results of pre-construction wetland field delineations to identify the wetland type and associated plant communities, in addition to hydrological characteristics of the site. This information, along with site-specific conditions, will be utilized to determine the appropriate seed mix to install. Additional vegetation requirements may also be contained within Project-specific permits, such as peatland/wetland crossing and restoration plans. No fertilizer, lime, or mulch will be applied in wetlands. Mulch may be applied in peatlands as described in Section 7.7.3. Enbridge will reestablish wetland vegetation using the MDNR-approved seed mixes or techniques on public lands as described in Enbridge's Planting Plan within the VMP.

As discussed in Section 3.0 and presented in Figures 32 and 33, construction equipment will operate off of construction mats, and grading and topsoil removal in wetlands will be limited to the trench line, which is approximately 20 feet wide on average. As discussed in Section 3.6.1, when constructing in wetland areas without standing water, up to 1 foot of topsoil (organic layer) will be stripped from the trench line and stockpiled separate from trench spoil to preserve the native seed stock. In standing water wetlands, organic soil segregation is not typically practical because of the inability to maintain a cohesive spoil pile due to liquid nature of soil; however, Enbridge will attempt to segregate as much of the organic layer as possible based on site saturation conditions. Where topsoil segregation occurred, it will be spread uniformly over the trench area from which it was removed following rough grading (see Section 3.9).

7.7.1 Sedge Meadows Fresh (Wet) Meadows, Wet to Wet-Mesic Prairies

These communities are generally saturated up to 1 foot of the surface and transition upslope into upland plant communities or downslope into other wetland types. Remnant seed banks can sometimes be relied upon for some species in these communities. The natural revegetation process will be encouraged by the seeds and rhizomes in the topsoil spread back over the construction workspace after pipe installation. Non-standing water wetlands in Minnesota will be

seeded with the appropriate Emergent Wetland, Wet Meadow, or Wet Prairie seed mixes provided in Appendix C.

7.7.2 Shallow and Deep Marsh, and Shallow, Open Water Communities

Shallow marshes, deep marshes, and open water communities occur in areas with permanent to seasonal shallow water. The dominant vegetation type is emergent aquatic plants in shallow marshes with a transition to floating-leaved and submergent plants with increasing water depths (BWSR, 2019). In standing water wetlands, organic soil segregation is not typically practical because of the inability to maintain a cohesive spoil pile due to liquid nature of soil; however, Enbridge will attempt to segregate as much of the organic layer as possible based on site saturation conditions. Enbridge does not propose to seed standing water wetland areas. It is widely accepted that the reestablishment of vegetation within standing water wetlands occurs best through natural process without supplemental seeding, except where there is repeated disturbance or sediment accumulation (BWSR, 2019).

7.7.3 Peatland Communities

Peatlands include open and coniferous bogs that consist of water-saturated soils composed of partly decayed remains of plants. In Sphagnum-dominated peatlands, Enbridge will separate approximately 1 foot of the organic material where standing water is not present and will store it separately from the subsoil. Once the trench has been backfilled, Enbridge will uniformly spread the previously segregated organic material over the trench area. The application of straw mulch has been shown to improve Sphagnum moss establishment and survival by providing humid conditions. Enbridge will apply certified weed-free straw or hay at a rate of 1.5 tons/acre on top of the reintroduced Sphagnum moss where conditions allow (BWSR, 2014 and 2019).

7.7.4 Shrub and Forested Wetland Communities

Other than where applicable permits issued for the Project require specific restoration procedures, Enbridge proposes to allow natural reforestation of the TWS area within forested wetlands via stump sprouting, root sprouting, and natural recruitment.

7.8 PERMANENT SEEDING OF WATERBODY BANKS

Enbridge will reestablish stream bank vegetation using the BWSR Riparian seed mixes for the northeast or south and west regions unless an alternate seed mix is requested by applicable agencies. Enbridge will reestablish stream bank vegetation using the MDNR-approved seed mixes on public lands as described in Enbridge's Planting Plan within the VMP. Additional vegetation requirements may also be contained within Project-specific permits, such as site-specific restoration plans. Where a waterbody is located within a wetland, Enbridge will re-seed the banks with the applicable wetland seed mix described in Section 7.7.

7.9 SPECIALIZED SEED MIXES

Specialized seed mixes will be utilized for restoring areas discussed in the following sections.

7.9.1 Agricultural Ditches

Enbridge will utilize the BWSR Native Construction seed mix to restore the sides of agricultural ditches where appropriate based on site-specific conditions. Enbridge will utilize the MDNR-approved seed mixes to restore the sides of agricultural ditches where appropriate based on site-specific conditions on public lands as described in Enbridge's Planting Plan within the VMP.

7.9.2 Eroding Bank Stabilization and Sandy Soils

Enbridge will utilize the BWSR Eroding Bank Stabilization pilot seed mix to restore and stabilize steep eroding slopes with early and late successional species where appropriate based on site-specific conditions. For disturbed areas with sandy soils, Enbridge may utilize the BWSR Sand Mine Reclamation South & West pilot seed mix for dry prairie establishment, as appropriate based on site-specific conditions. Enbridge will utilize MDNR-approved seed mixes to restore and stabilize eroding slopes or sandy soils on public lands as described in Enbridge's Planting Plan within the VMP.

7.9.3 Landowner Requests

Enbridge will provide other specialized seed mixes upon landowner request on a site-specific basis for agricultural and residential areas, which will be identified in the CLL:

- BWSR Conservation Grazing pilot seed mix for native prairie conservation grazing in the south and west Minnesota region;
- BWSR Native Forage Buffer pilot seed mix for haying once or twice per year;
- BWSR Beneficial Insects pilot seed mix to establish diverse vegetation for beneficial insects in agricultural areas for the south and west Minnesota region;
- Lawn mixes to reestablish residential lawns or other types of "turf-type" land cover;
- Food plot mixes to provide a desirable food source for wildlife, specifically deer; or
- Stormwater (Northeast, South, and West) and Dry Swale/Pond for temporarily flooded areas and stormwater pond edges at Enbridge pump station facilities.

7.9.4 Herbicide Treatment Areas

As described in Section 1.6 and in Enbridge's INS Management Plan (Appendix B), Enbridge may utilize herbicides to manage terrestrial INS within the construction workspace and temporary access roads. Enbridge will select the appropriate BWSR seed mixes, as available, to use following herbicide treatment to enhance revegetation success. Examples of seed mixes that may be used, as appropriate, include:

- BWSR Wetland Rehabilitation for interseeding into establishing wetlands after weed control spraying;

- BWSR Forest Groundcover East pilot seed mix for soil stabilizing in forests following invasive species removal and other disturbances;

- BWSR Compacted Trail General to establish vegetation on passive recreation trails; or

- BWSR Early Successional Floodplain General pilot seed mix to establish cover in floodplains where natural colonization will add to diversity over time.

Enbridge will utilize these or other seed mixes as approved by the MDNR on public lands as described in Enbridge's Planting Plan within the VMP.

7.10 CONSERVATION RESERVE PROGRAM PROPERTIES

Enbridge's Land Agents will contact landowners where the construction workspace crosses land enrolled in Conservation Reserve Program ("CRP"). Enbridge will work with the respective landowners to identify the parcel-specific CRP seed mixes. CRP lands will be seeded at the direction of the landowner per the site-specific landowner CRP requirements for that parcel and no non-CRP approved seed mix will be planted on CRP lands. CRP parcels will also be seeded with Enbridge's temporary cover seed mix. Seed for CRP seeding will meet the same criteria as other seed described in Section 7.2.

7.11 ENVIRONMENTAL INSPECTIONS

As described in Enbridge's EMCP, Enbridge will maintain EIs and environmental labor crew(s) on-site or on-call to monitor erosion and sediment control BMPs and stabilization efforts and to make adjustments or repairs as needed in accordance with conditions identified in the applicable Project permits, certifications, and/or licenses. The EI will determine the most effective means of dealing with identified problems, taking into consideration the suitability of access to the ROW, potential equipment damage to the ROW, and the urgency of the issue to be addressed.

8.0 WINTER CONSTRUCTION

Enbridge has prepared a Winter Construction Plan that describes the construction procedures that will differ from the procedures outlined in this EPP during frozen conditions. The Winter Construction Plan describes procedures for the following:

- Identifying “winter” or “frozen” conditions;
- Construction of frost/ice roads;
- Snow removal;
- Bridges;
- Trenching and Topsoil Segregation;
- Backfilling;
- Waterbody Crossing Techniques (open cut, dry crossings, and HDDs);
- Trench Excavation, Lowering-In, and Backfill;
- Construction Dewatering;
- Hydrostatic Testing and Discharges;
- Drilling Fluid Response, Containment, and Notification Procedures; and
- Site Stabilization and Restoration.

9.0 WASTE MANAGEMENT

Enbridge will ensure proper handling, storage, and disposal of all solid and hazardous materials and wastes that are used or generated as a result of the Project. Enbridge will ensure that the materials and wastes associated with the Project are properly classified as hazardous materials and/or wastes in accordance with applicable federal and/or state criteria. Enbridge will ensure documentation is maintained to substantiate findings of the regulatory status of materials and/or wastes used and/or generated as a result of the Project.

Enbridge will ensure that all waste materials, including oil or other waste liquids generated as a result of Project work, are collected and placed into suitable DOT specification containers (i.e., labeled and meeting any relevant regulatory requirements). Enbridge will recycle wastes, such as motor oil, where there is an established recycling program available. Wastes such as grease or oily rags will be disposed of in accordance with state requirements. Throughout the duration of the Project, Enbridge will ensure areas are cleaned up and proper off-site disposal of all wastes generated during the Project within the time allowed by the regulations. No wastes will be left on Enbridge property, along the construction workspace, or buried in an excavation or otherwise disposed of on Enbridge property or ROW.

9.1 HAZARDOUS WASTES

Enbridge is responsible for ensuring that all workers are properly trained in the proper storage, handling and disposal of hazardous wastes generated during construction. Enbridge will ensure that any hazardous waste generated from materials brought on-site (e.g., paint cleanup solvents, waste paints) are properly collected, stored, and disposed of in accordance with all applicable regulations. Enbridge will ensure that wastes are properly classified per the federal and state hazardous waste regulations and are properly containerized, marked with start accumulate dates, labeled and, if liquid, stored on-site with secondary containment and otherwise managed in accordance with all U.S. Environmental Protection Agency and DOT regulatory requirements. Enbridge will ensure proper handling, storage, and disposal of the hazardous waste. Personnel will be prohibited from placing, spilling, or pouring wastes onto the ground. Any release of the hazardous waste, hazardous materials, or hazardous substances as a result of the improper handling, storage, or disposal will be rectified to the satisfaction of Enbridge and all applicable regulatory agencies. Enbridge is responsible for immediately reporting the spill as described in Section 10.8.

9.2 ABRASIVE BLAST DEBRIS

Enbridge will ensure that as much spent abrasive blast materials (sandblasting material) are contained and collected as practical and placed into appropriate containers. Enbridge will ensure containers are covered with appropriate means to prevent stormwater from entering the container or impacting stormwater runoff. Enbridge will ensure disposal of the spent abrasive in accordance with applicable federal, Tribal, state, and local regulatory requirements. Enbridge will ensure that spent abrasive is classified as a “hazardous” or “special” waste as defined by applicable federal and state regulations. If the spent abrasive is determined to be hazardous waste as a direct result of constituents of an Enbridge facility or equipment, Enbridge will coordinate proper disposal as previously discussed.

10.0 SPILL PREVENTION, CONTAINMENT, AND CONTROL MEASURES

This section describes planning, prevention, and control measures to minimize impacts resulting from spills of fuels, petroleum products, or other regulated substances as a result of construction.

In the event of a suspected Enbridge pipeline release (or from an adjacent pipeline), Enbridge's Emergency Pipeline Control Center will be notified at 1-800-858-5253 (24-hours/day), as well as the Enbridge EI. Actions requiring emergency response will be coordinated by Enbridge.

10.1 PLANNING AND PREVENTION

Enbridge requires proper planning and preventative measures be implemented to minimize the likelihood of spills, and to quickly and successfully clean up a spill should one occur.

This section sets forth minimum standards for handling and storing regulated substances and cleaning up spills. If the aggregate volume of petroleum stored in tanks and containers greater than or equal to 55 gallons will be equal to or more than 1,320 gallons for any site, Enbridge will prepare and implement a Spill Prevention, Containment, and Control ("SPCC") plan(s) that meets the requirements of 40 Code of Federal Regulations 112. This requirement also extends to any petroleum storage at Enbridge-managed construction yards.

Potential sources of construction-related spills include machinery and equipment failure, fuel handling, transfer accidents, and storage tank leaks. Enbridge will be responsible for implementing, at a minimum, the following planning and prevention measures.

10.2 ROLES AND RESPONSIBILITIES

10.2.1 Spill Coordinator

A Spill Coordinator will be designated and approved by Enbridge. For all construction related spills, the Spill Coordinator will:

- report all spills to the Enbridge Representative immediately;
- in Minnesota, pursuant to Minnesota Statute Section 115.061, report discharges ("spills") of any material that may cause pollution of state waters immediately to the Minnesota Duty Officer (1-800-422-0798 or 651-649-5451) (see Appendix D);
- within the exterior boundaries of the FdL Reservation, report spills immediately to the FdL Resource Department (1-800-424-8802) (see Appendix D);
- in North Dakota, report discharges immediately to the North Dakota Department of Health or the North Dakota Hazardous Materials Emergency Assistance and Releases Reporting (1-800-472-2121 or 1-701-328-2121) (see Appendix D);
- in Wisconsin, report spills immediately to the Wisconsin Department of Natural Resources (1-800-943-0003);

- report spills to other appropriate federal, Tribal, state, and local agencies as required and described in Appendix D;

- mobilize on-site personnel, equipment, and materials for containment and/or cleanup commensurate with the extent of the spill;

- assist the Emergency Response Contractor (refer to a list of potential contractors provided in Appendix E) and monitor containment procedures to ensure that the actions are consistent with the requirements of this section;

- in consultation with Enbridge and appropriate agencies, determine when it is necessary to evacuate spill sites to safeguard human health;

- in consultation with Enbridge, coordinate with appropriate agencies the need to contact additional parties or agencies;

- complete a Spill Report Form within 24 hours of the occurrence of a spill, regardless of the size of the spill; and

- Prepare and administer the SPCC plan(s) prepared for storage of petroleum on Enbridge sites, if applicable.

10.2.2 Environmental Inspector

The EI will monitor compliance with the provisions of this section to ensure that appropriate agency notifications are made, spill resources are allocated, and cleanup is accomplished in accordance with applicable agency requirements

10.2.3 Authorized Personnel

Authorized Personnel are designated to handle fuel, lubricants, or other regulated substances. Authorized Personnel will be familiar with the requirements of this section and the consequences of non-compliance.

10.2.4 Construction Superintendent

The Contractor's Construction Superintendent or representative will notify the EI immediately of any spill of a petroleum product or hazardous liquid, regardless of volume.

10.2.5 Construction Personnel

Construction Personnel will notify the crew foreman or Spill Coordinator immediately of any spill of a petroleum product or hazardous liquid, regardless of volume.

10.3 TRAINING

Enbridge will train all employees handling fuels and other regulated substances to follow spill prevention procedures. Enbridge will train all employees who handle fuels and other regulated substances to prevent spills and to quickly and effectively contain and clean up spills that may occur in accordance with applicable regulations.

10.4 SPILL AND FUELING EQUIPMENT

- Each construction crew will have adequate absorbent materials and containment booms on hand, to enable the rapid cleanup of any spill that may occur.

- Enbridge will maintain spill kits containing a sufficient quantity of absorbent and barrier materials to adequately contain and recover foreseeable spills. These kits may include, but are not limited to, absorbent pads, straw bales, absorbent clay, sawdust, floor-drying agents, spill containment barriers, plastic sheeting, skimmer pumps, and holding tanks. This equipment will be located near fuel storage areas, near each waterbody crossing, and at other locations as necessary to be readily available to control foreseeable spills.

- Suitable plastic lining materials will be available for placement below and on top of temporarily stored contaminated soils and materials.

- All fueling vehicles, and where necessary, service vehicles, will carry materials adequate to control foreseeable spills. Such material may include, but not be limited to, absorbent pads, commercial absorbent material, plastic bags with ties, and shovels.

- The Spill Coordinator will inform the Authorized Personnel, Construction Personnel, and the EIs of the locations of spill control equipment and materials and have them readily accessible during construction activity. Spill kits should be clearly labeled for quick and easy identification in the field.

- All fuel nozzles will be equipped with functional automatic shut-offs.

- Mobile refuelers transporting fuel to on-site construction equipment will travel only on approved access roads.

10.5 SUPERVISION AND INSPECTION

Enbridge will perform a pre-construction inspection and test of applicable equipment to ensure that it is in good working order. During construction, Enbridge will regularly inspect hoses, pipes, valves, containers, and tanks to ensure equipment is in good condition, compatible with the substance stored, and is free of leaks, dents, or other defects. Any equipment that is found to be leaking or in need of repair or replacement will be immediately removed from service and repaired or replaced, prior to resuming work.

10.6 STORAGE AND HANDLING OF FUELS/HAZARDOUS LIQUIDS

10.6.1 Fuel Storage – General

Enbridge will follow proper fuel storage practices, including, but not limited to the following:

- Fuel storage will be at Contractor yards only or as approved by Enbridge in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity.

- Proper signage at and adjacent to fuel storage areas to include “Fuel Storage Area – No Smoking within 50 feet.”

- Tools and materials needed for maintenance will be kept on-site. Such equipment may include, but not be limited to, plugs of various sizes, 3M tank patches, a hammer, assorted sizes of metal screws with rubber washers, a screwdriver, and plastic tape.

- Fuels, lubricants, waste oil, and any other regulated substances will not be stored in underground storage tanks.

- Storage tanks and containers will conform to all applicable industry codes (e.g., Steel Tank Institute, National Fire Protection Association, Unified Facilities Criteria).

- A suitable secondary containment structure or double-walled tank will be utilized at each fuel storage site. Secondary containment structures will be lined with suitable material (including plastic sheeting) and provide a minimum containment volume equal to 150 percent of the volume of the largest storage vessel.

- Secondary containment areas will not have drains. Precipitation may be drawn off as necessary. If visual inspection indicates that no spillage has occurred in the secondary containment structure, accumulated water may be drawn off and discharged in accordance with Section 5.0. If spillage has occurred in the structure or if visible sheen is present, accumulated waste will be drawn off and pumped into drum storage for appropriate off-site management.

10.6.2 Refueling

All fuel dispensing operations will be attended by Authorized Personnel at all times. Authorized Personnel will be stationed at both ends of the hose during fueling unless both ends are visible and are readily accessible by one person.

10.6.3 Refueling, Maintenance, and Fuel Storage Near Wetlands and Waterbodies

Enbridge requires that the storage of petroleum products, refueling, maintenance, and lubricating operations take place in upland areas that are more than 100 feet from wetlands, streams, and waterbodies (including drainage ditches), and water supply wells. In addition, the Contractor will store hazardous materials, chemicals, fuel, lubricating oils, and used oil, and perform concrete coating activities, outside these areas.

In certain instances, refueling or fuel storage within these areas may be unavoidable due to site-specific conditions or unique construction requirements (e.g., continuously operating pumps). These locations will be approved in advance by the EI. Site-specific precautions, in addition to those practices described above, will be taken when refueling or maintenance activities are required within 100 feet of streams, wetlands, or other waterbodies. These precautions include, but are not limited to:

- adequate amounts of absorbent materials and containment booms will be kept on hand by each construction crew to enable the rapid cleanup of any spill which may occur;

- if fuel will be stored within wetlands or near streams for refueling of continuously operating pumps, secondary containment will be used;

- secondary containment structures will be lined with suitable plastic sheeting, provide a containment volume of at least 150 percent of the storage vessel, and allow for at least 1 foot of freeboard; and

- adequate lighting will be provided for these locations and activities.

10.6.4 Overnight Parking

Overnight parking of equipment (including, but not limited to, light plants, generators, pumps, and machinery) is not allowed within 100 feet of a wetland or waterbody unless special containment provisions have been implemented and approved by the EI in advance. Equipment that is parked overnight on public lands in areas with aquifers ranked as high vulnerability to contamination will be supplied with kiddie pools to place underneath vehicles and equipment to capture potential leaks.

10.7 INITIAL SPILL MANAGEMENT

10.7.1 Immediate Response

Immediately upon discovery of any release of fuel, oil, hazardous material, or other regulated substance, or upon learning of conditions that will lead to an imminent spill, the person discovering the situation will:

- in Minnesota, pursuant to Minnesota Statute Section 115.061, report discharges ("spills") of any material that may cause pollution of state waters immediately to the Minnesota Duty Officer (1-800-422-0798 or 651-649-5451) (see Appendix D);

- within the exterior boundaries of the FdL Reservation, report spills immediately to the FdL Resource Department (1-800-424-8802) (see Appendix D);

- in North Dakota, report discharges immediately to the North Dakota Department of Health or the North Dakota Hazardous Materials Emergency Assistance and Releases Reporting (1-800-472-2121 or 1-701-328-2121) (see Appendix D);

- in Wisconsin, report spills immediately to the Wisconsin Department of Natural Resources (1-800-943-0003);

- report spills to other appropriate federal, Tribal, state, and local agencies as required and described in Appendix D;

- if safe to do so, initiate actions to contain the fluid that has spilled or is about to spill, and initiate action to eliminate the source of the spill; and

- notify the crew foreman and/or the Spill Coordinator and provide them with the following information:

    - location and cause of the spill;
    - the type of material that has spilled; and
    - whether the spill has reached or is likely to reach any surface water.

Upon learning of a spill or a potential spill the Spill Coordinator will:

- assess the situation and determine the need for further action;
- direct subsequent activities and/or further assign responsibilities to other personnel; and
- notify the EI.

10.7.2 Mobilization

The Spill Coordinator will mobilize on-site personnel, equipment, and materials for containment and/or cleanup commensurate with the extent of the spill. If the Spill Coordinator feels that a spill is beyond the scope of on-site equipment and personnel, the Spill Coordinator will immediately notify the Construction Superintendent that an Emergency Response Contractor is needed to contain and/or clean up the spill. Appendix E contains a list of potential Emergency Response Contractors. The Spill Coordinator will assist the Emergency Response Contractor and monitor containment procedures to ensure that the actions are consistent with the requirements of this section.

10.8 SPILL NOTIFICATION RESPONSIBILITIES

10.8.1 Notification Volumes

The Contractor's Construction Superintendent or representative will notify the Enbridge Representative and the EI immediately of any spill of a petroleum product or hazardous liquid, regardless of volume.

10.8.2 Spill Report Form

The Spill Coordinator will complete a Spill Report Form for each release of a regulated substance, regardless of volume. The Spill Report Form will be submitted to the EI within 24 hours of the occurrence of a spill. Follow-up written reports, associated laboratory analyses, and other documentation may also be required separately on a site-specific basis as directed by the EI.

10.8.3 Agency Notification

Enbridge will report spills to appropriate federal, Tribal, state, and local agencies immediately (or within the specific agency’s required reporting thresholds if not immediate). A listing of federal, Tribal, state, and local agencies including reporting thresholds and timeframes is provided in Appendix D.

Enbridge, in coordination with the appropriate federal, Tribal, state, and local agencies will ensure that additional parties or agencies are properly notified. Additionally, Enbridge will ensure that all cleanup, monitoring, remediation, and reporting activities required by a jurisdictional agency are satisfactorily met and will maintain documentation to demonstrate this compliance.

10.9 SPILL CONTAINMENT, RESPONSE, AND REMEDIATION

In the event of a release, Enbridge will abide by all applicable federal, Tribal, state and local regulations with respect to responding to and remediating the spill. Specific cleanup measures for both upland and wetland/waterbody spills are described below.

10.9.1 Spill Control – Upland Areas

- If a spill should occur during refueling operations, STOP the operation until the spill is controlled and the situation corrected.

- The source of the spill shall be identified and contained immediately.

- For large releases that occur on land (i.e., above the reportable limits as described in Appendix D), the spilled material will be contained and recovered immediately. Enbridge or, if necessary, an Emergency Response Contractor, will excavate contaminated soil.

- The recovered material and contaminated soil and other contaminated media will be treated and/or disposed of in accordance with all applicable federal, Tribal, state, and local agency requirements and Section 9.0.

- Smaller releases on land (i.e., below the reportable limits as described in Appendix D) shall be cleaned up with absorbent materials. Contaminated soil or other materials associated with these releases shall be collected and managed in accordance with applicable regulations and Section 9.0.

- To the best of ability, flowing spills will be contained and/or absorbed before reaching surface waters or wetlands.

- Absorbent material(s) will be placed over spills to minimize spreading and to reduce penetration into the soil.

- The Spill Coordinator, in consultation with the EI and appropriate agencies, will determine when spill sites will be evacuated as necessary to safeguard human health. Evacuation parameters will include consideration for the potential of fire, explosion, and hazardous gases.

10.10 SPILL CONTROL – WETLANDS AND WATERBODIES

In addition to the above measures, the following conditions apply if a spill occurs near or into a wetland or waterbody, regardless of size:

- If a spill occurs during refueling operations, **STOP** the operation until the spill can be controlled and the situation corrected.

- Enbridge will use absorbent booms and pads to contain and recover released materials in standing water, and plastic bags for storage and disposal of used absorbent booms and pads.

- Enbridge will excavate contaminated soils from wetlands and temporarily place them on plastic sheeting in a bermed area, a minimum of 100 feet away from the wetland. Contaminated soils will be covered with plastic sheeting while being temporarily stored and properly managed as soon as possible, in accordance with Sections 9.0 and 10.11.

10.11 STORAGE AND DISPOSAL OF CONTAMINATED MATERIALS

- Appendix E lists potential treatment and disposal facilities for contaminated materials, petroleum products, and other construction-related wastes. Enbridge will recycle those wastes, such as motor oil, where there is an established recycling program available. Wastes such as grease or oily rags shall be disposed of in accordance with state requirements.

- Enbridge will store and dispose of all contaminated soils, absorbent materials, and other wastes in accordance with all applicable federal, Tribal, and state regulations.

- Only licensed carriers may be used to transport contaminated material from the site to a disposal facility.

- If it is necessary to temporarily store excavated soils on site, these materials will be placed on, and covered by, plastic sheeting, and the storage area bermed to prevent and contain runoff.

11.0 DRILLING FLUID RESPONSE, CONTAINMENT, AND NOTIFICATION PROCEDURES

Construction of a pipeline may include the use of trenchless pressurized methods known as the HDD method. Section 3.6 of the Summary of Construction Methods and Procedures (Appendix A) provides a detailed description of this method. Throughout this section, this method is also referred to as "drilling." The HDD method always includes the use of drilling fluid. The drilling fluid or water is pumped directly to the jets in the drill bit to help excavate the hole and minimize friction between the surrounding soils, creating a pressurized system. This differs from the horizontal bores described in Section 4.1 that may introduce drilling fluids but are non-pressurized and therefore will not have the potential for an inadvertent release outside of the bore pits. The HDD drilling fluids/mud consists primarily of water mixed with inert bentonite clay. Under certain conditions an additive may need to be mixed with the drilling fluids/mud for viscosity or lubricating reasons. Only agency-approved additives will be used and a Safety Data Sheet for the drilling fluid additives will be maintained on-site.

This section elaborates on measures to be implemented if an inadvertent release of drilling fluid occurs despite prevention efforts. Prior to the commencement of drilling operations, construction personnel involved will be informed as to the responsible party(ies) for release containment and response. Enbridge will ensure that the appropriate response personnel and containment equipment are on site for each drill. Enbridge will implement agency-approved Inadvertent Release Response Plans at each HDD location that describe the monitoring, containment, and recovery procedures based on site-specific conditions.

Procedures for HDD monitoring, containment, and recovery during frozen conditions are described in Enbridge's Winter Construction Plan.

11.1 ON-SITE INSPECTION DURING CONSTRUCTION

Early detection is key to minimizing the area of potential impact from an inadvertent release. During construction of a drilled crossing, Enbridge will monitor the drill by implementing the following BMPs that allow for the early detection of drilling fluid loss and cessation of operations until such loss can be located and remedied. This procedure will occur regardless of seasonality. If fluid loss has been detected, physical surveys as described below will be conducted to determine if the fluid has migrated to the surface, and the appropriate corrective actions will be implemented:

- Maintain 24-hour operations which can help maintain consistent drilling fluid circulation and monitoring.

- The HDD operator will continuously monitor and maintain a log of drilling mud volume balance (mud in = mud out).

- Maintain drilling fluid circulation at entry and exit endpoints to ensure that cuttings are being carried out of the hole and properly segregated from the re-used drilling fluid.

- The HDD operator will monitor the annular drilling fluid pressures during drilling real-time, and record pressures every minute.

- If the HDD operator identifies a sustained loss in fluid pressure or loss of circulation:

- Shutdown will occur immediately;
- The operator will immediately notify the construction inspectors of the assumed position of the drill tool; and
- Enbridge will visually monitor the appropriate portion of the drill path where the drill tool is located to determine if an inadvertent return occurred. Enbridge may perform this monitoring by walking or by using a boat, as appropriate.

- Enbridge will inform construction inspectors on what to watch for and will make them aware of the importance of timely detection and response actions to any release of drilling fluid.

- Construction inspectors will have appropriate, operational communication equipment (e.g., radio and cell phones) available at all times during installation of the HDD crossing, with the ability to communicate directly with the HDD operator.

- At least one full-time personnel will continuously monitor the drill path by inspecting land surfaces and the waterbodies for surface migration during drilling, reaming, and pipe installation procedures. The inspector will also walk the drill path to monitor for surface seepage, sinkholes, and settlement. In addition, a flowing stream shall be monitored both upstream and downstream of the drill path. If an inspector notices inadvertent return conditions, shutdown will occur immediately. Enbridge will provide adequate lighting of the drill path to allow for monitoring during 24-hour continuous operation.

- Construction inspectors, EI(s), or the Enbridge HDD on-site personnel have the authority to order installation of containment structures, if needed, and to require additional response measures if deemed appropriate.

- Enbridge will contact the appropriate agencies, including the Minnesota State Duty Officer, if the release occurs in the State of Minnesota, immediately of a surface inadvertent release (refer to Appendix D).

11.2 CONTAINMENT, RESPONSE, AND CLEANUP EQUIPMENT

Containment, response, and cleanup equipment will be available at both sides of an HDD crossing location prior to the commencement to assure a timely response in the event of an inadvertent release of drilling fluid. Containment and response equipment includes, but is not limited to:

- straw bales and staking;
- pre-filled sandbags;
- turbidity curtain (type to be specified in the site-specific Inadvertent Release Response Plans);
- silt fence;
- plastic sheeting and/or geotextile fabric;

- shovels, brooms, buckets, and other appropriate hand tools;
- pumps and sufficient hose;
- fluid storage tanks;
- vacuum truck on-site prior to and throughout the drill execution;
- one small boat (type/motorization to be specified in site-specific Inadvertent Release Response Plans);
- light plant/generator (only necessary where operations are conducted outside of daylight hours); and
- Any other equipment specified by Enbridge based on site visit and specified in the site-specific Inadvertent Release Response Plans.

11.3 RESPONSE

In the event an inadvertent drilling fluid release is observed, Enbridge will assess to determine the amount of fluid being released and potential for the release to reach sensitive resource areas (e.g., wetlands and waterbodies). Response measures will vary based on location of inadvertent release as discussed below. The location of the inadvertent release will be documented by the EI with the site name, size of release, initial date of release, and GPS location. The EI will photograph the release site and include with the daily inspection report. Enbridge will coordinate containment, response, cleanup and reporting activities with the applicable agencies.

If a release were to occur outside of the authorized construction workspace, Enbridge will mobilize lightweight containment materials (e.g., straw bales, silt fence, sand bags) on foot to the release location to isolate the drilling fluid immediately. Once drilling fluid has been contained, Enbridge will determine if equipment access is necessary to aid in the response, and initiate agency consultations for developing alternate access, as necessary.

11.3.1 Upland Locations

Response measures in the event of a drilling fluid release in upland locations include the following:

- The EI will evaluate the release to determine if containment structures are warranted and if they will effectively contain the release.
- If the amount of the surface release is not great enough to allow the practical physical collection from the affected area, it will be diluted with clean water and/or the fluid will be allowed to dry and dissipate naturally.
- Earthen or sandbag berms, silt fence, and/or hay bales will be installed to contain small releases and prevent migration of drilling fluid.
- Enbridge will remove excess fluid at a rate sufficient to prevent an uncontrolled release.

- If the amount of the surface release exceeds that which can be completely contained with hand-placed barriers, collection sumps may be used (with approval from Enbridge) to remove released drilling fluid by the use of portable pumps and hoses.

- Enbridge will consult with the appropriate regulatory agencies to evaluate the circumstances of the release, discuss additional containment or cleanup requirements, and determine whether and under what conditions the HDD may proceed.

11.3.2 Wetland Locations

This section also applies to areas immediately adjacent to wetlands and waterbodies, such as stream banks or steep slopes, where drilling fluid releases could quickly reach surface waters.

In the event of a drilling fluid release in wetlands or adjacent areas:

- The EI will evaluate the release, and the appropriate containment measures will be implemented.

- Enbridge will evaluate the recovery measures to determine the most effective collection method.

- If the amount of the surface release exceeds that which can be contained with hand-placed barriers, small collection sumps (less than 5 cubic yards) may be utilized to collect released drilling fluid for removal by the use of portable pumps and hoses.

- Low ground pressure equipment (e.g., UTV, argo, morooka) will conduct limited passes to assist personnel carrying containment materials to the release location.

- Temporary access will be supported by construction matting installed during clearing within the wetland areas.

- If the amount of the surface release is not great enough to allow the practical physical collection from the affected area without causing additional impacts, with approval from both Enbridge Environment and Construction Management, the drilling fluid may be diluted with clean water and/or the fluid will be allowed to dry and dissipate naturally.

- Excess fluid will be held within the containment area and removed using pumps or other appropriate measures at a rate sufficient to maintain secure containment.

- Recovered fluid will be stored in a temporary holding tank or other suitable structure out of the floodplain and/or wetland for reuse or eventual disposal in an approved off-site location (see Section 11.5).

- Enbridge will consult with the appropriate regulatory agencies to evaluate the circumstances of the release, discuss additional containment or cleanup requirements, and determine whether and under what conditions the HDD may proceed.

11.3.3 Waterbody Locations

In the event of a drilling fluid release in waterbodies:

- The EI will evaluate the release, and the appropriate containment measures will be implemented.
- Enbridge will evaluate the recovery measures to determine the most effective collection method.
- Enbridge will consult with the appropriate regulatory agencies to evaluate the circumstances of the release, discuss additional containment or cleanup requirements, and determine whether and under what conditions the HDD may proceed.

The containment methods utilized will depend on the size of release, water depth, flow velocity, and location of the release. In aquatic environments bentonite may harden, effectively sealing the inadvertent release location. In this event, response activities will be limited or unnecessary. However, if drilling mud were to enter the water column, the typical response tactic will be to erect an isolation containment environment using the materials identified in Table 11.3-1, or their equivalent, to facilitate a spill response team's ability to contain and collect excess drilling mud. Containment is not always feasible for in-stream releases, especially in waterbodies with significant currents. However, Enbridge must ensure that any and all releases are addressed as rapidly and thoroughly as possible.

Enbridge will implement the agency-approved Inadvertent Release Response Plans that provide site-specific information regarding features crossed by each HDD and containment and recovery response tailored to site-specific conditions. Enbridge will complete a pre-construction visit at the site at least 2 weeks prior to initiating HDD setup and operations to determine if additional materials and equipment will be needed.

Drilling fluid recovery methodology in waterbodies is not as variable as containment measures. When such measures effectively isolate the release from the stream flow, pumps or other appropriate measures are used to recover drilling fluid. When the release location cannot be isolated after initial in-stream containment installation, drilling fluid that has settled from the water column typically collects in the acute upstream angle of the containment tool, and recovery efforts will be localized to that location.

Table 11.3-1
Inadvertent Return Containment Methods for Variable In-Stream Conditions

Water Conditions		Distance from Water's Edge		
Flow Velocity	**Water Depth**	**0 - 10 Feet**	**10 - 20 Feet**	**Greater Than 20 Feet**
Still/Slow (Less Than 1 ft/sec)	0 - 2 feet	Sand bag isolation structure; vertical culvert	Sand bag isolation structure; vertical culvert	Sand bag isolation and structure; vertical culvert
	2 - 5 feet	Turbidity curtain; Geotextile pipeline weights cofferdam; vertical culvert; bladder dams; jersey barriers and plastic sheeting	Turbidity curtain; Geotextile pipeline weights cofferdam; vertical culvert; bladder dams; jersey barriers and plastic sheeting	Turbidity curtain; vertical culvert; bladder dams
	Greater than 5 feet	Turbidity curtain; Geotextile pipeline weights cofferdam; vertical culvert; bladder dams; jersey barriers and plastic sheeting	Turbidity curtain; Geotextile pipeline weights cofferdam; vertical culvert; bladder dams; jersey barriers and plastic sheeting	Turbidity curtain; vertical culvert; bladder dams
Slow/Moderate (1 - 3 ft/sec)	0 - 2 feet	Sandbag cofferdam; vertical culvert	Sandbag cofferdam; vertical culvert; geotextile pipeline weights cofferdam; jersey barriers with plastic sheeting	Sandbag cofferdam; vertical culvert; geotextile pipeline weights; bladder dams
	2 - 5 feet	Turbidity curtain; Geotextile pipeline weights cofferdam; vertical culvert; bladder dams; jersey barriers and plastic sheeting	Turbidity curtain; geotextile pipeline weights cofferdam; vertical culvert; bladder dams; water gates (as upstream diversion aid)	Turbidity curtain; bladder dams; water gates (as upstream diversion aid)
	Greater than 5 feet	Turbidity curtain; Geotextile pipeline weights cofferdam; vertical culvert; bladder dams; water gates (as upstream diversion aid)	Turbidity curtain; geotextile pipeline weights; bladder dams; water gates (as upstream diversion aid)	Turbidity curtain; bladder dams; water gates (as upstream diversion aid)
Moderate/Rapid (Greater Than 3 ft/sec)	0 - 2 feet	Sandbag cofferdam; geotextile pipeline weights cofferdam; vertical culvert; jersey barriers and plastic sheeting	Sandbag cofferdam; geotextile pipeline weights cofferdam; vertical culvert; jersey barriers and plastic sheeting	Turbidity curtain; sand bags, bladder dams; water gates (as upstream diversion aid)
	2 - 5 feet	Turbidity curtain; Geotextile pipeline weights cofferdam; vertical culvert; bladder dams; jersey barriers and plastic sheeting	Turbidity curtain; geotextile pipeline weights; bladder dams; water gates (as upstream diversion aid)	Turbidity curtain; bladder dams; water gates (as upstream diversion aid)
	Greater than 5 feet	Turbidity curtain; Geotextile pipeline weights cofferdam; vertical culvert; bladder dams; water gates (as upstream diversion aid)	Turbidity curtain; geotextile pipeline weights; bladder dams; water gates (as upstream diversion aid)	Turbidity curtain; geotextile pipeline weights; bladder dams; water gates (as upstream diversion aid)

11.4 NOTIFICATION AND RESUMPTION OF SUSPENDED HDD OPERATIONS

The EI will be immediately notified of all drilling fluid releases, who will then immediately notify Enbridge Environment and Construction Management and the appropriate regulatory agencies, including the Minnesota State Duty Officer for releases that occur in the State of Minnesota (refer to Appendix D).

If notifications are necessary during non-business hours, they will be done according to prior arrangements made between Enbridge and the regulatory agencies. Follow-up notifications will be made as necessary and practicable.

The conditions under which drilling operations can resume will be discussed with appropriate regulatory agencies and/or field representatives. If containment measures are functioning, and the circumstances and potential impacts of the release are understood, HDD operations will resume.

11.5 CLEANUP

The following measures are to be considered as appropriate:

- Drilling fluid will be cleaned up by hand using hand shovels, buckets, and soft-bristled brooms as possible without causing extensive ancillary damage to existing vegetation. Clean water washes may also be employed if deemed beneficial and feasible.

- Containment structures will be pumped out and the ground surface scraped to bare topsoil without causing undue loss of topsoil or ancillary damage to existing and adjacent vegetation.

- Material will be collected for temporary storage prior to removal from the site to an off-site location that has the applicable landowner, agency or facility approval. Drilling mud may be land applied within the construction workspace or transported to an off-site land application location in accordance with federal, state, and Tribal regulations and as approved by Enbridge and the landowner. The MPCA does not require a permit or approval to land apply drilling mud with additives that meet the ANSI/NSF Standard 60 (drinking well material standards); however, those that do not meet the Minnesota Department of Health approved additive list and/or do not meet the ANSI/NSF Standard 60 must be disposed of as a solid waste at an approved facility or obtain a land application permit from the MPCA. A general land application permit is required from the North Dakota Department of Environmental Quality for land applying drilling mud that has been augmented with drilling mud additives. Drilling mud that has not been mixed with additives can be land applied in North Dakota and Minnesota without a permit from a state agency.

- Drilling mud will not be land applied or disposed of on public lands. Enbridge must pre-authorize the planned action at each proposed land application location to ensure compliance with regulatory requirements and secure landowner approval. Enbridge will conduct a site inspection to confirm that the material will not be placed in a location that could lead to sediment being transported into adjacent surface waters. Drilling mud may also be hauled to an authorized off-site disposal facility in accordance with the requirements of that facility. Testing required by the landowner, applicable agency, or operator will be performed prior to disposal.

- The EI will regularly evaluate the potential for secondary impact from the cleanup process and cleanup activities will be terminated if physical damage to the site is deemed to exceed the benefits of removal activities. This decision will be made in consultation with the appropriate regulatory agencies and/or Enbridge in conformance with the required regulatory authorizations and all applicable federal, state and local regulations governing this activity.

11.6 RESTORATION AND POST-CONSTRUCTION MONITORING

Following cleanup activities, restoration and revegetation of affected areas will be completed in accordance with all applicable local, state, Tribal, and federal permits in addition to Enbridge's EPP. Enbridge will monitor the release site as appropriate to assure adequate restoration.

11.7 REPORTING AND DOCUMENTATION

Enbridge will record the following information in the event of an inadvertent release:

- Date and time of the release;
- Name of Contractor executing the HDD and names of personnel on-site and their roles, including EIs and IEMs;
- Stage of the HDD operation (e.g., pilot hole, ream pass number, type of reamer);
- Description of site-specific conditions at release site (e.g., upland, wetland, vegetation, slope, sensitive features);
- GPS coordinates as close as possible to the center of the inadvertent release;
- Photograph of the inadvertent release location (see Section 11.3), and photographs of the release;
- Description of the size of the release (volume and area);
- Identification of any drilling mud additives present in the release;
- Description of how the release was contained, including how access was achieved;
- Description of how the release was cleaned up, the volume of the recovered material, and the area that was completely cleaned up, including description of how access was achieved;
- Description of any released material that was not cleaned up, including why access was not achieved, the volume of the material that could not be recovered, and the area that was not accessible to clean up;
- Description of corrective actions implemented to avoid additional inadvertent release (e.g., complete pilot hole, incorporation of additives); and
- Description of additional monitoring efforts taken to detect additional potential releases (e.g., additional monitor on site).

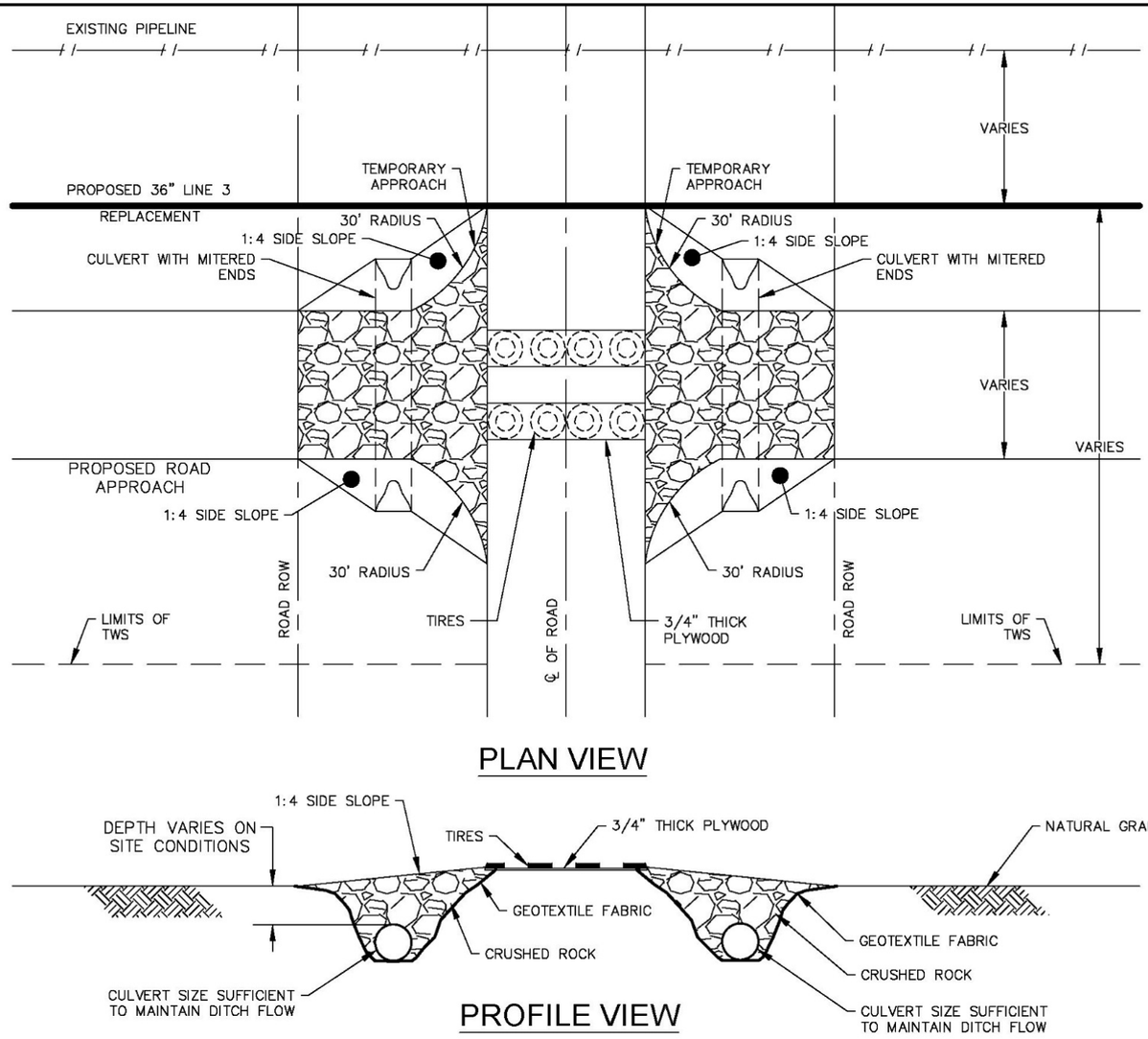
12.0 REFERENCES

Minnesota Board of Water & Soil Resources ("BWSR"). 2014. Minnesota Wetland Restoration Guide. 2nd Edition. Available online at: https://bwsr.state.mn.us/mn-wetland-restoration-guide. Accessed August 2019.

BWSR. 2019. Native Vegetation Establishment and Enhancement Guidelines. January 2019. Available online at: https://bwsr.state.mn.us/sites/default/files/2019-07/Updated%20guidelines%20Final%2007-01-19.pdf. Accessed August 2019.

Figures

Figure 1 Typical Temporary Rock Access Approach



ISSUED FOR PERMIT 09/16/20

NOTES:

1. ALL CULVERT PIPE OR ROCK ENDS OF ROAD ACCESS PADS MUST HAVE A 60 DEGREE ANGLE ON EACH END FOR SAFETY.
2. ALL TIRES AND PLYWOOD MUST BE STORED OUTSIDE ROAD ROW.
3. CULVERTS MUST MEET REQUIREMENTS SET FORTH IN PERMITS FROM AUTHORITY WITH JURISDICTION.
4. CONTRACTORS SHALL SCRAPE OR BRUSH ANY DEBRIS FROM ROAD PER EPP.
5. ALL SLOPES MUST HAVE A MINIMUM GRADE OF 1:4

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
I	ISSUED FOR PERMIT	JDW	09/16/20	KEH	MDM
H	ISSUED FOR REVIEW	DWA	11/04/19	KEH	MDM

		DATE
DWN. BY:	YL	06/07/16
CHK.	KEH	01/11/18
PROJ. ENGR.	MDM	01/11/18
PROJ. MGR.	BS	01/11/18
CLIENT APP.		

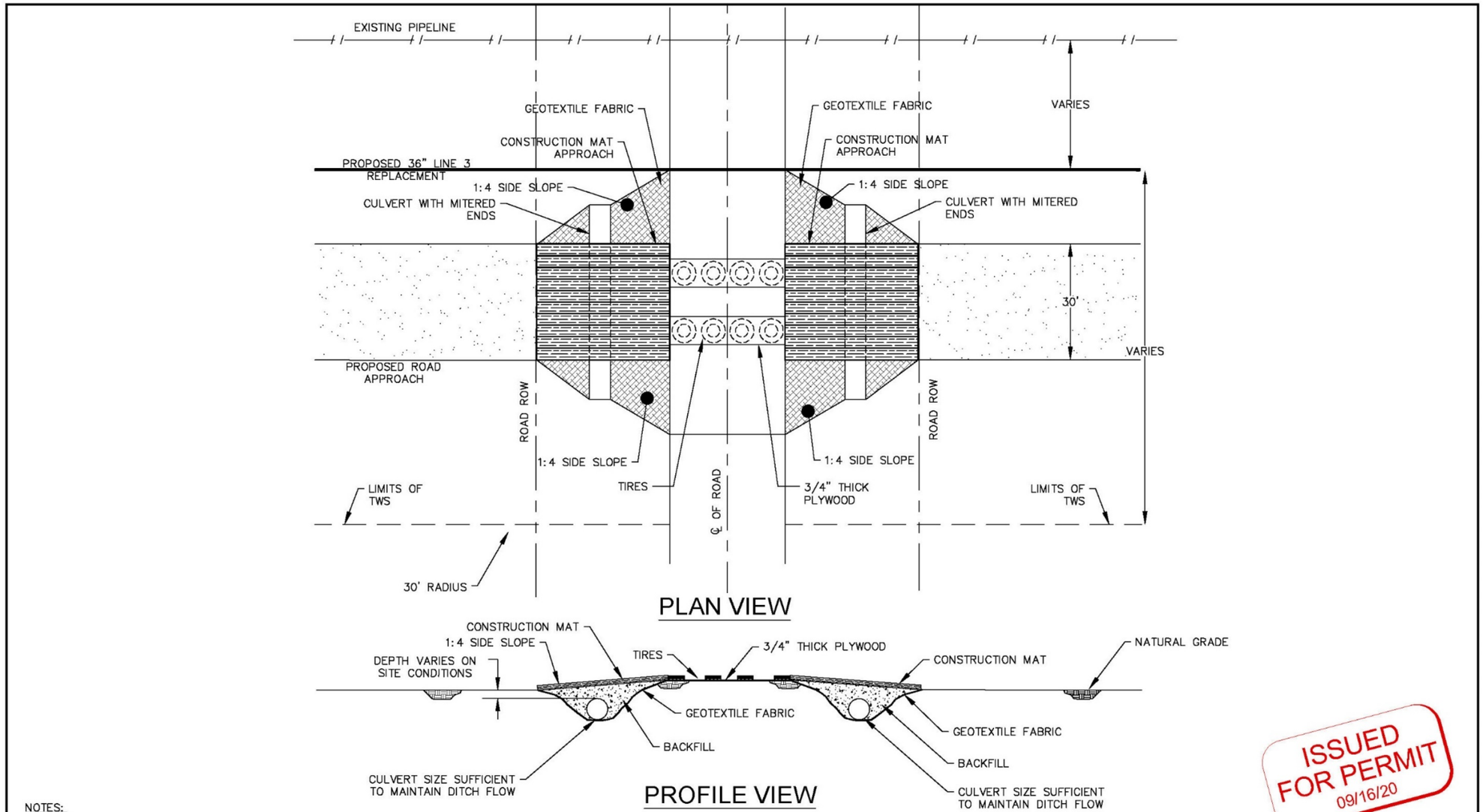
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
TEMPORARY ROCK
ACCESS APPROACH

SCALE: NTS

DWG. NO.

Figure 2 Typical Temporary Construction Mat Approach



NOTES:

1. ALL CULVERT PIPE OR ROCK ENDS OF ROAD ACCESS PADS MUST HAVE A 60 DEGREE ANGLE ON EACH END FOR SAFETY.
2. ALL TIRES AND PLYWOOD MUST BE STORED OUTSIDE ROAD ROW.
3. CULVERTS MUST MEET REQUIREMENTS SET FORTH IN PERMITS FROM AUTHORITY WITH JURISDICTION.
4. TO BE USED ONLY WHERE APPROVED.
5. ALL SLOPES MUST HAVE A MINIMUM GRADE OF 1:4
6. USE CRUSHED ROCK AS FILL IN WETLANDS ON TOP OF GEOTEXTILE FABRIC.
7. CONTRACTORS SHALL SCRAPE OR BRUSH ANY DEBRIS FROM ROAD PER EPP.

ISSUED FOR PERMIT 09/16/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
I	ISSUED FOR PERMIT	JDW	09/16/20	KEH	MDM
H	ISSUED FOR REVIEW	DWA	11/04/19	KEH	MDM

		DATE
DWN. BY:	YL	06/07/16
CHK.	KEH	01/11/18
PROJ. ENGR.	MDM	01/11/18
PROJ. MGR.	BS	01/11/18
CLIENT APP.		

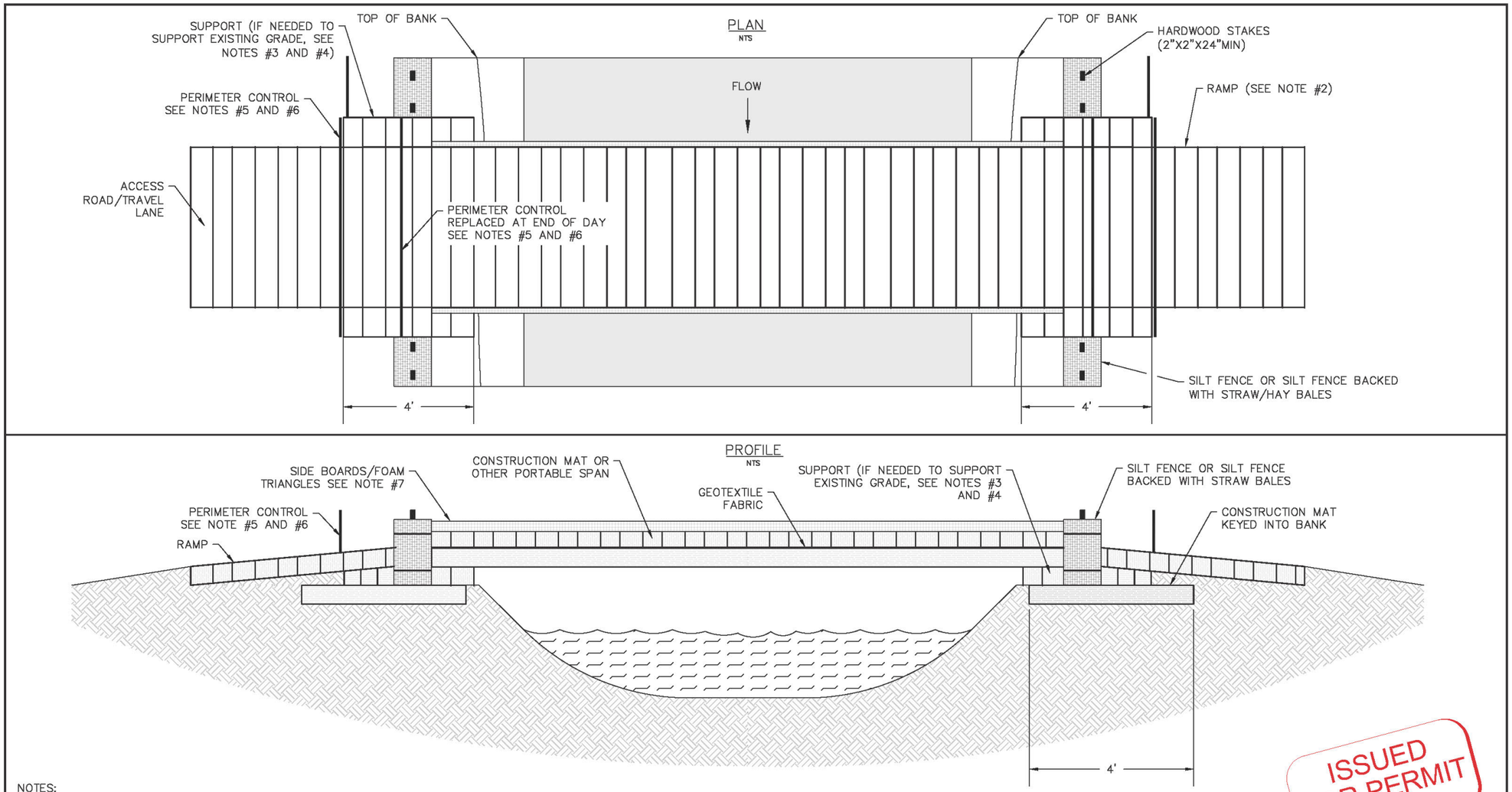
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
TEMPORARY CONSTRUCTION
MAT APPROACH

SCALE: NTS

DWG. NO.

Figure 3 Typical Clear Span Bridge



NOTES:

1. INSPECT BRIDGE OPENING PERIODICALLY AND REMOVE ANY DEBRIS RESTRICTING FLOW.
2. IF PHYSICAL CIRCUMSTANCES PROHIBIT WOOD OR METAL RAMPS, EARTHEN RAMPS MAY BE USED AS APPROVED– NO TOPSOIL.
3. INSPECT BRIDGE ELEVATION SO BRIDGE REMAINS SUPPORTED ABOVE OHWM.
4. THE BRIDGE MUST SPAN ABOVE OHWM TO OHWM. MAY/WILL HAVE SINGLE SPAN ENGINEERING BRIDGES OVER 13'.
5. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSPECTED AND MAINTAINED IN ACCORDANCE WITH THE COMPANY'S ENVIRONMENTAL PROTECTION PLAN SECTION 2.2.
6. REDUNDANT CONTROLS LOCATED PER SWPPP SECTION 3.4.1.
7. SIDEBOARDS WILL BE INSTALLED ON TEMPORARY BRIDGES TO MINIMIZE THE POTENTIAL FOR SEDIMENT TRANSPORT, AND AFFIXED TO THE OUTERSIDE OF THE BRIDGE. GEOTEXTILE FABRIC, OR EQUIVALENT, MUST ALSO BE ADEQUATELY SECURED TO THE UNDERSIDE OF THE BRIDGE TO PREVENT MATERIAL FROM FALLING THROUGH THE BRIDGE DECK. THE GEOTEXTILE FABRIC OR AN EQUIVALENT SHOULD BE SECURED TO THE BOTTOM OF THE BRIDGE AND WRAPPED AROUND THE SIDEBOARDS IN A CONTINUOUS FASHION.

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
E	ISSUED FOR PERMIT	JDW	10/22/20	KEH	NKD
D	ISSUED FOR PERMIT	JDW	10/13/20	KEH	NKD
C	ISSUED FOR PERMIT	JDW	09/21/20	KEH	NKD
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	NKD
A	ISSUED FOR REVIEW	JDW	11/04/19	KEH	NKD

DWN. BY: KEH	DATE 8/16/18	
CHK. NKD	8/16/18	
PROJ. ENGR. CP	8/16/18	
PROJ. MGR. BS	8/16/18	
CLIENT APP.		

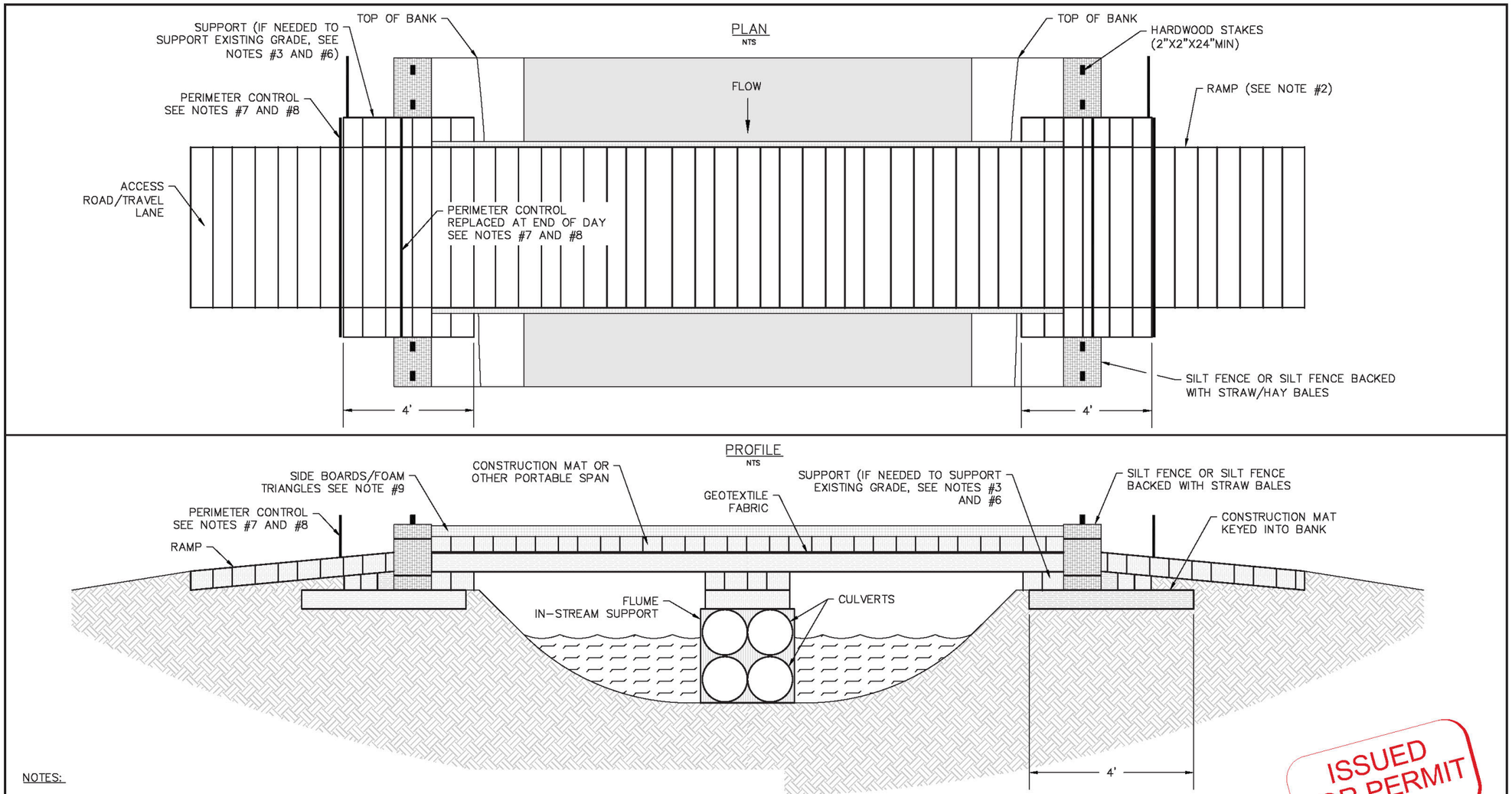
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
CLEAR SPAN BRIDGE

SCALE NTS | DWG. NO.

ISSUED FOR PERMIT 10/22/20

Figure 4 Typical Non-Clear Span Bridge



NOTES:

1. INSPECT BRIDGE OPENING PERIODICALLY AND REMOVE ANY DEBRIS RESTRICTING FLOW.
2. IF PHYSICAL CIRCUMSTANCES PROHIBIT WOOD OR METAL RAMPS, EARTHEN RAMPS MAY BE USED AS APPROVED– NO TOPSOIL.
3. INSPECT BRIDGE ELEVATION SO BRIDGE REMAINS SUPPORTED ABOVE OHWM.
4. THE CULVERT SUPPORT MUST BE PLACED ON THE STREAM BOTTOM AND MAY NOT BE SUPPORTED WITH FILL.
5. THE BRIDGE MUST SPAN ABOVE OHWM TO OHWM.
6. ADDITIONAL SUPPORT MUST BE ADDED ON TOP OF BANK AND UNDER SPAN IF INITIAL SUPPORT STARTS TO SETTLE.
7. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSPECTED AND MAINTAINED IN ACCORDANCE WITH THE COMPANY'S ENVIRONMENTAL PROTECTION PLAN SECTION 2.2.
8. REDUNDANT CONTROLS LOCATED PER SWPPP SECTION 3.4.1.
9. SIDEBOARDS WILL BE INSTALLED ON TEMPORARY BRIDGES TO MINIMIZE THE POTENTIAL FOR SEDIMENT TRANSPORT, AND AFFIXED TO THE OUTERSIDE OF THE BRIDGE. GEOTEXTILE FABRIC, OR EQUIVALENT, MUST ALSO BE ADEQUATELY SECURED TO THE UNDERSIDE OF THE BRIDGE TO PREVENT MATERIAL FROM FALLING THROUGH THE BRIDGE DECK. THE GEOTEXTILE FABRIC OR AN EQUIVALENT SHOULD BE SECURED TO THE BOTTOM OF THE BRIDGE AND WRAPPED AROUND THE SIDEBOARDS IN A CONTINUOUS FASHION.

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NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
D	ISSUED FOR PERMIT	JDW	10/13/20	KEH	NKD
C	ISSUED FOR PERMIT	JDW	09/21/20	KEH	NKD
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	NKD
A	ISSUED FOR REVIEW	JDW	11/04/19	KEH	NKD

		DATE
DWN. BY:	KEH	8/16/18
CHK.	NKD	8/16/18
PROJ. ENGR.	CP	8/16/18
PROJ. MGR.	BS	8/16/18
CLIENT APP.		

ENBRIDGE

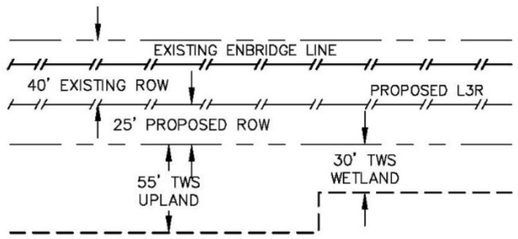
LINE 3 REPLACEMENT
TYPICAL
NON-CLEAR SPAN BRIDGE

SCALE NTS

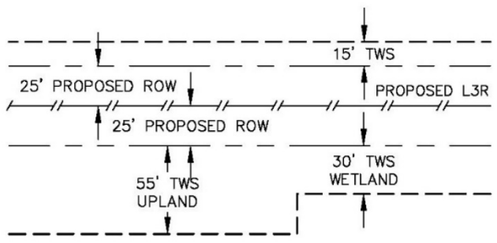
DWG. NO.

Figure 5 Typical Workspaces and Permanent ROW

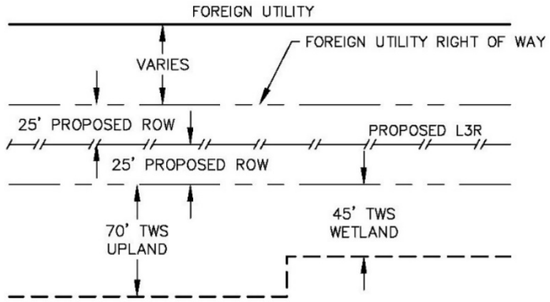
CO–LOCATED WITH ENBRIDGE LINES



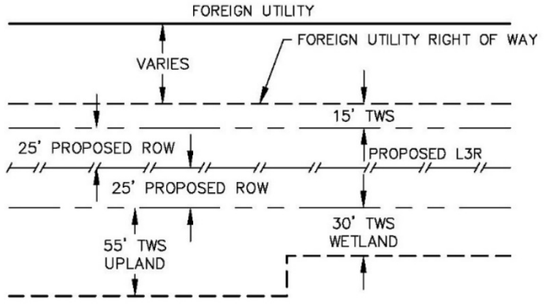
GREENFIELD



CO–LOCATED WITH FOREIGN UTILITY



CO–LOCATED WITH FOREIGN UTILITY
IN SATURATED WETLANDS



ISSUED FOR PERMIT
09/16/20

NOTES:

1. WORK SPACE AND LINE SPACING SHOWN IS TYPICAL FOR MOST SITUATIONS, TYPICAL CONSTRUCTION RIGHT OF WAY LIMITS ARE 120' IN UPLANDS, 95' IN WETLANDS.
2. ADDITIONAL NECK DOWNS MAY BE REQUIRED FOR ENVIRONMENTAL, AGENCY, OR LANDOWNER CONCERNS. REFER TO CONSTRUCTION ALIGNMENT SHEETS AND LINE LIST FOR FINAL CONSTRUCTION SPACING.
3. DIMENSIONS AND LOCATIONS OF ADDITIONAL TEMPORARY WORKSPACE VARY AND ARE BASED ON SITE SPECIFIC CONDITIONS.

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
E	ISSUED FOR PERMIT	JDW	09/16/20	KEH	MDM
D	ISSUED FOR REVIEW	AJM	11/04/19	KEH	MDM

DWN. BY: JDW	DATE	07/03/17
CHK. KEH		08/04/17
PROJ. ENGR. MDM		08/04/17
PROJ. MGR. BS		08/04/17
CLIENT APP.		

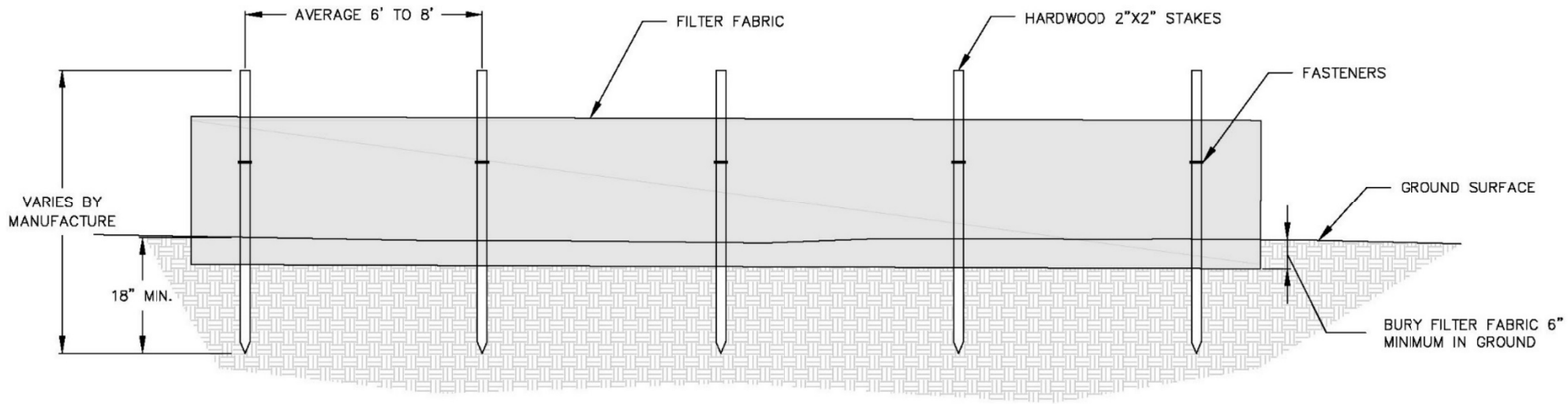
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
WORKSPACES AND PERMANENT ROW

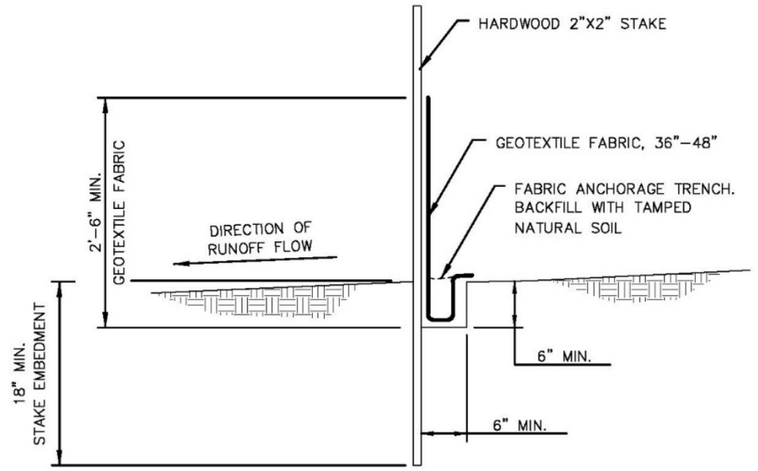
SCALE: NTS

DWG. NO.

Figure 6 Typical Silt Fence



SILT FENCE
PLAN



SILT FENCE
PROFILE

ISSUED FOR PERMIT
09/21/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	JDW	09/21/20	ND	RF
B	ISSUED FOR PERMIT	JDW	09/16/20	ND	RF
A	ISSUED FOR REVIEW	JDW	11/04/19	ND	RF

		DATE
DWN. BY:	KEH	7/11/19
CHK.	ND	7/11/19
PROJ. ENGR.	RF	11/01/19
PROJ. MGR.	TL	11/01/19
CLIENT APP.		

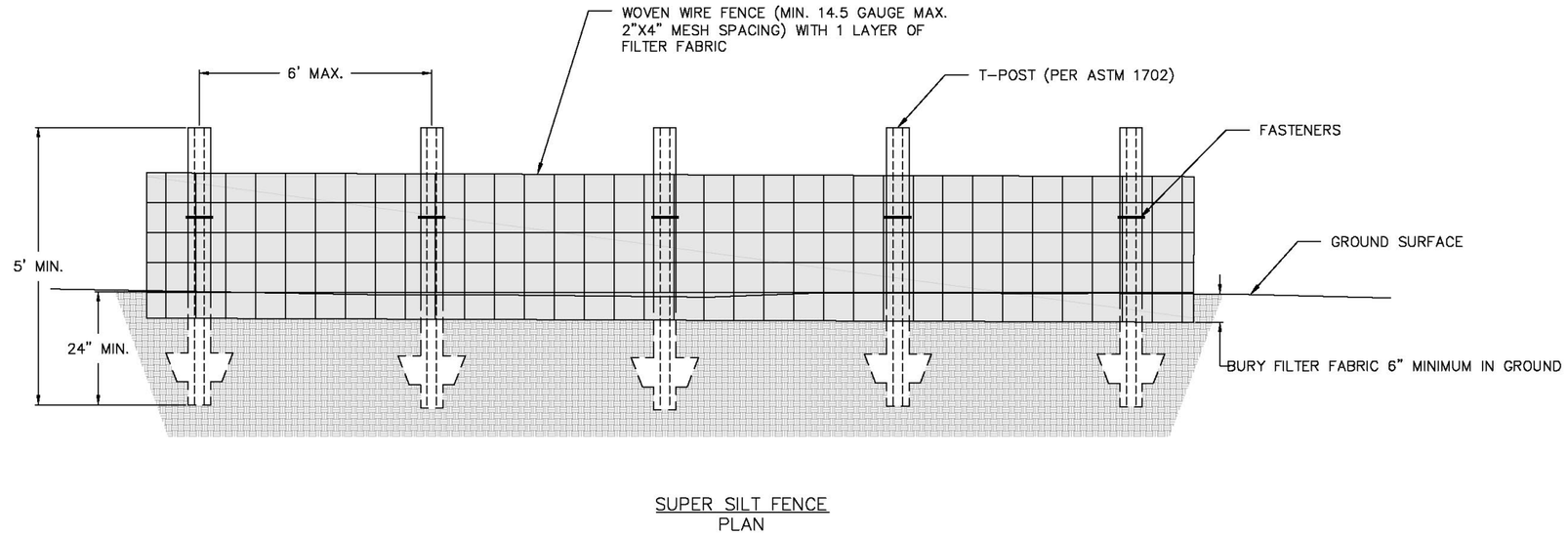
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
SILT FENCE

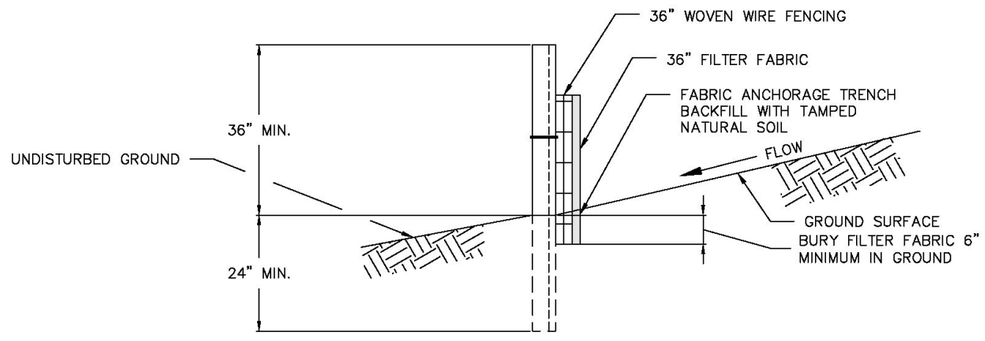
SCALE: NTS

DWG. NO.

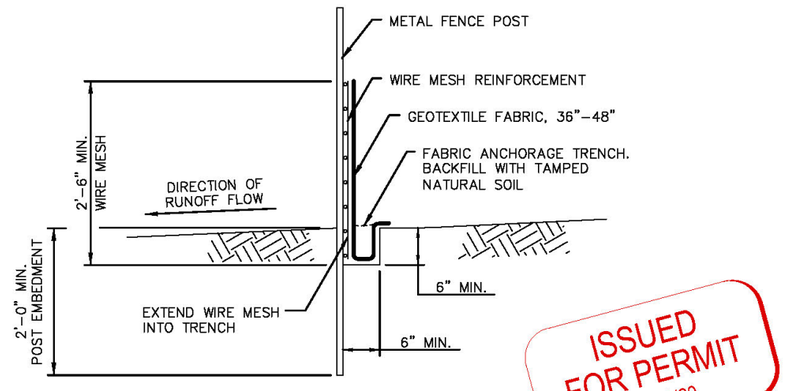
Figure 7 Typical Super Silt Fence



SUPER SILT FENCE
PLAN



36" SUPER SILT FENCE
SECTION



48" SUPER SILT FENCE
SECTION

ISSUED FOR PERMIT
09/21/20

NOTES:

1. FENCE POST SPACING SHALL NOT EXCEED 6' TO CENTER.
2. WOVEN WIRE FENCE TO BE FASTENED SECURELY TO T-POSTS WITH EITHER ZIP TIES OR WIRE TIES THAT HAVE A MINIMUM TENSILE STRENGTH OF 50 LBS.
3. FILTER FABRIC TO BE FASTENED TO WOVEN WIRE FENCE.
4. WHEN TWO SECTIONS OF FILTER FABRIC ADJOIN EACH OTHER THEY SHALL BE OVERLAPPED BY SIX INCHES AND FOLDED.
5. MAINTENANCE SHALL BE PERFORMED AS NEEDED BY ENBRIDGE EPP.
6. ENBRIDGE WILL NOT REQUIRE SUBMITTALS AS SPECIFIED IN ASTM A702.
7. FILTER FABRIC WILL CONSIST OF SD WOVEN OR NON-WOVEN GEOTEXTILE MATERIAL THAT IS A GRAB TENSILE STRENGTH OF 100 LBS, AN APPARENT OPENING SIZE OF A NO. 30 SIEVE, A UV STABILITY 500 H AT 70%.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
F	ISSUED FOR PERMIT	JDW	09/21/20	KEH	KD
E	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
D	ISSUED FOR REVIEW	AJM	11/04/19	KEH	KD

		DATE
DWN. BY:	JDW	04/25/19
CHK.	KEH	04/30/19
PROJ. ENGR.	DG	04/30/19
PROJ. MGR.	KD	04/30/19
CLIENT APP.		

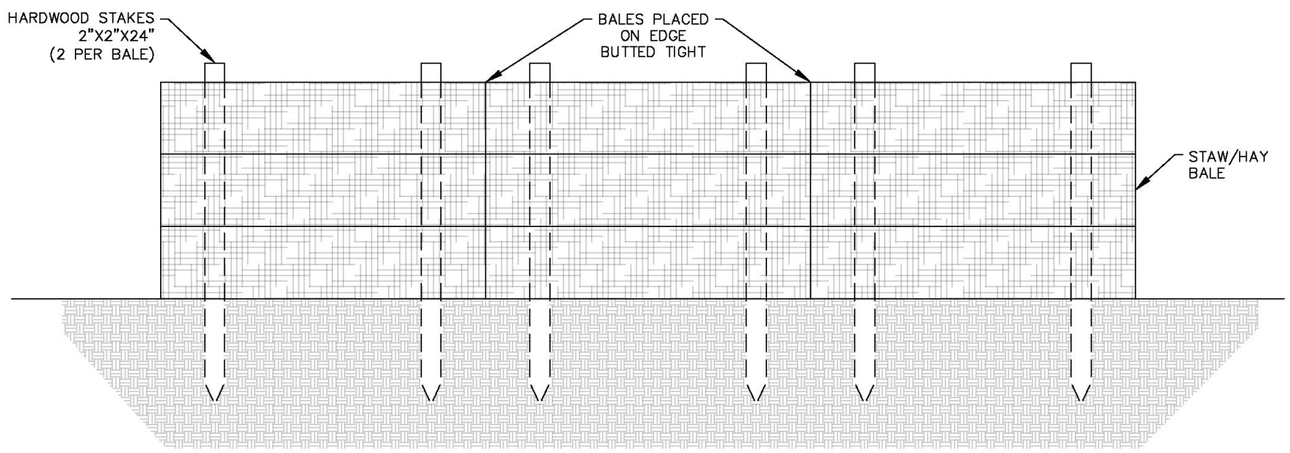
ENBRIDGE

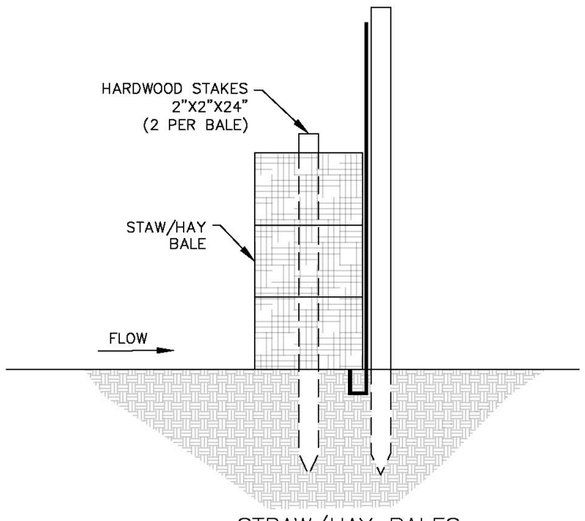
LINE 3 REPLACEMENT
TYPICAL
SUPER SILT FENCE

SCALE: NTS

DWG. NO.

Figure 8 Typical Straw or Hay Bale Installation





STRAW/HAY BALES
& SILT FENCE
NOT TO SCALE

STRAW/HAY BALES ONLY
NOT TO SCALE

ISSUED
FOR PERMIT
09/16/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	ND	KMD
A	ISSUED FOR REVIEW	JDW	11/04/19	ND	KMD

		DATE
DWN. BY:	JDW	04/04/19
CHK.	ND	04/04/19
PROJ. ENGR.	KMD	04/04/19
PROJ. MGR.	BS	04/04/19
CLIENT APP.		

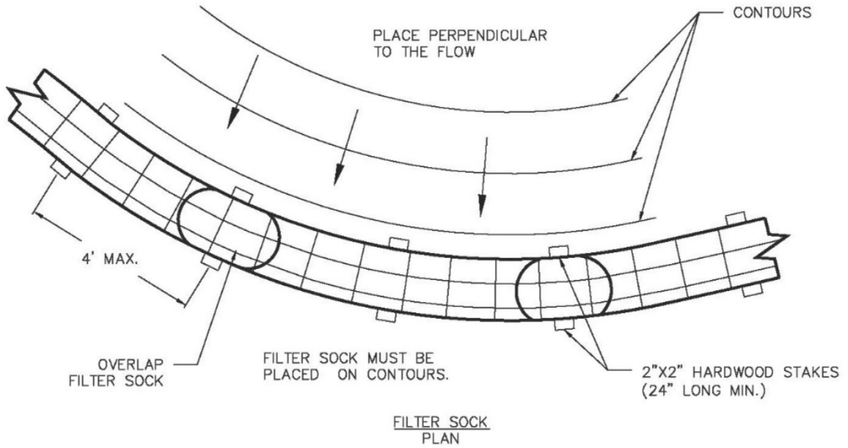
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
STRAW/HAY-BALE INSTALLATION

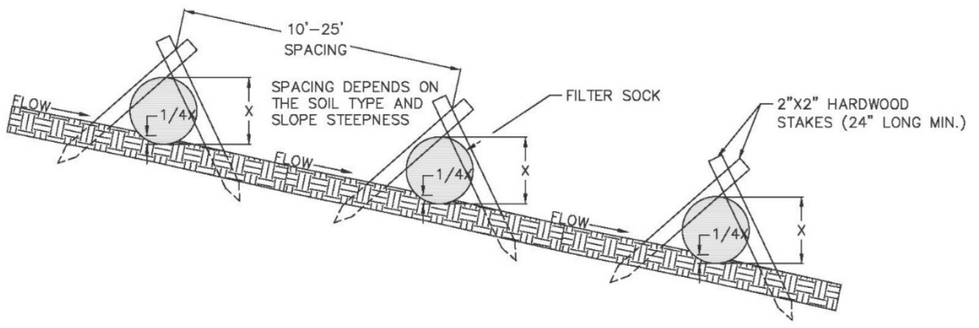
SCALE: NTS

DWG. NO.

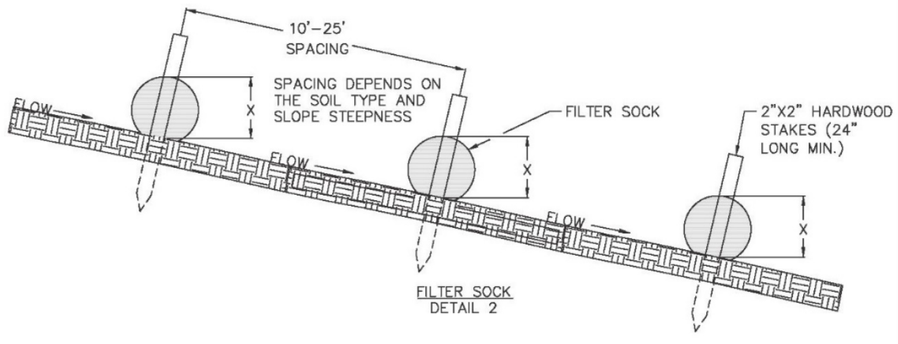
Figure 9 Typical Filter Sock



FILTER SOCK
PLAN



FILTER SOCK
DETAIL 1



FILTER SOCK
DETAIL 2

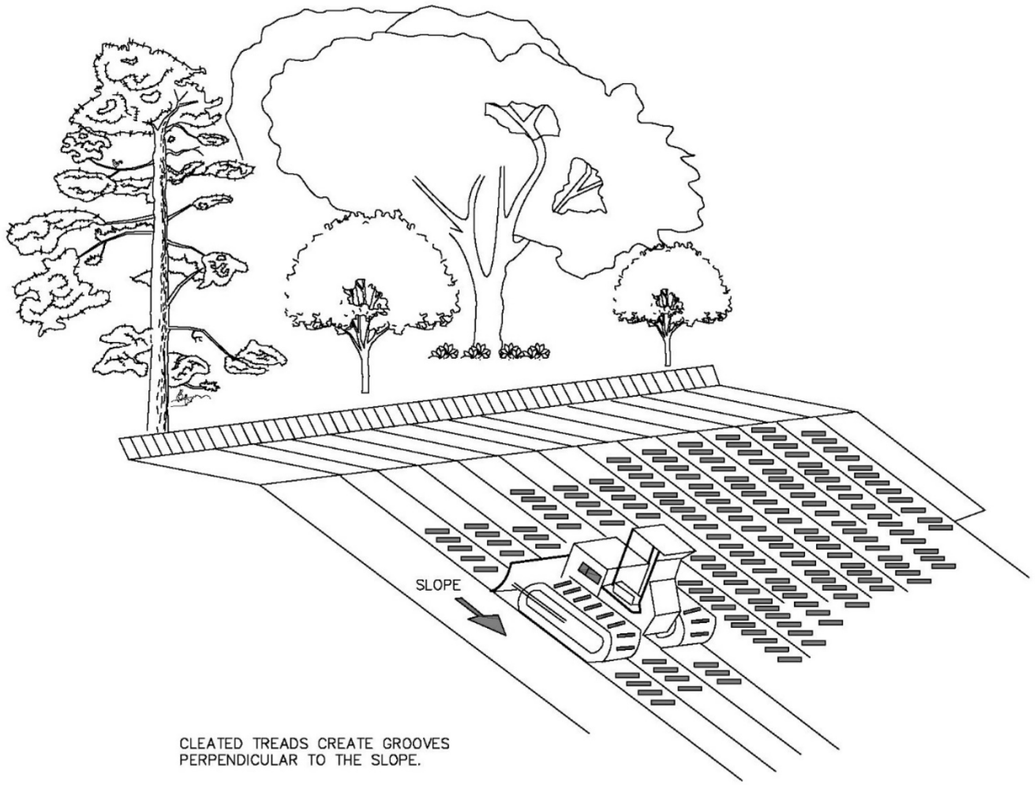
NOTES:
1. FILTER SOCKS WILL BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS.
2. FILTER SOCKS RANGE FROM 4" TO 24" IN DIAMETER. "X" REPRESENTS THE DIAMETER FOR THE SOCK.
3. FILTER SOCKS MAY BE INSTALLED AT GRADE AS ILLUSTRATED IN DETAIL 2, BUT MUST BE MONITORED FOR PERFORMANCE. IF PERFORMANCE AT GRADE IS NOT ACCEPTABLE, FILTER SOCK SHOULD BE TRENCHED IN AS ILLUSTRATED IN DETAIL 1. "1/4X" REPRESENTS THE DEPTH OF TRENCHING THE FILTER SOCK IN DETAIL 1.
4. STAKING WILL BE PERFORMED PER THE MANUFACTURER'S SPECIFICATIONS.

ISSUED FOR PERMIT 10/22/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
I	ISSUED FOR PERMIT	JDW	10/22/20	KEH	KD
H	ISSUED FOR PERMIT	JDW	10/07/20	KEH	KD
G	ISSUED FOR PERMIT	JDW	09/21/20	KEH	KD
F	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
E	ISSUED FOR REVIEW	DWA	11/04/19	KEH	KD

DWN. BY: JDW	DATE 04/25/19	ENBRIDGE
CHK. KEH	04/30/19	LINE 3 REPLACEMENT TYPICAL FILTER SOCK
PROJ. ENGR. DG	04/30/19	
PROJ. MGR. KD	04/30/19	
CLIENT APP.		SCALE NTS / DWG. NO.

Figure 10 Typical Cat Tracking



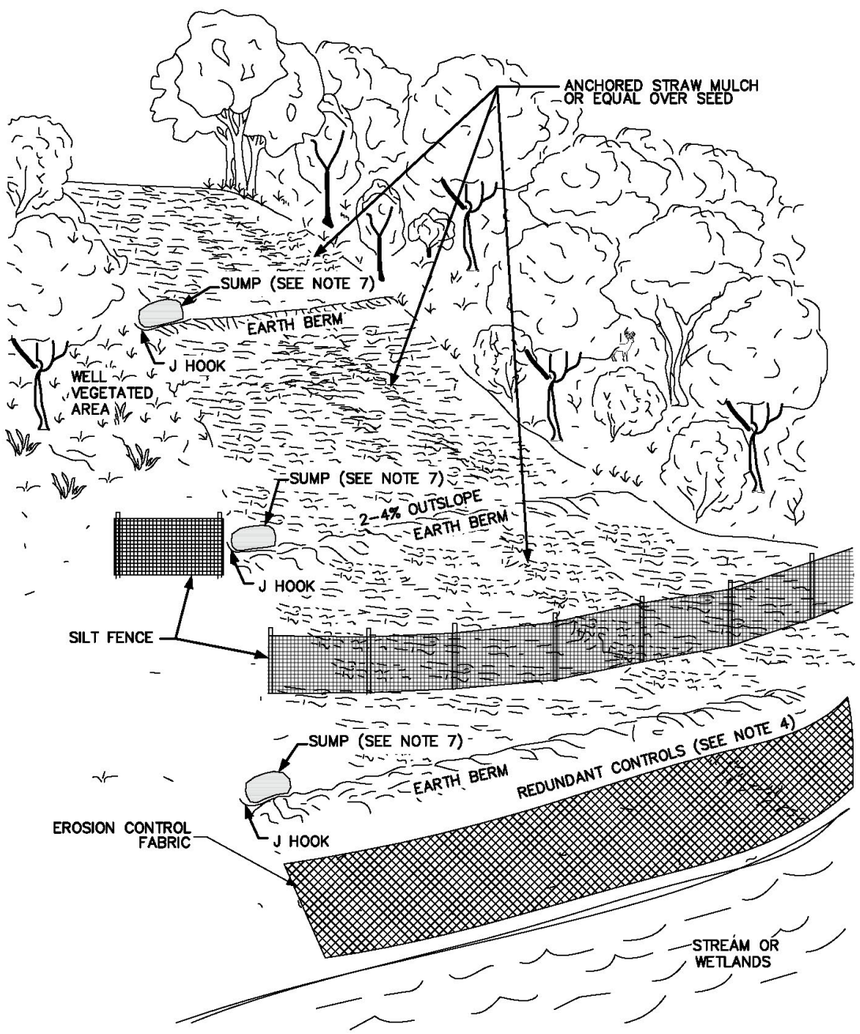
CLEATED TREADS CREATE GROOVES
PERPENDICULAR TO THE SLOPE.

ISSUED
FOR PERMIT
09/16/20

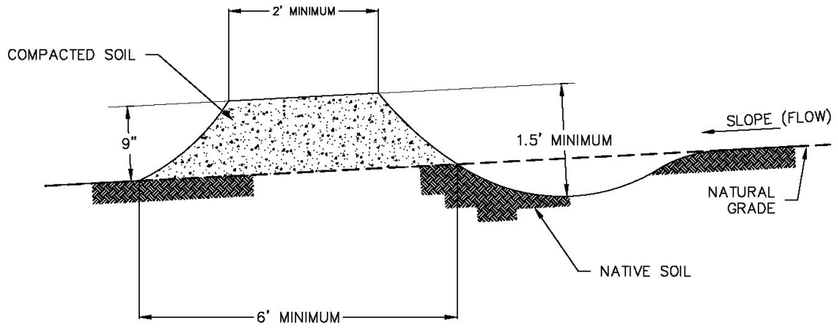
NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
A	ISSUED FOR REVIEW	AJM	11/04/19	KEH	KD

DWN. BY: AJM	DATE: 04/25/19	ENBRIDGE
CHK. KEH	04/30/19	LINE 3 REPLACEMENT TYPICAL CAT TRACKING
PROJ. ENGR. KN	04/30/19	
PROJ. MGR. BB	04/30/19	
CLIENT APP.		SCALE: NTS / DWG. NO.

Figure 11 Typical Temporary Slope Breakers – Perspective View



PERSPECTIVE VIEW



EARTH BERM DETAIL

NOTES:

1. BERMS SHALL BE CONSTRUCTED WITH 2 TO 4 PERCENT OUTSLOPE.
2. BERMS SHALL BE OUTLETED TO WELL VEGETATED STABLE AREAS, FILTER SOCKS, SILT FENCES, STRAW BALES, ROCK APRONS, OR SUMPS.
3. SILT FENCE REMOVED WHEN VEGETATION ESTABLISHED.
4. LOWEST BERM MAY BE OMITTED IF SILT FENCE OR STRAW BALES ARE INSTALLED AT THAT LOCATION, SUBJECT TO APPROVAL.
5. SEE SECTION 2.2 REGARDING ECD PLACEMENT AT SURFACE WATERS.
6. BERMS SHALL BE PLACED AS LISTED BELOW:
7. PERCENT OF SLOPE AND DISTANCE OF RUN WILL DETERMINE SIZE OF SUMP.

SLOPE%	APPROXIMATE SPACING (FT)
3–5	250
5–15	200
15–25	150
>25	<100

ISSUED FOR PERMIT 09/16/20

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
B	ISSUED FOR REVIEW	JDW	01/10/20	KEH	KD
A	ISSUED FOR REVIEW	DWA	11/04/19	KEH	KD

		DATE
DWN. BY:	DWA	10/25/19
CHK.	KEH	10/25/19
PROJ. ENGR.	DG	10/25/19
PROJ. MGR.	KD	10/25/19
CLIENT APP.		

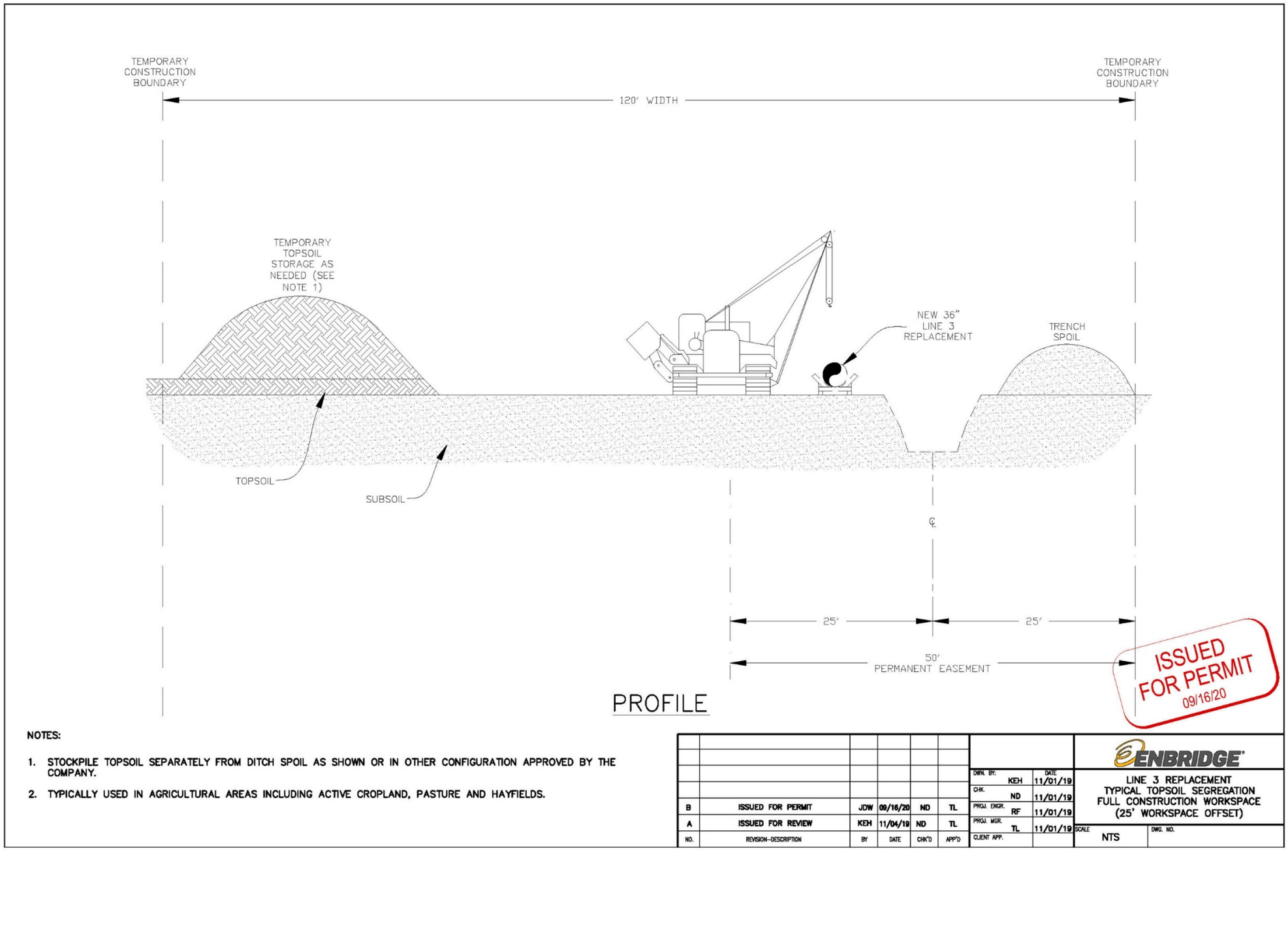
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
TEMPORARY SLOPE BREAKERS
PERSPECTIVE & ELEVATION VIEW

SCALE: NTS

DWG. NO.

Figure 12 Typical Topsoil Segregation – Full Construction Workspace (25' workspace offset)



PROFILE

NOTES:

1. STOCKPILE TOPSOIL SEPARATELY FROM DITCH SPOIL AS SHOWN OR IN OTHER CONFIGURATION APPROVED BY THE COMPANY.
2. TYPICALLY USED IN AGRICULTURAL AREAS INCLUDING ACTIVE CROPLAND, PASTURE AND HAYFIELDS.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	ND	TL
A	ISSUED FOR REVIEW	KEH	11/04/19	ND	TL

		DATE
DWN. BY:	KEH	11/01/19
CHK.	ND	11/01/19
PROJ. ENGR.	RF	11/01/19
PROJ. MGR.	TL	11/01/19
CLIENT APP.		

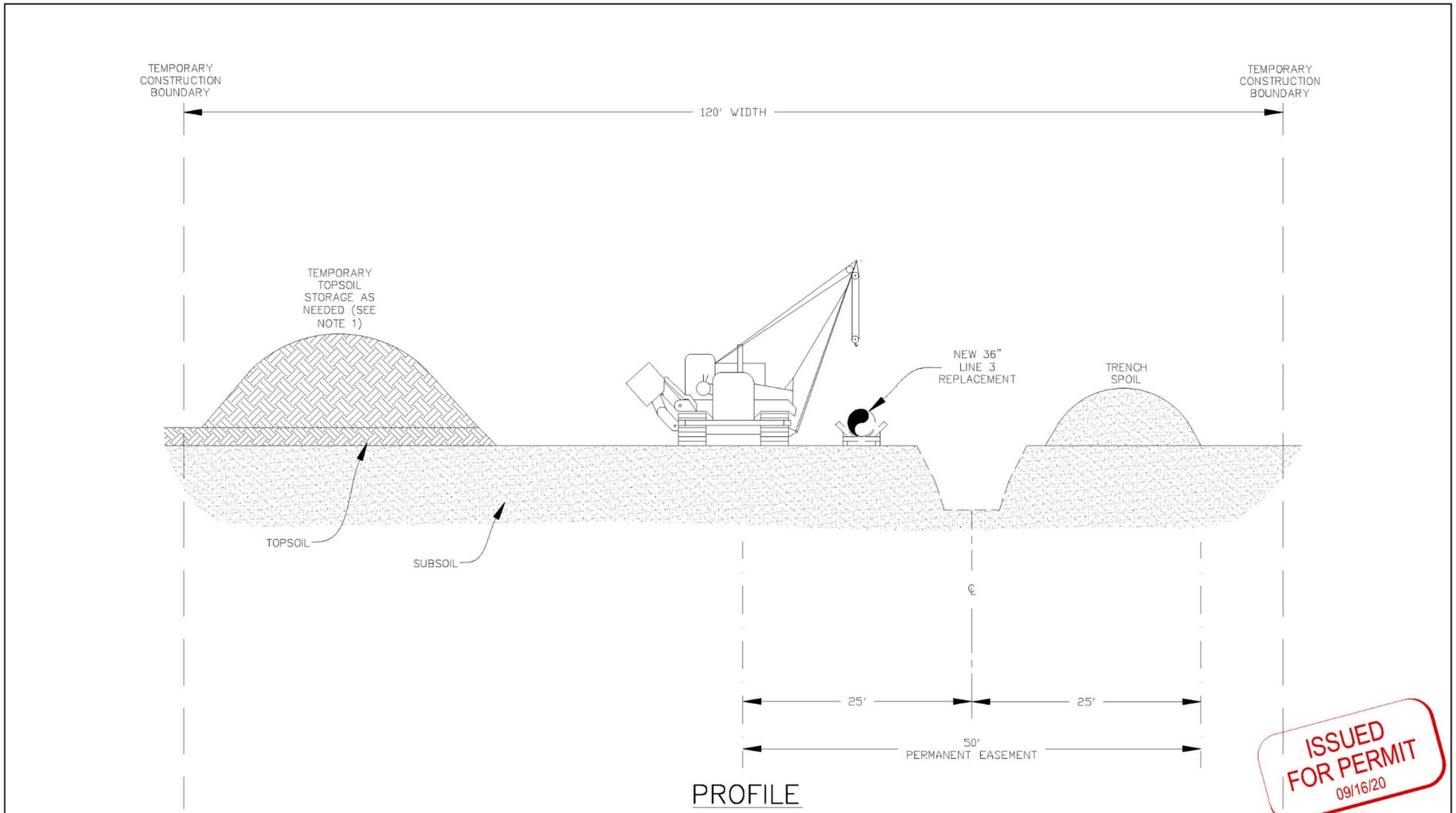
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL TOPSOIL SEGREGATION
FULL CONSTRUCTION WORKSPACE
(25' WORKSPACE OFFSET)

SCALE: NTS

DWG. NO.

Figure 13 Typical Topsoil Segregation – Full Construction Workspace (40’ workspace offset)



PROFILE

ISSUED FOR PERMIT 09/16/20

NOTES:

1. STOCKPILE TOPSOIL SEPARATELY FROM DITCH SPOIL AS SHOWN OR IN OTHER CONFIGURATION APPROVED BY THE COMPANY.
2. TYPICALLY USED IN AGRICULTURAL AREAS INCLUDING ACTIVE CROPLAND, PASTURE AND HAYFIELDS.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	ND	TL
A	ISSUED FOR REVIEW	KEH	11/04/19	ND	TL

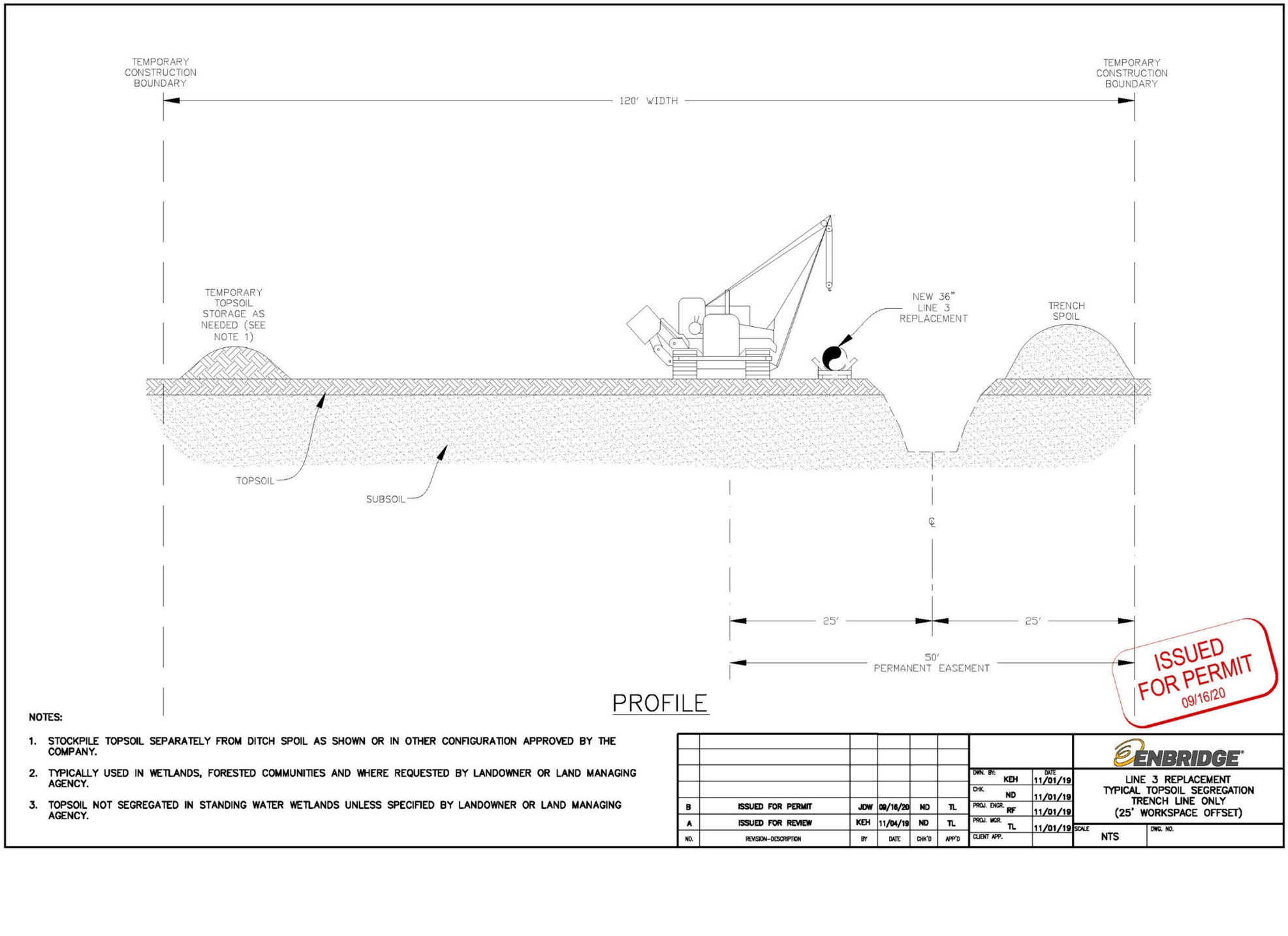
		DATE
DWN. BY:	KEH	11/01/19
CHK.	ND	11/01/19
PROJ. ENGR.	RF	11/01/19
PROJ. MGR.	TL	11/01/19
CLIENT APP.		

ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL TOPSOIL SEGREGATION
FULL CONSTRUCTION WORKSPACE
(40' WORKSPACE OFFSET)

SCALE: NTS DWG. NO.

Figure 14 Typical Topsoil Segregation – Trench Line Only (25’ workspace offset)



PROFILE

NOTES:

1. STOCKPILE TOPSOIL SEPARATELY FROM DITCH SPOIL AS SHOWN OR IN OTHER CONFIGURATION APPROVED BY THE COMPANY.
2. TYPICALLY USED IN WETLANDS, FORESTED COMMUNITIES AND WHERE REQUESTED BY LANDOWNER OR LAND MANAGING AGENCY.
3. TOPSOIL NOT SEGREGATED IN STANDING WATER WETLANDS UNLESS SPECIFIED BY LANDOWNER OR LAND MANAGING AGENCY.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	ND	TL
A	ISSUED FOR REVIEW	KEH	11/04/19	ND	TL

		DATE
DWN. BY:	KEH	11/01/19
CHK.	ND	11/01/19
PROJ. ENGR.	RF	11/01/19
PROJ. MGR.	TL	11/01/19
CLIENT APP.		

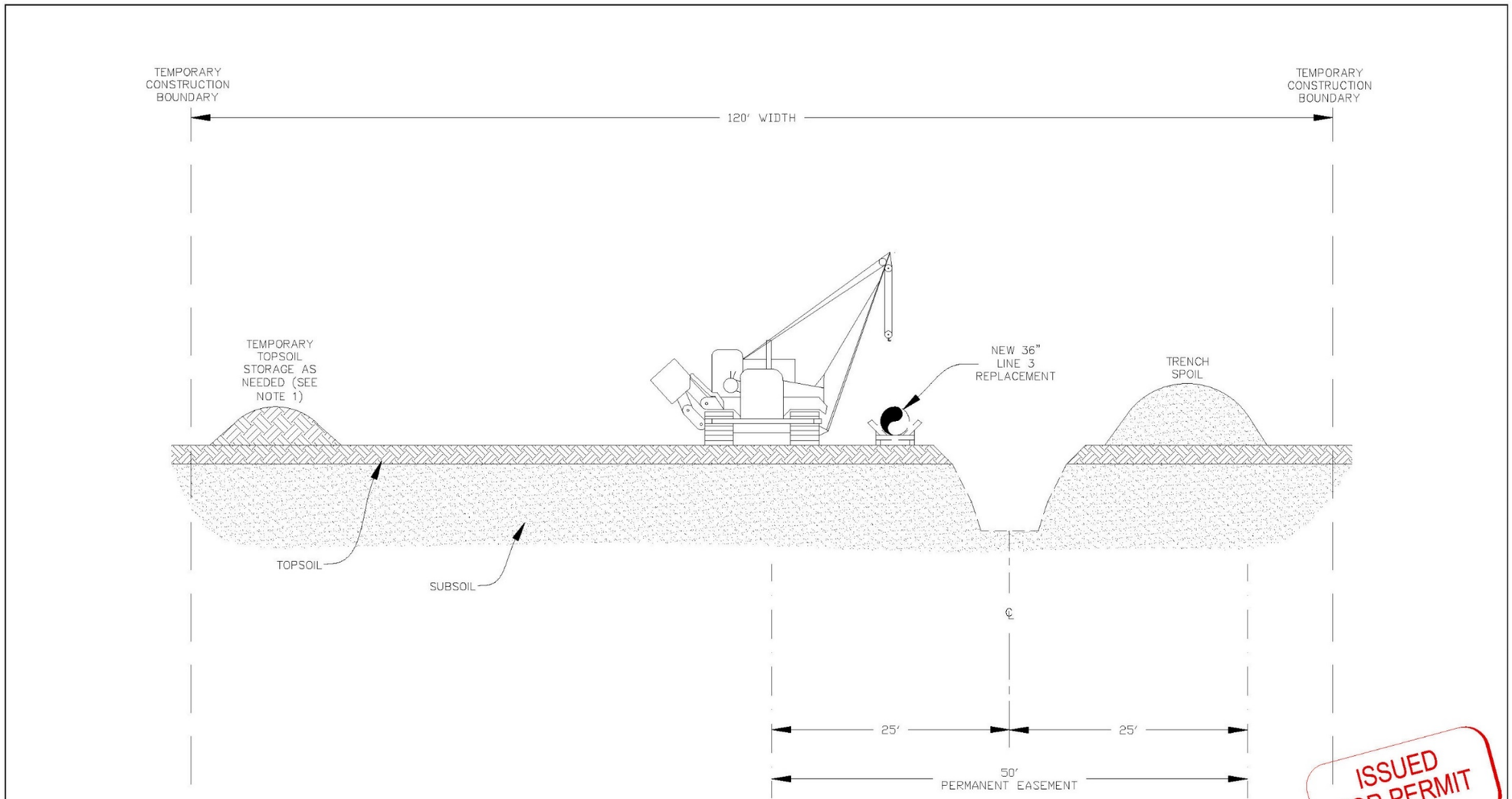
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL TOPSOIL SEGREGATION
TRENCH LINE ONLY
(25' WORKSPACE OFFSET)

SCALE: NTS

DWG. NO.

Figure 15 Typical Topsoil Segregation – Trench Line Only (40’ workspace offset)



PROFILE

ISSUED FOR PERMIT 09/16/20

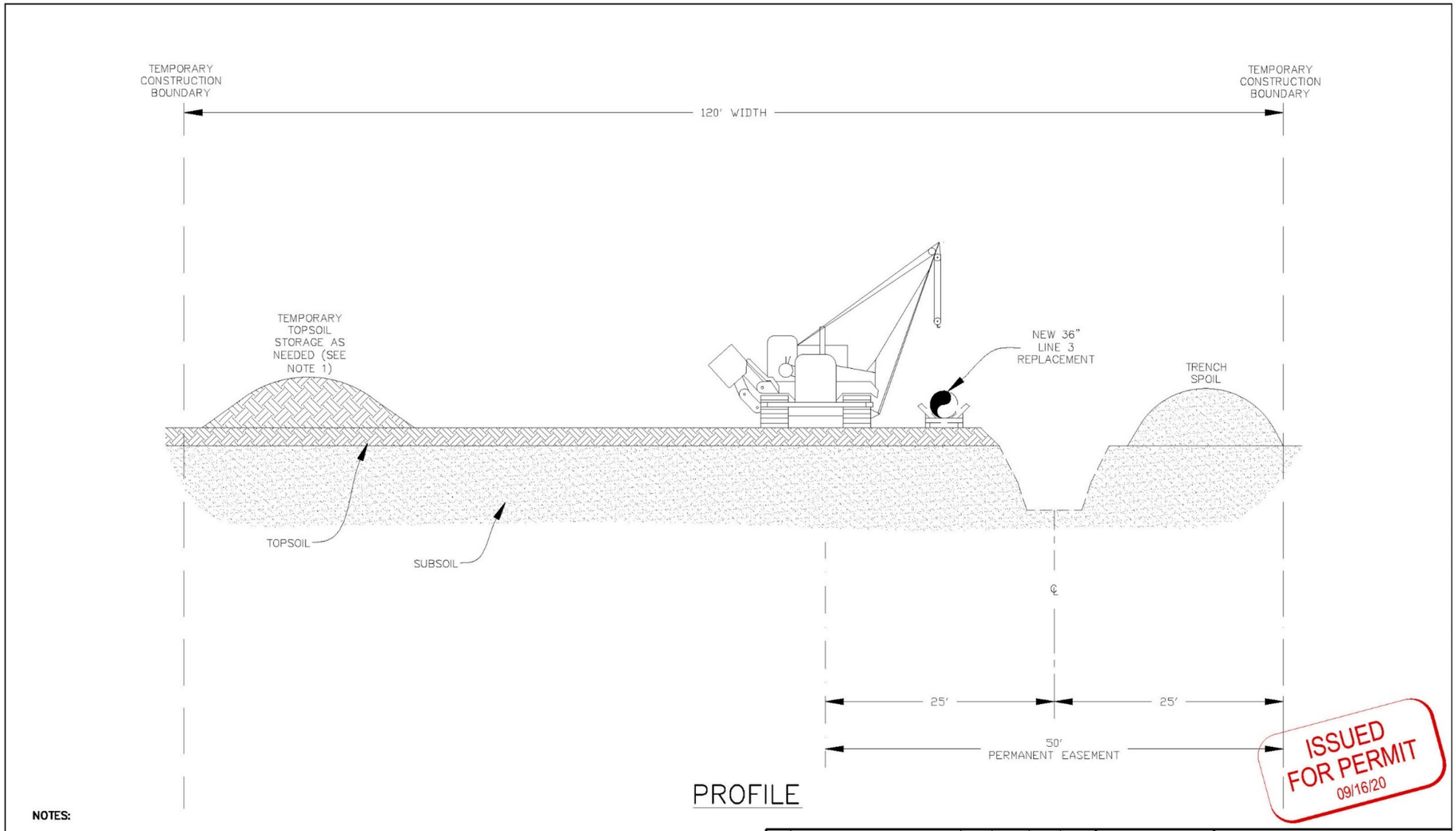
NOTES:

1. STOCKPILE TOPSOIL SEPARATELY FROM DITCH SPOIL AS SHOWN OR IN OTHER CONFIGURATION APPROVED BY THE COMPANY.
2. TYPICALLY USED IN WETLANDS, FORESTED COMMUNITIES AND WHERE REQUESTED BY LANDOWNER OR LAND MANAGING AGENCY.
3. TOPSOIL NOT SEGREGATED IN STANDING WATER WETLANDS UNLESS SPECIFIED BY LANDOWNER OR LAND MANAGING AGENCY.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	ND	TL
A	ISSUED FOR REVIEW	KEH	11/04/19	ND	TL

DWN. BY: KEH	DATE: 11/01/19	ENBRIDGE
CHK. ND	11/01/19	LINE 3 REPLACEMENT TYPICAL TOPSOIL SEGREGATION TRENCH LINE ONLY (40' WORKSPACE OFFSET)
PROJ. ENGR. RF	11/01/19	
PROJ. MGR. TL	11/01/19	SCALE: NTS
CLIENT APP.		DWG. NO.

Figure 16 Typical Topsoil Segregation – Modified Trench Plus Spoil Side (25' workspace offset)



PROFILE

NOTES:

1. STOCKPILE TOPSOIL SEPARATELY FROM DITCH SPOIL AS SHOWN OR IN OTHER CONFIGURATION APPROVED BY THE COMPANY.
2. ALTERNATIVE TOPSOIL SEGREGATION METHOD USED ON SITE SPECIFIC BASIS OR AS REQUESTED BY LANDOWNER OR LAND MANAGING AGENCY.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	ND	TL
A	ISSUED FOR REVIEW	KEH	11/04/19	ND	TL

		DATE
DWN. BY:	KEH	11/01/19
CHK.	ND	11/01/19
PROJ. ENGR.	RF	11/01/19
PROJ. MGR.	TL	11/01/19
CLIENT APP.		

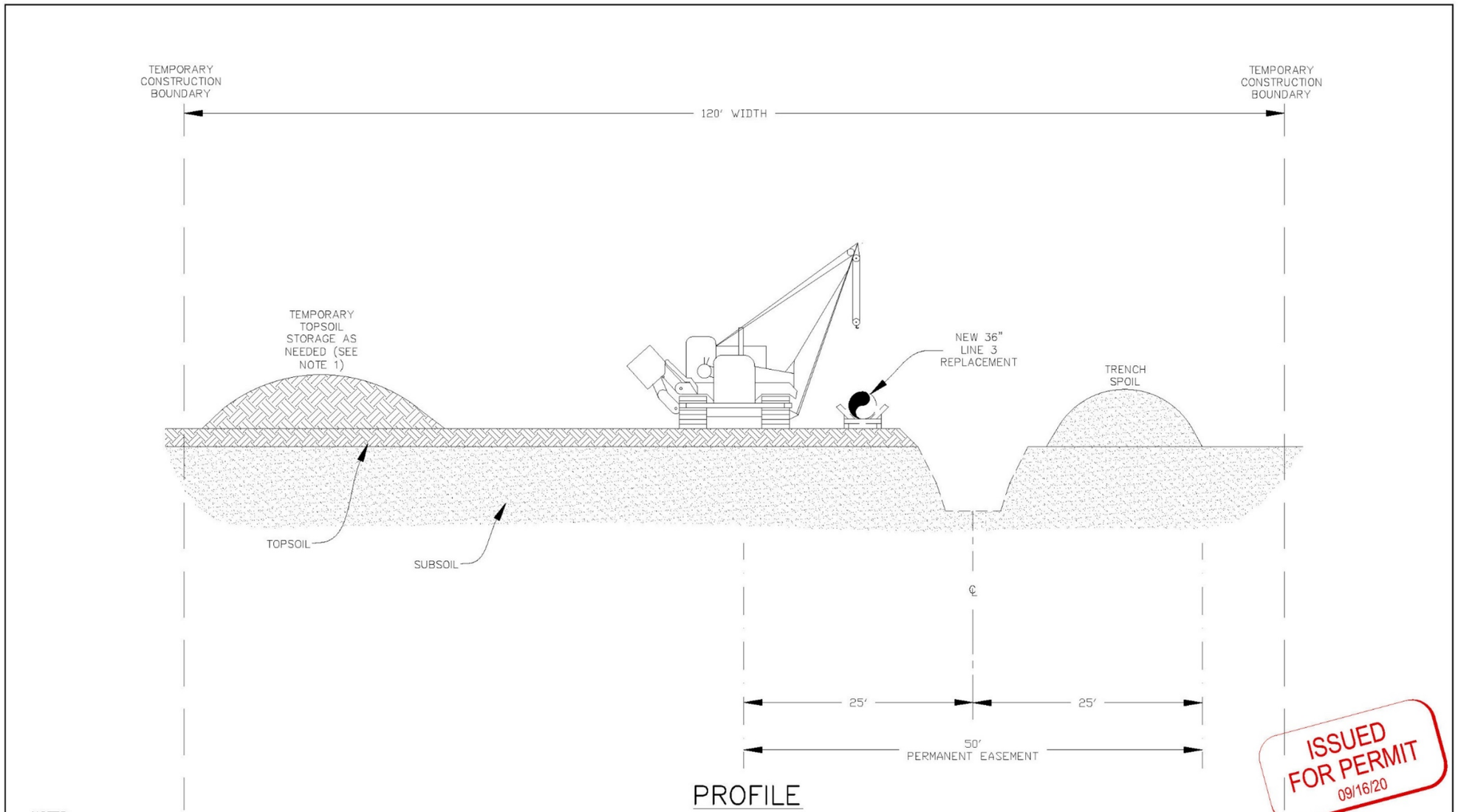
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL TOPSOIL SEGREGATION
MODIFIED TRENCH PLUS SPOIL SIDE
(25' WORKSPACE OFFSET)

SCALE: NTS

DWG. NO.

Figure 17 Typical Topsoil Segregation – Modified Trench Plus Spoil Side (40’ workspace offset)



PROFILE

ISSUED FOR PERMIT 09/16/20

NOTES:

1. STOCKPILE TOPSOIL SEPARATELY FROM DITCH SPOIL AS SHOWN OR IN OTHER CONFIGURATION APPROVED BY THE COMPANY.
2. ALTERNATIVE TOPSOIL SEGREGATION METHOD USED ON SITE SPECIFIC BASIS OR AS REQUESTED BY LANDOWNER OR LAND MANAGING AGENCY.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	ND	TL
A	ISSUED FOR REVIEW	KEH	11/04/19	ND	TL

		DATE
DWN. BY:	KEH	11/01/19
CHK.	ND	11/01/19
PROJ. ENGR.	RF	11/01/19
PROJ. MGR.	TL	11/01/19
CLIENT APP.		

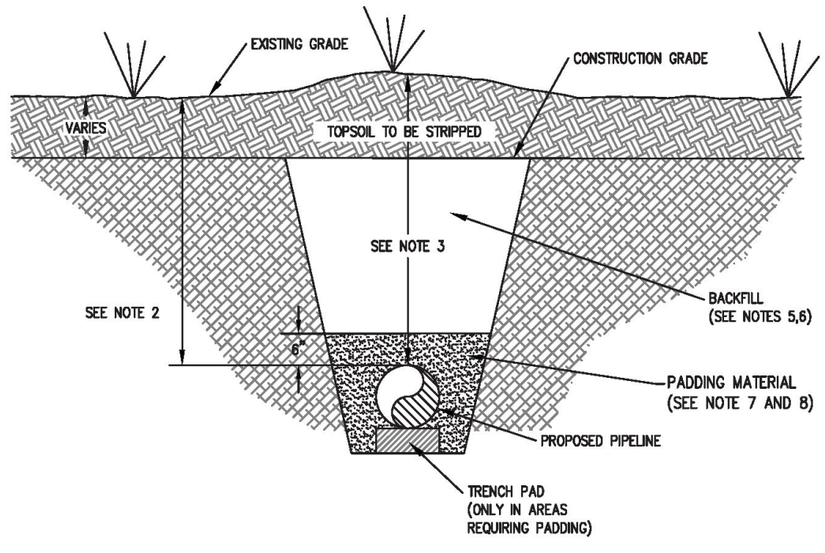
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL TOPSOIL SEGREGATION
MODIFIED TRENCH PLUS SPOIL SIDE
(40' WORKSPACE OFFSET)

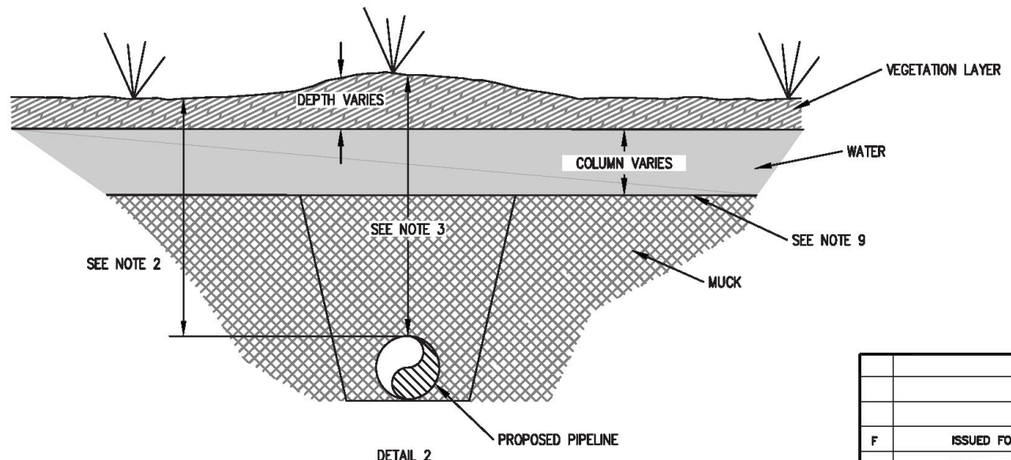
SCALE: NTS

DWG. NO.

Figure 18 Typical Trench and Backfill Requirements



DETAIL 1



DETAIL 2

NOTES

1. DEPTH OF COVER WILL VARY DEPENDING ON LAND USE.
2. (MN ONLY) MINIMUM OF 54" FROM CONSTRUCTION GRADE.
   a. IN THE REQUISITE AREAS WHERE WE DO NOT HAVE A DEPTH OF COVER WAIVER SPECIFIC TO THE MN STATUTE 216G.07.
3. MINIMUM OF 48" FROM CONSTRUCTION GRADE UNLESS STATED OTHERWISE ON THE ALIGNMENT SHEETS OR LINE LIST.
   a. (MN ONLY) IN THOSE AREAS WHEREIN WE HAVE A WAIVER OR ARE OUTSIDE OF THOSE AREAS DEFINED IN THE MN STATUTE 216G.07.
4. DEPTH OF COVER SHALL BE MEASURED AS THE SHORTEST DIMENSION FROM THE TOP OF THE PIPE, OR BUOYANCY CONTROL DEVICE TO THE GRADED RIGHT OF WAY.
5. REFER TO CONSTRUCTION SPECIFICATIONS REGARDING ROCK IN BACKFILL.
6. SIDE OF TRENCH TO BE SLOPED IN ACCORDANCE WITH OSHA SAFETY REGULATIONS REGARDING EXCAVATIONS.
7. THE PADDING MATERIAL SHALL BE PLACED ON THE PIPE USING A PROCEDURE THAT DOES NOT DAMAGE THE COATING OR PIPE.
8. THE MATERIAL USED FOR PADDING SHALL BE WELL GRADED FROM GRANULAR MATERIAL WITH A MAXIMUM PARTICLE SIZE OF 1.5 INCHES.
9. TOP OF MUCK LAYER WILL BE CONSIDERED CONSTRUCTION GRADE.

MN STATUTE 216G.07 PROTECTING PUBLIC FACILITIES AND AGRICULTURAL LAND:

SUBDIVISION 1. DEPTH OF COVER. UNLESS WAIVED IN THE MANNER PROVIDED IN SUBDIVISION 2 OR 3, ANY PIPELINE INSTALLED AFTER MAY 26, 1979, SHALL BE BURIED WITH A MINIMUM LEVEL COVER OF NOT LESS THAN 4–1/2 FEET IN ALL AREAS WHERE THE PIPELINE CROSSES THE RIGHT–OF–WAY OF ANY PUBLIC DRAINAGE FACILITY OR ANY COUNTY, TOWN OR MUNICIPAL STREET OR HIGHWAY AND WHERE THE PIPELINE CROSSES CULTIVATED AGRICULTURAL LAND. WHERE THE PIPELINE CROSSES THE RIGHT–OF–WAY OF ANY DRAINAGE DITCH, THE PIPELINE SHALL BE AT LEAST 4–1/2 FEET BELOW THE AUTHORIZED DEPTH OF THE DITCH, UNLESS WAIVED IN THE MANNER PROVIDED IN SUBDIVISION 2 AND 3.

ISSUED FOR PERMIT 10/13/20

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
F	ISSUED FOR PERMIT	JDW	10/13/20	KEH	RF
E	ISSUED FOR PERMIT	JDW	09/16/20	KEH	RF
D	ISSUED FOR REVIEW	AJM	11/04/19	KEH	RF

		DATE
DWN. BY:	JDW	08/13/18
CHK.	KEH	08/04/17
PROJ. ENGR.	MDM	08/04/17
PROJ. MGR.	BS	08/04/17
CLIENT APP.		

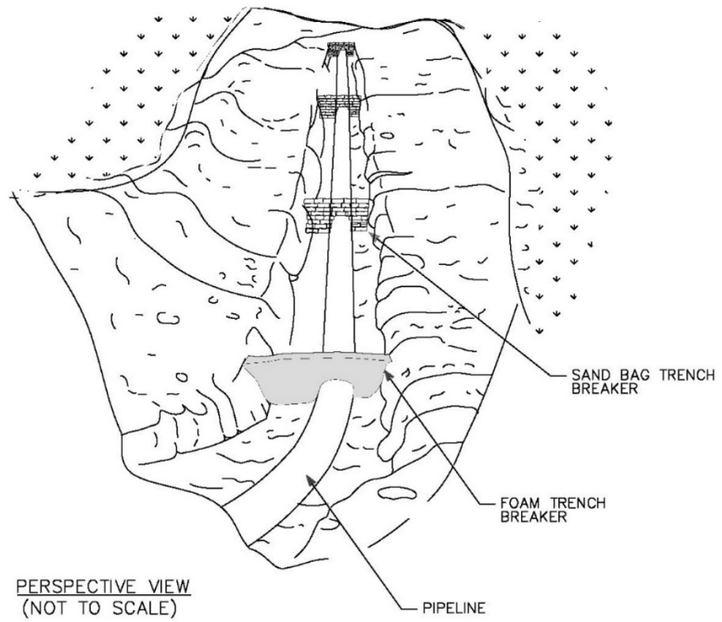
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL TRENCH AND
BACKFILL REQUIREMENTS

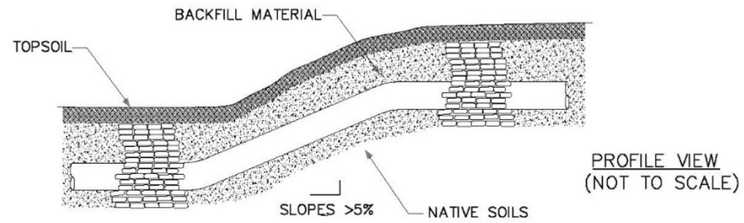
SCALE: NTS

DWG. NO.

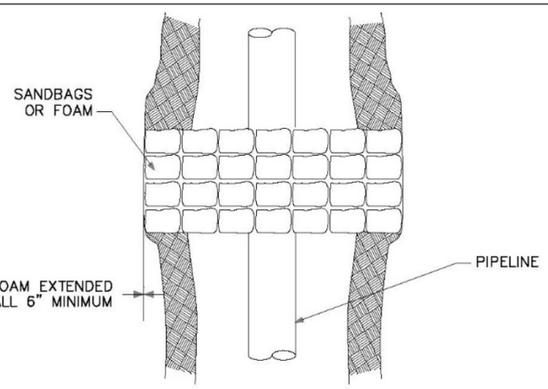
Figure 19 Typical Trench Breakers – Multiple Views



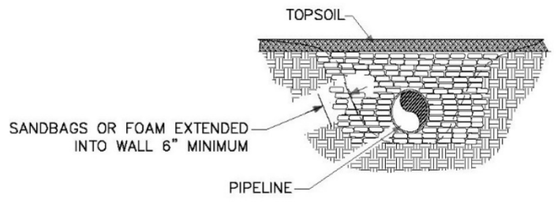
PERSPECTIVE VIEW
(NOT TO SCALE)



PROFILE VIEW
(NOT TO SCALE)



PLAN VIEW
(NOT TO SCALE)



FACE VIEW
(NOT TO SCALE)

NOTES:

1. BAGS WILL NOT BE FILLED WITH TOPSOIL.
2. ADDITIONAL INFORMATION INCLUDED ON OTHER DRAWINGS.
3. TRENCH BREAKERS SHALL BE PLACED AS LISTED BELOW:

SLOPE%	APPROXIMATE SPACING (FT)
3–5	250
5–15	200
15–25	150
>25	<100

NOTES
1. BAGS WILL NOT BE FILLED WITH TOPSOIL
2. ADDITIONAL INFORMATION INCLUDED ON OTHER DRAWINGS

ISSUED FOR PERMIT
09/16/20

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
A	ISSUED FOR REVIEW	DWA	11/04/19	KEH	KD

		DATE
DWN. BY: DWA		10/30/19
CHK. KEH		10/30/19
PROJ. ENGR. DG		10/30/19
PROJ. MGR. KD		10/30/19
CLIENT APP.		

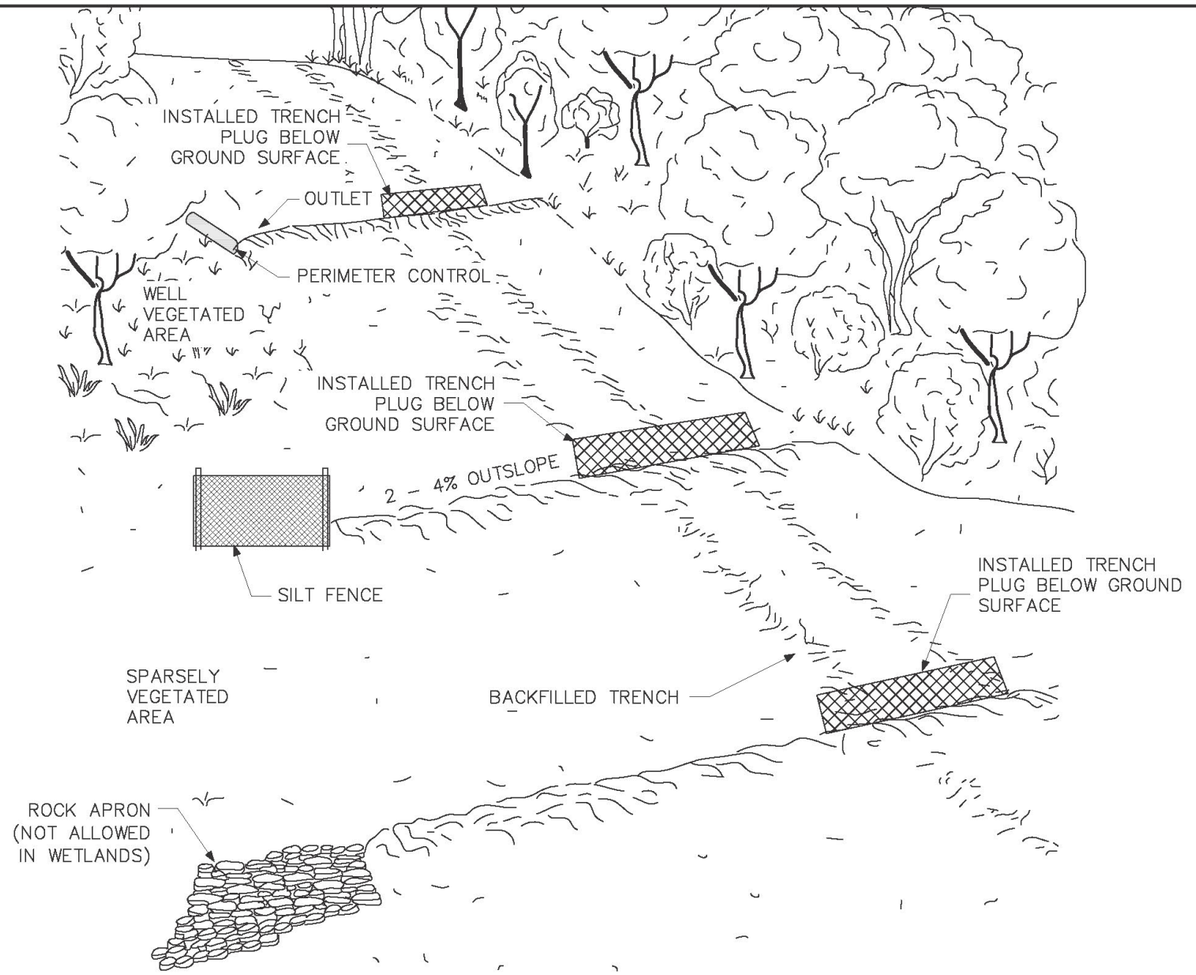
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL TRENCH BREAKERS–
MULTIPLE VIEWS

SCALE: NTS

DWG. NO.

Figure 20 Typical Permanent Slope Breakers – Perspective View



PERSPECTIVE VIEW
(NOT TO SCALE)

NOTES:

1. BERMS ARE PERMANENT.
2. SILT FENCE AND PERIMETER CONTROL REMOVED WHEN VEGETATION ESTABLISHED.
3. LOWEST BERM MAY BE OMITTED IF SILT FENCE OR STRAW BALES ARE INSTALLED AT THAT LOCATION, SUBJECT TO APPROVAL.
4. BERMS SHALL BE OUTLETED TO WELL VEGETATED STABLE AREAS, FILTER SOCKS, SILT FENCES, STRAW BALES, ROCK APRONS, OR SUMPS.
5. BERMS SHALL BE PLACED AS LISTED BELOW.

SLOPE%	APPROXIMATE SPACING (FT)
5	250
>5–15	200
15–25	150
>25	<100

ISSUED FOR PERMIT 10/22/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	JDW	10/22/20	KEH	NKD
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	NKD
A	ISSUED FOR REVIEW	JDW	11/04/19	KEH	NKD

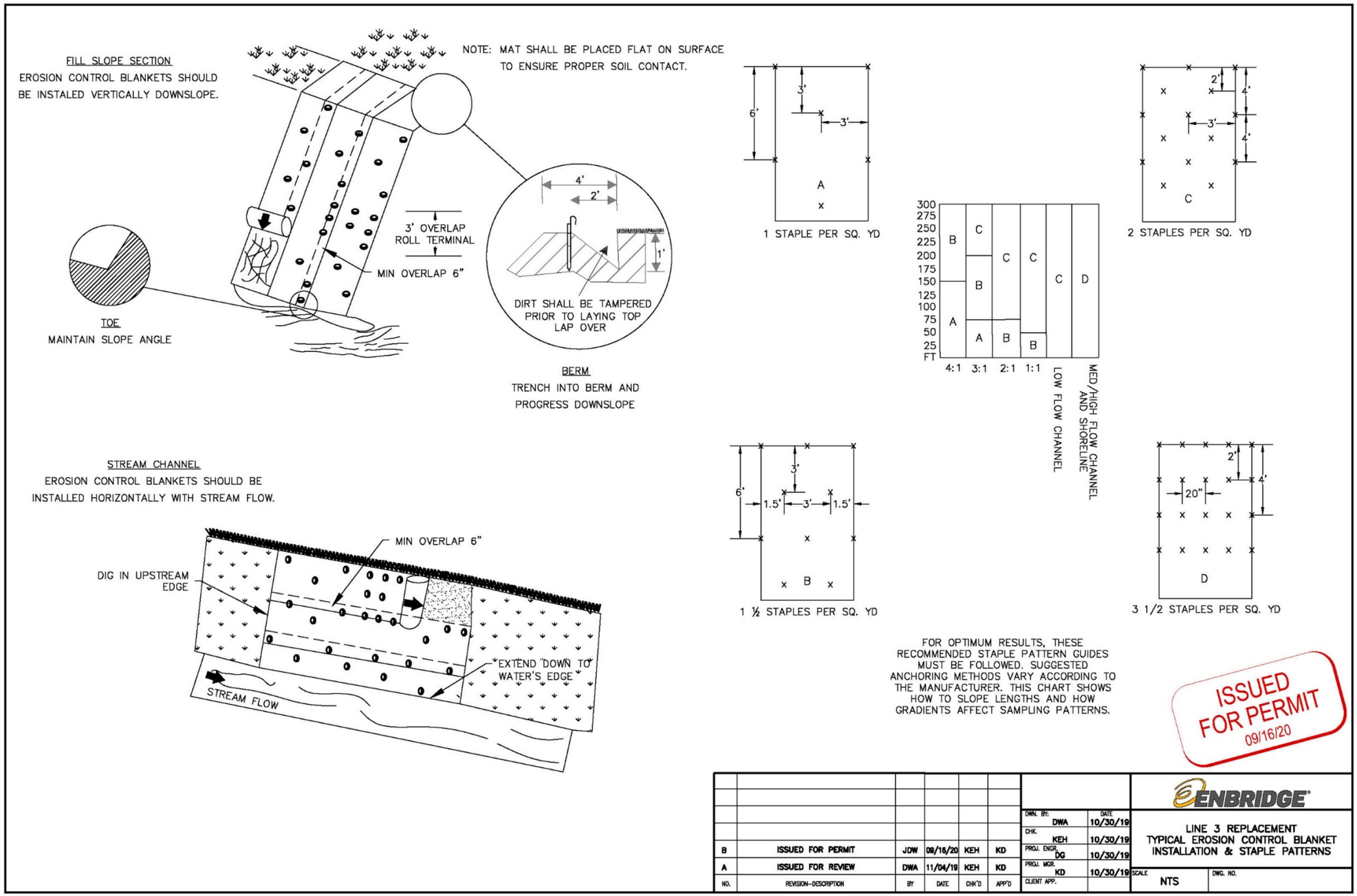
		DATE
DWN. BY:	KEH	8/15/18
CHK.	NKD	8/16/18
PROJ. ENGR.	CP	8/16/18
PROJ. MGR.	BS	8/16/18
CLIENT APP.		

ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
PERMANENT SLOPE BREAKERS

SCALE NTS DWG. NO.

Figure 21 Typical Erosion Control Blanket Installation



NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
A	ISSUED FOR REVIEW	DWA	11/04/19	KEH	KD

		DATE
DWN. BY:	DWA	10/30/19
CHK.	KEH	10/30/19
PROJ. ENGR.	DG	10/30/19
PROJ. MGR.	KD	10/30/19
CLIENT APP.		

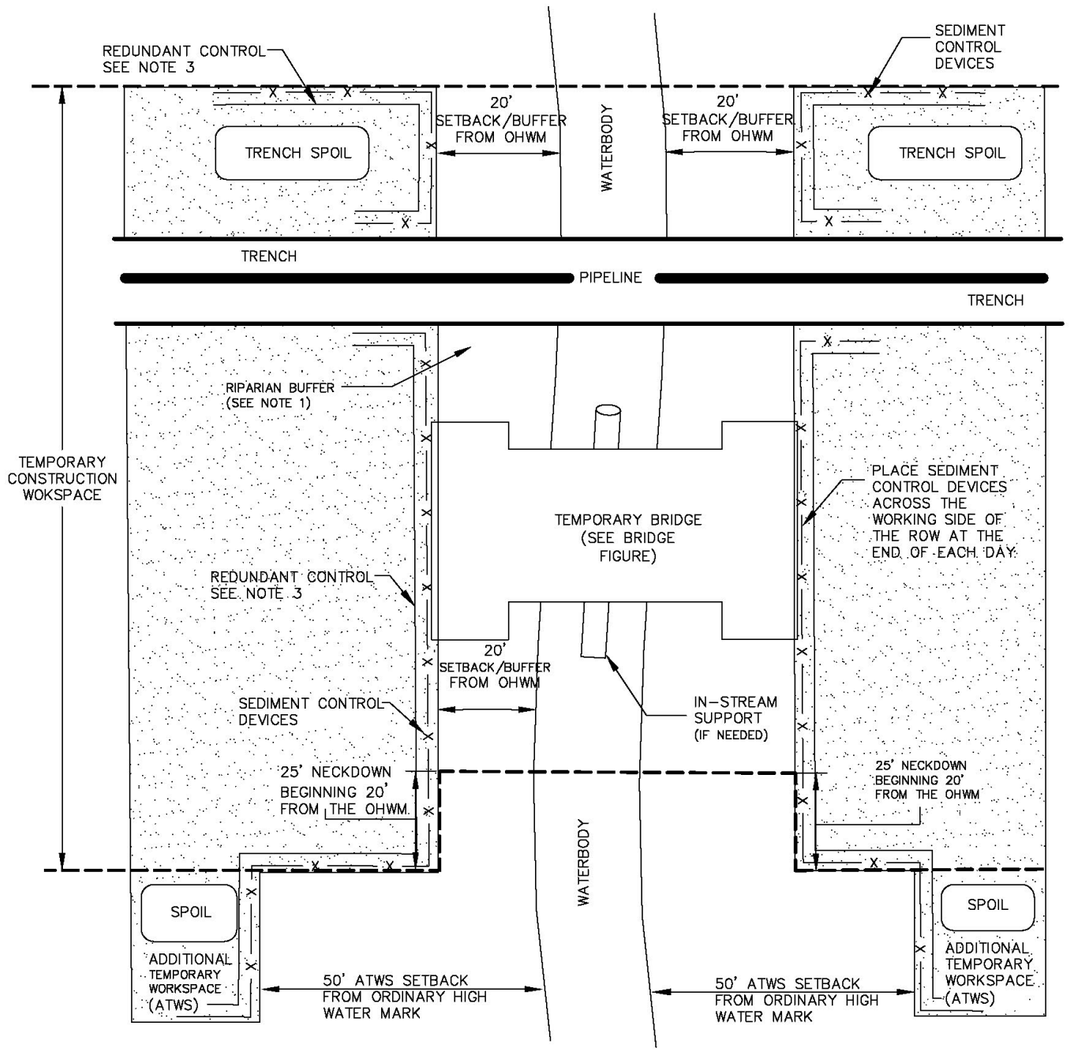
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL EROSION CONTROL BLANKET INSTALLATION & STAPLE PATTERNS

SCALE: NTS

DWG. NO.

Figure 22 Typical Waterbody Crossing – Open Cut Trench Method



ISSUED FOR PERMIT 10/13/20

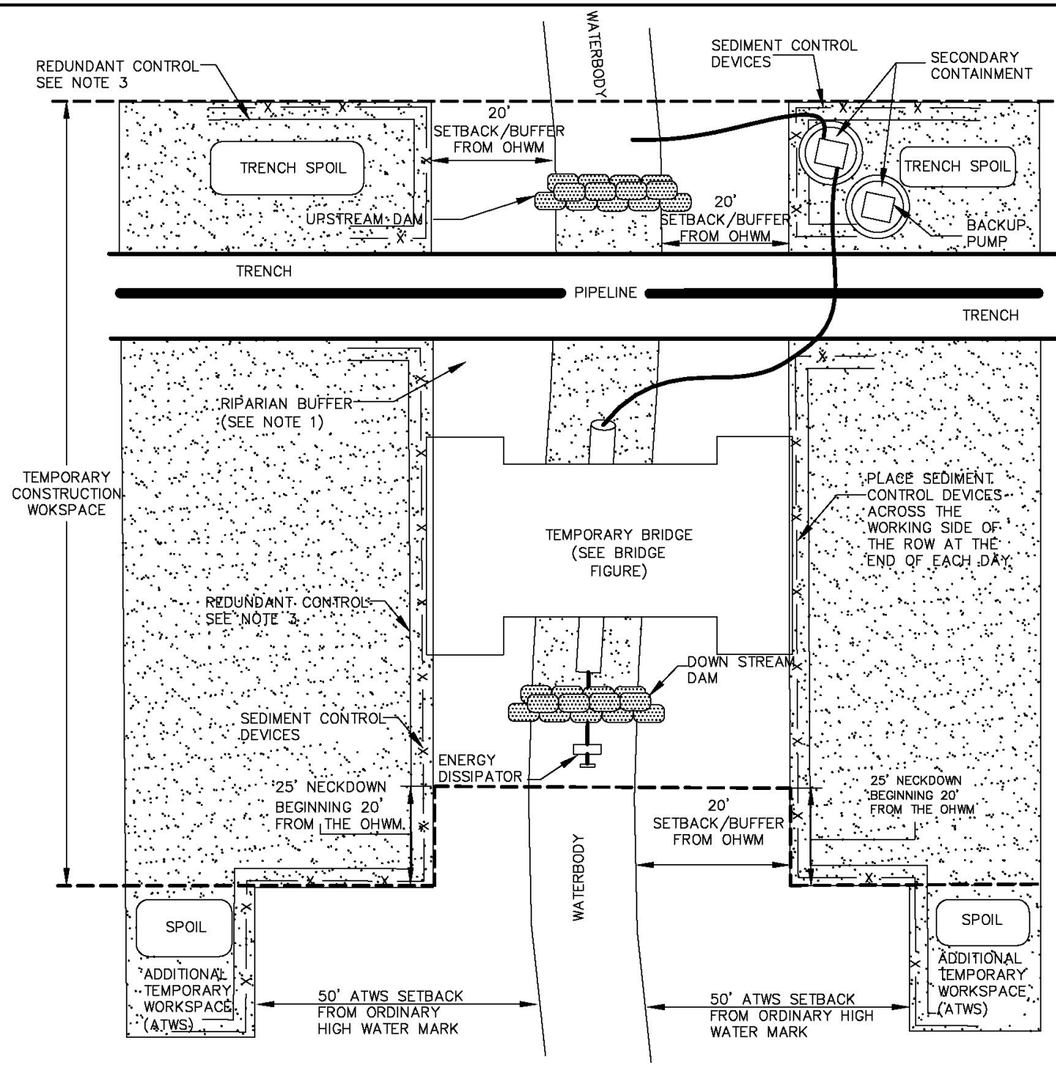
NOTES:

1. REFER TO 2.2 OF EPP FOR EROSION CONTROL REQUIREMENTS.
2. 50' ATWS SETBACK FROM ORDINARY HIGH WATER MARK (OHWM), AS CONDITIONS ALLOW, EXCEPT IN UPLAND AREAS OF CULTIVATED OR ROTATED CROPLAND OR OTHER DISTURBED LAND.
3. REDUNDANT CONTROLS LOCATED PER SWPPP SECTION 3.4.1.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	JDW	10/13/20	KEH	KD
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
A	ISSUED FOR REVIEW	AJM	11/04/19	KEH	KD

DWN. BY: AJM	DATE: 10/25/19	ENBRIDGE
CHK. KEH	10/25/19	LINE 3 REPLACEMENT TYPICAL WATERBODY CROSSING OPEN CUT TRENCH METHOD
PROJ. ENGR. DG	10/25/19	
PROJ. MGR. KD	10/25/19	
CLIENT APP.		SCALE: NTS / DWG. NO.

Figure 23 Typical Waterbody Crossing – Dam and Pump Method



ISSUED FOR PERMIT 10/13/20

NOTES:

1. REFER TO 2.2 OF EPP FOR EROSION CONTROL REQUIREMENTS.
2. 50' ATWS SETBACK FROM ORDINARY HIGH WATER MARK (OHWM), AS CONDITIONS ALLOW, EXCEPT IN UPLAND AREAS OF CULTIVATED OR ROTATED CROPLAND OR OTHER DISTURBED LAND.
3. REDUNDANT CONTROLS LOCATED PER SWPPP SECTION 3.4.1.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
D	ISSUED FOR PERMIT	JDW	10/13/20	KEH	KD
C	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
B	ISSUED FOR REVIEW	AJM	11/04/19	KEH	KD

		DATE
DWN. BY: AJM		04/25/19
CHK. KEH		04/30/19
PROJ. ENGR. DG		04/30/19
PROJ. MGR. KD		04/30/19
CLIENT APP.		

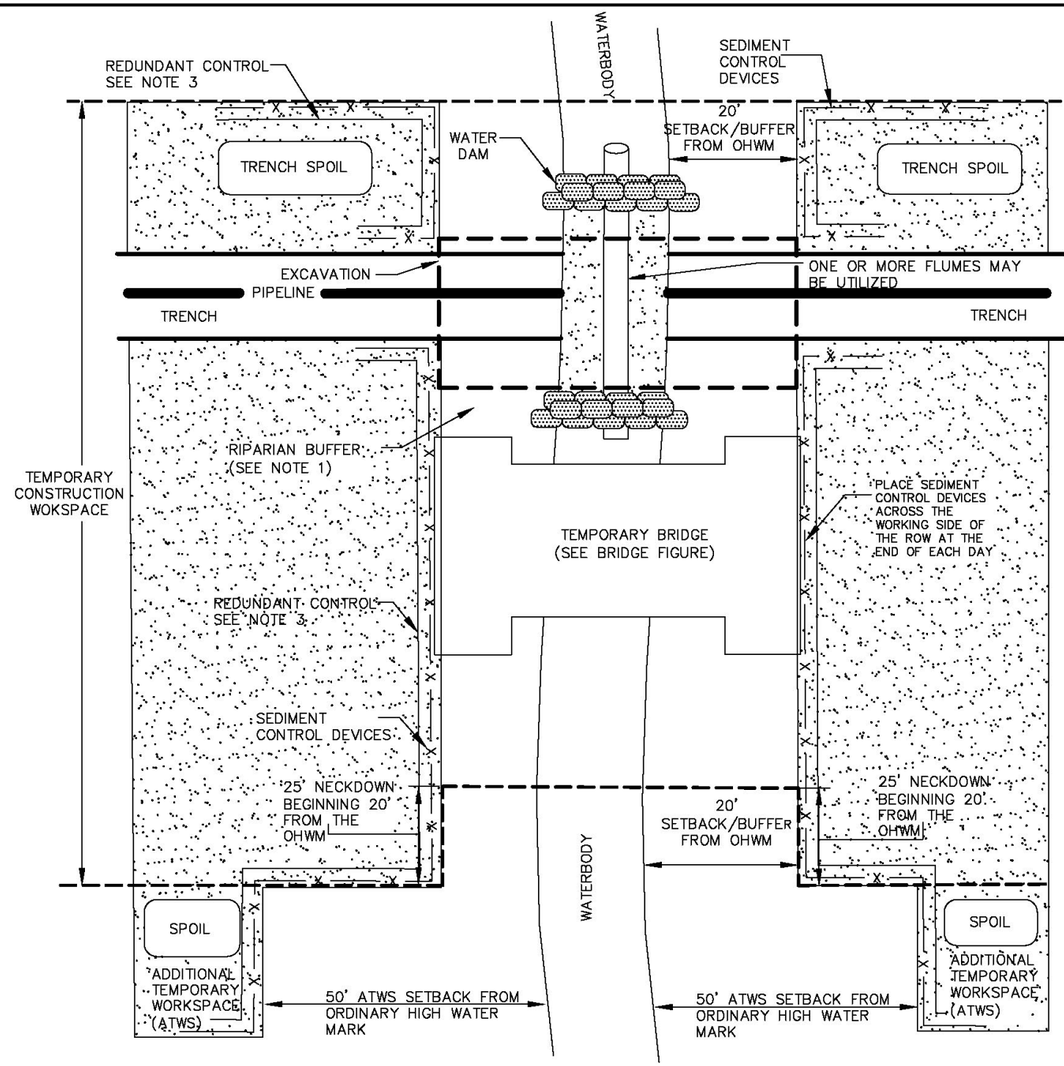
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
WATERBODY CROSSING
DRY CROSSING–DAM AND PUMP METHOD

SCALE: NTS

DWG. NO.

Figure 24 Typical Waterbody Crossing – Flume Method



NOTES:

1. REFER TO 2.2 OF EPP FOR EROSION CONTROL REQUIREMENTS.
2. 50' ATWS SETBACK FROM ORDINARY HIGH WATER MARK (OHWM), AS CONDITIONS ALLOW, EXCEPT IN UPLAND AREAS OF CULTIVATED OR ROTATED CROPLAND OR OTHER DISTURBED LAND.
3. REDUNDANT CONTROLS LOCATED PER SWPPP SECTION 3.4.1.

ISSUED FOR PERMIT 10/13/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
D	ISSUED FOR PERMIT	JDW	10/13/20	KEH	KD
C	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
B	ISSUED FOR REVIEW	AJM	11/04/19	KEH	KD

		DATE
DWN. BY:	AJM	04/25/19
CHK.	KEH	04/30/19
PROJ. ENGR.	DG	04/30/19
PROJ. MGR.	KD	04/30/19
CLIENT APP.		

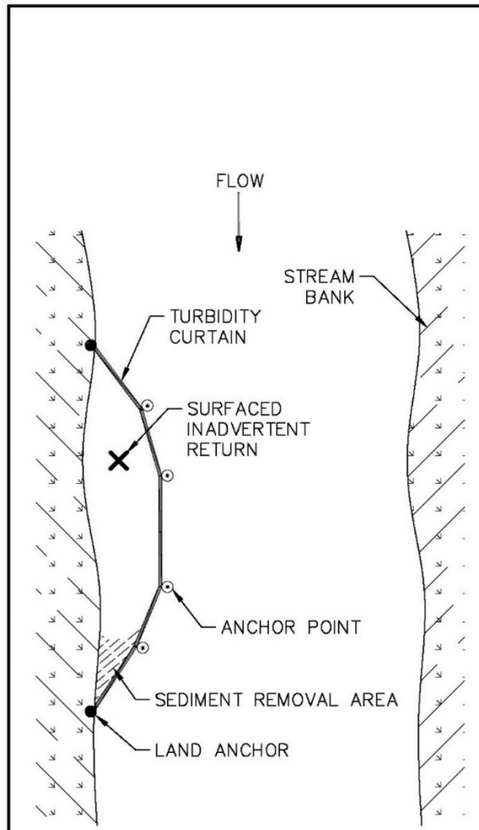
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
WATERBODY CROSSING
DRY CROSSING–FLUME METHOD

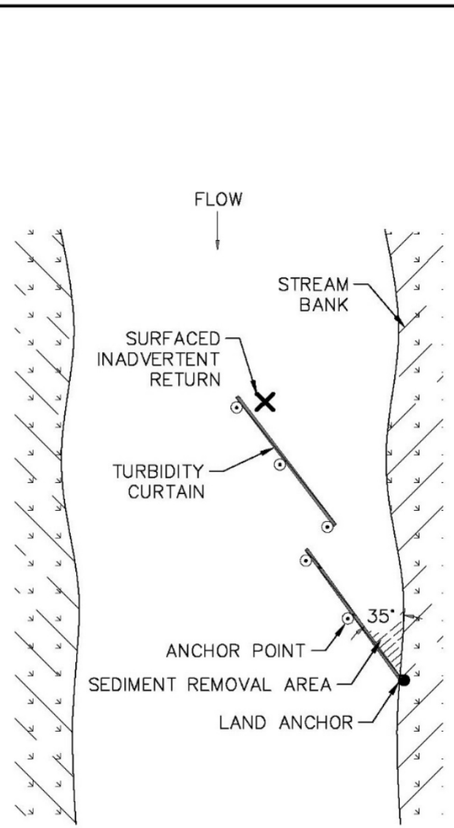
SCALE: NTS

DWG. NO.

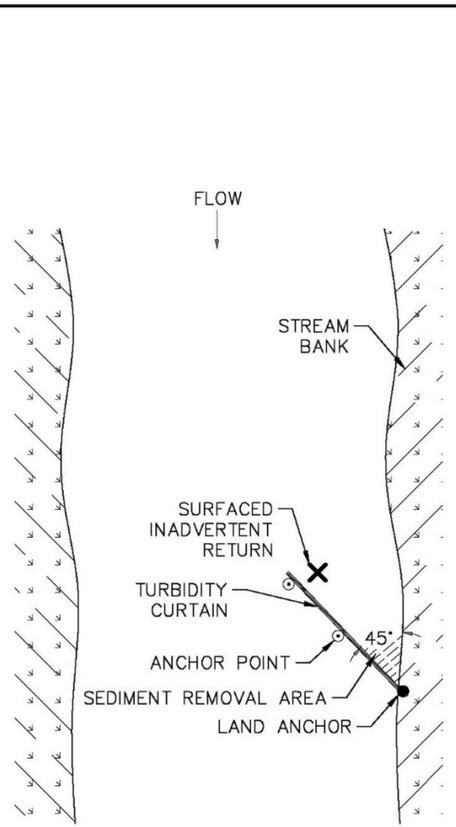
Figure 25 Typical Turbidity Curtain Installations



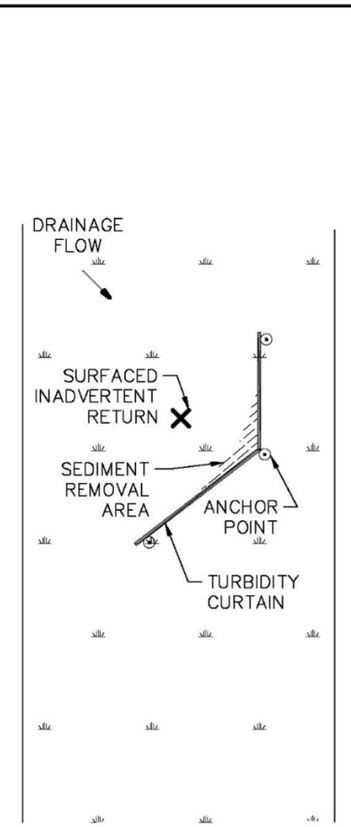
1 NEAR–SHORE PLAN VIEW



2 RAPID/MID–CHANNEL PLAN VIEW



3 MODERATE FLOW/SIDE–CHANNEL PLAN VIEW



3 STANDING/STILL WATER PLAN VIEW

ISSUED FOR PERMIT 09/16/20

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	NKD
A	ISSUED FOR REVIEW	JDW	11/04/19	KEH	NKD

		DATE
DWN. BY:	KEH	10/25/19
CHK.	NKD	10/25/19
PROJ. ENGR.	CP	10/25/19
PROJ. MGR.	BS	10/25/19
CLIENT APP.		

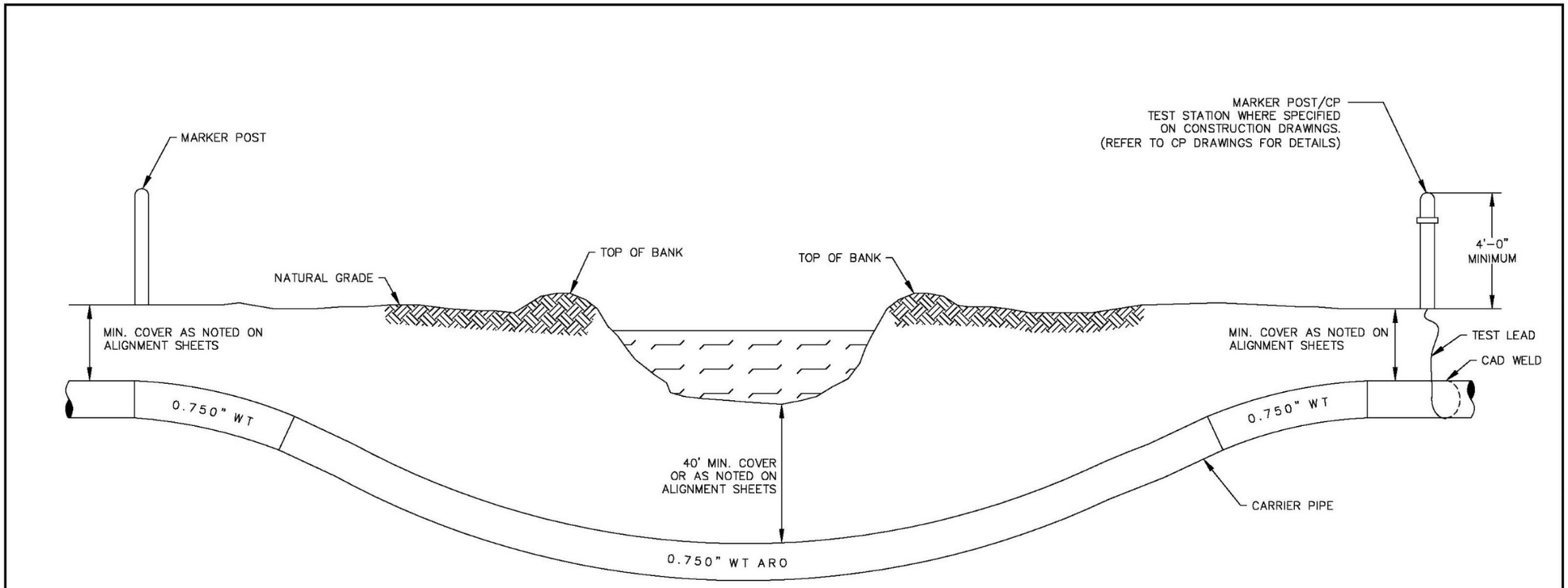
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
TURBIDITY CURTAIN INSTALLATIONS

SCALE: NTS

DWG. NO.

Figure 26 Typical HDD Entry and Exit



NOTES:

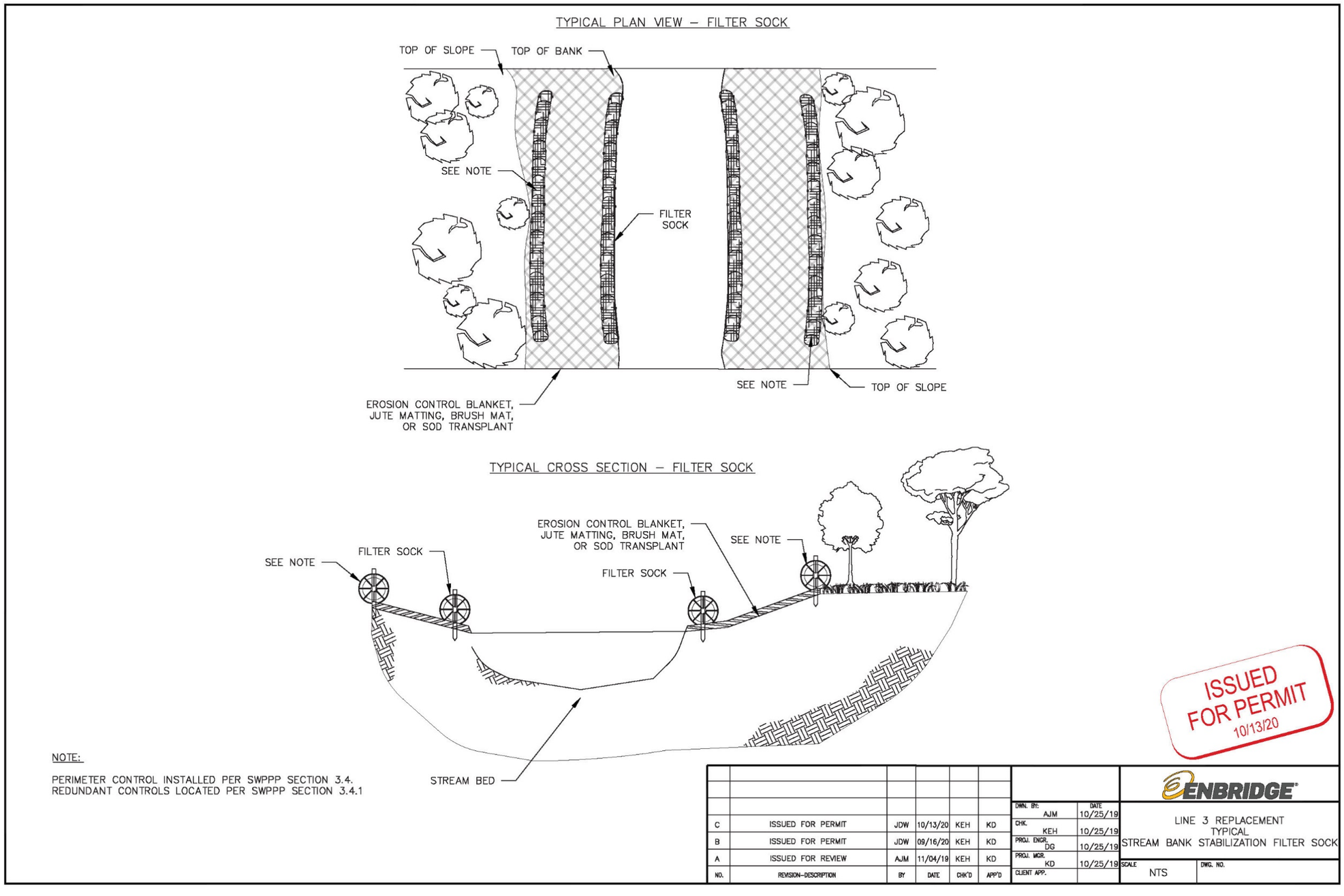
1. PIPE WALL THICKNESS AND GRADE AS SPECIFIED ON ALIGNMENT SHEETS, UNLESS NOTED OTHERWISE.
2. LOCATION, LENGTH OF CROSSING, MATERIAL AND TESTING REQUIREMENTS SHALL BE AS STATED ON THE ALIGNMENT SHEETS.
3. APPROPRIATE BUOYANCY CONTROL SHALL BE INSTALLED TO PROVIDE NEGATIVE BUOYANCY, AS SPECIFIED ON ALIGNMENT SHEETS OR SITE SPECIFIC DRAWING.
4. AS A MINIMUM, THE DEPTH OF COVER UNDER HDD CROSSING FEATURES SHALL BE 40', UNLESS OTHERWISE SPECIFIED IN APPLICABLE ENVIRONMENTAL PERMITS OR OTHER CONSTRUCTION DOCUMENTS.
5. CROSSING TIMING AND CONSTRUCTION WINDOW AS SPECIFIED IN ENVIRONMENTAL PERMITS AND/OR SITE SPECIFIC DRAWINGS AND TYPICAL CROSSING DETAILS.

ISSUED FOR PERMIT 09/16/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
D	ISSUED FOR PERMIT	JDW	09/16/20	NKD	RF
C	ISSUED FOR REVIEW	JWH	11/04/19	NKD	RF

DWN. BY: JWH	DATE 03/15/19	ENBRIDGE
CHK. NKD	11/04/19	LINE 3 REPLACEMENT TYPICAL HDD ENTRY AND EXIT
PROJ. ENGR. RF	11/04/19	
PROJ. MGR. TL	11/04/19	SCALE NTS / DWG. NO.
CLIENT APP.		

Figure 27 Typical Stream Bank Stabilization Filter Sock



NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	JDW	10/13/20	KEH	KD
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
A	ISSUED FOR REVIEW	AJM	11/04/19	KEH	KD

		DATE
DWN. BY:	AJM	10/25/19
CHK.	KEH	10/25/19
PROJ. ENGR.	DG	10/25/19
PROJ. MGR.	KD	10/25/19
CLIENT APP.		

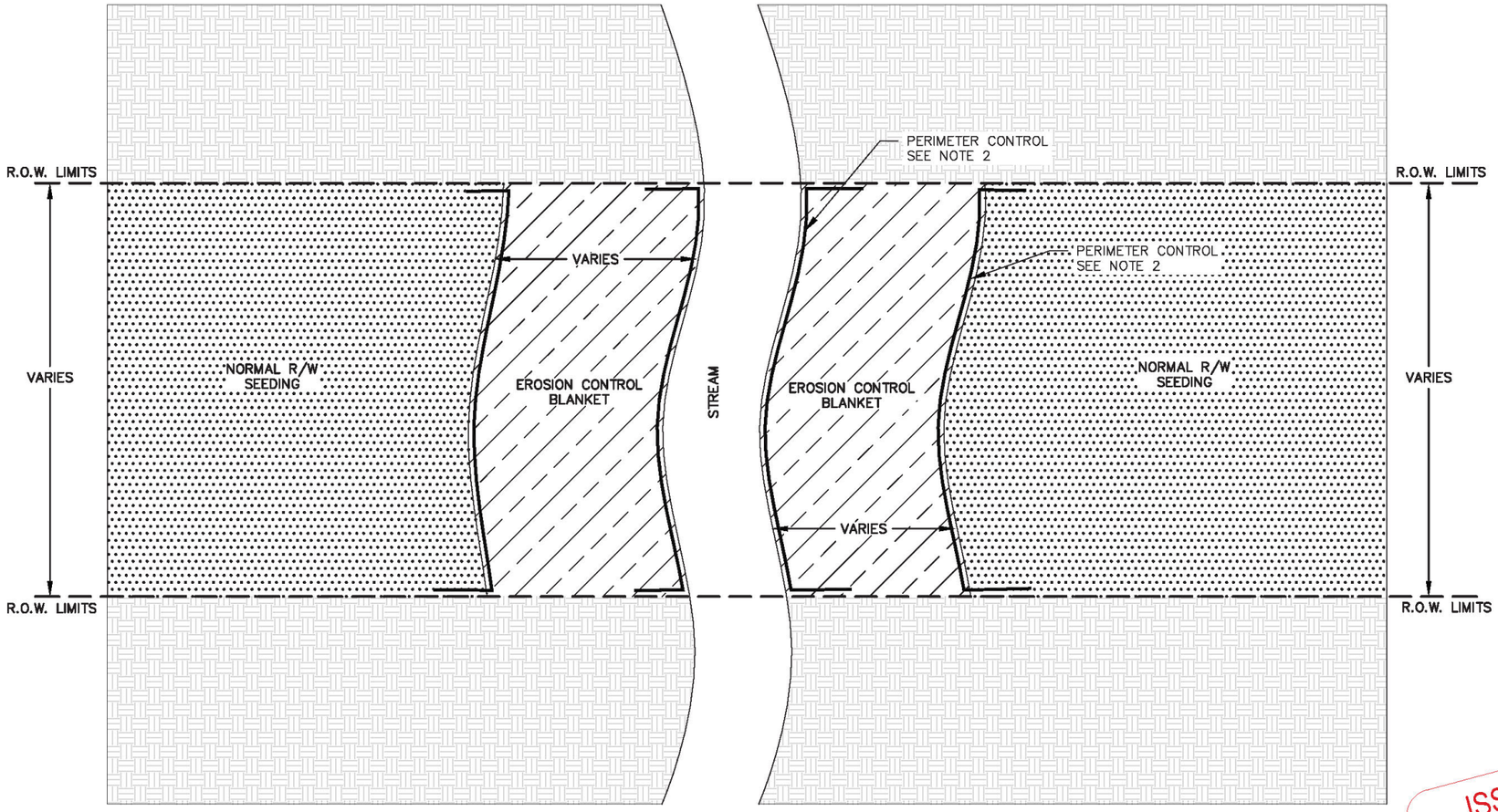
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
STREAM BANK STABILIZATION FILTER SOCK

SCALE: NTS

DWG. NO.

Figure 28 Typical Final Stream Bank Stabilization & Erosion Control



ISSUED FOR PERMIT 10/13/20

NOTE:
1. EXTEND EROSION CONTROL FROM MEAN HIGH WATER LEVEL TO SEVERAL FEET BEHIND HIGH BANK.
2. PERIMETER CONTROL INSTALLED PER SWPPP SECTION 3.4. REDUNDANT CONTROLS LOCATED PER SWPPP SECTION 3.4.1.
3. REFERENCE SITE SPECIFIC RESTORATION PLANS WHERE APPLICABLE.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	JDW	10/13/20	KEH	KD
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
A	ISSUED FOR REVIEW	AJM	11/04/19	KEH	KD

DWN. BY: AJM	DATE: 10/25/19	
CHK. KEH	10/25/19	
PROJ. ENGR. DG	10/25/19	
PROJ. MGR. KD	10/25/19	
CLIENT APP.		

ENBRIDGE

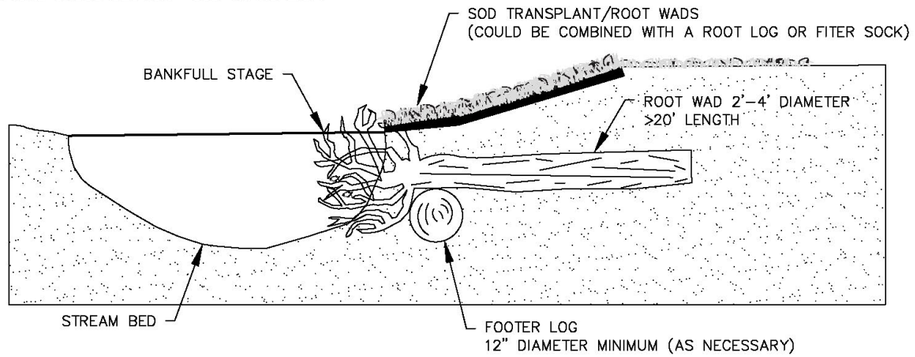
LINE 3 REPLACEMENT
TYPICAL
FINAL STREAM BANK STABILIZATION
& EROSION CONTROL

SCALE: NTS

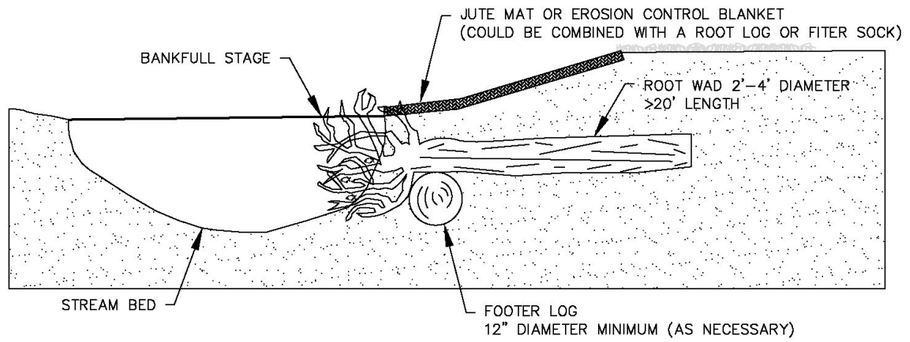
DWG. NO.

Figure 29 Typical Root Wad – Natural Material Revetment

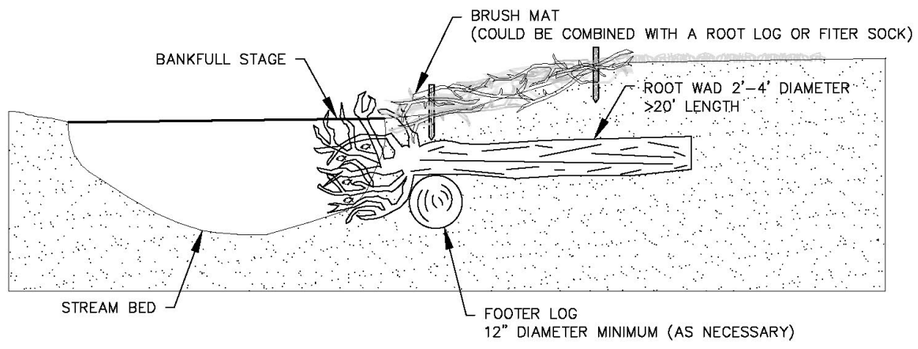
TYPICAL CROSS SECTION – SOD TRANSPLANT



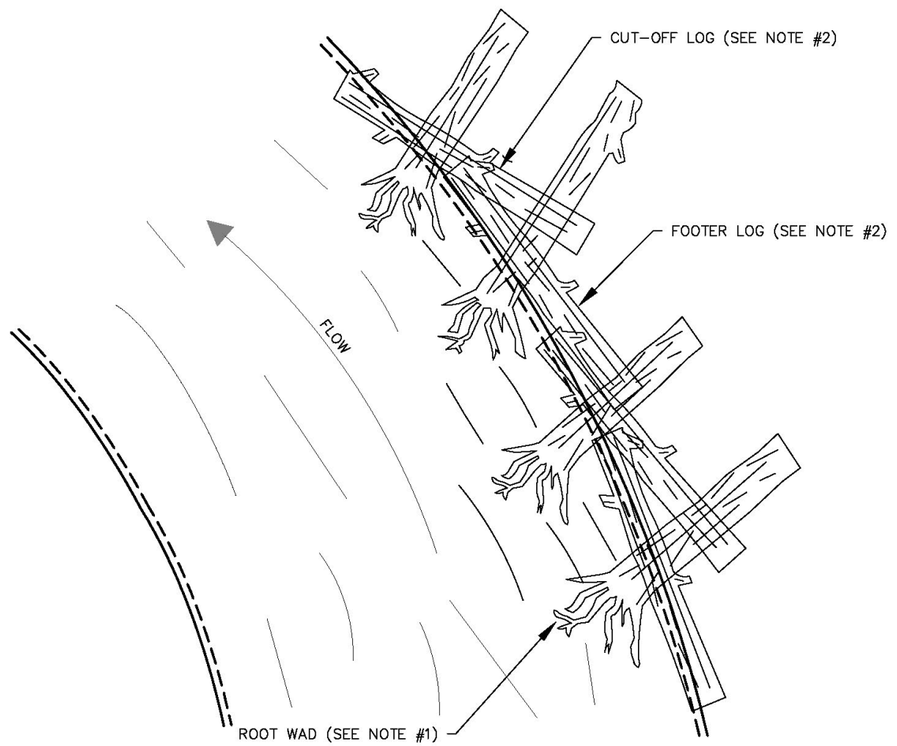
TYPICAL CROSS SECTION – JUTE MAT OR EROSION CONTROL BLANKET



TYPICAL CROSS SECTION – BRUSH MAT



TYPICAL PLAN VIEW – NATURAL MATERIAL REVETMENT



NOTES:

#1 – ROOT WAD LOGS TO BE USED ON STEEP BANKS OR BASED ON AGENCY RECOMMENDATIONS.

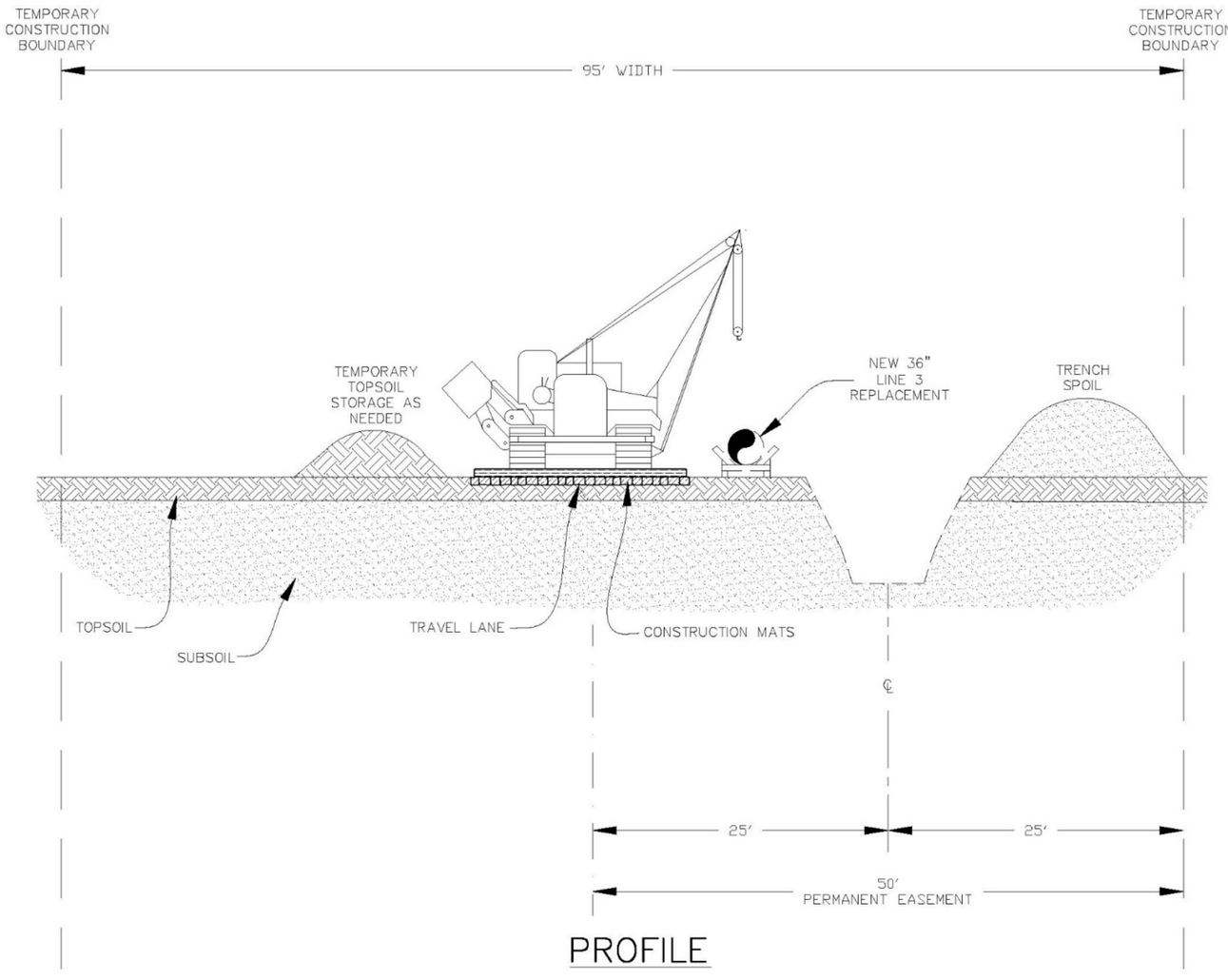
#2 – ROOT WAD LOGS TO BE ANCHORED APPROPRIATELY BASED ON SITE–SPECIFIC CONDITIONS OR AGENCY RECOMMENDATIONS.

ISSUED FOR PERMIT 09/16/20

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
A	ISSUED FOR REVIEW	DWA	11/04/19	KEH	KD

DWN. BY: DWA	DATE 10/30/19	ENBRIDGE
CHK. KEH	10/30/19	LINE 3 REPLACEMENT TYPICAL ROOT WAD – NATURAL MATERIAL REVETMENT
PROJ. ENGR. DG	10/30/19	
PROJ. MGR. KD	10/30/19	
CLIENT APP.		SCALE: NTS DWG. NO.

Figure 30 Typical Unsaturated Wetland Crossing Profile (25’ workspace offset)



PROFILE

ISSUED FOR PERMIT 09/16/20

NOTE:

1. TRENCH LINE ONLY SEGREGATION.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	ND	RF
A	ISSUED FOR REVIEW	KEH	11/04/19	ND	RF

		DATE
DWN. BY:	KEH	11/01/19
CHK.	ND	11/01/19
PROJ. ENGR.	RF	11/01/19
PROJ. MGR.	TL	11/01/19
CLIENT APP.		

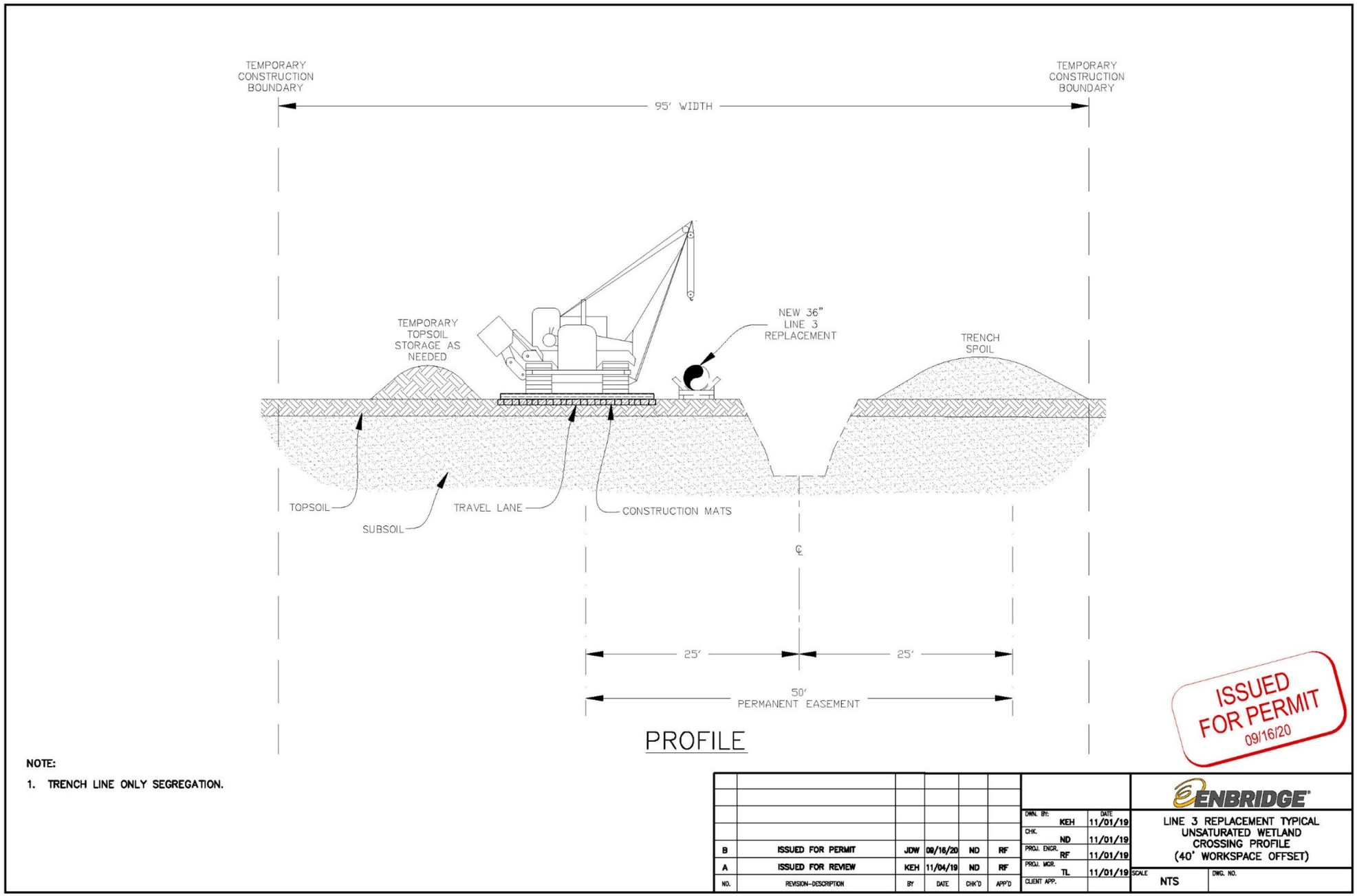
ENBRIDGE

LINE 3 REPLACEMENT TYPICAL UNSATURATED WETLAND CROSSING PROFILE (25' WORKSPACE OFFSET)

SCALE: NTS

DWG. NO.

Figure 31 Typical Unsaturated Wetland Crossing Profile (40’ workspace offset)



PROFILE

ISSUED FOR PERMIT 09/16/20

NOTE:

1. TRENCH LINE ONLY SEGREGATION.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	ND	RF
A	ISSUED FOR REVIEW	KEH	11/04/19	ND	RF

		DATE
DWN. BY:	KEH	11/01/19
CHK.	ND	11/01/19
PROJ. ENGR.	RF	11/01/19
PROJ. MGR.	TL	11/01/19
CLIENT APP.		

ENBRIDGE

LINE 3 REPLACEMENT TYPICAL UNSATURATED WETLAND CROSSING PROFILE (40' WORKSPACE OFFSET)

SCALE: NTS

DWG. NO.

Figure 32 Typical Saturated Wetland Crossing Profile (25’ workspace offset)

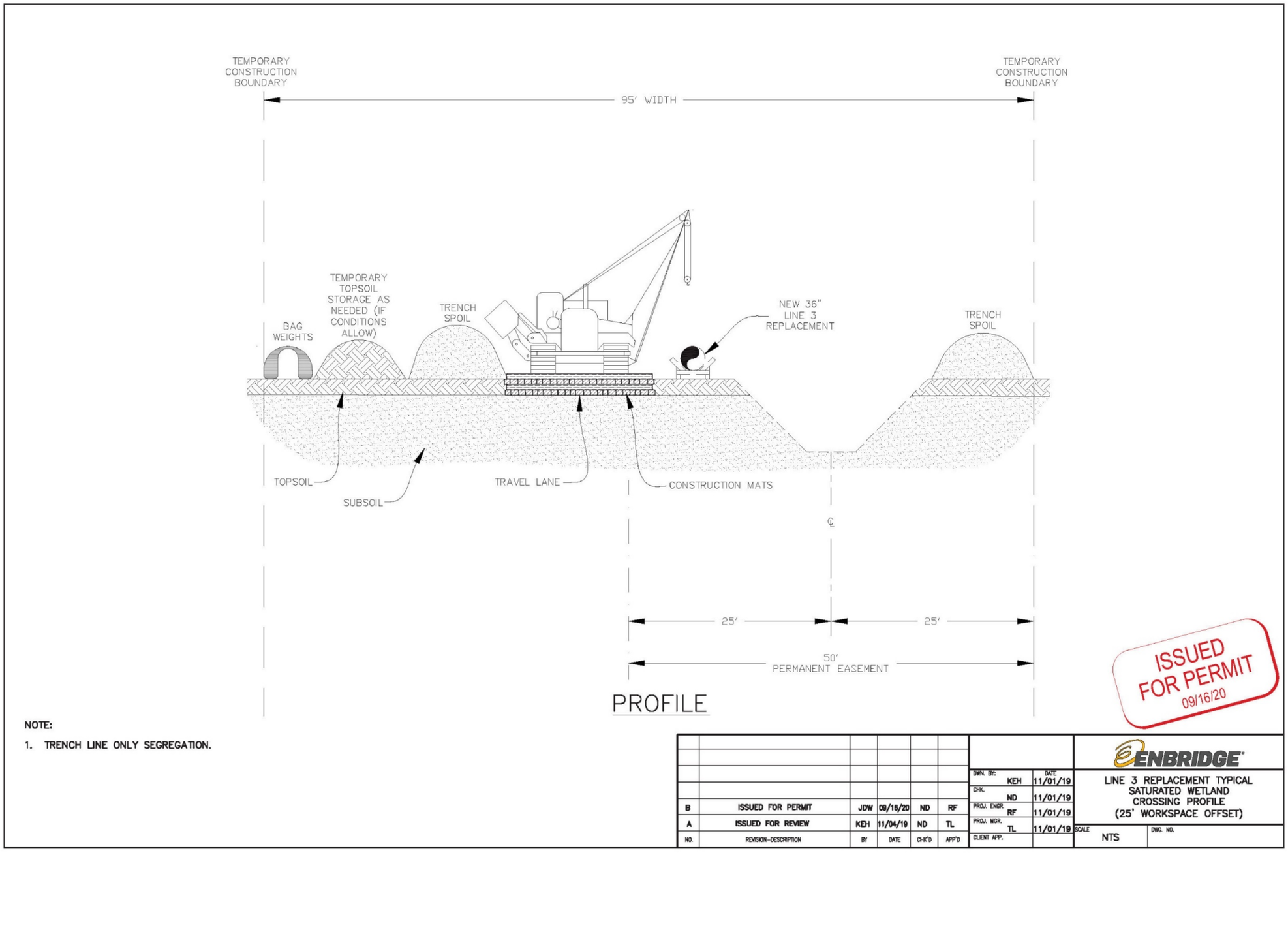
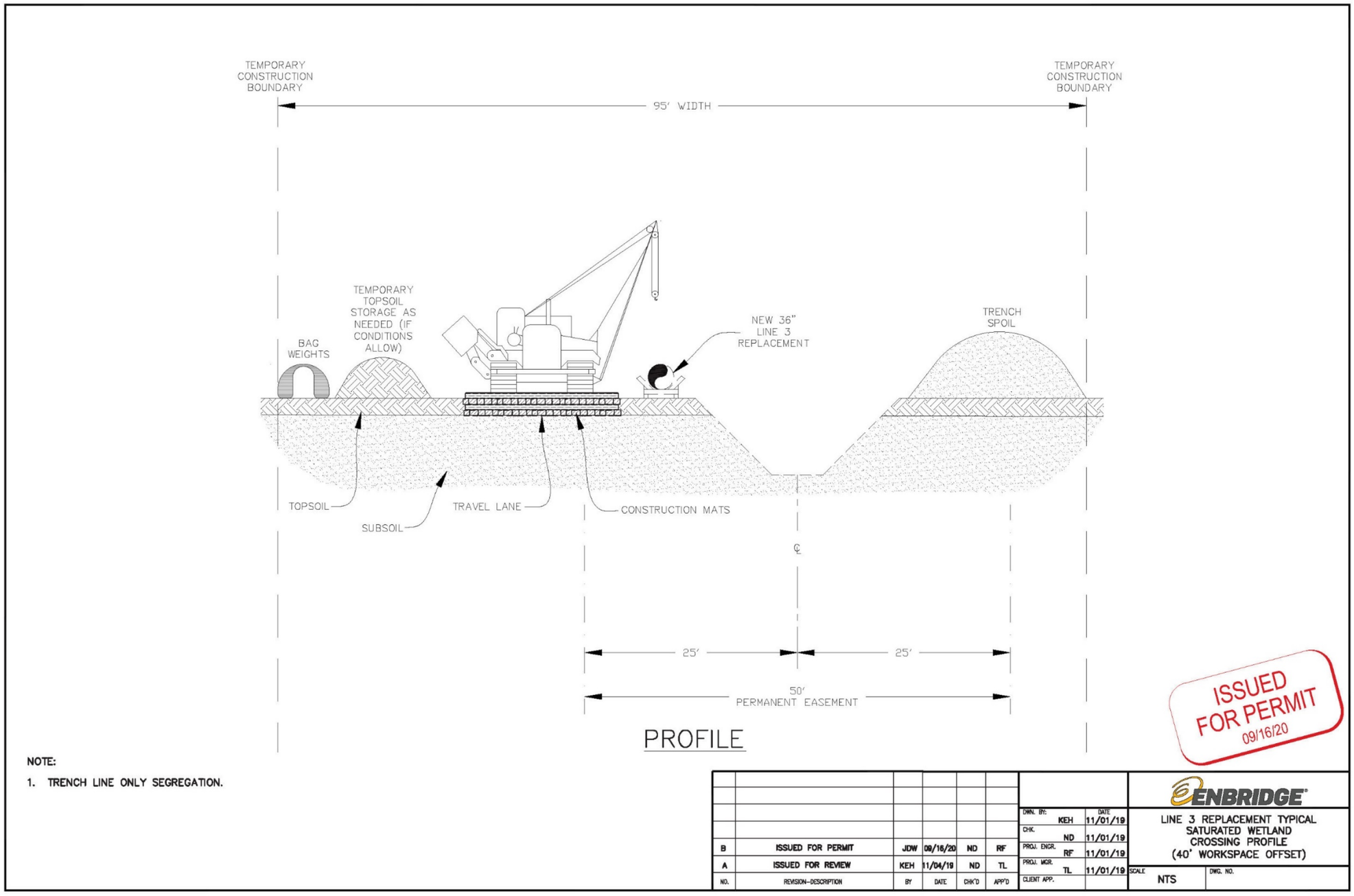


Figure 33 Typical Saturated Wetland Crossing Profile (40’ workspace offset)



PROFILE

ISSUED FOR PERMIT 09/16/20

NOTE:

1. TRENCH LINE ONLY SEGREGATION.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	ND	RF
A	ISSUED FOR REVIEW	KEH	11/04/19	ND	TL

		DATE
DWN. BY:	KEH	11/01/19
CHK.	ND	11/01/19
PROJ. ENGR.	RF	11/01/19
PROJ. MGR.	TL	11/01/19
CLIENT APP.		

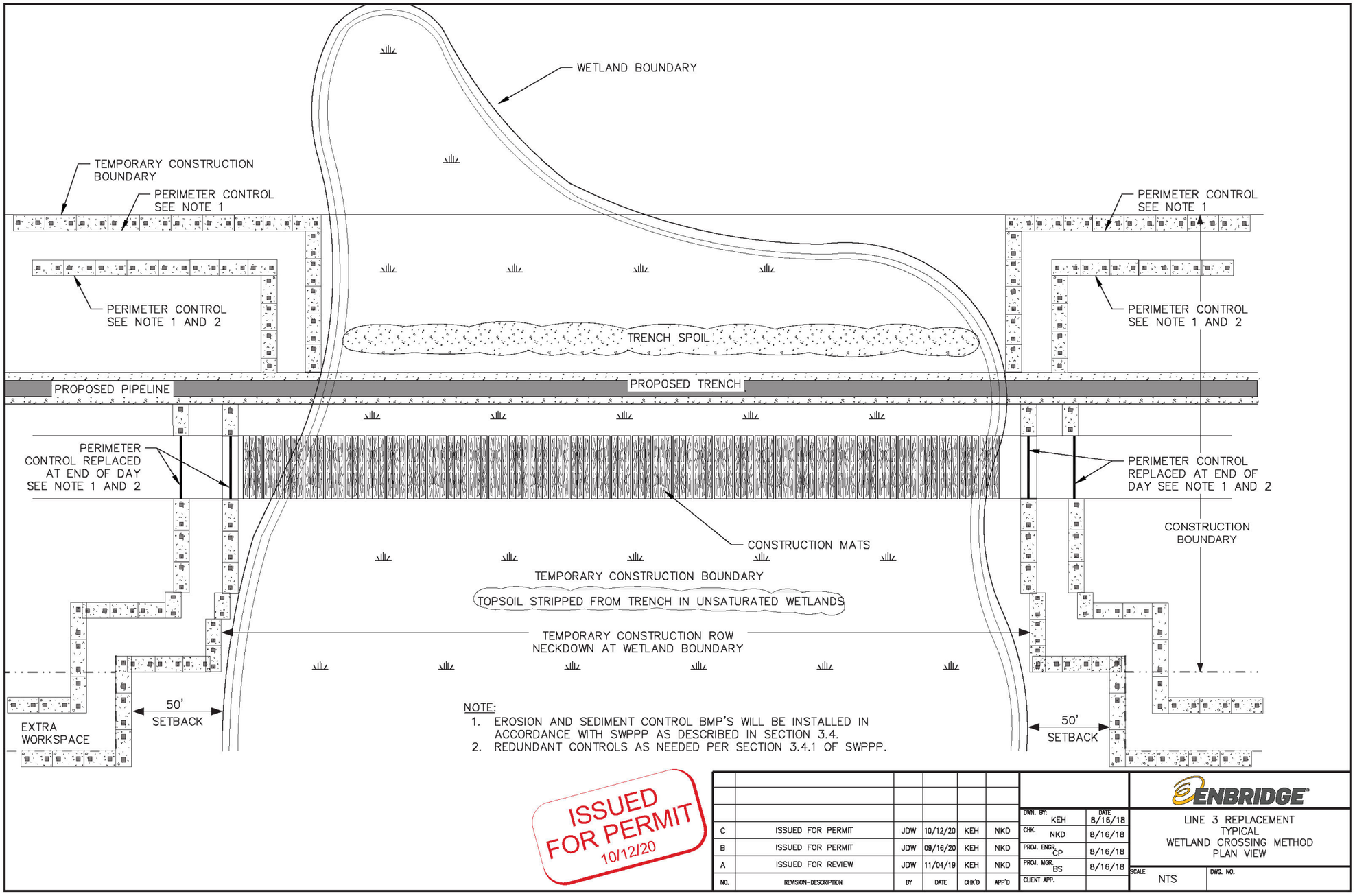
ENBRIDGE

LINE 3 REPLACEMENT TYPICAL SATURATED WETLAND CROSSING PROFILE (40' WORKSPACE OFFSET)

SCALE: NTS

DWG. NO.

Figure 34 Typical Wetland Crossing Method – Plan View



NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	JDW	10/12/20	KEH	NKD
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	NKD
A	ISSUED FOR REVIEW	JDW	11/04/19	KEH	NKD

		DATE
DWN. BY:	KEH	8/16/18
CHK.	NKD	8/16/18
PROJ. ENGR.	CP	8/16/18
PROJ. MGR.	BS	8/16/18
CLIENT APP.		

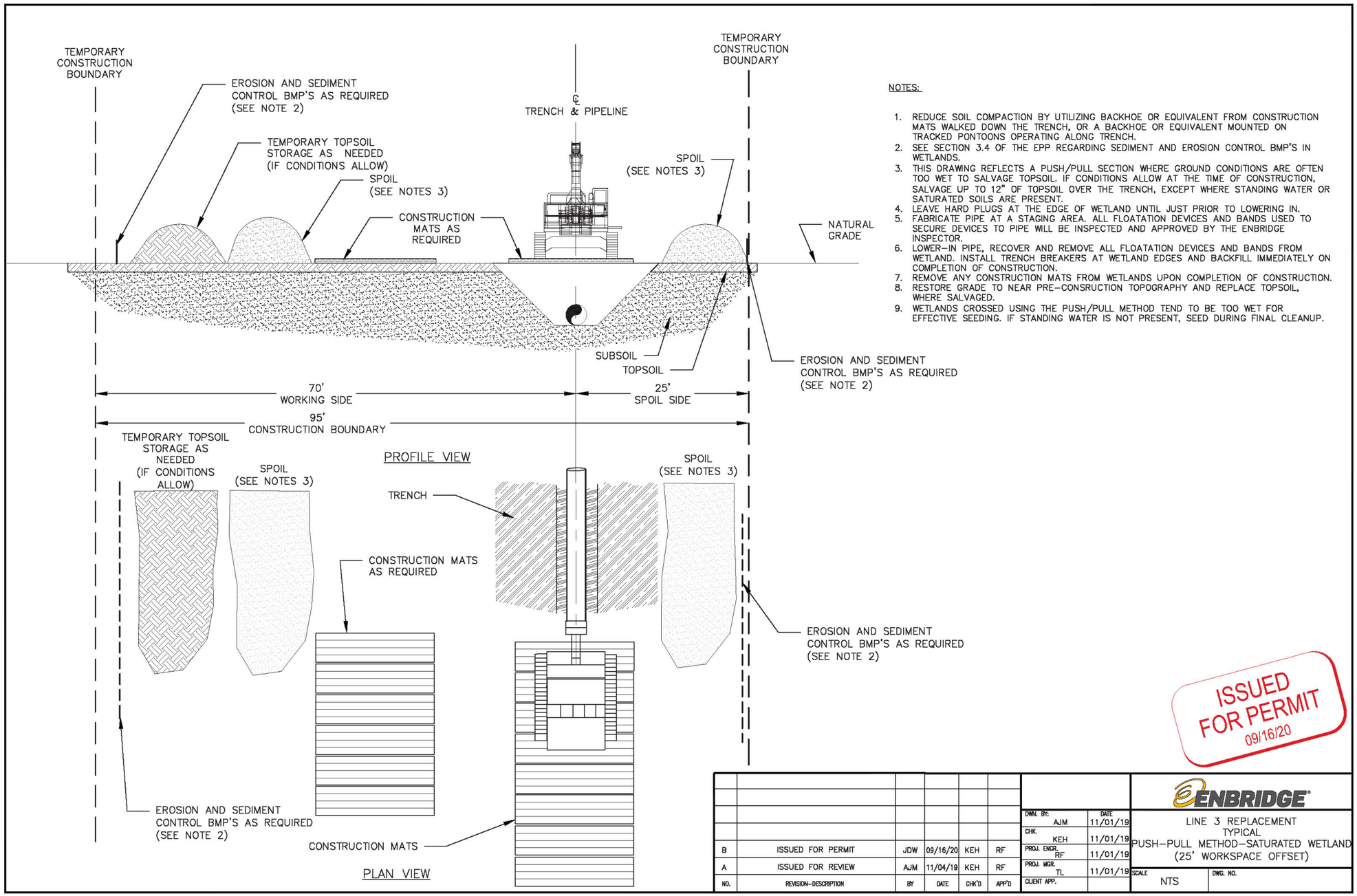
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
WETLAND CROSSING METHOD
PLAN VIEW

SCALE: NTS

DWG. NO.

Figure 35 Typical Push-Pull Method – Saturated Wetland (25' workspace offset)



NOTES:

1. REDUCE SOIL COMPACTION BY UTILIZING BACKHOE OR EQUIVALENT FROM CONSTRUCTION MATS WALKED DOWN THE TRENCH, OR A BACKHOE OR EQUIVALENT MOUNTED ON TRACKED PONTOONS OPERATING ALONG TRENCH.
2. SEE SECTION 3.4 OF THE EPP REGARDING SEDIMENT AND EROSION CONTROL BMP'S IN WETLANDS.
3. THIS DRAWING REFLECTS A PUSH/PULL SECTION WHERE GROUND CONDITIONS ARE OFTEN TOO WET TO SALVAGE TOPSOIL. IF CONDITIONS ALLOW AT THE TIME OF CONSTRUCTION, SALVAGE UP TO 12" OF TOPSOIL OVER THE TRENCH, EXCEPT WHERE STANDING WATER OR SATURATED SOILS ARE PRESENT.
4. LEAVE HARD PLUGS AT THE EDGE OF WETLAND UNTIL JUST PRIOR TO LOWERING IN.
5. FABRICATE PIPE AT A STAGING AREA. ALL FLOATATION DEVICES AND BANDS USED TO SECURE DEVICES TO PIPE WILL BE INSPECTED AND APPROVED BY THE ENBRIDGE INSPECTOR.
6. LOWER-IN PIPE, RECOVER AND REMOVE ALL FLOATATION DEVICES AND BANDS FROM WETLAND. INSTALL TRENCH BREAKERS AT WETLAND EDGES AND BACKFILL IMMEDIATELY ON COMPLETION OF CONSTRUCTION.
7. REMOVE ANY CONSTRUCTION MATS FROM WETLANDS UPON COMPLETION OF CONSTRUCTION.
8. RESTORE GRADE TO NEAR PRE-CONSRUCTION TOPOGRAPHY AND REPLACE TOPSOIL, WHERE SALVAGED.
9. WETLANDS CROSSED USING THE PUSH/PULL METHOD TEND TO BE TOO WET FOR EFFECTIVE SEEDING. IF STANDING WATER IS NOT PRESENT, SEED DURING FINAL CLEANUP.

ISSUED FOR PERMIT 09/16/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	RF
A	ISSUED FOR REVIEW	AJM	11/04/19	KEH	RF

DWN. BY: AJM	DATE 11/01/19	ENBRIDGE
CHK. KEH	11/01/19	LINE 3 REPLACEMENT TYPICAL PUSH-PULL METHOD-SATURATED WETLAND (25' WORKSPACE OFFSET)
PROJ. ENGR. RF	11/01/19	
PROJ. MGR. TL	11/01/19	
CLIENT APP.		SCALE NTS / DWG. NO.

Figure 36 Typical Push-Pull Method – Saturated Wetland (40' workspace offset)

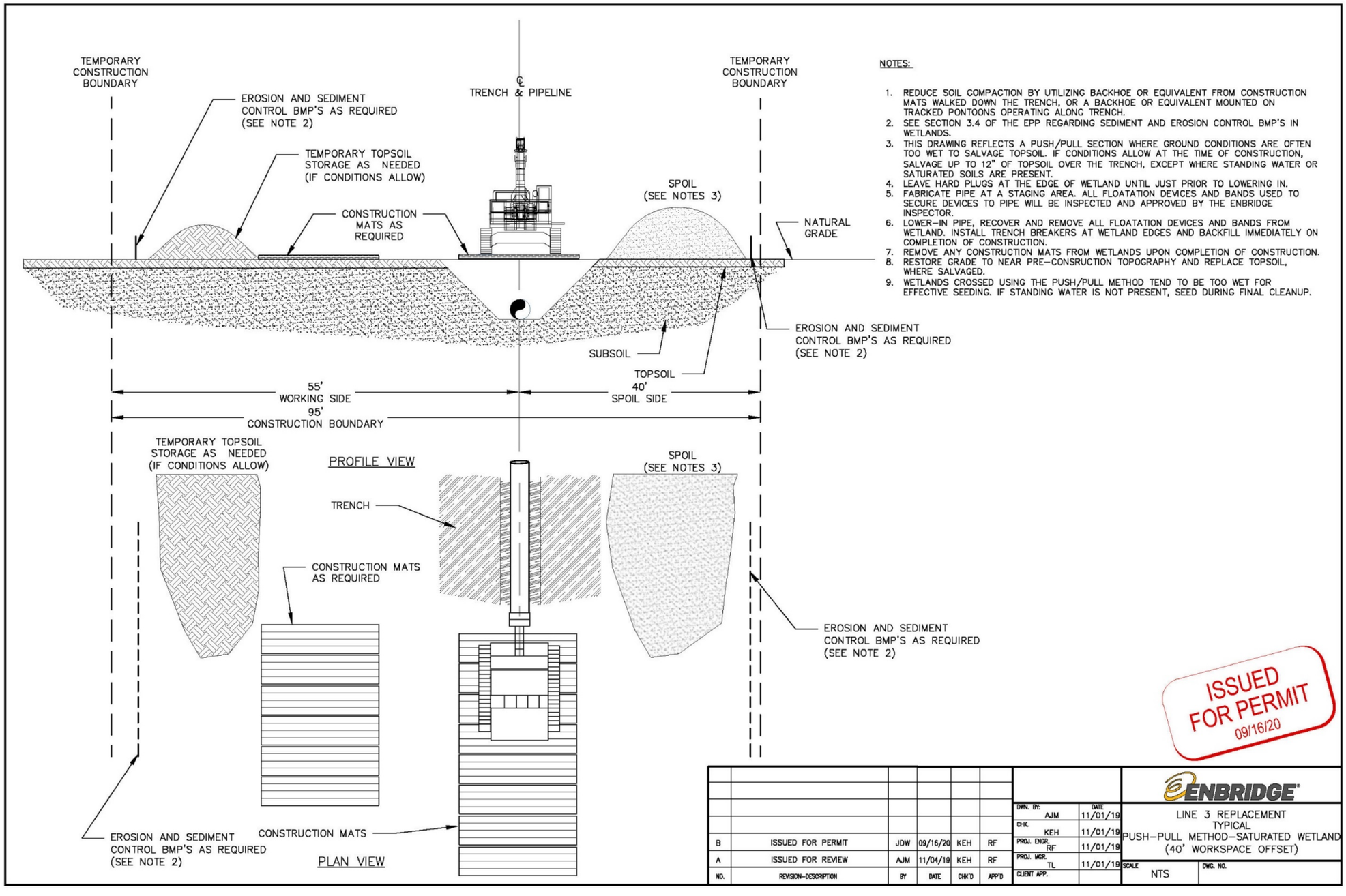
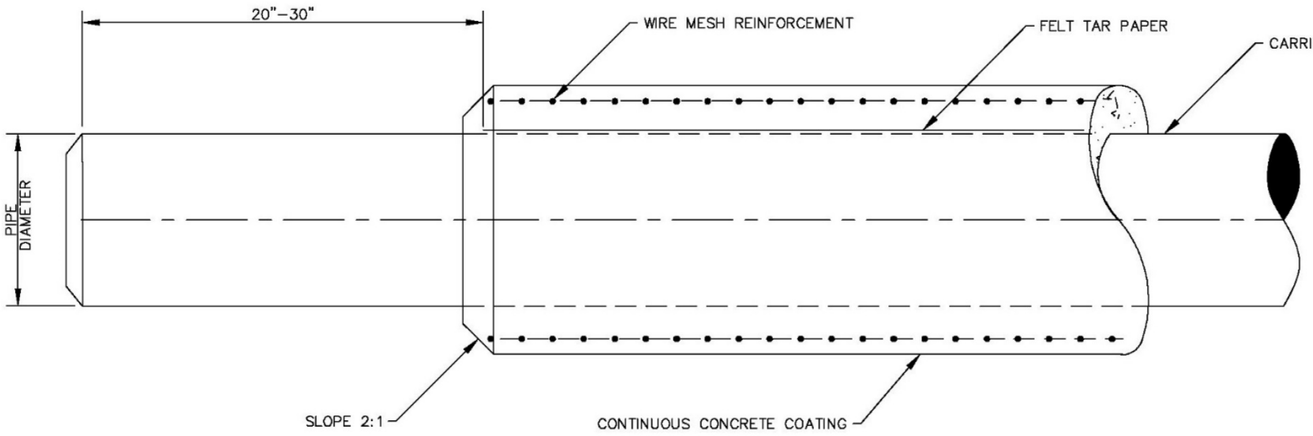


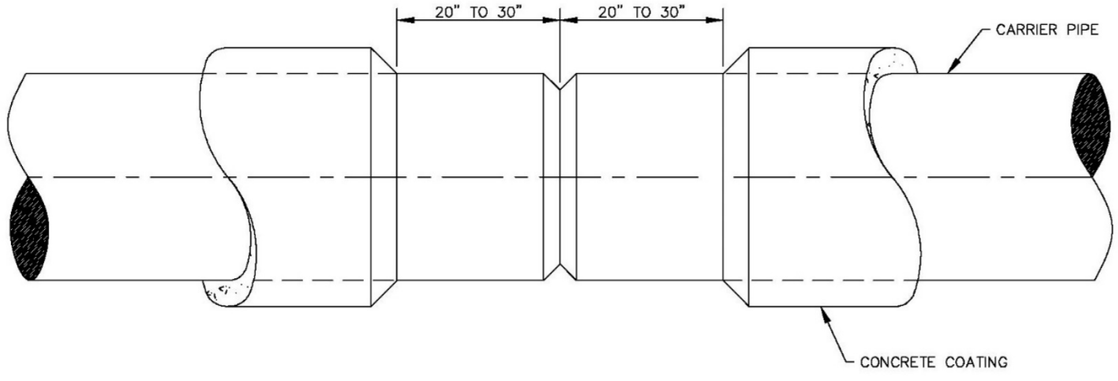
Figure 37 Typical Concrete Coating



CONTINUOUS CONCRETE COATING

NOTES:

1. MINIMUM CONCRETE DENSITY SHALL BE 150 LB/FT.^{3} UNLESS OTHERWISE APPROVED BY THE COMPANY.
2. CONCRETE COATING CUTBACK SHALL BE 20"–30".
3. CONCRETE COATING THICKNESS TO PROVIDE A MINIMUM NEGATIVE BUOYANCY OF 10% IN FLUID TO BE DISPLACED.
4. MINIMUM ALLOWABLE COMPRESSION STRENTH OF 3,000 PSI @28 DAYS.
5. ONE LAYER OF FELT TAR PAPER SHALL BE PLACE ALONG TOP OF PIPE TO PROTECT DURING CONCRETE POURING.
6. THE APPLICATION OF CONTINUOUS CONCRETE COATING SHALL ADHERE TO USPCS–SPEC–CCC–009 REV 1.
7. MESH REINFORCEMENT MATERIAL TO BE APPROVED BY COMPANY PRIOR TO USE.
8. REFER TO ALIGNMENT SHEETS, SITE SPECIFIC DRAWINGS, OR CONSTRUCTION STANDARDS FOR MINIMUM COATING THICKNESS.



DETAIL AT PIPE JOINT

SEE NOTE 4

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NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
H	ISSUED FOR PERMIT	JDW	10/22/20	NKD	RF
G	ISSUED FOR PERMIT	JDW	09/21/20	NKD	RF
F	ISSUED FOR PERMIT	JDW	09/16/20	NKD	RF
E	ISSUED FOR PERMIT	JDW	09/16/20	NKD	RF
D	ISSUED FOR REVIEW	DWA	11/04/19	NKD	RF

		DATE
DWN. BY:	YL	06/13/16
CHK.	KEH	08/04/17
PROJ. ENGR.	MDM	08/04/17
PROJ. MGR.	BS	08/04/17
CLIENT APP.		

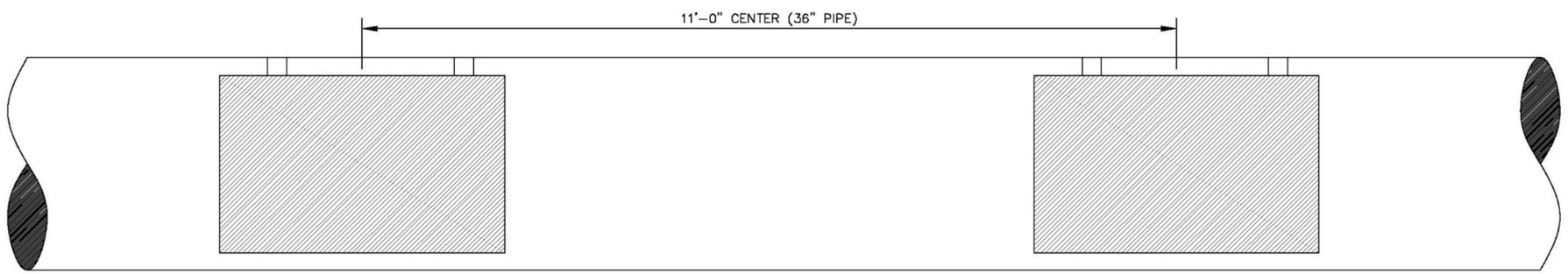
ENBRIDGE

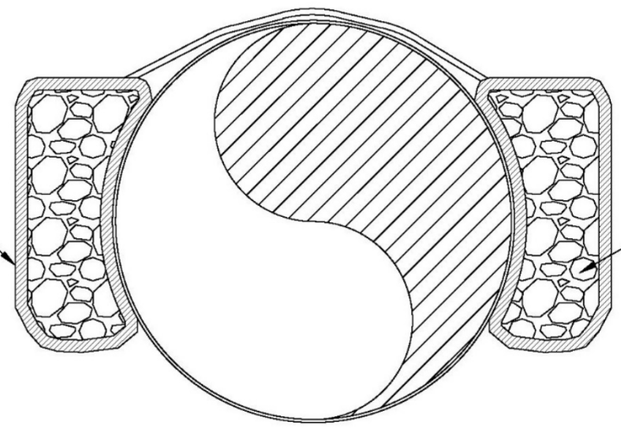
LINE 3 REPLACEMENT
TYPICAL
CONCRETE COATING

SCALE: NTS

DWG. NO.

Figure 38 Typical Buoyancy Control – Saddle-Bag Weights





ISSUED FOR PERMIT 09/16/20

NOTES:

1. BAG WEIGHT TYPE AND MANUFACTURER TO BE APPROVED BY COMPANY REPRESENTATIVE.
2. USE IN WETLANDS ACCORDING TO ALIGNMENT SHEETS AND COMPANY REPRESENTATIVE.
3. WEIGHT TO BE 9000 LBS AT 11'–0" SPACING FOR 36" DIAMETER PIPELINE.
4. REFER TO USPCS–SPEC–PIPELINE–001 REV3 FOR ADDITIONAL REQUIREMENTS.

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
E	ISSUED FOR PERMIT	JDW	09/16/20	NKD	RF
D	ISSUED FOR REVIEW	AJM	11/04/19	NKD	RF

DWN. BY: YL	DATE 06/13/16	ENBRIDGE
CHK. KEH	08/04/17	LINE 3 REPLACEMENT BUOYANCY CONTROL SADDLE–BAG WEIGHTS
PROJ. ENGR. MDM	08/04/17	
PROJ. MGR. BS	08/04/17	
CLIENT APP.		SCALE NTS / DWG. NO.

Figure 39 Typical Concrete Washout

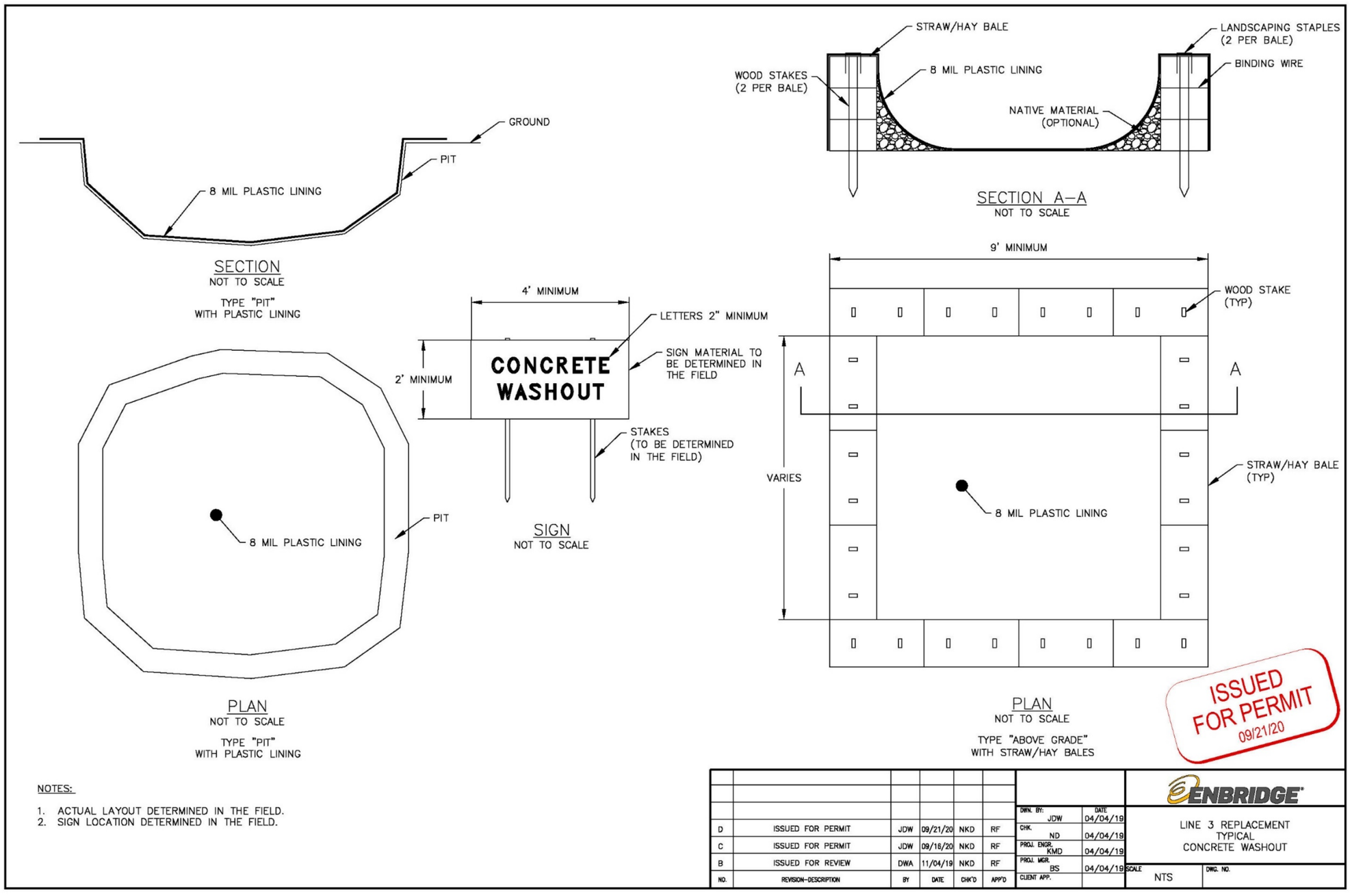
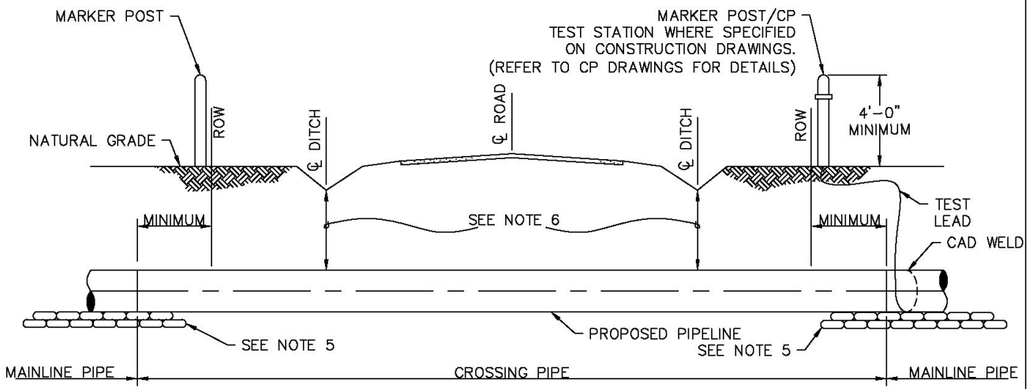
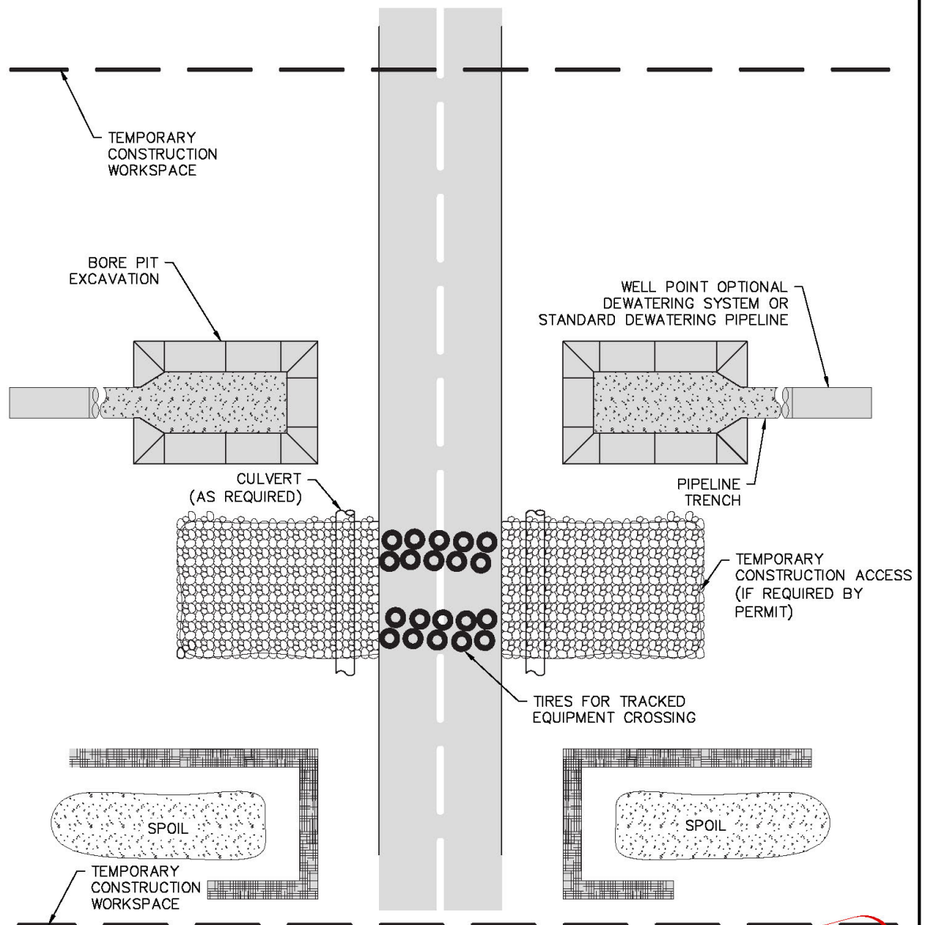


Figure 40 Typical Horizontal Bore Method – Uncased Slick Bored Road Crossing with Support



PROFILE VIEW



PLAN VIEW

NOTES:

1. CROSSING INSTALLATION SHALL BE IN ACCORDANCE WITH APPLICABLE ROAD PERMIT REQUIREMENTS.
2. LOCATION, LENGTH OF CROSSING, MATERIALS, AND TESTING REQUIREMENTS SHALL BE AS STATED ON THE ALIGNMENT SHEETS.
3. COUNTER BORE AND TAPER HEAVY WALL PIPE ENDS PER DWG B-TYP-CBORE-TAPER.
4. SUPPORT MATERIAL TO BE SAND BAGS OR OTHER ENBRIDGE APPROVED MATERIAL.
5. CONTRACTOR SHALL FIRMLY SUPPORT HEAVY WALL AND LINE PIPE WITH CONTINUOUS SUPPORT MATERIALS. SUPPORT MATERIAL SHALL EXTEND ACROSS TRANSITION WELD AND EXTEND A MINIMUM OF 3' OR UNTIL PIPE RESTS ON UNDISTURBED GROUND.
6. AS A MINIMUM, THE DEPTH OF COVER UNDER ROAD DITCHES SHALL BE 48", AND UNDER THE ROAD SURFACE SHALL BE 60", UNLESS OTHERWISE REQUIRED BY THE ROAD CROSSING PERMIT. THE PIPELINE SHALL BE BURIED AT LEAST 54" BELOW THE AUTHORIZED DEPTH OF ANY PUBLIC DRAINAGE FACILITY.
7. HEAVY WALL PIPE SHALL EXTEND BEYOND ROW LIMITS, INSTALLED LENGTH MAY VARY.

NOTES:

1. PROCEDURES SHOWN IN THIS DRAWING APPLY TO IMPROVED ROADS.
2. ROADS MUST BE CLEANED AFTER EQUIPMENT CROSSES AND DIRT PLACED IN SPOIL CONTAINMENT AREAS.
3. TEMPORARY ACCESS MATERIALS MUST BE REMOVED UPON PROJECT COMPLETION.
4. ADDITIONAL INFORMATION INCLUDED ON OTHER DRAWINGS OR PERMITS.
5. CONSTRUCTION AREAS LOCATED OUTSIDE ROAD ROW.

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NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	NKD	RF
A	ISSUED FOR REVIEW	JDW	11/04/19	NKD	RF

		DATE
DWN. BY:	YL	06/13/16
CHK.	KEH	08/04/17
PROJ. ENGR.	MDM	08/04/17
PROJ. MGR.	BS	08/04/17
CLIENT APP.		

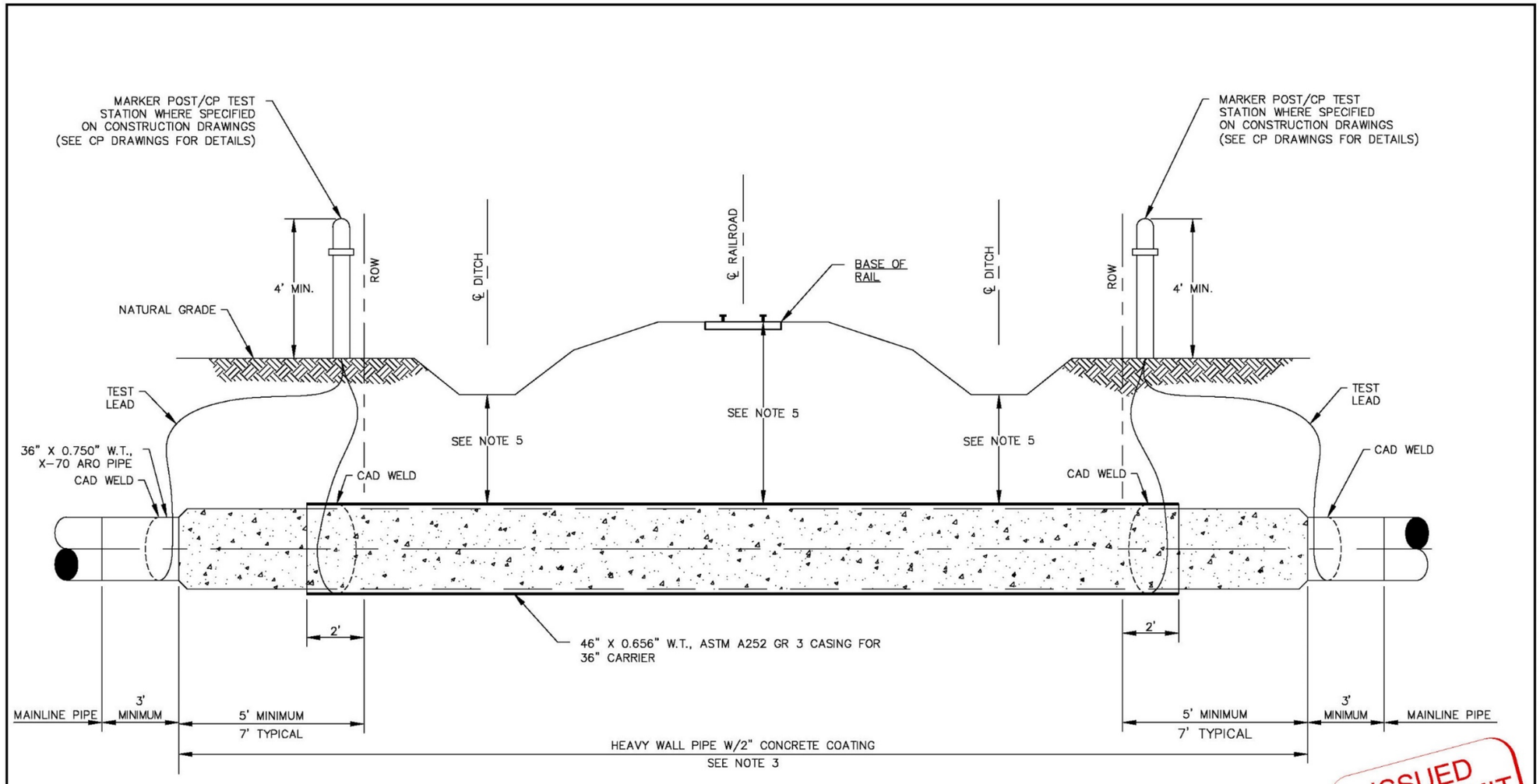
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL HORIZONTAL DIRECTIONAL BORE METHOD-UNCASED SLICK BORED ROAD CROSSING WITH SUPPORT

SCALE: NTS

DWG. NO.

Figure 41 Typical Horizontal Bore Method – Cased Slick Bore Railroad Crossing



PROFILE VIEW

ISSUED FOR PERMIT 09/21/20

NOTES:

1. CROSSING INSTALLATION SHALL BE IN ACCORDANCE WITH APPLICABLE ROAD PERMIT REQUIREMENTS.
2. LOCATION, LENGTH OF CROSSING, MATERIALS, AND TESTING REQUIREMENTS SHALL BE AS STATED ON THE ALIGNMENT SHEETS.
3. CASING PIPE SHALL EXTEND BEYOND THE EDGE OF THE ROW. CONCRETE COATING SHALL EXTEND BEYOND THE EDGE OF THE CASING PIPE. HEAVY WALL PIPE SHALL EXTEND BEYOND THE EDGE OF THE CONCRETE COATING.
4. CONCRETE COATING SHALL BE APPLIED IN ACCORDANCE WITH COMPANY SPECIFICATIONS. CONCRETE COATING, DWG B-TYP-CONC-COATING.
5. REFER TO SITE SPECIFIC CROSSING PERMITS FOR DEPTH OF COVER REQUIREMENTS.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	JDW	09/21/20	KEH	MDM
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	MDM
A	ISSUED FOR REVIEW	JDW	11/04/19	KEH	MDM

		DATE
DWN. BY:	YL	08/13/16
CHK.	KEH	08/04/17
PROJ. ENGR.	MDM	08/04/17
PROJ. MGR.	BS	08/04/17
CLIENT APP.		

ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL HORIZONTAL DIRECTIONAL BORE METHOD-CASED SLICK BORE RAILROAD CROSSING

SCALE: NTS

DWG. NO.

Figure 42 Typical Well Point Dewatering System

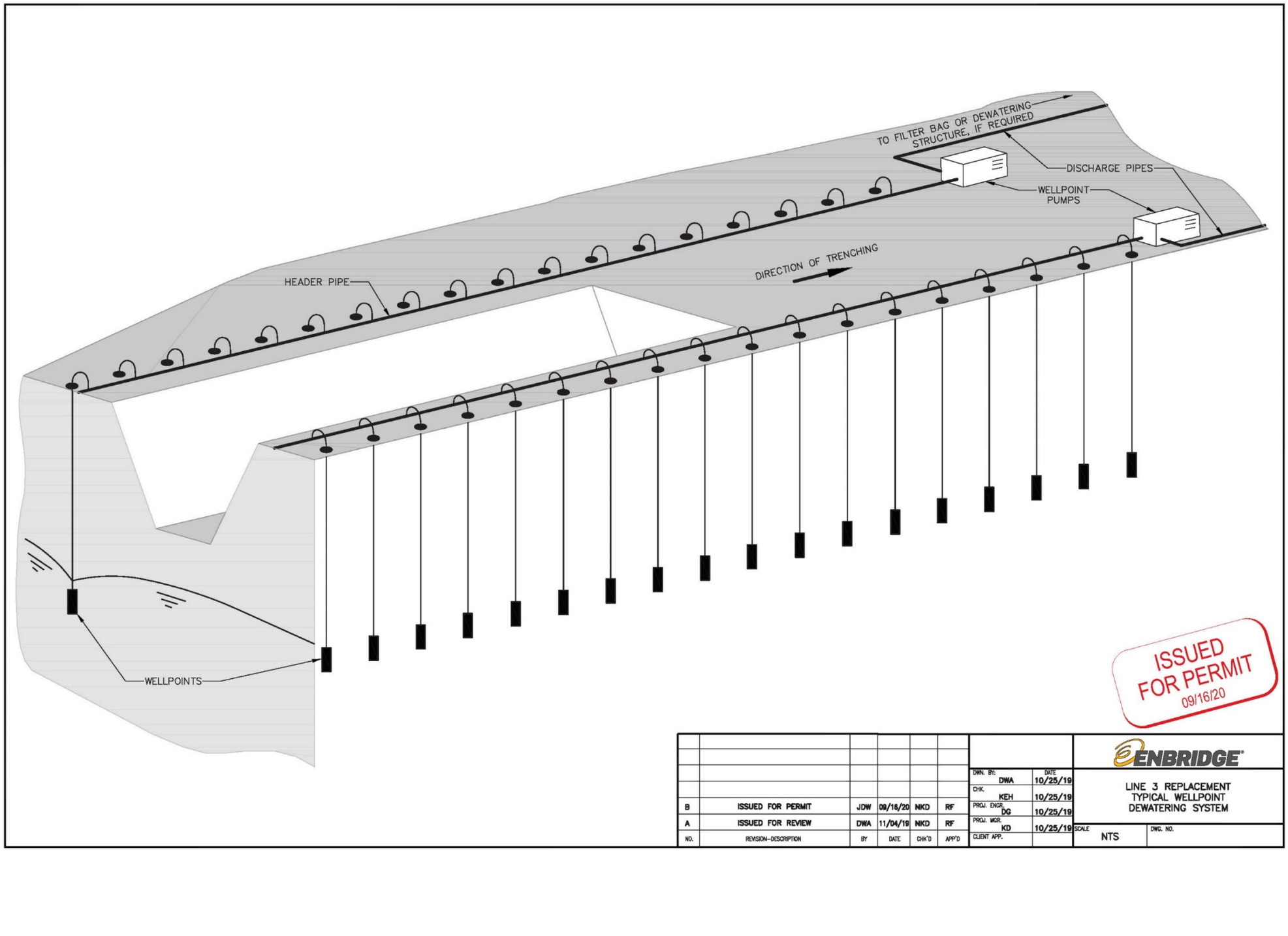
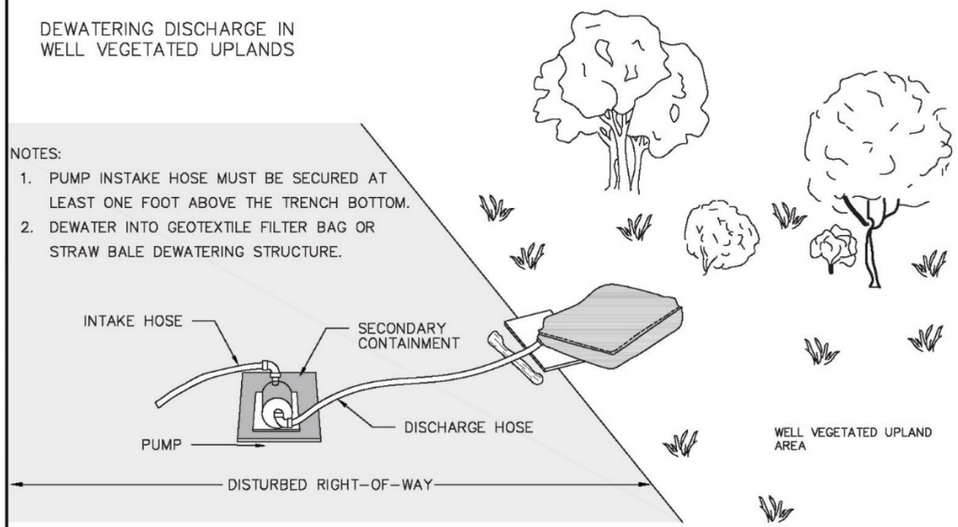


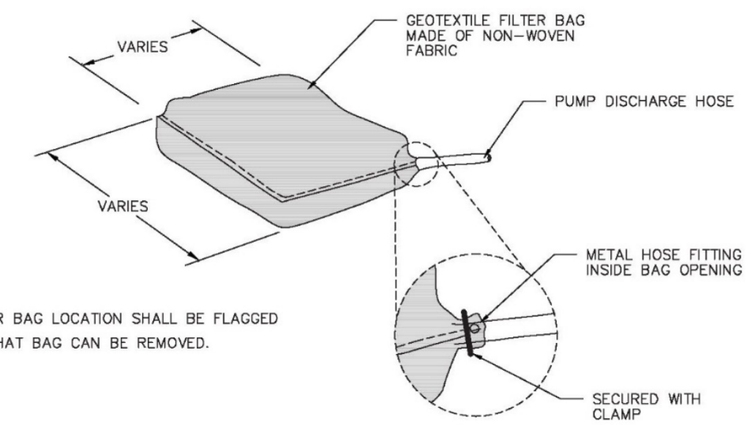
Figure 43 Typical Geotextile Filter Bag Dewatering - Upland

DEWATERING DISCHARGE IN WELL VEGETATED UPLANDS

NOTES:
1. PUMP INSTAKE HOSE MUST BE SECURED AT LEAST ONE FOOT ABOVE THE TRENCH BOTTOM.
2. DEWATER INTO GEOTEXTILE FILTER BAG OR STRAW BALE DEWATERING STRUCTURE.



GEOTEXTILE FILTER BAG



NOTE:
1. FILTER BAG LOCATION SHALL BE FLAGGED SO THAT BAG CAN BE REMOVED.

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NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	NKD	RF
A	ISSUED FOR REVIEW	DWA	11/04/19	NKD	RF

		DATE
DWN. BY:	DWA	10/25/19
CHK.	KEH	10/25/19
PROJ. ENGR.	DG	10/25/19
PROJ. MGR.	KD	10/25/19
CLIENT APP.		

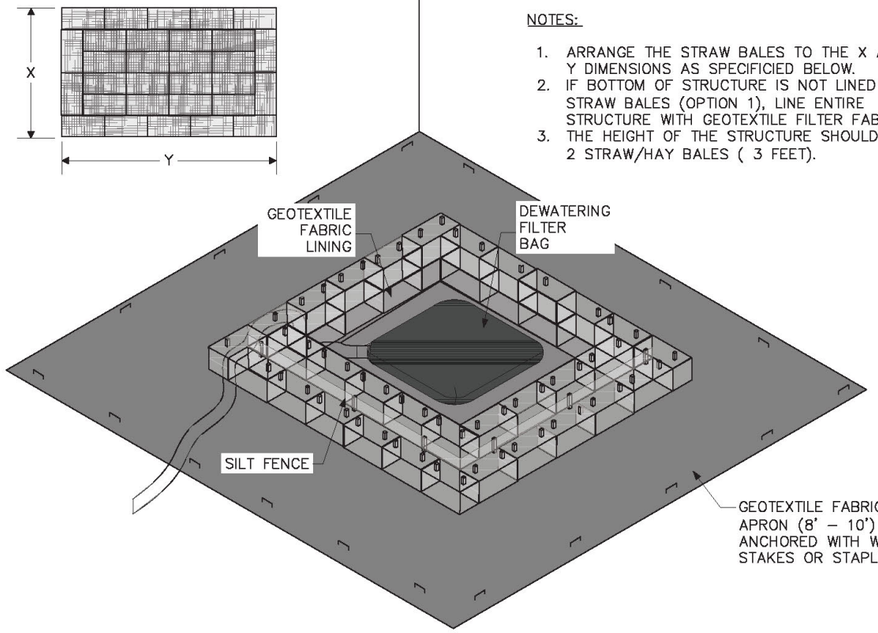
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
GEOTEXTILE FILTER BAG
DEWATERING-UPLAND

SCALE: NTS

DWG. NO.

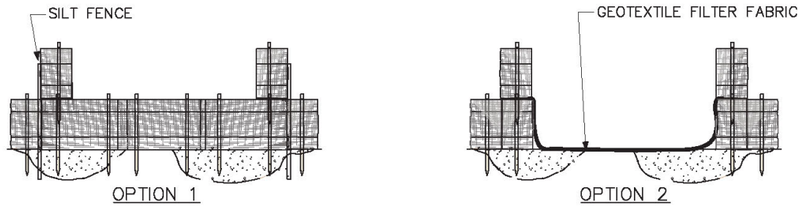
Figure 44 Typical Straw / Hay Bale Dewatering Structure



PERSPECTIVE VIEW

NOTES:

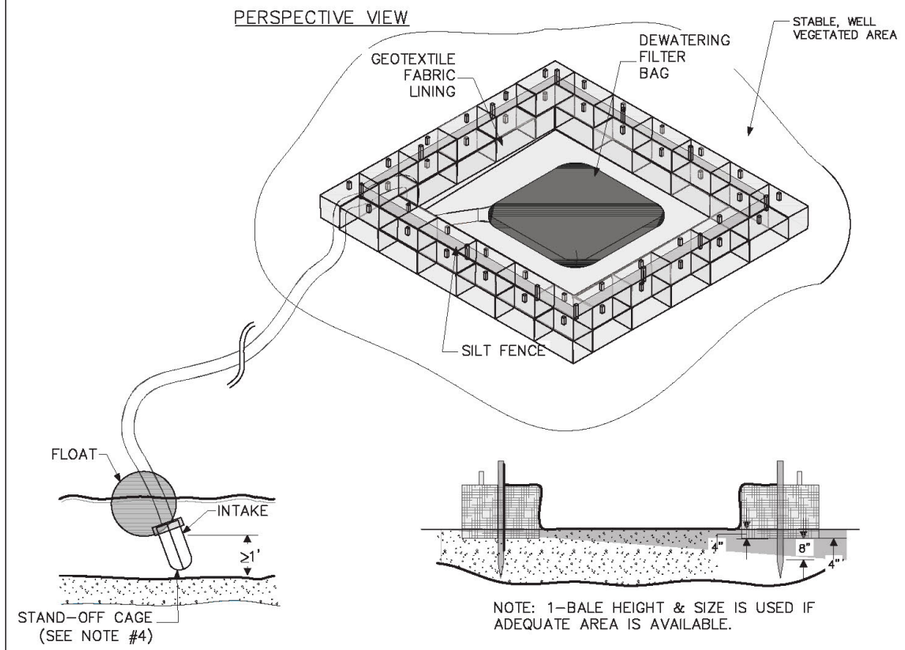
1. ARRANGE THE STRAW BALES TO THE X AND Y DIMENSIONS AS SPECIFICIED BELOW.
2. IF BOTTOM OF STRUCTURE IS NOT LINED WITH STRAW BALES (OPTION 1), LINE ENTIRE STRUCTURE WITH GEOTEXTILE FILTER FABRIC.
3. THE HEIGHT OF THE STRUCTURE SHOULD BE 2 STRAW/HAY BALES (3 FEET).



OPTION 1 OPTION 2

NOTE: TYPICAL DIMENSIONS AND MAXIMUM PUMPING RATES ARE BASED ON INDUSTRY EXPERIENCE, BEST MANAGEMENT PRACTICES, AND PUMP SIZE (4"–8").

TYPICAL MINIMUM SUMP DIMENSIONS (FEET)		MAXIMUM PUMPING RATE
X	Y	GALLONS PER MINUTE
10	20	300
15	20	350
20	20	400
20	25	450
25	25	500
25	30	550
30	30	660



PUMP INLET

NOTE: 1–BALE HEIGHT & SIZE IS USED IF ADEQUATE AREA IS AVAILABLE.

CROSS–SECTION OF STRUCTURE

NOTES:

1. SILT FENCE ENDS MUST BE WRAPPED TO JOIN TWO SECTIONS.
2. SILT FENCE SHALL BE ABOVE TOP OF BALES AND ANCHORED 6" BELOW GRADE.
3. SILT FENCE POST STAKING MUST BE 4 FEET OR LESS.
4. DEWATERING INTAKE HOSE SUPPORTED AT LEAST 1 FOOT FROM BOTTOM OF TRENCH BEING DEWATERED.
5. USE A FILTER BAG AT THE DISCHARGE HOSE END.
6. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSPECTED AND MAINTAINED AS NEEDED TO MAINTAIN EFFICACY PER INDUSTRY STANDARDS.
7. MAINLINE HYDROSTATIC TEST DEWATERING STRUCTURES WILL BE REINFORCED USING INDUSTRY STANDARD OPTIONS TO PREVENT BALE MOVEMENT DURING DISCHARGE (e.g.,CINCH STRAPS, WIRE, CATTLE GUARD FENCING).

ISSUED FOR PERMIT 09/16/20

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	NKD
A	ISSUED FOR REVIEW	JDW	11/04/19	KEH	NKD

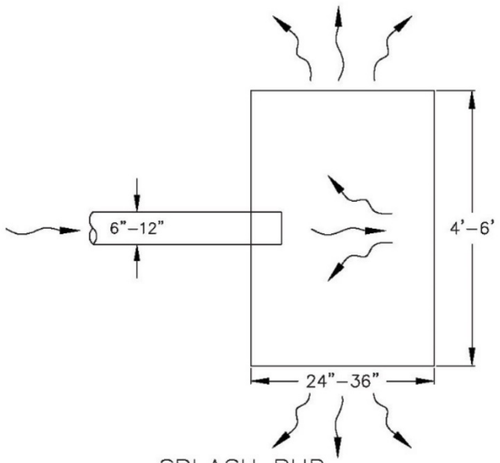
DWN. BY: JDW	DATE	10/24/19
CHK. NKD		10/24/19
PROJ. ENGR. RF		10/24/19
PROJ. MGR. TL		10/24/19
CLIENT APP.		

ENBRIDGE

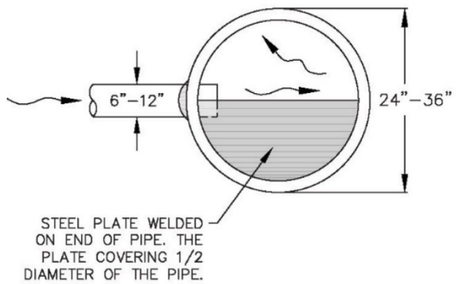
LINE 3 REPLACEMENT
TYPICAL
STRAW/HAY BALE
DEWATERING STRUCTURE

SCALE: NTS DWG. NO.

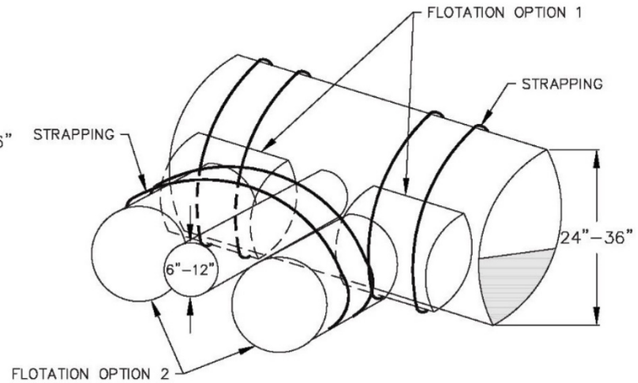
Figure 45 Typical Splash Pup Flotation



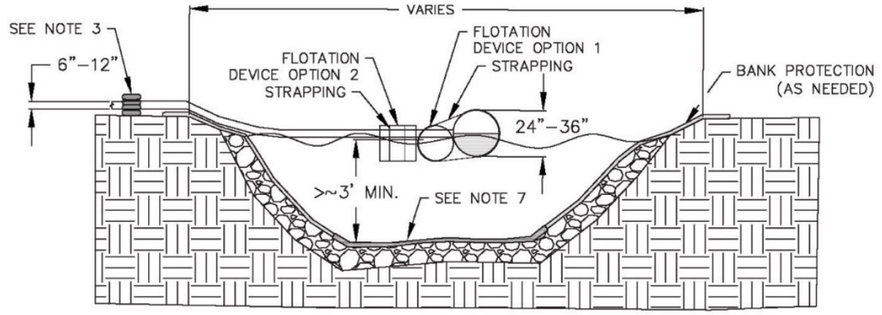
SPLASH PUP
PLAN



SPLASH PUP
PROFILE



SPLASH PUP
ISOMETRIC VIEW



SPLASH PUP
FLOTATION

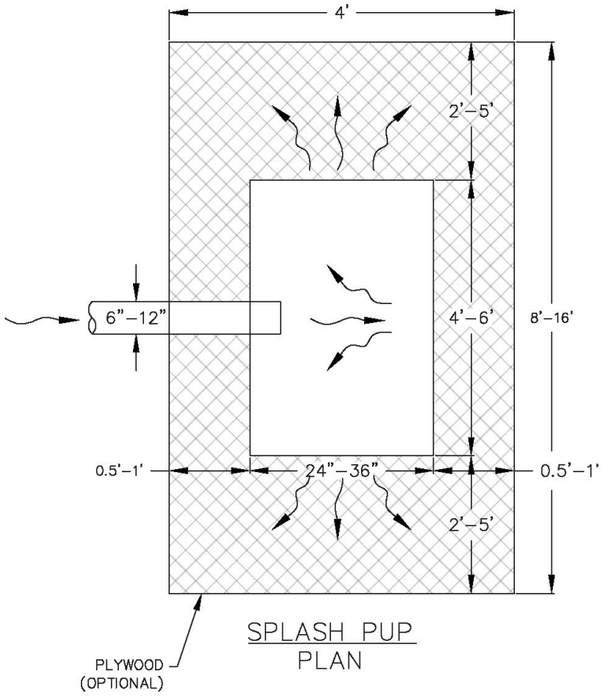
NOTES:
1. AN ENERGY DISSIPATER SHALL BE UTILIZED FOR ALL DISCHARGES (OR THE LIKE).
2. ENERGY DISSIPATERS ARE UTILIZED IN CONJUNCTION WITH PERMIT REQUIRED TREATMENT.
3. DISCHARGE PIPING WILL BE SECURED TO PREVENT MOVEMENT ON SURFACE APPROACHING WATERBODY AS NEEDED.
4. FLOTATION DEVICE AND SPACING DEVICE TBD IN FIELD USING INDUSTRY STANDARD MATERIALS (eg. CLEAN PLASTIC BARREL).
5. BANK PROTECTION TBD (eg. PLASTIC SHEETING, TARP, OR PLYWOOD) AS NEEDED.
6. IF OPTIONAL PLYWOOD PROTECTION IS USED AND COMES INTO CONTACT WITH INFESTED WATERS, IT WILL BE DISPOSED OF AFTER DISCHARGE IS COMPLETED. OTHER MATERIALS WOULD BE DECONTAMINATED PER APPLICABLE PERMIT REQUIREMENTS IF PLANNED FOR REUSE.
7. INDUSTRY STANDARD MATERIAL (eg. PLYWOOD, GEOTEXTILE, ETC.) AS NEEDED TBD AT PRE DISCHARGE SITE MEETING.

ISSUED FOR PERMIT
09/16/20

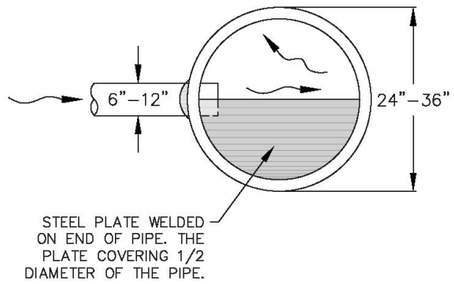
NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
F	ISSUED FOR PERMIT	JDW	09/16/20	KEH	RF
E	ISSUED FOR REVIEW	AJM	11/04/19	KEH	RF

DWN. BY: JDW	DATE: 04/25/19	ENBRIDGE
CHK. KEH	04/30/19	LINE 3 REPLACEMENT TYPICAL SPLASH PUP FLOTATION
PROJ. ENGR. DG	04/30/19	
PROJ. MGR. KD	04/30/19	
CLIENT APP.		SCALE: NTS / DWG. NO.

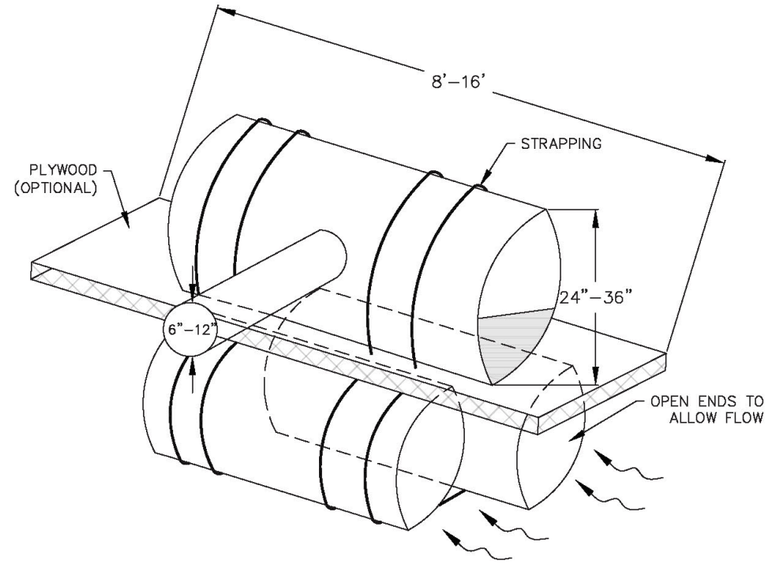
Figure 46 Typical Splash Pup Scour Prevention



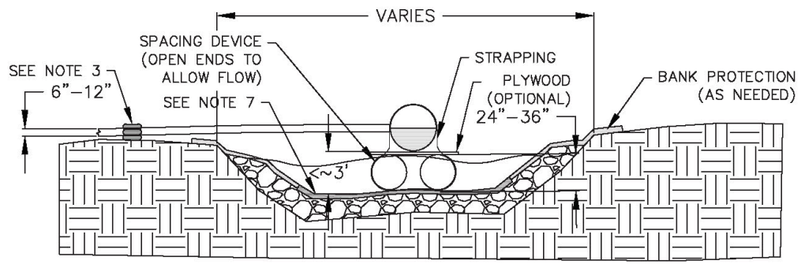
SPLASH PUP
PLAN



SPLASH PUP
PROFILE



SPLASH PUP
ISOMETRIC VIEW



SPLASH PUP
SCOUR PREVENTION

NOTES:
1. AN ENERGY DISSIPATER SHALL BE UTILIZED FOR ALL DISCHARGES (OR THE LIKE).
2. ENERGY DISSIPATERS ARE UTILIZED IN CONJUNCTION WITH PERMIT REQUIRED TREATMENT.
3. DISCHARGE PIPING WILL BE SECURED TO PREVENT MOVEMENT ON SURFACE APPROACHING WATERBODY AS NEEDED.
4. FLOTATION DEVICE AND SPACING DEVICE TBD IN FIELD USING INDUSTRY STANDARD MATERIALS (eg. CLEAN PLASTIC BARREL).
5. BANK PROTECTION TBD (eg. PLASTIC SHEETING, TARP, OR PLYWOOD) AS NEEDED.
6. IF OPTIONAL PLYWOOD PROTECTION IS USED AND COMES INTO CONTACT WITH INFESTED WATERS, IT WILL BE DISPOSED OF AFTER DISCHARGE IS COMPLETED. OTHER MATERIALS WOULD BE DECONTAMINATED PER APPLICABLE PERMIT REQUIREMENTS IF PLANNED FOR REUSE.
7. INDUSTRY STANDARD MATERIAL (eg. PLYWOOD, GEOTEXTILE, ETC.) AS NEEDED TBD AT PRE DISCHARGE SITE MEETING.

* USE 1 OR 2 4'X8' PLYWOOD SHEETS AS NEEDED TBD AT PRE DISCHARGE SITE MEETING.

ISSUED FOR PERMIT
09/16/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
F	ISSUED FOR PERMIT	JDW	09/16/20	KEH	RF
E	ISSUED FOR REVIEW	AJM	11/04/19	KEH	RF

DWN. BY: JDW	DATE 04/25/19	ENBRIDGE
CHK. KEH	04/30/19	LINE 3 REPLACEMENT
PROJ. ENGR. DG	04/30/19	TYPICAL
PROJ. MGR. KD	04/30/19	SPLASH PUP
CLIENT APP.		SCOUR PREVENTION
SCALE NTS		DWG. NO.

Figure 47 Road Intersection Corner Improvements

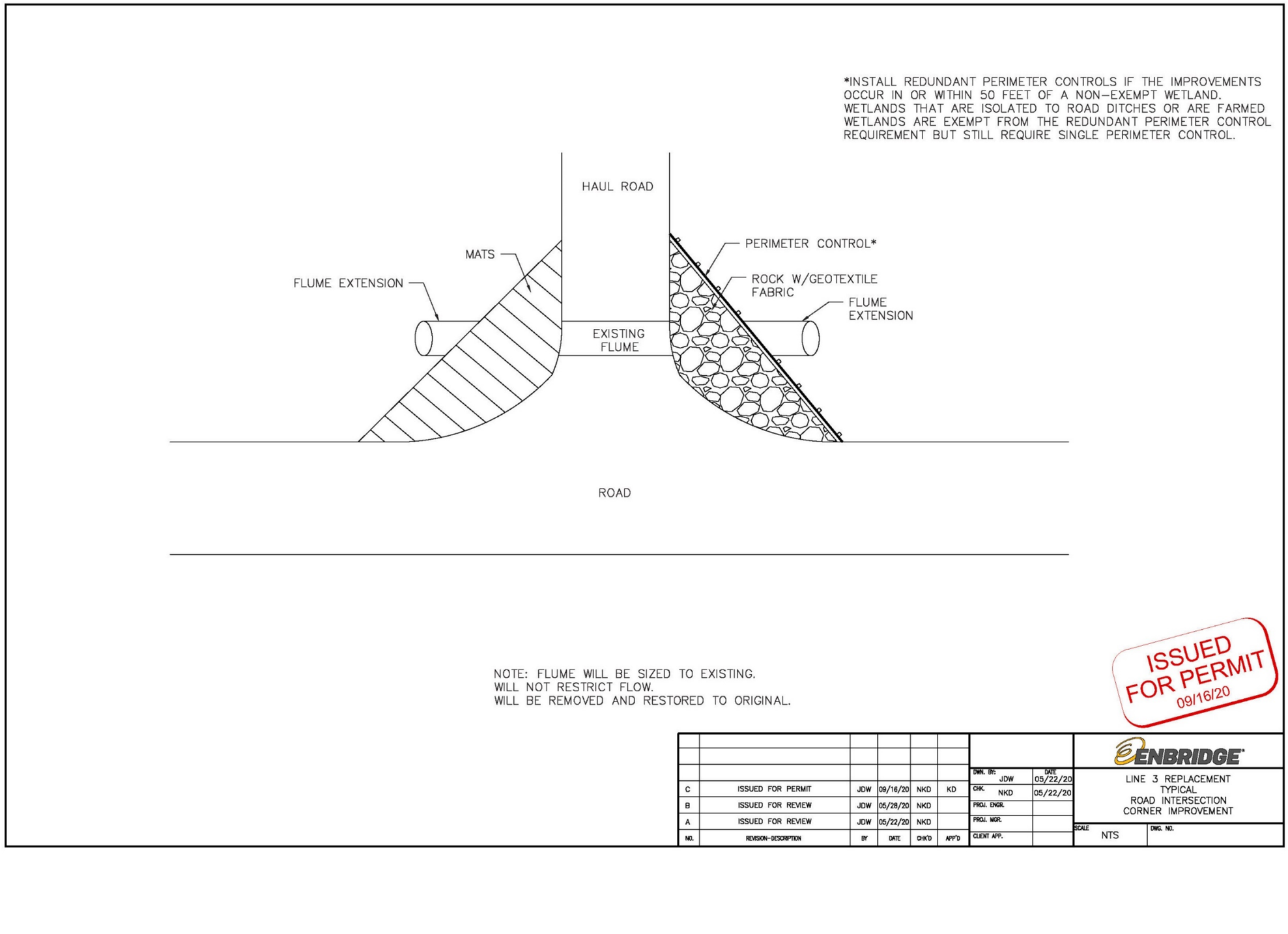
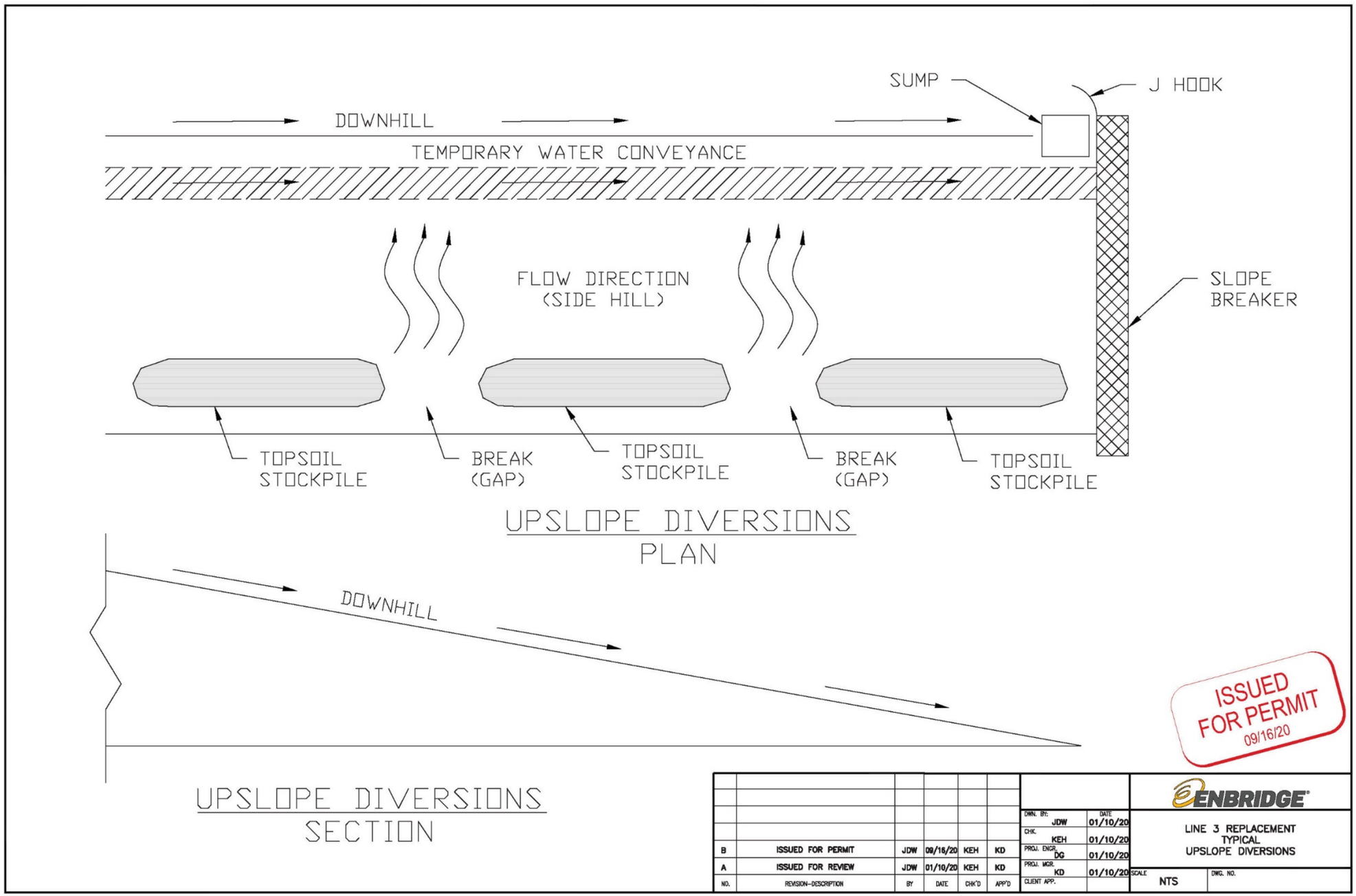


Figure 48 Upslope Diversions



NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
A	ISSUED FOR REVIEW	JDW	01/10/20	KEH	KD

		DATE
DWN. BY:	JDW	01/10/20
CHK.	KEH	01/10/20
PROJ. ENGR.	DG	01/10/20
PROJ. MGR.	KD	01/10/20
CLIENT APP.		

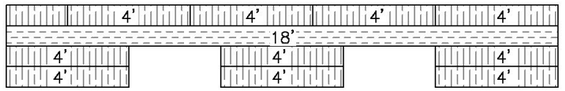
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
UPSLOPE DIVERSIONS

SCALE: NTS

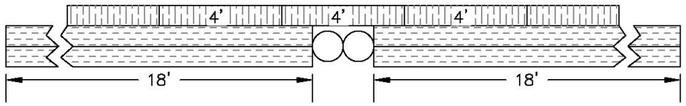
DWG. NO.

Figure 49 Construction Mat Design to Maintain Surface Flow



MAY BE USED IN INUNDATED AREAS GREATER THAN 2 FEET DEEP IN NON–FROZEN CONDITIONS. MID–LAYER MATS MAY OR MAY NOT BE NECESSARY FOR BRIDGE STABILITY BASED ON SITE–SPECIFIC CONDITIONS. CONFIGURATIONS MAY BE REPEATED/DEPTH MAY VARY.

OPTION A
PROFILE VIEW

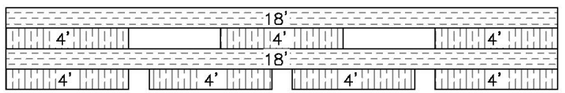


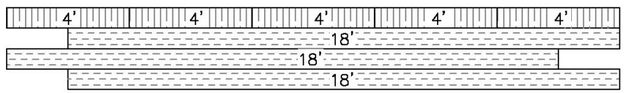
MAY BE USED IN AREAS LESS THAN 2 FEET DEEP IN NON–FROZEN CONDITIONS WITH CHANNELIZED FLOW. CULVERT(S) PLACED TO ALLOW FLOW.

OPTION B
PROFILE VIEW

MAY BE USED IN SHALLOW AREAS NOT ABOVE HEIGHT OF MAT ROAD IN NON–FROZEN CONDITIONS WITH CHANNELIZED FLOW. CULVERT(S) PLACED TO ALLOW FLOW.

OPTION C
PROFILE VIEW

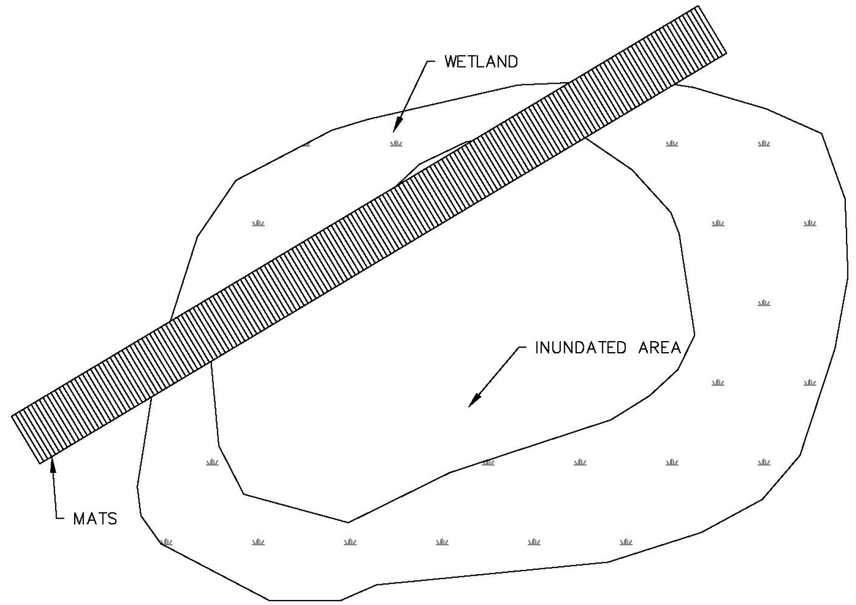




USED IN PEATLANDS DURING NON–FROZEN CONDITIONS TO AID IN MINIMIZING COMPACTION. CONFIGURATION MAY VARY, MULTIPLE LAYERS MAY BE USED.

OPTION D
END VIEW

OPTION D
PROFILE VIEW



PLAN VIEW

NOTE:

1. THE TOP IS THE "CAP" AND IS PLACED PERPENDICULAR TO FLOW. RUNNERS ARE INSTALLED IN MULTIPLE LAYERS AS NEEDED. THE NUMBER OF LAYERS USED IS BASED ON SITE–SPECIFIC CONDITIONS AT THE TIME OF CONSTRUCTION.
2. MAT APPROACH IS PLANNED BASED ON FIELD VISITS AND MODIFIED AT TIME OF CONSTRUCTION.
3. STANDARD MAT SIZE IS 8 INCHES THICK BY 4 FEET WIDE BY 18 FEET LONG.
4. CULVERTS AND SPANS WILL BE PLACED BY FIELD CREW IN COORDINATION WITH ENVIRONMENTAL INSPECTOR.
5. DURING WINTER CONSTRUCTION, ONE ROW OF FLAT MATS MAY OR MAY NOT BE USED WITH PRESENCE OF FROST.

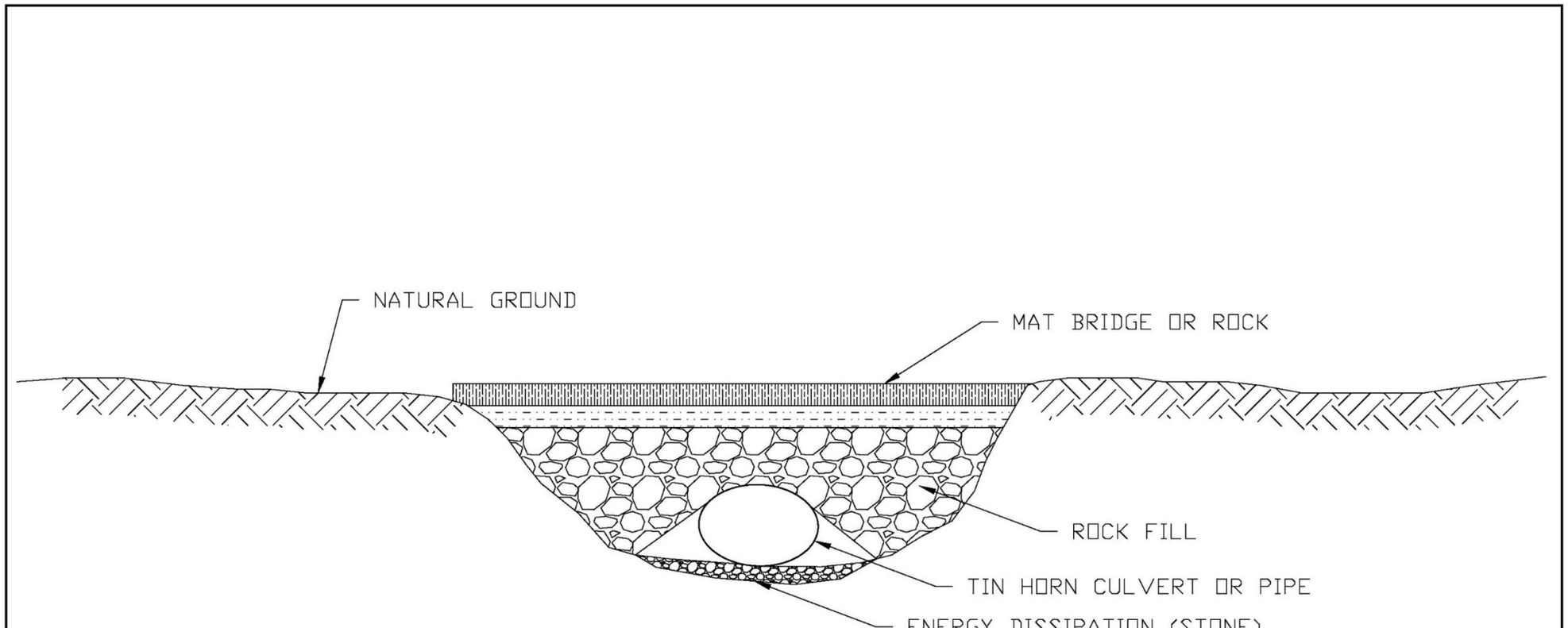
ISSUED FOR PERMIT
09/16/20

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
E	ISSUED FOR PERMIT	JDW	09/16/20	NKD	MDM
D	ISSUED FOR PERMIT	JDW	09/16/20	NKD	MDM
C	ISSUED FOR REVIEW	JDW	09/15/20	KEH	MDM
B	ISSUED FOR REVIEW	JDW	08/05/20	KEH	ND
A	ISSUED FOR REVIEW	JDW	08/04/20	KEH	MDM

ENBRIDGE

DWN. BY: JDW	DATE 08/04/20	LINE 3 REPLACEMENT TYPICAL CONSTRUCTION MAT DESIGN TO MAINTAIN SURFACE FLOW	
CHK. KEH	08/04/20		
PROJ. ENGR. MDM	08/04/20		
PROJ. MGR. BS	08/04/20	SCALE NTS	DWG. NO.
CLIENT APP.			

Figure 50 Bypass Pipe / Bridge



BYPASS PIPE/BRIDGE
SECTION

ISSUED
FOR PERMIT
09/21/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	JDW	09/21/20	KEH	KD
B	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
A	ISSUED FOR REVIEW	JDW	01/10/20	KEH	KD

		DATE
DWN. BY:	JDW	01/10/20
CHK.	KEH	01/10/20
PROJ. ENGR.	DG	01/10/20
PROJ. MGR.	KD	01/10/20
CLIENT APP.		

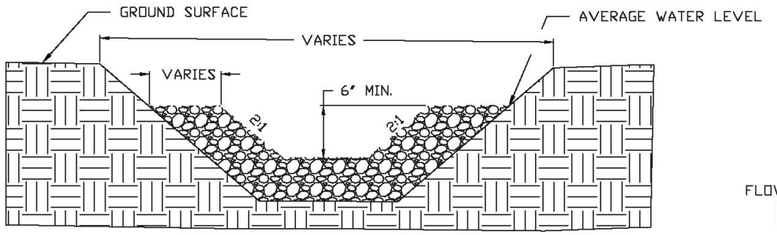
ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
BYPASS PIPE/BRIDGE

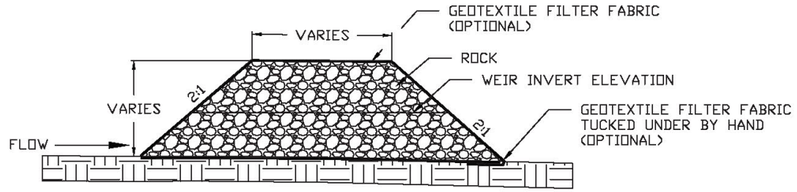
SCALE: NTS

DWG. NO.

Figure 51 Check Dam

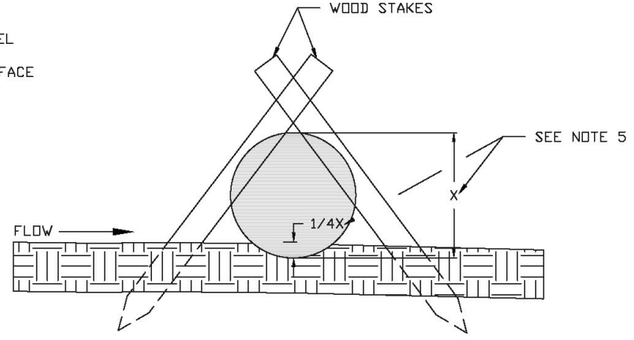


ROCK CHECK DAM
ELEVATION



ROCK CHECK DAM
SECTION

FILTER SOCK CHECK DAM
ELEVATION



FILTER SOCK CHECK DAM
SECTION

ISSUED
FOR PERMIT
09/16/20

NOTES:
1. WRAPPING THE ROCK CHECK DAM WITH GEOTEXTILE FABRIC IS OPTIONAL.
2. MAKE SURE TO NOT PENETRATE THE FILTER SOCK WITH THE STAKE DURING INSTALLATION.
3. FILTER SOCK CAN BE FILLED WITH INDUSTRY STANDARD MATERIALS (ROCK, WOOD CHIPPINGS, CELLULOSE, ETC.)
4. STAKE FILTER SOCK AT ENDS AND MIDDLE, IF MORE THAN ONE SOCK IS NEEDED OVERLAP SOCKS. MAKING SURE TO STAKE AT OVERLAP LOCATION.
5. FILTER SOCKS RANGE FROM 4" TO 24" IN DIAMETER. X IS REPRESENTING THE DIAMETER OF THE SOCK. ¼X IS REPRESENTING THE DEPTH OF TRENCHING THE FILTER SOCK.

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
D	ISSUED FOR PERMIT	JDW	09/16/20	KEH	KD
C	ISSUED FOR PERMIT	JDW	06/17/19	KEH	KD
B	ISSUED FOR PERMIT	JDW	04/30/19	KEH	KD
A	ISSUED FOR REVIEW	JDW	04/25/19	KEH	KD

		DATE
DWN. BY:	JDW	04/25/19
CHK.	KEH	04/30/19
PROJ. ENGR.	DG	04/30/19
PROJ. MGR.	KD	04/30/19
CLIENT APP.		

ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
CHECK DAM

SCALE: NTS

DWG. NO.

Figure 52 Cofferdam

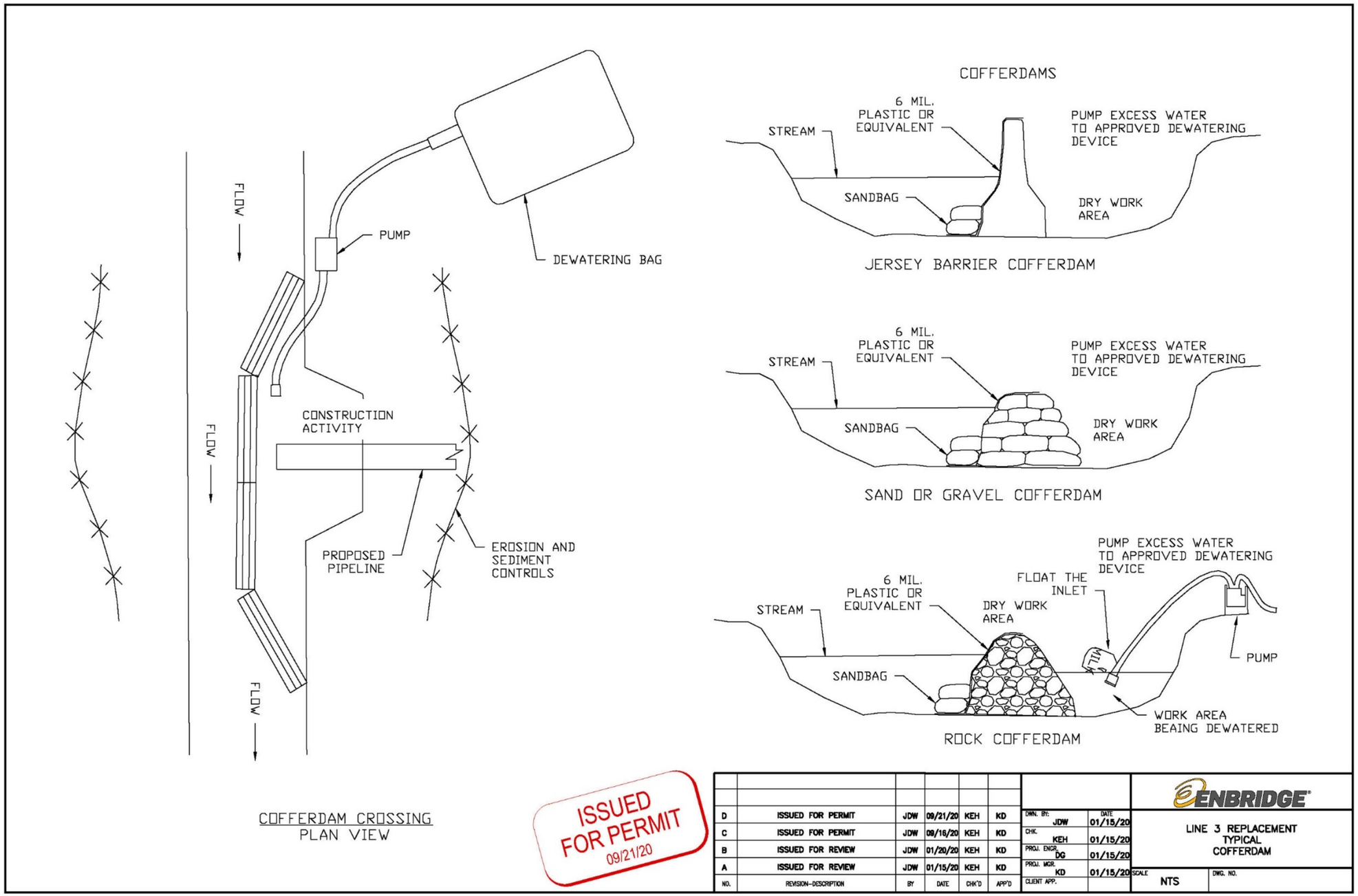
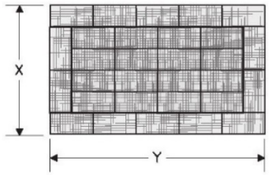
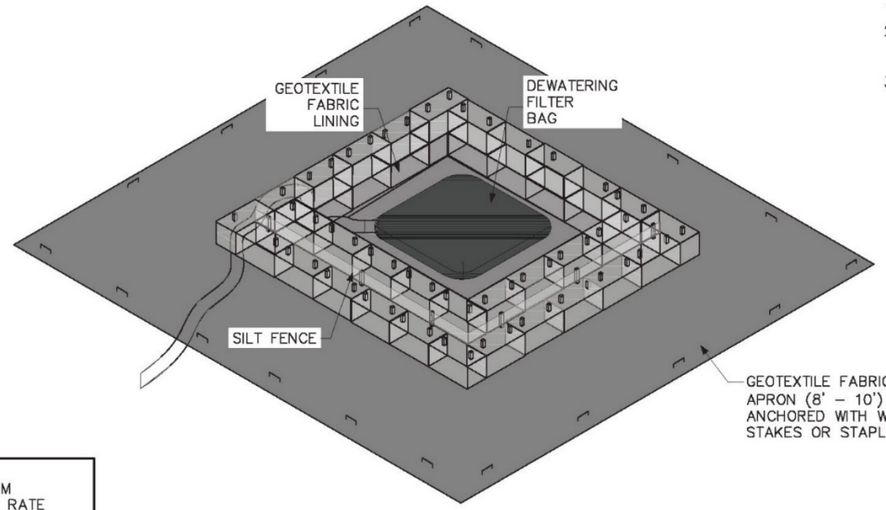


Figure 53 Curlex Block Dewatering Structure





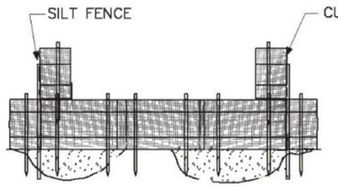
PERSPECTIVE VIEW

NOTES:

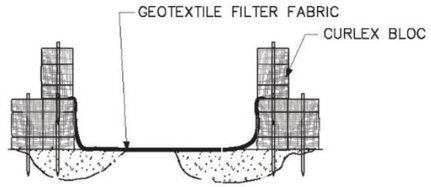
1. ARRANGE THE CULREX BLOCS TO THE X AND Y DIMENSIONS AS SPECIFICIED BELOW.
2. IF BOTTOM OF STRUCTURE IS NOT LINED WITH CURLEX BLOCS (OPTION 1), LINE ENTIRE STRUCTURE WITH GEOTEXTILE FILTER FABRIC.
3. THE HEIGHT OF THE STRUCTURE SHOULD BE 2 CURLEX BLOCS (3 FEET).

TYPICAL MINIMUM SUMP DIMENSIONS (FEET)		MAXIMUM PUMPING RATE
X	Y	GALLONS PER MINUTE
10	20	300
15	20	350
20	20	400
20	25	450
25	25	500
25	30	550
30	30	660

NOTE: TYPICAL DIMENSIONS AND MAXIMUM PUMPING RATES ARE BASED ON INDUSTRY EXPERIENCE, BEST MANAGEMENT PRACTICES, AND PUMP SIZE (4"–8").



OPTION 1
CROSS SECTION



OPTION 2
CROSS SECTION

ISSUED FOR PERMIT
09/16/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
C	ISSUED FOR PERMIT	JDW	09/16/20	NKD	KD
B	ISSUED FOR REVIEW	JDW	05/28/20	NKD	
A	ISSUED FOR REVIEW	JDW	05/21/20	NKD	

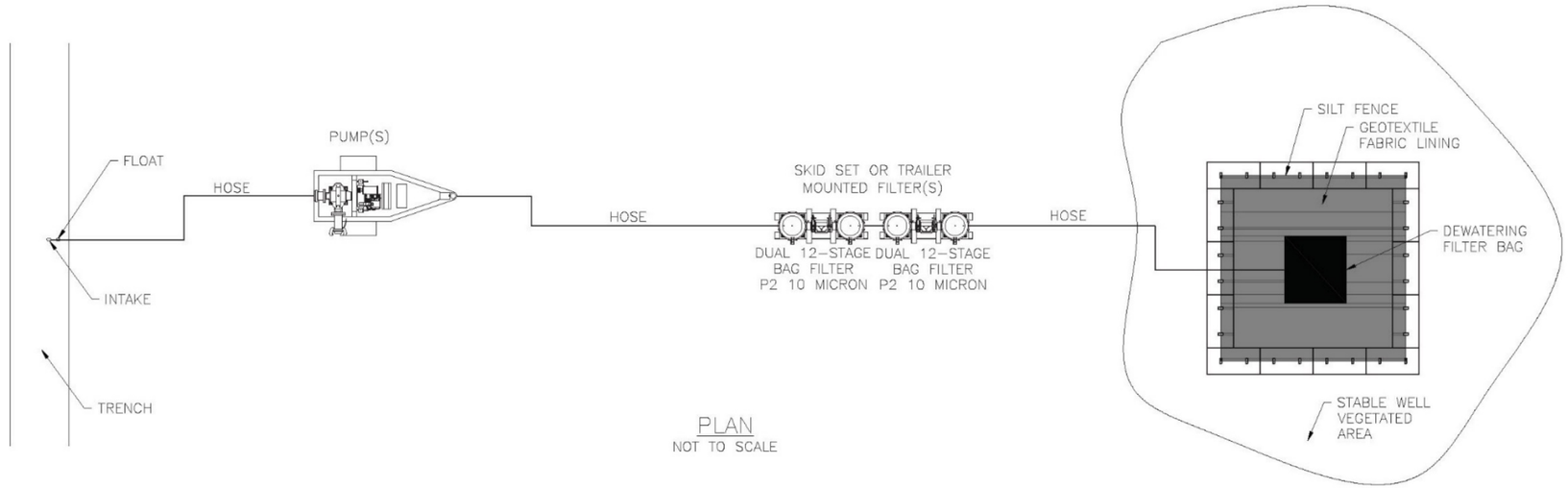
DWN. BY: JDW	DATE 05/21/20	
CHK. NKD	05/21/20	
PROJ. ENGR.		
PROJ. MGR.		
CLIENT APP.		

ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
CURLEX BLOC
DEWATERING STRUCTURE

SCALE NTS | DWG. NO.

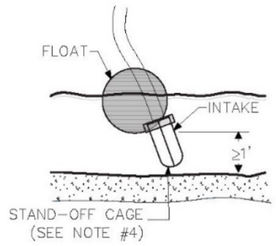
Figure 54 Trench Dewatering with Sock Filter



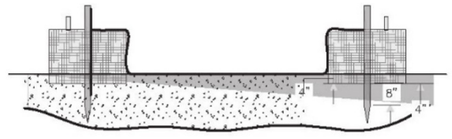
PLAN
NOT TO SCALE

NOTES:

1. SILT FENCE ENDS MUST BE WRAPPED TO JOIN TWO SECTIONS.
2. SILT FENCE SHALL BE ABOVE TOP OF BALES OR CURLEX BLOCS AND ANCHORED 6" BELOW GRADE.
3. SILT FENCE POST STAKING MUST BE 4 FEET OR LESS.
4. DEWATERING INTAKE HOSE SUPPORTED AT LEAST 1 FOOT FROM BOTTOM OF TRENCH BEING DEWATERED.
5. USE A FILTER BAG AT THE DISCHARGE HOSE END.
6. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSPECTED AND MAINTAINED AS NEEDED TO MAINTAIN EFFICACY PER INDUSTRY STANDARDS.
7. TRENCH DEWATERING STRUCTURES WILL BE REINFORCED USING INDUSTRY STANDARD OPTIONS TO PREVENT BALE MOVEMENT DURING DISCHARGE (e.g.,CINCH STRAPS, WIRE, CATTLE GUARD FENCING).
8. NUMBER OF FILTER STAGES AND FILTER SIZES WILL VARY DUE TO FIELD CONDITIONS.



PUMP INLET



NOTE: 1–BALE OR CURLEX BLOCS HEIGHT & SIZE IS USED IF ADEQUATE AREA IS AVAILABLE.

CROSS–SECTION OF STRUCTURE

ISSUED FOR PERMIT 09/21/20

NO.	REVISION–DESCRIPTION	BY	DATE	CHK'D	APP'D
D	ISSUED FOR PERMIT	JDW	09/21/20	NKD	KD
C	ISSUED FOR PERMIT	JDW	09/16/20	NKD	KD
B	ISSUED FOR REVIEW	JDW	05/29/20	NKD	
A	ISSUED FOR REVIEW	JDW	05/21/20	NKD	

		DATE
DWN. BY:	JDW	05/21/20
CHK.	NKD	05/21/20
PROJ. ENGR.		
PROJ. MGR.		
CLIENT APP.		

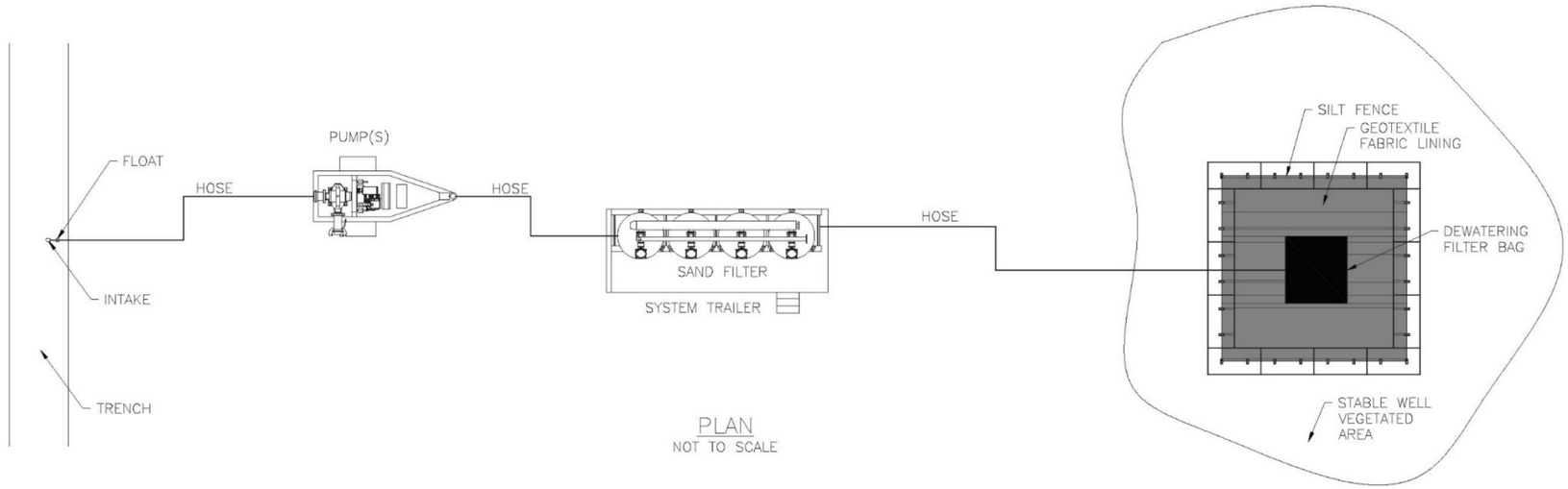
ENBRIDGE

LINE 3 REPLACEMENT
FOR TYPICAL
TRENCH DEWATERING
WITH SOCK FILTER

SCALE: NTS

DWG. NO.

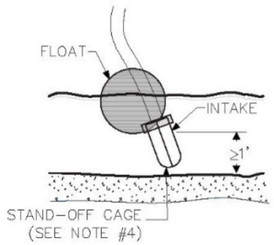
Figure 55 Trench Dewatering with Sand Filter



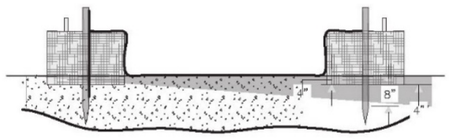
PLAN
NOT TO SCALE

NOTES:

1. SILT FENCE ENDS MUST BE WRAPPED TO JOIN TWO SECTIONS.
2. SILT FENCE SHALL BE ABOVE TOP OF BALES OR CURLEX BLOCS AND ANCHORED 6" BELOW GRADE.
3. SILT FENCE POST STAKING MUST BE 4 FEET OR LESS.
4. DEWATERING INTAKE HOSE SUPPORTED AT LEAST 1 FOOT FROM BOTTOM OF TRENCH BEING DEWATERED.
5. USE A FILTER BAG AT THE DISCHARGE HOSE END.
6. EROSION AND SEDIMENTATION CONTROL MEASURES SHALL BE INSPECTED AND MAINTAINED AS NEEDED TO MAINTAIN EFFICACY PER INDUSTRY STANDARDS.
7. TRENCH DEWATERING STRUCTURES WILL BE REINFORCED USING INDUSTRY STANDARD OPTIONS TO PREVENT BALE MOVEMENT DURING DISCHARGE (e.g.,CINCH STRAPS, WIRE, CATTLE GUARD FENCING).
8. NUMBER OF FILTER STAGES WILL VARY DUE TO FIELD CONDITIONS.



PUMP INLET
NOT TO SCALE



NOTE: 1-BALE OR CURLEX BLOCS HEIGHT & SIZE IS USED IF ADEQUATE AREA IS AVAILABLE.

CROSS-SECTION OF STRUCTURE
NOT TO SCALE

ISSUED FOR PERMIT
09/21/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
D	ISSUED FOR PERMIT	JDW	09/21/20	NKD	KD
C	ISSUED FOR PERMIT	JDW	09/16/20	NKD	KD
B	ISSUED FOR REVIEW	JDW	05/28/20	NKD	
A	ISSUED FOR REVIEW	JDW	05/21/20	NKD	

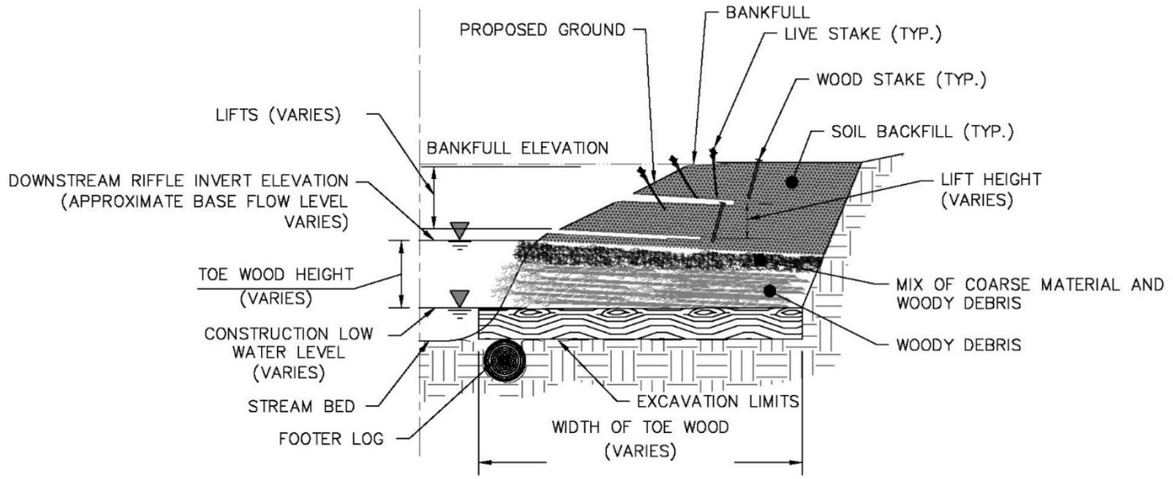
DWN. BY: JDW	DATE 05/21/20	
CHK. NKD	05/21/20	
PROJ. ENGR.		
PROJ. MGR.		
CLIENT APP.		

ENBRIDGE

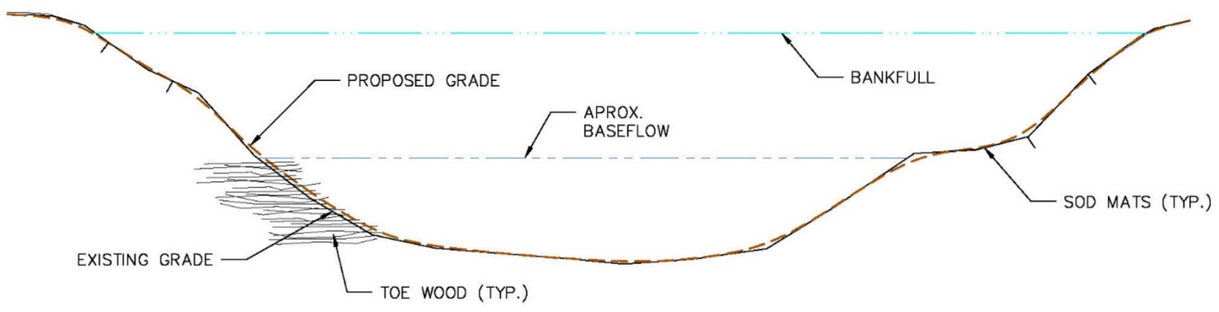
LINE 3 REPLACEMENT
FOR TYPICAL
TRENCH DEWATERING
WITH SAND FILTER

SCALE NTS | DWG. NO.

Figure 56 Toe Wood Stream Bank Restoration Method



SECTION



CROSSING RESTORATION

ISSUED FOR PERMIT 10/13/20

NO.	REVISION-DESCRIPTION	BY	DATE	CHK'D	APP'D
D	ISSUED FOR PERMIT	JDW	10/13/20	KEH	KD
C	ISSUED FOR REVIEW	JDW	03/27/20	KEH	KD
B	ISSUED FOR REVIEW	JDW	03/25/20	KEH	KD
A	ISSUED FOR REVIEW	AJM	03/20/20	KEH	KD

		DATE
DWN. BY:	AJM	03/20/20
CHK.	KEH	03/20/20
PROJ. ENGR.	KD	03/20/20
PROJ. MGR.	BH	03/20/20
CLIENT APP.		

ENBRIDGE

LINE 3 REPLACEMENT
TYPICAL
TOE WOOD

SCALE NTS

DWG. NO. B-TYP-TOE-WOOD

Appendix A

Summary of Construction Methods and Procedures





Summary of Construction Methods and Procedures

Enbridge Energy, Limited Partnership • Line 3 Replacement Project

October 2020

ENBRIDGE®

TABLE OF CONTENTS

TABLES

FIGURES

ACRONYMS AND ABBREVIATIONS

ATWS	additional temporary workspace
BMP	best management practice
CFR	Code of Federal Regulations
contractor yard or yard	pipeline, staging areas, and storage yards
EI	Environmental Inspector
EMCP	Environmental Monitor Control Plan
Enbridge	Enbridge Energy, Limited Partnership
EPP	Environmental Protection Plan
ESB	Electrical service building
HDD	horizontal directional drill
L3R or Project	Line 3 Replacement Project
OHWM	ordinary high water mark
PLM	Pipeline Maintenance

1.0 INTRODUCTION

This Summary of Construction Methods and Procedures ("Summary") describes the various construction methods that Enbridge Energy, Limited Partnership ("Enbridge") will utilize to construct the Line 3 Replacement Project ("L3R" or "Project") through uplands, wetlands and waterbodies, and the decision-making process that occurs during design and in the field when identifying the appropriate crossing technique. The discussion of each construction method includes:

- Description of the construction methods and procedures;
- Conditions required to employ the method (applicability of the method);
- Site characteristics that require modification to standard construction techniques; and
- Environmental and/or constructability advantages and disadvantages associated with the method.

The purpose of this document is to provide a more complete description of the construction techniques that are outlined in Enbridge's Environmental Protection Plan ("EPP"). The EPP contains elements of industry and company-wide best management practices ("BMPs") that will be implemented during the execution of these construction techniques, such as erosion and sediment control measures; construction spill prevention, containment, and control; measures to prevent and contain inadvertent drilling fluid releases; invasive and noxious species control; and restoration/revegetation measures.

1.1 DESIGN PROCESS AND METHOD SELECTION OVERVIEW

The design process is iterative and starts with developing a basic design that satisfies the intended Project purpose and meets engineering design standards established by the U.S. Department of Transportation. Enbridge gathers, examines, and analyzes both field and desktop environmental data to inform the route and construction techniques, which is further refined by consultations with federal, state, and local regulatory agencies, landowners, and other stakeholders.

During the design and planning process, Enbridge identifies the preferred method of pipeline installation based on the engineering design standards (e.g., U.S. Department of Transportation), presence of wetland features, waterbody features, sensitive resources, landowner/community considerations, environmental regulations, and constructability considerations, including the ability to safely and effectively construct through the area. Specifically, these considerations include the following:

- Sensitive Resources:
    - Federally or state-designated high value waters (e.g., Wild and Scenic Rivers, canoe routes, Nationwide Rivers Inventory)
    - Wildlife or aquatic management areas
    - Section 303(d) impaired waters and other water quality considerations

- Infested waters (presence of aquatic invasive or noxious species)
- Presence of sensitive aquatic resources (e.g., federally or state-listed species, trout fisheries)
- Sensitive ecological communities (e.g., old growth forests, Native Plant Communities, Sites of Biodiversity Significance)
- Fisheries concerns
- Wetland resources (types, extent)
- Recreational use
- Tribal, archaeological, and historic resources
- Other issues identified by resource agencies

- Landowner/Community Considerations:
  - Homeowner and/or business access
  - Noise and/or lighting impacts
  - Traffic
  - Community access to sites (e.g., recreational areas, hunting)
  - Adjoining land use activities (e.g., grazing, organic farms)
  - Safety, security, and exposure of the public and workers
  - Other issues identified by land-managing agencies (e.g., off-road vehicle access)
- Constructability:
  - Season of construction
  - Topography
  - Geology and soils (e.g., presence of bedrock, cobble/boulders, soil competency/ stability)
  - Geohazards (e.g., slope instability, seismic activity, ground subsidence, flooding, scour potential, buoyancy concern)
  - Geometry of the waterbody (straight, meanders)
  - Ability to manage water during crossing
  - Hydrology and soil saturation/inundation
  - Workspace limitations (e.g., roads, railroads, topography, sensitive resources)

- Availability of equipment and access
- Duration of activity
- Risk (or probability of success)
- Cost

Enbridge identifies a primary and alternate crossing method for each waterbody crossing method (discussed further in Section 4.0), based on these criteria and site-specific crossing conditions. In some cases, primary and alternate crossing methods are also defined for wetland crossings (discussed further in Section 3.0). Enbridge gathers information, such as wetland and waterbody field delineations, stream geomorphic field surveys, and/or geotechnical borings, and conducts risk assessments to inform these decisions. Enbridge also reviews construction reports from prior projects that have occurred in the vicinity of the proposed installations to determine if methods employed were successful or had complications.

The following sections describe the types of construction methods that could be employed to install the pipeline across uplands, wetlands, and waterbodies, and the specific conditions required for those methods to be feasible. These sections also describe the circumstances where a decision may be proposed in the field to change a construction method, or where additional tools may be utilized to ensure successful installation of the pipeline while minimizing adverse effects to the natural and/or human environment.

2.0 PROJECT COMPONENTS AND ASSOCIATED CONSTRUCTION PROCEDURES

The following describes standard construction methods and procedures that may apply to both upland and wetland environments, as noted. Additional details on the upland construction method BMPs are provided in Sections 1.8 through 1.21 of the EPP.

2.1 RIGHT-OF-WAY ACCESS

As described in Section 1.4 of the EPP, Enbridge will utilize the haul routes, access roads, or shoo-flies to access the construction workspace. Haul routes are existing public roads used to deliver equipment and materials to the workspace during construction. Because haul routes are existing maintained roads, improvements are not generally required. Enbridge will confine maintenance on haul routes to the legal road easement as established by the corresponding road authority.

There are a limited number of situations where Enbridge may need to extend a road intersection with stable footing to allow large construction equipment to make turns safely. In these cases, Enbridge may place construction mats or rock on top of geotextile fabric at the corners of the intersection (see Figure 47 of the EPP). If the construction mats cannot be installed flush with the existing road without excessive grading to key the mats in, the mats can become a safety hazard for passing vehicles. Enbridge may then utilize geotextile fabric with crushed rock to avoid this safety hazard. Geotextile fabric is used to maintain separation between the underlying soil and the temporary crushed rock fill, distribute load, and stabilize the underlying soil while maintaining drainage patterns. Small wetlands or wetland ditches may be present at some of these intersections. As illustrated in Figure 47 of the EPP, in these situations Enbridge will install geotextile fabric at the bottom of the ditch and will install a culvert/flume pipe as needed to obstruct

any actual or potential water flow. Crushed rock will be placed on top of the geotextile fabric and the culvert/flume pipe to form the solid base of the intersection. Once construction activities are complete, this material will be completely removed and the areas will be restored as described in Section 7.0 of the EPP. Exact locations of where crushed rock on top of geotextile fabric in wetland/waterbody ditches will be determined in the field based on conditions at the time of construction.

Temporary access roads to the construction workspace may be private or public roads along existing roads or trails, or they may be new greenfield roads on private or public land that are constructed for the purpose of the Project. In some cases, Enbridge proposes to construct a "shoo-fly," which is a short detour off the main access road or construction workspace used to avoid impacts to sensitive features, such as wetlands. For temporary access roads and shoo-flies, Enbridge will utilize maintained existing roads, improve existing trails or roads, or build new roads as needed and approved through applicable permits.

For existing developed roads that are 30 feet wide, Enbridge will only perform maintenance activities within the existing roadbed. This may include grading of gravel/dirt roads to smooth out bumps and holes, and/or placement of fill or construction mats where needed within the existing road grade and as agreed upon with the road authority. Gravel will only be added to maintain existing roads that have an existing gravel road base, or to develop permanent access roads, if needed. The application of gravel on a non-graveled roadbed creates an impermeable surface that must be permitted under the Minnesota Pollution Control Agency Construction Stormwater General Permit. If Enbridge determines that gravel is needed on a non-graveled roadbed for safety or stability reasons, it will be removed and the area will be restored to pre-construction conditions following construction unless the road authority or landowner requests that it remain in place, and all applicable permits, certifications and authorizations have been obtained.

Activities that occur beyond the existing road grade, such as widening (including tree removal), placement of construction mats in wetlands, placement of structures within the Ordinary High Water Mark ("OHWM") of waterbodies, or development of a new road, are considered temporary improvements requiring environmental survey and applicable permits and authorizations. For existing access roads that are not 30 feet wide, Enbridge may be required to widen the roadbed. Widening may require mowing or tree trimming/clearing along the edge(s) of the existing roadbed. The existing roadbed may be graded to level it out. Where road widening is needed in wetland areas, Enbridge will install construction mats; construction mats may also be used in some upland areas to expand the roadbed. However, more commonly in uplands, Enbridge will grade the existing roadbed crown to level and expand the road to the needed width. In limited areas, additional dirt or gravel fill may be required; however, typically the soil at the site will be used to level and expand the road.

Construction mats or rock on top of geotextile fabric may also be used at temporary access road intersections or the intersection of an access road with the construction workspace as described above. Once construction activities are complete, this material will be completely removed and the areas will be restored as described in Section 7.0 of the EPP.

Ice/frost roads may be used during frozen conditions as described in Enbridge's Winter Construction Plan. Typical drawings for rock and construction mat approaches are provided in Figures 1 and 2 of the EPP.

After construction, Enbridge will return improved temporary access roads and shoo-flies to their pre-construction condition unless the road authority, landowner, or land-managing agency requests that the improvements be left in place, and all applicable permits, certifications, and

authorizations are obtained. Restoration of temporary access roads will proceed as described in Section 7.0 of the EPP.

Permanent access roads must be built to provide access to pump stations and mainline valve site locations for operations and as required by Section 2.1.5 of the Minnesota Public Utilities Commission Route Permit Order. Pipeline safety, including valve placement requirements, is regulated by the U.S. Department of Transportation's Pipeline and Hazardous Materials Safety Administration under Title 49 Code of Federal Regulations ("CFR") Parts 100-199. Specifically, 49 CFR Part 195 prescribes safety standards and reporting requirements for hazardous liquid transportation pipeline facilities and 49 CFR Part 195.260 presents the minimum standards for valve installations. Valves are remotely controllable so that they can be closed quickly in the event of an incident, significantly reducing the potential volume of crude that can be released. All valves, however, must be physically accessible by roads so that they can be maintained and operated manually, if necessary. Enbridge will maintain a permanent access road to each mainline valve as required by 49 CFR 195.258 Part (a), which requires that each valve site be installed in a location that is accessible to authorized employees and that it is protected from damage or tampering. All valves and facilities are designed to have maintained access roads, as well as protective fence(s) with locked gates. Enbridge will maintain permanent access roads to these aboveground facilities throughout Project operation.

2.1.1 Bridges and Culverts

As described above, Enbridge will utilize existing public roads as haul routes and to access the workspace as much as possible. Generally, the bridges and culverts associated with existing roads will be sufficient to allow the passage of construction equipment and vehicles. However, in some cases, improvements to existing infrastructure may be needed, such as:

- Air bridges or construction mats over existing infrastructure;
- Extension of culverts to widen the travel lane; and/or
- Additional in-stream supports.

For new access roads or shoo-flies over a waterbody, and road approaches to the construction workspace, the following infrastructure may be installed as appropriate for site-specific conditions:

- Clear span bridges: Temporary clear span bridges will typically be used to cross waterbodies that are less than 13 feet from top of bank to top of bank with stable banks. No direct excavation of the waterbody bed or in-stream supports are required.

- Non-clear span bridges: Typically used to cross waterbodies with top of bank to top of bank 13 feet wide or greater as required by Enbridge's engineering specifications, or where additional stabilization is required to ensure the bridge installation allows for the safe passage of construction equipment and vehicles. Installation of infrastructure or supports within the OHWM are required.

- Culverts/flumes: Cylinder or box-shaped structures placed in the waterbody channel below the OHWM to allow water flow. The size and shape of the culvert is dependent on the waterbody.

Table 2.1-1 summarizes the site-specific conditions, advantages, and disadvantages associated with these bridge and culvert types.

Table 2.1-1
Types of Bridges

Type	Description	Applicability	Advantages	Disadvantages
Clear Span Type Bridge (construction mats or engineered structures)	Construction of temporary bridge utilizing construction mats or an imported engineered portable bridge material from top of bank to top of bank without instream supports (refer to Figure 3 of the EPP).	Suitable for waterbodies less than 13 feet wide top of bank to top of bank with stable banks. Regular bridge maintenance required. Preferred bridge type to provide safe crossing for heavy construction equipment.	• Strong, removable, and portable bridge that can be optimally located • Limited in-stream disturbance • Limited sediment release • Maintains streamflow • Maintains fish passage	• Specialized equipment/crew required • Substantial amount of work may be necessary to transport and/or construct • Limited span for construction mat bridges and cap may be required • Regular maintenance of erosion and sediment controls required • Possible sediment release from bank and approach disturbance or if cap used over construction mat bridge • May cause interference on navigable waterways • Bridges need to be keyed into the banks
Non-clear Span Bridge (construction mats or engineered structures with instream supports)	Construction of temporary bridge utilizing construction mats or an imported engineered portable bridge material from top of bank to top of bank with instream supports (e.g., mats or flume) (refer to Figure 4 of the EPP).	Suitable for waterbody crossings 13 feet wide or greater top of bank to top of bank with stable banks. Can be used on larger watercourses with multiple bridge spans and instream supports. Regular bridge maintenance required. Preferred bridge type to provide safe crossing for heavy construction equipment.	• Strong, removable, and portable bridge that can be optimally located • Limited in-stream disturbance • Limited sediment release • Maintains streamflow • Maintains fish passage	• Specialized equipment/crew required • Substantial amount of work may be necessary to transport and/or construct • Limited span for construction mat bridges and cap may be required • Regular maintenance of erosion and sediment controls required • Possible sediment release from bank, approach, and instream support disturbance or if cap used over construction mat bridge • May cause interference on navigable waterways • Bridges need to be keyed into the banks

Type	Description	Applicability	Advantages	Disadvantages
Culvert/Flume	Place steel flume pipe or culvert to allow waterbody flow. Place ramp over culvert or flume using construction mats. Rock may be placed on top geotextile fabric over culvert or flume in waterbodies or ditches at road approaches to support construction traffic (refer to Figure 1 of the EPP).	Appropriate for small or medium-sized waterbodies with or without flow and with defined channel and banks. Used where streamflow and fish passage are of concern.	• Limited sediment release • Maintains stream flow and fish passage	• Sediment release when filling around the culvert/flume and upon removal • Susceptible to washout during high flow • Icing in winter may block flow and fish passage • May require bank grading • Some culverts may not be able to withstand heavy construction traffic • Requires specialized materials such as sand bags and select fill
Source: Canadian Association of Petroleum Producers, Canadian Energy Pipeline Association, and Canadian Gas Association, 2005.				

2.1.2 Bridge and Culvert Design

Equipment bridges and culverts will be designed to meet the requirements of the applicable agencies and local authorities. Bridges will be installed parallel to the pipeline centerline so that equipment does not need to turn while working or crossing the bridge. For bridges that are installed on designated canoe routes, the bridge height will be designed to allow for adequate clearance to allow recreational users to pass safely under the bridge. Enbridge may also prepare site-specific bridge or culvert designs at specific wetland or waterbody crossings for agency approval, as required.

Enbridge has engineering specifications that require in-stream supports on bridges crossing waterbodies 13 feet wide or greater top of bank to top of bank with stable banks. In-stream supports will not be installed in or removed from waterbodies during agency-timing restrictions unless approved by the agency. Bridges will not restrict flow or pool water while the bridge is in place and will be constructed with clean materials. Bridges will be designed to prevent soil from entering the waterbody (refer to Figures 3 and 4 of the EPP).

2.2 CONSTRUCTION YARDS

In order to construct the pipeline, staging areas, and storage yards (collectively referred to as "construction yards" or "yards") will be strategically located outside of the right-of-way along the route. Yards will be sited in accordance with local permits, as required. These areas are used to stockpile pipe, and other equipment required during construction. Yards provide parking for construction equipment and employee trucks, and locations for offices and trailers. Yards may also be used to clean equipment, or prepare materials for use, such as concrete coating of pipe segments.

Enbridge will seek previously disturbed areas in proximity to the route to utilize as a yard site, such as gravel pits, railroad yards, cleared fields, or parking areas. Yards will be cleared and may be covered in rough stone gravel and/or construction mats as needed. Yards may also be fenced for security purposes. After construction is complete, yards will be restored back to pre-construction conditions unless otherwise requested by the landowner, and applicable permits, certifications, and authorizations are obtained.

2.3 TEMPORARY AND PERMANENT RIGHTS-OF-WAY

Construction in upland[1] areas will generally require a 120-foot-wide construction workspace.[2] The construction workspace will allow for temporary storage of topsoil and trench spoil (nonworking side), as well as accommodate the safe operation of construction equipment and a travel lane (working side) (refer to Section 2.4). Topsoil will also be stored on the working side. The 50-foot-

[1] Uplands: Uplands are defined as an elevated region of land lying above the level where water flows or collects in basins.

[2] The terms "construction right-of-way," "temporary construction right-of-way," "construction workspace," and "temporary construction workspace" define the primary mainline workspace area required for installation of L3R. For clarity, Enbridge will generically use "construction workspace" instead of "temporary construction right-of-way," temporary construction workspace," or "construction right-of-way" as the terminology for 1) the permanent right-of-way; and 2) the temporary construction area (which includes the following defined terms: Temporary Workspace and Additional Temporary Workspace). All construction equipment and vehicles will be confined to this approved construction workspace.

wide permanent right-of-way[3] will be wholly contained within the 120-foot-wide construction workspace. Table 2.3-1 presents the typical construction workspace and permanent right-of-way dimensions that will be used for pipeline construction and operation in upland and wetland areas (refer to Section 3.0 for a description of construction methods and workspace dimensions in wetland areas). Figure 5 of the EPP presents the temporary construction workspace[4] and permanent right-of-way configurations when co-located with existing Enbridge or third-party pipelines or utilities, and in greenfield[5] locations. Overall, the L3R will be co-located[6] with other Enbridge pipelines; third-party pipelines or utilities; or roads, railroads, or highways for the majority of the route.

Table 2.3-1
Typical Construction Workspace and Permanent Right-of-Way Dimensions for the Line 3 Replacement Project

Route Segment	Permanent Right-of-Way (feet)	Temporary Construction Workspace (feet)	Total Land Requirements (feet)
Co-located with Enbridge Pipeline	50 (~25 new)	70 (uplands)	120 (uplands)
		45 (wetlands)	95 (wetlands
Co-located with Foreign (Third-Party) Utility	50	70 (uplands)	120 (uplands)
		45 (wetlands)	95 (wetlands
Co-located with Foreign Utility in Saturated Wetlands	50	70 (uplands)	120 (uplands)
		45 (wetlands)	95 (wetlands
Greenfield	50	70 (uplands)	120 (uplands)
		45 (wetlands)	95 (wetlands

During construction, topsoil and subsoil will be separated and stored within the construction workspace.

Where co-located with Enbridge's existing pipelines, Enbridge will use approximately 40 feet of existing permanent right-of-way as temporary workspace that will revert back to permanent right-of-way after construction (see Figure 5 of the EPP). The offset distance between L3R and an existing foreign pipeline or utility will vary, as presented in Figure 5 of the EPP.

2.4 TRAVEL LANES

As described in Section 2.3, the working side of the construction workspace will include a travel lane to allow for the safe passage of construction vehicles and equipment. Construction mats or ice roads will be installed in wetlands for travel lanes, as conditions allow (see Section 3.1). Temporary equipment bridges will be used (upon approval by the appropriate agency) at waterbody crossings (including small waterways such as ditches and intermittent streams) where there is a potential for stormwater runoff or rain events to transport sediment downstream from equipment crossing the waterway. Refer to Sections 2.1.1 and 2.1.2 for additional information on bridge and culvert types and design.

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[3] Permanent right-of-way: The legally acquired land rights used to install, maintain, operate, and access L3R.

[4] Temporary workspace: Land located adjacent to and contiguous with the proposed right-of-way.

[5] Greenfield: The term "greenfield" refers to land that has not previously been used for another pipeline, utility, road, or railroad right-of-way. For the purposes of this document, the term greenfield is applied to land that is more than 250 feet away from an existing parallel pipeline, utility, road, or railroad right-of-way.

[6] Co-located: Co-located is any portion of the route that is within 250-feet from the centerline of a known utility.

2.5 ADDITIONAL TEMPORARY WORKSPACES

Additional temporary workspaces ("ATWS")[7] will be required outside of the typical construction workspace to facilitate specific aspects of construction. For example, ATWS will be needed at select locations such as steep slopes, roads, waterbodies, and some wetland crossings, and where it is necessary to cross under existing pipelines or foreign utilities, HDD sites, and other special circumstances to stage equipment and materials, and store spoil. Enbridge will also use ATWS to accommodate equipment and resources used for appropriating and discharging water. The dimensions of ATWS will vary according to site-specific conditions.

Enbridge may also require ATWS for:

- construction equipment and working personnel to travel safely within the Project's construction site;
- environmental monitoring and mitigation to be employed as required; and
- continuous ingress/egress for emergency equipment and personnel.

Enbridge attempts to locate ATWS outside of wetlands wherever practicable. However, ATWS may be sited in select wetlands where the wetland is adjacent to a waterbody, road, railroad, foreign utility crossing, pipeline cross-over, and/or where required based on site-specific conditions with prior approval from the applicable regulatory agencies.

2.6 PIPELINE CONSTRUCTION SEQUENCE

Enbridge will install the replacement pipeline using industry-accepted construction methods. Pipeline construction will typically follow a sequential process, which includes: development of construction yards, survey and staking of the construction workspace and roads, access road and haul route improvements, clearing, installation of erosion and sediment control BMPs, site preparation, pipe stringing, bending, welding, coating, trenching, lowering-in, backfilling, hydrostatic testing,[8] and cleanup, grading, and restoration. In most areas, these construction processes will proceed in an orderly assembly-line fashion with construction crews moving along the construction workspace (see Figure 2.6-1). Appropriate safety measures will be implemented before excavation begins, including notification through the One-Call system to ensure third-party utilities and adjacent pipelines are properly marked. Four-way sweeps[9] will also be conducted to positively locate any existing underground utilities. Pipe, valves, and fittings will be transported to the workspace and placed along the workspace. Construction crews will use temporary access roads and shoo-flies for ingress/egress to the Project workspace where travel down the workspace is not feasible.

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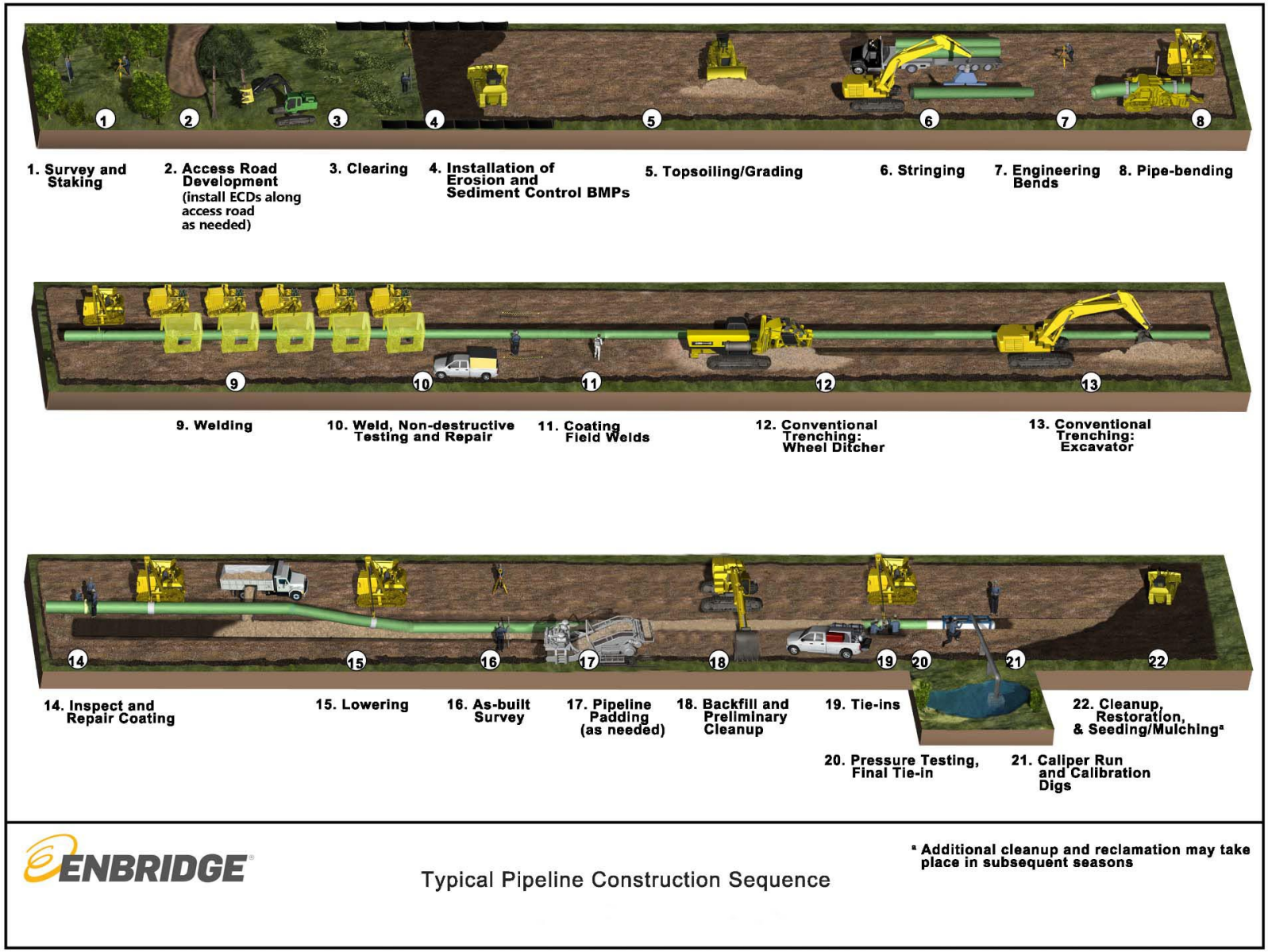
7 ATWS: ATWS is temporary construction workspace needed when encountering environmental features that require special construction methods.

8 Hydrostatic testing: Hydrostatic testing is a process of verifying the integrity of the pipeline before it is placed into service. Hydrostatic testing involves filling the pipeline with water to a designated pressure and holding it for a specified period of time.

9 A four-way sweep is a method of locating underground utilities that involves scanning the ground with electromagnetic induction or ground-penetrating radar equipment to detect the presence of buried features; it does not involve digging or other ground-disturbing activities. The term "four-way sweep" comes from the fact that an area typically is scanned (or swept) in at least four directions.

Figure 2.6-1: Typical Pipeline Construction Sequence



2.7 MINIMUM DEPTH OF COVER

In accordance with federal requirements (49 Code of Federal Regulations 195.248), the depth of cover between the top of the pipe and the ground level,[10] road bed, or river bottom can range between 18 to 48 inches, depending on the location of the pipe and the presence of rock, which is provided below (see Table 2.7-1).

Table 2.7-1
Depth of Cover Requirements

Location	Cover in inches	
	Normal Excavation	Rock Excavation [a]
Industrial, commercial, and residential areas	36	30
Crossing of inland bodies of water with a width of at least 100 ft. from high water mark to high water mark	48	18
Drainage ditches at public roads and railroads	36	36
Deepwater port safety zones	48	24
Gulf of Mexico and its inlets in waters less than 15 feet deep as measured from mean low water	36	18
Other offshore areas under water less than 12 feet deep as measured from mean low water	36	18
Any other area	30	18
[a] Rock excavation is any excavation that requires blasting or removal by equivalent means.		

Minnesota Statute § 216G.07, Subd. 1 requires that the pipeline trench be excavated to a depth of at least 54 inches of backfill from ground surface to the top of pipeline in all areas where the pipeline crosses the right-of-way of any public drainage facility; or any county, town, or municipal street or highway; and where the pipeline crosses cultivated agricultural land. This depth requirement may be waived as described in Minnesota Statute § 216G.07, Subd. 2; however, the pipe must still be buried to a minimum depth that complies with the federal requirements outlined in Table 2.7-1. While Enbridge will seek waivers for Minnesota state depth of cover requirements in some circumstances, it will meet all federal depth of cover requirements and also target a nominal 48 inches of cover across the Project (refer to Figure 18 of the EPP).

In addition, agencies have requested additional depth of coverage at certain wetland and waterbody crossings. Enbridge will work with the agencies to determine the appropriate depth of cover at these locations. This design change will be reflected in the construction alignment sheets and applicable site-specific drawings.

49 CFR 195.204 also requires that the pipe be inspected prior to backfill to ensure that the installation of the pipe or pipeline systems is in accordance with the requirements of 49 CFR 195.248. Enbridge must maintain a complete record for the life of the pipe facility that documents the amount, location, and cover of each size of pipe installed (49 CFR 195.266). In order to comply with these regulations, once the pipeline is installed and prior to backfill, Enbridge civil survey crews will confirm the depth of cover for each pipeline section and record this data as part of the as-built survey data. This information will be maintained by Enbridge in its Pipeline Integrity Program database.

[10] Note that depth of cover is measured from the top of the pipe and ground level as defined in 49 CFR 195.248, not the surface water level.

As part of Enbridge's Pipeline Integrity Program, annual depth of cover surveys, annual flood monitoring, and annual geohazard inspection are performed on the pipeline during operations. If these surveys or inspections identify additional potential geotechnical or hydrotechnical hazards, Enbridge will engage with a qualified Geohazard Consultant to determine if additional remediations are needed. Should the depth of cover for a pipe segment be reduced to 36 inches of cover, the pipe section would be flagged for an on-the-ground maintenance inspection and repairs would be made, as appropriate.

2.8 ASSOCIATED FACILITIES

Facility construction will follow the same initial sequential process as mainline pipeline construction, including survey and staking, clearing, and site preparation.

2.8.1 Pump Stations

Pump stations will be located at regular intervals along the pipeline to boost the pressure lost due to friction as the liquids move through the pipe. All pump stations will be installed on property that has been or will be purchased by Enbridge in fee.

Each pump station property will include a:

- Pumphouse building;
- Electrical service building ("ESB");
- Substation;
- Permanent access road and parking area;
- Snow storage area(s);
- Containment basin; and
- Infiltration basin or wet sedimentation basin.

Prior to excavation, four-way sweeps will be conducted to positively locate any existing underground utilities. Temporary construction trailers will be placed, material laydown areas[11] prepared, and temporary utilities (e.g., power, telephone) will be installed at the site. Topsoil will be stripped and stored prior to initiating excavation work.

The pumphouse building footprint will measure approximately 120 feet by 70 feet and the excavation will vary between approximately 5 to 10 feet deep depending on site-specific conditions. Typical construction procedures for the building foundation are to excavate the foundation base depth, establish concrete foundations, fill, and construct. Dewatering of the excavations will occur as described in Section 5.0 of the EPP and applicable permit conditions.

Several components at the pump station site will require foundation footings, including the pumphouse, ESB, and substations. Foundation footings will consist of either poured concrete piers or helical footings that will average between 10 to 15 feet deep but may extend up to 40 feet deep depending on site specific conditions.

The piping associated with the pump stations will either be welded onsite or pre-fabricated spools made from fabrication shops will be installed. All station piping will be pressure tested after on-

[11] Material laydown area: A material laydown area is a piece of land where materials are stored and staged for construction.

site installation. Pressure testing will be completed with a liquid test medium that will be trucked on- and off-site. Piping will be tested for 4.25 hours if above grade; below grade piping will be tested for 8.25 hours. There will be three pressure tests per facility; one test for the mainline piping inside the station, one test for the station piping, and one for the drain line piping.

The modular-designed ESBs will be placed onsite and all associated electrical and controls equipment will be installed. Power and control cables will be routed, and additional pre-operational testing can begin once the system(s) are energized. All sites will require the construction of a new electrical substation.

The containment basin, wet sedimentation basin, or infiltration basin associated with each facility will be designed and constructed in accordance with the applicable federal and Minnesota Pollution Control Agency requirements.

Upon completion of all pre-operational testing, the equipment will be flooded with crude oil according to the detailed flood plans developed for each site. Equipment operation will then be verified. Final site civil work and painting will be completed, and the pump station property will be fenced in and gated to restrict access to the site. The area within the fence will be graveled and/or maintained as grass. Once all final checks have been completed, the facility will be turned over to Enbridge Operations for service.

2.8.2 Valves

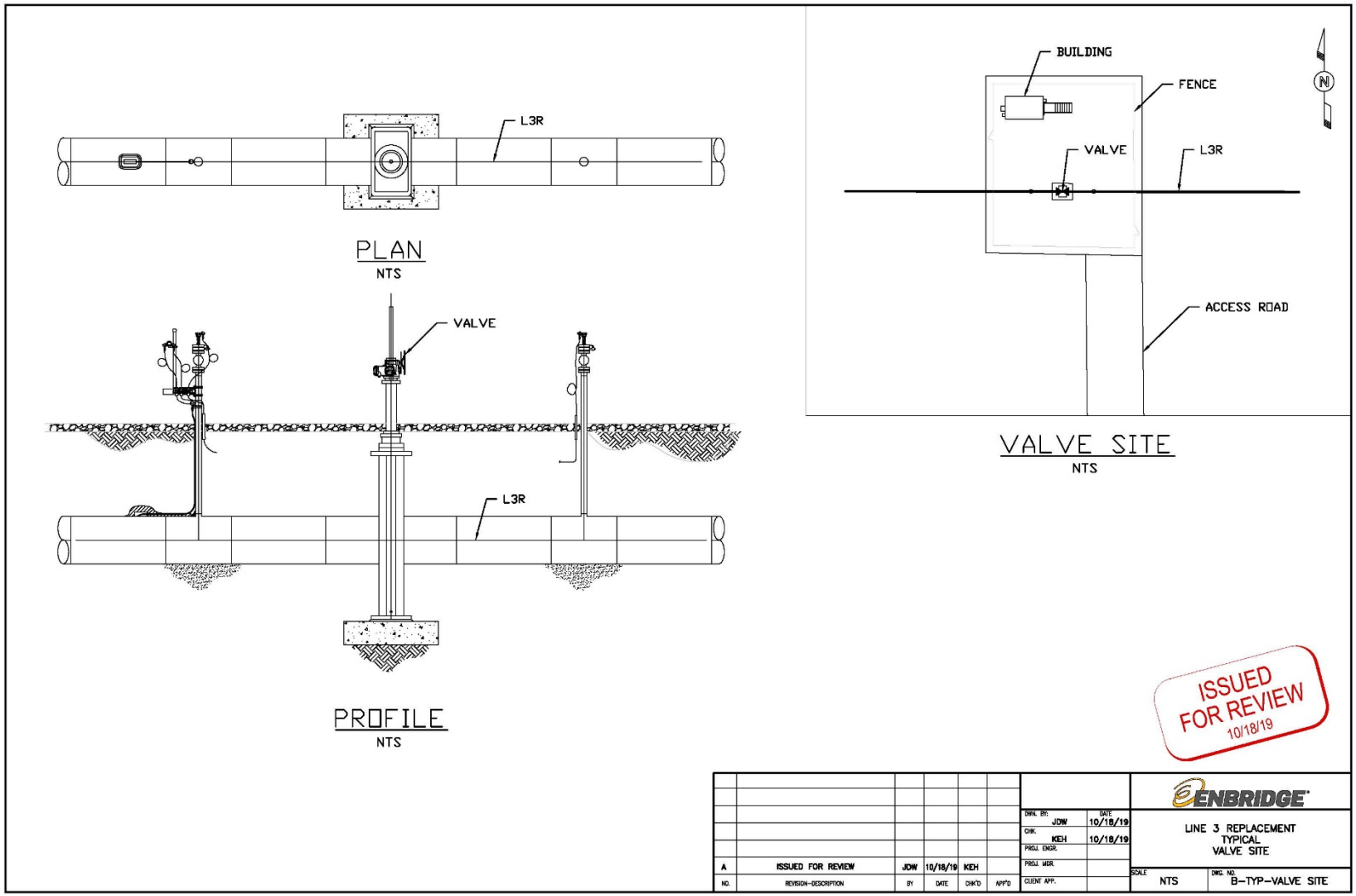
Valves[12] will be installed concurrently with the mainline pipe. Each valve site will consist of:

- one 8-foot by 14-foot building constructed 3 feet above grade on helical footings that do not require excavations or grout to install;
- one 36-inch mainline gate valve with electrical actuator and pressure transmitters on both upstream and downstream of the valve;
- ESB and associated electrical and controls equipment;
- service entrance and permanent access road; and
- security fencing and signage.

Refer to Figure 2.8-1 for a typical mainline valve layout.

[12] Valve: A valve is a piece of equipment used to control the flow of crude oil inside the pipeline. The valve acts as a gateway that can be opened and closed. A mainline valve describes an entire aboveground facility on the pipeline that is equipped with shutoff valves capable of stopping pipeline flow in the event of an emergency or for maintenance. A slide gate valve is a particular type of shutoff valve that operates by sliding a steel plate across the entire diameter of the pipe to seal off flow.

Figure 2.8-1: Line 3 Replacement Project Typical Mainline Valve Layout



Excavations at valve sites will be required to connect valve components to the belowground pipeline. The excavation dimensions are approximately 15 feet wide by 15 feet long by 15 feet deep, stepped back to 20 feet wide by 20 feet long at the ground surface. The mainline valve footing will be concrete 1.5 feet thick on a 1-foot thick gravel pad with the footing surface located just over 5 feet (5 feet 1 3/8 inches) below the installed centerline of the pipe. Total depth of the excavation is therefore anticipated to be approximately 13 to 15 feet below ground surface. Additional excavation will include cable routing trenches that will be approximately 24 inches deep and 12 inches wide.

After backfilling is complete, the valve will be filled with water and hydrostatically tested as part of the mainline spread hydrostatic test. The ESB will be placed and all associated electrical and controls equipment will be installed. Power and control cables will be routed, and additional pre-operational testing will begin once the system(s) are energized. Some sites will require the construction of a new electrical service.

Upon completion of all pre-operational testing, the valve will be ready for use. Equipment operation will be re-checked and final site civil work including fencing installation, permanent access road construction, and painting will be completed. The valve site within the fenced area will be graveled. After the final site civil work is complete, the site will be cleaned up and restored. After all final checks have been completed, the valve site will be turned over to Enbridge Operations for service.

2.8.3 Corrosion Protection

A cathodic protection[13] and impressed current mitigation systems will be constructed for L3R. Construction of this system includes both anode arrays installed in both conventional beds near the surface as well as in deep wells. Construction of cathodic protection systems includes excavation of soils at the site of installation. Methods utilized typically involve digging a trench for a cable using a mini-excavator, or ground trenching equipment such as a Ditch Witch. The technique used to install the cables associated with the cathodic protection system is similar to the methods used for installing fiber optic or telephone lines used for communications, which typically requires an approximately 30-foot-wide construction workspace.

Conventional surface bed type cathodic protection systems will be installed between 300 and 600 feet perpendicular to the pipeline. Anodes will be installed in either vertical or horizontal fashion and cables will be trenched to connect the anodes electrically to the protected metallic structures. Enbridge will also construct deep well cathodic protection systems where the anodes will be installed vertically in a well using construction methods similar to that of water wells. Deep well cathodic protection systems are normally installed closer to the pipeline, with the anodes themselves installed deeper (200 to 400 feet deep) than a conventional surface bed.

Both types of systems utilize native backfill for areas where trenching for the cable occurs. However, the area directly around the anodes will be backfilled with a more suitable backfill such

[13] Cathodic protection: Cathodic protection is a method for safeguarding the pipeline against corrosion. In a cathodic protection system, the metal to be protected (the pipeline) is connected to a metal that corrodes more easily (*anode array* or *anode groundbed*). The metal that corrodes more easily corrodes instead of the pipeline. Cathodic protection can be achieved by using reactive anode metals that are electrically connected to the pipeline (also known as a *galvanic anode* systems) or by using inert anode metals and impressing an electric current on the system (also known as an *impressed current* system). Enbridge's proposed cathodic protection system includes anode arrays installed in conventional beds near the ground surface as well as in deeper wells.

as coke breeze.[14] Additionally, in a deep well cathodic protection system, a natural clay plug will be installed above the anodes to seal the well and prevent water from entering the hole.

2.8.4 Pipeline Maintenance Shops

Pipeline Maintenance ("PLM") shops are strategically located along the pipeline route and are staffed by operations personnel. The PLM shops are stocked with equipment needed during operations and maintenance of the pipeline.

Construction will proceed similar to the pump stations, beginning with initial survey, staking, and four-way sweeps. The site will then be cleared and stripped of topsoil to prepare for excavation activities. Excavations will be made for the building foundations, septic and well, power, and communication. The excavation for the building will be approximately 125 feet by 75 feet by 6 feet deep to accommodate the foundations. Once foundations are poured, the excavation will be backfilled to rough grade and the building will be constructed.

After the building is constructed, the site will be stabilized, fenced, signed, and turned over to Enbridge Operations for their use.

3.0 PIPELINE CONSTRUCTION THROUGH WETLANDS

3.1 RIGHT-OF-WAY ACCESS

Enbridge will use the construction workspace and only approved roads to access wetland areas. Construction mats will be placed along the travel lane within delineated wetlands within the construction workspace and along access roads (refer to Section 2.1). Mat travel lanes are typically a single layer (see Figures 30 and 31 of the EPP); however, there may be cases in saturated areas where more than one layer of mats must be placed to provide a stable working surface (see Figures 32 and 33 of the EPP). Enbridge may use multiple mat configurations in inundated areas depending upon the depth of inundation and presence of channelized flow to maintain surface flow. These mat configurations are illustrated in Figure 49 of the EPP. Enbridge may use the following types of construction mats:

- Timber Mats: Timber mats are available in a variety of sizes and are constructed of hardwood materials that are bolted together. On this Project, most timber mats are 8 inches thick, 4 feet wide, and 18 feet long. No individual timbers will be used. Timber mats are suitable for all vehicle types present on the construction workspace, have high durability under traffic, and are easily installed and removed using typical construction equipment. Timber mats are suitable for use in all soil conditions for all pipeline construction activities.

- Laminated Mats: Laminated mats are available in a variety of sizes and are constructed of laminated wood materials. Laminated mats are suitable for all vehicle types but are limited in their weight bearing capacity (e.g., 600 pounds per square inch). They have high durability and are easily installed and removed using typical construction equipment. Laminated mats are suitable for use in most soil conditions but should not be used in

[14] Coke Breeze: Coke breeze is common carbonaceous backfill material used in cathodic protection. It provides a conductive path for current flow and ensures optimal effectiveness of the cathodic protection system.

extremely saturated conditions. Laminated mats can be used on access roads, at drill pads, and for storage and staging of equipment.

3.2 CHOOSING A CONSTRUCTION METHOD

Table 3.2-1 summarizes the wetland crossing techniques Enbridge intends to utilize during construction, the site-specific conditions required for the method to be feasible, and the advantages and disadvantages associated with each technique. Enbridge will typically install the pipelines through wetlands with moderate- to high-bearing strength soils using standard upland crossing methods utilizing construction mats or equivalent to avoid rutting, minimizing disturbance to soils and vegetation, and to ensure safe and stable working surfaces for construction equipment and personnel.

Enbridge may install the pipeline through saturated wetlands with low bearing strength soils by using push-pull techniques, if practicable, or by using standard upland crossing techniques with frost/ice roads during frozen conditions (see Enbridge's Winter Construction Plan for additional information). In some cases, Enbridge may install sheet piling within the trench to stabilize the trench walls. Enbridge may install the pipelines through narrow wetlands or ditches adjacent to roads or railroads and sensitive wetlands or riparian areas adjacent to waterbody crossings using trenchless techniques such as a non-pressurized horizontal bore method or the HDD (pressurized) method.

Table 3.2-1
Pipeline Wetland Installation Methods

Method (Season)	Description [a]	Site Characteristics	Applicable Wetland Type(s)[b]	Advantages	Disadvantages
Trench: Modified Upland Construction Method (open cut) (Spring-Fall/non-frozen)	Conduct construction from construction mats or equivalent (refer to Figures 30 and 31 from the EPP). Multiple layers of construction mats may be required in saturated wetland conditions (refer to Figures 32 and 33 of the EPP). Vegetation is cut at ground surface to maintain the root structure and seed bank in the soil profile along the travel lane.	Suitable in wetlands with unsaturated mineral soils constructed during non-frozen conditions. Also, suitable in saturated wetlands (typically <12-inch inundation) with moderate to high bearing strength, shallow peat soils over mineral substrate, or forested peatlands where roots provide a relatively firm foundation for construction mats or equivalent.	The following wetland types are typically suitable, as along as the criteria described in the Site Characteristics column is also met: • Wet/Wet Mesic Prairie • Fresh (Wet) Meadow • Sedge Meadow • Alder Thicket • Shrub-Carr • Floodplain Forest • Hardwood Swamp • Coniferous Swamp	• Relatively quick construction/installation • No need for specialized equipment • Minimizes impacts on soils and vegetation by limiting disturbance to Trench-Line only and operating off of construction mats • Facilitates revegetation from seedbank and provides favorable plant growth conditions	• Clearing and brush removal required along travel lane in forested wetlands • Potential need for wider than normal trench and therefore additional construction workspace to avoid trench sidewall slump in loose, poorly graded sands • Multiple mat layers may be required in some wetlands; additional time for installation and removal of construction mats, • Potential compaction of the travel lane; additional restoration efforts of travel lane may be needed as compressed surface rebounds
Trench: Modified Upland Construction Method (open cut) (Winter/Freeze down)	Conduct construction from frost/ice roads, and/or construction mats, or equivalent (refer to Appendix A of the Winter Construction Plan). Topsoil segregation performed as practicable but modified dependent on depth of frost and thickness of topsoil. May use a ripper to break up frozen topsoil over the trench line only. Topsoil in spoil storage graded smooth to minimize mixing during backfilling. Vegetation is cut at ground surface to maintain the root structure and seed bank in soil profile along the travel lane.	Suitable for wetlands with unsaturated mineral soils or saturated or shallow inundated wetlands with moderate to low strength peat over mineral soils during frozen conditions.	The following wetland types are typically suitable, as along as the criteria described in the Site Characteristics column is also met: • Wet/Wet Mesic Prairie • Fresh (Wet) Meadow • Sedge Meadow • Alder Thicket • Shrub-Carr • Floodplain Forest • Hardwood Swamp • Coniferous Swamp • Shallow Marsh • Coniferous Bog • Open Bog	• Relatively quick construction/installation • Minimizes impacts on wetland soils and vegetation by limiting to disturbance to Trench-Line only and operating off of frost/ice roads or construction mats • Stable foundations for spoil storage and travel lane • Facilitates revegetation from seedbank and provides favorable plant growth conditions	• Potential need for wider than normal trench and therefore additional construction workspace to avoid trench sidewall slump in loose, poorly graded sands • Susceptible to winter thaw; limited to freezing conditions and contingency required for thawing conditions • Additional safety concerns associated with cold weather work • Potential for mixing of topsoil and subsoil during excavation • Backfilling of frozen spoil piles may result in subsidence of the trench during thaw introducing potential increase in backfill volume and/or additional restoration efforts • If post-thaw restoration is necessary, mats will typically be left in place increasing the period of disturbance • Frost/ice roads often require a water source

Method (Season)	Description [a]	Site Characteristics	Applicable Wetland Type(s)[b]	Advantages	Disadvantages
Trench: Push-Pull Method: Backhoe (Spring-Fall)	Use a backhoe (or equivalent) to excavate the trench operating from construction mats "walked" down the trenchline (refer to Figures 35 and 36 of the EPP). Push-pull or float and sink the pre-assembled pipe then backfill. May or may not use a travel lane depending on conditions with backfilling occurring from the spoil storage side or the working side. When a travel lane is used, vegetation will be cut above the ground surface to maintain the root structure and seed bank in the soil profile. May or may not require trench dewatering.	Suitable in inundated wetlands or wetland/ waterbody complexes (typically >12-inch inundation) with relatively competent peat soils, shallow peat over mineral soils, or forested peatlands with moderate bearing strength soils.	The following wetland types are typically suitable, as along as the criteria described in the Site Characteristics column is also met: • Shallow Marsh • Deep Marsh • Shallow, Open Water • Coniferous Bog • Open Bog	• Minimizes impacts on wetland soils and vegetation • No specialized equipment needed and allows for construction in unfrozen, saturated wetlands • Reduced heavy equipment traffic	• Topsoil segregation typically not practical; inability to maintain a cohesive spoil pile due to liquid nature of soil • Potential for stranding of the excavator if extremely loose, deep peat soils are encountered unexpectedly • Additional workspace required for pipe assembly or pipe may be fabricated off-site and brought in as a drag section • Due to lack of travel lane, additional adjacent workspace required for equipment turnarounds • May require spread move around
Push-Pull Method: Swamphoe (Spring-Fall)	Excavate the trench using a backhoe (or equivalent) mounted on tracked pontoons operating along the trenchline (refer to Figures 35 and 36 of the EPP). Push-pull or float and sink the pre-assembled pipe then backfill. May or may not use a travel lane depending on conditions with backfilling occurring from the spoil storage side or the working side. When a travel lane is used, vegetation will be cut above the ground surface to maintain the root structure and seed bank in the soil profile. May or may not require trench dewatering.	Suitable in inundated (typically > 12-inch inundation) emergent and scrub-shrub wetlands with loose, deep peat soils or floating mat peat, low-bearing strength soils.	The following wetland types are typically suitable, as along as the criteria described in the Site Characteristics column is also met: • Shallow Marsh • Deep Marsh • Shallow, Open Water • Coniferous Bog • Open Bog	• Allows for construction in saturated wetlands during unfrozen conditions • Reduced heavy equipment traffic	• Specialized equipment (i.e., swamphoe) required • Topsoil segregation typically not practical; inability to maintain a cohesive spoil pile due to liquid nature of soil • Potential for spoil settlement preventing complete replacement of backfill and potentially resulting in open water along the trenchline • Additional adjacent workspace required for pipe assembly or pipe may be fabricated off-site and brought in as a drag section • Additional adjacent workspace may be required for equipment turnarounds • Slower than normal construction progress in the wetland due to equipment speed • May require spread move around

Method (Season)	Description [a]	Site Characteristics	Applicable Wetland Type(s)[b]	Advantages	Disadvantages
Trenchless: Bore (Non-Pressurized)	Bore under feature from bore pit on one side to bore pit on the other side with or without casing (see Figures 40 and 41 of the EPP). Non-pressurized water or bentonite may be introduced if soil conditions dictate; any release will travel back along the path of the pipe and into the bore pit.	Suitable for narrow highways, roads, railroads, and watercourses. Not suitable where there are high water tables, loose sand/gravel substrates, or adjacent steep slopes.	The following wetland types are typically suitable, as along as the criteria described in the Site Characteristics column is also met: • Wet/Wet Mesic Prairie • Fresh (Wet) Meadow • Sedge Meadow • Alder Thicket • Shrub-Carr • Floodplain Forest • Hardwood Swamp • Coniferous Swamp	• Avoids surface ground disturbance in the wetland or ditch adjacent to the feature crossed • No sediment release • No potential for inadvertent release outside of the bore pits	• Requires additional workspace for bore pits, spoil piles, and sump(s) • Large excavations required on both sides of the crossing • Deep bore pits may require sump pump or well point dewatering system and/or sheet-piling • Slower than trench crossing techniques
Trenchless: HDD (Pressurized)	Place a rig on one side of the wetland and drill a small-diameter pilot-hole under the feature along a prescribed profile (see Figure 26 of the EPP). Upon completion of the pilot-hole, use a combination of cutting and reaming tools to accommodate the desired pipeline diameter. Drilling mud is necessary to remove cuttings and maintain the integrity of the hole. Once the hole is reamed to the appropriate size, the welded pipe section is then pulled back through the hole.	Suitable to cross sensitive wetland areas and riparian wetlands adjacent to waterbody crossings depending on site-specific topography and the local geologic substrate. Feasibility limitations in high flow artesian conditions, areas of glacial till or outwash interspersed with boulder and cobbles, fractured bedrock, or non-cohesive coarse sands and gravels. Geotechnical borings and hydrofracture risk analysis are performed to determine HDD feasibility and potential for inadvertent returns.	All wetland types that meet the criteria described in the Site Characteristics column.	• No sediment release unless an inadvertent return occurs • Avoids surface ground disturbance in riparian wetlands adjacent to sensitive or large waterbodies • Limits vegetation disturbance to within the permanently maintained easement • Significantly reduces clean-up and restoration between entry and exit points	• Potential for inadvertent release of drilling fluids (refer to Section 11.0 of the EPP) • Requires ATWS on both sides of the crossings to stage construction, fabricate the pipeline, and store materials • Tree and brush clearing is necessary for operations • Requires obtaining water to formulate the drilling fluid, buoyancy control, as well as hydrostatic testing • Feasibility and success depends on substrate • Requires specialized equipment (limited availability) • Pull string area along the alignment for the same length of the crossing to allow continuous pullback • Requires a straight alignment for the length of the HDD • May require several weeks to complete the HDD

Method (Season)	Description [a]	Site Characteristics	Applicable Wetland Type(s)[b]	Advantages	Disadvantages

Notes:

[a] For all methods except HDD, vegetation and trees within wetlands will be cut off at ground level along the entire workspace, leaving existing root systems intact; clearing debris will be removed from the wetland for disposal. For the HDD method, vegetation and trees within the wetland will be removed along 30 feet of the permanent right-of-way to allow for aerial inspection of the pipe during operations.

[b] Typical wetland types (Eggers and Reed, 2014) suitable for the referenced crossing method; the construction technique selected will depend on the site-specific conditions described in the site characteristics column.

Source: Canadian Energy Pipeline Association, Canadian Association of Petroleum Producers, Canadian Gas Association, 2018.

3.3 TRENCH: MODIFIED UPLAND CONSTRUCTION METHOD

The modified upland construction method (also referred to as open cut or the standard wetland construction method) differs from standard upland construction method to minimize disturbance to the wetland features. These main differences, described in more detail in Section 3.0 of the EPP, include:

1) Reducing the construction workspace compared to uplands (from 120 to 95 feet) (refer to Table 2.3-1, and Figure 5 of the EPP);

2) Performing workspace clearing using low ground-pressure equipment or operating off construction mats or ice/frost roads to limit disturbance to the wetland (Section 3.2 of the EPP and the Winter Construction Plan);

3) Clearing vegetation in wetlands to the ground level, but leaving intact root wads except over the trench line (Section 3.2 of the EPP);

4) Installing and maintaining erosion and sediment control BMPs to prevent sediment flow from uplands into wetlands (Section 3.4 of the EPP);

5) Trench-Line-Only topsoil segregation, involving stripping and segregating up to 1 foot of the organic layer/topsoil from the trench line (approximately 20 feet wide depending on soil conditions) and storing the material separate from trench spoil to preserve the native seed stock from wetlands without standing water. In standing water wetlands, the Contractor will attempt to segregate as much of the soil surface as possible based on site and saturation conditions (Section 3.6.1 of the EPP); and

6) Implementing revegetation techniques suitable to wetland conditions, as described in Section 7.7 of the EPP.

As described in Table 3.2-1, this technique is suitable in wetlands with unsaturated mineral soils constructed during unfrozen conditions or can be used in saturated wetlands (typically <12-inch inundation) with moderate to high bearing strength, shallow peat soils over mineral substrate, or forested peatlands where roots provide a relatively firm foundation for construction mats or equivalent. It can also be used in wetlands with unsaturated mineral soils or saturated wetlands with moderate to low strength peat over mineral soils during frozen conditions.

The construction workspace width throughout the wetland is 95 feet wide starting at the upland/ wetland boundary. The trench spoil is stored adjacent to the trench on the outside boundary of the construction workspace. Approximately 40 feet is required to store the trench spoil. On average, the trench width required to install the 36-inch pipe is 20 feet wide and at least 7 feet deep to accommodate the minimum depth of cover of 4 feet. In wetland conditions with unstable and/or unconsolidated soils, the trench width may be wider to accommodate a shallower angle and maintain the integrity of the trench walls. For those wetlands that require bag weights for buoyancy control, the trench will need to be wider to accommodate the bag weights. An approximately 18-foot-wide construction mat travel lane will be installed where conditions allow. Equipment will then excavate the trench, string and lower-in the pipe, and backfill the trench. Finally, adjacent to the travel lane on the working side of the construction workspace, space is required for additional spoil storage, and also equipment such as bag weights that may be used for buoyancy control in certain saturated wetland environments to ensure the pipe is maintained in place to achieve the required depth of cover.

Because this method does not require any specialized equipment, it proceeds more quickly than other wetland construction methods, which further minimizes disturbance to wetland soils and vegetation. By limiting the removal of root wads to the trench line, the integrity of adjacent soils is maintained, and the seed bed remains undisturbed. The use of low-ground pressure equipment, construction mats, and/or ice/frost roads also further reduces soil compaction issues. Enbridge will remove the construction mats during final cleanup activities. If there are multiple layers of mats, Enbridge will probe the soil after mats have been removed to verify that no additional mats remain.

Sheet-piling may be used at wetland crossing locations in order to stabilize the trench, or to assist with water management. At potential sheet-piling locations, a test hole may be dug in proximity to the crossing location to assess soil stability and other conditions (e.g., bedrock, cobbles, boulders), and to determine if the crossing will be conducive to the installation of sheet piling. Based on these results, a decision will be made between Enbridge Construction and the Environmental Compliance team.

Once the pipe has been installed, trench breakers will be installed as appropriate (see Section 1.13 of the EPP). As described in Section 3.9 of the EPP, Enbridge will backfill the trench in wetlands to an elevation similar to the adjacent areas outside the ditch line and will add a slight crown of approximately 3 to 6 inches (depending on soil type) over the backfilled trench to allow for subsidence. Periodic breaks in the crown will be implemented to allow for normal hydrologic flow across the backfilled trench. Crowning will not extend beyond the previously excavated trench limits. Revegetation will proceed as described in Section 7.0 of the EPP. Enbridge will monitor wetlands after construction as described in Enbridge's Post-Construction Wetland and Waterbody Monitoring Plan.

3.4 TRENCH: PUSH-PULL METHOD

Push-pull technique can only be utilized in non-frozen conditions where there is sufficient inundation to push-pull or float the pipe and open water can be maintained. If these conditions do not exist at the time of the crossing, then the modified upland construction technique will be utilized.

The push-pull method is utilized in large (greater than 200 feet) saturated wetlands or wetland/ waterbody complexes (greater than 12-inch inundation) with relatively competent peat soils, shallow peat over mineral soils, floating mat peat, forested peatlands with moderate bearing soils strengths, emergent and scrub-shrub wetlands with loose, deep peat soils, or floating mat peat, low-bearing strength soils (refer to Section 3.7.1 and Figures 35 and 36 of the EPP). This technique can also be used to cross waterbodies located within these wetland complexes.

The construction workspace is 95 feet wide starting at the upland/wetland boundary. Within the wetland portion, the trench spoil is stored adjacent to the trench within approximately 40 feet of the construction workspace. In wetlands with unstable and/or unconsolidated soils, additional space is required to store the additional spoil from the wider trench, and because the spoil may not stack neatly due to its more liquified condition. On average, the trench width required to install the 36-inch pipe is 20 feet wide and at least 7 feet deep to accommodate the minimum depth of cover of 4 feet. In wetland conditions with unstable and/or unconsolidated soils, the trench width may be wider to accommodate a shallower angle and maintain the integrity of the trench walls. For those wetlands that require buoyancy control, the trench will need to be wider. An approximate 18-foot-wide construction mat travel lane will be installed where conditions allow. This may include a temporary bridge across the waterbody feature. Finally, adjacent to the travel lane on the

working side of the construction workspace, space is required for additional spoil storage (especially for saturated wetland conditions), and also for material such as floats. Trench spoil will not be stored within the streambed of the waterbody features.

Because push-pull crossing methods are typically used to install longer sections of pipe, ATWS is needed in the adjacent areas to string (i.e., weld) the pipe together, and to install the equipment, such as rollers, sidebooms, or excavators to push the pipe into place. Furthermore, if the conditions are such that spoil or buoyancy control materials cannot be stored within the construction workspace in the wetland, these materials will be stored in the adjacent ATWS.

The trench is excavated using a backhoe (or equivalent) operating either from construction mats in more stable soils, or from an excavator mounted on tracked pontoons (referred to as a "swamphoe") along the trenchline. As discussed in Section 3.1, multiple layers of construction mats may be installed to provide a stable surface in these saturated wetland areas. Sheet-piling may also be installed to assist with trench stability and groundwater management. The pre-assembled pipe is then pushed-pulled or floated into position across the wetland and waterbody feature, if present. Usually this fabrication requires use of ATWS adjacent to the construction workspace. Once the pipeline is in position, floats, if used, will be removed and the pipe will sink; buoyancy control methods may be used (refer to Section 3.7.3 and Figures 37 and 38 of the EPP). Trench breakers will be used as appropriate. The trench will then be backfilled using a backhoe or equivalent working from construction mats or by low ground pressure equipment, and the wetland will be restored as near as practicable to pre-construction conditions.

Enbridge will monitor wetlands after construction as described in Enbridge's Post-Construction Wetland and Waterbody Monitoring Plan.

3.5 TRENCHLESS: BORE (NON-PRESSURIZED)

The conventional non-pressurized bore method is typically used to cross features such as road or railroad features; however, wetlands and waterbodies adjacent to these features may also be crossed in conjunction with the bore crossing (refer to Section 4.0 of the EPP).

The construction workspace will be reduced to 95 feet starting 20 feet from the OHWM along both sides of the wetland or waterbody feature to minimize vegetation clearing. Because the bore is installed under the features at a minimum depth of cover of 4 feet for the waterbodies, the construction workspace over the wetland or waterbody will be limited to the travel lane (temporary bridge), if a bridge is proposed. In some cases, Enbridge may use an access road to go around the feature and will not cross the features directly. On either side of the features to be crossed, the construction workspace will be utilized to establish the bore hole excavation. Both the launching and receiving bore pits will be set back approximately 10 to 15 feet from the feature(s) being crossed. The bore pits must be of sufficient size to house the boring machine and tracks or cradle, and therefore vary in length depending on the depth of the feature being crossed, length of the bore, and soil conditions. The average excavation is a minimum of 15 feet deep and 15 feet wide and requires a minimum length of approximately 70 to 110 feet. The remainder of the construction workspace, and TWS that will also be sited on both sides of the features to be crossed, provide area to string and stage the pipe, stage the boring equipment, prepare drilling mud (as needed), stage pumps used to dewater the bore pits (as needed), and to store the spoils from the bore pit.

An auger bore uses a revolving cutting head that is located at the leading end of an auger assembly to excavate the soil. Common practice is to use a sacrificial casing pipe the same

diameter and length as the carrier pipe at the crossing. The spoil is then transported back to the shaft area by the rotation of the helical auger within the sacrificial casing pipe.

A pneumatic hammer (also called a thumper) may be used in place of the auger system and may be used on moderate length bores (under 200 feet) in good to fair soil conditions. Thumping uses an air compressor and hammering device attached to the end of the sacrificial casing pipe. The open-ended casing pipe is then driven through the crossing, filling itself with spoil material until it reaches the exit point. Proper elevation and direction are monitored by line of sight, water level, electronic smart level and/or a transit.

Water and bentonites can be introduced if soil conditions dictate in order to lubricate the sacrificial casing pipe, allowing it to move through the ground more freely; approved chemical additives may also be introduced. Pressurized water or drilling mud is never used to hold the hole open, as it will be during an HDD (see Section 3.6); therefore, there is no risk for an inadvertent return of drilling mud at these locations. If drilling mud is needed at these locations, any release will travel back along the path of the pipe and into the bore pit. Once the sacrificial casing pipe has ran the length of the bore, the carrier pipe is temporarily attached and pulled through.

Once the bore is completed, the bore pits will be backfilled and any wetland impacts will be restored as described in Section 7.0 of the EPP after the tie-in has been completed. Enbridge will monitor these wetland areas after construction as discussed in the Post-Construction Wetland and Waterbody Monitoring Plan.

3.6 TRENCHLESS: HORIZONTAL DIRECTIONAL DRILL METHOD (PRESSURIZED)

The HDD method is a trenchless crossing technique that involves drilling a hole underneath sensitive resources and installing a pre-fabricated pipe segment through the hole. No direct excavation to the banks or beds of the feature being crossed is involved. Installation of a pipeline by HDD is accomplished in three stages as illustrated in Figure 3.6-1. The first stage consists of directionally drilling a small-diameter pilot hole at an entry point along a designed directional path to an exit point. The second stage involves enlarging this pilot hole to a diameter suitable for installation of the pipeline. The third stage consists of pulling the prefabricated pipe section from the exit point back into the enlarged hole to the entry point. A guidance system is used to accurately track the location of the drill cutting head.

The HDD method utilizes drilling fluid (also referred to as drilling mud) that is pumped under pressure through the inside of the drill pipe to lubricate the drill bit and convey drill cuttings back to the drill entry point, where it is reconditioned and re-used in a closed, circulating process (refer to Section 3.6.1 for additional discussion of drilling fluids).

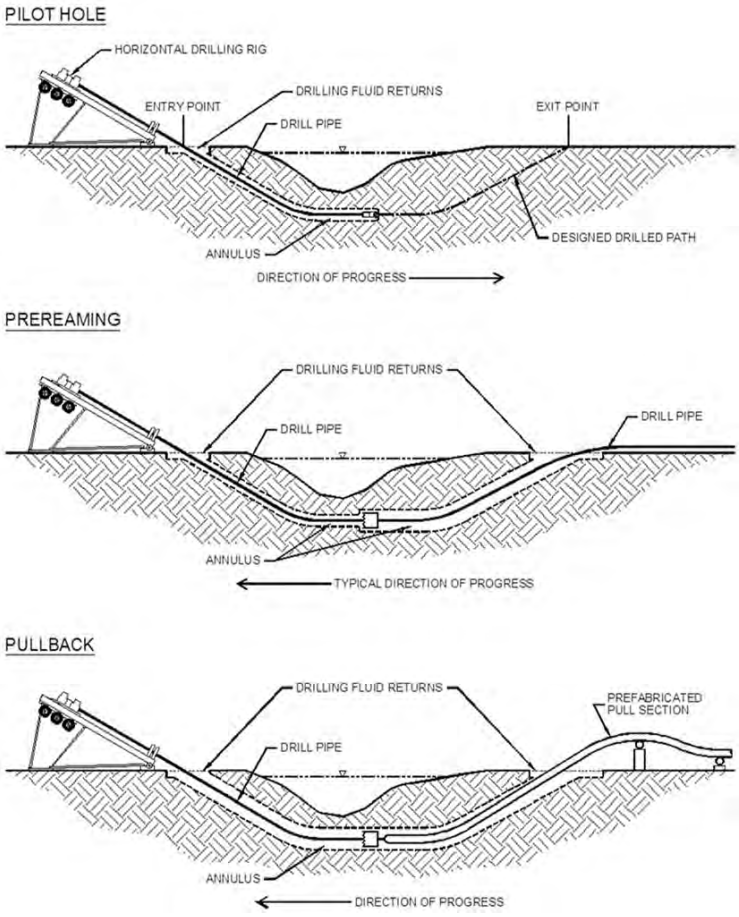


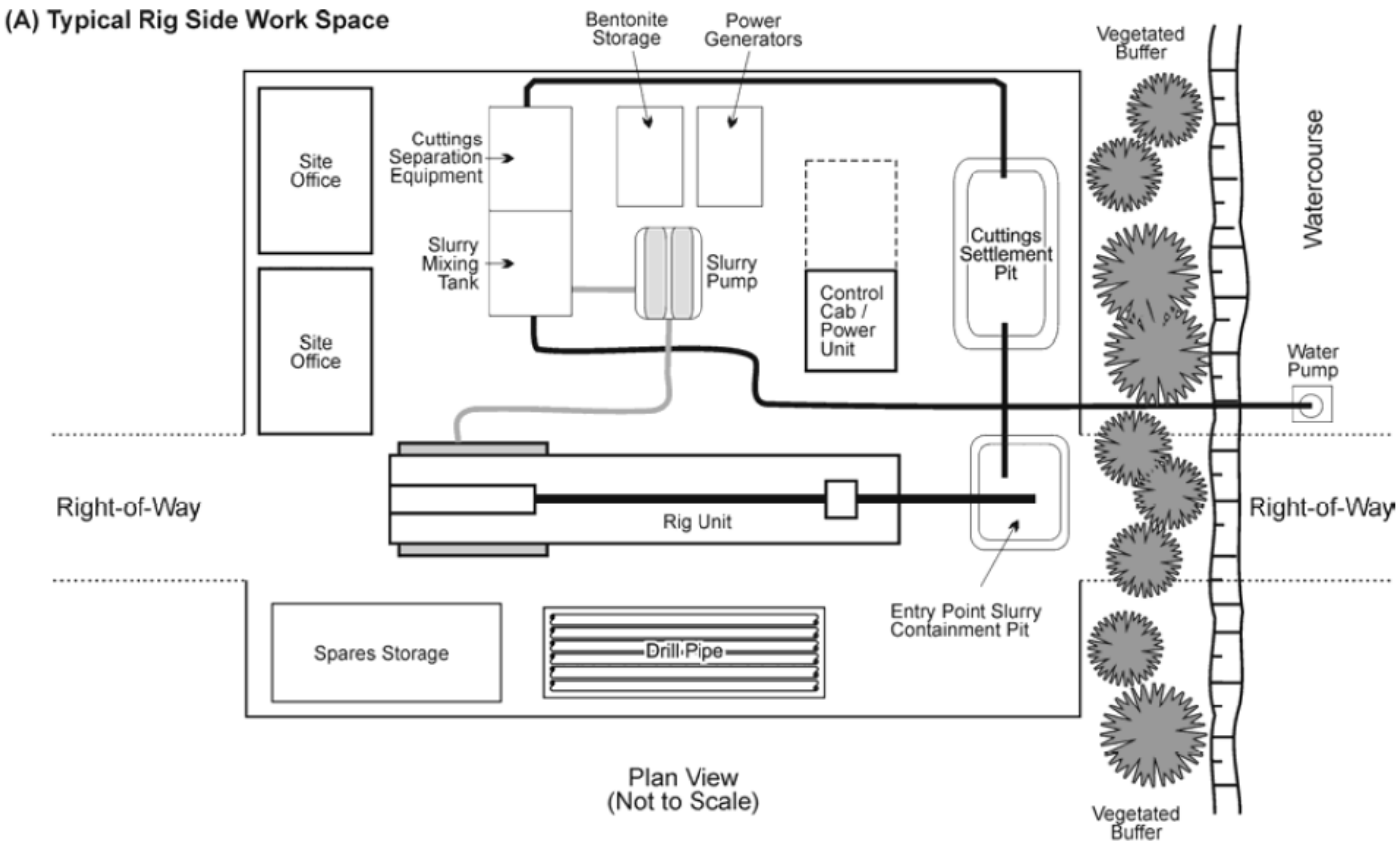
Figure 3.6-1: General Stages of an HDD

The entry pit is where the main drilling activities occur and where drill rig and drilling mud system is staged. Refer to Figure 3.6-2 for a typical configuration of an HDD entry workspace (rig side).

The exit point is where pipe installation is accomplished by attaching a pipeline pull section behind a reaming assembly at the exit point, then pulling the reaming assembly and pull section back to the drilling rig. Refer to Figure 3.6-3 for a typical configuration of an HDD exit workspace (pullback).

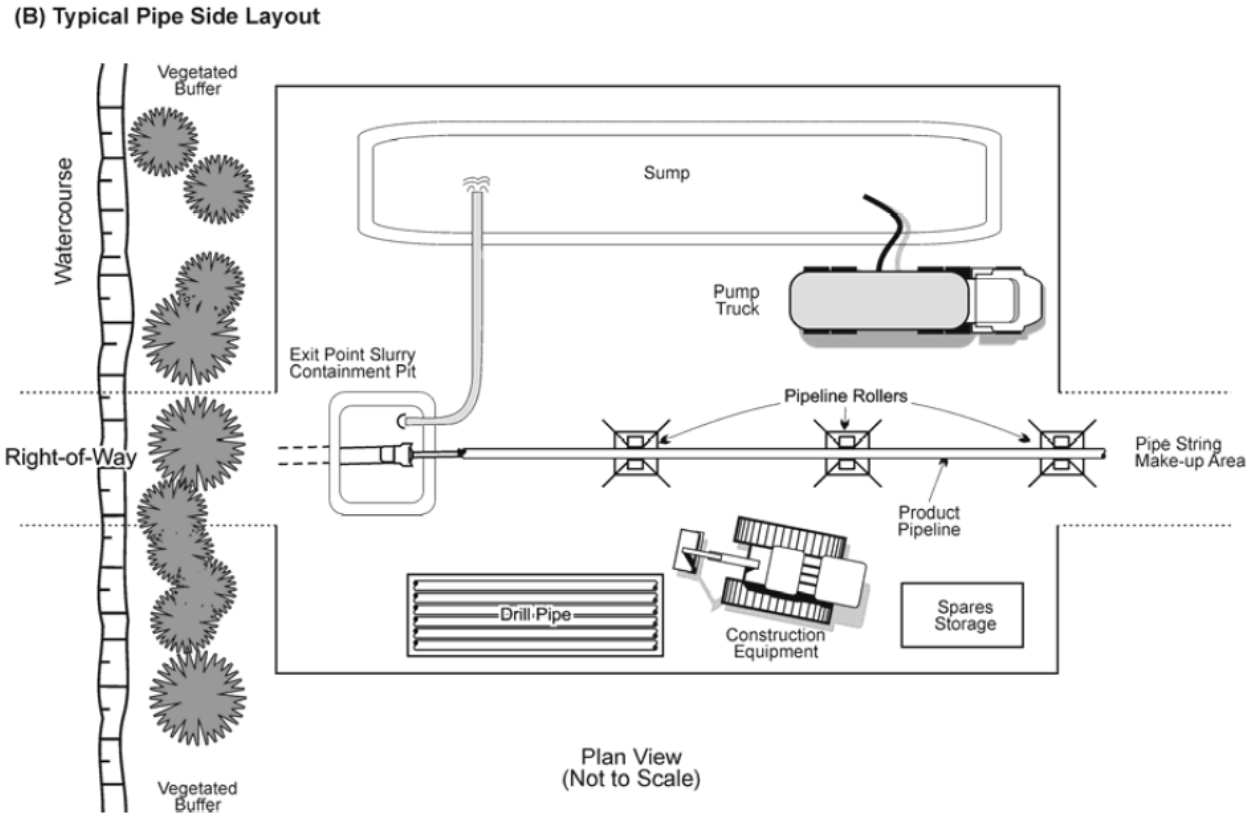
Should the entry or exit points be located within wetlands, Enbridge will mat the entire workspace within wetlands for the staging of equipment and materials. Once the drill and tie-in is completed, the construction mats will be removed, the entry and exit pits will be backfilled and the wetland will be restored as described in Section 7.0 of the EPP. Enbridge will monitor these wetland areas after construction as discussed in the Post-Construction Wetland and Waterbody Monitoring Plan.

Figure 3.6-2: HDD Typical Workspace Configuration – Entry/Rig Side



Source: Canadian Association of Petroleum Producers, 2005. Pipeline Associated Watercourse Crossings, 3rd Edition.

Figure 3.6-3: HDD Typical Workspace Configuration – Exit/Pullback



Source: Canadian Association of Petroleum Producers, 2005. Pipeline Associated Watercourse Crossings, 3rd Edition.

Enbridge does not present an alternate crossing method for proposed HDD crossings. If the primary drill path fails during the crossing, Enbridge will consider an alternate drill path before abandoning use of the HDD method for an alternative, non-HDD crossing method. If necessary, alternate drill paths will be selected by analyzing geotechnical studies and after review of site-specific conditions. Enbridge will consult with the appropriate permitting agencies as needed for approval of new drill paths and workspace.

3.6.1 Technical Feasibility Considerations

The design and feasibility of an HDD is determined by factors including the length, depth, and curvature (i.e., profile) of the proposed drill; surrounding topography; pipeline diameter; availability and orientation of land on which to assemble the HDD pipeline segment; land use constraints; and geotechnical suitability of the subsurface environment. Enbridge conducts geotechnical surveys at each the proposed HDD site to determine the subsurface conditions and identify potential obstacles. This information, along with the HDD design and layout and any other available data, is used to model the capacity of the soil to withstand the pressures of the drill and avoid widening or creating a fracture (hydraulic fracturing) through which drilling mud fluid will migrate. This information is consolidated in a Hydrofracture Report for each site.

3.6.1.1 Composition of Drilling Fluid

Drilling fluid is primarily composed of water and a viscosifier,[15] typically naturally occurring clay in the form of bentonite mixed with small amounts of extending polymers to increase its yield (high yield bentonite); meaning that more drilling fluid can be produced with less bentonite clay.

Various additives may also be used to enhance the performance of the bentonite-based drilling mud. Chemical drilling additives help control sand content and flow, water hardness, keep the bore hole open and stable, prevent groundwater inundation and allow the bentonite to yield properly. Small amounts of drilling mud additives are added to the bentonite and water slurry. Enbridge will only use those drilling mud additives approved by the appropriate agencies.

3.6.1.2 Functions of Drilling Fluid

The principal functions of drilling fluid in HDD pipeline installation include:

- Transportation of Spoil – Drilled spoil, consisting of excavated soil or rock cuttings, is suspended in the fluid and carried to the surface by the fluid stream flowing in the annulus between the wall of the hole and the pipe.

- Cleaning and Cooling of Cutters – High velocity fluid streams directed at the cutters remove drilled spoil build-up on bit or reamer cutters. The fluid also cools the cutters.

- Reduction of Friction – Friction between the pipe and the wall of the hole is reduced by the lubricating properties of the drilling fluid.

- Hole Stabilization – The drilling fluid stabilizes the drilled or reamed hole. This is critical in HDD pipeline installation as holes are often in loose soil formations and are uncased. Stabilization is accomplished by the drilling fluid building up a wall cake and exerting a

[15] A viscosifier is a thickening agent.

positive pressure on the hole wall. Ideally, the wall cake will seal pores and produce a bridging mechanism to hold soil particles in place.

- Transmission of Hydraulic Power – Power required to turn a bit and mechanically drill a hole is transmitted to a downhole motor by the drilling fluid.

- Hydraulic Excavation – Soil is excavated by erosion from high velocity fluid streams directed from jet nozzles on bits or reaming tools.

- Soil Modification – Mixing of the drilling fluid with the soil along the drilled path facilitates installation of a pipeline by reducing the shear strength of the soil to a near fluid condition. The resulting soil mixture can then be displaced as a pipeline is pulled into it.

3.6.1.3 Inadvertent Returns

HDD involves the subsurface discharge of drilling fluids. Because the drilling fluid is pressurized, it can be lost beyond the immediate vicinity of the drill hole and will flow in the path of least resistance, resulting in lost drilling fluids in the subsurface environment or inadvertent returns to the ground surface. This loss of drilling fluid is also referred to as an inadvertent release.

Drilling parameters may be adjusted to maximize drilling fluid circulation and minimize the risk of inadvertent returns. However, the possibility of lost circulation and inadvertent returns cannot be eliminated. Enbridge has developed contingency plans addressing possible remedial action for review by the appropriate agencies.

Section 11.0 of the EPP describe the procedures that will be implemented during the execution of an HDD to monitor, contain, and recover a potential inadvertent release.

4.0 PIPELINE CONSTRUCTION THROUGH WATERBODIES

Table 4.0-1 describes the waterbody crossing techniques Enbridge intends to utilize during construction, the site-specific conditions required for the method to be feasible, and the advantages and disadvantages associated with each technique. Enbridge will typically use the open cut technique through dry or frozen waterbodies, or where flow isolation is not feasible. The push-pull method may also be utilized to cross waterbodies that are part of a larger inundated wetland/waterbody complex during non-frozen conditions. Dry crossing techniques are suitable for low flow streams with defined banks where isolation is feasible. Similar to wetland crossings, sheet-piling may be used at waterbody crossing locations in order to stabilize the trench, stabilize the stream banks, or to assist with water management (see Section 3.3). Enbridge may also install the pipelines through narrow waterbodies or ditches adjacent to roads or railroads and sensitive waterbodies or riparian areas adjacent to waterbody crossings using trenchless techniques such as a non-pressurized bore method or the HDD (pressurized) method.

Enbridge's construction contractor(s) and Environmental Inspectors ("EIs") will monitor upcoming weather forecasts to determine if significant rainfall is anticipated during construction.

Refer to Section 2.0 of the EPP for details regarding construction procedures and mitigation measures for each crossing method. The EPP also details procedures for temporary and permanent stabilization. When construction is complete at each waterbody crossing, revegetation and monitoring will occur as described in Section 7.0 of the EPP. After construction, Enbridge will monitor waterbodies crossed by the construction workspace as discussed in Enbridge's Post-Construction Wetland and Waterbody Monitoring Plan.

Table 4.0-1
Pipeline Waterbody Installation Methods

Method	Description	Applicability	Advantages	Disadvantages
Trench: Open Cut (Non-Isolated)	Open-cut crossing technique that involves trenching through the dry or frozen waterbody with no perceptible flow, or while water continues to flow across the in-stream work area (refer to Figure 22 of the EPP).	Suitable for ephemeral and intermittent waterbodies where there is no perceptible flow (dry or frozen), such as agricultural ditches. This method may also be used in waterbodies that are part of a wetland complex where isolating the flow is not feasible. In Minnesota, these are primarily waterbodies located within large, saturated wetlands, and waterbodies impacted by beaver dams.	• Rapid construction/installation • No need for specialized equipment • Compatible with granular substrates and some rock • Minimizes period of in-stream activity • Maintains streamflow • No sediment release or relatively short duration of sediment release (<24 hours)	• May require implementation of erosion and sediment control BMPs to mitigate sediment release during excavation and backfilling • May interrupt streamflow
Trench: Push-Pull Method: Backhoe (Spring-Fall)	Use a backhoe (or equivalent) to excavate the trench operating from construction mats (refer to Figures 35 and 36 of the EPP). Push-pull or float and sink the pre-assembled pipe then backfill.	Suitable in inundated wetland/waterbody complexes (typically >12-inch inundation) with relatively competent peat soils, or shallow peat over mineral soils.	• Minimizes impacts on wetland/waterbody complex soils and vegetation • No specialized equipment needed and allows for construction in unfrozen, saturated wetland/waterbody complexes • Reduced heavy equipment traffic	• Potential for stranding of the excavator if extremely loose, deep peat soils are encountered unexpectedly • Additional workspace required for pipe assembly or pipe may be fabricated off-site and brought in as a drag section • Due to lack of travel lane, additional adjacent workspace required for equipment turnarounds • May require spread move around
Push-Pull Method: Swamphoe (Spring-Fall)	Excavate the trench using a backhoe (or equivalent) mounted on tracked pontoons operating along the trenchline (refer to Figures 35 and 36 of the EPP). Push-pull or float and sink the pre-assembled pipe then backfill.	Suitable in inundated (typically > 12-inch inundation) wetland/waterbody complexes with loose, deep peat soils or floating mat peat, low-bearing strength soils.	• Allows for construction in saturated wetlands during unfrozen conditions • Reduced heavy equipment traffic	• Specialized equipment (i.e., swamphoe) required • Additional adjacent workspace required for pipe assembly or pipe may be fabricated off-site and brought in as a drag section • Additional adjacent workspace may be required for equipment turnarounds • Slower than normal construction progress in the wetland/ waterbody complex due to equipment speed • May require spread move around

Method	Description	Applicability	Advantages	Disadvantages
Trench: Dry Crossing (Isolated): Dam and Pump	Create a dry work area by damming the flow up- and downstream of the crossing and pumping water around. Dam materials may include but are not limited to: sand bags, aqua dams, sheet piling, or street plates (refer to Figure 23 of the EPP).	Suitable for streams with low flow and defined banks where fish passage is not of concern. Works best in non-permeable substrate and preferred for crossing meandering channels.	• Maintains streamflow • Minimal release and transport of sediment downstream that is not likely to result in effects on aquatic habitat • Relatively dry working conditions • May reduce trench sloughing and trench width	• Minor sediment release during dam construction, dam removal and as water flushes over area of construction • Fish salvage may be required from dried up reach within the workspace • Short-term barrier to fish movement • Specialized equipment and materials required • Seepage may occur in coarse, permeable substrate
Trench: Dry Crossing (Isolated): Flume	Create a dry work area by damming the flow up- and downstream of the crossing and installing flume to convey water. Dam materials may include but are not limited to: sand bags, aqua dams, sheet piling, or street plates (refer to Figure 24 from the EPP).	Suitable for crossing relatively narrow streams that have straight channels and are relatively free of large rocks and bedrock at the point of crossing where fish passage is of concern. The waterbody should have defined banks and channel with solid, fine-textured substrate.	• Maintains streamflow • May allow fish passage • Minimal release and transport of sediment downstream that is not likely to result in negative effects on aquatic habitat • Relatively dry or no flow working conditions • May reduce trench sloughing and trench width	• Minor sediment release during dam construction, removal and as water flushes over area of construction • Fish salvage may be required from dried up reach within the construction workspace • Short-term barrier fish passage if water velocity in culvert is too high • Difficult to trench and lay pipe, especially large diameter pipe, under flume pipe • Work area may not stay dry in coarse, permeable substrate • Seepage may occur in coarse, permeable substrate
Trench: Modified Dry Crossing (Isolated): Dam and Pump	Dam the flow up- and downstream of the crossing and pumping water around; however, water is not pumped from the trench area. Dam materials may include but are not limited to: sand bags, aqua dams, sheet piling, or street plates. Buoyancy control used to sink the pipe.	Suitable for streams with stable banks where fish passage is not of concern and conditions are too saturated to effectively dewater from the construction workspace.	• Maintains streamflow • Minimal release and transport of sediment downstream that is not likely to result in effects on aquatic habitat • May reduce trench sloughing and trench width	• Minor sediment release during dam construction, dam removal and as water flushes over area of construction • Short-term barrier to fish movement • Specialized equipment and materials required

Method	Description	Applicability	Advantages	Disadvantages
Trenchless: Bore (Non-Pressurized)	Bore under watercourse from bore pit on one side to bore pit on the other side with or without casing (see Figures 40 and 41 of the EPP). Non-pressurized water or bentonite may be introduced if soil conditions dictate; any release will travel back along the path of the pipe and into the bore pit.	Suitable for fine-textured impermeable soils and deep water table. Used most commonly for highway, road, and railroad crossings and can include adjacent ditches. Requires a slightly incised watercourse with approach slopes that are absent or slight.	• Avoids surface ground disturbance in the waterbody or ditch adjacent to the feature crossed. • No sediment release • No potential for inadvertent release outside of the bore pits • No disturbance of streambed or banks • Maintains normal streamflow • Maintains fish passage	• Requires additional workspace for bore pits, spoil piles, and sump(s) • Large excavations required both sides of the crossing • Deep bore pits may require sump pump or well point dewatering system and/or sheet-piling • Slower than trench crossing techniques
Trenchless: HDD (Pressurized)	Place a rig on one side of the waterbody and drill a small-diameter pilot hole under the feature along a prescribed profile (see Figure 26 of the EPP). Upon completion of the pilot hole, the use a combination of cutting and reaming tools to accommodate the desired pipeline diameter. Drilling mud is necessary to remove cuttings and maintain the integrity of the hole. Once the hole is reamed to the appropriate size, the welded pipe section is then pulsed back through the hole.	Suitable to cross sensitive or particularly deep, wide, or high-flow waterbodies depending on site-specific topography and the local geologic substrate. Feasibility limitations in areas of glacial till or outwash interspersed with boulder and cobbles, fractured bedrock, or non-cohesive coarse sands and gravels. Geotechnical borings and hydrofracture risk analysis are performed to determine HDD feasibility and potential for inadvertent returns.	• No sediment release unless an inadvertent return occurs • Avoids surface disturbance of the riparian area and stream bed and banks • Limits vegetation disturbance to within the permanently maintained easement • Maintains normal streamflow • Maintains fish passage • May enable construction during restricted activity windows for sensitive fisheries with agency approval • Significantly reduces clean-up and restoration between entry and exit points	• Potential for inadvertent release of drilling fluids (refer to Section 11.0 of the EPP) • Requires ATWS on both sides of the crossings to stage construction, fabricate the pipeline, and store materials • Tree and brush clearing is necessary for operations • Requires obtaining water to formulate the drilling fluid, buoyancy control, as well as hydrostatic testing • Feasibility and success depends on substrate • Requires specialized equipment (limited availability) • Pull string area along the alignment for the same length of the crossing to allow continuous pullback • Requires a straight alignment for the length of the HDD • May require several weeks to complete the HDD
Sources: Canadian Association of Petroleum Producers, Canadian Energy Pipeline Association, and Canadian Gas Association, 2005. Canadian Energy Pipeline Association, Canadian Association of Petroleum Producers, Canadian Gas Association, 2018.				

4.1 TRENCH: OPEN CUT (NON-ISOLATED) METHOD

The open cut (non-isolated) crossing method involves digging a trench through the waterbody, placing the pipe in the trench, backfilling the trench, and restoring the contours of the stream bed and banks to pre-construction conditions. Enbridge will further reduce the workspace by 25 feet starting 20 feet from the OHWM at waterbody crossings (95-foot-wide corridor) (refer to Figure 22 of the EPP). In order to excavate a trench and install the pipe across the waterbody, vegetation will need to be cleared from the top of the stream bank to the water's edge within the 95-foot-wide construction workspace. Following restoration, Enbridge will maintain a 10-foot-wide corridor centered on the pipeline free of woody shrubs, and a 30-foot-wide corridor free of trees within the riparian area of the waterbody crossing to maintain the integrity of the pipeline (see Figure 4.1-1).

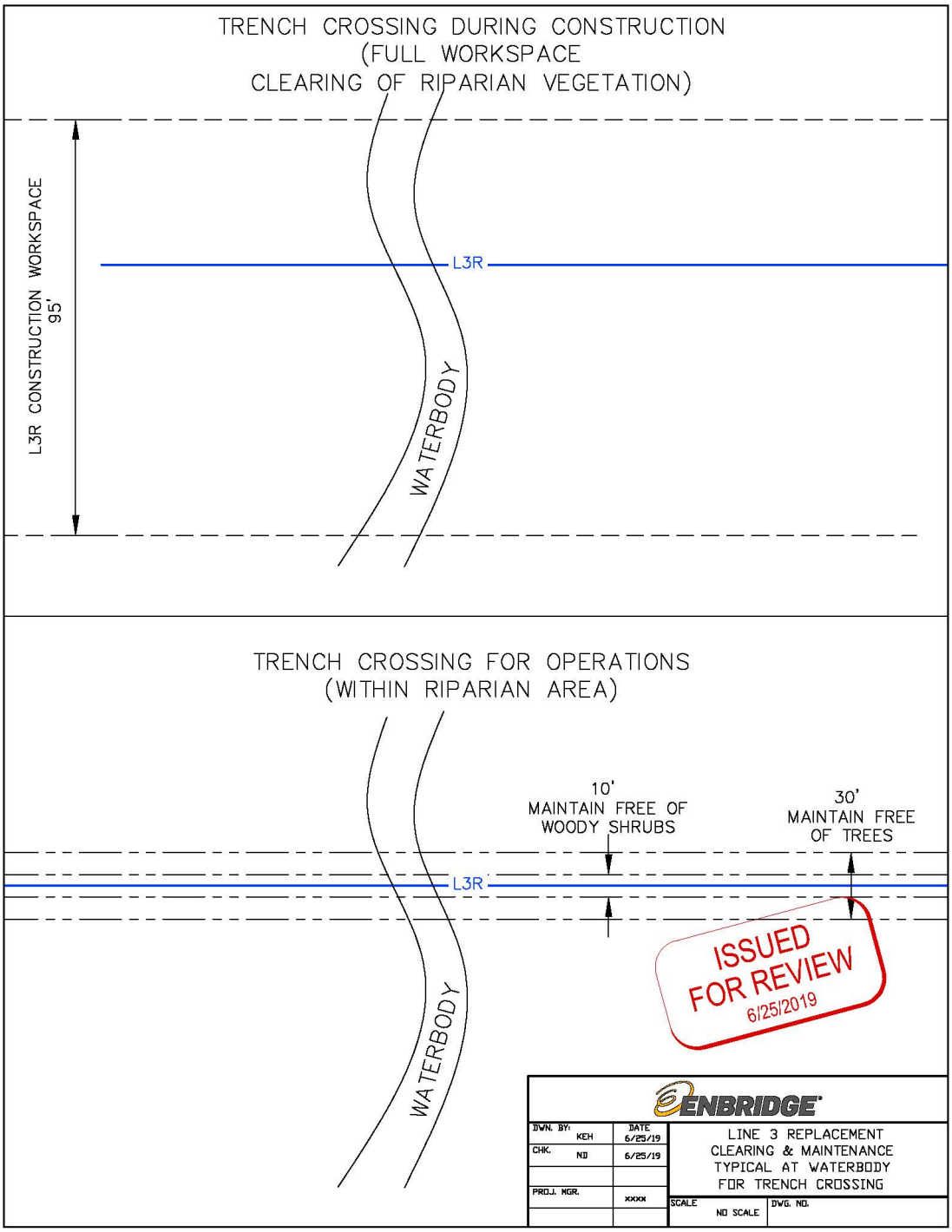
The trench line excavation requires an average of 20 feet depending on topography and soil conditions. An approximate 18-foot-wide temporary bridge will be installed at most waterbodies where equipment may operate during the trenching process. The trench will be excavated to a minimum depth of 7 feet to allow for four feet depth of cover. Because streambed material and subsoil (i.e., "spoil") are not stored within the waterbody itself, this spoil must be stored on either or both sides of the waterbody. This means that typically, Enbridge will only occupy 40 to 50 feet of the construction workspace over the waterbody itself, of which the only activity occurring in the stream bed will be the excavation of the approximate 20-foot-wide trench by equipment operating from the bank(s) or temporary bridge. Depending on the terrain, length of the crossing, and conditions at the crossing, ATWS may be required on one or both sides of the waterbody to store additional spoil material, string the pipe, and stage and prepare crossing equipment and materials. ATWS ranges from 50 x 150 feet, 75 x 100 feet, and 75 x 150 feet. ATWS will typically be located in uplands adjacent to the construction workspace and set back at least 50 feet from sensitive resource boundaries where site-specific field conditions allow. However, to complete work safely, Enbridge may need to locate ATWS within a wetland or within the 50-foot setback from a wetland or waterbody based on site-specific conditions.

Open cut crossings are typically completed within 24 to 48 hours depending on the size of the watercourse as described in Section 2.1 of the EPP. Open cut crossing methods typically involve trenching through the waterbody while it is dry or frozen to the bottom (no perceptible flow) and direct excavation of the trench through the banks and bed of the watercourse can proceed similar to upland construction techniques. Construction while the waterbody is dry or frozen avoids the potential for sediment release during in-channel work.

Crossing of waterbodies when they are dry or frozen and not flowing may proceed using the open cut trench crossing technique in accordance with the EPP, provided that the EI verifies that water is unlikely to flow between initial disturbance and final stabilization of the feature. This applies to features that an agency has identified as waterbodies, but that field delineations determined were wetlands based on conditions at the time of survey. If unanticipated flow conditions develop during construction of a given waterbody, Enbridge's EIs will be notified immediately to determine the extent of the flow and will install additional erosion and sediment control BMPs as necessary. If flows are significant, and sedimentation is likely to occur, work will be stopped, or Enbridge will switch to a dry crossing technique with agency approval.

There are additional locations where, due to surrounding saturated wetlands, it is not feasible to isolate the waterbody flow and an open cut trench crossing may be proposed. The push-pull method can sometimes be implemented at these locations (refer to Section 3.4). However, if there is no manner to isolate the feature and/or manage water, a standard open cut through the flowing waterbody may be the only feasible method for pipe installation.

Figure 4.1-1: Vegetation Clearing during Construction and Operations at Trench Crossings of Waterbodies



4.2 TRENCH: PUSH-PULL METHOD

Refer to Section 3.4 for a full description of this method.

4.3 TRENCH: DRY (ISOLATED) METHODS

Dry crossing (isolated) methods also involve digging a trench through the waterbody, placing the pipe in the trench, backfilling the trench, and restoring the contours of the stream bed and banks to pre-construction conditions, while the stream is diverted around the work area. Dry (isolated) crossings use either the dam and pump or flume technique. Both methods dam the stream both upstream and downstream of the crossing. The water is then routed around the dry work area either by pumping water through hoses or through a flume pipe(s). As described in Section 2.5.2 of the EPP, dams may consist of sand bags, inflatable dams, aqua-dams, sheet piling, and/or steel plates. The trench is then excavated in the dry work area to install the pipe. The construction work area will also be dewatered and discharged into well-vegetated area on an adjacent stream bank as described in Section 5.1 of the EPP. Dry crossings are typically completed within 24 to 48 hours depending on the size of the watercourse as described in Section 2.1 of the EPP.

As with the open cut crossing method, Enbridge will further reduce the workspace by 25 feet starting 20 feet from the OHWM at waterbody crossings (95-foot-wide corridor) (refer to Section 2.2, and Figures 23 and 24 of the EPP). In order to excavate a trench and install the pipe across the waterbody, vegetation will need to be cleared from the top of the stream bank to the water's edge within the 95-foot-wide construction workspace. Following restoration, Enbridge will maintain a 10-foot-wide corridor centered on the pipeline free of woody shrubs, and a 30-foot-wide corridor free of trees within the riparian area of the waterbody crossing to maintain the integrity of the pipeline (see Figure 4.1-1).

The typical workspace configuration required for a dry crossing is similar to the discussed open cut (non-isolated) crossing; however, the full 95-foot-wide workspace within the stream will be utilized to install the upstream and downstream dams. The adjacent construction workspace outside of the waterbody and/or ATWS will be used to stage the pumps, dam materials, and for spoil storage.

In locations where the stream banks are stable, but conditions are too saturated to effectively dewater from the construction workspace, Enbridge will conduct a modified dam and pump method. The only difference from the standard dam and pump method and this modified technique is that Enbridge will not dewater the trench and will utilize buoyancy control methods (see Section 3.7.3 of the EPP) as appropriate to sink the pipe to the bottom of the trench.

The dry crossing technique can also be implemented in frozen conditions if there is perceptible flow. Winter construction procedures for dry crossing techniques are described in Enbridge's Winter Construction Plan.

Enbridge will consider switching to an open cut crossing technique at a waterbody previously identified as a dry crossing if:

- the waterbody is dry or frozen at the time of crossing as described in Section 4.1; or
- when there are water management concerns based on field conditions at the time of the crossing, such as downstream obstructions that cause ponding, or a high water table.

In either case, Enbridge will seek agency concurrence on any changes to crossing methods prior to initiating the crossing.

4.4 TRENCHLESS: BORE (NON-PRESSURIZED)

Refer to Section 3.5 for a discussion of this method.

4.5 TRENCHLESS: HORIZONTAL DIRECTIONAL DRILL METHOD (PRESSURIZED)

Refer to Section 3.6 for a full description of this method. In order to monitor for inadvertent drilling fluid release, and to allow access to the waterbody for water appropriation, riparian vegetation will need to be cleared within a 30-foot-wide corridor along the drill path. Following restoration, Enbridge will maintain the 30-foot-wide corridor centered on the pipeline free of woody vegetation to maintain the integrity of the pipeline and to facilitate aerial inspection (see Figure 4.5-1).

The containment and recovery methods of an inadvertent release in a waterbody differ from a release in a wetland and are described in Section 11.0 of the EPP.

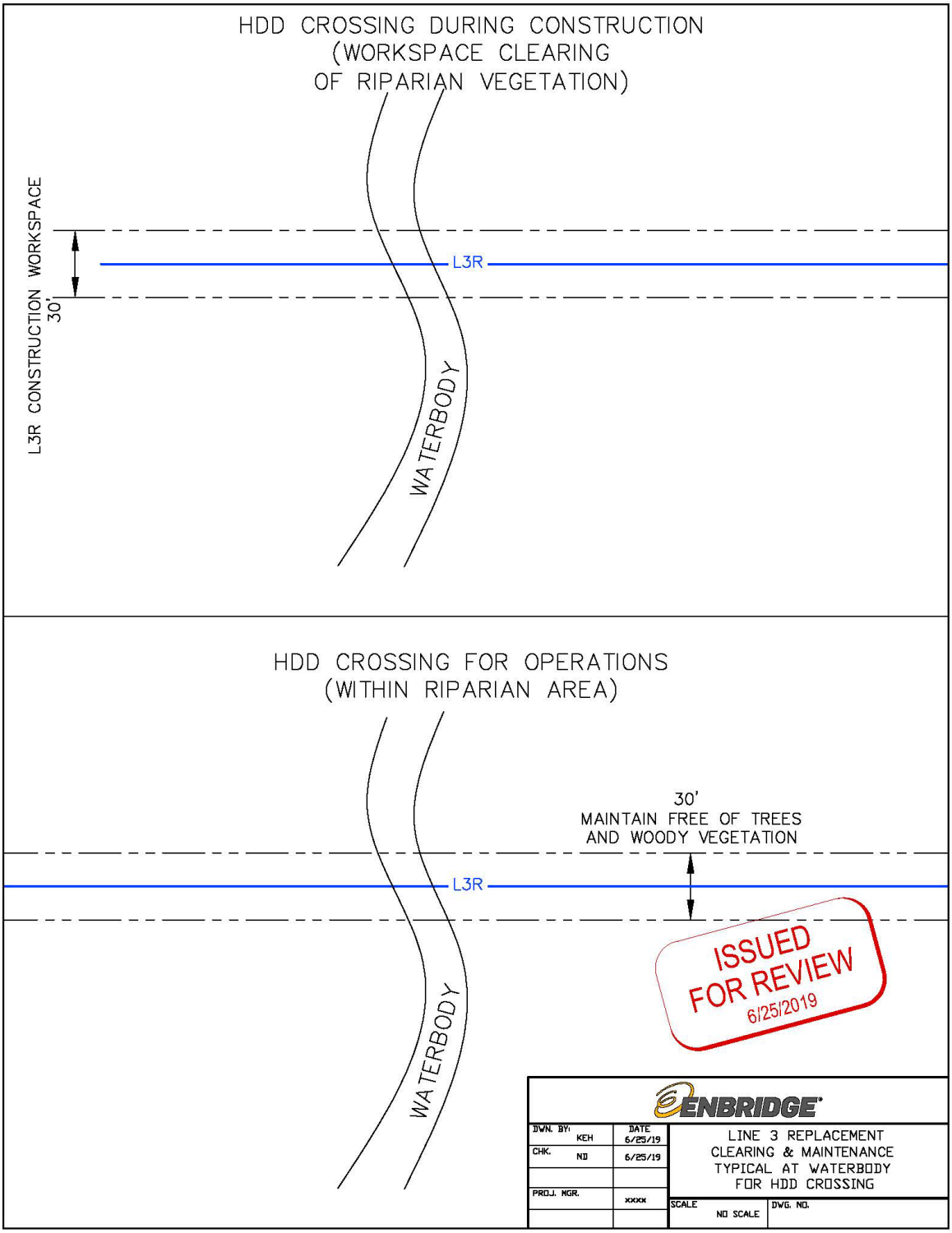
4.6 UNFORESEEN CONDITIONS

Enbridge may need to implement alternative crossing methods or locations due to the following situations, including but not specifically limited to:

- Significant fluctuation in water level (i.e., up or down) at the time of installation and/or significant changes to soil conditions at the time of installation (e.g., trench wall stability);
- Change in time of year of construction due to the timing of permit issuance (i.e., timing restrictions);
- Weather conditions at the time of installation; and
- Failure of HDD method.

Enbridge identifies a primary and alternative crossing method for waterbody crossings (see Section 3.6). In the case of an unforeseen condition that makes the primary crossing method not practicable, Enbridge will proceed with the alternative crossing method with agency approval.

Figure 4.5-1: Vegetation Clearing during Construction and Operations at Horizontal Directional Drill Crossings of Waterbodies



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Appendix B

Invasive and Noxious Species Management Plan





Invasive and Noxious Species Management Plan

Enbridge Energy, Limited Partnership • Line 3 Replacement Project

October 2020

ENBRIDGE®

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

BMPs	best management practices
CLL	construction line list
Enbridge	Enbridge Energy, Limited Partnership
EPP	Environmental Protection Plan
FDL	Fond du Lac Band of Lake Superior Chippewa
HDD	horizontal directional drill
INS	invasive and noxious species
L3R or Project	Line 3 Replacement Project
MDA	Minnesota Department of Agriculture
MDNR	Minnesota Department of Natural Resources
NDDA	North Dakota Department of Agriculture
PCMP	Post-Construction Wetland and Waterbody Monitoring Plan
Plan	Invasive and Noxious Species Management Plan
USDA	U.S. Department of Agriculture
VMP	Post-Construction Vegetation Management Plan for Public Lands and Waters

1.0 INTRODUCTION

Enbridge Energy, Limited Partnership ("Enbridge") is committed to minimizing the spread of invasive and noxious species ("INS") as defined by law or regulation, including invasive and noxious terrestrial plants, invasive aquatic species, and tree pests, along the construction right-of-way and associated access roads and haul routes where improvements are needed due to construction of the Line 3 Replacement Project ("L3R" or "Project"). The L3R route extends approximately 330 miles across the state of Minnesota, and an additional 12 miles in North Dakota. As proposed, of the majority of the route is co-located with Enbridge's existing mainline system, foreign utilities, or transportation corridors (e.g., road, railroad).

1.1 PURPOSE OF THE PLAN

The goal of this Invasive and Noxious Species Management Plan ("Plan") is to outline the INS management strategies that will be used to minimize the spread of INS identified within the Project construction workspace,[1] access roads, and improved haul routes in compliance with law or regulation. Management strategies will be implemented where applicable and appropriate prior to construction, and during Project construction, restoration, and post-construction monitoring phases. Existing INS occurrences will be documented throughout the construction workspace, access roads, and improved haul routes, through pre-construction surveys, publicly available datasets, or monitoring.

Management strategies for INS on the Project are outlined below by INS group: terrestrial plant species, aquatic species, and tree pests (including oak wilt).

2.0 TERRESTRIAL PLANT INVASIVE AND NOXIOUS SPECIES

This Plan defines terrestrial plant INS as any species that is listed by the U.S. Department of Agriculture ("USDA") as Noxious; or Minnesota Department of Agriculture ("MDA") as Prohibited Noxious Weeds; or North Dakota Department of Agriculture ("NDDA") and/or Pembina County, North Dakota as Noxious; or species otherwise determined to be invasive by the Minnesota Department of Natural Resources ("MDNR") on MDNR-Administered Lands or Fond du Lac Band of Lake Superior Chippewa ("FDL") within the exterior boundaries of the FDL Reservation.

2.1 MINNESOTA REGULATIONS

In Minnesota, the management objectives for INS within the Project area are to minimize the spread of documented occurrences of terrestrial plant INS that are: 1) listed as Noxious by the

[1] The terms "construction right-of-way," "temporary construction right-of-way," "construction workspace," and "temporary construction workspace" define the primary mainline workspace area required for installation of L3R. For clarity, Enbridge will generically use "construction workspace" instead of "temporary construction right-of-way," temporary construction workspace," or "construction right-of-way" as the terminology for 1) the permanent right-of-way; and 2) the temporary construction area (which includes the following defined terms: Temporary Workspace and Additional Temporary Workspace). Additional Temporary Workspace is temporary construction workspace needed when encountering environmental features that require special construction methods. All construction equipment and vehicles will be confined to this approved construction workspace.

USDA; or 2) listed as "eradicate"[2] or "control"[3] (see Table 2.1-1) under the "Prohibited Noxious Weed" category by the MDA.

Table 2.1-1
Minnesota Department of Agriculture Prohibited Noxious Weeds

Eradicate List		Control List	
Species	**Common Name**	**Species**	**Common Name**
Ailanthus altissima	Tree of Heaven	*Berberis vulgaris*	Common Barberry
Amaranthus palmeri	Palmer Amaranth	*Cardamine impatiens*	Narrowleaf Bittercress
Celastrus orbiculatus	Oriental Bittersweet	*Carduus acanthoides* [a]	Plumeless Thistle
Centaurea diffusa	Diffuse Knapweed	*Centaurea stoebe* [a]	Spotted Knapweed
Centaurea jacea [a]	Brown Knapweed	*Cirsium arvense* [a]	Canada Thistle
Centaurea solstitialis	Yellow Starthistle	*Euphorbia esula* [a]	Leafy Spurge
Centaurea x moncktonii	Meadow Knapweed	*Lythrum salicaria* [a]	Purple Loosestrife
Conium maculatum	Poison Hemlock	*Pastinaca sativa* [a]	Wild Parsnip
Cynanchum louiseae	Black Swallow-wort	*Polygonum cuspidatum*	Japanese knotweed
Digitalis lanata	Grecian Foxglove	*Polygonum sachalinese*	Giant knotweed
Dipsacus fullonum	Common Teasel	*Polygonum x bohemicum*	Bohemian knotweed
Dipsacus laciniatus	Cutleaf Teasel	*Tanacetum vulgare* [a]	Common Tansy
Heracleum mantegazzianum [b]	Giant Hogweed		
Hieracium aurantiacum[c]	Orange Hawkweed		
Hieracium caespitosum[c]	Yellow Hawkweed		
Humulus japonicus	Japanese Hops		
Linaria dalmatica	Dalmatian Toadflax		
Lonicera japonica	Japanese honeysuckle		

Notes:
Source: MDA, 2020.
[a] Indicates species that have been documented in the Project area based on pre-construction surveys.
[b] This species is also listed as noxious by the USDA.
[c] Clearwater County Approved Noxious Weed - MDA Prohibited in Clearwater County Only.

On public lands,[4] the INS management objectives are to minimize the spread of documented occurrences of terrestrial plant INS that are: 1) listed as Noxious by the USDA; 2) listed as "Prohibited Noxious Weeds," "Restricted Noxious Weeds," or "Specially Regulated Plants" by the MDA; or 3) listed as invasive by MDNR Operational Order 113 . In addition, Enbridge will adhere to the requirements set forth by the MDNR licenses and lease agreements.

On the FDL Reservation, the INS management objectives are to minimize the spread of documented occurrences of INS that are: 1) listed as Noxious by the USDA; 2) listed as

[2] Prohibited noxious weeds placed on the noxious weed eradicate list are plants that are not currently known to be present in Minnesota or are not widely established. These species must be eradicated (Minnesota Statute §18.771 (b)(1)).

[3] Prohibited noxious weeds placed on the noxious weed control list are plants that are already established throughout Minnesota or regions of the state. Species on this list must be controlled (Minnesota Statute §18.771 (b)(1)).

[4] All tracts or lots of real property belonging to the state and under the control and supervision of the commissioner of natural resources.

"Prohibited Noxious Weeds," "Restricted Noxious Weeds," or "Specially Regulated Plants" by the MDA; 3) listed as invasive by MDNR Operational Order 113; or 4) listed as invasive by the Minnesota Invasive Species Advisory Council or the Minnesota Invasive Terrestrial Plants and Pests Center as requested by the FDL. Enbridge will coordinate with the FDL regarding ongoing terrestrial plant INS prevention and control efforts per the requirements of FDL permits.

2.2 NORTH DAKOTA REGULATIONS

In North Dakota, the INS management objectives are to minimize the spread of documented occurrences of terrestrial plant INS that are: 1) listed as Noxious by the USDA; or 2) listed as noxious (see Table 2.2-1) by the NDDA or Pembina County, North Dakota (NDDA, 2017; NDDA, 2020).

Table 2.2-1
North Dakota Department of Agriculture and Pembina County, North Dakota Noxious Weeds

Species	Common Name
Amaranthus palmeri	Palmer Amaranth
Artemisia absinthium [a]	Absinth Wormwood
Bassia scoparia [a]	Kochia
Carduus nutans [a]	Musk Thistle
Centaurea diffusa	Diffuse Knapweed
Centaurea repens	Russian Knapweed
Centaurea maculosa [a]	Spotted Knapweed
Cirsium arvense [a]	Canada Thistle
Cynoglossum officinale	Houndstongue
Euphorbia esula [a]	Leafy spurge
Linaria dalmatica	Dalmatian Toadflax
Linaria vulgaris [a]	Yellow Toadflax
Lythrum salicaria [a]	Purple Loosestrife
Tamarisk spp.	Saltcedar
Tanacetum vulgare [a]	Common Tansy

Notes:
Source: NDDA, 2017; NDDA, 2020.
[a] Indicates species that have been documented in the Project area based on pre-construction surveys.

2.3 TERRESTRIAL PLANT INVASIVE AND NOXIOUS SPECIES SURVEYS

Enbridge conducted terrestrial INS plant surveys between 2015 to 2020 along a 50-foot-wide buffer on the construction workspace, and 30-foot-wide buffer on access roads and improved haul routes focused on MDNR-administered tracts and lands within the exterior boundaries of the FDL Reservation. Surveys have been completed on 100 percent of MDNR-administered lands and 80 percent of the entire Project construction workspace, access roads, and improved haul routes.

Enbridge survey crews identified 46 terrestrial plant INS and mapped their locations (Attachment A). No USDA Noxious Weeds were observed. Brown knapweed (*Centaurea jacea*), a species that must be eradicated in Minnesota, was observed at three locations. The most commonly observed INS was Canada thistle (*Cirsium arvense*), a Prohibited Noxious Weed in Minnesota and North Dakota that must be controlled by all landowners. Tables 2.2-1 and 2.2-2 note MDA and NDDA species identified during surveys.

2.4 STANDARD BEST MANAGEMENT PRACTICES

Enbridge has committed to several Best Management Practices ("BMPs") described in the Environmental Protection Plan ("EPP") that will limit the amount of disturbance associated with construction activities and assist with managing terrestrial INS infestations. These BMPs include:

- Reducing the width of the construction workspace in wetlands and near waterbodies as described in Appendix A of the EPP;
- Limiting grading and topsoil segregation to trench-line-only in wetlands and forested vegetation communities as described in Section 1.10.1 of the EPP;
- Installing construction mats for travel lanes in wetlands and other specific locations as described in Appendix A of the EPP, and Section 3.1 of the EPP;
- Utilizing certified weed-free mulch as described in Section 1.9.2 of the EPP;
- Removing accumulated sediment from silt fence when depth reaches one-third of height as described in Section 1.9 of the EPP;
- Stabilization[5] of all exposed areas, including spoil piles, must be initiated immediately[6] to limit soil erosion when construction activity has permanently or temporarily ceased on any portion of the site and will not resume for a period exceeding 14 calendar days. Stabilization must be completed no later than 14 calendar days after the construction activity has ceased as described in Section 1.9.1 of the EPP;
- In areas within 1 mile of, and draining to, a special or impaired water (refer to Section 2.2.2 of the EPP), stabilization measures will be initiated immediately and completed within 7 calendar days whenever construction activity has permanently or temporarily ceased on any portion of the site as described in Section 1.9.1 of the EPP;
- On portions of the Project where work will be occurring during applicable "work in water restrictions" for Public Waters (refer to Section 2.1 of the EPP), all exposed soil areas within 200 feet of the water's edge, and that drain to that water, will be stabilized within 24 hours during the restriction period as described in Section 1.9.1 of the EPP;
- Utilizing Minnesota Board of Water & Soil Resources native seed mixes and adapted restoration guidelines as described in Section 7.0 and Appendix C of the EPP;
- Decompacting subsoil as described in Sections 1.18 and 7.1 of the EPP; and

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[5] Stabilization means that the exposed ground surface has been covered by appropriate materials such as mulch, staked sod, riprap, erosion control blanket, mats or other material that prevents erosion from occurring. Grass seeding, agricultural crop seeding or other seeding alone is not stabilization. Mulch materials must achieve approximately 90 percent ground coverage (Minnesota Rules 7090).

[6] Initiated immediately means taking an action to commence soil stabilization as soon as practicable, but no later than the end of the work day, following the day when the land-disturbing activities temporarily or permanently cease (Minnesota Rules 7090).

- Utilizing seed mixes labelled “Noxious Weeds: None Found” as required by regulations and will utilize yellow tag seed when available (Section 7.2 of the EPP).

Construction activities in agricultural lands will proceed as described in the Agricultural Protection Plan.

Enbridge has also prepared a Post-Construction Wetland and Waterbody Monitoring Plan (“PCMP”) that includes monitoring and performance standards for INS within these features. Similar monitoring and performance standards for public lands are included in the Post-Construction Vegetation Management Plan for Public Lands and Waters (“VMP”) (see Section 2.6).

2.5 OVERVIEW OF ACTIVE MANAGEMENT STRATEGIES FOR TERRESTRIAL PLANT INVASIVE AND NOXIOUS SPECIES

Enbridge will implement active management strategies and BMPs during one or more of the following phases as appropriate:

- Prior to clearing: Where practicable and feasible, Enbridge will implement BMPs prior to initiating clearing of the construction workspace. However, the ability to implement BMPs is dependent upon the timing of the receipt of required permits and authorizations, landowner or land-managing agency permissions, seasonality, INS ecology (e.g., maturity of plant, aggressiveness), and the proposed treatment method, effectiveness, and frequency of application.

- During clearing or other construction activities: Should the implementation of certain BMPs not be feasible prior to clearing (e.g., herbicide treatment), alternative BMPs (e.g., cleaning stations) may be implemented during clearing or other construction activities to minimize the spread of INS.

- Restoration: Once construction activities are complete, and final grading and permanent seeding is complete as described in Sections 2.6, 3.9, and 7.0 of the EPP, Enbridge will continue to monitor and manage terrestrial INS until the revegetation performance standards have been met (refer to Section 2.6).

- Post-Construction Monitoring: Enbridge will perform post-construction monitoring at wetlands and waterbodies as described in Enbridge’s PCMP, the Gully 30 Fen Management Plan, and in uplands on public lands as described in the VMP. Enbridge will manage INS until the performance standards described in the PCMP and VMP have been met.

As described in Sections 1.4 and 1.5 of the EPP, construction, restoration, and post-construction monitoring activities are restricted to the construction workspace and designated access roads and haul routes. Once restoration and/or post-construction monitoring activities are complete, terrestrial INS will be managed by Enbridge Operations within the 50-foot-wide permanent right-of-way easement.

The following sections provide a general overview of the active management strategies that will be implemented on the Project to minimize the spread of documented occurrences of terrestrial plant INS. Enbridge has prepared INS Implementation Plans that provide additional execution

detail, including the procedures to be implemented based on results of INS surveys and applicable laws and regulations for the lands crossed by the Project as follows:

- INS Implementation Plan for Private and County Lands (Attachment B); and
- INS Implementation Plan for Public Lands (Attachment C).

Enbridge will work directly with the FDL Resource Management Department for lands within the external boundaries of the FDL Reservation.

2.5.1 Personnel Training

Enbridge will provide terrestrial plant INS awareness training that:

- Ensures that personnel conducting monitoring and terrestrial plant INS treatments are qualified to distinguish between INS and commonly mistaken native species. This may include, for example, documentation of personnel experience with control of the target INS and their INS control work in similar environments with sensitive resources.

- Require personnel that will work within the construction workspace, access roads, and improved haul routes to view the MDNR land-based prevention staff training video "Cleaning to Avoid Spreading Terrestrial Invasive Species."

- Require personnel that will work within the construction workspace, access roads and improved haul routes to review the Minnesota Department of Transportation "Minnesota Noxious Weeds" guide (Attachment D), or excerpts of this guide that highlight known INS in the Project area.

2.5.2 Pre-Treatment

Pre-treatment will be prioritized for INS listed by the MDA as Prohibited Noxious Weeds that must be eradicated or controlled in Minnesota (Table 2.1-1). Where possible, Enbridge will pre-treat known locations of terrestrial plant INS by spot mowing, mechanical removal (e.g., hand-pulling, digging), spot herbicide application, prescribed burning, spot propane weed torching, or an integrated management approach that combines one or more of these techniques prior to clearing. Any of these methods or combination thereof may also be used during construction, restoration, and/or post-construction monitoring as needed. The pre-treatment objective will be to reduce the observable aboveground vegetative growth and seed production by INS at known locations and reduce the likelihood that plants, seeds (observable on aboveground seed heads), and propagules are viable when clearing and ground-disturbing activities begin. Where possible, Enbridge will attempt to minimize the spread of INS by first managing the outlying populations, and then working toward the center of an infestation. The chosen method(s) will be species-specific and will consider the timing of implementation, quality of the surrounding vegetation, proximity to water resources, and other considerations as noted below. Pre-treatment will commence when all necessary permits and authorizations, and the necessary landowner or land-managing agency permissions are in place and will continue until the start of clearing or other construction activities.

A treatment method or combination of methods will be selected based on several considerations, including MDA status (i.e., eradicate or control) and/or land-managing agency specifications, biological characteristics, and season, and will be based on consultation with the appropriate state

and local agencies. Specific site factors such as topography, soil types and condition, water table level, open bodies of water, domestic water wells, and precipitation rates must also be taken into consideration when deciding the appropriate treatment option for a site. Additional important ecological and local land use factors that will be considered in designing and implementing treatment methods will include:

- Aquatic or wetland environments;
- Presence of federal or state-listed species or species of concern;
- Desirable existing vegetation community;
- Areas used for wildlife habitat or grazing;
- Recreation areas (e.g., campsite or picnic areas); and
- Residences.

Pre-treatment strategies and methods, while taking into account all of the considerations noted above, are generally prescribed in the INS Implementation Plans in Attachments B and C. The INS Implementation Plans also prioritize infestations and includes a decision-making process for personnel conducting treatments to prescribe the most effective and efficient methods for adapting to site-specific and species-specific circumstances and responses.

Pesticide Use and Application

Enbridge will only utilize those pesticides (including herbicides) and methods of application approved by the MDA, MDNR, and the U.S. Environmental Protection Agency in the state of Minnesota. For proposed use of herbicides on MDNR-administered lands, a proposed Pre-Treatment Plan is in included in the INS Implementation Plan for Public Lands (Attachment C), subject to approval by the appropriate MDNR land-managing division and INS staff prior to implementation. Selective foliage or basal application will be used when practicable. All pesticides will be applied in a safe and cautious manner so as not to damage adjacent properties including crops, orchards, tree farms, apiaries, or gardens, and sensitive environmental resources. Enbridge will obtain necessary permits and/or certifications for the use of the applicable herbicides, will be responsible to limit off-right-of-way overspray, and will comply with state laws regarding the use of those herbicides. Pesticide application will be completed by knowledgeable and licensed personnel.

Enbridge will contact the landowner or designee to obtain approval for the use of pesticide (including herbicides) at least 14 days prior to any application on their property. A minimum of 14 days prior to the proposed application of herbicide, the Enbridge right of way agent assigned to affected tracts will provide a map of the proposed herbicide treatment location on the property in question and describe the type(s) of pesticides proposed for use and approximate application timeframe. The landowner may request that there be no application of pesticides on any part of the site within the landowner's property. A contact note showing that contact was made, whether the landowner has approved or denied herbicide application, and any application specifications or concerns that arose will be tracked in Enbridge’s database system and will be identified in the construction line list (“CLL”). If a landowner does not respond within the required timeframe, it will be recorded as “herbicide application prohibited” on the CLL. Enbridge will provide notice of pesticide application to affected landowners and known beekeepers operating apiaries within 3 miles of the site at least 14 days prior to such application. This notification will be recorded in Enbridge’s database system. If the landowner or land-managing agency does not approve the use of pesticides, an alternative treatment method will be selected. Enbridge will keep proper documentation of the locations where pesticides have been used.

The following best management practices will be considered for herbicide use:

- Integrate biological controls instead of, or to complement, herbicide use, if available;
- Select spot treatments over broadcast applications when practicable to minimize potential impacts on pollinators and associated nectar or host plants;
- Products should be selected to be the most target-specific and applied on the smallest area practical to meet management objectives;
- The type of herbicide and treatment method will be selected to minimize impacts to wildlife (e.g., spot treatment, herbicides appropriate for application near aquatic resources); and
- Follow herbicide label instructions and industry standard practices to minimize non-target damage.

Cut stump or basal treatments may be used within the 75-foot vegetative buffer zone of aquatic resources. If herbicide treatment is necessary near rare species or rare natural communities or in or near aquatic resources, the herbicide must be designed for such use as designated by manufacturer's specifications and federal and state regulations. Additional restrictions will be followed for INS control as required by federal, Tribal, and state permits or other environmental plans.

If herbicide treatment is limited due to landowner restrictions, or proximity to sensitive resources, an alternative treatment method may be selected.

2.5.3 Alternative Best Management Practices

In areas where pre-treatment cannot be implemented prior to clearing, a combination of the following BMPs may be implemented, where appropriate and as determined prior to construction.

Topsoil Segregation

Enbridge may implement topsoil segregation of the infested area to minimize the spread of INS and to allow equipment to work through the area after topsoil has been stripped, as long as equipment stays on the subsoil (clearing, grading, and restoration equipment will still be cleaned as described in the "Cleaning Stations" section or other BMPs will be implemented as appropriate).

Stored topsoil in heavily infested areas will be covered or sprayed with tackifier or mulch to reduce the viability of INS seeds and rootstock prior to the restoration phase and prevent transport by wind. Weed-infested stockpiles will be marked with clearly visible signage until the restoration phase. During restoration, Enbridge will return topsoil and vegetative material from infestation sites to the areas from which they were stripped and will not move soil and/or vegetative matter outside of the identified and marked noxious weed infestation areas.

Installation of Construction Mats

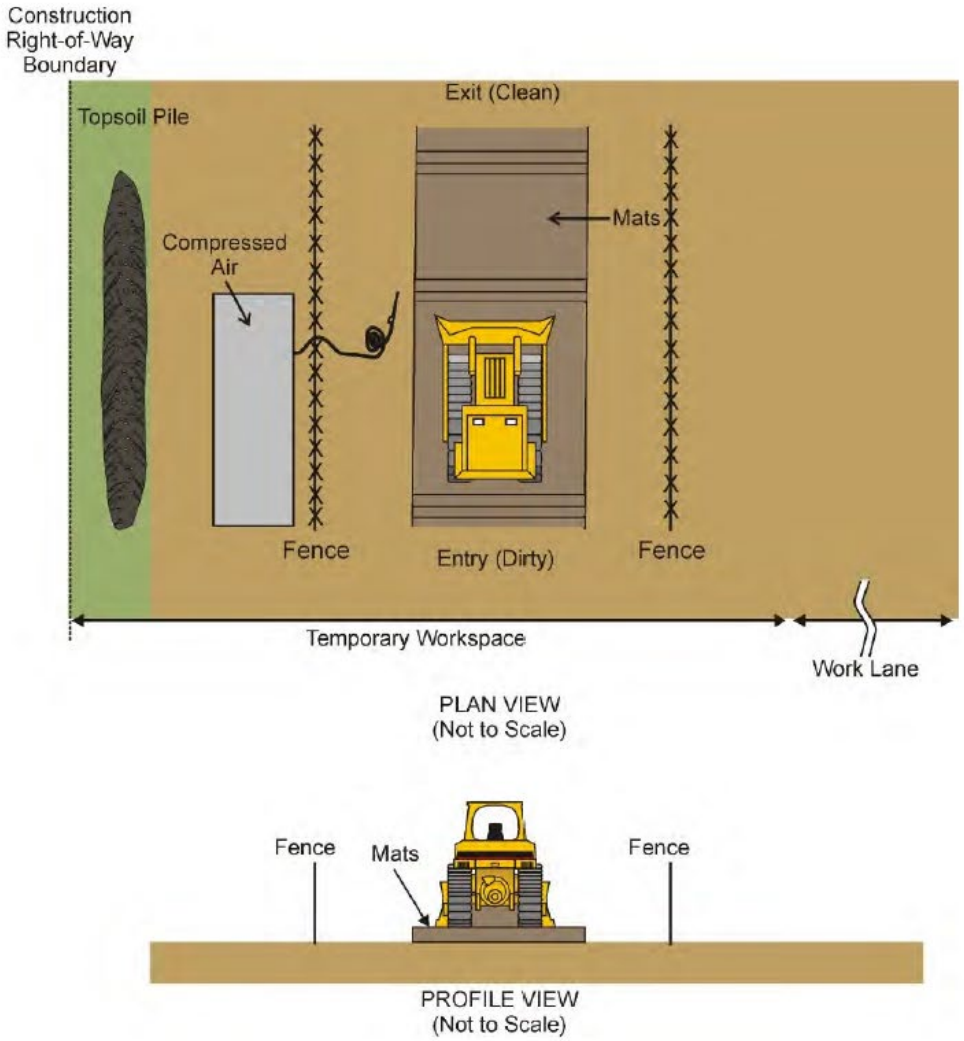
In areas of the construction workspace where pre-treatment of the INS population or topsoil segregation is not feasible, Enbridge will install and work off of construction mats or equivalent to cover the INS source. Construction mats will then be cleaned before use at another non-infested site as described in the "Cleaning Stations" section. Enbridge will also consider the use of construction mats in pre-treated areas with heavy infestations of INS.

Cleaning Stations

In areas where pre-treatment of terrestrial plant INS has not been implemented prior to clearing, Enbridge may establish cleaning stations to remove visible dirt and plant material from equipment and mats when exiting a known terrestrial INS infestation area along the construction workspace. Cleaning stations may also be implemented at select sites during construction, restoration, or post-construction monitoring, as needed. Construction mats utilized in an INS site will either be cleaned at designated cleaning stations or will be transported to constructions yards for storage and/or cleaning prior to re-use. Construction mats will be covered and contained in plastic tarps or geotextile fabric when they are transported and stored to minimize the spread of seeds. Removal of dirt and plant material will be documented in a cleaning log. See Figure 2.5-1 for a typical drawing of a cleaning station.

Mechanical means (initial scrape down followed by blow down) will be the primary method used to remove dirt and plant materials from vehicles, equipment, and construction mats at the cleaning stations or construction yards. Enbridge does not propose the exclusive use of high-pressure wash stations due the need for additional water and space, and the challenges with containing and disposing of the cleaning water.

Figure 2.5-1 Typical Compressed Air Cleaning Station



Representation Only

3.0 INVASIVE AQUATIC SPECIES

The MDNR regulates non-native and invasive aquatic plants and wild animals and designates infested waters. Non-native invasive aquatic species present in the Project area, include the zebra mussel (*Dreissena polymorpha*), faucet snail (*Bithynia tentaculata*), and Eurasian watermilfoil (*Myriophyllum spicatum*). The Minnesota Aquatic Invasive Species Research Center (2018) guide to aquatic invasive species identification is provided in Attachment E.

Aquatic invasive species are typically spread via movement of equipment used in infested waters, such boats, docks, and other equipment. Faucet snail can close their shell with their operculum and survive out of water for multiple days (MDNR, 2020a). Adult zebra mussels can survive out of the water up to 21 days in wet conditions. The larvae of the zebra mussel are microscopic and may spread in any water-containing device (MDNR, 2020b). Eurasian watermilfoil spreads primarily through vegetative fragmentation whereby a fragment from the plant breaks off, grows roots, and establishes a new plant; it looks similar to and may hybridize with native beneficial watermilfoils, including the northern watermilfoil (MDNR, 2020c).

The L3R crosses over 200 waterbodies in the state of Minnesota and will appropriate from water sources to support horizontal directional drills ("HDDs"), hydrostatic testing, and fugitive dust control. Most equipment and construction activities will be in the water (either for crossing or water appropriation) for 24 hours or less. Equipment exposed to water for longer periods of time[7] incudes HDD equipment (refer to the Summary of Construction Methods and Procedures in Appendix A of the EPP for a complete description), and in-stream bridge supports. HDD installation can take several weeks to complete, and in-stream bridge supports may remain in the water through restoration (see Section 2.6.3 of the EPP).

Enbridge has reviewed MDNR's list of designated infested waters (MDNR, 2020d) and has removed designated infested waters as water sources where practical in an effort to reduce the potential risk of spread of these species. Based on the MDNR's list of infested waters (MDNR, 2020d), only one of the water sources currently proposed as a primary source for use has aquatic INS (see Table 3.0-1); the other three sources are contingency sources that would only be used if there is inadequate water flow at the primary source. In all cases, Enbridge will discharge back to the source water or infiltrate the discharge to control potential spread of INS (see Section 3.1.1). Further, none of the currently designated infested waters will be crossed using trenching methods that require in-water work.

Table 3.0-1
Line 3 Replacement Proposed Infested Water Sources

Milepost	County	Water Name	Crossing Method	Infestation Species	Appropriation Purpose	Proposed Discharge Method
801.8	Kittson	Red River	HDD	Zebra mussel	HDD and Mainline Hydrostatic Test Appropriation	Back to source or infiltration
991.2	Wadena	Shell River	HDD	Faucet snail	HDD (winter contingency only)	Back to source
993.3	Wadena	Crow Wing River	HDD	Faucet snail	HDD (winter contingency only)	Back to source

[7] Higher risk equipment is defined as equipment that is in the water for longer periods; the longer period of exposure the higher the risk (Zook and Phillips, 2012).

Milepost	County	Water Name	Crossing Method	Infestation Species	Appropriation Purpose	Proposed Discharge Method
1120.3	Carlton	Chub Lake	N/A	Eurasian water-milfoil	Mainline Hydrostatic Test Appropriation (contingency only)	Back to source

3.1 MANAGEMENT STRATEGIES FOR INVASIVE AQUATIC SPECIES

To minimize the spread of invasive aquatic species in Minnesota and North Dakota, Enbridge will implement the following procedures when working in waterbodies in compliance with Minnesota Statute 84D.10 Subd. 4, and consistent with the *Recommended Uniform Minimum Protocols and Standards for Water Craft Interception Programs for Dreissenid Mussels in the Western United States* (Zook and Phillips, 2012 as cited by Minnesota Statutes 84D.01), and MDNR and North Dakota Game and Fish recommendations (MDNR, 2020e; North Dakota Game and Fish, 2016). As described in Section 1.1 of the EPP, Enbridge will post signs at designated infested waters.

Equipment will not be allowed to operate within waterbodies until verification by the Environmental Inspector or Site Inspector that the appropriate inspection and/or decontamination procedures described in Sections 3.1.1 through 3.1.3 have been implemented.

3.1.1 Procedures at Any State Watercourse

- Equipment intended for use at the Project site will be free of invasive species prior to being transported to the worksite. Equipment (e.g., hoe stick and bucket, pumps, hoses) used in any state watercourses, regardless of designated infestation status, will be inspected for invasive aquatic species prior to and following in-water work.

- Pumps, hoses, and other equipment with water intakes will be drained of water after use. Enbridge will remove plants, mud, debris, and organisms from the exterior of the equipment (e.g., hoe stick and bucket). Hoses will be flushed with clean water and thoroughly drained or be allowed to freeze for 6 to 8 hours to further mitigate potential transmittal of infestations.

- If aquatic invasive species are identified during inspection of the equipment, Enbridge will implement one or more of the following decontamination procedures[8] before use in another waterbody:

    - clean with heated high-pressure washer; heated water contact from the pressure water will be maintained for the duration prescribed in Table 3.1-1;

    - rinse or soak equipment (e.g., pumps) with heated water at the temperature and duration prescribed in Table 3.1-1;

    - dry for 5 days prior to using at another waterbody; or

[8] https://www.dnr.state.mn.us/invasives/preventspread_watercraft.html and https://files.dnr.state.mn.us/natural_resources/invasives/protect-waters.pdf.

- freeze for 6 to 8 hours prior to using at another waterbody.

- For crossings of completely frozen waterbodies during winter, if no liquid water comes in contact with equipment, no decontamination will occur.

- Decontamination water will be allowed to infiltrate in an upland area at least 300 feet from any watercourse, or within 300 feet of the aquatic invasive species source in accordance with applicable permits.

- Felt-soled waders will not be allowed for use in any state watercourse because felt can easily trap, and thus potentially transport, invasive species.

- If personnel enter any state watercourse, personnel will scrub clothes, waders, boots, and other personal gear with a stiff brush to remove debris.

- Enbridge will notify the MDNR if any aquatic invasive species are identified in a watercourse not previously designated as an infested water.

Table 3.1-1
Line 3 Replacement Temperature and Duration for Decontamination using Heated Water

Water Temperature (degrees Fahrenheit)	Duration
Pressure Washing Activities	
140	10 seconds
130	20 seconds
120	40 seconds
100	80 seconds
Soaking Decontamination Activities and Pre-Treatment	
130	10 minutes
115	15 minutes
These guidelines were provided by the MDNR (G. Montz, MDNR Aquatic Invertebrate Biologist) on March 27 and March 30, 2020.	

3.1.2 Designated Infested Waters

- If equipment has been used in a designated infested water, Enbridge will implement one or more of the following decontamination procedures[5] before use in another waterbody:

  - clean with heated high-pressure washer; heated water contact from the pressure water will be maintained for the duration prescribed in Table 3.1-1; or

  - rinse or soak equipment (e.g., hoses, pumps) with heated water at the temperature and duration prescribed in Table 3.1-1; or

  - dry for 5 days prior to using at another waterbody; or

  - freeze for 6 to 8 hours prior to using at another waterbody.

- For crossings of completely frozen waterbodies during winter, if no liquid water comes in contact with equipment, no decontamination will occur.

- Decontamination water will be allowed to infiltrate in an upland area at least 300 feet from any watercourse, or within 300 feet of the aquatic invasive species source in accordance with applicable permits.

- If personnel enter infested waterbodies, personnel will scrub clothes, waders, boots, and other personal gear with a stiff brush to remove debris.

3.1.3 Public Watercourses,[9] Sensitive Non-Public Watercourses, and Surface Water Appropriation Sites[10]

- Enbridge will implement the procedures described in Section 3.1.2 at public watercourses, the non-public watercourses identified in Table 3.1-2, and surface water appropriation sites for in-water construction activities and for the equipment used at HDD installations.

- Enbridge will discharge appropriated water for HDD and hydrostatic testing activities[8] either back to source or infiltrate in an upland area at least 300 feet from any watercourse and in accordance with applicable permits.

Table 3.1-2
Line 3 Replacement Non-Public Sensitive Watercourses

Approximate Milepost	County	Waterbody Survey ID	Waterbody Name
867.4	Red Lake	s-152n43w4-a	Unnamed Ditch
893.9	Polk	s-150n39w19-d	Unnamed Ditch
894.2	Polk	s-150n39w30-a	County Ditch No. 89
894.8	Polk	s-150n39w29-a	Unnamed Ditch
894.8	Polk	s-150n39w29-b	Unnamed Ditch
894.9	Polk	s-150n39w29-c	Unnamed Ditch
999.6	Cass	CAC5006aWB	Unnamed Ditch
1056.6	Aitkin	s-51n26w33-b	Unnamed Tributary to Moose Lake
1081.5	Aitkin	s-51n22w22-a	Unnamed Stream
1084.4	Aitkin	s-51n22w24-a	Unnamed Stream
1108.3	Carlton	s-49n18w18-b	Unnamed Tributary to Stoney Brook

HDD Drilling Mud Preparation

During the execution of an HDD, equipment will not come into contact with the surface water of the waterbody being crossed, except where surface water is utilized to prepare the drilling mud that is utilized throughout the drilling process. To prevent the need for decontamination of equipment after an HDD, Enbridge may instead pre-treat the surface water utilized to prepare the HDD drilling mud by either:

- Using Enbridge's filtration system consisting of sand filter, 10-micron bag filter and 0.5-micron bag filter; or

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[9] Public water or public waters means those waters of the state identified under Minnesota Statutes, section 103G.005, subdivision 15 or 15a, or 103G.201, as shown on the public water inventory maps.

[10] Surface water appropriation sites submitted to the MDNR as part of the Water Appropriation Permit Application for HDD and Hydrostatic Testing Activities (MPARS Reference No. 2018-3690).

- Heating the water to the temperature and duration prescribed in Table 3.1-1 for the Soaking Decontamination and Pre-Treatment Activities.

4.0 INVASIVE TREE PESTS

Invasive tree pests occur in the Project area as well, including the native eastern larch beetle (*Dendroctonus simplex*) and non-native emerald ash borer (*Agrilus planipennis*). Eastern larch beetle infests tamarack trees (eastern larch or *Larix laricina*). Adults of the eastern larch beetle emerge in the spring from infected wood; removal of infected tamaracks prior to spring can reduce the spread of the disease (Seybold et al., 2002). Emerald ash borer larvae feed on all species of ash trees. Most of the species' life cycle occurs underneath the bark; early indications of infestation are bark removal or flecking from woodpeckers that eat the larvae (MDNR, 2020f).

As described in Sections 1.8 and 3.2 of the EPP, Enbridge would clear vegetation in upland and wetland areas and would generally dispose of non-merchantable timber and slash by mowing, cutting, chipping, mulching and/or hauling off site to an approved disposal facility. Merchantable timber would be disposed of in accordance with Enbridge contract specifications and applicable permits and licenses. The Project does not cross any existing quarantine areas for tree pests[11]; therefore, no special management strategies have been proposed. Enbridge Environmental will monitor quarantine notifications during construction; should any portion of the Project come under quarantine during construction, Enbridge would consult with applicable agencies to identify the appropriate management procedures.

4.1 OAK WILT

In the event that a healthy oak tree adjacent to the construction workspace is damaged or wounded during construction activities in counties where the oak wilt fungus is present, Enbridge will treat the cut surface with water-based paint, a pruning/wound sealer, or shellac to prevent further spread of the disease. Treated trees will be inspected by the Environmental Inspector.

5.0 REFERENCES

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Attachment A

Terrestrial Plant Invasive and Noxious Species Survey Results

Attachment A
INS Documented from 2015-2020 within the Line 3 Replacement Project [a]

County	Scientific Name	Common Name	Listing [b]	Land Owner / Administrator			Total
				FDL [c]	MDNR [c]	Other [d]	
Aitkin	*Carduus acanthoides*	Plumeless Thistle	MISAC; MITPPC (77.39); MDA (C); Op Order 113	-	3	-	**3**
	Centaurea stoebe	Spotted Knapweed	MISAC; MITPPC (93.35); MDA (E); Op Order 113	-	3	-	**3**
	Cirsium arvense	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	-	24	10	**34**
	Lotus corniculatus	Bird‘s-foot Trefoil	MISAC; MITPPC (68.72); Op Order 113	-	17	1	**18**
	Phalaris arundinacea	Reed Canary Grass	MISAC; MITPPC (78.18); Op Order 113	-	28	3	**31**
	Phragmites australis	Common Reed	MITPPC (86.32); MDA (R); Op Order 113	-	6	-	**6**
	Securigera varia	Crown Vetch	MISAC; MITPPC (77.32); MDA (R); Op Order 113	-	18	2	**20**
	Tanacetum vulgare	Common Tansy	MISAC; MITPPC (91.39); MDA (C); Op Order 113	-	37	6	**43**
	Toxicodendron radicans	Poison Ivy	MDA (S)	-	12	2	**14**
Carlton	*Arctium minus*	Common Burdock	MISAC	3	-	-	**3**
	Berteroa incana	Hoary Alyssum	MISAC; MITPPC (69.09)	21	-	-	**21**
	Campanula rapunculoides	Creeping Bellflower	MISAC	5	-	-	**5**
	Caragana arborescens	Siberian Peashrub	MITPPC (57.16); Op Order 113	1	-	-	**1**
	Centaurea stoebe	Spotted Knapweed	MISAC; MITPPC (93.35); MDA (E); Op Order 113	26	-	6	**32**
	Cirsium arvense	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	79	12	15	**106**
	Cirsium vulgare	Bull Thistle	MISAC	36	-	-	**36**
	Convolvulus arvensis	Field bindweed	MISAC	3	-	-	**3**
	Daucus carota	Wild Carrot	MISAC; MITPPC (52.84); MDA (R); Op Order 113	16	-	-	**16**
	Echinochloa crusgalli	Barnyard Grass	MISAC	11	-	-	**11**
	Elytrigia repens	Quackgrass	MISAC	26	-	-	**26**
	Euphorbia esula	Leafy Spurge	MISAC; MITPPC (79.05); MDA (C); Op Order 113	3	-	-	**3**
	Glechoma hederacea	Creeping Charlie	MISAC	1	-	-	**1**
	Hemerocallis fulva	Orange Day Lily	MISAC	1	-	-	**1**
	Hieracium spp.	Hawkweed	MITPPC (60.52/60.46)	63	-	-	**63**
	Hypericum perforatum	St. John‘s Wort	MISAC	3	-	-	**3**
	Leucanthemum vulgare	Oxeye Daisy	MISAC	45	-	-	**45**
	Linaria vulgaris	Butter-and-Eggs	MISAC	7	-	-	**7**
	Lonicera x bella	Bell's Honeysuckle	MISAC; MDA (R); Op Order 113	6	-	-	**6**
	Lotus corniculatus	Bird‘s-foot Trefoil	MISAC; MITPPC (68.72); Op Order 113	55	-	-	**55**
	Lupinus polyphyllus	Big-leaf Lupine	MISAC	3	-	-	**3**
	Lythrum salicaria	Purple Loosestrife	MISAC; MDA (C); Op Order 113	2	-	-	**2**
	Medicago lupulina	Black Medic	MISAC	14	-	-	**14**
	Melilotus spp.	Sweetclover	MITPPC (70.33/71.49)	20	-	-	**20**

County	Scientific Name	Common Name	Listing [b]	Land Owner / Administrator			Total
				FDL [c]	MDNR [c]	Other [d]	
	Pastinaca sativa	Wild Parsnip	MITPPC (78.86); MDA (C); Op Order 113	15	-	-	**15**
	Phalaris arundinacea	Reed Canary Grass	MISAC; MITPPC (78.18); Op Order 113	79	1	-	**80**
	Phleum pratense	Timothy	MISAC	62	-	-	**62**
	Potentilla argentea	Silver Cinquefoil	MISAC	14	-	-	**14**
	Potentilla recta	Sulphur Cinquefoil	MISAC	15	-	-	**15**
	Ranunculus acris	Tall Buttercup	MISAC	16	-	-	**16**
	Securigera varia	Crown Vetch	MISAC; MITPPC (77.32); MDA (R); Op Order 113	1	-	-	**1**
	Silene latifolia	White Campion	MISAC	27	-	-	**27**
	Solanum dulcamara	Bittersweet Nightshade	MISAC	1	-	-	**1**
	Sonchus arvensis	Perennial Sowthistle	MISAC	11	-	-	**11**
	Tanacetum vulgare	Common Tansy	MISAC; MITPPC (91.39); MDA (C); Op Order 113	144	18	43	**205**
	Trifolium spp.	Clover	MISAC	57	-	-	**57**
	Verbascum thaspus	Common Mullein	MISAC	3	-	-	**3**
	Viburnum opulus	Highbush Cranberry	MISAC	1	-	-	**1**
Cass	*Carduus acanthoides*	Plumeless Thistle	MISAC; MITPPC (77.39); MDA (C); Op Order 113	-	-	2	**2**
	Centaurea stoebe	Spotted Knapweed	MISAC; MITPPC (93.35); MDA (E); Op Order 113	-	2	8	**10**
	Cirsium arvense	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	-	1	38	**39**
	Lotus corniculatus	Bird‘s-foot Trefoil	MISAC; MITPPC (68.72); Op Order 113	-	2	-	**2**
	Phalaris arundinacea	Reed Canary Grass	MISAC; MITPPC (78.18); Op Order 113	-	3	-	**3**
	Securigera varia	Crown Vetch	MISAC; MITPPC (77.32); MDA (R); Op Order 113	-	3	-	**3**
	Tanacetum vulgare	Common Tansy	MISAC; MITPPC (91.39); MDA (C); Op Order 113	-	5	9	**14**
	Toxicodendron radicans	Poison Ivy	MDA (S)	-	2	-	**2**
Clearwater	*Carduus acanthoides*	Plumeless Thistle	MISAC; MITPPC (77.39); MDA (C); Op Order 113	-	2	85	**87**
	Carduus nutans	Musk Thistle	MISAC	-	-	2	**2**
	Centaurea stoebe	Spotted Knapweed	MISAC; MITPPC (93.35); MDA (E); Op Order 113	-	7	112	**119**
	Cirsium arvense	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	-	5	129	**134**
	Lotus corniculatus	Bird‘s-foot Trefoil	MISAC; MITPPC (68.72); Op Order 113	-	2	-	**2**
	Lythrum salicaria	Purple Loosestrife	MISAC; MDA (C); Op Order 113	-	-	2	**2**
	Phalaris arundinacea	Reed Canary Grass	MISAC; MITPPC (78.18); Op Order 113	-	2	-	**2**
	Rhamnus cathartica	Common Buckthorn	MISAC; MITPPC (84.38); MDA (R); Op Order 113	-	-	11	**11**
	Tanacetum vulgare	Common Tansy	MISAC; MITPPC (91.39); MDA (C); Op Order 113	-	6	39	**45**
	Toxicodendron radicans	Poison Ivy	MDA (S)	-	3	-	**3**
Hubbard	*Carduus acanthoides*	Plumeless Thistle	MISAC; MITPPC (77.39); MDA (C); Op Order 113	-	4	87	**91**
	Centaurea jacea	Brown Knapweed	MDA (E); Op Order 113	-	-	1	**1**

County	Scientific Name	Common Name	Listing [b]	Land Owner / Administrator			Total
				FDL [c]	MDNR [c]	Other [d]	
	Centaurea stoebe	Spotted Knapweed	MISAC; MITPPC (93.35); MDA (E); Op Order 113	-	3	120	**123**
	Cirsium arvense	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	-	2	87	**89**
	Lotus corniculatus	Bird's-foot Trefoil	MISAC; MITPPC (68.72); Op Order 113	-	1	2	**3**
	Phalaris arundinacea	Reed Canary Grass	MISAC; MITPPC (78.18); Op Order 113	-	3	1	**4**
	Rhamnus cathartica	Common Buckthorn	MISAC; MITPPC (84.38); MDA (R); Op Order 113	-	-	1	**1**
	Securigera varia	Crown Vetch	MISAC; MITPPC (77.32); MDA (R); Op Order 113	-	1	-	**1**
	Tanacetum vulgare	Common Tansy	MISAC; MITPPC (91.39); MDA (C); Op Order 113	-	2	64	**66**
	Toxicodendron radicans	Poison Ivy	MDA (S)	-	3	1	**4**
Kittson	*Cirsium arvense*	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	-	-	20	**20**
Marshall	*Carduus acanthoides*	Plumeless Thistle	MISAC; MITPPC (77.39); MDA (C); Op Order 113	-	-	1	**1**
	Centaurea jacea	Brown Knapweed	MDA (E); Op Order 113	-	-	2	**2**
	Cirsium arvense	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	-	-	74	**74**
	Pastinaca sativa	Wild Parsnip	MITPPC (78.86); MDA (C); Op Order 113	-	-	3	**3**
	Rhamnus cathartica	Common Buckthorn	MISAC; MITPPC (84.38); MDA (R); Op Order 113	-	-	9	**9**
	Tanacetum vulgare	Common Tansy	MISAC; MITPPC (91.39); MDA (C); Op Order 113	-	-	3	**3**
Pembina	*Bassia scoparia*	Kochia	NDDA	-	-	2	**2**
	Cirsium arvense	Canada Thistle	NDDA	-	-	29	**29**
	Euphorbia esula	Leafy Spurge	NDDA	-	-	2	**2**
	Tanacetum vulgare	Common Tansy	NDDA	-	-	2	**2**
Pennington	*Carduus acanthoides*	Plumeless Thistle	MISAC; MITPPC (77.39); MDA (C); Op Order 113	-	-	1	**1**
	Centaurea stoebe	Spotted Knapweed	MISAC; MITPPC (93.35); MDA (E); Op Order 113	-	-	1	**1**
	Cirsium arvense	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	-	7	47	**54**
	Pastinaca sativa	Wild Parsnip	MITPPC (78.86); MDA (C); Op Order 113	-	-	1	**1**
	Rhamnus cathartica	Common Buckthorn	MISAC; MITPPC (84.38); MDA (R); Op Order 113	-	4	7	**11**
	Tanacetum vulgare	Common Tansy	MISAC; MITPPC (91.39); MDA (C); Op Order 113	-	2	2	**4**
	Toxicodendron radicans	Poison Ivy	MDA (S)	-	-	1	**1**
Polk	*Carduus acanthoides*	Plumeless Thistle	MISAC; MITPPC (77.39); MDA (C); Op Order 113	-	-	22	**22**
	Centaurea stoebe	Spotted Knapweed	MISAC; MITPPC (93.35); MDA (E); Op Order 113	-	-	21	**21**
	Cirsium arvense	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	-	-	23	**23**
	Phragmites australis	Common Reed	MITPPC (86.32); MDA (R); Op Order 113	-	-	1	**1**
	Rhamnus cathartica	Common Buckthorn	MISAC; MITPPC (84.38); MDA (R); Op Order 113	-	-	2	**2**
	Tanacetum vulgare	Common Tansy	MISAC; MITPPC (91.39); MDA (C); Op Order 113	-	-	5	**5**

County	Scientific Name	Common Name	Listing [b]	Land Owner / Administrator			Total
				FDL [c]	MDNR [c]	Other [d]	
Red Lake	*Carduus acanthoides*	Plumeless Thistle	MISAC; MITPPC (77.39); MDA (C); Op Order 113	-	-	6	**6**
	Centaurea stoebe	Spotted Knapweed	MISAC; MITPPC (93.35); MDA (E); Op Order 113	-	-	3	**3**
	Cirsium arvense	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	-	-	32	**32**
	Rhamnus cathartica	Common Buckthorn	MISAC; MITPPC (84.38); MDA (R); Op Order 113	-	-	4	**4**
	Tanacetum vulgare	Common Tansy	MISAC; MITPPC (91.39); MDA (C); Op Order 113	-	-	1	**1**
St. Louis	*Berteroa incana*	Hoary Alyssum	MISAC; MITPPC (69.09)	1	-	-	**1**
	Campanula rapunculoides	Creeping Bellflower	MISAC	2	-	-	**2**
	Centaurea stoebe	Spotted Knapweed	MISAC; MITPPC (93.35); MDA (E); Op Order 113	16	-	-	**16**
	Cirsium arvense	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	6	-	-	**6**
	Cirsium vulgare	Bull Thistle	MISAC	7	-	-	**7**
	Daucus carota	Wild Carrot	MISAC; MITPPC (52.84); MDA (R); Op Order 113	2	-	-	**2**
	Echinochloa crusgalli	Barnyard Grass	MISAC	7	-	-	**7**
	Elytrigia repens	Quackgrass	MISAC	3	-	-	**3**
	Hieracium spp.	Hawkweed	MITPPC (60.52/60.46)	8	-	-	**8**
	Hypericum perforatum	St. John‘s Wort	MISAC	4	-	-	**4**
	Leucanthemum vulgare	Oxeye Daisy	MISAC	14	-	-	**14**
	Lonicera x bella	Bell's Honeysuckle	MISAC; MDA (R); Op Order 113	2	-	-	**2**
	Lotus corniculatus	Bird‘s-foot Trefoil	MISAC; MITPPC (68.72); Op Order 113	68	2	-	**70**
	Lythrum salicaria	Purple Loosestrife	MISAC; MDA (C); Op Order 113	2	-	-	**2**
	Medicago lupulina	Black Medic	MISAC	6	-	-	**6**
	Melilotus spp.	Sweetclover	MITPPC (70.33/71.49)	16	-	-	**16**
	Pastinaca sativa	Wild Parsnip	MITPPC (78.86); MDA (C); Op Order 113	9	-	-	**9**
	Phalaris arundinacea	Reed Canary Grass	MISAC; MITPPC (78.18); Op Order 113	9	1	-	**10**
	Phleum pratense	Timothy	MISAC	67	-	-	**67**
	Potentilla argentea	Silver Cinquefoil	MISAC	1	-	-	**1**
	Potentilla recta	Sulphur Cinquefoil	MISAC	1	-	-	**1**
	Ranunculus acris	Tall Buttercup	MISAC	7	-	-	**7**
	Securigera varia	Crown Vetch	MISAC; MITPPC (77.32); MDA (R); Op Order 113	-	2	-	**2**
	Sonchus arvensis	Perennial Sowthistle	MISAC	4	-	-	**4**
	Tanacetum vulgare	Common Tansy	MISAC; MITPPC (91.39); MDA (C); Op Order 113	142	3	-	**145**
	Trifolium spp.	Clover	MISAC	66	-	-	**66**
Wadena	*Carduus acanthoides*	Plumeless Thistle	MISAC; MITPPC (77.39); MDA (C); Op Order 113	-	6	1	**7**
	Centaurea stoebe	Spotted Knapweed	MISAC; MITPPC (93.35); MDA (E); Op Order 113	-	1	2	**3**
	Cirsium arvense	Canada Thistle	MISAC; MITPPC (82.76); MDA (C); Op Order 113	-	7	6	**13**

County	Scientific Name	Common Name	Listing [b]	Land Owner / Administrator			Total
				FDL [c]	MDNR [c]	Other [d]	
	Lotus corniculatus	Bird's-foot Trefoil	MISAC; MITPPC (68.72); Op Order 113	-	1	-	**1**
	Phalaris arundinacea	Reed Canary Grass	MISAC; MITPPC (78.18); Op Order 113	-	3	-	**3**
	Securigera varia	Crown Vetch	MISAC; MITPPC (77.32); MDA (R); Op Order 113	-	5	2	**7**
	Toxicodendron radicans	Poison Ivy	MDA (S)	-	3	1	**4**
Total				**1,366**	**290**	**1,228**	**2,884**

[a] Includes Permanent Right-of-Way, Temporary Workspace, Additional Temporary Workspace, and Access Roads and Haul Route Improvements.

[b] MISAC - Minnesota Invasive Species Advisory Council (October 2009); MITPPC - Minnesota Invasive Terrestrial Plants and Pests Center (2018); MDA - Minnesota Department of Agriculture (E-Eradicate, C-Control, S-Special) (September 2020); Op Order 113 - Minnesota Department of Natural Resources Operational Order 113 (June 2019); NDDA – North Dakota Department of Agriculture (2017, 2020).

[c] Three MDNR-administered properties overlap with the FDL reservation; therefore, observed occurrences within the overlapping boundaries are counted under both the FDL and MDNR categories.

[d] "Other" includes private land and public land (i.e., County land) that is not administered by the MDNR.

Attachment B

Invasive and Noxious Species Implementation Plan for Private and County Lands





Invasive and Noxious Species Implementation Plan for Private and County Lands

Enbridge Energy, Limited Partnership • Line 3 Replacement Project

October 2020

ENBRIDGE®

TABLE OF CONTENTS

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

BMP	Best Management Practice
Enbridge	Enbridge Energy, Limited Partnership
EPP	Environmental Protection Plan
ESA	Environmentally Sensitive Area
FDL	Fond du Lac Band of Lake Superior Chippewa
Gully 30 Fen	Gully 30 calcareous fen
INS	Invasive and Noxious Species
L3R or Project	Line 3 Replacement Project
MDA	Minnesota Department of Agriculture
MDNR	Minnesota Department of Natural Resources
NDDA	North Dakota Department of Agriculture
Plan	Invasive and Noxious Species Management Plan for MDNR Lands
Project Area	private and County lands in Minnesota and North Dakota
USDA	U.S. Department of Agriculture

1.0 INTRODUCTION

Enbridge Energy, Limited Partnership ("Enbridge") is committed to minimizing the spread of invasive and noxious species ("INS") as defined by law or regulation (Attachment A), along the construction workspace and associated access roads and haul routes where improvements are associated with the construction of the Line 3 Replacement Project ("L3R" or "Project") in Minnesota. The L3R route extends approximately 330 miles across the state of Minnesota, and an additional 12 miles in North Dakota.

1.1 PURPOSE OF THE PLAN

The goal of this Invasive and Noxious Species Implementation Plan (the "Plan") is to outline the specific INS management strategies that will be used to minimize the spread of target INS species identified within the Project construction workspace, access roads, and improved haul routes that occur on private and County lands in Minnesota and North Dakota (the "Project Area") in compliance with law or regulation. Existing INS occurrences that have been documented throughout the Project Area through pre-construction surveys were used to create a target species list for this Plan. Management strategies, including methodology and timing of implementation, are included in the Plan and will be implemented where applicable and appropriate prior to construction, and during Project construction, restoration, and post-construction monitoring phases.

This plan is complimentary to Enbridge's Environmental Protection Plan ("EPP") and INS Management Plan (Appendix B of the EPP). This Plan further describes the methodology and implementation of active management strategies for target INS species, and implementation of Best Management Practices ("BMPs") during construction, restoration, and post-construction monitoring in accordance with federal and state law. Active management methods for the target species list and detailed BMPs to minimize spread of INS during construction within the Project are outlined below.

Enbridge would like to emphasize that the treatment method selected for an INS population will be dependent on a number of factors, including the time of year and species-specific biology, proximity to sensitive species, and construction activities and the timing of those activities as further explained in the following sections. Although this Plan describes a preference for herbicide pre-treatment, it will not be feasible in all locations; in those situations, a different methodology will be selected by Enbridge's INS Consultant (Stantec) and Enbridge's Environmental Inspection Team in coordination with the Enbridge Construction Team in the field at the time of construction. Should treatment not be possible during construction, Enbridge will manage INS as appropriate during the restoration and/or post-construction monitoring phases. The Post-Construction Wetland and Waterbody Monitoring Plan and the Gully 30 Fen Management Plan establish performance standards for the management of the INS to ensure that these infestations are appropriately managed.

2.0 TERRESTRIAL PLANT INVASIVE AND NOXIOUS SPECIES MANAGEMENT STRATEGIES

2.1 MINNESOTA REGULATIONS

On private and County lands in Minnesota, the management objectives for INS within the Project Area are to minimize the spread of documented occurrences of terrestrial plant INS that are: 1) listed as Noxious by the U.S. Department of Agriculture ("USDA"); or 2) listed as "eradicate" or "control" (see Section 2.1 of the INS Management Plan and Attachment B) under the "Prohibited Noxious Weed" category by the Minnesota Department of Agriculture ("MDA").

Additional rules and regulations must be followed on Minnesota Department of Natural Resources ("MDNR") lands and are addressed in the INS Implementation Plan for Public Lands.[1] The Project Area also intersects with Gully 30 calcareous fen ("Gully 30 Fen") (Fen ID No. 35382) and management of INS within the fen is addressed in the Gully 30 Calcareous Fen Management Plan.

Invasive and noxious species on the portion of the Project that intersects with the Fond Du Lac Band of Lake Superior Chippewa ("FDL") Reservation will be managed internally by the FDL government. In accordance with the Section 401 Water Quality Certification Permit issued to Enbridge on the April 15, 2019, all equipment, including personal equipment such as boots, hats, and gloves, will be cleaned before entering FDL land. Enbridge will establish cleaning stations at entry and exit points to the FDL Reservation.

2.2 NORTH DAKOTA REGULATIONS

In North Dakota, the INS management objectives are to minimize the spread of documented occurrences of terrestrial plant INS that are: 1) listed as Noxious by the USDA; or 2) listed as noxious (see Section 2.2 of the INS Management Plan and Attachment B) by the North Dakota Department of Agriculture ("NDDA") or Pembina County, North Dakota (NDDA, 2017; NDDA, 2019).

2.3 MANAGEMENT STRATEGIES FOR TERRESTRIAL PLANT INVASIVE AND NOXIOUS SPECIES

Two primary strategies are developed to minimize the spread of INS within the Project Area. The first strategy is application of prevention measures to limit spread of INS through establishment of INS BMPs. The second strategy is active management to minimize the spread of documented occurrences of terrestrial INS. Active management practices will be selected based on the site-specific conditions, timing, and INS ecology.

[1] All tracts or lots of real property belonging to the state and under the control and supervision of the commissioner of natural resources

2.3.1 Prevention Measures

Prevention measures will be employed to limit spread and introduction of INS through activities such as construction or site management. The following BMPs will be implemented during construction and site management activities.

2.3.1.1 Identification of INS Populations

Prior to clearing, Enbridge will flag the boundaries of known INS populations that overlap with the construction workspace. For INS populations larger than 10,000 square feet or at INS sites where flagging is not practical, the boundaries will be marked by a series of flagged wooden stakes.

2.3.1.2 Movement of Equipment

Equipment used during construction and restoration activities includes trucks, tractors, off-highway vehicles, heavy equipment, tools, personal gear, etc.

1. Before leaving an INS site, inspect the equipment and remove visible plants, seeds, mud, dirt clods, and animals.

2. Enbridge is requiring personnel that will work within the Project Area to view the MDNR land-based prevention staff training video “Cleaning to Avoid Spreading Terrestrial Invasive Species.” (Section 2.5.1 of INS Management Plan).

3. Equipment will be cleaned prior to arriving to the Project.

    a. Construction mats will be new/unused, or cleaned, prior to arriving to the Project.

4. If pre-treatment of INS is not possible and mitigation measures such as topsoil segregation and construction mat or ice/frost road installation cannot practicably be employed, Enbridge will conduct additional cleaning of equipment (see cleaning stations section in Section 2.2.2 of INS Management Plan), as prudent and feasible.

2.3.1.3 Movement of Material

Materials include organisms and organic and inorganic material including plants, mulch, soil, gravel, rock, etc.

1. Enbridge will not plant or knowingly introduce prohibited or regulated invasive species.

2. To reduce the likelihood of introducing or spreading invasive species, Enbridge will employ the following measures:

    a. Use only certified weed-free mulch and hay (Section 1.9.2 of the EPP).

    b. Stored topsoil in heavily infested areas will be covered or sprayed with tackifier or mulch to reduce the viability of INS seeds and rootstock prior to the restoration phase and prevent transport by wind. Weed-infested stockpiles will be marked with clearly visible signage until the restoration phase. During restoration, Enbridge will return topsoil and vegetative material from INS sites to the areas from which they were

stripped and will not move soil and/or vegetative matter outside of the identified and marked noxious weed infestation areas (Section 2.5.3 of the INS Management Plan).

c. For revegetation, Enbridge will utilize seed mixes labelled "Noxious Weeds: None Found" as required by regulations and will utilize yellow tag seed when available (Section 7.2 of the EPP).

3. Enbridge will not knowingly move soil, dredge material, or raw wood products that may harbor invasive species from INS sites except under contract specifications, permit, or compliance agreements.

   a. Enbridge will generally dispose of non-merchantable timber and slash by mowing, cutting, chipping, and mulching and left in upland areas and/or hauling off-site to an approved location. All merchantable timber will be managed in accordance with Enbridge contract specifications and applicable permits and licenses. The Project does not cross any existing quarantine areas for tree pests; therefore, no special management strategies have been proposed (Section 4.0 of INS Management Plan).

   b. During restoration, Enbridge will return topsoil and vegetative material from INS sites to the areas from which they were stripped and will not move soil and/or vegetative matter outside of the identified and marked noxious weed infestation areas (Section 2.5.6 of the INS Management Plan).

2.3.2 Active Invasive Species Management

Pre-construction surveys were conducted between 2015-2020 along a 50-foot-wide buffer on the construction workspace, and 30-foot-wide buffer on access roads and improved haul routes. These data were used to create a list of INS that were observed in the Project Area. Where existing INS occurrences have been documented, pre-treatment management will be implemented where possible. The pre-treatment objective will be to reduce the observable aboveground vegetative growth and seed production by INS at known locations. The intended effects of pre-treatment are to reduce potential spread of INS plants, seeds (observable on above-ground seed heads), and propagules by reducing INS populations prior to clearing and ground-disturbing activities. Prior to conducting pre-treatment, the herbicide contractor or vegetation management specialist will verify identification to species level. Following pre-treatment, a visual assessment will be conducted to evaluate whether herbicide treatment has had the intended effects; where this is not the case Enbridge will consider implementing additional BMPs.

2.3.2.1 Pre-Treatment Management

Pre-treatment management strategies for target INS are specified in Attachment C. Multiple treatment options are listed for some species. Treatment method or combination of methods will be selected based on management timing, size of INS population, site factors, access, and proximity to environmentally sensitive features. Mechanical treatments will be prioritized over herbicide for INS occurrences within a 100-foot buffer of an environmentally sensitive area ("ESA"), if mechanical means are likely to provide reasonable control. Some INS are most effectively managed using herbicides; in these cases, selective/spot spraying or wicking treatments will be utilized within the 100-foot buffer. For herbicide treatment within 100 feet of aquatic ESA features, the selected herbicides and adjuvants must be registered for use in aquatic areas.

INS occurrences have been ranked in order of highest to lowest priority for receiving pre-treatment to ensure that the best use of resources will be used in the limited time before clearing begins (Attachment D). Ranking is based on spread risk, size of the population and/or population extent, number of INS species at each occurrence, suppression potential, safety, access, and streambank revegetation concerns. INS that have the greatest risk of spreading, such as occurrences in transportation corridors (e.g. temporary access roads or haul routes) will be assigned as high priority for pre-treatment. Large INS occurrence defined in terms of abundance and extent, as well as occurrences with multiple different invasive species, will also be assigned a high priority. Occurrences that have high suppression potential (determined by the species type and access to the site) will be prioritized over occurrences of INS species that have poor suppression potential. Occurrences of poison ivy (*Toxicodendron radicans)* that do not occur along transportation corridors will be ranked lower.

Occurrences where there is high potential of soil erosion if INS are removed will be ranked as very low for priority for pre-treatment. In some cases, it may be necessary to implement erosion control and sediment control BMPs, such as soil stabilization with a cover crop, after treatment of INS. Erosion control and sediment control BMPs are described in Section 1.9 of the EPP.

2.3.2.2 INS Treatment Signage

As described above, the INS populations will be flagged prior to construction. Upon treatment, signage will be posted after pre-treatment with information on the species, when it was treated, and recommended timeframe to leave vegetation and soils undisturbed for herbicide uptake and plant activity (see Attachment E). This information will also be recorded in an electronic reporting system that will be used to monitor and communicate the management of INS populations between the Enbridge Environmental Compliance Team and the Enbridge Construction team.

2.3.2.3 Construction Best Management Practices

In areas where INS occurrences have been documented and pre-treatment cannot be implemented prior to clearing or between clearing and construction, or pre-treatment has not had the intended effect, one or more of the BMPs listed below will be implemented to limit spread of INS. An example of where one or more BMPs may be implemented is areas where the INS infestation extends beyond one or both sides of the construction workspace and is difficult to control using herbicide application.

1. Topsoil segregation, consisting of the following:

    - Topsoil will be stripped from the infested area and stockpiled.
    - Equipment work will be allowed only on subsoil.
    - Stored topsoil in heavily infested areas will be covered or sprayed with tackifier or mulch.
    - Weed-infested stockpiles will be marked with clearly visible signage.
    - During restoration, Enbridge will return topsoil and vegetative material from infestation sites to the areas from which they were stripped and will not move soil and/or vegetative matter outside of the identified and marked infestation areas.

2. Installation of construction mats or ice/frost roads, consisting of the following:

    - Construction mats, ice/frost roads or equivalent will be installed to cover the INS source prior to work.

    - Construction mats will then be cleaned before use at another site as described below under “Cleaning Stations.”

    - Enbridge will also consider the use of construction mats in pre-treated high priority INS sites where there is still concern of spread.

    - Construction mats utilized at an INS site will either be cleaned at designated cleaning stations or will be transported to construction yards for storage and/or cleaning prior to re-use (Section 2.5.3 of the INS Management Plan).

    - Used construction mats will be covered and contained in plastic tarps or geotextile fabric when they are transported and stored to minimize the spread of INS (Section 2.5.3 of the INS Management Plan).

3. Cleaning stations, consisting of the following:

    - An initial superficial cleaning with hand tools (e.g., scraping, agitation) will be done at the INS site to remove accumulated soil and plant material on mat surfaces prior to transport.

    - Cleaning of mats at designated cleaning stations will be done by initial scrape, followed by pressurized blow down with air or water. Additional hand tool cleaning will be used, as needed, to clean equipment at designated cleaning stations, followed by pressurized blow down with air or water.

    - Removal of dirt and plant material will be documented in a cleaning log (see Attachment F).

    - Off-site cleaning stations will be placed in existing disturbed areas (e.g., construction yards that were previously used as construction yards, rail yards, sand/gravel mines) that are clearly designated as a cleaning station area, and where the appropriate erosion and sediment control BMPs have been implemented to prevent off-site surface run-off.

For the details and specifications of the previous three construction BMPs please reference Section 2.5.3 of Enbridge’s INS Management Plan.

2.3.2.4 Order of Active Management Protocols

The protocols discussed above will be prioritized in the following order:

1. Pre-treatment when possible based on construction schedule, access, and INS treatment timing.

- If clearing begins during winter months, there will be no pre-treatment until the following spring/early summer as appropriate. Pre-treatment would then occur as feasible and appropriate during the growing season following the INS prioritization criteria (Attachment D).

2. Topsoil segregation of the infested site if pre-treatment cannot be completed.

    - During winter/frozen conditions, topsoil segregation may be implemented along areas of the construction workspace or temporary access roads at INS locations where soil movement (e.g., grading or trench excavation) is proposed, where feasible.

3. Installation of construction mats may be used where pre-treatment of the INS population or topsoil segregation is not feasible (e.g., wetlands and access roads). Installation of mats may also be used at high priority INS occurrences (Attachment D) that have been pre-treated, but where a post-treatment evaluation reveals that the herbicide application did not achieve the intended effect.

    - During winter/frozen conditions, ice/frost road development or construction mat installation may be implemented as a BMP where feasible and appropriate for the portions of access roads that overlap with INS infestations where grading would otherwise be required to develop the road.

4. Cleaning stations may be used when other BMPs are deemed insufficient to minimize the spread of INS.

5. Finally, in some areas where pre-treatment is not feasible, implementation of INS treatments may be proposed during restoration and post-construction monitoring. In all cases, INS infestations along the construction workspace and temporary access roads will be managed until the performance standards established in Enbridge's Post-Construction Wetland and Waterbody Monitoring Plan and Gully 30 Fen Management Plan have been met.

The decision on which treatment method will be implemented will be made collaboratively between Enbridge's Environmental Inspection Team, Enbridge's INS Management consultant, and the Construction Team in the field during construction. As discussed in Section 1.0, it is necessary to involve these parties in the decision-making process in order to coordinate treatment with the construction schedule.

2.3.2.5 Pesticide Use and Annual Reporting

Enbridge will only utilize those herbicides and methods of application approved by the MDA and the U.S. Environmental Protection Agency in the state of Minnesota. All herbicide applications will be made according to product labels and as otherwise specified by local, state, and federal regulations (see Attachment G). All personnel applying pesticide will possess a current MDA or NDDA commercial pesticide licenses with certification(s) in appropriate categories. Records of herbicide applications will be and kept in accordance with MDA and NDDA requirements.

2.3.2.6 Protocol for Unanticipated INS Populations

It is anticipated that Enbridge will encounter previously undocumented INS populations. When unanticipated populations of INS are found they will be documented and reported to Enbridge. Enbridge Environmental Inspectors that encounter unanticipated INS populations will document occurrences through an electronic reporting system. Documentation will include, species, approximate size, Global Positioning System location, and inspector name. This information will be communicated to the contractor conducting INS active management for species verification and incorporation into treatment plans. In addition, signage will be installed to notify the Construction Team of the INS occurrence and treatment status (Attachment E). Flagging will be used to delineate the INS population within the Project. For INS populations larger than 10,000 square feet or at INS sites where flagging is not practical, the boundaries will be marked by a series of flagged wooden stakes.

3.0 REFERENCES

Minnesota Department of Agriculture. 2020 Noxious Weed List. Available at: https://www.mda.state.mn.us/plants-insects/minnesota-noxious-weed-list. Accessed September 21, 2020.

Natural Resources Conservation Service. Undated. Introduced, Invasive, and Noxious Plants. Available at http://plants.usda.gov/java/noxious. Accessed April 20, 2020.

North Dakota Department of Agriculture ("NDDA"). 2017. Noxious Weeds. Available at: https://www.nd.gov/ndda/plant-industries/noxious-weeds. Accessed April 23, 2019.

NDDA. 2020. North Dakota County and City Listed Noxious Weeds. Available at: https://www.nd.gov/ndda/sites/default/files/resource/2019%20April%20-%20City%20County%20Noxious%20Weeds%20List%204.19.pdf. September 21, 2020.

Attachment A

Noxious and Invasive Species Regulations

Attachment A Invasive and Noxious Species Regulations			
Regulatory Category	**State**	**Agency**	**Reference**
State Prohibited, Restricted, and Specially Regulated Noxious Weeds (terrestrial plants)	MN	MDA	https://www.mda.state.mn.us/plants-insects/minnesota-noxious-weed-list
State Noxious Weeds NDDA	ND	NDDA	https://www.nd.gov/ndda/plant-industries/noxious-weeds
Federal Noxious Weeds (aquatic and terrestrial plants)	MN, ND	USDA-APHIS	https://plants.usda.gov/java/noxious?rptType=Federal

Attachment B

Noxious and Invasive Species List

Attachment B - Terrestrial Invasive and Noxious Plant List		
Species	**Common Name**	**List Source[1]**
Ailanthus altissimma	Tree of Heaven	MDA (E)
Amaranthus palmeri	Palmer Amaranth	MDA (E); NDDA
Artemisia absinthium	Absinth Wormwood	NDDA
Bassia scoparia	Kochia	NDDA; Pembina
Berberis vulgaris	Common Barberry	MDA (C)
Cardamine impatiens	Narrowleaf Bittercress	MDA (C)
Carduus acanthoides	Thistle, plumeless	MDA (C)
Carduus nutans	Thistle, musk	NDDA
Celastrus orbiculatus	Oriental Bittersweet	MDA (E)
Centaurea diffusa	Diffuse Knapweed	MDA (E); NDDA
Centaurea jacea	Brown Knapweed	MDA (E)
Centaurea repens	Russian Knapweed	NDDA
Centaurea solstitialis	Yellow Star Thistle	MDA (E)
Centaurea stoebe (Syn Centaurea maculosa)	Spotted Knapweed	MDA (C); NDDA
Centaurea x moncktonii	Meadow Knapweed	MDA (E)
Cirsium arvense	Thistle, Canada	MDA (C); NDDA
Conium maculatum	Poison Hemlock	MDA (E)
Cuscuta spp.	Dodder	USDA
Cynanchum louiseae (Syn Vincetoxicum nigrum)	Black Swallow-wort	MDA (E)
Cynoglossum officinale	Houndstongue	NDDA
Digitalis lanata	Foxglove, Grecian	MDA (E)
Dipsacus fullonum (Syn Dipsacus sylvestris)	Teasel, common	MDA (E)
Dipsacus laciniatus	Teasel, cut leaf	MDA (E)
Euphorbia esula	Spurge, Leafy	MDA (C); NDDA
Heracleum mantegazzianum	Giant Hogweed	MDA (E)
Hieracium aurantiacum[2]	Orange Hawkweed	MDA (Prohibited - Clearwater County)
Hieracium caespitosum[2]	Yellow Hawkweed	MDA (Prohibited - Clearwater County)
Humulus japonicus	Japanese Hops	MDA (E)
Kochia scoparia	Mexican Fireweed	NDDA
Linaria dalmatica	Dalmation Toadflax	MDA (E); NDDA
Linaria vulgaris	Butter-and-eggs	NDDA
Lonicera japonica	Japanese Honeysuckle	MDA (E)
Lythrum salicaria	Purple Loosestrife	MDA (C); NDDA
Pastinaca sativa	Wild Parsnip	MDA (C)
Polygonum cuspidatum	Japanese Knotweed	MDA (C)
Polygonum sachalinese	Giant Knotweed	MDA (C)
Polygonum x bohemicum	Bohemian Knotweed	MDA (C)
Tamarisk spp.	Saltcedar	NDDA
Tanacetum vulgare	Tansy	MDA (C); Pembina

[1] MDA-Minnesota Department of Agriculture (E-Eradicate, C-Control); NDDA-North Dakota Department of Agriculture; Pembina- Pembina County, North Dakota

[2] Clearwater County Approved Noxious Weeds - MDA Prohibited in Clearwater County Only

Attachment C

Treatment Methods for Target Terrestrial Invasive and Noxious Species

Attachment C
Treatment Methods for Target Terrestrial Invasive and Noxious Species

Species	Common Name	Site Sensitivity	Population Size	Priority	Method Descriptions	Timing	Herbicide*
Bassia scoparia (summer A/F)	**kochia**	Low	Small	1	Low spot mowing / cutting (hand-held or tractor) before flowering. Frequent mowing may be required to minimize regrowth throughout the growing season. Hand pull shallow taproot at early growth stage. Cut / dig tap root below the soil surface.	spring - fall	NO herbicide treatments recommended for small populations and isolated plants
		Low	Large	1	Low spot mowing / cutting (tractor) before flowering is preferred, especially in areas with grasses and desirable vegetation. Frequent mowing may be required to minimize regrowth throughout the growing season. Herbicide should be prioritized for monotypic stands. Preference is to treat plants in early growth stage.	spring - fall ***Special Note:*** *Germination and new flush of seedlings occurs throughout the growing season. Kochia is one of the first annual broadleaf weeds to germinate in spring so treatment may occur before other target plants are treatable.*	For seedlings / small plants use: • fluroxypyr (trade names Vista® XRT and Starane® Ultra), • dicamba (or dicamba + 2,4-D), or • spot treat using aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas For mature plants up to early flowering stage us fluroxypyr (trade names Vista® XRT and Starane® Ultra; non-residual) ***Special Note****: some kochia populations have developed resistance to dicamba and glyphosate. Post-treatment monitoring is recommended.*
		High	All	1	Low spot mowing / cutting (hand-held or tractor) before flowering. Frequent mowing may be required to minimize regrowth. Hand pull shallow taproot at early growth stage. Cut / dig tap root below the soil surface.	spring - fall	NO herbicide treatments recommended for sensitive sites
Carduus acanthoides (B/F)	**plumeless thistle**	Any	Small	1	Hand cut taproots 1 to 2 inches below ground before seed set.	spring to mid-summer	NO herbicide
			Large	1	Spot mow with equipment (hand-held, walk-behind, or tractor) in flower bud stage. Repeat as needed through the season.	early summer	NO herbicide
			All	2	Selectively spot treat individual plants/patches as rosettes or during early bolting phase.	spring to early summer and/or fall	2,4-D ester, aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Centaurea jacea (SLP/F)	**brown knapweed**	Any	All	1	Selectively spot treat rosettes.	spring - fall	aminopyralid, clopyralid
			Small	1	Hand-pull or dig if population is small. Dispose of propagating parts off-site. Use in conjunction with selective spot treatment of rosettes.	spring - fall	aminopyralid, clopyralid
Centaurea stoebe (P/F)	**spotted knapweed**	Low	Small	1	Hand-pull or dig upper 3 inches of crown. Mowing is ineffective for control but may be used in budding stage to extend treatment window. Dispose of propagating parts off-site. Use in conjunction with selective spot treatment of rosettes.	spring - fall	aminopyralid or clopyralid
			All	1	Selectively spot treat in rosette to bud stage.	spring - fall	aminopyralid or clopyralid
		High	Small	1	Hand-pull or dig upper 3 inches of crown. Mowing is ineffective for control but may be used in budding state to extend treatment window. Dispose of propagating parts off-site. Use in conjunction with herbicide treatments.	spring - fall	aminopyralid or clopyralid
			All	1	Selectively spot treat in rosette to bud stage.	spring - fall	aminopyralid or clopyralid
			Large (>1/3 acre)	2	Release biological control agents, seedhead weevils (*Larinus minutus* and *L. obtusus*) and a root-boring weevil (*Cyphocleonus achates*).	Mid-summer - fall	NO herbicide
Cirsium arvense (P/F)	**Canada thistle**	Low	All	1	Selectively spot treat plants as they bolt prior to flower set or rosettes in late summer.	spring or late summer/fall	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands, ditches, and riparian areas
Euphorbia esula (P/F)	**leafy spurge**	Low	All	1	Cut or mow before flower development to suppress seed production. Frequent mowing through growing season is best to weaken plants, then conduct a foliar herbicide application in fall.	mow/cut in spring herbicide in fall	imazapic in late summer / early fall aminocyclopyrachlor (trade name Method®), aminopyralid + florpyrauxifen-benzyl (trade name TerraVue™) when plants are actively growing
			All	2	Spot herbicide foliar application.	spring - fall	
		High	Large (>1/3 acre)	1	For assistance with long-term control, use flea beetles (*Aphthona spp.*) at high stocking rate. Permit not required from USDA but check local regulations. Use herbicide for immediate control and in combination with flea beetles for more effective long-term control. Foliar herbicide application (spot, pistol, or boom spray depending on density of population and presence of desirable plants).	beetle release in spring / early summer herbicide in fall	

Species	Common Name	Site Sensitivity	Population Size	Priority	Method Descriptions	Timing	Herbicide*
Hieracium caespitosum (MP/F)	**yellow hawkweed**	All	All	1	Spot herbicide foliar application to rosettes in spring through bolting stage or rosettes in fall. Cut or mow bolting through early flowering to reduce seed production. Minimize ground disturbance. Follow-up selective spot treatments prior to re-flowering.	spring or fall	aminopyralid, 2,4-D, clopyralid
Hieracium aurantiacum (MP/F)	**orange hawkweed**	All	All	1	Spot herbicide foliar application to rosettes in spring through bolting stage or rosettes in fall. Cut or mow bolting through early flowering to reduce seed production. Minimize ground disturbance. Follow-up selective spot treatments prior to re-flowering.	spring or fall	aminopyralid, 2,4-D, clopyralid
Lythrum salicaria (P/F)	**purple loosestrife**	Low	All	1	Hand-pull or dig small plants. Spot herbicide foliar application through early flowering stage. Cut and collect mature flowers or plants with seed then spot herbicide remaining plant.	spring – summer	aquatic glyphosate, (non-selective) imazamox (trade name Clearcast®), triclopyr choline or amine in standing water and wetlands imazapyr (non-selective) in standing water only (caution: high residual activity in terrestrial settings)
		High	All	1	Hand-pull or dig small plants. Spot herbicide foliar application through early flowering stage.	spring – summer	
			Large	2	For assistance with long-term control, use leaf beetles (*Galerucella calmariensis* and G. *pusilla*). Permit not required from USDA but check local regulations. Use in combination with herbicides for more effective removal.	spring – summer	NO herbicide
Pastinaca sativa (MP or B/F)	**wild parsnip**	All	All	1	Spot herbicide foliar application through early flowering stage. Spot herbicide foliar application to rosettes until first hard frost. Mow or cut at first inflorescence ONLY to minimize seed production. Wear PPE when spraying, cutting, or mowing.	spring - early summer	metsulfuron-methyl aquatic glyphosate (non-selective) or 2,4-D amine in wetlands, ditches, and riparian areas
Tanacetum vulgare (P/F)	**common tansy**	Low	All	1	Cut or mow from bolting through early flowering to suppress growth (avoid contact with sap).	spring	NO herbicide
			All	2	Spot herbicide foliar to rosettes through early bud stage for best results but can continue throughout growing season.	spring - fall	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
		High	All	1	Cut or mow from bolting through early flowering to suppress growth (avoid contact with sap). Integrate with selective spot treatments.	spring	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas

(Life History): A=Annual, P=Perennial, B=Biennial, SLP = Short Lived Perennial, F = Forb, M = Monocarpic

*For herbicide rate follow product label recommendations.

Attachment D

Prioritized Treatment Areas

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Aitkin	MN-AI-035.000	I-51n26w33-b	Cirsium arvense	0-25					Intermittent	Yes	2	High control potential
Aitkin	MN-AI-C5-027.000	I-51n26w32-a	Cirsium arvense	0-25					Intermittent	Yes	2	High control potential
Aitkin	MN-AI-C5-023.000	I-51n26w31-d	Cirsium arvense	0-100					Rare	No	2	High control potential
Aitkin	MN-AI-C5-021.000	I-51n26w31-f	Cirsium arvense	0-100					Rare	No	2	High control potential
Aitkin	MN-AI-C5-023.000	I-51n26w31-ab	Tanacetum vulgare	101-250					Intermittent	Yes	1	High spread risk
Aitkin	MN-AI-C5-025.200	I-51n26w31-aa	Cirsium arvense	51-75	Tanacetum vulgare	76-100			Intermittent	Yes	1	High spread risk
Aitkin	MN-AI-C5-018.000	I-51n27w25-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Aitkin	MN-AI-C5-017.000	I-51n27w25-b	Cirsium arvense	101-500					Rare	No	2	High control potential
Aitkin	MN-AI-C5-015.000	I-51n27w26-h	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Aitkin	MN-AI-077.000	I-51n23w30-f	Toxicodendron radicans	51-75					Intermittent	Yes	3	Safety
Aitkin	MN-AI-C5-009.000	I-51n27w26-e	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Aitkin	MN-AI-C5-006.000	I-51n27w26-f	Cirsium arvense	0-100					Rare	No	2	High control potential
Aitkin	MN-AI-090.000	I-51n23w24-a	Cirsium arvense	751-1000					Common	Yes	2	High control potential
Aitkin	MN-AI-090.000	I-51n23w24-a	Cirsium arvense	1000+						Yes	1	Population size
Aitkin	MN-AI-090.000	I-51n23w24-b	Cirsium arvense	1000+						Yes	1	Population size
Aitkin County	MN-AI-C5-036.000TR	i-50n26w4-bm	Tanacetum vulgare	100s					some	Yes	1	High spread risk
Aitkin County	MN-AI-C5-035.000TR	i-50n26w4-bp	Tanacetum vulgare	100s					some	Yes	1	High spread risk
Carlton	MN-CR-161.000	I-48n16w36-b	Cirsium arvense	101-500					Rare	Yes	2	High control potential
Carlton	MN-CR-161.000	I-48n16w36-a	Tanacetum vulgare	101-500					Rare	No	2	High control potential
Carlton	MN-CR-160.000	I-48n16w36-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Carlton	MN-CR-156.200	I-48n16w35-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Carlton	MN-CR-R51-010.639	I-48n16w35-l	Cirsium arvense	101-500					Rare	No	2	High control potential
Carlton	MN-CR-R51-010.638	I-48n16w35-o	Cirsium arvense	0-100					Rare	No	2	High control potential
Carlton	MN-CR-147.000	I-48n16w34-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Carlton	MN-CR-R51-010.640	I-48n16w35-f	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Carlton	MN-CR-157.200	I-48n16w36-j	Tanacetum vulgare	5000+					Intermittent	Yes	1	Population size
Carlton	MN-CR-156.200	I-48n16w35-d	Tanacetum vulgare	1001-5000					Intermittent	No	1	Population size
Carlton	MN-CR-R51-010.639	I-48n16w35-i	Tanacetum vulgare	1001-5000					Rare	No	1	Population size
Carlton	MN-CR-157.200	I-48n16w36-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Carlton	MN-CR-149.200	I-48n16w35-q	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Carlton	MN-CR-147.000	I-48n16w34-c	Tanacetum vulgare	101-500					Rare	Yes	2	High control potential
Carlton	MN-CR-145.000	I-48n16w34-m	Tanacetum vulgare	501-1000					Intermittent	Yes	2	High control potential
Carlton	MN-CR-145.000	I-48n16w34-n	Cirsium arvense	501-1000					Intermittent	Yes	2	High control potential
Carlton	MN-CR-144.000	I-48n16w34-h	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Carlton	MN-CR-143.000	I-48n16w34-i	Cirsium arvense	0-100					Rare	No	2	High control potential
Carlton	MN-CR-138.000	I-48n16w27-b	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Carlton	MN-CR-135.000	I-48n16w28-f	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Carlton	MN-CR-134.200	I-48n16w28-c	Tanacetum vulgare	101-500					Rare	Yes	2	High control potential
Carlton	MN-CR-134.000	I-48n16w28-d	Tanacetum vulgare	501-1000					Intermittent	Yes	2	High control potential
Carlton	MN-CR-133.000	I-48n16w28-h	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Carlton	MN-CR-131.000	I-48n16w29-g	Centaurea stoebe	0-100					Rare	No	2	High control potential
Carlton	MN-CR-132.000	I-48n16w29-c	Centaurea stoebe	0-100					Rare	No	2	High control potential
Carlton	MN-CR-132.000	I-48n16w29-d	Tanacetum vulgare	101-500					Rare	No	2	High control potential
Carlton	MN-CR-131.000	I-48n16w29-e	Tanacetum vulgare	501-1000					Intermittent	No	2	High control potential
Carlton	MN-CR-127.000	I-48n16w30-c	Tanacetum vulgare	101-500					Rare	No	2	High control potential
Carlton	MN-CR-127.000	I-48n16w30-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Carlton	MN-CR-125.000	I-48n16w30-g	Cirsium arvense	0-100					Rare	No	2	High control potential
Carlton	MN-CR-125.000	I-48n16w30-e	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Carlton	MN-CR-124.000	I-48n16w30-i	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Carlton	MN-CR-123.000	I-48n16w30-h	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Carlton	MN-CR-121.000	I-48n16w19-b	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Carlton	MN-CR-120.000	I-48n16w19-g	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Carlton	MN-CR-119.000	I-48n16w19-e	Tanacetum vulgare	101-500					Rare	No	2	High control potential
Carlton	MN-CR-119.000	I-48n16w19-f	Cirsium arvense	0-100					Rare	No	2	High control potential
Carlton	MN-CR-118.000	I-48n17w24-b	Tanacetum vulgare	501-1000					Common	No	2	High control potential
Carlton	MN-CR-117.000	I-48n17w24-g	Tanacetum vulgare	101-500					Intermittent	Yes	2	High control potential

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Carlton	MN-CR-R51-010.637	I-48n17w24-h	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Carlton	MN-CR-R51-010.637.220	I-48n17w24-l	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Carlton	MN-CR-106.000	I-48n17w13-a	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Carlton	MN-CR-145.000	I-48n16w34-l	Cirsium arvense	101-250	Tanacetum vulgare	0-25				Yes	1	Cluster multiple spp.
Carlton	MN-CR-156.200	I-48n16w35-a	Tanacetum vulgare	1001-5000						No	1	Population size
Carlton	MN-CR-132.210	I-48n16w29-a	Tanacetum vulgare	1001-5000						Yes	1	Population size
Carlton	MN-CR-132.000	I-48n16w29-a	Tanacetum vulgare	1001-5000						Yes	1	Population size
Carlton	MN-CR-157.200	I-48n16w36-k	Tanacetum vulgare	1001-5000						No	1	Population size
Carlton	MN-CR-132.000	I-48n16w29-b	Tanacetum vulgare	1001-5000	Centaurea stoebe	251-500	Cirsium arvense			No	1	Cluster multiple spp.
Carlton	MN-CR-122.000	I-48n16w30-f	Tanacetum vulgare	1001-5000	Cirsium arvense	101-250				No	1	Cluster multiple spp.
Carlton	MN-CR-123.000	I-48n16w30-f	Tanacetum vulgare	1001-5000	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Carlton	MN-CR-124.000	I-48n16w30-f	Tanacetum vulgare	1001-5000	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Carlton	MN-CR-125.000	I-48n16w30-f	Tanacetum vulgare	1001-5000	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Carlton	MN-CR-125.000	I-48n16w30-f	Tanacetum vulgare	1001-5000	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Carlton	MN-CR-131.200	I-48n16w29-i	Tanacetum vulgare	1001-5000	Cirsium arvense	251-500	Centaurea stoebe			No	1	Cluster multiple spp.
Carlton	MN-CR-130.000	I-48n16w29-i	Tanacetum vulgare	1001-5000	Cirsium arvense	251-500	Centaurea stoebe			Yes	1	Cluster multiple spp.
Carlton	MN-CR-131.000	I-48n16w29-i	Tanacetum vulgare	1001-5000	Cirsium arvense	251-500	Centaurea stoebe			No	1	Cluster multiple spp.
Carlton	MN-CR-159.000	I-48n16w36-h	Tanacetum vulgare	101-250						No	2	High control potential
Carlton	MN-CR-119.000	I-48n16w19-d	Tanacetum vulgare	101-250						Yes	2	High control potential
Carlton	MN-CR-120.000	I-48n16w19-d	Tanacetum vulgare	101-250						Yes	2	High control potential
Carlton	MN-CR-127.000	I-48n16w30-b	Tanacetum vulgare	101-250						Yes	2	High control potential
Carlton	MN-CR-117.000	I-48n17w24-d	Tanacetum vulgare	101-250						No	2	High control potential
Carlton	MN-CR-R51-010.637.220	I-48n17w24-k	Tanacetum vulgare	101-250						No	2	High control potential
Carlton	MN-CR-R51-010.637.220	I-48n17w24-k	Tanacetum vulgare	101-250						No	2	High control potential
Carlton	MN-CR-R51-010.637.220	I-48n17w24-k	Tanacetum vulgare	101-250						No	2	High control potential
Carlton	MN-CR-143.000	I-48n16w34-k	Tanacetum vulgare	101-250	Cirsium arvense	0-25				No	1	Cluster multiple spp.
Carlton	MN-CR-R51-010.639	I-48n16w35-j	Tanacetum vulgare	101-250	Cirsium arvense	0-25				No	1	Cluster multiple spp.
Carlton	MN-CR-118.000	I-48n17w24-a	Tanacetum vulgare	101-250	Cirsium arvense	0-25				No	1	Cluster multiple spp.
Carlton	MN-CR-147.000	I-48n16w34-b	Tanacetum vulgare	101-250	Cirsium arvense	26-50				Yes	1	Cluster multiple spp.
Carlton	MN-CR-145.000	I-48n16w34-d	Tanacetum vulgare	101-250	Cirsium arvense	26-50				Yes	1	Cluster multiple spp.
Carlton	MN-CR-144.000	I-48n16w34-e	Tanacetum vulgare	101-250	Cirsium arvense	26-50				Yes	1	Cluster multiple spp.
Carlton	MN-CR-145.000	I-48n16w34-e	Tanacetum vulgare	101-250	Cirsium arvense	26-50				Yes	1	Cluster multiple spp.
Carlton	MN-CR-156.200	I-48n16w35-b	Tanacetum vulgare	251-500						No	2	High control potential
Carlton	MN-CR-156.200	I-48n16w35-b	Tanacetum vulgare	251-500						No	2	High control potential
Carlton	MN-CR-156.200	I-48n16w35-b	Tanacetum vulgare	251-500						No	2	High control potential
Carlton	MN-CR-R51-010.635	I-48n17w13-b	Tanacetum vulgare	251-500						No	2	High control potential
Carlton	MN-CR-R51-010.635	I-48n17w13-b	Tanacetum vulgare	251-500						No	2	High control potential
Carlton	MN-CR-118.000	I-48n17w24-c	Tanacetum vulgare	251-500						No	2	High control potential
Carlton	MN-CR-133.000	I-48n16w28-g	Tanacetum vulgare	251-500						Yes	2	High control potential
Carlton	MN-CR-R51-010.638	I-48n16w35-k	Tanacetum vulgare	251-500	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Carlton	MN-CR-R51-010.639	I-48n16w35-k	Tanacetum vulgare	251-500	Cirsium arvense	0-25				No	1	Cluster multiple spp.
Carlton	MN-CR-121.000	I-48n16w19-a	Tanacetum vulgare	251-500	Cirsium arvense	26-50	Centaurea stoebe			No	1	Cluster multiple spp.
Carlton	MN-CR-144.000	I-48n16w34-f	Tanacetum vulgare	251-500	Cirsium arvense	51-100				Yes	4	Streambank cover concerns
Carlton	MN-CR-134.000	I-48n16w28-e	Tanacetum vulgare	501-1000						Yes	1	Cluster multiple spp.
Carlton	MN-CR-135.000	I-48n16w28-e	Tanacetum vulgare	501-1000						Yes	1	Cluster multiple spp.
Carlton	MN-CR-127.000	I-48n16w30-a	Tanacetum vulgare	501-1000						Yes	1	Cluster multiple spp.
Carlton	MN-CR-117.000	I-48n17w24-e	Tanacetum vulgare	501-1000						Yes	1	Cluster multiple spp.
Carlton	MN-CR-117.000	I-48n17w24-e	Tanacetum vulgare	501-1000						Yes	1	Cluster multiple spp.
Carlton	MN-CR-117.000	I-48n17w24-f	Tanacetum vulgare	501-1000						No	1	Cluster multiple spp.
Carlton	MN-CR-R51-010.637	I-48n17w24-f	Tanacetum vulgare	501-1000						No	1	Cluster multiple spp.
Carlton	MN-CR-131.200	I-48n16w29-f	Tanacetum vulgare	501-1000	Centaurea stoebe	0-25	Cirsium arvense			Yes	1	Cluster multiple spp.
Carlton	MN-CR-131.200	I-48n16w29-f	Tanacetum vulgare	501-1000	Centaurea stoebe	0-25	Cirsium arvense			No	1	Cluster multiple spp.
Carlton	MN-CR-131.000	I-48n16w29-f	Tanacetum vulgare	501-1000	Centaurea stoebe	0-25	Cirsium arvense			Yes	1	Cluster multiple spp.
Carlton	MN-CR-143.000	I-48n16w34-g	Tanacetum vulgare	501-1000	Cirsium arvense	101-250				No	1	Cluster multiple spp.
Carlton	MN-CR-144.000	I-48n16w34-g	Tanacetum vulgare	501-1000	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Cass	MN-CW-C5-011.000	I-138n29w14-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential

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Cass	MN-CW-C5-007.000	I-138n29w14-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CW-C5-012.000	I-138n29w14-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CW-C5-013.000	I-138n29w11-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-031.000	I-138n30w8-b	Cirsium arvense	0-100					Common	No	2	High control potential
Cass	MN-CA-C5-069.100	I-138n29w9-e	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-032.000	I-138n30w8-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-038.000	I-138n30w8-f	Centaurea stoebe	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-067.000	I-138n29w9-i	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-069.000	I-138n29w9-h	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-069.000	I-138n29w9-g	Carduus acanthoides	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-030.000	I-138n30w8-a	Cirsium arvense	0-100					Common	No	2	High control potential
Cass	MN-CW-C5-015.000	I-138n29w12-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-066.000	I-138n29w9-m	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Cass	MN-CA-C5-065.000	I-138n29w8-b	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-065.000	I-138n29w8-a	Centaurea stoebe	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-064.000	I-138n29w8-e	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-059.000	I-138n29w7-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-047.000	I-138n30w10-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-049.000	I-138n30w11-d	Cirsium arvense	101-500					Rare	No	2	High control potential
Cass	MN-CA-C5-050.000	I-138n30w11-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-052.000	I-138n30w11-e	Centaurea stoebe	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-052.000	I-138n30w12-b	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Cass	MN-CA-C5-051.000	I-138n30w11-b	Carduus acanthoides	0-100					Rare	No	2	High control potential
Cass	MN-CW-C5-018.000	I-138n29w12-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-006.000	I-138n32w4-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-001.530	I-138n32w5-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-010.000	I-138n32w3-b	Tanacetum vulgare	0-100					Rare	Yes	1	High spread risk
Cass	MN-CA-C5-010.000	I-138n32w3-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-018.000	I-138n31w5-a	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-093.000	I-139n28w26-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-091.300	I-139n28w27-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-096.000	I-139n28w25-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-099.000	I-139n28w24-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-101.000	I-139n28w24-b	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-135.000	I-139n26w20-b	Cirsium arvense	501-1000					Intermittent	No	2	High control potential
Cass	MN-CA-C5-136.000	I-139n26w20-c	Cirsium arvense	101-500					Rare	No	2	High control potential
Cass	MN-CA-C5-104.000	I-139n27w19-e	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-139.000	I-139n26w21-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-139.200	I-139n26w21-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-132.000	I-139n26w19-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-106.000	I-139n27w19-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-130.000	I-139n26w19-d	Cirsium arvense	101-500					Rare	Yes	2	High control potential
Cass	MN-CA-C5-127.000	I-139n27w24-b	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-127.000	I-139n27w24-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-113.000	I-139n27w21-f	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-113.000	I-139n27w21-e	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-111.000	I-139n27w20-c	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-115.000	I-139n27w21-b	Cirsium arvense	101-500					Rare	Yes	2	High control potential
Cass	MN-CA-C5-126.000	I-139n27w24-e	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-126.200	I-139n27w13-b	Cirsium arvense	0-100					Rare	No	1	High spread risk
Cass	MN-CA-C5-117.200	I-139n27w15-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-119.200	I-139n27w15-a	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Cass	MN-CA-C5-119.200	I-139n27w15-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-148.300	I-139n26w15-k	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Cass	MN-CA-C5-066.000	I-138n29w9-l	Centaurea stoebe	1001-5000						No	1	Population size
Cass	MN-CA-C5-126.000	I-139n27w13-a	Centaurea stoebe	101-250						Yes	2	High control potential

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Cass	MN-CA-C5-126.200	I-139n27w13-a	Centaurea stoebe	101-250						Yes	2	High control potential
Cass	MN-CA-C5-127.000	I-139n27w13-a	Centaurea stoebe	101-250						Yes	2	High control potential
Cass	MN-CA-C5-127.200	I-139n27w13-a	Centaurea stoebe	101-250						Yes	2	High control potential
Cass	MN-CA-C5-066.000	I-138n29w9-a	Centaurea stoebe	5000+						No	1	Population size
Cass	MN-CA-C5-066.000	I-138n29w9-a	Centaurea stoebe	5000+						No	1	Population size
Cass	MN-CA-C5-085.000	I-139n28w28-c	Cirsium arvense	101-250						Yes	2	High control potential
Clearwater	MN-CL-C5-122.000	I-144n36w24-e	Centaurea stoebe	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-122.000	I-144n36w24-d	Centaurea stoebe	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-122.000	I-144n36w24-c	Tanacetum vulgare	501-1000					Common	Yes	2	High control potential
Clearwater	MN-CL-C5-119.300	I-144n36w13-i	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-119.300	I-144n36w13-j	Cirsium arvense	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-115.000	I-144n36w13-e	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-113.000	I-144n36w13-d	Centaurea stoebe	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-113.000	I-144n36w13-c	Carduus acanthoides	1001-5000					Common	Yes	1	Population size
Clearwater	MN-CL-C5-113.000	I-144n36w13-b	Tanacetum vulgare	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-112.000	I-144n36w12-a	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-112.000	I-144n36w12-s	Tanacetum vulgare	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-112.000	I-144n36w12-q	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-111.000	I-144n36w12-n	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-111.000	I-144n36w12-m	Tanacetum vulgare	101-500					Common	No	2	High control potential
Clearwater	MN-CL-C5-111.000	I-144n36w12-l	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-110.000	I-144n36w12-k	Centaurea stoebe	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-110.000	I-144n36w12-j	Cirsium arvense	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-110.000	I-144n36w12-i	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-109.000	I-144n36w12-h	Cirsium arvense	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-109.000	I-144n36w12-g	Centaurea stoebe	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-109.000	I-144n36w12-f	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-107.000	I-144n36w12-d	Centaurea stoebe	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-107.000	I-144n36w12-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-107.000	I-144n36w11-b	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-107.000	I-144n36w11-a	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-106.000	I-144n36w11-c	Centaurea stoebe	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-106.000	I-144n36w2-p	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-106.000	I-144n36w2-o	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-106.000	I-144n36w2-n	Tanacetum vulgare	101-500					Common	No	2	High control potential
Clearwater	MN-CL-C5-105.000	I-144n36w2-j	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-105.000	I-144n36w2-h	Cirsium arvense	501-1000					Common	No	2	High control potential
Clearwater	MN-CL-C5-102.000	I-144n36w2-d	Tanacetum vulgare	101-500					Common	No	2	High control potential
Clearwater	MN-CL-C5-104.000	I-144n36w2-f	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-104.000	I-144n36w2-e	Tanacetum vulgare	101-500					Common	Yes	2	High control potential
Clearwater	MN-CL-C5-099.000	I-145n36w35-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-098.000	I-145n36w35-a	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-097.000	I-145n36w26-u	Centaurea stoebe	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-097.000	I-145n36w26-p	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-096.000	I-145n36w26-n	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-095.000	I-145n36w26-h	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-095.000	I-145n36w26-e	Carduus acanthoides	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-095.000	I-145n36w26-d	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-095.000	I-145n36w26-c	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-057.000	I-146n37w12-c	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-055.210	I-146n37w12-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-054.000	I-146n37w2-m	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-054.000	I-146n37w2-l	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-053.000	I-146n37w2-k	Centaurea stoebe	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-053.000	I-146n37w2-i	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-053.000	I-146n37w2-h	Cirsium arvense	501-1000					Common	No	2	High control potential

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Clearwater	MN-CL-C5-053.000	I-146n37w2-g	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-051.000	I-146n37w2-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-051.000	I-146n37w2-b	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-051.000	I-146n37w2-a	Centaurea stoebe	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-050.000	I-146n37w3-a	Centaurea stoebe	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-050.000	I-146n37w3-c	Carduus acanthoides	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-049.000	I-147n37w34-q	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-049.000	I-147n37w34-n	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-049.000	I-147n37w34-l	Cirsium arvense	501-1000					Common	Yes	2	High control potential
Clearwater	MN-CL-C5-049.000	I-147n37w34-j	Carduus acanthoides	501-1000					Common	Yes	2	High control potential
Clearwater	MN-CL-C5-046.000	I-147n37w34-h	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-046.000	I-147n37w34-c	Carduus acanthoides	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-046.000	I-147n37w34-b	Cirsium arvense	501-1000					Common	No	2	High control potential
Clearwater	MN-CL-C5-046.000	I-147n37w34-a	Centaurea stoebe	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-044.000	I-147n37w27-d	Cirsium arvense	501-1000					Common	No	2	High control potential
Clearwater	MN-CL-C5-044.000	I-147n37w27-b	Centaurea stoebe	501-1000					Common	No	2	High control potential
Clearwater	MN-CL-C5-044.000	I-147n37w27-a	Carduus acanthoides	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-043.000	I-147n37w28-n	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-043.000	I-147n37w28-l	Centaurea stoebe	1001-5000					Common	No	1	Population size
Clearwater	MN-CL-C5-043.000	I-147n37w28-k	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-043.000	I-147n37w28-j	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-042.000	I-147n37w28-h	Centaurea stoebe	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-042.000	I-147n37w28-g	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-042.000	I-147n37w28-e	Carduus acanthoides	0-100					Rare	No	2	High control potential
Clearwater	MN-CL-C5-041.000	I-147n37w28-c	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-038.000	I-147n37w21-o	Centaurea stoebe	0-100					Common	Yes	2	High control potential
Clearwater	MN-CL-C5-038.000	I-147n37w21-p	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-037.000	I-147n37w21-n	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-037.000	I-147n37w21-m	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-036.000	I-147n37w21-k	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-036.000	I-147n37w21-j	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-034.000	I-147n37w21-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-034.000	I-147n37w21-b	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-031.000	I-147n37w17-k	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-029.000	I-147n37w8-k	Carduus acanthoides	0-100					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-029.000	I-147n37w8-l	Cirsium arvense	0-100					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-028.000	I-147n37w8-i	Carduus acanthoides	501-1000					Common	No	2	High control potential
Clearwater	MN-CL-C5-025.000	I-147n37w5-l	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-025.000	I-147n37w5-j	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-024.000	I-147n37w5-f	Centaurea stoebe	501-1000					Common	No	2	High control potential
Clearwater	MN-CL-C5-023.000	I-147n37w5-d	Cirsium arvense	0-100					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-019.000	I-148n37w32-a	Centaurea stoebe	101-500					Common	Yes	2	High control potential
Clearwater	MN-CL-C5-018.000	I-148n37w29-n	Centaurea stoebe	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-017.000	I-148n37w29-g	Cirsium arvense	101-500					Common	No	2	High control potential
Clearwater	MN-CL-C5-017.000	I-148n37w29-f	Centaurea stoebe	501-1000					Common	No	2	High control potential
Clearwater	MN-CL-C5-016.000	I-148n37w29-a	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-016.000	I-148n37w29-b	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-013.000	I-148n37w17-n	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-012.000	I-148n37w17-i	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-011.000	I-148n37w17-b	Cirsium arvense	501-1000					Common	Yes	2	High control potential
Clearwater	MN-CL-C5-011.000	I-148n37w17-a	Centaurea stoebe	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-010.000	I-148n37w8-n	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-010.000	I-148n37w8-l	Lythrum salicaria, virgatum	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-008.000	I-148n37w8-c	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-008.000	I-148n37w8-e	Centaurea stoebe	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-007.000	I-148n37w7-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential

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Clearwater	MN-CL-C5-007.000	I-148n37w7-a	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-006.000	I-148n37w6-t	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-006.000	I-148n37w6-s	Centaurea stoebe	0-100					Intermittent	No	2	High control potential
Clearwater	MN-CL-C5-020.310	I-149n37w32-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-020.300	I-149n37w32-d	Centaurea stoebe	0-100					Intermittent	Yes	2	High control potential
Clearwater	MN-CL-C5-020.300	I-149n37w32-f	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-020.300	I-149n37w32-g	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-021.310	I-149n37w32-o	Carduus acanthoides	0-100					Rare	No	2	High control potential
Clearwater	T-709	I-149n37w30-f	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	T-0707-OL	I-149n37w28-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	T-0708-A-1	I-149n37w29-aa	Cirsium arvense	26-50	Centaurea stoebe	0-25			Rare	Yes	1	Cluster multiple spp.
Clearwater	T-0708-A	I-149n37w29-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	T-710	I-149n37w30-d	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Clearwater	T-710	I-149n37w30-c	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Clearwater	T-710	I-149n37w30-g	Centaurea stoebe	0-100					Rare	No	2	High control potential
Clearwater	T-712	I-149n38w25-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Clearwater	T-712	I-149n38w25-b	Carduus acanthoides	501-1000					Intermittent	Yes	2	High control potential
Clearwater	T-714A	I-149n38w25-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	T-714A	I-149n38w25-d	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Clearwater	T-714	I-149n38w24-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	T-716A	I-149n38w23-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	T-716	I-149n38w23-d	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Clearwater	T-720	I-149n38w22-a	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Clearwater	T-720	I-149n38w22-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	T-721	I-149n38w15-c	Carduus acanthoides	0-100					Rare	No	2	High control potential
Clearwater	T-721A	I-149n38w15-a	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Clearwater	T-722A	I-149n38w16-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	T-723	I-149n38w16-b	Cirsium arvense	501-1000					Intermittent	Yes	2	High control potential
Clearwater	T-725	I-149n38w16-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	T-725	I-149n38w16-c	Carduus acanthoides	101-500					Intermittent	Yes	2	High control potential
Clearwater	T-725	I-149n38w16-e	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Clearwater	T-726	I-149n38w9-b	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Clearwater	T-726	I-149n38w9-a	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Clearwater	T-726	I-149n38w9-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Clearwater	T-727	I-149n38w8-c	Carduus acanthoides	0-100					Rare	No	2	High control potential
Clearwater	T-728	I-149n38w8-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Clearwater	T-729	I-149n38w8-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	T-731	I-149n38w7-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Clearwater	T-732	I-149n38w7-a	Cirsium arvense	501-1000					Intermittent	Yes	2	High control potential
Clearwater	T-733	I-149n38w6-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Clearwater	MN-CL-C5-044.000	I-147n37w27-f	Carduus acanthoides	1001-5000	Cirsium arvense	101-250				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-049.000	I-147n37w34-k	Carduus acanthoides	101-250	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-012.000	I-148n37w17-j	Carduus acanthoides	251-500						No	2	High control potential
Clearwater	MN-CL-C5-027.000	I-147n37w8-f	Carduus acanthoides	251-500						Yes	2	High control Potential
Clearwater	MN-CL-C5-030.000	I-147n37w17-d	Carduus acanthoides	251-500	Centaurea stoebe	101-250				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-047.000	I-147n37w34-f	Carduus acanthoides	251-500	Centaurea stoebe	101-250	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-049.000	I-147n37w34-i	Carduus acanthoides	5000+	Centaurea stoebe	501-1000	Cirsium arvense			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-030.000	I-147n37w17-e	Carduus acanthoides	501-1000	Centaurea stoebe	0-25				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-028.000	I-147n37w8-h	Carduus acanthoides	501-1000	Centaurea stoebe	251-500				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-093.000	I-145n36w23-d	Carduus acanthoides	501-1000	Centaurea stoebe	5000+				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-106.000	I-144n36w11-d	Carduus acanthoides	501-1000	Tanacetum vulgare	251-500	Cirsium arvense	Centaurea stoebe		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-107.000	I-144n36w11-d	Carduus acanthoides	501-1000	Tanacetum vulgare	251-500	Cirsium arvense	Centaurea stoebe		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-027.000	I-147n37w8-e	Carduus acanthoides	51-100						No	2	High control potential
Clearwater	T-716	I-149n38w23-h	Carduus nutans	1001-5000	Carduus acanthoides					Yes	1	Cluster multiple spp.
Clearwater	T-716	I-149n38w23-e	Carduus nutans	1001-5000	Carduus acanthoides	501-1000	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	T-717	I-149n38w23-e	Carduus nutans	1001-5000	Carduus acanthoides	501-1000	Cirsium arvense			Yes	1	Cluster multiple spp.

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Clearwater	MN-CL-C5-036.000	I-147n37w21-l	Centaurea stoebe	1001-5000						Yes	1	Population size
Clearwater	MN-CL-C5-004.000	I-148n37w6-b	Centaurea stoebe	1001-5000						Yes	1	Population size
Clearwater	MN-CL-C5-024.000	I-147n37w5-g	Centaurea stoebe	1001-5000	Carduus acanthoides	0-25				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-024.000	I-147n37w5-g	Centaurea stoebe	1001-5000	Carduus acanthoides	0-25				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-025.000	I-147n37w5-i	Centaurea stoebe	1001-5000	Carduus acanthoides	0-25	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-017.000	I-148n37w29-j	Centaurea stoebe	1001-5000	Cirsium arvense	0-25	Carduus acanthoides			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-044.000	I-147n37w27-e	Centaurea stoebe	1001-5000	Cirsium arvense	0-25	Carduus acanthoides			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-006.000	I-148n37w6-u	Centaurea stoebe	1001-5000	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-006.000	I-148n37w6-u	Centaurea stoebe	1001-5000	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-015.000	I-148n37w20-g	Centaurea stoebe	1001-5000	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-015.000	I-148n37w20-g	Centaurea stoebe	1001-5000	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-018.200	I-148n37w29-u	Centaurea stoebe	1001-5000	Cirsium arvense	251-500	Carduus acanthoides			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-018.200	I-148n37w29-u	Centaurea stoebe	1001-5000	Cirsium arvense	251-500	Carduus acanthoides			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-018.200	I-148n37w29-u	Centaurea stoebe	1001-5000	Cirsium arvense	251-500	Carduus acanthoides			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-018.000	I-148n37w29-p	Centaurea stoebe	1001-5000	Cirsium arvense	26-50				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-018.000	I-148n37w29-p	Centaurea stoebe	1001-5000	Cirsium arvense	26-50				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-020.300	I-149n37w32-e	Centaurea stoebe	1001-5000	Cirsium arvense	26-50				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-005.000	I-148n37w6-l	Centaurea stoebe	1001-5000	Cirsium arvense	26-50	Rhamnus cathartica			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-023.000	I-147n37w5-c	Centaurea stoebe	1001-5000	Cirsium arvense	51-100				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-024.000	I-147n37w5-c	Centaurea stoebe	1001-5000	Cirsium arvense	51-100				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-020.300	I-149n37w32-i	Centaurea stoebe	1001-5000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-020.300	I-149n37w32-i	Centaurea stoebe	1001-5000	Cirsium arvense	51-100				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-020.300	I-149n37w32-i	Centaurea stoebe	1001-5000	Cirsium arvense	51-100				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-020.300	I-149n37w32-i	Centaurea stoebe	1001-5000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-042.000	I-147n37w28-i	Centaurea stoebe	1001-5000	Cirsium arvense	51-100	Tanacetum vulgare	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-015.000	I-148n37w20-h	Centaurea stoebe	251-500	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-030.000	I-147n37w17-g	Centaurea stoebe	5000+	Carduus acanthoides	101-250				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-031.000	I-147n37w17-g	Centaurea stoebe	5000+	Carduus acanthoides	101-250				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-029.000	I-147n37w8-j	Centaurea stoebe	5000+	Carduus acanthoides	26-50	Cirsium arvense			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-029.000	I-147n37w8-j	Centaurea stoebe	5000+	Carduus acanthoides	26-50	Cirsium arvense			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-029.000	I-147n37w8-j	Centaurea stoebe	5000+	Carduus acanthoides	26-50	Cirsium arvense			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-031.000	I-147n37w17-h	Centaurea stoebe	5000+	Carduus acanthoides	501-1000	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-004.000	I-148n37w6-g	Centaurea stoebe	5000+	Cirsium arvense	0-25	Carduus acanthoides			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-004.000	I-148n37w6-g	Centaurea stoebe	5000+	Cirsium arvense	0-25	Carduus acanthoides			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-016.000	I-148n37w29-d	Centaurea stoebe	5000+	Cirsium arvense	26-50				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-019.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-019.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-019.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-019.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-020.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-020.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-020.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-020.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-021.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-021.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-021.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-021.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-022.000	I-148n37w32-b	Centaurea stoebe	5000+	Tanacetum vulgare	5000+	Cirsium arvense	Carduus acanthoides		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-004.000	I-148n37w6-h	Centaurea stoebe	501-1000						Yes	2	High control potential
Clearwater	MN-CL-C5-023.000	I-147n37w5-a	Centaurea stoebe	501-1000						No	2	High control potential
Clearwater	MN-CL-C5-010.000	I-148n37w8-o	Centaurea stoebe	501-1000						Yes	2	High control potential
Clearwater	MN-CL-C5-055.000	I-146n37w11-b	Centaurea stoebe	501-1000	Carduus acanthoides	0-25	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-008.000	I-148n37w8-g	Centaurea stoebe	501-1000	Carduus acanthoides	0-25	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-049.000	I-147n37w34-m	Centaurea stoebe	501-1000	Carduus acanthoides	101-250	Cirsium arvense			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-049.000	I-147n37w34-m	Centaurea stoebe	501-1000	Carduus acanthoides	101-250	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-030.000	I-147n37w17-f	Centaurea stoebe	501-1000	Carduus acanthoides	251-500				No	1	Cluster multiple spp.

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Clearwater	MN-CL-C5-030.000	I-147n37w17-b	Centaurea stoebe	501-1000	Carduus acanthoides	26-50				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-009.000	I-148n37w8-h	Centaurea stoebe	501-1000	Carduus acanthoides	26-50				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-054.000	I-146n37w2-n	Centaurea stoebe	501-1000	Carduus acanthoides	26-50	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-049.000	I-147n37w34-r	Centaurea stoebe	501-1000	Carduus acanthoides	51-100				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-049.000	I-147n37w34-o	Centaurea stoebe	501-1000	Carduus acanthoides	51-100	Cirsium arvense			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-049.000	I-147n37w34-p	Centaurea stoebe	501-1000	Carduus acanthoides	51-100	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-008.000	I-148n37w8-d	Centaurea stoebe	501-1000	Carduus acanthoides	51-100	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-008.000	I-148n37w8-d	Centaurea stoebe	501-1000	Carduus acanthoides	51-100	Cirsium arvense			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-008.000	I-148n37w8-d	Centaurea stoebe	501-1000	Carduus acanthoides	51-100	Cirsium arvense			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-004.000	I-148n37w6-i	Centaurea stoebe	501-1000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-005.000	I-148n37w6-i	Centaurea stoebe	501-1000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-017.000	I-148n37w29-h	Centaurea stoebe	501-1000	Cirsium arvense	0-25				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-017.000	I-148n37w29-i	Centaurea stoebe	501-1000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-044.000	I-147n37w27-c	Centaurea stoebe	501-1000	Cirsium arvense	0-25				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-043.000	I-147n37w28-m	Centaurea stoebe	501-1000	Cirsium arvense	0-25				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-034.000	I-147n37w21-f	Centaurea stoebe	501-1000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-007.000	I-148n37w7-b	Centaurea stoebe	501-1000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-015.000	I-148n37w20-i	Centaurea stoebe	501-1000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-046.000	I-147n37w34-d	Centaurea stoebe	501-1000	Cirsium arvense	0-25	Tanacetum vulgare			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-041.000	I-147n37w28-d	Centaurea stoebe	501-1000	Cirsium arvense	251-500				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-042.000	I-147n37w28-d	Centaurea stoebe	501-1000	Cirsium arvense	251-500				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-042.000	I-147n37w28-d	Centaurea stoebe	501-1000	Cirsium arvense	251-500				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-005.000	I-148n37w6-m	Centaurea stoebe	501-1000	Cirsium arvense	26-50				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-005.000	I-148n37w6-q	Centaurea stoebe	501-1000	Cirsium arvense	26-50				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-005.000	I-148n37w6-o	Centaurea stoebe	501-1000	Cirsium arvense	26-50	Tanacetum vulgare			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-018.000	I-148n37w29-m	Centaurea stoebe	501-1000	Cirsium arvense	26-50	Tanacetum vulgare			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-096.000	I-145n36w26-o	Centaurea stoebe	501-1000	Cirsium arvense	501-1000	Carduus acanthoides			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-097.000	I-145n36w26-t	Centaurea stoebe	501-1000	Cirsium arvense	501-1000	Carduus acanthoides	Tanacetum vulgare		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-034.000	I-147n37w21-e	Centaurea stoebe	501-1000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-007.000	I-148n37w7-d	Centaurea stoebe	501-1000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-005.000	I-148n37w6-r	Centaurea stoebe	501-1000	Cirsium arvense	51-100				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-005.000	I-148n37w6-r	Centaurea stoebe	501-1000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-020.300	I-149n37w32-h	Centaurea stoebe	501-1000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-018.000	I-148n37w29-o	Centaurea stoebe	501-1000	Cirsium arvense	51-100	Tanacetum vulgare			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-018.000	I-148n37w29-o	Centaurea stoebe	501-1000	Cirsium arvense	51-100	Tanacetum vulgare			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-011.000	I-148n37w17-d	Cirsium arvense	101-250						No	2	High control potential
Clearwater	MN-CL-C5-041.000	I-147n37w28-b	Cirsium arvense	101-250						No	2	High control potential
Clearwater	MN-CL-C5-011.000	I-148n37w17-e	Cirsium arvense	101-250	Carduus acanthoides	0-25				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-053.000	I-146n37w2-j	Cirsium arvense	101-250	Carduus acanthoides	0-25				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-012.000	I-148n37w17-k	Cirsium arvense	251-500						Yes	2	High control potential
Clearwater	MN-CL-C5-011.000	I-148n37w17-c	Cirsium arvense	251-500						Yes	2	High control potential
Clearwater	MN-CL-C5-011.000	I-148n37w17-f	Cirsium arvense	501-1000	Carduus acanthoides	0-25				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-095.000	I-145n36w26-g	Cirsium arvense	501-1000	Carduus acanthoides	251-500				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-095.000	I-145n36w26-g	Cirsium arvense	501-1000	Carduus acanthoides	251-500				No	1	Cluster multiple spp.
Clearwater	T-721	I-149n38w15-d	Cirsium arvense	501-1000	Carduus acanthoides	251-500	Tanacetum vulgare			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-095.000	I-145n36w26-f	Cirsium arvense	501-1000	Carduus acanthoides	51-100				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-095.000	I-145n36w26-i	Cirsium arvense	501-1000	Carduus acanthoides	51-100	Tanacetum vulgare			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-095.000	I-145n36w26-i	Cirsium arvense	501-1000	Carduus acanthoides	51-100	Tanacetum vulgare			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-015.000	I-148n37w20-f	Lythrum salicaria, virgatum	501-1000						Yes	2	High control potential
Clearwater	MN-CL-C5-020.310	I-149n37w32-b	Rhamnus cathartica	501-1000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-020.310	I-149n37w32-b	Rhamnus cathartica	501-1000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-122.000	I-144n36w24-b	Tanacetum vulgare	1001-5000	Centaurea stoebe	1001-5000	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-122.000	I-144n36w24-b	Tanacetum vulgare	1001-5000	Centaurea stoebe	1001-5000	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-093.000	I-145n36w23-e	Tanacetum vulgare	251-500						Yes	2	High control potential
Clearwater	MN-CL-C5-122.000	I-144n36w24-g	Tanacetum vulgare	251-500	Centaurea stoebe	51-100				Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-104.000	I-144n36w2-g	Tanacetum vulgare	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Centaurea stoebe		Yes	1	Cluster multiple spp.

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Clearwater	MN-CL-C5-105.000	I-144n36w2-g	Tanacetum vulgare	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Centaurea stoebe		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-105.000	I-144n36w2-l	Tanacetum vulgare	5000+	Carduus acanthoides	501-1000	Cirsium arvense	Centaurea stoebe		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-105.000	I-144n36w2-m	Tanacetum vulgare	5000+	Centaurea stoebe	501-1000	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-105.000	I-144n36w2-m	Tanacetum vulgare	5000+	Centaurea stoebe	501-1000	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-107.000	I-144n36w12-e	Tanacetum vulgare	5000+	Cirsium arvense	5000+	Carduus acanthoides	Centaurea stoebe		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-108.000	I-144n36w12-e	Tanacetum vulgare	5000+	Cirsium arvense	5000+	Carduus acanthoides	Centaurea stoebe		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-108.000	I-144n36w12-e	Tanacetum vulgare	5000+	Cirsium arvense	5000+	Carduus acanthoides	Centaurea stoebe		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-108.000	I-144n36w12-e	Tanacetum vulgare	5000+	Cirsium arvense	5000+	Carduus acanthoides	Centaurea stoebe		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-109.000	I-144n36w12-e	Tanacetum vulgare	5000+	Cirsium arvense	5000+	Carduus acanthoides	Centaurea stoebe		No	1	High spread risk
Clearwater	MN-CL-C5-102.000	I-144n36w2-a	Tanacetum vulgare	5000+	Cirsium arvense	501-1000	Centaurea stoebe	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-102.000	I-144n36w2-a	Tanacetum vulgare	5000+	Cirsium arvense	501-1000	Centaurea stoebe	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-103.000	I-144n36w2-a	Tanacetum vulgare	5000+	Cirsium arvense	501-1000	Centaurea stoebe	Carduus acanthoides		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-112.000	I-144n36w13-a	Tanacetum vulgare	501-1000	Carduus acanthoides	0-25	Cirsium arvense	Centaurea stoebe		No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-113.000	I-144n36w13-a	Tanacetum vulgare	501-1000	Carduus acanthoides	0-25	Cirsium arvense	Centaurea stoebe		Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-110.000	I-144n36w12-o	Tanacetum vulgare	501-1000	Centaurea stoebe	501-1000	Cirsium arvense			No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-111.000	I-144n36w12-o	Tanacetum vulgare	501-1000	Centaurea stoebe	501-1000	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-111.000	I-144n36w12-o	Tanacetum vulgare	501-1000	Centaurea stoebe	501-1000	Cirsium arvense			Yes	1	Cluster multiple spp.
Clearwater	MN-CL-C5-119.300	I-144n36w13-k	Tanacetum vulgare	501-1000	Cirsium arvense	0-25				No	1	Cluster multiple spp.
Clearwater	MN-CL-C5-112.000	I-144n36w12-b	Tanacetum vulgare	501-1000	Cirsium arvense	0-25	Centaurea stoebe	Carduus acanthoides		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-193.310.100	I-139n34w36-b	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-193.310.100	I-139n34w36-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-159.300	I-139n35w33-c	Carduus acanthoides	0-100					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-159.300	I-139n35w33-d	Cirsium arvense	0-100					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-151.000	I-139n35w31-k	Centaurea stoebe	0-100					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-159.300	I-139n35w33-b	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-153.000	I-139n35w32-a	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-157.000	I-139n35w32-b	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-148.000	I-139n35w31-e	Carduus acanthoides	1001-5000					Common	No	1	Population size
Hubbard	MN-HU-C5-148.000	I-139n35w31-f	Centaurea stoebe	1001-5000					Common	No	1	Population size
Hubbard	MN-HU-C5-193.300	I-139n34w35-k	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-162.900-RX	I-139n35w34-a	Centaurea stoebe	0-100					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-166.000	I-139n35w34-b	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-192.000	I-139n34w35-b	Centaurea stoebe	1001-5000					Common	No	1	Population size
Hubbard	MN-HU-C5-191.000	I-139n34w34-c	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-191.000	I-139n34w34-b	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-192.000	I-139n34w35-e	Carduus acanthoides	501-1000					Common	No	2	High control potential
Hubbard	MN-HU-C5-193.000	I-139n34w35-h	Centaurea stoebe	1001-5000					Common	No	1	Population size
Hubbard	MN-HU-C5-193.000	I-139n34w35-j	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-147.000	I-139n35w31-c	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-147.000	I-139n35w31-d	Centaurea stoebe	101-500					Rare	No	2	High control potential
Hubbard	MN-HU-C5-174.000	I-139n35w35-a	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-182.000	I-139n34w32-c	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-179.000	I-139n34w31-c	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-179.000	I-139n34w31-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-142.000	I-139n35w30-f	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-140.000	I-139n35w30-d	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-134.000	I-139n35w19-h	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-134.000	I-139n35w19-g	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-133.000	I-139n35w19-f	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-133.000	I-139n35w19-d	Centaurea stoebe	101-500					Rare	No	2	High control potential
Hubbard	MN-HU-C5-130.000-RX	I-139n35w19-c	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-130.000	I-139n35w19-b	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-129.000	I-139n35w18-h	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-129.000	I-139n35w18-g	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-129.000	I-139n35w18-f	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-127.000	I-139n35w18-e	Cirsium arvense	0-100					Rare	Yes	2	High control potential

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Hubbard	MN-HU-C5-128.000	I-139n35w18-c	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-128.000	I-139n35w18-b	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-125.000	I-139n35w7-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-124.000	I-139n35w7-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-118.000	I-140n35w32-a	Centaurea stoebe	0-100					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-117.000	I-140n35w29-f	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-116.000	I-140n35w29-a	Tanacetum vulgare	501-1000					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-113.000-RX	I-140n35w29-d	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-107.200	I-140n35w20-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-107.200	I-140n35w20-a	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-102.000	I-140n35w7-c	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-101.000	I-140n35w7-b	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-099.000	I-140n35w6-a	Carduus acanthoides	1001-5000					Common	No	1	Population size
Hubbard	MN-HU-C5-099.000	I-140n35w6-d	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-099.000	I-140n35w6-o	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-098.000	I-140n35w6-g	Carduus acanthoides	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-098.000	I-140n35w6-h	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-097.000	I-140n35w6-i	Tanacetum vulgare	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-097.000	I-140n35w6-j	Carduus acanthoides	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-097.000	I-140n35w6-k	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-095.000	I-141n35w31-b	Tanacetum vulgare	1001-5000					Common	Yes	1	High spread risk
Hubbard	MN-HU-C5-095.000	I-141n35w31-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-092.000	I-141n35w32-a	Carduus acanthoides	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-093.000	I-141n35w31-j	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-090.000	I-141n35w29-i	Centaurea jacea	100s	Cirsium arvense	100s			Common	No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-089.000	I-141n35w29-a	Carduus acanthoides	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-089.000	I-141n35w29-b	Centaurea stoebe	501-1000					Common	Yes	2	High control potential
Hubbard	MN-HU-C5-089.000	I-141n35w29-d	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-088.000	I-141n35w29-g	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-087.000	I-141n35w20-o	Centaurea stoebe	501-1000					Common	No	2	High control potential
Hubbard	MN-HU-C5-087.000	I-141n35w20-n	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-086.000	I-141n35w20-l	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-086.000	I-141n35w20-j	Tanacetum vulgare	0-100					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-086.000	I-141n35w20-i	Centaurea stoebe	101-500					Common	No	2	High control potential
Hubbard	MN-HU-C5-085.000	I-141n35w20-h	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-083.000	I-141n35w20-b	Centaurea stoebe	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-083.000	I-141n35w20-a	Carduus acanthoides	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-082.000	I-141n35w17-e	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-077.000	I-141n35w8-k	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-076.000	I-141n35w8-h	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-076.000	I-141n35w8-f	Centaurea stoebe	0-100					Rare	No	1	High spread risk
Hubbard	MN-HU-C5-076.000	I-141n35w8-g	Tanacetum vulgare	0-100					Rare	No	1	High spread risk
Hubbard	MN-HU-C5-076.000	I-141n35w8-e	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-071.000	I-141n35w5-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-071.000	I-141n35w5-d	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-068.000	I-142n35w32-l	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-066.000	I-142n35w32-d	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-066.000	I-142n35w32-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-066.000	I-142n35w32-b	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-064.000	I-142n35w29-f	Centaurea stoebe	101-500					Common	No	2	High control potential
Hubbard	MN-HU-C5-064.000	I-142n35w29-g	Carduus acanthoides	101-500					Common	No	2	High control potential
Hubbard	MN-HU-C5-062.000	I-142n35w29-d	Tanacetum vulgare	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-060.000	I-142n35w20-q	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-060.000	I-142n35w20-p	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-061.000	I-142n35w20-o	Centaurea stoebe	501-1000					Common	No	2	High control potential
Hubbard	MN-HU-C5-060.000	I-142n35w20-m	Centaurea stoebe	501-1000					Common	No	2	High control potential

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Hubbard	MN-HU-C5-056.000	I-142n35w20-h	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-056.000	I-142n35w20-g	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-054.000	I-142n35w20-e	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-054.000	I-142n35w20-d	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-052.000	I-142n35w17-h	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-051.000	I-142n35w17-d	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-050.000	I-142n35w8-p	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-050.000	I-142n35w8-m	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-050.000	I-142n35w8-n	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-050.000	I-142n35w8-o	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-046.000	I-142n35w8-h	Centaurea stoebe	501-1000					Common	No	2	High control potential
Hubbard	MN-HU-C5-044.000	I-142n35w5-o	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-044.000	I-142n35w5-n	Centaurea stoebe	501-1000					Common	Yes	2	High control potential
Hubbard	MN-HU-C5-043.000	I-142n35w5-g	Centaurea stoebe	101-500					Intermittent	Yes	1	High spread risk
Hubbard	MN-HU-C5-042.000	I-142n35w5-a	Centaurea stoebe	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-040.000	I-143n35w32-h	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-040.000	I-143n35w32-e	Centaurea stoebe	501-1000					Intermittent	Yes	1	High spread risk
Hubbard	MN-HU-C5-039.000	I-143n35w32-d	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-039.000	I-143n35w32-c	Carduus acanthoides	0-100					Rare	Yes	1	High spread risk
Hubbard	MN-HU-C5-039.000	I-143n35w32-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-038.000	I-143n35w29-f	Tanacetum vulgare	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-037.000	I-143n35w29-d	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-037.000	I-143n35w29-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-030.210-RX-2	I-143n35w21-d	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-030.210-RX-2	I-143n35w21-c	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-030.210-RX-2	I-143n35w21-b	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-030.210	I-143n35w21-a	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-028.000	I-143n35w17-i	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-027.000	I-143n35w17-h	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-025.000	I-143n35w8-o	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-025.000	I-143n35w8-m	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-024.000	I-143n35w8-k	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-024.000	I-143n35w8-j	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-021.000	I-143n35w8-c	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-021.000	I-143n35w8-a	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-020.000	I-143n35w5-s	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-019.000	I-143n35w5-p	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-020.000	I-143n35w5-r	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-019.000	I-143n35w5-q	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-019.000	I-143n35w5-m	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-019.000	I-143n35w5-n	Centaurea stoebe	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-018.000	I-143n35w5-k	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-017.000	I-143n35w5-h	Centaurea stoebe	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-017.000	I-143n35w5-g	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-015.000	I-144n35w32-u	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-015.000	I-144n35w32-t	Tanacetum vulgare	501-1000					Common	No	2	High control potential
Hubbard	MN-HU-C5-015.000	I-144n35w32-q	Carduus acanthoides	501-1000					Common	No	2	High control potential
Hubbard	MN-HU-C5-013.000	I-144n35w32-m	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-013.000	I-144n35w32-l	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-012.000	I-144n35w32-j	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-012.000	I-144n35w32-h	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-011.000	I-144n35w32-e	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-010.000	I-144n35w32-d	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-010.000	I-144n35w32-b	Centaurea stoebe	501-1000					Common	No	2	High control potential
Hubbard	MN-HU-C5-009.000	I-144n35w29-c	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Hubbard	MN-HU-C5-009.000	I-144n35w29-b	Carduus acanthoides	101-500					Intermittent	Yes	2	High control potential

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Hubbard	MN-HU-C5-009.000	I-144n35w29-a	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-008.000	I-144n35w30-b	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-008.000	I-144n35w30-c	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-008.000	I-144n35w30-d	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-007.000	I-144n35w30-g	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-007.000	I-144n35w30-h	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-006.000	I-144n35w30-j	Tanacetum vulgare	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-006.000	I-144n35w30-k	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-006.000	I-144n35w30-l	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-006.000	I-144n35w30-m	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-005.000	I-144n35w30-n	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Hubbard	MN-HU-C5-005.000	I-144n35w30-p	Cirsium arvense	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-005.000	I-144n35w30-q	Carduus acanthoides	0-100					Rare	No	2	High control potential
Hubbard	MN-HU-C5-004.000	I-144n35w19-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-004.000	I-144n35w19-b	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Hubbard	MN-HU-C5-148.000	I-139n35w31-g	Carduus acanthoides	1001-5000						No	1	Population size
Hubbard	MN-HU-C5-099.000	I-140n35w6-f	Carduus acanthoides	1001-5000						Yes	1	Population size
Hubbard	MN-HU-C5-015.000	I-144n35w32-r	Carduus acanthoides	1001-5000	Centaurea stoebe	501-1000	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-015.000	I-144n35w32-r	Carduus acanthoides	1001-5000	Centaurea stoebe	501-1000	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-015.000	I-144n35w32-r	Carduus acanthoides	1001-5000	Centaurea stoebe	501-1000	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-015.000	I-144n35w32-r	Carduus acanthoides	1001-5000	Centaurea stoebe	501-1000	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-099.000	I-140n35w6-e	Carduus acanthoides	501-1000	Centaurea stoebe	101-250				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-024.000	I-143n35w8-l	Carduus acanthoides	501-1000	Cirsium arvense	101-250	Centaurea stoebe			Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-025.000	I-143n35w8-l	Carduus acanthoides	501-1000	Cirsium arvense	101-250	Centaurea stoebe			No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-025.000	I-143n35w8-l	Carduus acanthoides	501-1000	Cirsium arvense	101-250	Centaurea stoebe			Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-135.000	I-139n35w19-l	Centaurea stoebe	1001-5000						Yes	1	Population size
Hubbard	MN-HU-C5-135.000	I-139n35w19-l	Centaurea stoebe	1001-5000						No	1	Population size
Hubbard	MN-HU-C5-136.000	I-139n35w19-l	Centaurea stoebe	1001-5000						No	1	High spread risk
Hubbard	MN-HU-C5-103.000	I-140n35w18-a	Centaurea stoebe	1001-5000						No	1	Population size
Hubbard	MN-HU-C5-088.000	I-141n35w29-h	Centaurea stoebe	1001-5000						Yes	1	Population size
Hubbard	MN-HU-C5-067.000	I-142n35w32-j	Centaurea stoebe	1001-5000	Carduus acanthoides	101-250	Tanacetum vulgare	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-067.000	I-142n35w32-j	Centaurea stoebe	1001-5000	Carduus acanthoides	101-250	Tanacetum vulgare	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-068.000	I-142n35w32-m	Centaurea stoebe	1001-5000	Carduus acanthoides	101-250	Tanacetum vulgare	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-068.000	I-142n35w32-m	Centaurea stoebe	1001-5000	Carduus acanthoides	101-250	Tanacetum vulgare	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-068.000	I-142n35w32-m	Centaurea stoebe	1001-5000	Carduus acanthoides	101-250	Tanacetum vulgare	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-068.000	I-142n35w32-m	Centaurea stoebe	1001-5000	Carduus acanthoides	101-250	Tanacetum vulgare	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-068.000	I-142n35w32-m	Centaurea stoebe	1001-5000	Carduus acanthoides	101-250	Tanacetum vulgare	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-087.000	I-141n35w20-q	Centaurea stoebe	1001-5000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-083.000	I-141n35w20-c	Centaurea stoebe	1001-5000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-079.000	I-141n35w8-s	Centaurea stoebe	1001-5000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-079.000	I-141n35w8-s	Centaurea stoebe	1001-5000	Cirsium arvense	0-25				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-079.000	I-141n35w8-s	Centaurea stoebe	1001-5000	Cirsium arvense	0-25				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-043.000	I-142n35w5-k	Centaurea stoebe	1001-5000	Cirsium arvense	26-50	Carduus acanthoides	Tanacetum vulgare		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-043.000	I-142n35w5-k	Centaurea stoebe	1001-5000	Cirsium arvense	26-50	Carduus acanthoides	Tanacetum vulgare		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-044.000	I-142n35w5-k	Centaurea stoebe	1001-5000	Cirsium arvense	26-50	Carduus acanthoides	Tanacetum vulgare		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-038.000	I-143n35w29-j	Centaurea stoebe	1001-5000	Tanacetum vulgare	101-250				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-038.000	I-143n35w29-j	Centaurea stoebe	1001-5000	Tanacetum vulgare	101-250				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-038.000	I-143n35w29-j	Centaurea stoebe	1001-5000	Tanacetum vulgare	101-250				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-044.000	I-142n35w5-l	Centaurea stoebe	1001-5000	Tanacetum vulgare	501-1000				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-044.000	I-142n35w5-l	Centaurea stoebe	1001-5000	Tanacetum vulgare	501-1000				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-066.000	I-142n35w32-f	Centaurea stoebe	1001-5000	Tanacetum vulgare	501-1000	Cirsium arvense	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-066.000	I-142n35w32-f	Centaurea stoebe	1001-5000	Tanacetum vulgare	501-1000	Cirsium arvense	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-066.000	I-142n35w32-f	Centaurea stoebe	1001-5000	Tanacetum vulgare	501-1000	Cirsium arvense	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-066.000	I-142n35w32-f	Centaurea stoebe	1001-5000	Tanacetum vulgare	501-1000	Cirsium arvense	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-066.000	I-142n35w32-f	Centaurea stoebe	1001-5000	Tanacetum vulgare	501-1000	Cirsium arvense	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-066.000	I-142n35w32-f	Centaurea stoebe	1001-5000	Tanacetum vulgare	501-1000	Cirsium arvense	Cirsium arvense		No	1	Cluster multiple spp.

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Hubbard	MN-HU-C5-133.000	I-139n35w19-e	Centaurea stoebe	101-250						No	2	High control potential
Hubbard	MN-HU-C5-089.000	I-141n35w29-e	Centaurea stoebe	101-250						Yes	2	High control potential
Hubbard	MN-HU-C5-193.310	I-139n34w35-l	Centaurea stoebe	101-250	Carduus acanthoides	101-250	Cirsium arvense			No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-105.000	I-140n35w18-d	Centaurea stoebe	251-500						No	2	High control potential
Hubbard	MN-HU-C5-120.000	I-139n35w5-a	Centaurea stoebe	251-500						No	2	High control potential
Hubbard	MN-HU-C5-182.000	I-139n34w32-b	Centaurea stoebe	251-500						No	2	High control potential
Hubbard	MN-HU-C5-025.000	I-143n35w8-p	Centaurea stoebe	251-500						No	2	High control potential
Hubbard	MN-HU-C5-192.000	I-139n34w35-g	Centaurea stoebe	251-500	Carduus acanthoides	0-25				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-071.000	I-141n35w5-e	Centaurea stoebe	251-500	Carduus acanthoides	51-100				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-045.000	I-142n35w8-f	Centaurea stoebe	251-500	Tanacetum vulgare	0-25	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-191.000	I-139n34w34-a	Centaurea stoebe	5000+						No	1	Population size
Hubbard	MN-HU-C5-062.000	I-142n35w29-e	Centaurea stoebe	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Tanacetum vulgare		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-063.000	I-142n35w29-e	Centaurea stoebe	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Tanacetum vulgare		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-063.000	I-142n35w29-e	Centaurea stoebe	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Tanacetum vulgare		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-064.000	I-142n35w29-e	Centaurea stoebe	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-064.000	I-142n35w29-e	Centaurea stoebe	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-064.000	I-142n35w29-e	Centaurea stoebe	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-064.000	I-142n35w29-e	Centaurea stoebe	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Tanacetum vulgare		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-064.000	I-142n35w29-e	Centaurea stoebe	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-064.200	I-142n35w29-e	Centaurea stoebe	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-065.000	I-142n35w29-e	Centaurea stoebe	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-066.000	I-142n35w29-e	Centaurea stoebe	5000+	Carduus acanthoides	1001-5000	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-082.000	I-141n35w17-d	Centaurea stoebe	5000+	Carduus acanthoides	251-500	Cirsium arvense			Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-082.000	I-141n35w17-d	Centaurea stoebe	5000+	Carduus acanthoides	251-500	Cirsium arvense			Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-083.000	I-141n35w17-d	Centaurea stoebe	5000+	Carduus acanthoides	251-500	Cirsium arvense			Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-083.000	I-141n35w17-d	Centaurea stoebe	5000+	Carduus acanthoides	251-500	Cirsium arvense			Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-048.000	I-142n35w8-k	Centaurea stoebe	5000+	Carduus acanthoides	251-500	Cirsium arvense	Tanacetum vulgare		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-050.000	I-142n35w8-k	Centaurea stoebe	5000+	Carduus acanthoides	251-500	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-047.000	I-142n35w8-j	Centaurea stoebe	5000+	Carduus acanthoides	251-500	Cirsium arvense	Tanacetum vulgare		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-047.000	I-142n35w8-j	Centaurea stoebe	5000+	Carduus acanthoides	251-500	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-047.000	I-142n35w8-j	Centaurea stoebe	5000+	Carduus acanthoides	251-500	Cirsium arvense	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-048.000	I-142n35w8-j	Centaurea stoebe	5000+	Carduus acanthoides	251-500	Cirsium arvense	Tanacetum vulgare		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-083.000	I-141n35w20-d	Centaurea stoebe	5000+	Carduus acanthoides	501-1000	Tanacetum vulgare	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-084.000	I-141n35w20-d	Centaurea stoebe	5000+	Carduus acanthoides	501-1000	Tanacetum vulgare	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-084.000	I-141n35w20-d	Centaurea stoebe	5000+	Carduus acanthoides	501-1000	Tanacetum vulgare	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-085.000	I-141n35w20-d	Centaurea stoebe	5000+	Carduus acanthoides	501-1000	Tanacetum vulgare	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-078.000	I-141n35w8-m	Centaurea stoebe	5000+	Cirsium arvense	101-250	Tanacetum vulgare			No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-079.000	I-141n35w8-m	Centaurea stoebe	5000+	Cirsium arvense	101-250	Tanacetum vulgare			Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-079.000	I-141n35w8-m	Centaurea stoebe	5000+	Cirsium arvense	101-250	Tanacetum vulgare			Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-026.000	I-143n35w17-a	Centaurea stoebe	5000+	Cirsium arvense	501-1000	Carduus acanthoides	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-026.000-A	I-143n35w17-a	Centaurea stoebe	5000+	Cirsium arvense	501-1000	Carduus acanthoides	Tanacetum vulgare		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-053.000	I-142n35w17-k	Centaurea stoebe	5000+	Tanacetum vulgare	1001-5000	Carduus acanthoides	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-053.000	I-142n35w17-k	Centaurea stoebe	5000+	Tanacetum vulgare	1001-5000	Carduus acanthoides	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-053.000	I-142n35w17-k	Centaurea stoebe	5000+	Tanacetum vulgare	1001-5000	Carduus acanthoides	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-053.000	I-142n35w17-k	Centaurea stoebe	5000+	Tanacetum vulgare	1001-5000	Carduus acanthoides	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-046.000	I-142n35w8-i	Centaurea stoebe	5000+	Tanacetum vulgare	101-250	Cirsium arvense	Carduus acanthoides		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-047.000	I-142n35w8-i	Centaurea stoebe	5000+	Tanacetum vulgare	101-250	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-045.000	I-142n35w8-g	Centaurea stoebe	5000+	Tanacetum vulgare	251-500	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-046.000	I-142n35w8-g	Centaurea stoebe	5000+	Tanacetum vulgare	251-500	Cirsium arvense	Carduus acanthoides		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-052.000	I-142n35w17-g	Centaurea stoebe	5000+	Tanacetum vulgare	501-1000	Carduus acanthoides	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-052.000	I-142n35w17-g	Centaurea stoebe	5000+	Tanacetum vulgare	501-1000	Carduus acanthoides	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-052.000	I-142n35w17-g	Centaurea stoebe	5000+	Tanacetum vulgare	501-1000	Carduus acanthoides	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-053.000	I-142n35w17-g	Centaurea stoebe	5000+	Tanacetum vulgare	501-1000	Carduus acanthoides	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-135.000	I-139n35w19-j	Centaurea stoebe	501-1000						No	2	High control potential
Hubbard	MN-HU-C5-135.000	I-139n35w19-j	Centaurea stoebe	501-1000						Yes	2	High control potential
Hubbard	MN-HU-C5-136.000	I-139n35w19-p	Centaurea stoebe	501-1000						No	2	High control potential

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Hubbard	MN-HU-C5-110.510	I-140n35w20-c	Centaurea stoebe	501-1000						No	2	High control potential
Hubbard	MN-HU-C5-113.000-RX	I-140n35w20-c	Centaurea stoebe	501-1000						No	2	High control potential
Hubbard	MN-HU-C5-119.000	I-140n35w32-b	Centaurea stoebe	501-1000						No	2	High control potential
Hubbard	MN-HU-C5-080.000	I-141n35w17-b	Centaurea stoebe	501-1000						Yes	2	High control potential
Hubbard	MN-HU-C5-182.000	I-139n34w32-a	Centaurea stoebe	501-1000						No	2	High control potential
Hubbard	MN-HU-C5-192.000	I-139n34w35-a	Centaurea stoebe	501-1000						No	2	High control potential
Hubbard	MN-HU-C5-038.000	I-143n35w29-k	Centaurea stoebe	501-1000						Yes	1	High spread risk
Hubbard	MN-HU-C5-089.000	I-141n35w29-f	Centaurea stoebe	501-1000						No	2	High control potential
Hubbard	MN-HU-C5-086.000	I-141n35w20-k	Centaurea stoebe	501-1000	Carduus acanthoides	0-25				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-086.000	I-141n35w20-m	Centaurea stoebe	501-1000	Carduus acanthoides	101-250				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-087.000	I-141n35w20-m	Centaurea stoebe	501-1000	Carduus acanthoides	101-250				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-099.000	I-140n35w6-c	Centaurea stoebe	501-1000	Carduus acanthoides	101-250				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-062.000	I-142n35w29-a	Centaurea stoebe	501-1000	Carduus acanthoides	101-250				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-062.000	I-142n35w29-a	Centaurea stoebe	501-1000	Carduus acanthoides	101-250				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-062.000	I-142n35w29-a	Centaurea stoebe	501-1000	Carduus acanthoides	101-250				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-062.000	I-142n35w29-a	Centaurea stoebe	501-1000	Carduus acanthoides	101-250				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-062.000	I-142n35w29-a	Centaurea stoebe	501-1000	Carduus acanthoides	101-250				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-062.000	I-142n35w29-a	Centaurea stoebe	501-1000	Carduus acanthoides	101-250				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-062.000-A	I-142n35w29-a	Centaurea stoebe	501-1000	Carduus acanthoides	101-250				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-093.000	I-141n35w31-i	Centaurea stoebe	501-1000	Carduus acanthoides	101-250	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-192.000	I-139n34w35-f	Centaurea stoebe	501-1000	Carduus acanthoides	251-500				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-079.000	I-141n35w8-r	Centaurea stoebe	501-1000	Carduus acanthoides	501-1000	Tanacetum vulgare	Cirsium arvense		No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-079.000	I-141n35w8-r	Centaurea stoebe	501-1000	Carduus acanthoides	501-1000	Tanacetum vulgare	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-089.000	I-141n35w29-c	Centaurea stoebe	501-1000	Carduus acanthoides	51-100				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-089.000	I-141n35w29-c	Centaurea stoebe	501-1000	Carduus acanthoides	51-100				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-074.000	I-141n35w8-a	Centaurea stoebe	501-1000	Cirsium arvense	0-25				No	1	High spread risk
Hubbard	MN-HU-C5-074.000	I-141n35w8-a	Centaurea stoebe	501-1000	Cirsium arvense	0-25				Yes	1	High spread risk
Hubbard	MN-HU-C5-040.000	I-143n35w32-i	Centaurea stoebe	501-1000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-040.000	I-143n35w32-i	Centaurea stoebe	501-1000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-077.000	I-141n35w8-j	Centaurea stoebe	501-1000	Cirsium arvense	0-25				No	1	High spread risk
Hubbard	MN-HU-C5-077.000	I-141n35w8-j	Centaurea stoebe	501-1000	Cirsium arvense	0-25				No	1	High spread risk
Hubbard	MN-HU-C5-072.000	I-141n35w5-h	Centaurea stoebe	501-1000	Cirsium arvense	0-25	Carduus acanthoides			Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-043.000	I-142n35w5-j	Centaurea stoebe	501-1000	Cirsium arvense	26-50				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-042.000	I-142n35w5-f	Centaurea stoebe	501-1000	Cirsium arvense	26-50	Carduus acanthoides	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-043.000	I-142n35w5-f	Centaurea stoebe	501-1000	Cirsium arvense	26-50	Carduus acanthoides	Cirsium arvense		Yes	1	High spread risk
Hubbard	MN-HU-C5-044.000	I-142n35w5-q	Centaurea stoebe	501-1000	Tanacetum vulgare	101-250				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-006.000	I-144n35w30-i	Centaurea stoebe	501-1000	Tanacetum vulgare	101-250	Carduus acanthoides			No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-007.000	I-144n35w30-i	Centaurea stoebe	501-1000	Tanacetum vulgare	101-250	Carduus acanthoides			No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-042.000	I-142n35w5-d	Centaurea stoebe	501-1000	Tanacetum vulgare	101-250	Carduus acanthoides	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-044.000	I-142n35w8-a	Centaurea stoebe	501-1000	Tanacetum vulgare	251-500				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-045.000	I-142n35w8-a	Centaurea stoebe	501-1000	Tanacetum vulgare	251-500				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-007.000	I-144n35w30-e	Centaurea stoebe	501-1000	Tanacetum vulgare	251-500	Carduus acanthoides	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-051.000	I-142n35w17-e	Centaurea stoebe	501-1000	Tanacetum vulgare	51-100	Carduus acanthoides	Cirsium arvense		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-016.000	I-143n35w5-e	Cirsium arvense	501-1000	Carduus acanthoides	51-100				No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-095.000	I-140n35w6-n	Tanacetum vulgare	5000+	Centaurea stoebe	1001-5000	Cirsium arvense	Carduus acanthoides		Yes	1	High spread risk
Hubbard	MN-HU-C5-096.000	I-140n35w6-n	Tanacetum vulgare	5000+	Centaurea stoebe	1001-5000	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-096.000	I-140n35w6-n	Tanacetum vulgare	5000+	Centaurea stoebe	1001-5000	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-098.000	I-140n35w6-n	Tanacetum vulgare	5000+	Centaurea stoebe	1001-5000	Cirsium arvense	Carduus acanthoides		No	1	High spread risk
Hubbard	MN-HU-C5-095.000	I-141n35w31-e	Tanacetum vulgare	5000+	Centaurea stoebe	5000+	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-093.000	I-141n35w31-h	Tanacetum vulgare	5000+	Centaurea stoebe	5000+	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-094.000	I-141n35w31-h	Tanacetum vulgare	5000+	Centaurea stoebe	5000+	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-094.000	I-141n35w31-h	Tanacetum vulgare	5000+	Centaurea stoebe	5000+	Cirsium arvense	Carduus acanthoides		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-009.000	I-144n35w29-d	Tanacetum vulgare	501-1000	Carduus acanthoides	0-25	Cirsium arvense	Centaurea stoebe		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-009.000	I-144n35w29-d	Tanacetum vulgare	501-1000	Carduus acanthoides	0-25	Cirsium arvense	Centaurea stoebe		Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-017.000	I-143n35w5-l	Tanacetum vulgare	501-1000	Centaurea stoebe	101-250	Carduus acanthoides			No	1	Cluster multiple spp.
Hubbard	MN-HU-C5-037.000	I-143n35w29-e	Tanacetum vulgare	501-1000	Centaurea stoebe	251-500				Yes	1	High spread risk

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Hubbard	MN-HU-C5-037.000	I-143n35w29-e	Tanacetum vulgare	501-1000	Centaurea stoebe	251-500				Yes	1	High spread risk
Hubbard	MN-HU-C5-013.000	I-144n35w32-n	Tanacetum vulgare	501-1000	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Hubbard	MN-HU-C5-054.000	I-142n35w20-a	Tanacetum vulgare	501-1000	Cirsium arvense	51-100	Centaurea stoebe			No	1	Cluster multiple spp.
Hubbard Cou	MN-HU-C5-158.300	i-139n35w32-hc	Toxicodendron radicans	1000s					Many	No	1	High spread risk
Hubbard Cou	MN-HU-C5-158.300	i-139n35w32-hd	Tanacetum vulgare	10s					Few	No	1	High spread risk
Hubbard Cou	MN-HU-C5-158.300	i-139n35w32-he	Carduus acanthoides	10s					Few	No	1	High spread risk
Hubbard Cou	MN-HU-C5-183.000	i-139n34w32-ha	Centaurea stoebe	10s					Few	No	1	High spread risk
Hubbard Cou	<Null>	i-139n34w33-ha	Tanacetum vulgare	100s					Some	No	1	High spread risk
Hubbard Cou	MN-HU-C5-071.400	i-141n35w5-hb	Toxicodendron radicans	100s					Some	Yes	3	Safety
Kittson	T-991A	I-159n48w31-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-993A	I-159n49w36-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-993	I-159n49w36-b	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Kittson	T-994	I-159n49w25-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-996-2	I-159n49w26-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Kittson	T-998A	I-159n49w23-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Kittson	T-1001	I-159n49w14-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-1002B	I-159n49w15-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-1002-A	I-159n49w15-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Kittson	T-1007	I-159n49w5-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-1009	I-160n49w31-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-1010	I-160n49w31-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-1012A	I-160n49w31-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-1013	I-160n49w30-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-1016	I-160n50w25-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Kittson	T-1018-RX	I-160n50w23-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-1018A	I-160n50w23-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-1023	I-160n50w14-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Kittson	T-1025	I-160n50w15-b	Cirsium arvense	501-1000					Intermittent	Yes	2	High control potential
Kittson	T-1029	I-160n50w4-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-882	I-154n45w12-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-882-1	I-154n45w11-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-885	I-154n45w2-h	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-885-1	I-154n45w2-f	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-886	I-154n45w2-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-888	I-154n45w2-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-890B	I-155n45w34-m	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-889	I-155n45w35-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-890A1	I-155n45w34-f	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-893C	I-155n45w28-d	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-893A	I-155n45w28-e	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-895	I-155n45w28-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-896	I-155n45w21-a	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Marshall	T-896	I-155n45w21-b	Carduus acanthoides	0-100					Rare	No	2	High control potential
Marshall	T-896	I-155n45w21-c	Centaurea jacea	0-100					Rare	No	2	High control potential
Marshall	T-898	I-155n45w20-k	Centaurea jacea	0-100					Rare	Yes	2	High control potential
Marshall	T-899	I-155n45w20-l	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-899-A	I-155n45w20-i	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-900	I-155n45w20-h	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-900	I-155n45w20-g	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Marshall	T-901	I-155n45w20-d	Tanacetum vulgare	101-500					Intermittent	Yes	2	High control potential
Marshall	T-902	I-155n45w20-a	Cirsium arvense	101-500					Rare	Yes	2	High control potential
Marshall	T-903	I-155n45w17-a	Cirsium arvense	1001-5000					Intermittent	Yes	1	Population size
Marshall	T-903-2	I-155n45w18-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-903-5	I-155n45w18-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-903-5A	I-155n45w7-a	Cirsium arvense	101-500					Rare	Yes	2	High control potential
Marshall	T-908	I-155n46w12-e	Cirsium arvense	0-100					Rare	Yes	2	High control potential

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Marshall	T-910	I-155n46w12-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-911	I-155n46w1-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-926	I-156n46w20-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-928	I-156n46w17-c	Cirsium arvense	501-1000					Intermittent	Yes	2	High control potential
Marshall	T-930A	I-156n46w17-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-932	I-156n46w7-b	Cirsium arvense	501-1000					Intermittent	Yes	2	High control potential
Marshall	T-934	I-156n46w7-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-935	I-156n47w12-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-936A	I-156n47w1-d	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-938B	I-156n47w1-e	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Marshall	T-938	I-156n47w1-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-939	I-156n47w1-b	Cirsium arvense	501-1000					Intermittent	Yes	2	High control potential
Marshall	T-940	I-156n47w2-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-941-A	I-157n47w36-b	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Marshall	T-947	I-157n47w26-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-948	I-157n47w26-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-949	I-157n47w27-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-950	I-157n47w22-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-953-1A	I-157n47w21-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-952-1	I-157n47w21-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-954	I-157n47w21-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-959	I-157n47w8-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-960	I-157n47w7-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-961	I-157n47w6-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-963A	I-157n48w1-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-966	I-158n48w36-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-966-1	I-158n48w35-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-968	I-158n48w26-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Marshall	T-970	I-158n48w26-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-972	I-158n48w22-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-971	I-158n48w23-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-975A	I-158n48w15-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-978	I-158n48w15-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-981	I-158n48w9-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-983	I-158n48w5-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Marshall	T-903	I-155n45w17-d	Cirsium arvense	1001-5000						Yes	1	Population size
Marshall	T-903	I-155n45w17-d	Cirsium arvense	1001-5000						Yes	1	Population size
Marshall	T-901	I-155n45w20-f	Cirsium arvense	251-500						Yes	2	High control potential
Marshall	T-901	I-155n45w20-f	Cirsium arvense	251-500						No	2	High control potential
Marshall	T-902	I-155n45w20-f	Cirsium arvense	251-500						Yes	2	High control potential
Marshall	T-886	I-154n45w2-d	Cirsium arvense	251-500						No	2	High control potential
Marshall	T-895	I-155n45w28-b	Cirsium arvense	251-500						Yes	2	High control potential
Marshall	T-895	I-155n45w28-c	Cirsium arvense	251-500						Yes	2	High control potential
Marshall	T-893A	I-155n45w28-l	Cirsium arvense	251-500	Pastinaca sativa	51-100				Yes	1	Cluster multiple spp.
Marshall	T-931	I-156n46w18-a	Cirsium arvense	501-1000						Yes	2	High control potential
Marshall	T-903	I-155n45w17-b	Cirsium arvense	501-1000						Yes	2	High control potential
Marshall	T-903	I-155n45w17-b	Cirsium arvense	501-1000						Yes	2	High control potential
Marshall	T-903	I-155n45w17-c	Cirsium arvense	501-1000						No	2	High control potential
Marshall	T-891	I-155n45w34-d	Cirsium arvense	501-1000						Yes	2	High control potential
Marshall	T-891	I-155n45w34-d	Cirsium arvense	501-1000						No	2	High control potential
Marshall	T-891	I-155n45w34-d	Cirsium arvense	501-1000						No	2	High control potential
Marshall	T-891	I-155n45w34-e	Cirsium arvense	501-1000						No	2	High control potential
Marshall	T-893	I-155n45w28-h	Pastinaca sativa	251-500	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Marshall	T-893A	I-155n45w28-h	Pastinaca sativa	251-500	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Marshall	T-893	I-155n45w28-j	Pastinaca sativa	501-1000	Cirsium arvense	251-500				Yes	1	Cluster multiple spp.
Marshall	T-893A	I-155n45w28-j	Pastinaca sativa	501-1000	Cirsium arvense	251-500				Yes	1	Cluster multiple spp.

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Marshall	T-890A	I-155n45w34-j	Rhamnus cathartica	1001-5000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Marshall	T-890B	I-155n45w34-j	Rhamnus cathartica	1001-5000	Cirsium arvense	51-100				No	1	Cluster multiple spp.
Marshall	T-908	I-155n46w12-g	Rhamnus cathartica	251-500	Cirsium arvense	26-50				No	1	Cluster multiple spp.
Marshall	T-925	I-156n46w21-b	Rhamnus cathartica	501-1000	Cirsium arvense	101-250				No	1	Cluster multiple spp.
Marshall	T-925	I-156n46w21-b	Rhamnus cathartica	501-1000	Cirsium arvense	101-250				No	1	Cluster multiple spp.
Marshall	T-925	I-156n46w21-b	Rhamnus cathartica	501-1000	Cirsium arvense	101-250				Yes	1	Cluster multiple spp.
Marshall	T-890A	I-155n45w34-i	Rhamnus cathartica	501-1000	Cirsium arvense	26-50				Yes	1	Cluster multiple spp.
Marshall	T-901	I-155n45w20-e	Tanacetum vulgare	101-250	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Pembina	T-1032C	I-160n50w5-h	Euphorbia esula	501-1000					Intermittent	Yes	2	High control potential
Pembina	T-1032A	I-160n50w5-g	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Pembina	T-1032B	I-160n50w5-d	Cirsium arvense	0-100					Rare	No	2	High control potential
Pembina	T-1036	I-161n50w31-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Pembina	T-1037	I-161n50w31-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Pembina	T-1040	I-161n51w25-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Pembina	T-1044A	I-161n51w23-b	Cirsium arvense	101-500					Intermittent	No	2	High control potential
Pembina	T-1045	I-161n51w23-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Pembina	T-1049	I-161n51w15-f	Cirsium arvense	0-100					Intermittent	No	2	High control potential
Pembina	T-1050A	I-161n51w15-j	Bassia scoparia	0-100					Rare	Yes	2	High control potential
Pembina	T-1050B	I-161n51w15-e	Bassia scoparia	0-100					Rare	Yes	2	High control potential
Pembina	T-1050B	I-161n51w15-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pembina	T-1051	I-161n51w15-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pembina	T-1053	I-161n51w9-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pembina	T-1057A	I-161n51w5-g	Cirsium arvense	1001-5000					Common	Yes	1	Population size
Pembina	T-1063	I-162n51w30-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pembina	T-1064	I-162n51w30-a	Cirsium arvense	501-1000					Intermittent	No	2	High control potential
Pembina	T-1065	I-162n52w25-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pembina	T-1057	I-161n51w5-f	Cirsium arvense	1001-5000						Yes	1	Population size
Pembina	T-1057A	I-161n51w5-f	Cirsium arvense	1001-5000						Yes	1	Population size
Pembina	T-1057A	I-161n51w5-f	Cirsium arvense	1001-5000						Yes	1	Population size
Pembina	T-1057A	I-161n51w5-f	Cirsium arvense	1001-5000						No	1	Population size
Pembina	T-1057A	I-161n51w5-f	Cirsium arvense	1001-5000						No	1	Population size
Pembina	T-1057A	I-161n51w5-f	Cirsium arvense	1001-5000						Yes	1	Population size
Pembina	T-1035	I-161n50w32-d	Cirsium arvense	1001-5000						Yes	1	Population size
Pembina	T-1035	I-161n50w32-e	Cirsium arvense	1001-5000						Yes	1	Population size
Pembina	T-1032A	I-160n50w5-f	Cirsium arvense	1001-5000	Euphorbia esula	51-100	Tanacetum vulgare			Yes	1	Cluster multiple spp.
Pembina	T-1057	I-161n51w5-e	Cirsium arvense	101-250						Yes	2	High control potential
Pembina	T-1058	I-161n51w5-b	Cirsium arvense	251-500						Yes	2	High control potential
Pembina	T-1032	I-160n50w5-e	Cirsium arvense	251-500						Yes	2	High control potential
Pembina	T-1064	I-162n51w30-b	Cirsium arvense	501-1000						Yes	2	High control potential
Pembina	T-1064	I-162n51w30-b	Cirsium arvense	501-1000						Yes	2	High control potential
Pembina	T-1032C	I-160n50w5-c	Cirsium arvense	501-1000						Yes	2	High control potential
Pembina	T-1035	I-161n50w32-b	Cirsium arvense	501-1000						No	2	High control potential
Pembina	T-1035	I-161n50w32-c	Cirsium arvense	501-1000						Yes	2	High control potential
Pembina	T-1035	I-161n50w32-f	Cirsium arvense	501-1000						No	2	High control potential
Pennington	T-821	I-152n43w24-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-823	I-152n43w14-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-825	I-152n43w14-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-826	I-152n43w14-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-825	I-152n43w14-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-827B	I-152n43w15-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-830	I-152n43w10-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-832	I-152n43w4-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Pennington	T-835	I-152n43w4-a	Cirsium arvense	101-500					Rare	Yes	2	High control potential
Pennington	T-835A	I-152n43w5-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-838B	I-153n43w33-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Pennington	T-838B	I-153n43w33-c	Centaurea stoebe	0-100					Rare	No	2	High control potential

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
Pennington	T-839A	I-153n43w29-g	Cirsium arvense	0-100					Rare	No	2	High control potential
Pennington	T-839A	I-153n43w29-i	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Pennington	T-840	I-153n43w29-f	Cirsium arvense	0-100					Intermittent	Yes	2	High control potential
Pennington	T-840	I-153n43w29-e	Cirsium arvense	0-100					Intermittent	No	2	High control potential
Pennington	T-840A-RX	I-153n43w29-c	Cirsium arvense	0-100					Intermittent	Yes	2	High control potential
Pennington	T-840A	I-153n43w29-b	Cirsium arvense	0-100					Intermittent	Yes	2	High control potential
Pennington	T-841	I-153n43w29-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Pennington	T-842	I-153n43w20-a	Cirsium arvense	0-100					Intermittent	No	2	High control potential
Pennington	T-846	I-153n44w13-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-847	I-153n44w13-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Pennington	T-849	I-153n44w12-a	Cirsium arvense	1001-5000					Intermittent	Yes	1	Population size
Pennington	T-849	I-153n44w12-e	Cirsium arvense	0-100					Rare	No	2	High control potential
Pennington	T-850	I-153n44w12-d	Cirsium arvense	0-100					Rare	No	2	High control potential
Pennington	T-852	I-153n44w11-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Pennington	T-854	I-153n44w2-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Pennington	T-856	I-153n44w2-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Pennington	T-856	I-153n44w2-c	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Pennington	T-857	I-153n44w3-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-858	I-154n44w34-e	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-860A	I-154n44w34-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-861A	I-154n44w33-c	Cirsium arvense	501-1000					Rare	No	2	High control potential
Pennington	T-863A	I-154n44w33-f	Cirsium arvense	0-100					Rare	No	2	High control potential
Pennington	T-863	I-154n44w33-j	Cirsium arvense	1001-5000					Intermittent	Yes	1	Population size
Pennington	T-864	I-154n44w28-a	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Pennington	T-866	I-154n44w28-e	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Pennington	T-867	I-154n44w28-h	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-872	I-154n44w20-aa	Toxicodendron radicans	0-25					Rare	Yes	3	Safety
Pennington	T-872	I-154n44w20-ab	Cirsium arvense	26-50					Rare	Yes	2	High control potential
Pennington	T-877	I-154n44w18-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-878	I-154n44w18-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-879	I-154n45w13-b	Cirsium arvense	101-500					Intermittent	Yes	2	High control potential
Pennington	T-881A	I-154n45w12-e	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Pennington	T-881	I-154n45w12-d	Carduus acanthoides	101-500					Intermittent	No	2	High control potential
Pennington	T-863	I-154n44w33-h	Cirsium arvense	1001-5000						Yes	1	Population size
Pennington	T-863A	I-154n44w33-h	Cirsium arvense	1001-5000						Yes	1	Population size
Pennington	T-862	I-154n44w33-k	Cirsium arvense	1001-5000						Yes	1	Population size
Pennington	T-843A	I-153n43w19-b	Cirsium arvense	101-250						No	2	High control potential
Pennington	T-849	I-153n44w12-c	Cirsium arvense	251-500						Yes	2	High control potential
Pennington	T-860	I-154n44w34-f	Cirsium arvense	251-500						Yes	2	High control potential
Pennington	T-860	I-154n44w34-g	Cirsium arvense	251-500						Yes	2	High control potential
Pennington	T-849	I-153n44w12-b	Cirsium arvense	501-1000						Yes	2	High control potential
Pennington	T-861	I-154n44w33-b	Cirsium arvense	501-1000						No	2	High control potential
Pennington	T-861A	I-154n44w33-b	Cirsium arvense	501-1000						No	2	High control potential
Pennington	T-863	I-154n44w33-g	Cirsium arvense	501-1000						No	2	High control potential
Pennington	T-863A	I-154n44w33-g	Cirsium arvense	501-1000						No	2	High control potential
Pennington	T-875A	I-154n44w20-ad	Pastinaca satira	251-500						Yes	2	High control potential
Pennington	T-837	I-153n43w33-f	Rhamnus cathartica	1001-5000	Cirsium arvense	1001-5000				Yes	1	Cluster multiple spp.
Pennington	T-837	I-153n43w33-f	Rhamnus cathartica	1001-5000	Cirsium arvense	1001-5000				Yes	1	Cluster multiple spp.
Pennington	T-849	I-153n44w12-f	Rhamnus cathartica	1001-5000	Cirsium arvense	51-100				No	1	Cluster multiple spp.
Pennington	T-849	I-153n44w12-f	Rhamnus cathartica	1001-5000	Cirsium arvense	51-100				No	1	Cluster multiple spp.
Pennington	T-855A	I-153n44w3-b	Rhamnus cathartica	1001-5000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Pennington	T-855A	I-153n44w3-b	Rhamnus cathartica	1001-5000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Pennington	T-855B	I-153n44w3-b	Rhamnus cathartica	1001-5000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Pennington	T-840	I-153n43w29-d	Tanacetum vulgare	1001-5000	Cirsium arvense	1001-5000				Yes	1	Cluster multiple spp.
Pennington	T-823	I-152n43w23-a	Tanacetum vulgare	101-250	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Polk	T-734	I-149n38w6-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential

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Polk	T-735	I-149n39w1-d	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Polk	T-735	I-149n39w1-c	Centaurea stoebe	0-100					Rare	No	2	High control potential
Polk	T-736A	I-149n39w1-f	Cirsium arvense	0-100					Rare	No	2	High control potential
Polk	T-735	I-149n39w1-b	Carduus acanthoides	0-100					Rare	No	2	High control potential
Polk	T-736A	I-149n39w2-a	Centaurea stoebe	0-100					Rare	No	2	High control potential
Polk	T-736A	I-149n39w1-e	Carduus acanthoides	0-100					Rare	No	2	High control potential
Polk	T-735	I-149n39w1-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Polk	T-737	I-149n39w2-b	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Polk	T-737	I-149n39w2-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Polk	T-738	I-149n39w2-h	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Polk	T-738B	I-149n39w2-g	Tanacetum vulgare	0-100					Rare	No	2	High control potential
Polk	T-738B	I-149n39w2-f	Centaurea stoebe	1001-5000					Common	No	1	Population size
Polk	T-738C-1	I-149n39w3-a	Centaurea stoebe	0-100					Rare	No	2	High control potential
Polk	T-738C-1	I-149n39w3-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Polk	T-738C	I-149n39w2-d	Centaurea stoebe	0-100					Rare	No	2	High control potential
Polk	T-739	I-149n39w3-c	Centaurea stoebe	501-1000					Intermittent	No	2	High control potential
Polk	T-739	I-150n39w34-a	Carduus acanthoides	0-100					Rare	No	2	High control potential
Polk	T-739	I-150n39w34-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Polk	T-740	I-150n39w34-f	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Polk	T-740	I-150n39w34-e	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Polk	T-744	I-150n39w34-h	Centaurea stoebe	501-1000					Intermittent	No	2	High control potential
Polk	T-744	I-150n39w34-i	Carduus acanthoides	0-100					Rare	No	2	High control potential
Polk	T-745	I-150n39w33-g	Carduus acanthoides	0-100					Rare	No	2	High control potential
Polk	T-745	I-150n39w33-f	Centaurea stoebe	1001-5000					Common	No	1	Population size
Polk	T-746	I-150n39w33-e	Carduus acanthoides	0-100					Rare	No	2	High control potential
Polk	T-746	I-150n39w33-d	Centaurea stoebe	501-1000					Common	No	2	High control potential
Polk	T-747A	I-150n39w28-a	Centaurea stoebe	501-1000					Common	No	2	High control potential
Polk	T-748	I-150n39w29-a	Centaurea stoebe	501-1000					Intermittent	No	2	High control potential
Polk	T-751	I-150n39w29-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Polk	T-752	I-150n39w30-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Polk	T-753A	I-150n39w30-e	Carduus acanthoides	0-100					Rare	No	2	High control potential
Polk	T-754-1-1A	I-150n39w19-b	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Polk	T-757-1	I-150n40w24-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Polk	T-758-1	I-150n40w24-e	Carduus acanthoides	501-1000					Intermittent	No	2	High control potential
Polk	T-758-1	I-150n40w24-d	Cirsium arvense	1001-5000					Intermittent	Yes	1	Population size
Polk	T-757-1	I-150n40w24-c	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Polk	T-760-1	I-150n40w14-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Polk	T-760-1	I-150n40w14-b	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Polk	T-761	I-150n40w14-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Polk	T-766	I-150n40w16-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Polk	T-767	I-150n40w9-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Polk	T-769A	I-150n40w8-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Polk	T-771A	I-150n40w7-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Polk	T-757-1	I-150n40w24-a	Carduus acanthoides	1001-5000	Cirsium arvense	501-1000				Yes	1	Cluster multiple spp.
Polk	T-758-1	I-150n40w24-f	Carduus acanthoides	1001-5000	Cirsium arvense	501-1000				Yes	1	Cluster multiple spp.
Polk	T-747	I-150n39w33-a	Centaurea stoebe	1001-5000						No	1	Population size
Polk	T-747C	I-150n39w33-a	Centaurea stoebe	1001-5000						No	1	Population size
Polk	T-747D	I-150n39w33-a	Centaurea stoebe	1001-5000						No	1	Population size
Polk	T-747D	I-150n39w33-a	Centaurea stoebe	1001-5000						No	1	Population size
Polk	T-747A	I-150n39w28-c	Centaurea stoebe	1001-5000	Carduus acanthoides	0-25				No	1	Cluster multiple spp.
Polk	T-745	I-150n39w33-h	Centaurea stoebe	1001-5000	Carduus acanthoides	51-100				No	1	Cluster multiple spp.
Polk	T-745	I-150n39w33-h	Centaurea stoebe	1001-5000	Carduus acanthoides	51-100				No	1	Cluster multiple spp.
Polk	T-744	I-150n39w33-i	Centaurea stoebe	1001-5000	Carduus acanthoides	51-100				No	1	Cluster multiple spp.
Polk	T-744-1	I-150n39w33-i	Centaurea stoebe	1001-5000	Carduus acanthoides	51-100				No	1	Cluster multiple spp.
Polk	T-744-1	I-150n39w33-i	Centaurea stoebe	1001-5000	Carduus acanthoides	51-100				No	1	Cluster multiple spp.
Polk	T-745	I-150n39w33-i	Centaurea stoebe	1001-5000	Carduus acanthoides	51-100				No	1	Cluster multiple spp.

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Polk	T-745-A	I-150n39w33-i	Centaurea stoebe	1001-5000	Carduus acanthoides	51-100				No	1	Cluster multiple spp.
Polk	T-739	I-150n39w34-c	Centaurea stoebe	1001-5000	Cirsium arvense	101-250	Carduus acanthoides			Yes	1	Cluster multiple spp.
Polk	T-747	I-150n39w33-b	Centaurea stoebe	1001-5000	Cirsium arvense	501-1000	Carduus acanthoides			No	1	Cluster multiple spp.
Polk	T-747	I-150n39w33-b	Centaurea stoebe	1001-5000	Cirsium arvense	501-1000	Carduus acanthoides			No	1	Cluster multiple spp.
Polk	T-747B	I-150n39w33-b	Centaurea stoebe	1001-5000	Cirsium arvense	501-1000	Carduus acanthoides			No	1	Cluster multiple spp.
Polk	T-740	I-150n39w34-g	Centaurea stoebe	1001-5000	Tanacetum vulgare	51-100	Cirsium arvense			No	1	Cluster multiple spp.
Polk	T-747A	I-150n39w28-b	Centaurea stoebe	501-1000	Carduus acanthoides	0-25				No	1	Cluster multiple spp.
Polk	T-747A-RR	I-150n39w28-b	Centaurea stoebe	501-1000	Carduus acanthoides	0-25				No	1	Cluster multiple spp.
Polk	T-738	I-149n39w2-j	Centaurea stoebe	501-1000	Carduus acanthoides	501-1000	Tanacetum vulgare	Cirsium arvense		No	1	Cluster multiple spp.
Polk	T-738B	I-149n39w2-j	Centaurea stoebe	501-1000	Carduus acanthoides	501-1000	Tanacetum vulgare	Cirsium arvense		No	1	Cluster multiple spp.
Red Lake	T-773	I-150n41w1-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Red Lake	T-774D	I-150n41w1-b	Centaurea stoebe	0-100					Rare	No	2	High control potential
Red Lake	T-774	I-150n41w1-g	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-776	I-150n41w1-f	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Red Lake	T-776	I-150n41w1-e	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-776	I-150n41w1-d	Carduus acanthoides	0-100					Rare	No	2	High control potential
Red Lake	T-776	I-150n41w1-c	Cirsium arvense	501-1000					Intermittent	Yes	2	High control potential
Red Lake	T-778	I-150n41w1-i	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-780	I-150n41w2-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-784	I-151n41w34-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Red Lake	T-786	I-151n41w33-e	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Red Lake	T-785	I-151n41w34-b	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Red Lake	T-785	I-151n41w34-d	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Red Lake	T-787A	I-151n41w28-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Red Lake	T-793A	I-151n41w29-c	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Red Lake	T-796	I-151n41w19-a	Cirsium arvense	1001-5000					Common	Yes	1	Population size
Red Lake	T-797	I-151n41w19-d	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-797	I-151n42w24-a	Carduus acanthoides	0-100					Rare	Yes	2	High control potential
Red Lake	T-798	I-151n42w24-d	Tanacetum vulgare	0-100					Rare	Yes	2	High control potential
Red Lake	T-798	I-151n42w24-c	Cirsium arvense	501-1000					Intermittent	No	2	High control potential
Red Lake	T-799	I-151n42w24-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-799A	I-151n42w24-e	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-800	I-151n42w23-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-801	I-151n42w14-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-805	I-151n42w15-d	Carduus acanthoides	0-100					Rare	No	2	High control potential
Red Lake	T-805	I-151n42w15-c	Cirsium arvense	501-1000					Intermittent	No	2	High control potential
Red Lake	T-806	I-151n42w10-b	Cirsium arvense	1001-5000					Common	Yes	1	Population size
Red Lake	T-810C	I-151n42w5-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Red Lake	T-809B	I-151n42w5-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-812	I-151n42w5-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-814A	I-152n42w32-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-815	I-152n42w32-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-816	I-152n42w31-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Red Lake	T-818	I-152n42w30-a	Cirsium arvense	0-100					Rare	No	2	High control potential
Red Lake	T-820	I-152n43w25-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Red Lake	T-807	I-151n42w9-l	Cirsium arvense	1001-5000						Yes	1	Population size
Red Lake	T-809	I-151n42w9-e	Cirsium arvense	1001-5000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Red Lake	T-809	I-151n42w9-e	Cirsium arvense	1001-5000	Cirsium arvense	0-25				Yes	1	Cluster multiple spp.
Red Lake	T-810	I-151n42w9-a	Cirsium arvense	251-500						Yes	2	High control potential
Red Lake	T-809	I-151n42w9-c	Cirsium arvense	251-500						Yes	2	High control potential
Red Lake	T-809	I-151n42w9-g	Rhamnus cathartica	501-1000	Cirsium arvense	251-500				Yes	1	Cluster multiple spp.
Red Lake	T-809	I-151n42w9-g	Rhamnus cathartica	501-1000	Cirsium arvense	251-500				Yes	1	Cluster multiple spp.
Red Lake	T-809	I-151n42w9-g	Rhamnus cathartica	501-1000	Cirsium arvense	251-500				Yes	1	Cluster multiple spp.
Red Lake	T-807	I-151n42w9-i	Rhamnus cathartica	501-1000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Red Lake	T-807-A	I-151n42w9-i	Rhamnus cathartica	501-1000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.
Red Lake	T-808	I-151n42w9-i	Rhamnus cathartica	501-1000	Cirsium arvense	51-100				Yes	1	Cluster multiple spp.

County	DNR Tract Name	Invasive Occurrence ID*	Species 1	Population Estimate	Species 2	Population Estimate	Species 3	Species 4	Distribution	ESA Feature(s)	Priority Ranking	Priority Rationale
St Louis	T-0150	I-50n19w22-p718a	Phalaris arundinacea	1001-5000	Phleum pratense	1001-5000	Trifolium complx	Echinochloa crusgalli		Yes	1	Cluster multiple spp.
St Louis	T-0150	I-50n19w27-p804b	Phalaris arundinacea	1001-5000	Phleum pratense	1001-5000	Trifolium complx	Medicago lupulina		Yes	1	Cluster multiple spp.
St. Louis	T-0150	I-50n19w27-718b	Cirsium arvense	43840						Yes	1	High control potential
St. Louis	T-0150	I-50n19w27-718c	Tanacetum vulgare	10-100						Yes	2	High control potential
Wadena	MN-CA-C5-001.510	I-138n32w6-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Wadena	MN-WA-021.000	I-138n33w1-b	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Wadena	MN-WA-021.000	I-138n33w1-a	Centaurea stoebe	0-100					Rare	Yes	2	High control potential
Wadena	MN-CA-C5-001.500	I-138n32w6-a	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Wadena	MN-WA-020.000	I-138n33w1-c	Cirsium arvense	0-100					Rare	Yes	2	High control potential
Wadena	MN-WA-013.000	I-138n33w4-b	Cirsium arvense	0-100					Rare	No	2	High control potential
Wadena	MN-WA-013.000	I-138n33w4-c	Cirsium arvense	0-100					Rare	No	2	High control potential
Wadena	MN-WA-004.000	I-138n33w6-c	Centaurea stoebe	101-500					Intermittent	No	2	High control potential
Wadena	MN-WA-001.000	I-138n34w1-a	Carduus acanthoides	0-100					Rare	No	2	High control potential

*Includes both polygon and point invasive occurrences

Attachment E

Pesticide Application Signage

Invasive Species Alert

Species:

Treated Date:

Do Not Disturb Marked Area Until:

Enbridge

Attachment F

Cleaning Log

Equipment Cleaning Log

Form Completed By: _____

Date: _____ Time: _____

Location of Equipment (tract & milepost): _____

Equipment Type and ID (e.g., company, unique ID number:

_____

_____

_____

_____

_____

_____

_____

_____

Cleaning Method: (check all that apply)

- ☐ Scrape Down
- ☐ Steam Wash Blow Down (compressed air)
- ☐ Power/Pressure Wash (water)
- ☐ Other (Describe): _____

Comments: _____

_____

_____

_____

Attachment G

NPDES Vegetative Pests and Algae Control Pesticide General Permit and North Dakota Pesticide Rule

STATE OF MINNESOTA

Minnesota Pollution Control Agency

Industrial Division

National Pollutant Discharge Elimination System (NPDES) /
State Disposal System (SDS) General Permit MNG87D000
Vegetative Pests and Algae Control Pesticide General Permit

ISSUANCE DATE: April 11, 2012 **EXPIRATION DATE: October 31, 2016**

The state of Minnesota, on behalf of its citizens through the Minnesota Pollution Control Agency (MPCA), **authorizes the Permittee to discharge a biological pesticide or chemical pesticide that leaves a residue for control of Vegetative Pests and Algae** in accordance with the requirements of this permit. If pesticides are applied by the Decision-makers listed in this permit in excess of the Threshold in Section 1.4, then a Notice of Intent (NOI) must be submitted.

The goal of this permit is to protect water quality in accordance with Minnesota and U.S. statutes and rules, including Minn. Stat. chs. 115 and 116, Minn. R. chs. 7001, 7050, 7052, and 7053; and the U.S. Clean Water Act (CWA).

This permit is effective on the issuance date identified above. This permit expires at midnight on the expiration date identified above.

Signature: _____

Jeff Stollenwerk, Manager *for* The Minnesota Pollution Control Agency
Land and Water Quality Permits Section
Industrial Division

Permit Required Submittals:

Submit Reports to:
Attention: WQ Submittals Center
Minnesota Pollution Control Agency
520 Lafayette Rd N
St Paul, MN 55155-4194

Questions on this permit?
- Contact:
  Elise M. Doucette
  Environmental Analysis and Outcomes Division
  elise.doucette@state.mn.us
  651-757-2316

Table of Contents

VEGETATIVE PESTS AND ALGAE CONTROL GENERAL PERMIT REQUIREMENTS

1. General Permit Applicability and Eligibility

1.1 This permit applies to individuals, groups, units of government, or other entities who discharge to waters of the state biological pesticides or chemical pesticides that leave a residue (hereinafter collectively "pesticides") when the application is to control **algae and aquatic and terrestrial vegetative pests in waters of the state**.

1.2 Individuals, groups, units of government, and other entities associated with the application of pesticides which result in a discharge to a water of the state under this permit are considered Decision-makers or Applicators. For the purpose of this permit, "Decision-maker" means any entity with control over the decision to perform pesticide applications, including the ability to modify those decisions. "Applicator" means any entity who performs the application of a pesticide or who has day-to-day control of the application (i.e., they are authorized to direct workers to carry out those activities). More than one entity (Decision-maker and/or Applicator) may be responsible for complying with this permit for any single discharge from the application of pesticides. A Decision-maker that self-applies pesticides is also considered an Applicator and must comply with applicable requirements imposed on both Applicators and Decision-makers.

1.3 For the purposes of this permit, both Decision-makers and Applicators are considered "Permittees" unless otherwise noted and regardless of whether a NOI is required to be submitted.

1.4 The following Decision-makers are required to submit a NOI under this general permit for discharges to waters of the state resulting from the application of pesticides (hereinafter "Thresholds"):

Threshold for Vegetative Pests and Algae	
Lakes ≥20 acres in size	Decision-makers that treat greater than 15% of the littoral zone[1]
	Decision-makers that treat the whole lake[1] (ex: algae control)
All other waters of the state	Decision-makers that apply to a treatment area[2] of 1200 acres or greater that have visible standing water at the time of application (see NOTE below).

[1] Littoral zone – means the surface area of a water body where the depth is 15 feet or less.

[2] The treatment area for a lake is the surface area where the application is intended to provide pesticidal benefits taking into effect wind and wave action.

[3] Treatment Area – The area to which pesticides are being applied and where the pesticide application is intended to provide pesticidal benefits. In some instances, the treatment area will be larger than the area where pesticides are actually applied. If aerially applying the pesticide, all waters of the state under that area should be added to the "treatment area." If spot spraying and a discharge to waters of the state is unavoidable, then the area that receives application should be added to the calendar year total to determine if the Threshold is exceeded. This Threshold is cumulative and based on a calendar year total. For example, treating the same 100-acre wetland three times a year would result in a treatment total of 300 acres.

NOTE: If you are treating an area that is intermittently wet, count it toward the threshold total only when visible standing water is present at the time of application.

1.5 The following discharges, consistent with the permit eligibility provisions in Section 1.1, are automatically authorized by the issuance date of this permit:

a. Eligible discharges made prior to the Notice of Intent submission deadline Section 4.2;
b. Eligible discharges that result from the application of a pesticide as part of pesticide research and development (defined in Section 6.39);
c. Eligible discharges for which submission of an NOI is not required.

However, these discharges are still required to comply with the minimum requirements of this permit as defined in Section 3 (Basic Requirements) and Section 5 (Standard Permit Requirements).

1.6 Consistent with the permit eligibility provisions of Section 1.1, dischargers that submit an application and are issued an Aquatic Plant Management (APM) permit through MN Rules 6280 by the Department of Natural Resources fulfill the requirements of this permit's NOI and are granted coverage under this NPDES/SDS general permit. Compliance with an APM permit satisfies the requirements of this NPDES/SDS permit, and no further reporting to MPCA is required.

1.7 Decision-makers required to submit a NOI, see Sections 4.1-4.5 for timing of submittal and authorization of discharge.

1.8 Decision-makers and Applicators covered under this permit that are not required to submit a NOI are terminated from permit coverage when they no longer have a discharge from the application of pesticides nor activities associated with the discharge required by this Permit, including, but not limited to monitoring, reporting and recordkeeping.

2. Exclusions / Limitations on Coverage

2.1 Decision-makers and Applicators are not eligible for coverage under this permit for discharges to:

a. Waters of the state identified as impaired for the pesticide or its degradates. Impaired waters are those which have been identified pursuant to Section 303(d) of the CWA as not meeting applicable state water quality standards.
b. Waters designated by the state as Prohibited Outstanding Resource Value Waters (ORVWs) for nondegradation purposes under Minn. R. 7050.0180 subp. 3 through 5 (Nondegradation for ORVWs).

2.2 Decision-makers and Applicators are not eligible for coverage under this permit due to other NPDES/SDS coverage in the following cases:

a. Discharges currently covered under another point source NPDES/SDS permit.

b. Discharges covered within five years prior to the effective date of this permit by an individual permit or alternative general permit that established numeric water quality-based limitations for the pesticide in question or its degradates. See Section 4.43 for submittal of an application for an individual permit or alternative general permit.
c. Discharges from activities where any NPDES/SDS permit has been or is in the process of being denied, terminated, or revoked by MPCA (this does not apply to the routine reissuance of permits every five years).

3. Technology-Based Effluent Limits for Pesticide Application

3.1 **Decision-makers' Responsibilities.** To meet the effluent limitations of this permit, all Decision-makers must minimize the discharge of pesticides to waters of the state from the application of pesticides, through the use of pest management measures (defined in Section 6.38).To the extent the Decision-maker determines the amount of pesticide or frequency of pesticide application, the Decision-maker must use the lowest effective amount of pesticide product per application and optimum frequency of pesticide application necessary to control the target pest, consistent with reducing the potential for development of pest resistance.

3.2 **Applicators' Responsibilities**. To meet the effluent limitations of this permit, all Applicators must implement the following requirements to minimize the discharge of pesticides to waters of the state from the application of pesticides, through the use of pest management measures:

a. To the extent not determined by the Decision-maker, use the lowest effective amount of pesticide product per application and optimum frequency of pesticide application necessary to control the target pest, consistent with reducing the potential for development of pest resistance, and apply pesticides in accordance with the product label or labeling and in a manner that will not cause unreasonable adverse effects to the environment. This includes using equipment and application procedures appropriate for this task.
b. Maintain pesticide application equipment in proper operation conditions, including requirement to calibrate, clean, and repair such equipment to prevent leaks, spills or other unintended discharges and to ensure the rate of pesticide application is calibrated (i.e. nozzle choice, droplet size, etc.) to deliver the precise quantity of pesticide needed to achieve the requirements outlined in Section 3.2.a. above.
c. Assess weather conditions (e.g. temperature, wind speed, and wind direction) in the treatment area to ensure application is consistent with all applicable federal requirements.

Water Quality-Based Effluent Limitations

3.3 Your discharge must be controlled as necessary to meet applicable numeric and narrative state water quality standards in accordance with Minn. R. 7000, 7050, 7052, and 7053 including the narrative standards governing nondegradation for all waters and ORVWs.

3.4 If at any time you become aware, or the MPCA determines, that your discharge causes or contributes to an exceedance of applicable water quality standards, you must take corrective action as required in Section 3.13 – 3.17 of this Permit (Corrective Action).

3.5 The MPCA may impose additional water quality-based limitations or require you to obtain coverage under an individual permit if information in your NOI, required reports, or other sources indicates that your discharges are not controlled as necessary to meet applicable water quality standards.

Site Monitoring

3.6 **Applicators Responsibilities.** All Applicators must, when considerations for safety and feasibility allow, visually assess the area to and around where pesticides are applied for possible and observable Adverse Incidents (defined in Section 6.4), caused by application of pesticides, including the unanticipated death or distress of non-target organisms and disruption of wildlife habitat, recreational or municipal water use.

3.7 **Decision-makers Responsibilities.** If any post-application surveillance occurs, Decision-makers must visually assess the area to and around where pesticides were applied for possible and observable Adverse Incidents caused by application of pesticides, including the unanticipated death or distress of non-target organisms and disruption of wildlife habitat, recreational or municipal water use.

Adverse Incident Notification and Reporting for both Decision-makers and Applicators

3.8 **Immediate Adverse Incident Notification.** If you observe or are otherwise made aware of an Adverse Incident that may have resulted from a discharge from your pesticide application, you must notify the Minnesota Public Safety Duty Officer at 800-422-0798 (651-649-5451 in the metro area) immediately. "Adverse Incident" means an incident that you have observed upon inspection or of which you otherwise become aware in which non-target organisms may have been exposed to a pesticide residue and suffered a toxic or adverse effect. See Section 6.4 for the full definition.

The Adverse Incident notification must include at least the following information:

a. The caller's name and telephone number.
b. Decision-makers and/or Applicators name and mailing address.
c. If covered by a NOI, the NPDES/SDS tracking number.
d. The name and telephone number of a contact person, if different than the person providing the 24-hour notice.
e. How and when you became aware of the Adverse Incident.
f. Description of the Adverse Incident identified and the location.
g. The U.S. Environmental Protection Agency (EPA) pesticide registration number for each product you applied in the area of the Adverse Incident. If not a pesticide, provide the chemical product name.
h. Description of any steps you have taken or will take to correct, repair, remedy, cleanup, or otherwise address any adverse effects, if applicable.

The Adverse Incident notification and reporting requirements are in addition to what the registrant is required to submit under Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) section 6(a)(2) and its implementing regulations at 40 CFR pt. 159.

3.9 Following Immediate Adverse Incident Notification in Section 3.8, submittal of an Adverse Incident Report per Section 3.10 is not required in situations identified in a. through d. below. However, documentation must be submitted to the MPCA either by electronic mail to the assigned MPCA staff or by letter to the Water Quality Submittals Center within fifteen (15) days of the Notification and must include justification as to why the Decision-maker and/or Applicator believes the Adverse Incident meets one or more of the situations identified below:

a. An Adverse Incident occurs to pests that are similar in kind to pests identified as potential targets on the FIFRA label. For example, herbicides used to control vegetative aquatic pests may also impact non-target organisms and if identified on the label, reporting is not required.
b. You are aware of facts that clearly establish that the Adverse Incident was not related to toxic effects or exposure from your application.
c. You have been notified in writing by the MPCA that the reporting requirement has been waived for this incident or category of incidents.
d. You receive information notifying you of an Adverse Incident but that information is clearly erroneous.

3.10 **Adverse Incident Report.** Within fifteen (15) days of a reportable Adverse Incident pursuant to Section 3.8 of this Permit, you must provide a written Adverse Incident Report to the MPCA Water Quality Submittals Center. Your Adverse Incident Report must include at least the following information:

a. Information required to be provided in Section 3.8.
b. Date and time you notified authorities, whom you spoke with, and any instructions you received.
c. Location of incident, including the names of any waters affected and appearance of those waters (sheen, color, clarity, etc).
d. A description of the circumstances, including species affected, estimated number of individual and approximate size of dead or distressed organisms.
e. Magnitude and scope of the affected area (e.g. aquatic square area or total stream distance affected).
f. Pesticide application rate, intended use site (e.g., banks, above, or direct to water), method of application, and name of pesticide, description of pesticide, and EPA registration number.
g. Description of the habitat and the circumstances under which the Adverse Incident occurred (including any available ambient water data for pesticides applied).
h. If laboratory tests were performed, indicate what test(s) were performed and when, and provide a summary of the test results within 5 days after they become available.
i. Actions to be taken to prevent recurrence of Adverse Incidents.
j. Signed and dated in accordance with Section 5.17 (Required Signatures).

3.11 **Adverse Incident to Threatened or Endangered Species or Critical Habitat.** Notwithstanding any of the other Adverse Incident notification requirements of Section 3.8 and 3.10, if you become aware of an Adverse Incident to a federally or state-listed threatened or endangered species or its federally-designated critical habitat, that may have resulted from your discharge, you must immediately notify the U.S. Fish and Wildlife Service (FWS) – Twin Cities Field Office (Ecological Services) at 612-725-3548 (TwinCities@fws.gov) or the Minnesota Department of Natural Resources (MDNR) Division of Ecological and Water Resources at 1 888-646-6367

(or 651-296-6157 in the metro area). This notification must be made by telephone immediately upon your becoming aware of the Adverse Incident and must include at least the following information:

a. The caller's name and telephone number.
b. Applicator name, mailing address, and telephone number (if different than above).
c. The name of the affected species.
d. How and when you became aware of the Adverse Incident.
e. Description of the location of the Adverse Incident.
f. Description of the Adverse Incident, including the EPA pesticide registration number for each product you applied in the area of the Adverse Incident. If not a pesticide, provide the chemical product name.
g. Description of any steps you have taken or will take to alleviate the adverse impact to the species.

Additional information on federal and state-listed threatened or endangered species and critical habitat is available from FWS (http://www.fws.gov/midwest/TwinCities/) and MDNR (http://www.dnr.state.mn.us/eco/index.html).

3.12 Where multiple entities are authorized for a discharge that results in an Adverse Incident, notification and reporting by any one of the entities (Decision-maker or Applicator) constitutes compliance for all of the entities, provided a copy of the written report required in Section 3.10 is also provided to all of the other authorized Decision-makers and/or Applicators within 30 days of the reportable adverse incident.

Corrective Action

3.13 If any site-monitoring activities conclusively indicate that you failed to meet the basic requirements in Section 3.1 through 3.4 of this Permit, you must review and, as necessary, revise the evaluation and selection of your pest management measures to ensure that the situation is eliminated and will not be repeated in the future.

3.14 If any of the following situations occur, Decision-makers and Applicators must review and, as necessary, revise the evaluation and selection of your pest management measures to ensure that the situation is eliminated and will not be repeated in the future:

a. An unauthorized release or discharge associated with the application of pesticides occurs (e.g., a spill, leak, or discharge not authorized by this or another NPDES/SDS permit consistent with Minn Stat. 115.061).
b. You become aware, or the MPCA concludes, that your control measures are not adequate/sufficient for the discharge to meet applicable water quality standards.
c. An inspection or evaluation of your activities by an MPCA official or local entity reveals that modifications to the control measures are necessary to meet the non-numeric effluent limits in this permit.
d. You observe, or are otherwise made aware of, a Reportable Adverse Incident.

3.15 If you determine that changes to your pest management measures are necessary to eliminate any situation identified in Section 3.13 and 3.14, such changes must be made before the next

pesticide application that results in a discharge if practicable, or if not, as soon as possible thereafter.

3.16 The occurrence of a situation identified in Section 3.13 and 3.14 may constitute a violation of the permit. Correcting the situation does not absolve you of liability for any original violation. However, failure to comply with Sections 3.13 and 3.14 constitute an additional permit violation. The MPCA will consider the appropriateness and promptness of corrective action in determining enforcement responses to permit violations.

3.17 The MPCA or a court may impose additional requirements and schedules of compliance, including requirements to submit additional information concerning the condition(s) triggering corrective action or schedules and requirements more stringent than specified in this permit. Those requirements and schedules will supersede those of Section 3.13 and 3.14 if such requirements conflict.

Recordkeeping

3.18 Decision-makers and Applicators must keep written records as required in this permit. These records must be accurate and complete and sufficient to demonstrate your compliance with the conditions of this permit. You can substitute records and documents developed for other obligations, such as requirements under FIFRA and state or local programs, provided all requirements of this permit are satisfied.

3.19 Decision-makers and Applicators shall keep records of acres or percentage of littoral zone receiving treatment for all activities covered under this general permit. The records must be kept up-to-date to help you determine if your permitted discharge meets the Thresholds as identified in Section 1.4.

3.20 Decision-makers and Applicators must keep the following records:
a. A copy of any Adverse Incident Reports (Section 3.10).
b. Your rationale for any determination that reporting of an identified Adverse Incident is not required consistent with allowances in Section 3.9.

3.21 Applicators must retain the following records when applying a pesticide. These records are required under authority of the Minnesota Department of Agriculture and when an application is performed by a for-hire Applicator, the Applicator is required to give a copy of the records to the Decision-maker (customer):

a. Name of Target pest.
b. Name of Applicator (individual and company), including license number and company address .
c. Pesticide application date(s) and time(s).
d. Brand name of the pesticide, the United States Environmental Protection Agency registration number, and dosage used.
e. Location of the site where the pesticide was applied, including number of units treated (acres or linear feet, or gallons of pesticide applied).
f. Temperature, wind speed, and wind direction at time of each pesticide application.
g. Documentation of equipment calibration.

h. Whether or not visual monitoring was conducted during pesticide application and if not, why not and whether monitoring identified any possible or observable adverse incidents caused by application of pesticides.

4. Requirements for Decision-makers that Must Submit a NOI

Authorization to Discharge under This Permit

4.1 To obtain authorization under this permit, a Decision-maker must meet the eligibility requirements identified in Section 1.1 and if so required, submit a NOI in accordance with Section 1.4 (Thresholds) of this Permit.

4.2 Decision-makers are authorized to discharge under this permit as follows:

Type	NOI Submission Deadline	Discharge Authorization Date
Any Decision-maker not required to submit an NOI	Not applicable	Immediately upon beginning the discharge
Decision-makers whose discharge begins before final permit issuance and that meet the criteria in Section 1.4 requiring submission of an NOI.	Due between April 30, 2012, and July 30, 2012.	Immediately upon beginning to discharge. Authorization granted until July 30, 2012. If MPCA receive a complete and accurate NOI on or before July 30, 2012, uninterrupted coverage continues.
Decision-makers whose discharges begin after final permit issuance and that meet the criteria in Section 1.4 requiring submission of an NOI.	Due prior to exceeding a Threshold.	Immediately upon beginning to discharge, until the discharge exceeds a Threshold. If a Decision-maker submits an NOI after July 30, 2011, they are reauthorized after MPCA notifies them of receipt of a complete and accurate NOI.
Decision-makers whose discharge is in response to a declared pest emergency situation, as defined in Section 6.15 for which that activity triggers the NOI requirement identified in Section 1.4.	No later than 30 days after beginning discharge but no earlier than April 30, 2012.	Immediately, for activities conducted in response to declared emergency situation. A complete and accurate NOI shall be submitted within 30 days of the declared emergency. Coverage is reauthorized after MPCA notifies them of receipt of a complete and accurate NOI.
Any Decision-makers requiring permit coverage for a treatment area not within the pest management area identified on a previously submitted NOI. (If the Decision-maker cannot determine whether a revised NOI is needed, the Decision-maker may contact the MPCA.)	At least 10 days before beginning to discharge in that newly identified area unless discharges are in response to a declared pest emergency, in which case not later than 30 days after beginning discharge.	After MPCA notifies the Decision-maker of receipt of a complete and accurate NOI, unless discharges are in response to a declared pest emergency. If a declared pest emergency, a complete and accurate NOI shall be submitted within 30 days of the declared emergency. Coverage is reauthorized after MPCA notifies the Decision-maker of receipt of a complete and accurate NOI.

4.3 Coverage is for the Decision-maker who filed a NOI, including its employees, contractors, subcontractors, Applicators (commercial/for-hire applicators) and other agents, for all activities identified on the NOI. Applicators that are not also Decision-makers do not need to submit a NOI.

4.4 Electronic reporting of the NOI (eNOI) will be available online beginning April 30, 2012. If required to submit an NOI, a Decision-maker must submit the NOI once, in accordance with the deadlines in Section 4.3. The Decision-maker must prepare and submit the NOI using MPCA's electronic Notice of Intent system (eNOI) available on MPCA's website (www.pca.state.mn.us/pesticidepermit) unless eNOI is otherwise unavailable or the Decision-maker has obtained a waiver from the requirement to use eNOI for submission of the NOI. Decision-makers waived from the requirement to use eNOI for NOI submission must certify on paper that use of eNOI will incur undue burden or expense over the use of a paper form and then provide a basis for this determination. MPCA will notify Decision-makers of complete and accurate NOIs received. Late NOIs will be accepted, but authorization to discharge will not be retroactive.

4.5 Based on a review of your NOI or other information, the MPCA may delay coverage for further review, notify you that additional effluent limitations are necessary, or may deny coverage under this permit and require submission of an application for an individual NPDES/SDS permit, as detailed in Section 4.39 – 4.42. In these instances, the MPCA will notify you in writing of the delay, of the need for additional effluent limits, or of the request for submission of an individual NPDES/SDS permit application.

Technology-Based Effluent Limits

Pest Management Measures

4.6 If you discharge pollutants as a result of the application of pesticides for the sole purpose of research and development (defined in Section 6.40), you are not required to fully implement Section 4.8 – 4.10 for such discharges, but you still must implement Sections 3.1 – 3.5 to the extent that its requirements do not compromise the research design.

4.7 Decision-makers that submit a NOI are required to evaluate, select, and implement site-specific control measures that reduce and/or eliminate discharges of pesticides to waters of the state to the extent technologically available and economically practicable and achievable to meet the effluent limits in Sections 3.1 -3.5 and Sections 4.8 – 4.10 of the permit. Control measures can be actions (including processes, procedures, schedules of activities, prohibitions on practices, and other management practices), or structural or installed devices to minimize discharges of pesticides to waters of the state.

Part 1: Identify the Problem

4.8 Prior to the first pesticide application covered under this permit after the Threshold is reached, and at least once each year thereafter during which you will have a discharge, you must do the following for each pest management area:

a. Identify areas with vegetative pest or algae problems and **characterize the extent of the problems**, including, for example, water use goals not attained (e.g. wildlife habitat, fisheries, vegetation, and recreation).
b. Identify **target vegetative pest species**.
c. Identify possible factors **causing or contributing to the vegetative pest or algae problem** (e.g., nutrients, invasive species, etc).

d. Establish past or present vegetative pest or algae densities to serve as pest **action threshold(s)** for implementing pest management strategies. The action threshold is a point at which pest populations or environmental conditions indicate that pest control action must be taken.
e. In the event there are no data for one or more proposed pest management area(s) in the past calendar year, use other data as appropriate to meet the permit conditions a - d above.

Part 2: Pest Management Strategies

4.9 Prior to the first pesticide application covered under this permit after the Threshold has been reached, and at least once each year thereafter during which you will have a discharge, you must select and implement for each pest management area efficient and effective means of pest management strategies that most successfully minimize discharges resulting from application of pesticides to control vegetative pests and algae, including the use of pesticide and non-pesticide methods. In developing your pest management strategies, you must evaluate the following management options considering impact to water quality, non-target organisms, pest resistance, feasibility, and cost effectiveness:

a. No action.
b. Prevention.
c. Mechanical/physical methods.
d. Cultural methods.
e. Biological control agents.
f. Pesticides.

Part 3: Pesticide Use

4.10 If a pesticide is selected for managing pests and application of the pesticide will result in a discharge to waters of the state, after the Threshold has been reached, you must:

a. Conduct surveillance prior to each pesticide application to assess the pest management area and to determine when the action threshold is met that necessitates the need for pest management.
b. Reduce the impact on the environment and non-target organisms by applying the pesticide only when the action threshold has been met.

Pesticide Discharge Management Plan (PDMP) for Large Entities

4.11 Decision-makers who submit a NOI, apply pesticides, and are a Large Entity (defined in Section 6.25) must prepare a Pesticide Discharge Management Plan (PDMP) for discharges from all treatment areas covered under this permit. The PDMP does not contain effluent limitations; the limitations are contained in Sections 3.1 – 3.6 and Sections 4.8 – 4.10 of this Permit. One PDMP may cover one or more treatment areas for each pesticide application activity.

4.12 The PDMP is intended to document the evaluation and selection of control measures. The additional documentation requirements (see Adverse Incidents and Recordkeeping Sections of this permit) are intended to document the implementation (including inspection, maintenance, monitoring, and corrective action) of the permit requirements. In your PDMP, you may refer to

procedures in other documents that meet the requirements of this permit. If you reference other documents, you must keep a copy of relevant portions of those documents with your PDMP and make it available for review consistent with Sections 4.24 and 4.26 (PDMP Availability).

4.13 Your PDMP must contain the following elements:

a. Pesticide Discharge Management Team.
b. Problem Description.
c. Control Measures Description.
d. Schedules and Procedures
    1) Spill Response Procedures.
    2) Adverse Incident Response Procedures.
e. Signature Requirements.

PDMP – Team

4.14 You must identify the persons (by name or title) that comprise the team as well as their individual responsibilities, including:

a. Person(s) responsible for managing pests in the treatment area described below.
b. Person(s) responsible for developing and revising the PDMP.
c. Person(s) responsible for taking corrective actions where required.
d. Person(s) responsible for pesticide applications, or Applicators. If the Applicator is unknown at the time of plan development, indicate whether or not a for-hire Applicator will be used.

4.15 Identification of team members must include any written agreement(s), such as a for-hire pesticide Applicator, that specify the division of responsibilities between Decision-makers and Applicators as necessary to comply with the provisions of this permit.

PDMP – Problem and Pest Management Area Description

4.16 You must document the pest problem in your pest management area as required in Section 4.8 of this permit, including, but not limited to, identification of the target pest(s), source of the pest problem, and source of data used to identify the problem, action thresholds, and how they were determined.

4.17 You must include a general location map (e.g., USGS quadrangle map, a portion of a city or county map, or other map) that identifies the geographic boundaries of the area to which the plan applies and location of the waters of the state.

4.18 You must document any waters identified as impaired by a substance which either is an active ingredient or a degradate of such an active ingredient.

PDMP – Control Measures Description

4.19 You must document your evaluation of control measures for your pest management area. You must document the control measures you will implement to comply with the effluent limitations

required in Sections 3.1 – 3.5 and Sections 4.8 – 4.10. Include in the description the active ingredient(s) evaluated.

PDMP –Schedules and Procedures

4.20 You must document schedules and procedures in your PDMP pertaining to control measures and pest management used to comply with the Effluent Limitations in Section 3.1 – 3.5 and Sections 4.8 – 4.10 of this Permit, including:

a. Spill Response Procedures – At a minimum, Decision-makers must have:

1) Procedures for expeditiously stopping, containing, and cleaning up leaks, spills, and other releases to Waters of the United States. Employees who may cause, detect, or respond to a spill or leak must be trained in these procedures and have necessary spill response equipment available. If possible, one of these individuals should be a member of the PDMP team.
2) Procedures for notification of appropriate facility personnel, emergency response agencies, and regulatory agencies.

b. Adverse Incident Response Procedures – At a minimum, Decision-makers must have:

1) Procedures for responding to any adverse incident resulting from pesticide applications;
2) Procedures for notification of the adverse incident, both internal to the Decision-maker's agency/organization and external. Contact information for state/federal permitting agency, nearest emergency medical facility, and nearest hazardous chemical responder must be in locations that are readily accessible and available.

PDMP – Signatures and Modifications

4.21 You must sign, date, and certify your PDMP in accordance with Section 5.17 (Required Signatures).

4.22 You must modify your PDMP whenever necessary to address any of the triggering conditions for corrective action in Section 3.13 and 3.14 (Corrective Actions) or when a change in pest control activities significantly changes the type or quantity of pollutants discharged.

4.23 Changes to your PDMP must be made before the next pesticide application that results in a discharge, if practicable, or if not, as soon as possible thereafter. The revised PDMP must be signed and dated in accordance with Section 5.17.

4.24 You must review your PDMP at a minimum once per calendar year and whenever necessary to update the pest problem identified and pest management strategies evaluated for your pest management area.

PDMP – Availability

4.25 You must retain a copy of the current PDMP, along with all supporting maps and documents, at the address provided in the NOI. The PDMP and all supporting documents must be readily available, upon request, and copies of any of these documents provided, upon request, to the

MPCA or agencies governing discharges or pesticide applications within their respective jurisdictions.

4.26 The MPCA may provide copies of your PDMP or other information related to this permit that is in its possession to members of the public. Any Confidential Business Information (CBI), as defined in Minn. Stat. § 116.075 (40 CFR pt. 2), may be withheld from the public provided that a claim of confidentiality is properly asserted and documented in accordance with Minn. R. 7000.1300 (40 CFR pt. 2). However, CBI must be submitted to the MPCA if requested, and may not be withheld from those staff within the MPCA or local/federal agencies cleared for CBI review (See Section 5.19, Confidential Information).

Corrective Action Documentation

4.27 Decision-makers required to submit an NOI, for situations identified in Section 3.13 and 3.14 that do not include Adverse Incidents, must document the situation triggering corrective action and the planned corrective action within fifteen (15) days of becoming aware of the situation and retaining a copy of this documentation. This documentation must include, but is not limited to the following information:

a. Identification of the condition triggering the need for corrective action review, including any ambient water quality monitoring that assisted in determining that discharges did not meet water quality standards.
b. Brief description of the situation.
c. Date the problem was identified.
d. Brief description of how the problem was identified, how you learned of the situation, and date you learned of the situation.
e. Summary of corrective action taken or to be taken including date initiated and date completed or expected to be completed.
f. For large entities, whether PDMP modifications are required as a result of the problem.

Recordkeeping

4.28 In addition to the recordkeeping requirements under Section 3.18 through 3.21 of this permit, Decision-makers who submit a NOI are required to keep records listed below at the address provided on the NOI. This includes recordkeeping requirement under Section 3.21, which is required by Minnesota Department of Agriculture to be recorded by any for-hire Applicators and copied to the Decision-maker (customer):

a. A copy of the NOI submitted to the MPCA, any correspondence exchanged between you and the MPCA specific to coverage under this permit, and your assigned permit tracking number.
b. Documentation of any equipment cleaning, calibration, and repair (only if Decision-maker is also the Applicator)
c. Description of pest management measures(s) implemented prior to the first pesticide application.
d. Target pest(s) and pest density prior to pesticide application.
e. Identification of any waters, either by name or by location, to which you discharged any pesticide(s).
f. Quantity of each pesticide product applied to each treatment area.

g. Whether or not visual monitoring was conducted during pesticide application and/or post-application and if not, why not and whether monitoring identified any possible or observable adverse incidents caused by application of pesticides.

Recordkeeping for Pesticide Application by Large Entities

4.29 In addition to Section 4.28, any Decision-maker required to submit an NOI and is a Large Entity (defined in Section 6.25) must retain the following records at the address provided on the NOI:

a. A copy of the PDMP, including any modifications made to the PDMP during the term of this permit.
b. Copy of Annual Reports submitted to MPCA.
c. Action Thresholds.
d. Method and/or data used to determine that action threshold(s) has been met.

4.30 All required records must be documented as soon as possible but no later than 15 days following pesticide application. You must retain any records required under this permit for at least 5 years after the date of pesticide application. You must make available to the MPCA, including an authorized representative of the MPCA, all records, including electronic records, kept under this permit upon request and provide copies of such records, upon request.

Annual Reporting

4.31 If you submitted a NOI and are considered a Large Entity, you must submit an Annual Report to the MPCA by February 15 for all pesticide activities covered under this permit occurring during the previous calendar year. You must retain a copy for your records. The report shall be completed on MPCA's Annual Report form. The first Annual Report is due February 15, 2013, for facilities that discharged during 2012

4.32 Once you meet the obligation to submit an Annual Report, you must submit an Annual Report each calendar year thereafter for the duration of coverage under this general permit. If pesticide application does not occur in a subsequent calendar year, you may check the "No Discharge" box on the Annual Report form for that year.

4.33 The Annual Report must include information for the calendar year. The first annual report must include activities for the portion of the calendar year after the effective date of the posting of a NOI. If the effective date is after November 1, you are not required to submit an Annual Report for that first partial year but must submit annual reports thereafter, with the first Annual Report submitted also including information from the first partial year.

4.34 When you terminate permit coverage, as specified in Sections 4.36 – 4.38, you must submit an Annual Report for the portion of the year up through the date of your termination. The Annual Report must be postmarked no later than 45 days after your termination date, or February 15 of the following year, whichever is earlier.

4.35 The Annual Report must contain the following information:

a. Decision-maker's name.

b. NPDES/SDS permit tracking number(s).
c. Contact person name, title, e-mail address (if any), and phone number.
d. For each treatment area, report the following information:

    1.) Identification of any waters or other treatment area either by name or by location, including size, Latitude and Longitude (if known), and Public Water Inventory number (if known), to which you discharged any pesticide(s).
    2.) Pesticide use pattern(s) and target pest(s).
    3.) Total amount of each pesticide product applied for the reporting year listed by the EPA registration number(s), if applicable, and by application method (e.g., aerially by fixed-wing or rotary aircraft, broadcast spray, etc.).
    4.) Whether this control activity was addressed in your PDMP prior to pesticide application, if applicable.
    5.) If applicable, a Report of any Adverse Incidents as a result of these treatment(s).
    6.) A description of any corrective action(s), including spill responses, resulting from pesticide application activities and the rationale for such action(s).

Terminating Coverage

4.36 Decision-makers covered by the posting of a NOI must submit a complete and accurate Permit Change Request form to terminate permit coverage. Authorization to discharge under this permit terminates after the Decision-maker receives either written or electronic notification by the MPCA that permit coverage has been terminated. You are responsible for meeting the terms of this permit until your authorization is terminated.

4.37 You must submit a Permit Change Request form within 30 days after one of the following conditions has been met:

a. You have ceased all discharges from the application of pesticides for which you obtained permit coverage and you do not expect to discharge during the remainder of the permit term for the activity identified in Section 1.1 including, but not limited to monitoring, reporting and recordkeeping; or
b. You have obtained coverage under an individual permit or an alternative general permit for all discharges required to be covered by an NPDES/SDS permit, unless you obtained coverage consistent with Section 4.39 – 4.42 below, in which case no Permit Change Request form is required.

    If you submit a Permit Change Request form without meeting one of the above conditions, your form is not valid.

4.38 Decision-makers are required to submit Annual Reports pursuant to Section 4.31 – 4.35 and must file an Annual Report for the portion of the year up through the date of your termination. The Annual Report is due no later than 45 days after your termination date.

Individual or Alternative General Permits

MPCA Requiring Coverage under an Individual or Alternative General Permit

4.39 The MPCA may require you to obtain authorization to discharge under either an individual NPDES/SDS permit or an alternative NPDES/SDS general permit in accordance with 40 CFR § 122.64 and § 124.5, and Minn. R. ch. 7001.

4.40 If the MPCA requires you to apply for an individual NPDES/SDS permit, the MPCA will notify you in writing that a permit application is required. This letter will include a brief statement of the reasons for this decision and will provide application information, including a deadline to file the permit application. The MPCA may grant additional time to submit the application if you submit a request setting forth reasonable grounds for additional time.

4.41 If you are covered under this permit and fail to submit an individual NPDES/SDS permit application as required by the MPCA, then the this permit's coverage to you is terminated at the end of the day specified by the MPCA as the deadline for application submittal. The MPCA may take appropriate enforcement action for any unpermitted discharge.

4.42 If during the course of this general permits' term the water of the state being discharged to is listed as Impaired pursuant to Section 303(d) of the CWA for a pesticide or its degradates, and general permit coverage is for the discharge of that specific pesticide or one of its degradates, you shall notify the MPCA whether you will retain coverage under the general permit and thus are required to change the pesticide being used, or obtain an individual permit or an alternative general permit by meeting the requirements of Sections 4.43 and 4.44. The listing of Impaired Waters can be found at http://www.pca.state.mn.us/index.php/view-document.html?gid=8262

Decision-maker Requesting Coverage under an Individual or Alternative General Permit

4.43 You may request to be excluded from coverage under this general permit by applying for an individual permit. In such a case, you must submit an individual permit application in accordance with the requirements of Minn. R. 7001.0050 with reasons supporting the request. The request may be granted by issuance of an individual permit or authorization of coverage under an alternative general permit if your reasons are warranted.

4.44 When an individual NPDES/SDS permit or an alternative NPDES/SDS general permit is issued, authorization to discharge under this permit is terminated on the effective date of the individual permit or the date of authorization of coverage under the alternative general permit.

5. Standard Permit Requirements

5.1 Incorporation by Reference. The following applicable federal and state laws are incorporated by reference in this permit, are applicable to the Permittee, and are enforceable parts of this permit: 40 CFR §§ 122.41, 122.42, pts. 136, 403 and 503; Minn. R. chs. 7001, 7041, 7045, 7050, 7052, 7053, 7060, and 7080; and Minn. Stat. chs. 115 and 116.

5.2 Other federal and state laws. Permittees must comply with all other applicable federal and state laws and regulations that pertain to the application of pesticides. For example, this permit does not negate the requirements under the FIFRA and its implementing regulations to use registered pesticides consistent with the product's labeling. In fact, applications in violation of certain FIFRA requirements could also be a violation of the permit and therefore a violation of the CWA (e.g. exceeding label application rates).

5.3 Permittee Responsibility. The Permittee shall perform the actions or conduct the activity authorized by the permit in compliance with the conditions of the permit and, if required, in accordance with the plans and specifications approved by the Agency (Minn. R. 7001.0150, subp. 3, item E).

5.4 Toxic Discharges Beyond Impact to Target Species Prohibited. Whether or not this permit includes effluent limitations for toxic pollutants, the Permittee shall not discharge a toxic pollutant that will impact non-target species except according to 40 CFR pts. 400 to 460 and Minn. R. chs. 7050, 7052, 7053 and any other applicable MPCA rules (Minn. R. 7001.01090, subp. 1, item A).

5.5 Nuisance Conditions Prohibited. The Permittee's discharge shall not cause any nuisance conditions including, but not limited to floating solids, scum and visible oil film, acutely toxic conditions to non-target aquatic life, or other adverse impact on the receiving water (Minn. R. 7001.0210, subp. 2).

5.6 Property Rights. This permit does not convey a property right or an exclusive privilege (Minn. R. 7001.0150, subp 3. item C).

5.7 Liability Exemption. In issuing this permit, the state and the MPCA assume no responsibility for damage to persons, property, or the environment caused by the activities of the Permittee in the conduct of its actions, including those activities authorized, directed, or undertaken under this permit. To the extent the state and the MPCA may be liable for the activities of its employees, that liability is explicitly limited to that provided in the Tort Claims Act (Minn. R. 7001.0150, subp. 3, item O).

5.8 Agency Obligations. The MPCA's issuance of this permit does not obligate the MPCA to enforce local laws, rules, or plans beyond what is authorized by Minn. Stat. (Minn. R. 7001.0150, subp. 3, item D).

5.9 Liabilities. The MPCA's issuance of this permit does not release the Permittee from any liability, penalty or duty imposed by Minnesota or federal statutes or rules or local ordinances, except the obligation to obtain the permit (Minn. R. 7001.0150, subp. 3, item A).

5.10 More Stringent Rules. The issuance of this permit does not prevent the future adoption by the MPCA of pollution control rules, standards, or orders more stringent than those now in existence and does not prevent the enforcement of these rules, standards, or orders against the Permittee (Minn. R. 7001.0150, subp. 3, item B).

5.11 Severability. The provisions of this permit are severable, and if any provisions of this permit, or the application of any provision of this permit to any circumstance, are held invalid, the

application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

5.12 Compliance with Other Rules and Statutes. The Permittee shall comply with all applicable air quality, solid waste, and hazardous waste statutes and rules.

5.13 Inspection and Entry. When authorized by Minn. Stat. §§ 115.04; 115B.17, subd. 4; and 116.091, and upon presentation of proper credentials, the agency, or an authorized employee or agent of the agency, shall be allowed by the Permittee to enter at reasonable times upon the property of the Permittee to examine and copy books, papers, records, or memoranda pertaining to the construction, modification, or operation of the facility covered by the permit or pertaining to the activity covered by the permit; and to conduct surveys and investigations, including sampling or monitoring, pertaining to the construction, modification, or operation of the facility covered by the permit or pertaining to the activity covered by the permit (Minn. R. 7001.0150, subp. 3, item I).

5.14 Completing Reports. The Permittee shall submit the results of the required sampling and monitoring activities on the forms provided, specified, or approved by the MPCA. The information shall be recorded in the specified areas on those forms and in the units specified (Minn. R. 7001.1090, subp. 1, item D; Minn. R. 7001.0150, subp. 2, item B).

Required forms may include:

a. Adverse Incident Report
c. Annual Report

5.15 **Submitting Reports. Forms shall be submitted to:**

MPCA
Attn: Pesticide NPDES/SDS Permitting Reports
520 Lafayette Road North
St. Paul, Minnesota 55155-4194

Forms shall be submitted as specified in this permit. Annual Reports shall be submitted for each event even if no discharge occurred during the reporting period (Minn. R. 7001.0150, subp. 2 item B and 3, item H).

5.16 Incomplete or Incorrect Reports. The Permittee shall immediately submit an amended report to the MPCA upon discovery by the Permittee or notification by the MPCA that it has submitted an incomplete or incorrect report. The amended report shall contain the missing or corrected data along with a cover letter explaining the circumstances of the incomplete or incorrect report (Minn. R. 7001.0150, subp. 3, item G).

5.17 Required Signatures. All forms, reports, and other documents submitted to the MPCA shall be signed by the Permittee or the duly authorized representative of the Permittee. Minn. R. 7001.0150, subp. 2, item D. The person or persons that sign the forms, reports, or other documents must certify that he or she understands and complies with the certification requirements of Minn. R. 7001.0070 and 7001.0540, including the penalties for submitting false information.

5.18 Records. The Permittee shall, when requested by the Agency, submit within a reasonable time the information and reports that are relevant to the control of pollution regarding the construction, modification, or operation of the facility covered by the permit or regarding the conduct of the activity covered by the permit (Minn. R. 7001.0150, subp. 3, item H).

5.19 Confidential Information. Except for data determined to be confidential according to Minn. Stat. § 116.075, subd. 2, all reports required by this permit shall be available for public inspection. In order to maintain data for confidential use of the MPCA, pursuant to Minn. Stat § 116.075, or as nonpublic data not on individuals or private data as it relations to individuals, pursuant to Minn. Stat. § 13.37, a person must affirmatively request such recognition by providing the Commissioner a written request setting forth the statutory grounds and the reasons that justify the classification of the records or other information as not public (Minn. R. 7001.1300, subp. 1). Effluent data shall not be considered confidential. To request the Agency maintain data as confidential, the Permittee must follow Minn. R. 7000.1300.

Noncompliance and Enforcement

5.20 Subject to Enforcement Action and Penalties. Noncompliance with a term or condition of this permit subjects the Permittee to penalties provided by federal and state law set forth in section 309 of the CWA; United States Code, title 33, section 1319, as amended; and in Minn. Stat. §§ 115.071 and 116.072, including monetary penalties, imprisonment, or both (Minn. R. 7001.1090, subp. 1, item D).

5.21 Criminal Activity. The Permittee may not knowingly make a false statement, representation, or certification in a record or other document submitted to the Agency. A person who falsifies a report or document submitted to the Agency, or tampers with, or knowingly renders inaccurate a monitoring device or method required to be maintained under this permit is subject to criminal and civil penalties provided by federal and state law (Minn. R. 7001.0150, subp. 3[G]).

5.22 Noncompliance Defense. It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit (40 CFR § 122.41 [c]).

5.23 Civil and Criminal Liability. Nothing in this permit shall be construed to relieve the Permittee from civil or criminal penalties for noncompliance with the terms and conditions provided herein. Nothing in this permit shall be construed to preclude the initiation of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties to which the Permittee is or may be subject to under Section 311 of the CWA and Minn. Stat. chs. 115 and 116, as amended; and any rules adopted thereunder.

5.24 Noncompliance. If the Permittee discovers, through any means, including notification by the MPCA, that noncompliance with a condition of the permit has occurred, the Permittee shall take all reasonable steps to minimize the adverse impacts on human health, public drinking water supplies, or the environment resulting from the noncompliance (Minn. R. 7001.1090, subp. 3[J]).

5.25 Unauthorized Releases of Wastewater Prohibited. Except for conditions specifically described in Minn. R. 7001.1090, subp. 1, items J and K, all unauthorized bypasses, overflows, discharges,

spills, or other releases of wastewater or materials to the environment, whether intentional or not, are prohibited. However, the MPCA will consider the Permittee's compliance with permit requirements, frequency of release, quantity, type, location, and other relevant factors when determining appropriate action (40 CFR § 122.41 and Minn. Stat. § 115.061).

5.26 Discovery of a Release. Upon discovery of a release, the Permittee shall:

a. Immediately take all reasonable action necessary to minimize or abate the incident and to recover any pesticides involved in the incident.
b. Notify the Minnesota Department of Public Safety Duty Officer at 800-422-0798 (toll free) or 651-649-5451 (metro area) immediately upon discovery of the release. In addition, you may also contact the MPCA during business hours at 800-657-3864.
c. Recover as rapidly and as thoroughly as possible all substances and materials released or immediately take other action as may be reasonably possible to minimize or abate pollution to waters of the state or potential impacts to human health caused thereby. If the released materials or substances cannot be immediately or completely recovered, the Permittee shall contact the MPCA. If directed by the MPCA, the Permittee shall consult with other local, state or federal agencies (such as the MDNR and/or the Wetland Conservation Act authority) for implementation of additional clean-up or remediation activities in wetland or other sensitive areas.
d. If directed by the MPCA, the Permittee shall collect representative samples of the release. The Permittee shall sample the release for parameters of concern immediately following discovery of the release. The Permittee may contact the MPCA during business hours to discuss the sampling parameters and protocol. If the release cannot be immediately stopped, the Permittee shall consult with MPCA regarding additional sampling requirements. Samples shall be collected at least, but not limited to, two times per week for as long as the release continues.
e. Submit the sampling results as directed by the MPCA. At a minimum, the results shall be submitted to the MPCA within 15 days of the release.

5.27 Upset Defense. In the event of temporary noncompliance by the Permittee with an applicable effluent limitation resulting from an upset of the Permittee's activity due to factors beyond the control of the Permittee, the Permittee has an affirmative defense to an enforcement action brought by the Agency as a result of the noncompliance if the Permittee demonstrates by a preponderance of competent evidence:

a. The specific cause of the upset.
b. That the upset was unintentional.
c. That the upset resulted from factors beyond the reasonable control of the Permittee and did not result from operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or increases in production which are beyond the design capability of the treatment facilities.
d. That at the time of the upset the facility was being properly operated.
e. That the Permittee properly notified the Commissioner of the upset in accordance with Minn. R. 7001.1090, subp. 1, item I.
f. That the Permittee implemented the remedial measures required by Minn. R. 7001.0150, subp. 3, item J.

5.28 The Permittee shall at all times properly operate and maintain the equipment and systems of treatment and control, and the appurtenances related to them, which are installed or used by the Permittee to achieve compliance with the conditions of the permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures.

5.29 Report Changes. The Permittee shall give advance notice as soon as possible to the MPCA of any substantial changes in operational procedures, activities that may alter the nature or frequency of the discharge, and/or material factors that may affect compliance with the conditions of this permit (Minn. R. 7001.0150, subp. 3, item M).

5.30 The MPCA Initiated Permit Modification, Suspension, or Revocation. The MPCA may modify or revoke and reissue this permit pursuant to Minn. R. 7001.0170. The MPCA may revoke without reissuance this permit pursuant to Minn. R. 7001.0180.

5.31 TMDL Impacts. Facilities that discharge to an impaired surface water, watershed or drainage basin may be required to comply with additional permits or permit requirements, including additional restrictions as authorized by the CWA 303(d)(4)(A) and 40 CFR § 122.44 (l)(2)(i) necessary to ensure consistency with the assumptions and requirements of any applicable EPA approved wasteload allocations resulting from Total Maximum Daily Load (TMDL) studies.

5.32 Permit Transfer. The permit is not transferable to any person without the express written approval of the Agency after compliance with the requirements of Minn. R. 7001.0190. A person to whom the permit has been transferred shall comply with the conditions of the permit (Minn. R. 7001.0150, subp. 3, item N).

5.33 Permit Reissuance. If the Decision-maker desires to continue permit coverage beyond the date of permit expiration, the Decision-maker shall submit an application for reissuance at least 180 days before permit expiration. If the Decision-maker does not intend to continue the activities authorized by this permit after the expiration date of this permit, the Decision-maker shall notify the MPCA in writing at least 180 days before permit expiration.

If the Decision-maker has submitted a timely application for permit reissuance, the Permittee may continue to conduct the activities authorized by this permit, in compliance with the requirements of this permit, until the MPCA takes final action on the application, unless the MPCA determines any of the following (Minn. R. 7001.0040 and 7001.0160):

a. The Permittee is not in substantial compliance with the requirements of this permit, or with a stipulation agreement or compliance schedule designed to bring the Permittee into compliance with this permit.
b. The MPCA, as a result of an action or failure to act by the Permittee, has been unable to take final action on the application on or before the expiration date of the permit.
c. The Permittee has submitted an application with major deficiencies or has failed to properly supplement the application in a timely manner after being informed of deficiencies.

6. Permit Specific Definitions

6.1 "Act" means the federal CWA, as amended, 33 U.S. Code 1251 et seq.

6.2 "Action Threshold" means the point at which pest populations or environmental conditions can no longer be tolerated, necessitating that pest control action be taken based on economic, human health, aesthetic, or other effects. Sighting a single pest does not always mean control is needed. Action Thresholds help determine both the need for control actions and the proper timing of such actions.

6.3 "Active Ingredient" means any substance (or group of structurally similar substances if specified by the Agency) that will prevent, destroy, repel, or mitigate any pest, or that functions as a plant regulator, desiccant, or defoliant within the meaning of FIFRA sec. 2(a) (40 CFR § 152.3). Active ingredient also means a pesticidal substance that is intended to be produced and used in a living plant, or in the produce thereof, and the genetic material necessary for the production of such a pesticidal substance (40 CFR § 174.3).

6.4 "Adverse Incident" means an incident that you have observed upon inspection or of which you otherwise become aware, in which (1) Non-target organism may have been exposed to a pesticide residue, and (2) The non-target organism suffered a toxic or adverse effect.

The phrase "toxic or adverse effects" includes effects that occur within waters of the U.S. on non-target plants, fish, or wildlife that are unusual or unexpected (e.g., effects are to organisms not otherwise described on the pesticide product label or otherwise not expected to be present) as a result of exposure to a pesticide residue, and may include:

a. Distressed or dead juvenile and small fishes.
b. Washed up or floating fish.
c. Fish swimming abnormally or erratically.
d. Fish lying lethargically at water surface or in shallow water.
e. Fish that are listless or nonresponsive to disturbance.
f. Stunting, wilting, or desiccation of non-target submerged or emergent aquatic plants.
g. Other dead or visibly distressed non-target aquatic organisms (amphibians, turtles, invertebrates, etc.).

The phrase, "toxic or adverse effects," also includes any adverse effects to humans (e.g., skin rashes) or domesticated animals that occur either directly or indirectly from a discharge to waters of the state that are temporally and spatially related to exposure to a pesticide residue (e.g., vomiting, lethargy).

6.5 "Agency" means the Minnesota Pollution Control Agency (MPCA).

6.6 "Applicator" means a person or commercial business that applies pesticides or other chemicals covered by this permit to a water of the state. Applicators are required to be licensed if hired or to apply registered pesticides. See Minn. Stat. § 18B.29 through 18B.35 for specifics on certification and licensing.

6.7 "Best Management Practices" or "BMPs" means practices to prevent or reduce the pollution of waters of the state, including schedules of activities, prohibitions of practices, and other management practices, and also includes treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal or drainage from raw material storage (Minn. R. 7001.1020, subp 5).

6.8 "Biological Control Agents" mean agents that are organisms that can be introduced to your sites, such as herbivores, predators, parasites, and hyperparasites (Source: FWS IPM Guidance, 2004).

6.9 "Biological Pesticides" (also called biopesticides) include microbial pesticides, biochemical pesticides, and plant-incorporated protectants (PIP). Microbial pesticide means a microbial agent intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant, or dessicant, that: (1) is a eucaryotic microorganism including, but not limited to, protozoa, algae, and fungi; (2) is a procaryotic microorganism, including, but not limited to, Eubacteria and Archaebacteria; or (3) is a parasitically replicating microscopic element, including but not limited to, viruses (40 CFR § 158.2100[b]). Biochemical pesticide mean a pesticide that: (1) is a naturally-occurring substance or is structurally-similar and functionally identical to a naturally-occurring substance; (2) has a history of exposure to humans and the environment demonstrating minimal toxicity, or in the case of a synthetically-derived biochemical pesticides, is equivalent to a naturally-occurring substance that has such a history; and (3) has a non-toxic mode of action to the target pest(s) (40 CFR § 158.2000[a][1]). Plant-incorporated protectant means a pesticidal substance that is intended to be produced and used in a living plant, or in the produce thereof, and the genetic material necessary for production of such a pesticidal substance. It also includes any inert ingredient contained in the plant, or produce thereof (40 CFR §174.3).

6.10 "CFR" means the Code of Federal Regulations.

6.11 "Chemical Pesticides" means all pesticides not otherwise classified as biological pesticides.

6.12 "Commissioner" means the commissioner of the Minnesota Pollution Control Agency or a designated representative.

6.13 "Control Measures" refers to any BMP or other method used to meet the effluent limitations. Control measures must comply with manufacturer specifications, industry standards and recommended industry practices related to the application of pesticides, and relevant legal requirements. Additionally, control measures could include other actions that a prudent operator would implement to reduce and/or eliminate pesticide discharges to waters of the state to comply with the effluent limitations in Sections 3 and 4 of this permit.

6.14 "Cultural Methods" means manipulation of the habitat to increase pest mortality by making the habitat less suitable to the pest.

6.15 "Decision-maker" means any entity associated with the application of pesticides which results in a discharge to waters of the state and that has control over the decision to perform pesticide applications, including the ability to modify those decisions. This does not include local, state or other units of government that may provide instruction or control documents based on their

authority over pests or the use of pesticides by another party (i.e. the Lake Association is considered the Decision-maker even if the DNR may direct the Lake Association to use a specific pesticide product or limit the amount to be applied).

6.16 "Declared Pest Emergency Situation" means an event defined by a public declaration by a federal agency, state, or local government of a pest problem determined to require control through application of a pesticide beginning less than ten days after identification of the need for pest control. This public declaration may be based on:

a. Significant risk to human health.
b. Significant economic loss.
c. Significant risk to:
    1) Endangered species.
    2) Threatened species.
    3) Beneficial organisms.
    4) The environment (40 CFR pt. 166).

6.17 "Discharge" when used without qualification, means the "discharge of a pollutant" (40 CFR § 122.2).

6.18 "Duty Officer" means the Minnesota Duty Officer, Department of Public Safety, Division of Emergency Management.

6.19 "Facility or Activity" means any NPDES "point source" (including land or appurtenances thereto) that is subject to regulation under the NPDES program (40 CFR § 122.2).

6.20 "Federal Facility" means any buildings, installations, structures, land, public works, equipment, aircraft, vessels, and other vehicles and property, owned, operated, or leased by, or constructed or manufactured for the purpose of leasing to, the federal government.

6.21 "For-Hire Applicator" includes persons who make contractual pesticide applications for which they or their employer receives compensation (e.g., lawn care firms, pest control companies). This includes "Commercial Applicators" as defined in Minn. Stat. ch. 18B.

6.22 "General Permit" means a permit issued under Minn. R. 7001.0210 to a category of permittees whose operations, emissions, activities, discharges, or facilities are the same or substantially similar.

6.23 "Impaired Water" or "Water Quality Impaired Water," for the purposes of this permit, means a water identified by the state pursuant to Section 303(d) of the CWA as not meeting applicable state water quality standards (these waters are called "water quality limited segments" under 40 CFR § 130.2(j). Impaired waters include both waters with approved or established TMDLs, and those for which a TMDL has not yet been approved or established.

6.24 "Inert Ingredient" means any substance (or group of structurally similar substances if designated by the Agency), other than an active ingredient, that is intentionally included in a pesticide product (40 CFR §152.3). Inert ingredient also means any substance, such as a selectable marker, other than the active ingredient, where the substance is used to confirm or ensure the

presence of the active ingredient, and includes the genetic material necessary for the production of the substance, provided that genetic material is intentionally introduced into a living plant in addition to the active ingredient (40 CFR § 174.3).

6.25 **"**Large Entity" means any: (a) public entity that serves a population greater than 10,000 or (b) private enterprise that exceeds the Small Business Administration size standard as identified at 13 CFR § 121.201.

6.26 "Littoral zone" means the surface area of a water body where the depth is 15 feet or less (Minn. R. 6280.0100, subp.9).

6.27 "Mechanical/Physical Methods" means mechanical tools or physical alterations of the environment, for pest prevention or removal.

6.28 "Minimize" means to reduce and/or eliminate pesticide discharges to waters of the state through the use of "control measures" to the extent technologically available and economically practicable and achievable.

6.29 "MPCA" means the Minnesota Pollution Control Agency, or Minnesota Pollution Control Agency staff as delegated by the Minnesota Pollution Control Agency.

6.30 "Non-target Organisms" includes the plant and animal hosts of the target species, the natural enemies of the target species living in the community, and other plants and animals, including vertebrates, living in or near the community that are not the target of the pesticide.

6.31 "NPDES" means National Pollutant Discharge Elimination System which is the program for issuing, modifying, revoking, reissuing, terminating, monitoring, and enforcing permits and imposing and enforcing pretreatment requirements under sections, 307, 318, 402, and 405 of the CWA: 33 U.S.C. §§ 1317, 1328, 1342, and 1345.

6.32 "Outstanding Resource Value Waters" are waters within the Boundary Waters Canoe Area Wilderness, Voyageur's National Park, and Department of Natural Resources designated scientific and natural areas, wild, scenic, and recreational river segments, Lake Superior, those portions of the Mississippi River from Lake Itasca to the southerly boundary of Morrison County that are included in the Mississippi Headwaters Board comprehensive plan dated February 12, 1981, and other waters of the state with high water quality, wilderness characteristics, unique scientific or ecological significance, exceptional recreational value, or other special qualities which warrant stringent protection from pollution (Minn. R. 7050.0180 subp. 2(A), including any updates).

6.33 "Permittee" means any entity associated with the application of pesticides which results in a discharge to waters of the state regardless of whether a NOI is required to be submitted.

6.34 "Person" means an individual, association, partnership, corporation, municipality, State or Federal agency, or an agent or employee thereof.

6.35 "Pest" means an insect, rodent, nematode, fungus, weed, terrestrial or aquatic plant, animal life, virus, bacteria, or other organism designated by rule as a pest, except a virus, bacteria, or

other microorganism on or in living humans or other living animals (Minn. Stat. § 18B.01, subd. 17).

6.36 "Pest Management Area" means the area of land, including any water, for which you are conducting pest management activities covered by this permit.

6.37 "Pest Management Measure" means any practice used to meet the effluent limitations that comply with manufacturer specifications, industry standards and recommended industry practices related to the application of pesticides, relevant legal requirements and other provisions that a prudent Permittee would implement to reduce and/or eliminate pesticide discharges to waters of the state.

6.38 "Pesticide" means a substance or mixture of substances intended to prevent, destroy, repel, or mitigate a pest, and a substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant. (Minn. Stat. 18B.01, subd. 18)

Under FIFRA Section 2(u), "Pesticide" means: (1) any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, (2) any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant, and (3) any nitrogen stabilizer, except that the term ''pesticide'' shall not include any article that is a "new animal drug" within the meaning of section 201(w) of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 321[w]), that has been determined by the Secretary of Health and Human Services not to be a new animal drug by a regulation establishing conditions of use for the article, or that is an animal feed within the meaning of section 201(x) of such Act (21 U.S.C. 321[x]) bearing or containing a new animal drug. The term "pesticide" does not include liquid chemical sterilant products (including any sterilant or subordinate disinfectant claims on such products) for use on a critical or semi-critical device, as defined in section 201 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 321). For purposes of the preceding sentence, the term "critical device" includes any device that introduced directly into the human body, either into or in contact with the bloodstream or normally sterile areas of the body and the term ''semi-critical device'' includes any device that contacts intact mucous membranes but which does not ordinarily penetrate the blood barrier or otherwise enter normally sterile areas of the body.

The term "pesticide" applies to insecticides, herbicides, fungicides, rodenticides, and various other substances used to control pests. The definition encompasses all uses of pesticides authorized under FIFRA including uses authorized under sections 3 (registration), 5 (experimental use permits), 18 (emergency exemptions), 24(c) (special local needs registrations), and 25(b) (exemptions from FIFRA).

Note: drugs used to control diseases of humans or animals (such as livestock and pets) are not considered pesticides; such drugs are regulated by the Food and Drug Administration. Fertilizers, nutrients, and other substances used to promote plant survival and health are not considered plant growth regulators and thus are not pesticides. Biological control agents, except for certain microorganisms, are exempted from regulation under FIFRA. (Biological control agents include beneficial predators such as birds or ladybugs that eat insect pests, parasitic wasps, fish, etc).

This permit uses the term "pesticide" when referring to the "pesticide, as applied." When referring to the chemical in the pesticide product with pesticidal qualities, the permit uses the term "active ingredient."

6.39 "Pesticide Product" means a pesticide in the particular form (including composition, packaging, and labeling) in which the pesticide is, or is intended to be, distributed or sold. The term includes any physical apparatus used to deliver or apply the pesticide if distributed or sold with the pesticide.

6.40 "Pesticide Research and Development" **–** Activities undertaken on a systematic basis to gain new knowledge (research) and/or the application of research findings or other scientific knowledge for the creation of new or significantly improved products or processes (experimental development). These types of activities are generally categorized under the four-digit code of 5417 under the 2007 NAICS.

6.41 "Pesticide Residue" – includes that portion of a pesticide application that is discharged from a point source to waters of the U.S. and no longer provides pesticidal benefits. It also includes any degradates of the pesticide.

6.42 "Point source" means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural stormwater runoff. (40 CFR § 122.2)

6.43 "Pollutant" means any sewage, industrial waste, or other wastes, as defined in Minnesota Statutes chapter 115.01, discharged into a disposal system or to waters of the state, and includes dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. For purposes of this definition, a "biological pesticide" is considered a "biological material," and any "pesticide residue" resulting from use of a "chemical pesticide" is considered a "chemical waste." [excerpted from 40 CFR § 122.2]

6.44 "Release" means any bypass, overflow, discharge, spill, or other release of wastewater or materials to the environment.

6.45 "SDS" means State Disposal System and generally describes a permit issued by the state of Minnesota that is non-surface water discharging or land application facilities.

6.46 "Small Entity" means any: (a) public entity that serves a population of 10,000 or less or (b) private enterprise that does not exceed the Small Business Administration size standard as identified at 13 CFR § 121.201.

6.47 "Target Pest" is the organism toward which pest control measures are being directed.

6.48 "Technology-based effluent limitation, standard, or prohibition" means an effluent limitation, standard, or prohibition promulgated by the EPA at 40 CFR pts. 400 to 460; under sections 301 and 306 of the CWA; 33 U.S.C. §§ 1311 and 1316. (Minn. R. 7010.0120, subp. 29).

6.49 "Total maximum daily load" or "TMDL" means the sum of the individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background, as more fully defined in 40 CFR §130.2(i). A TMDL sets and allocates the maximum amount of a pollutant that may be introduced into a water of the state and still assure attainment and maintenance of water quality standards. (Minn. R. 7052.0010 subp. 42).

6.50 "Upset" means an exceptional incident in which the permit discharge limits are unintentionally and temporarily exceeded due to factors beyond the reasonable control of the Permittee.

6.51 "Waters of the State" means all streams, lakes, ponds, marshes, wetlands, watercourses, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, which are contained within, flow through, or border upon the state or any portion thereof. (Minn. Stat. 115.01, subp. 22).

6.52 “You” and “Your,” as used in this permit are intended to refer to the permittee as the context indicates and that party’s activities or responsibilities.

ARTICLE 60-03
PESTICIDES

CHAPTER 60-03-01
PESTICIDE, DISTRIBUTION, HANDLING, AND USE

60-03-01-01. Scope.

Repealed effective January 1, 2013.

60-03-01-02. Definitions.

As used in this chapter, the following words shall have the meaning given to them below, unless otherwise made inappropriate by use and context. Words not defined in this section shall have the meaning given to them in North Dakota Century Code chapter 4.1-33.

1. "Agricultural plants" means any plants grown or maintained for commercial or research purposes.

2. "Board" means the North Dakota pesticide control board created pursuant to North Dakota Century Code section 4.1-33-02.

3. "Bulk pesticide" means any volume of pesticide that is intended to be repackaged, can be accurately measured, and can be transported or held in an individual container.

4. "Bulk pesticide facility" means any place used to handle or store bulk pesticides.

5. "Certification" means recognition by the board or its designee that a person is competent and thus authorized as a:

    a. Certified private applicator to use or supervise the use of restricted use pesticides in noncommercial settings.

    b. Certified commercial applicator to use a restricted use pesticide or supervise the use of a general use pesticide in commercial settings.

    c. Certified public applicator to use a restricted use pesticide or supervise the use of a general use pesticide in settings that do not require maintaining proof of financial responsibility.

    d. Certified dealer to distribute restricted use pesticides.

6. "Commissioner" means the North Dakota agriculture commissioner.

7. "Compensation" means monetary payment for a specific service.

8. "Competent" means qualified to perform functions associated with pesticide applications, the degree of competency required being directly related to the nature of the activity and the associated responsibility, including receiving proper training to know and understand the pesticide label, the product name and application rate, proper application techniques, recordkeeping requirements, worker protection standards, and emergency response and being able to identify workplace hazards.

9. "Custom blend" means any diluted mixture of pesticide prepared by a dealer to the specifications of the end-user and not held in inventory.

10. "End-use labeling" means the written, printed, or graphic matter on, attached to, or accompanying the pesticide or device or any of its containers or wrappers.

11. "End-user" means the person who applies the pesticide.

12. "FIFRA" means the Federal Insecticide, Fungicide, and Rodenticide Act of 1947, as codified and amended at 7 U.S.C. 136-136y.

13. "Fumigant pesticide" means a chemical compound whose pesticidal action occurs in a gaseous state.

14. "General use pesticide" means any pesticide formulation which is not classified for restricted use.

15. "Handling" means the mixing, loading, application, repackaging, storage, transportation, distribution, sale, purchase, or disposal of pesticides.

16. "Mixture" means any pesticide combined with fertilizer, seed, or other substance.

17. "Mobile container" means a container used to transport pesticides.

18. "Operational area" means:

    a. An area within a permanent containment area where pesticides are transferred, loaded, unloaded, mixed, repackaged, or refilled; or

    b. An area where pesticides are rinsed from a container.

19. "Permanent containment area" means:

a. An aboveground pad or dike constructed of impervious material, such as sealed concrete, stainless steel, or other material as approved by the registrant, unless the commissioner approves or requires material other than that approved by the registrant; or

b. An area that has a berm or curb or is otherwise designed to contain discharges that may occur while handling pesticides or pesticide-containing materials.

20. "Pesticide-containing material" means:

a. Any container of a pesticide product that has not been triple-rinsed or the equivalent of triple-rinsed;

b. Any rinsate that is derived from a pesticide container, pesticide application equipment, or equipment washing;

c. Any material that is used to collect or contain excess or spilled pesticide or rinsate;

d. Any mixture of pesticide and diluent such as wash water, rinse water, or rainwater; or

e. Material that is generated as a result of contact with or utilization of a pesticide in an application, containment, recovery, reuse, or treatment system. The term does not include personal protective equipment that contains pesticide residue.

21. "Pesticide-producing establishment" means any site where a pesticide is manufactured, packaged, repackaged, prepared, processed, labeled, relabeled, or held for distribution.

22. "Registrant" means the person holding the pesticide product registration under North Dakota Century Code chapter 4.1-34.

23. "Repackaging" means the transfer of a pesticide in an unaltered state from a container into a designated or dedicated refillable container for the purpose of distribution.

24. "Spill kit" means a portable kit or other equipment that is designed to recover, minimize, contain, or absorb discharges of pesticides. A spill kit must include the following:

a. Enough absorbent material, or any combination of absorbent pads, pillows, or tubes sufficient to absorb five gallons [18.93 liters] of liquid;

b. One or more impervious containers with a combined minimum capacity of ten gallons [37.85 liters]; and

c. Adequate tools to collect and place pesticide-contaminated material in containers.

25. "Under the direct supervision" means the act or process whereby the application of a pesticide is made by a competent person acting under the instructions and control of a certified applicator who is responsible for the actions of that person and who is available if and when needed, even though the certified applicator is not physically present at the time and place the pesticide is applied. The certified applicator must be able to physically arrive at the location of a supervised applicator within thirty minutes.

26. "Use of a pesticide" means mixing, filling application equipment, applying, storing, distributing, and disposing of a pesticide.

27. "Use of a pesticide in a manner inconsistent with its labeling" means using any pesticide in a manner that is not permitted by the labeling, except that the term does not apply to any of the following:

a. Applying a pesticide at any dosage, concentration, or frequency that is less than that specified on the label, unless the labeling specifically prohibits deviation from the specified dosage, concentration, or frequency.

b. Applying a pesticide against any target pest that is not specified on the labeling if the application is to the crop, animal, or site that is specified on the label.

c. Employing any method of application that is not prohibited by the labeling unless the label specifically states that the product may be applied only by the methods specified on the labeling.

d. Mixing a pesticide or pesticides with a fertilizer when the labeling does not prohibit such mixture.

e. Any use of a pesticide that is in compliance with section 5, 18, or 24 of the Federal Insecticide, Fungicide, and Rodenticide Act of 1947 [Pub. L. 104-170; Stat. 7 U.S.C. 136 et seq.].

History: Amended effective April 15, 1985; October 1, 1990; July 1, 1992; March 1, 2003; July 1, 2004; January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-03

60-03-01-03. Restricted use pesticides.

Repealed effective January 1, 2013.

60-03-01-04. Prohibited pesticides. [Reserved]

60-03-01-05. Classes of commercial applicator, public applicator, and dealer certifications.

A commercial applicator, public applicator, or dealer certificate may be issued to individuals who pass a core certification examination and who have obtained certification in one or more of the following classes:

1. **Agricultural pest control (plant and animal).** This class authorizes the use of pesticides intended for agricultural crop land, grasslands, animals, animal facilities, and noncrop lands, including natural areas, fallow, nonproducing agricultural lands, and mines.

2. **Seed treatment.** This class authorizes the use of pesticides intended for agricultural crop seeds, other seeds, and vegetative seed stocks.

3. **Commodity and structural fumigation.** This class authorizes the use of fumigant pesticides intended for raw agricultural commodities, processed foods, nonfood commodities, transport vessels, commodity processing facilities, and commodity storage structures.

4. **Ornamental and turf pest control.** This class authorizes the use of pesticides intended for producing and maintaining ornamental trees, shrubs, flowers, and turf.

5. **Greenhouse.** This class authorizes the use of pesticides intended for greenhouses.

6. **Right of way.** This class authorizes the use of pesticides in parking lots and rights of way for roads, powerlines, telecommunication lines, pipelines, and railways, and in other similar areas.

7. **Public health pest control.** This class authorizes the use of pesticides by government employees, applicators working under government contract, or other persons for public health purposes.

8. **Research and demonstration pest control.** This class authorizes the use of pesticides by individuals for the purpose of education or research. These would include county agents, state, federal, and commercial employees, plus other persons conducting research or demonstrating the proper application of restricted use pesticides.

9. **Home, industrial, and institutional pest control.** This class authorizes the use of pesticides in or around food-handling establishments, human dwellings, public or private institutions, warehouses, grain elevators, and any other structures.

10. **Wood preservatives.** This class authorizes the use of pesticides intended to preserve lumber products.

11. **Vertebrate.** This class authorizes the use of pesticides intended to control vertebrate pests, such as rodents, certain predators, and bats not in or around structures.

12. **Sewer root control.** This class authorizes the use of pesticides intended to control tree or other plant roots infesting sewer systems.

History: Amended effective February 1, 1982; October 1, 1990; November 1,1991; March 1, 1996; August 1, 2000; March 1, 2003; January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-03, 4.1-33-06, 4.1-33-07, 4.1-33-11, 4.1-33-12

60-03-01-05.1. Commercial applicator, public applicator, and dealer certifications.

1. A commercial applicator, public applicator, or dealer certificate shall be issued only to persons who:

   a. Are eighteen years of age or older;

   b. Complete an application on forms and in the manner required by the board or its designee;

   c. Demonstrate competence in the use of pesticides; and

   d. Pay the costs of training and education and any other fees.

2. Commercial applicator, public applicator, and dealer certificates shall expire on April first following the third anniversary of the year of certification or recertification. A person holding these certificates may be recertified by attending a board-approved seminar or by passing a board-approved examination, or both if required by the board, at least every third year.

3. A person holding a commercial applicator, public applicator, or dealer certificate who is unable to complete recertification requirements due to active duty military service may apply for an extension of the person's certification status for a time period not to extend beyond April first of the year following the person's return from active duty. The application must be in writing and accompanied by a certified copy of military orders or other trustworthy proof showing the date on which active duty military service began and ended. The board has discretion whether to grant the application.

4. A person holding an aerial core commercial or aerial core public applicator certificate shall attend a professional aerial applicators' support system (PAASS) program or other board-approved program at least once every three years. Proof of attendance at a PAASS

program or other board-approved program must be received by the North Dakota state university extension service before recertification is issued.

5. Any person who fails an examination may retake it after three or more days.

6. All commercial and public applicators must be certified, under section 60-03-01-05, in the class that applies to how they use pesticides.

7. All dealers must be certified, under section 60-03-01-05, in the class that applies to the pesticides they distribute.

8. If a pesticide is labeled for more than one target pest, a dealer only needs to be certified in one of the applicable classes.

9. The board designates the North Dakota state university extension service to provide training, administer testing, and issue certifications under this section.

History: Effective March 1, 2003; amended effective July 1, 2004; January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-06, 4.1-33-07, 4.1-33-08, 4.1-33-11

60-03-01-05.2. Private applicator certification.

1. A private applicator certification shall be issued only to persons who:

   a. Are eighteen years of age or older;

   b. Complete an application on forms and in the manner required by the board or its designee;

   c. Demonstrate competence in the use of pesticides; and

   d. Pay the costs of training and education and any other fees.

2. The board designates the North Dakota state university extension service to provide training, administer testing, and issue certifications under this section. An individual seeking certification as a private applicator may demonstrate competence by:

   a. Attending a board-approved educational seminar, signing of a certificate of attendance, and passing a written examination administered by the board or its designee;

   b. Completing a course of self-instruction and passing a written examination administered by the board or its designee; or

   c. Passing the dealer, public applicator, or commercial applicator certification examination and submitting the passing grade to the board or its designee.

3. Certified private applicators purchasing, storing, or applying restricted use fumigant pesticides intended for use on agricultural commodities and in grain storage structures must pass a board-approved commodity and structural fumigation examination. The fee for the private fumigation certification will be set by the North Dakota state university extension service.

4. Certified private applicators purchasing, storing, or applying restricted use fumigant pesticides for burrowing pest control must pass a board-approved vertebrate examination. The fee for the private vertebrate certification will be set by the North Dakota state university extension service.

5. A certified private applicator must be recertified by attending a board-approved seminar or by passing a board-approved examination, or both if required by the board, at least every third year.

6. A person holding a private applicator certificate who is unable to complete recertification requirements due to active duty military service may apply for an extension of the person's certification status for a time period not to extend beyond April first of the year following the person's return from active duty. The application must be in writing and accompanied by a certified copy of military orders or other trustworthy proof showing the date on which active duty military service began and ended. The board has discretion whether to grant the application.

7. Any person who fails an examination may retake such examination after three or more days. No more than three examinations may be given before requiring attendance at another initial training course.

8. The board designates the North Dakota state university extension service to provide training, administer testing, and issue certifications under this section.

History: Effective March 1, 2003; amended effective July 1, 2004; January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-06, 4.1-33-12

60-03-01-05.3. Pesticide certification examination - Cheating.

1. An individual who seeks certification under section 60-03-01-05.1 or 60-03-01-05.2 may not, while taking a written examination, give or receive information or assistance to or from any other person, utilize the assistance of any electronic device capable of storing data, or consult any written materials unless expressly authorized in advance by the board or its designee. The written examination and any other writings made during the examination period must be provided to the board or its designee at the end of the examination period.

2. Cheating by an applicant in applying for or taking the examination may result in the invalidating of examination grades, expulsion from the examination room, disqualification from taking the examination for a specified period of time, and other penalties the board may impose. When the board believes that cheating has occurred, the applicant or certified individual must be given notice and an opportunity to be heard pursuant to North Dakota Century Code chapter 28-32 before imposing any penalties.

History: Effective July 1, 2004; amended effective January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-06, 4.1-33-07, 4.1-33-11, 4.1-33-12

60-03-01-05.4. Certification denial.

1. The board, or its designee, may refuse to issue a pesticide certification, including an applicant for reciprocal certification under North Dakota Century Code section 4.1-34-15, to an individual who has had that individual's certification suspended or revoked in the past three years in any state or province or to an individual that has committed a documented violation of FIFRA or the pesticide regulations of any state, provincial, or tribal authority within the last three years.

2. The board, or its designee, may require an additional demonstration of applicator qualification if the applicator has had a license suspended or revoked or has otherwise had a history of pesticide violations.

History: Effective July 1, 2004; amended effective January 1, 2013.

General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-06, 4.1-33-07, 4.1-33-11, 4.1-33-12, 4.1-33-15

60-03-01-06. Pesticide mixing, filling, and application - Storage - Transportation - Disposal.

1. **Mixing, filling, and application**.

   a. All pesticides must be used in accordance with the labeling.

   b. Pesticide applications must be made in a manner that prevents off-target discharges of pesticides.

   c. Pesticide application equipment or equipment used to fill application equipment that is designed to draw water from surface water must have a properly functioning antisiphoning device attached to the inlet hose.

   d. Applications must not occur when the atmospheric conditions favor the off-target drift of pesticides or prevent the proper deposition of pesticides to the target area.

   e. Pesticides must be applied in a manner that minimizes exposure to animals. Unless permitted by the labeling, an applicator shall take all reasonable precautions to prevent a pesticide from being applied if unprotected persons are present within the application site or are present in adjacent areas when off-target drift may occur.

   f. Pesticide applicators and persons assisting with an application shall follow all safety precautions as specified on the labeling.

   g. All equipment used in pesticide mixing, filling application equipment, and application must be operationally sound and properly calibrated to prevent adverse effects on the environment.

   h. Any commercial or public applicator who mixes, fills application equipment, or otherwise uses pesticides shall have immediate access to a spill kit at the filling site. The spill kit requirement does not apply to a person using only ready-to-use pesticides.

   i. The labeling, a legible reproduction of the labeling, or a specimen labeling of the pesticides being applied must be at the application site during the application. Aerial applicators must have the labeling available at the filling site.

2. **Storage**.

   a. All pesticides, except bulk pesticides, must be stored in their original container and in accordance with labeling recommendations. All labeling of stored pesticides must be plainly visible. All pesticide containers must have a proper label affixed to them.

   b. All pesticides must be stored in dry, well-ventilated spaces, and in a manner that will not endanger humans, animals, or the environment, nor contaminate food, feed, seed, or any goods intended for consumer distribution, through a release or escape of pesticide products.

   c. If a storage area contains a floor drain, it must be sealed or self-contained.

   d. Pesticide storage areas containing products intended for distribution or use by commercial or public applicators and dealers must be marked at all entrances. Storage areas containing only hard surface disinfectants are exempt from this requirement.

   e. Label-specific safety equipment for all pesticides stored must be available at the immediate storage site.

f. Stored pesticides must be secured in a manner that prevents children, unauthorized persons, or animals from gaining entry or access to them. Security of a pesticide storage area is achieved when normal points of access are closed and locked while unattended and the structural integrity of the area prevents access by other than normal means.

3. **Transportation**.

a. All pesticides, except bulk pesticides, must be transported in their original containers. All pesticides must be transported in a secure manner to avoid breakage of containers, spills, or any other manner of contamination.

b. Pesticides must not be transported with foodstuffs, feed, or any other product or material so as to pose a hazard to humans, animals, or the environment.

c. Pesticides in an unattended transport vehicle must be secured to prevent children, unauthorized persons, or animals from gaining access.

d. Equipment contaminated while transporting pesticides must be cleaned and decontaminated prior to any other use.

4. **Disposal**.

a. Empty pesticide containers must be stored in accordance with label recommendations and in a manner that will not endanger humans, animals, or the environment.

b. Empty nonreturnable pesticide containers must be triple-rinsed or the equivalent on the day of their use. Secondary use of such containers that would endanger humans, animals, or the environment is prohibited.

c. Pesticide containers must be disposed of in accordance with labeling directions and in a manner that will not endanger humans, animals, or the environment.

History: Amended effective April 15, 1985; October 1, 1990; July 1, 1992; May 1, 1994; March 1, 1996; March 1, 2003; July 1, 2004; January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-03, 4.1-33-17

60-03-01-07. Recordkeeping - Commercial, public, and private applicators and dealers.

1. **Dealers**. Every pesticide dealer shall keep separate, accurate, and complete records of all of the dealer's purchases and sales of restricted use pesticides and all pesticides used under section 18 (emergency exemption) and section 24-c (special local needs) of FIFRA. Dealers shall positively identify all purchasers of restricted use pesticides using any trustworthy proof of identification. If a restricted use pesticide is to be delivered to a person other than the certified applicator making the purchase, the dealer must have a completed and signed authorization to receive restricted use pesticides form on file for the purchaser for the current year. The records must include the following for each pesticide purchased or sold:

a. Purchases.

(1) Dealer's name and address.

(2) Pesticide trade name and environmental protection agency registration number, if available.

(3) Quantity of pesticide.

(4) Date pesticide was shipped or received.

(5) Name of the person from whom the pesticide was received.

b. Sales.

(1) Dealer's name and address and identification of the person making the sale.

(2) Name, address, certification number, and signature of the certified applicator making the purchase.

(3) Date of sale.

(4) Trade name and environmental protection agency registration number, if available.

(5) Quantity of pesticide.

(6) Accurate inventory by product.

(7) Certification class and expiration date of the certification.

(8) Intended application site or intended crop for all pesticides used under section 18 of FIFRA.

(9) Dealers shall positively identify all purchasers of restricted use pesticide products.

2. **Commercial or public applicators**. Commercial and public applicators shall keep a record of all pesticide applications and of the use or disposal of all pesticide rinsate. The record must be made within twenty-four hours of the pesticide application or the use or disposal of the pesticide rinsate. A copy of the record must be provided to the applicator's client as soon as possible, not to exceed thirty days, unless the applicator has on file a signed letter from the client waiving the right to receive a copy. The record must include for each application:

a. Name and address of the person for whom the pesticide was applied.

b. Legal description of the land, grain bin identification, railcar number, or other description of where the pesticide was applied.

c. Pest or pests controlled.

d. Start and completion time of the pesticide application (month, day, year, and hour).

e. Person who supplied the pesticide that was applied, if other than the person making the application or that person's employer.

f. Specific trade name and environmental protection agency registration number of the pesticide that was applied.

g. Direction and estimated velocity of the wind and the estimated temperature of the outdoor air at the time the pesticide was applied. This requirement shall not apply to seed treatment applications or if bait is used to attract the pest or pests or if the application is made indoors.

h. Amount of pesticide used, including:

(1) Pounds [kilograms] or gallons [liters] per acre [.40 hectare] of formulated product.

(2) Pounds [kilograms] or gallons [liters] of tank mix applied per acre [.40 hectare].

i. Specific crops, commodities, and total acreage [hectarage] or other common identifying unit of measure to which the pesticide was applied.

j. Description of equipment used in application.

k. Signature and number of applicator, if any.

l. Right-of-way applicators must record weather conditions and geographic location in two-hour increments.

3. **Private applicators.** Private applicators shall keep a record of all restricted use pesticide applications. The record must be made within twenty-four hours of the pesticide application or the use or disposal of the pesticide rinsate. The record must include for each application:

a. Legal description of the land, grain bin identification, or other description of where the pesticide was applied.

b. State and completion time of the pesticide application (month, day, year, and hour).

c. Specific trade name and environmental protection agency registration number of the restricted use pesticide that was applied.

d. Amount of pesticide used, including:

(1) Pounds [kilograms] or gallons [liters] per acre [.40 hectare] of formulated product.

(2) Pounds [kilograms] or gallons [liters] of tank mix applied per acre [.40 hectare].

e. Specific crops, commodities, and total acreage [hectarage] or other common identifying unit of measure to which the pesticide was applied.

f. Signature and certification number of applicator, if any.

History: Amended effective October 1, 1990; May 1, 1994; March 1, 1996; March 1, 2003; July 1, 2004; January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-03, 4.1-33-14

60-03-01-07.1. Report of loss records.

Repealed effective January 1, 2013.

60-03-01-08. Unlawful acts.

Repealed effective March 1, 2003.

60-03-01-09. Reports of pesticide incidents.

Any person who is involved in or causes a pesticide incident that could result in adverse effects to humans, animals, or the environment must report it to the commissioner. The report must be made within twenty-four hours after the incident. The report may be filed by letter or electronic mail at the address or number identified in subsection 4 of section 60-01-01-01. A telephone report is acceptable if followed within twenty-four hours by a letter or electronic mail report. The report must contain:

1. The specific trade name of the pesticide.

2. The amount of pesticide or tank mix or both.

3. The location of the incident.

4. The time of the incident (month, day, year, and hour).

5. The direction and estimated velocity of the wind and estimated temperature at the time of the incident, if outdoors.

6. Actions taken to remedy the adverse effects on humans, animals, and the environment.

7. The name of and contact information for the person making the report.

History: Effective February 1, 1982; amended effective March 1, 1996; March 1, 2003; January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-03

60-03-01-10. Identifying information for pesticide mixtures, custom blends, and bulk containers.

1. Any person who produces a mixture of any quantity of pesticide, to be applied by another person must have an environmental protection agency establishment number.

   The person making the mixture must supply the person applying the mixture with end-use labeling for each pesticide in the mixture. The end-use labeling must include the environmental protection agency establishment number of the facility that supplied the mixture.

2. The environmental protection agency establishment number of the facility that supplied the pesticide, end-use labeling, and the business name and physical address of the facility where the bulk storage container resides must be attached to bulk pesticide storage containers.

3. The environmental protection agency establishment number of the facility that supplied the pesticide, end-use labeling, and quantity of pesticide must accompany or be attached to the mobile bulk pesticide container.

4. Any person who custom blends any quantity of pesticide to be applied by another person must ensure that end-use labeling for all pesticides in the blend accompanies the blend to the point where the blend leaves that person's control. No environmental protection agency establishment number is required for the blending facilities.

History: Effective April 15, 1985; amended effective October 1, 1990; July 1, 1992; May 1, 1994; January 1, 1997; March 1, 2003; January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-03, 4.1-33-13, 4.1-33-17

60-03-01-11. Storage and transportation of bulk pesticides.

1. Transporting and storing bulk pesticides must comply with the manufacturer's requirements.

2. Transporting bulk pesticides must comply with all applicable state and United States department of transportation rules and regulations.

3. A bulk pesticide storage container must be made of materials approved by the registrant and so constructed to be compatible with the pesticide stored and the conditions of storage, including any specifications that may appear on the pesticide label and labeling. The commissioner may approve or require materials other than those approved by the registrant.

4. A bulk storage container and loading areas must be constructed and located on a site in a manner so that pesticides will not contaminate the environment, such as streams and water supplies.

5. A permanent bulk storage container must be equipped with a locking withdrawal valve or must be stored in a secure locked area. The valves or storage area must be locked during nonbusiness hours or while unattended.

6. A bulk pesticide storage container that is going to be refilled with a different pesticide must be cleaned and rinsed according to both the facility's and manufacturer's agreed-upon written instructions and all former labeling must be removed.

History: Effective March 1, 2003; amended effective July 1, 2004; January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-03, 4.1-33-13

60-03-01-11.1. Adoption of the environmental protection agency pesticide container regulations.

The environmental protection agency pesticide container regulations effective as of August 17, 2011, as provided under title 40, Code of Federal Regulations, part 165 subparts A, B, C, and D, are hereby adopted by the board and incorporated by reference and made part of this title. Copies of title 40, Code of Federal Regulations, part 165 subparts A, B, C, and D, are available upon request by contacting the board at its inquiry address listed in section 60-01-01-01.

History: Effective January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-03, 4.1-33-13

60-03-01-11.2. Permanent containment area - Construction - Inspection - Maintenance - Recordkeeping requirements.

1. An outdoor permanent containment area must be constructed of sufficient size and material so as to contain any spilled or discharged materials. Minimum containment capacity must be one hundred twenty-five percent of the single largest bulk pesticide storage container, or sufficient to recover and contain a volume of a four-inch rainfall, whichever is greater.

2. An indoor permanent containment area located within an enclosed structure must be constructed of sufficient size and material to contain any spilled or discharged materials, and approved by the pesticide registrant. Minimum containment capacity must be one hundred ten percent of the single largest bulk pesticide storage container.

3. A permanent containment area must not have a drain that exits the containment area.

4. A permanent containment area must be constructed to provide protection of appurtenances (hoses, pumps, valves, pipes, etc.) and stationary pesticide containers against damage from operating personnel and moving equipment.

5. Appurtenances, discharge outlets, or gravity drains must not be configured through the base or wall of the permanent containment structure, except for direct connections between adjacent structures. The configuration of appurtenances must allow easy observation of discharges.

6. Inspections of permanent containment areas, bulk pesticide containers within containment areas, and appurtenances must be completed at least monthly during periods when pesticides are being stored or dispensed.

7. Initial repairs on any damage, cracks, or gaps in permanent containment areas and bulk pesticide containers must begin within twenty-four hours from when the problem is noticed. Completed repairs using materials approved by the registrant of the pesticides stored in the containment area or bulk pesticide container must be made within a reasonable time, taking

into account factors such as the weather and the availability of cleanup materials, trained staff, and equipment. Additional pesticides must not be stored in the permanent containment area or bulk pesticide container until repairs are completed.

8. Records of inspection and maintenance for permanent containment areas and for bulk pesticide containers and their appurtenances must be kept for three years and must including the following:

   a. Name of the individual conducting the inspection or maintenance;

   b. Date the inspection or maintenance was conducted;

   c. A description of the conditions found during the inspection; and

   d. Specific maintenance performed.

History: Effective January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-03, 4.1-33-08

60-03-01-12. Repackaging requirements for bulk pesticides.

1. A person must obtain a repackaging agreement from the registrant prior to repackaging bulk pesticides.

2. Repackaging must be performed at a facility with an environmental protection agency establishment number.

3. Repackaging must use meters or scales, or both, compatible with the pesticide being repackaged.

4. Repackaging must be done in a permanent containment area with a primary shutoff valve or switch within immediate reach of the person who is repackaging.

5. The repackaging area must be kept clean of clutter and not used as a storage area for items not immediately used for repackaging.

6. A spill kit must be located within fifty feet of an operational area.

7. During repackaging, clean up of any discharged pesticide or pesticide-containing materials must be performed immediately after the occurrence and reported according to local, state, and federal guidelines.

8. During repackaging, a discharged pesticide or pesticide-containing material must be contained by the permanent containment area, mitigated using a spill kit, or drained, pumped, or transferred to an additional impermeable, aboveground holding tank or reservoir until utilized or disposed of in compliance with applicable local, state, and federal laws. The holding tank or reservoir must be suitably constructed to prevent the release of pesticides or pesticide-containing materials to the environment.

History: Effective March 1, 2003; amended effective January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-03, 4.1-33-13, 4.1-33-17

60-03-01-13. Prohibitions.

No person may:

1. Repackaging into a container unless the container is capable of holding, in undivided quantities, the capacity as specified by the environmental protection agency.

2. Hold in inventory a mixture or custom blend of any quantity of pesticide, but rather, after producing a mixture or custom blend, it must be promptly delivered to the person requesting it.

3. Place bulk pesticide storage containers underground.

4. Repackage into improperly labeled containers.

5. Repackage into containers not designated as refillable by the registrant and container manufacturer.

History: Effective March 1, 2003; amended effective January 1, 2013.
General Authority: NDCC 4.1-33-03
Law Implemented: NDCC 4.1-33-03, 4.1-33-13, 4.1-33-17

Attachment C

Invasive and Noxious Species Implementation Plan for Public Lands





Invasive and Noxious Species Implementation Plan for Public Lands

Enbridge Energy, Limited Partnership • Line 3 Replacement Project

October 2020

ENBRIDGE®

TABLE OF CONTENTS

ATTACHMENTS

ACRONYMS AND ABBREVIATIONS

BMP	Best Management Practice
Enbridge	Enbridge Energy, Limited Partnership
EPP	Environmental Protection Plan
ESA	Environmentally Sensitive Area
INS	Invasive and Noxious Species
L3R or Project	Line 3 Replacement Project
MDA	Minnesota Department of Agriculture
MDNR	Minnesota Department of Natural Resources
NPCs	Native Plant Communities
PCMP	Post-Construction Wetland and Waterbody Monitoring Plan
Plan	Invasive and Noxious Species Implementation Plan for Public Lands
SOBS	High or Outstanding Biodiversity Significance
USDA	U.S. Department of Agriculture
VMP	Post-Construction Vegetation Management Plan for Public Lands and Waters

1.0 INTRODUCTION

Enbridge Energy, Limited Partnership ("Enbridge") is committed to minimizing the spread of invasive and noxious species ("INS") as defined by law or regulation (Attachment A), along the construction workspace and associated access roads and haul routes where improvements are associated with the construction of the Line 3 Replacement Project ("L3R" or "Project") in Minnesota.

1.1 PURPOSE OF THE PLAN

The goal of this Invasive and Noxious Species Implementation Plan (the "Plan") is to outline the specific INS management strategies that will be used to minimize the spread of target INS species identified within the Project construction workspace, access roads and improved haul routes that occur on Minnesota Department of Natural Resources ("MDNR")-administrated lands ("public lands") in compliance with law or regulation. Existing INS occurrences that have been documented on public lands through pre-construction surveys were used to create a target species list for this Plan. Management strategies including methodology and timing of implementation are included in the Plan and will be implemented where applicable and appropriate prior to construction, and during Project construction, restoration, and post-construction monitoring phases.

This plan is complimentary to Enbridge's, Environmental Protection Plan ("EPP"), INS Management Plan (Appendix B of the EPP), and the Post-Construction Vegetation Management Plan for Public Lands and Waters ("VMP"). This Plan further describes the methodology and implementation of active management strategies for target INS species, and implementation of Best Management Practices ("BMPs") during construction, restoration, and post-construction monitoring in accordance with federal and state law and within the specific rules and regulations of Operational Order 113. Active management methods for the target species list and detailed BMPs to minimize spread of INS during construction within the Project are outlined below.

Enbridge would like to emphasize that the treatment method selected for an INS population will be dependent on a number of factors, including the time of year and species-specific biology, proximity to sensitive species, and construction activities and the timing of those activities as further explained in the following sections. Although this plan describes a preference for herbicide pre-treatment, it will not be feasible in all locations; in those situations, a different methodology will be selected by Enbridge's INS Consultant (Stantec) and Enbridge's Environmental Inspection Team in coordination with the Enbridge Construction Team in the field at the time of construction. Should treatment not be possible during construction, Enbridge will manage INS as appropriate during the restoration and/or post-construction monitoring phases. Both the Post-Construction Wetland and Waterbody Monitoring Plan ("PCMP") and the VMP establish performance standards for the management of the INS to ensure that these infestations are appropriately managed.

1.2 QUALIFICATIONS

Vegetation management specialists will perform species identification and determine active management strategies during construction, restoration, and post-construction monitoring. Personnel under contract with Enbridge will meet the following requirements:

- Personnel leading the monitoring activities for a given monitoring team will hold a bachelor's degree in botany, ecology, or other natural resource-related science field.

Alternatively, personnel should have 5 years of equivalent botany, ecology, or natural resource-related professional or academic experience.

- Personnel shall demonstrate knowledge of regional flora prior to fieldwork, including the identification of the range of native and non-native plant species expected to be encountered onsite, and ability to identify plants during multiple life stages. Personnel should be qualified to identify unknown plant species using a dichotomous key, herbarium records, field guides, or consultation with other experts, as appropriate, and to the extent practicable, based on plant growth stage.

Pesticide application will be completed by knowledgeable and licensed personnel.

2.0 TERRESTRIAL PLANT INVASIVE AND NOXIOUS SPECIES MANAGEMENT STRATEGIES

On public lands, the INS management objectives are to minimize the spread of documented occurrences of terrestrial plant INS that are 1) listed as Noxious by the U.S. Department of Agriculture ("USDA"); 2) listed as "Prohibited Noxious Weeds," "Restricted Noxious Weeds," or "Specially Regulated Plants" by the Minnesota Department of Agriculture ("MDA"); or 3) listed as invasive by MDNR Operational Order 113 (see Attachment B).

2.1 OPERATIONAL ORDER 113 REGULATIONS

Operational Order 113 sets forth two major policy goals: 1) Prevent or limit the introduction, establishment, and spread of invasive species by MDNR actions; and 2) Implement site-level management to limit the spread and impact of invasive species. Detailed policies and procedures from the Order are included in the following sections.

2.2 MANAGEMENT STRATEGIES FOR TERRESTRIAL PLANT INVASIVE AND NOXIOUS SPECIES

Two primary strategies are developed to minimize the spread of INS on public lands. The first strategy is application of prevention measures to limit spread of INS through establishment of INS BMPs. The second strategy is active management to minimize the spread of documented occurrences of terrestrial INS. Active management practices will vary depending on the MDNR property administrator and will be selected based on the site-specific conditions, timing, and INS ecology.

2.2.1 Prevention Measures

Prevention measures will be employed to limit spread and introduction of INS through activities such as construction or site management. The following BMPs will be implemented during construction and site management activities, consistent with Operational Order 113 (MDNR 2017).

2.2.1.1 Identification of INS Populations

Prior to clearing, Enbridge will flag the boundaries of known INS populations that overlap with the construction workspace. For INS populations larger than 10,000 square feet or at INS sites where flagging is not practical, the boundaries will be marked by a series of flagged wooden stakes.

2.2.1.2 Movement of Equipment

Equipment used during construction and restoration activities includes trucks, tractors, off-highway vehicles, heavy equipment, tools, personal gear, etc.

1. Before leaving an INS site, inspect the equipment and remove visible plants, seeds, mud, dirt clods, and animals.

2. Enbridge is requiring personnel that will work within public lands to view the MDNR land-based prevention staff training video “Cleaning to Avoid Spreading Terrestrial Invasive Species.” (Section 2.5.1 of INS Management Plan).

3. Equipment will be cleaned prior to arriving to the Project. Scrape and brush down all equipment (outside and interior cabs), removing visible debris, at the beginning or ending of each day (once/day).

    a. Construction mats will be new/unused or cleaned prior to arriving to the Project.

4. If pre-treatment of INS is not possible and mitigation measures such as topsoil segregation or construction mat or ice/frost road installation cannot practicably be employed, Enbridge will conduct additional cleaning of equipment (see cleaning stations section in Section 2.2.2 of INS Management Plan).

2.2.1.3 Movement of Material

Materials include organisms and organic and inorganic material including plants, mulch, soil, gravel, rock, etc.

1. Enbridge will not plant or knowingly introduce prohibited or regulated invasive species or other listed invasive species as listed on the MDNR website and the Operational Order 113 Invasive Species List.

2. To reduce the likelihood of introducing or spreading invasive species, Enbridge will employ the following measures:

    a. Use only certified weed-free mulch and hay (Section 1.9.2 of the EPP).

    b. Stored topsoil in heavily infested areas will be covered or sprayed with tackifier or mulch to reduce the viability of INS seeds and rootstock prior to the restoration phase and prevent transport by wind. Weed-infested stockpiles will be marked with clearly visible signage until the restoration phase. During restoration, Enbridge will return topsoil and vegetative material from INS sites to the areas from which they were stripped and will not move soil and/or vegetative matter outside of the identified and marked noxious weed infestation areas (Section 2.5.3 of the INS Management Plan).

c. For revegetation, Enbridge will utilize seed mixes labelled “Noxious Weeds: None Found” as required by regulations and will utilize yellow tag seed when available (Section 7.2 of the EPP).

3. Enbridge will not knowingly move soil, dredge material, or raw wood products that may harbor invasive species from INS sites except under contract specifications, permit, or compliance agreements.

   a. Enbridge will generally dispose of non-merchantable timber and slash by mowing, cutting, and mulching and left in upland areas on public lands in accordance with MDNR policies and regulations. Chipping is not allowed on state lands. Merchantable timber will be salvaged in accordance with MDNR issued licenses. No merchantable timber will be disposed of on state lands (Sections 1.8 and 3.2 of the EPP). The Project does not cross any existing quarantine areas for tree pests; therefore, no special management strategies have been proposed (Section 4.0 of INS Management Plan).

   b. During restoration, Enbridge will return topsoil and vegetative material from INS sites to the areas from which they were stripped and will not move soil and/or vegetative matter outside of the identified and marked noxious weed infestation areas (Section 2.5.6 of the INS Management Plan).

2.2.2 Active Invasive Species Management

Pre-construction surveys were conducted between 2015-2020 along a 50-foot-wide buffer on the construction workspace, and 30-foot-wide buffer on access roads and improved haul routes focused on public lands. These data were used to create a list of INS species. Where existing INS occurrences have been documented, pre-treatment management with herbicide will be implemented where possible. The pre-treatment objective will be to reduce the observable aboveground vegetative growth and seed production by INS at known locations. The intended effects of pre-treatment are to reduce potential spread of INS plants, seeds (observable on above-ground seed heads), and propagules by reducing INS populations prior to clearing and ground-disturbing activities. Prior to conducting pre-treatment, the vegetation management specialist will verify identification to species level. Following pre-treatment, a visual assessment will be conducted to evaluate whether herbicide treatment has had the intended effects; where this is not the case Enbridge will consider implementing additional BMPs.

2.2.2.1 Pre-Treatment Management

Pre-treatment management strategies for target INS are specified in Attachment C. Multiple treatment options are listed for some species. Treatment method or combination of methods will be selected based on management timing, size of INS population, site factors, access, and proximity to environmentally sensitive features. Mechanical treatments will be prioritized over herbicide for INS occurrences within a 100-foot buffer of an environmentally sensitive area (“ESA”), if mechanical means are likely to provide reasonable control. Some INS are most effectively managed using herbicides; in these cases, selective/spot spraying or wicking treatments will be utilized within the 100-foot buffer. For herbicide treatment within 100 feet of aquatic ESA features, the selected herbicides and adjuvants must be registered for use in aquatic areas.

INS occurrences have been ranked in order of highest to lowest priority for receiving pre-treatment to ensure that the best use of resources will be used in the limited time between clearing and construction (Attachment D). Ranking is based on spread risk, size of the population and/or population extent, number of INS species at each occurrence, suppression potential, safety, access, and streambank revegetation concerns. INS that have the greatest risk of spreading, such as occurrences in transportation corridors (e.g. temporary access roads, near OHV trails, near forestry road crossings) will be assigned as high priority for pre-treatment. Large INS occurrence defined in terms of abundance and extent, as well as occurrences with multiple different invasive species, will also be assigned a high priority. Occurrences that have high suppression potential (determined by the species type and access to the site) will be prioritized over occurrences of INS species that have poor suppression. Species with low suppression potential include Bird's foot trefoil (*Lotus corniculatus*), and crown vetch (*Securigera varia)* and extensive populations of reed canary grass (*Phalaris arundinacea)*. Occurrences of poison ivy (*Toxicodendron radicans)* that do not occur along transportation corridors and occurrences with poor site access will be ranked lower.

Occurrences where there is high potential of soil erosion if INS are removed will be ranked as very low for priority for pre-treatment. In some cases, it may be necessary to implement erosion control and sediment control BMPs, such as soil stabilization with a cover crop, after treatment of INS. Erosion control and sediment control BMPs are described in Section 1.9 of the EPP.

2.2.2.2 INS Treatment Signage

As described above, the INS populations will be flagged prior to construction. Upon treatment, signage will be posted after pre-treatment with information on the species, when it was treated, and recommended timeframe to leave vegetation and soils undisturbed for herbicide uptake and plant activity (see Attachment E). This information will also be recorded in an electronic reporting system that will be used to monitor and communicate the management of INS populations between the Enbridge Environmental Compliance Team and the Enbridge Construction Team.

2.2.2.3 Construction Best Management Practices

In areas where INS occurrences have been documented and pre-treatment cannot be implemented prior to clearing or between clearing and construction, or pre-treatment has not had the intended effect, one or more of the BMPs listed below will be implemented to limit spread of INS. An example of where one or more BMPs may be implemented is areas where the INS infestation extends beyond one or both sides of the construction workspace and is difficult to control using herbicide application.

1. Topsoil segregation, consisting of the following:

    - Topsoil will be stripped and stockpiled.
    - Equipment work will be allowed only on subsoil.
    - Stored topsoil in heavily infested areas will be covered or sprayed with tackifier or mulch.
    - Weed-infested stockpiles will be marked with clearly visible signage.

- During restoration, Enbridge will return topsoil and vegetative material from infestation sites to the areas from which they were stripped and will not move soil and/or vegetative matter outside of the identified and marked infestation areas.

2. Installation of construction mats or ice/frost roads, consisting of the following:

    - Construction mats, ice/frost roads or equivalent will be installed to cover the INS source prior to work.

    - Construction mats will then be cleaned before use at another site as described below under “Cleaning Stations.”

    - Enbridge will also consider the use of construction mats in pre-treated high priority INS sites where there is still concern of spread.

    - Construction mats utilized at an INS site will either be cleaned at designated cleaning stations or will be transported to construction yards for storage and/or cleaning prior to re-use.

    - Used construction mats will be covered and contained in plastic tarps or geotextile fabric when they are transported and stored to minimize the spread of INS.

3. Cleaning stations, consisting of the following:

    - An initial superficial cleaning with hand tools (e.g. scraping, agitation) will be done at the INS site to remove accumulated soil and plant material on mat surfaces prior to transport.

    - Cleaning of mats at designated cleaning stations will be done by initial scrape, followed by pressurized blow down with air or water. Inside of cab of equipment will be swept out. Additional hand tool cleaning will be used, as needed, to clean equipment at designated cleaning stations, followed by pressurized blow down with air or water.

    - Removal of dirt and plant material will be documented in a cleaning log (see Attachment F).

    - Off-site cleaning stations will be placed in existing disturbed areas (e.g., construction yards that were previously used as construction yards, rail yards, sand/gravel mines, etc.) that are clearly designated as a cleaning station area, and where the appropriate erosion and sediment control BMPs have been implemented to prevent off-site surface run-off.

For the details and specifications of the previous three construction BMPs please reference Section 2.5.3 of Enbridge’s INS Management Plan.

2.2.2.4 Order of Active Management Protocols

The protocols discussed above will be prioritized in the following order:

1. Pre-treatment when possible based on construction schedule, access, and INS treatment timing.

    - If clearing begins during winter months, there will be no pre-treatment until the following spring/early summer as appropriate. Pre-treatment would then occur as feasible and appropriate during the growing season following the INS prioritization criteria (Attachment D).

2. Topsoil segregation of the infested site if pre-treatment cannot be completed.

    - During winter/frozen conditions, topsoil segregation may be implemented along areas of the construction workspace or temporary access roads at INS locations where soil movement (e.g., grading or trench excavation) is proposed, where feasible.

3. Installation of construction mats may be used where pre-treatment of the INS population or topsoil segregation is not feasible (e.g., wetlands and access roads). Installation of mats may also be used at high priority INS occurrences (Attachment D) that have been pre-treated, but where a post-treatment evaluation reveals that the herbicide application did not achieve the intended effect.

    - During winter/frozen conditions, ice/frost road development or construction mat installation may be implemented as a BMP where feasible and appropriate for the portions of access roads that overlap with INS infestations where grading would otherwise be required to develop the road.

4. Cleaning stations may be used when other BMPs are deemed insufficient to minimize the spread of INS.

    - Cleaning station locations will be selected based on evaluation of the risk of potential new invasion of INS in areas of High or Outstanding Biodiversity Significance (“SOBS”) and Native Plant Communities (“NPCs”) (as described in more detail below).

5. Finally, in some areas where pre-treatment is not feasible, implementation of INS treatments may be proposed during restoration and post-construction monitoring. In all cases, INS infestations along the construction workspace and temporary access roads will be managed until the performance standards established in Enbridge’s PCMP and VMP have been met.

2.2.2.5 Sites of Biodiversity Significance/Native Plant Communities

Cleaning stations or other construction BMPs will be added at the entrance to SOBS and NPCs ranked S1-S3 that are deemed to be more susceptible to new INS invasions. These high priority cleaning station sites include:

- Expansive SOBS or NPCs that are bisected by the construction workspace or temporary access roads; and

- Where INS have not been documented within the SOBS or NPC, and the INS documented within 5,000 feet[1] of the SOBS or NPCS is within the construction workspace and is a similar habitat type; or

- Where the INS documented within the SOBS or NPCs differs from that found within 5,000 feet and is within the construction workspace (including area outside of the SOBS or NPC and SOBS and NPCs within 5,000 feet) and is within a similar habitat type.

The following additional considerations for cleaning stations pertain to access roads, clearing, and unanticipated INS occurrences.

- During access road development, cleaning stations will be established where an access road intersects with a portion of the construction workspace that meets the definition of a high priority cleaning station site as defined above, and where BMPs have not already been implemented on the access road through the use of herbicide pre-treatment, topsoil segregation, and/or construction mat or ice/frost road installation. This only applies to access roads that will be graded in order to improve the road (i.e., widened). The portion of access roads intersecting wetlands will be matted, thus managing risk of spread. Topsoil segregation prior to grading, where feasible, or installation of mats or ice/frost roads in lieu of grading on upland access roads will also manage spread.

- During clearing along the construction workspace, Enbridge will implement cleaning stations near the entrances of high priority sites within the construction workspace regardless of whether BMPs have been implemented at the adjacent INS populations.

- After clearing along the construction workspace, Enbridge will implement cleaning stations near the entrances of high priority sites within the construction workspace if BMPs have not been implemented at the adjacent INS populations.

- If an unanticipated INS occurrence is recorded, then Enbridge will evaluate if the new occurrence shall be deemed a high priority site and apply BMP or cleaning station protocols as needed.

The decision on which treatment method will be implemented will be made collaboratively between Enbridge's Environmental Inspection Team, Enbridge's INS Management consultant, and the Construction Team in the field during construction. As discussed in Section 1.0, it is necessary to involve these parties in the decision-making process in order to coordinate treatment with the construction schedule.

2.2.2.6 Pesticide Use and Annual Reporting

Enbridge will only utilize those herbicides and methods of application approved by the MDA, MDNR, and the U.S. Environmental Protection Agency in the state of Minnesota. Attachment D describes the herbicides that may be used for each INS population, as appropriate. Enbridge is requesting that MDNR review and approve all locations for selected herbicide treatment, although as described above, herbicide may not necessarily be used depending on construction timing and other factors. All herbicide applications will be made according to product labels and as otherwise specified by local, state, and federal regulations (see Attachment G). All personnel applying

[1] 5,000 feet was utilized as it is the average anticipated construction crew daily progress rate and crews will be required to clean equipment on a daily basis as described under Section 2.2.1.2, thus further managing spread risk.

pesticide will possess a current MDA commercial pesticide license with certification(s) in appropriate categories.

In accordance with MDNR regulations, Enbridge or its contractor(s) will submit annual reports detailing herbicide or pesticide application on areas covered under the license. The report will include the dates, acres, location expressed as quarter-quarter section, township and range, herbicide used, and target species to document herbicide use on MDNR-lands.

Enbridge will post signage in places commonly used by the public within and immediately adjacent to proposed treatment areas. This includes kiosk, marked trails, and other legal access points.

2.2.2.7 Protocol for Unanticipated INS Populations

It is possible that Enbridge may encounter previously undocumented INS populations. When unanticipated populations of INS are found they will be documented and reported to Enbridge. Enbridge Environmental Inspectors that encounter unanticipated INS populations will document occurrences. This information will be communicated to MDNR for their records and the contractor conducting INS active management for species verification and incorporation into treatment plans. In addition, signage will be installed to notify the Construction Team of the INS occurrence and treatment status (Attachment E). Flagging will be used to delineate the INS population within the Project. For INS populations larger than 10,000 square feet or at INS sites where flagging is not practical, the boundaries will be marked by a series of flagged wooden stakes.

3.0 REFERENCES

Minnesota Department of Agriculture. 2020 Noxious Weed List. Available at: https://www.mda.state.mn.us/plants-insects/minnesota-noxious-weed-list. Accessed September 21, 2020.

Natural Resources Conservation Service. Undated. Introduced, Invasive, and Noxious Plants. Available at http://plants.usda.gov/java/noxious. Accessed September 21, 2020.

Minnesota Department of Natural Resources (“MDNR”). 2017. Invasive Species Prevention and Management. Available at: https://files.dnr.state.mn.us/assistance/grants/habitat/heritage/oporder_113.pdf. Accessed April 20, 2020.

Attachment A

Noxious and Invasive Species Regulations

Attachment A Invasive and Noxious Species Regulations		
Regulatory Category	Agency	Reference
MDNR Invasive Species Prevention and Management	MDNR	https://files.dnr.state.mn.us/assistance/grants/habitat/heritage/oporder_113.pdf
State Prohibited, Restricted, and Specially Regulated Noxious Weeds (terrestrial plants)	MDA	https://www.mda.state.mn.us/plants-insects/minnesota-noxious-weed-list

Attachment B

Noxious and Invasive Species List

Attachment B - Terrestrial Invasive and Noxious Plant List			
Species	**Common Name**	**List Source[1]**	**MISAC Status**
Acer ginnala	Amur Maple	*Op Order 113*	Moderate/Established
Acer platanoides	Norway Maple (all cultivars)	*MDA (S); Op Order 113*	Severe/Established
Ailanthus altissima	Tree of Heaven	*MDA (E); Op Order 113*	Not likely to establish
Allaria petiolata	Garlic Mustard	*Op Order 113*	Severe/Established
Alnus glutinosa	European Alder	*Op Order 113*	
Amaranthus palmeri	Palmer Amaranth	*MDA (E); Op Order 113*	NA
Ampelopsis brevipedunculata	Porcelain Berry	*MDA (R); Op Order 113*	Watch/Unknown
Berberis thunbergii	Japanese Barberry	*MDA (C); Op Order 113*	Moderate/Established
Berberis vulgaris	European or Common Barberry	*MDA (C); Op Order 113*	Severe/Established
Caragana arborescens	Siberean Peashrub	*MDA (R); Op Order 113*	NA
Cardamine impatiens	Narrowleaf Bittercress	*MDA (C); Op Order 113*	NA
Carduus acanthoides	Plumless Thistle	*MDA (C); Op Order 113*	Severe/Established
Celastrus orbiculatus	Oriental Bittersweet	*MDA (E); Op Order 113*	Severe/Not in state
Centaurea diffusa	Diffuse Knapweed	*MDA (E); Op Order 113*	NA
Centaurea jacea	Brown Knapweed	*MDA (E); Op Order 113*	NA
Centaurea solstitialis	Yellow Star Thistle	*MDA (E); Op Order 113*	NA
Centaurea stoebe (Syn. Centaurea maculosa)	Spotted Knapweed	*MDA (C); Op Order 113*	Severe/Established
Centaurea x moncktonii	Meadow Knapweed	*MDA (E); Op Order 113*	NA
Cirsium arvense	Canada Thistle	*MDA (C); Op Order 113*	Severe/Established
Conium maculatum	Poison Hemlock	*MDA (E)*	NA
Cynanchum louiseae	Black Swallow-wort	*MDA (E); Op Order 113*	Severe/Not in state
Daucus carota	Wild Carrot	*MDA (R); Op Order 113*	Moderate/Established
Digitalis lanata	Grecian Foxglove	*MDA (E); Op Order 113*	Severe/Established
Dipsacus fullonum	Common Teasal	*MDA (E); Op Order 113*	Moderate/Not in state
Dipsacus laciniatus	Cut Leaf Teasal	*MDA (E); Op Order 113*	Moderate/Established
Elaeagnus angustifolia	Russian Olive	*Op Order 113*	
Elaeagnus umbellata	Autumn Olive	*Op Order 113*	Severe/Established
Euonymus alatus	Winged Burning-bush (all cultivars)	*MDA (S); Op Order 113*	
Euphorbia esula	Leafy Spurge	*MDA (C); Op Order 113;*	Severe/Established
Frangula alnus	Glossy Buckthorn (all cultivars)	*MDA (R); Op Order 113*	Severe/Established
Heracleum mantegazzianum	Giant Hogweed	*MDA (E); Op Order 113*	Severe/Not in state
Humulus japonicus	Japanese Hops	*MDA (E); Op Order 113*	Watch/Unknown
Linaria dalmatica	Dalmation Toadflax	*MDA (E);Op Order 113*	Moderate/Established
Lonicera japonica	Japanese Honeysuckle	*MDA (E); Op Order 113*	
Lonicera maackii	Amur Honeysuckle	*MDA (R); Op Order 113*	Severe/Not in state
Lonicera morrowii	Morrow's Honeysuckle	*MDA (R); Op Order 114*	Severe/Established
Lonicera tatarica	Tartarian Honeysuckle	*MDA (R); Op Order 115*	Severe/Established
Lonicera x bella	Bela Honeysuckle	*MDA (R); Op Order 116*	Severe/Established
Lotus corniculatus	Bird's-foot trefoil	*Op Order 113*	Severe/Established
Lythrum salicaria	Purple Loosestrife	*MDA (C); Op Order 113*	Severe/Established
Pastinaca sativa	Wild Parsnip	*MDA (C); Op Order 113*	NA
Phalaris arundinacea	Reed Canary Grass	*Op Order 113*	Severe/Established
Phellodendron amurense	Amur Cork Tree	*Op Order 113*	
Phragmites australis subsp. australis	Common Reed - Non-native	*MDA (R); Op Order 113*	NA
Polygonum cuspidatum (Syn. Polygonum japonica)	Japanese Knotweed	*MDA (C); Op Order 113*	Severe/Established
Polygonum sachalinense	Giant Knotweed	*MDA (C); Op Order 113*	Severe/Established
Polygonum x bohemicum	Bohemian knotweed	*MDA (C); Op Order 113*	
Rhamnus cathartica	Common Buckthorn	*MDA (R); Op Order 113*	Severe/Established
Robinia pseudocacia	Black Locust	*MDA (R); Op Order 113*	Severe/Established
Rosa multiflora	Multiflora Rose	*MDA (R); Op Order 113*	Severe/Established
Securigera varia	Crown Vetch	*MDA (R); Op Order 113*	Severe/Established
Tanacetum vulgare	Tansy	*MDA (C); Op Order 113;*	Severe/Established
Toxicodendron radicans	Poison Ivy	*MDA (S);*	
Ulmus pumila	Siberian Elm	*Op Order 113*	NA
Viburnum opulus var. opulus	European Highbush Cranberry	*Op Order 113*	

[1] MDA-Minnesota Department of Agriculture (E-Eradicate, C-Control, R-Restricted, S-Specially Regulated); Op Order 113-Minnesota Department of Natural

Attachment C

Treatment Methods for Target Terrestrial Invasive and Noxious Species

Attachment C Treatment Methods for INS Plant Species Identified within Construction Limits on MDNR Land

Species	Common Name	Site Sensitivity	Population Size	Priority	Method Descriptions	Timing	Herbicide*
Ailanthus altissima (P/T)	**tree-of-heaven**	All	All	1	Apply herbicide in oil solution as basal bark treatment to trees less than 6 inches in diameter from late summer through fall. At full leaf-out during active growth, apply foliar herbicide to smaller trees and resprouts (less than about 6 feet tall). Cut for removal (as needed) only after herbicide treatment show deleterious effects on plant growth.	summer-fall	Basal bark: triclopyr ester (all upland areas) or imazapyr (as oil mixture; non-sensitive sites) Foliar: triclopyr amine or choline; glyphosate (non-sensitive sites)
Alliaria petiolata (B/F)	**garlic mustard**	Low	All	1	Selectively spot treat foliage preferably in early spring or fall when garlic mustard is active and native plants are dormant.	spring or fall	Triclopyr amine or choline (including wetlands), metsulfuron-methyl, imazapic or glyphosate (when native plants are dormant)
		High	Small-Medium	1	Hand pull or dig in early spring to flowering. Mow or cut during early flowering to prevent seed set. Bag and dispose of plant waste in approved facility if mature flowers or seed pods are present.	early spring to early summer	NO herbicide
Carduus acanthoides (B/F)	**plumeless thistle**	All	Small	1	Hand cut taproots 1 to 2 inches below ground before seed set.	spring to mid-summer	NO herbicide
			Large	1	Spot mow with equipment (hand-held, walk-behind, or tractor) in flower bud stage. Repeat as needed through the season.	early summer	NO herbicide
			All	2	Selectively spot treat individual plants/patches as rosettes or during early bolting phase.	spring to early summer and/or fall	aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Centaurea stoebe (P/F)	**spotted knapweed**	Low	Small	1	Hand-pull or dig upper 3 inches of crown. Mowing is ineffective for control but may be used in budding stage to extend treatment window. Dispose of propagating parts off-site. Use in conjunction with selective spot treatment of rosettes.	spring - fall	aminopyralid or clopyralid
			All	1	Selectively spot treat in rosette to bud stage.	spring - fall	aminopyralid or clopyralid
		High	Small	1	Hand-pull or dig upper 3 inches of crown. Mowing is ineffective for control but may be used in budding state to extend treatment window. Dispose of propagating parts off-site. Use in conjunction with herbicide treatments.	spring - fall	aminopyralid or clopyralid
			All	1	Selectively spot treat in rosette to bud stage.	spring - fall	aminopyralid or clopyralid
			Large (>1/3 acre)	2	Release biological control agents, seedhead weevils (*Larinus minutus* and *L. obtusus*) and a root-boring weevil (*Cyphocleonus achates*).	mid-summer - fall	NO herbicide
Cirsium arvense (P/F)	**Canada thistle**	All	All	1	Selectively spot treat plants as they bolt prior to flower set or rosettes in late summer/fall.	spring or late summer/fall	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Cirsium vulgare (P/F)	**Bull thistle**	All	All	1	Selectively spot treat plants as they bolt prior to flower set or rosettes in late summer/fall.	spring or late summer/fall	aminopyralid, clopyralid, or metsulfuron-methyl
Daucus carota (B/F)	**wild carrot**	Low	Small	1	Hand pull plants when bolting up until flowering.	spring-summer	NO herbicide
			Med-Large	2	Selectively spot treat rosettes.	spring-fall	triclopyr or glyphosate (non-sensitive sites); aminopyralid and florpyrauxifen-benzyl
		High	Small	1	Hand pull plants when bolting up until flowering.	spring-summer	NO herbicide

Species	Common Name	Site Sensitivity	Population Size	Priority	Method Descriptions	Timing	Herbicide*
Galeopsis tetrahit (summer A/F)	**hemp nettle**	All	All	1	Mow plants when bolting through early flowering. Repeat as needed throughout growing season if re-bolting / re-flowering.	begin in spring continue through fall	NO herbicide
Linaria dalmatica (P/F)	**dalmatian toadflax**	All	All	1	Selectively spot treat with herbicide in spring before flowering or in fall. Re-treatment will likely be necessary for effective control.	spring or fall	Chlorsulfuron (spring or fall) or imazapic (fall)
Lotus corniculatus (P/F)	**bird's-foot trefoil**	All	All	1	Selectively spot treat. Pistol / broadcast if population is dense, not mixed with desirable species, and in travel corridor.	spring-fall	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Phalaris arundinacea (P/G)	**reed canary grass**	Low	All	1	Apply herbicide between 2nd leaf and flowering stages or to secondary growth in fall using spot spray or broadcast if population is very dense and in travel corridor (MDNR 2019). Consider mowing up to early flowering stage in some infestations to facilitate treatment and reduce flowering. If plants go to advanced flowering stage, cut flowers and collect for disposal off-site.	spring-fall	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
		High	All	1	Apply herbicide between 2nd leaf and flowering stages or to secondary growth in fall using spot spray or wick using a backpack sprayer (MDNR 2019). Consider mowing up to early flowering stage in some infestations to facilitate treatment and reduce flowering. If plants go to advanced flowering stage, cut flowers and collect for disposal off-site.	spring-fall	
Phragmites australis* subsp. *australis (P/G)	**common reed**	All	All	1	Verify population is the non-native *Phragmites* species. Cut or mow in conjunction with herbicide. Selectively spot treat foliage. Cut as needed to reduce flowering or seed formation to facilitate an even application of herbicide or access to plants.	summer/early fall	aquatic formulations of imazapyr and/or glyphosate
Securigera varia (P/F)	**crown vetch**	All	All	1	Spot/selective herbicide foliar application before flower or during active growing periods. Pistol / broadcast if population is dense, not mixed with desirable species, and in travel corridor. Can use mowing before flowering to reduce vigor but mowing alone will not prevent spread.	spring-fall	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Tanacetum vulgare (P/F)	**common tansy**	Low	All	1	Cut or mow from bolting through early flowering to suppress growth (avoid contact with sap).	spring	NO herbicide
			All	2	Spot herbicide foliar to rosettes through early bud stage for best results but can continue throughout growing season.	spring - fall	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
		High	All	1	Cut or mow from bolting through early flowering to suppress growth (avoid contact with sap). Integrate with selective spot treatments.	spring	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Toxicodendron radicans (P/F)	**poison ivy**	All	All	1	Cut or mow to inhibit flowering. Must be continued in order to deplete energy reserves and to deplete seed banks. Wear PPE when cutting or mowing.	spring – repeat through fall	No herbicide
			All	2	Selectively spot treat foliage of plants. May have to repeat to exhaust seed banks.	spring - summer	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor

(Life History): A=Annual, P=Perennial, B=Biennial, T= Tree, F = Forb, G=Grass

*For herbicide rate follow product label recommendations.

Citation: Minnesota Department of Natural Resources. Draft Reed Canary and Other Invasive Wetland Species Guidance. Dated: 27 Aug 2019.

Attachment D

Prioritized Treatment Areas

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Aitkin	MN-AI-037.000	I-51n26w34-a	Toxicodendron radicans	0-25	Intermittent	Yes	wetland	4	Safety		wetland/nontarget effects to consider	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin	MN-AI-037.000	I-51n26w34-jj	Toxicodendron radicans	100s	Common	Yes	wetland	4	Safety		wetland/nontarget effects to consider	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin	MN-AI-039.000	I-51n26w34-d	Cirsium arvense	0-25	Intermittent	Yes	wetland	2	High control potential		roadside-limited habitat, W side US TH169; great access	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-040.000	I-51n26w35-a	Cirsium arvense	0-25	Intermittent	Yes	wetland	2	High control potential		roadside-limited habitat, E side US TH169; great access	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-040.000	I-51n26w35-aa	Cirsium arvense	100s	Common	Yes	wetland	2	High control potential		roadside-limited habitat, E side US TH169; great access	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-040.000	I-51n26w35-bb	Phalaris arundinacea	100s	Common	Yes	wetland	3	Reveg Cover Concerns		roadside-limited habitat, E side US TH169; great access	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-040.002	i-51n26w25-cc	Securigera varia (Syn. Coronilla varia)	100s	Common	Yes	wetland	1	High spread risk	AR537-a	wetland surrounds access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-041.000	I-51n26w36-a	Cirsium arvense	0-25	Intermittent	Yes	wetland	4	Very poor access		growing season access extremely limited by extensive surrounding wetland; there's another point with this same unique ID on MDNR land, but it occurs outside of the construciton limits	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-041.000	i-51n26w36-ee	Phalaris arundinacea	1000s	Many	Yes	wetland	1	High spread risk	AR537-b	wetland surrounds access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-041.000	i-51n26w36-ff	Tanacetum vulgare	10s	Few	Yes	wetland	1	High spread risk	AR537-b	wetland surrounds access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-041.001	i-51n26w25-ha	Tanacetum vulgare	1000s	Many	Yes	wetland	1	High spread risk	HR-MN-AI-004.13-592ND LANE-1	wetland on either side of access road, occcurence overlaps wetland; occurrence extends off access road, will only treat portion of INS occurrence that intersects with the access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-041.001	i-51n21w25-bb	Tanacetum vulgare	100s	Common	Yes	wetland	1	High spread risk	AR537-a	wetland surrounds access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-041.001	i-51n26w25-aa	Phalaris arundinacea	1000s	Many	Yes	wetland	1	High spread risk	AR537-b	wetland surrounds access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-041.001	i-51n26w25-bb	Phalaris arundinacea	100s	Common	Yes	wetland	1	High spread risk	HR-MN-AI-004.13-592ND LANE-1	wetland surrounds haul route	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-041.001	i-51n26w25-hb	Securigera varia (Syn. Coronilla varia)	100s	Some	Yes	wetland	1	High spread risk	HR-MN-AI-004.13-592ND LANE-1	wetland surrounds haul route	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-041.001	i-51n26w25-hc	Cirsium arvense	10s	Few	Yes	wetland	1	High spread risk	HR-MN-AI-004.13-592ND LANE-1	wetland surrounds haul route, just within wetland boundary	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-041.001	i-51n26w25-he	Securigera varia (Syn. Coronilla varia)	10s	Few	Yes	wetland	1	High spread risk	HR-MN-AI-004.13-592ND LANE-1	wetland surrounds haul route	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-041.001	i-51n26w25-hf	Phalaris arundinacea	100s	Some	Yes	wetland	1	High spread risk	HR-MN-AI-004.13-592ND LANE-1	wetland surrounds haul route	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-041.001	i-51n26w25-hg	Tanacetum vulgare	100s	Some	Yes	wetland	1	High spread risk	HR-MN-AI-004.13-592ND LANE-1	wetland surrounds haul route	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-041.001	i-51n26w25-hh	Securigera varia (Syn. Coronilla varia)	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-004.13-592ND LANE-1		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-041.001	i-51n26w25-hi	Phalaris arundinacea	100s	Some	Yes	wetland	1	High spread risk	AR538-a	wetland surrounds haul route	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-043.000	I-51n25w31-c	Toxicodendron radicans	0-25	Intermittent	Yes	wetland	4	Safety		in mainline corridor; wetland/nontarget effects to consider	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin	MN-AI-043.000	I-51n25w31-dd	Toxicodendron radicans	100s	Common	Yes	wetland	3	Safety		in mainline corridor near haul route entry, Botryichium lanceolatum ~115 feet away	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Aitkin	MN-AI-044.000	I-51n25w31-ff	Toxicodendron radicans	100s	Common	Yes	wetland	4	Safety, Very poor access		in mainline corridor; growing season access extremely limited by extensive surrounding wetland	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin	MN-AI-044.000	I-51n25w31-gg	Securigera varia	100s	Common	Yes	wetland	4	Very poor access		growing season access extremely limited by extensive surrounding wetland	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-046.000	I-51n25w32-ff	Cirsium arvense	100s	Common	Yes	wetland	2	High control potential		within wetland need aquatic-approved herbicide; existing forest cover	triclopyr amine or choline in wetlands
Aitkin	MN-AI-056.000	i-51n24w31-hh	Tanacetum vulgare	1000s		Yes	wetland	1	High Spread Risk		near construction yard & valve site road, and forestry road crossing ID56; will only treat portion of INS occurrence that intersects with construction workspace boundaries	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-056.000	I-51n24w31-hh1	Tanacetum vulgare	1000s		No	n/a	1	High Spread Risk	HR Corner Improvements MDNR 2	near construction yard & valve site road, and forestry road crossing ID56; very small portion of INS occurrence overlaps with construction workspace, will only treat portion that intersects with construction workspace	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-057.000	i-51n24w31-ff	Tanacetum vulgare	1000s		Yes	wetland	1	High Spread Risk	AR708 ATWS	near construction yard & valve site road, and forestry road crossing ID56; INS occurrence extends outside of construction workspace, will only treat portion that intersects with construction workspace	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-057.000	i-51n24w31-ii	Phalaris arundinacea	1000s		Yes	wetland, Willow R.	4	Streambank Cover Concerns	HR-MN-AI-004.13-592ND LANE-1	w/in construction ROW/ATWS haul route across Willow River (**s-51n24w31-bb**), NOT mainline crossing of Willow River (s-51n24w31-b) for that crossing HDD had been recommended, with maintaining stream buffer along with aggressive re-veg; Rosgen DNR site data for mainline crossing: Bank Erosion Hazard Index = Moderate; Pfankuch Stability Rating = Good (stable); will only treat portion of polygon that intersects with construction workspace	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-059.000	i-51n24w31-aa	Phalaris arundinacea	1000s		Yes	wetland	4	Poor suppression potential		extensive popn parallels pipeline through this TR and adjacent TR128, TR130	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-059.000	i-51n24w31-cc	Toxicodendron radicans	100s	Few	Yes	wetland	4	Safety		in mainline corridor; forested wetland	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin	MN-AI-060.000	i-51n24w32-c	Phalaris arundinacea	1000s		Yes	wetland	4	Poor suppression potential		extensive popn parallels pipeline through this TR and adjacent TR129; extends outside of construction workspace, will only treat portion that intersects with construction workspace	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-060.000	i-51n24w32-ha	Phalaris arundinacea	1000s	Many	Yes	wetland	1	High spread risk	HR Corner Improvements MDNR 2	this population encompasses the portion of occurrence I-51n24w32-c1 that intersects with the access road; population extends far out of the construction workspace; will only treat the portion that intersects with access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-060.000	i-51n24w32-hb	Securigera varia (Syn. Coronilla varia)	10s	Few	Yes	wetland	1	High spread risk	HR Corner Improvements MDNR 2	wetland surrounds haul route	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-060.000	i-51n24w32-hc	Tanacetum vulgare	10s	Few	Yes	wetland	1	High spread risk	HR Corner Improvements MDNR 2	wetland surrounds haul route	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-060.000	i-51n24w32-hd	Lotus corniculatus	100s	Some	Yes	wetland	1	High spread risk	HR Corner Improvements MDNR 2	wetland surrounds haul route	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-060.000	i-51n24w32-he	Cirsium arvense	10s	Few	Yes	wetland	1	High spread risk	HR Corner Improvements MDNR 2	wetland surrounds haul route	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-064.000	I-51n24w28-a	Cirsium arvense	100s		Yes	wetland	2	High control potential		good access	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-064.000	i-51n24w28-a	Cirsium arvense	100s	Many	Yes	wetland	2	High control potential		good access; within wetland need aquatic-approved herbicide	triclopyr amine or choline in wetlands
Aitkin	MN-AI-067.000	i-51n24w27-a	Tanacetum vulgare	1000s		Yes	wetland	3	Poor suppression potential		most of popn beyond CL in existing pipeline corridor; will only treat portion that intersects with construction workspace	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-067.000	i-51n24w27-a1	Tanacetum vulgare	1000s		Yes	wetland	1	High spread risk	RA22-3 Driveway	roadside; will only treat portion that intersects with construction workspace	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-067.000	i-51n24w27-a-b-c	Cirsium arvense	1000s		Yes	wetland	2	Popn Size/Extent		roadside; will only treat portion that intersects with construction workspace	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-067.000	i-51n24w27-a-b-c	Tanacetum vulgare	1000s		Yes	wetland	2	Popn Size/Extent		roadside; will only treat portion that intersects with construction workspace	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-067.000	i-51n24w27-a-b-c	Phalaris arundinacea	1000s		Yes	wetland	5	Reveg Cover Concerns		roadside; will only treat portion that intersects with construction workspace	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Aitkin	MN-AI-068.000	i-51n24w27-h1	Cirsium arvense	1000s		Yes	Mississippi R	5	Streambank Cover Concerns		waterbody ID **s-51n24w27-a**; Rosgen DNR site data: Bank Erosion Hazard Index = Low to Moderate; Pfankuch Stability Rating = Good (stable); most of popn beyond CL downstream;HDD crossing method; will only treat portion of INS occurrence that intersects with construction workspaces	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-068.000	i-51n24w27-h1	Phalaris arundinacea	1000s		Yes	Mississippi R	5	Streambank Cover Concerns		waterbody ID **s-51n24w27-a**; Rosgen DNR site data: Bank Erosion Hazard Index = Low to Moderate; Pfankuch Stability Rating = Good (stable); most of popn beyond CL downstream;HDD crossing method; will only treat portion of INS occurrence that intersects with construction workspaces	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-068.000	i-51n24w27-i	Toxicodendron radicans	100s	Common	Yes	Mississippi R shore	3	Safety		in mainline corridor	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin	MN-AI-076.002	i-51n23w30-ee	Toxicodendron radicans	100s	Common	No	n/a	1	High spread risk	AR55d		triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin	MN-AI-076.002	i-51n23w30-gg	Cirsium arvense	100s	Common	No	n/a	1	High spread risk	AR550-d		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-076.002	i-51n23w30-hh	Phalaris arundinacea	100s	Common	No	n/a	1	High spread risk	AR55d		aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-076.002	i-51n23w30-ii	Tanacetum vulgare	100s	Common	No	n/a	1	High spread risk	AR55d		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-077.001	i-51n23w30-cc1	Cirsium arvense	1000s	Common	No	n/a	1	High spread risk	AR550-d	occurrence extends off access road; will only treat portion of INS occurrence that intersects with access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-079.000	i-51n23w28-aa	Cirsium arvense	100s	Common	Yes	wetland	1	High Spread Risk	AR553-b	AR Temp, inside wetland	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-079.000	I-51n23w28-b	Cirsium arvense	0-25	Intermittent	No	n/a	2	High control potential		small popn size	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-079.000	i-51n23w28-cc	Tanacetum vulgare	100s	Common	Yes	wetland	1	High Spread Risk	AR553-b	AR Temp	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-079.000	i-51n23w28-dd	Securigera varia	100s	Common	No	n/a	1	High Spread Risk	AR553-b	on AR Temp	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-086.000	i-51n23w22-ha	Securigera varia (Syn. Coronilla varia)	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-086.000	i-51n23w22-hc	Tanacetum vulgare	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-086.000	i-51n23w27-ha	Phalaris arundinacea	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-086.001	i-51n23w22-hb	Lotus corniculatus	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-086.001	i-51n23w22-hb	Lotus corniculatus	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-087.000	I-51n21w23-a	Phalaris arundinacea	100s	Common	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-088.000	I-51n21w23-c	Tanacetum vulgare	100s	Common	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-088.000	I-51n21w23-c	Alliaria petiolata			No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1	recommended herbicide treatment in spring or fall when native plants are dormant	triclopyr amine or choline (including wetlands), metsulfuron-methyl, imazapic or glyphosate (when native plants are dormant)
Aitkin	MN-AI-088.000	i-51n22w23-hg	Tanacetum vulgare	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-088.000	i-51n22w23-hg	Tanacetum vulgare	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-088.000	i-51n23w22-c	Cirsium arvense	100s	Common	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Aitkin	MN-AI-088.000	i-51n23w22-he	Lotus corniculatus	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-088.000	i-51n23w22-he	Lotus corniculatus	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-004.9-DNR-HEDBOON TRAIL-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-091.005	i-51n22w18-b	Toxicodendron radicans	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland immediately north of access road	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin	MN-AI-091.005	I-51n22w18-c	Securigera varia (Syn. Coronilla varia)	10s	Few	Yes	wetland	1	High spread risk	AR556	wetland immediately north of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-092.001	i-51n22w19-ll	Tanacetum vulgare	100s	Common	Yes	wetland	1	High spread risk	AR563	wetland north of the INS site	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-092.001	i-51n22w19-oo	Lotus corniculatus	100s	Common	No	n/a	1	High spread risk	AR563		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-092.001	i-51n22w19-pp	Cirsium arvense	10s	Few	No	n/a	1	High spread risk	AR563		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-092.003	i-51n22w18-e	Toxicodendron radicans	100s	Common	Yes	wetland	1	High spread risk - Safety	AR556 ATWS	ATWS is on north side of access road and wetland on south of access road	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin	MN-AI-092.003	i-51n22w18-g	Securigera varia (Syn. Coronilla varia)	10s	Few	Yes	wetland	1	High spread risk	AR556	wetland on south border of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-092.003	I-51n22w18-h	Tanacetum vulgare	10s	Few	Yes	wetland	1	High spread risk	AR556	wetland on south border of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-092.004	i-51n22w19-be	Carduus acanthoides	10s	Few	Yes	wetland	1	High spread risk	AR566	wetland on both sides of access road	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Aitkin	MN-AI-092.004	i-51n22w19-bf	Tanacetum vulgare	10s	Few	Yes	wetland	1	High spread risk	AR566	wetland on both sides of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-092.006	I-51n22w-18-k	Tanacetum vulgare	10s	Few	Yes	wetland	1	High spread risk	AR556	small strip of wetland on east side of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-092.007	i-51n22w18-n	Lotus corniculatus	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland east of access road	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-092.007	i-51n22w18-q	Centaurea stoebe (Syn. Centaurea maculosa)	10s	Few	No	n/a	1	High spread risk	AR690 ATWS		aminopyralid or clopyralid
Aitkin	MN-AI-092.008	i-51n22w18-o	Phalaris arundinacea	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland on both sides of access road - technically site is in wetland	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-092.008	i-51n22w18-p	Tanacetum vulgare	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland on both sides of access road - technically site is in wetland	aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-094.000	I-51n22w20-a	Toxicodendron radicans	0-25	Intermittent	Yes	wetland	3	Safety		in mainline corridor	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin	MN-AI-094.001	i-51n22w17-f	Cirsium arvense	1000s	Many	Yes	wetland	1	High spread risk	AR556 ATWS	wetland just south and north of population; will only treat portion of INS occurrence that intersects ATWS	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-094.001	I-51n22w17-c	Centaurea stoebe (Syn. Centaurea maculosa)	100s	Common	Yes	wetland	1	High spread risk	AR556 ATWS	wetland north of ATWS and south of access road	aminopyralid or clopyralid
Aitkin	MN-AI-094.001	I-51n22w-17-d	Lotus corniculatus	10s	Few	Yes	wetland	1	High spread risk	AR556 ATWS	wetland north of ATWS and south of access road	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-094.001	i-51n22w17-e	Carduus acanthoides	10s	Few	No	n/a	1	High spread risk	AR556 ATWS		selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Aitkin	MN-AI-094.001	i-51n22w17-f	Cirsium arvense	1000s	Invasion	No	n/a	1	High spread risk	AR556 ATWS		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-094.002	i-51n22w8-a	Tanacetum vulgare	100s	Common	Yes	n/a	1	High spread risk	AR556	wetland north and south of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-094.002	i-51n22w8-b	Lotus corniculatus	10s	Few	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-095.001	I-51n22w16-b	Phalaris arundinacea	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-095.001	i-51n22w16-c	Lotus corniculatus	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aminopyralid or clopyralid; triclopyr amine or choline in wetlands

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Aitkin	MN-AI-095.001	i-51n22w16-e	Cirsium arvense	100s	Common	No	n/a	1	High spread risk	AR568-a	Carex pallescens and Botryichium lanceolatum occurrences on access road far outside of buffer range	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-095.001	i-51n22w9-b	Tanacetum vulgare	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-095.001	i-51n22w9-c	Phalaris arundinacea	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-095.002	I-51n21w9-a	Lotus corniculatus	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north of road	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-096.003	I-51 22w10-b	Lotus corniculatus	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-096.003	i-51n22w10-a	Phalaris arundinacea	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-096.003	i-51n22w10-e	Lotus corniculatus	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-096.003	i-51n22w10-g	Phalaris arundinacea	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-096.003	I-51n22w-15-b	Lotus corniculatus	100s	Common	Yes	wetland	1	High spread risk	AR556		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-096.003	I-51n22w15-c	Centaurea stoebe (Syn. Centaurea maculosa)	100s	Common	No	n/a	1	High spread risk	AR556		aminopyralid or clopyralid
Aitkin	MN-AI-096.003	i-51n22w15-d	Tanacetum vulgare	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-096.003	I-51n22w15-e	Phragmites australis	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road; pre-treatment Is most successful in summer to early fall so if pre-treatment occurs in spring these populations may not be treated until restoration/post construction monitoring	aquatic formulations of imazapyr and/or glyphosate in summer/early fall
Aitkin	MN-AI-097.005	i-51n22w10-h	Tanacetum vulgare	100s	Common	Yes	wetland	1	High spread risk	AR556	within wetland boundary	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-098.001	i-51n22w11-a	Phalaris arundinacea	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-098.001	I-51n22w11-b	Lotus corniculatus	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-098.001	i-51n22w14-a	Phalaris arundinacea	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-098.001	I-51n22w14-b	Lotus corniculatus	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-098.001	i-51n22w14-c	Tanacetum vulgare	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-098.002	I-51n22w11-d	Phragmites australis	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road; pre-treatment Is most successful in summer to early fall so if pre-treatment occurs in spring these populations may not be treated until restoration/post construction monitoring	aquatic formulations of imazapyr and/or glyphosate in summer/early fall
Aitkin	MN-AI-099.002	i-51n21w18-cc	Phalaris arundinacea	1000s	Many	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-099.002	I-51n22w12-a	Phalaris arundinacea	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-099.002	I-51n22w12-a1	Phragmites australis	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road; pre-treatment Is most successful in summer to early fall so if pre-treatment occurs in spring these populations may not be treated until restoration/post construction monitoring	aquatic formulations of imazapyr and/or glyphosate in summer/early fall

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Aitkin	MN-AI-099.002	i-51n22w12-b	Cirsium arvense	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-099.002	I-51n22w12-c	Lotus corniculatus	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-099.002	i-51n22w13-a	Tanacetum vulgare	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-099.002	I-51n22w13-b	Lotus corniculatus	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-099.002	I-51n22w13-c	Cirsium arvense	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-099.002	I-51n22w13-c1	Phalaris arundinacea	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-099.002	I-51n22w13-e	Phragmites australis	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland north and south of access road; pre-treatment Is most successful in summer to early fall so if pre-treatment occurs in spring these populations may not be treated until restoration/post construction monitoring	aquatic formulations of imazapyr and/or glyphosate in summer/early fall
Aitkin	MN-AI-47-0-025300	i-50n25w16-ha	Lotus corniculatus	100s	Some	Yes	wetland	1	High spread risk	HR Corner Improvements MDNR 1	HR corner improvements, within wetland	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin	MN-AI-47-0-025300	i-50n25w16-hb	Securigera varia (Syn. Coronilla varia)	10s	Few	No	n/a	1	High spread risk	HR Corner Improvements MDNR 1	HR corner improvements	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-47-0-026400	i-50n25w17-ha	Phalaris arundinacea	100s	Some	No	n/a	1	High spread risk	HR Corner Improvements MDNR 1	HR corner improvements	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-47-0-026400	i-50n25w17-hb	Tanacetum vulgare	100s	Some	No	n/a	1	High spread risk	HR Corner Improvements MDNR 1	HR corner improvements	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-C5-019.000	I-51n27w36-b	Cirsium arvense	0-100	Rare	Yes	wetland	2	High control potential		small popn size (though addnl small popn pts mapped beyond CL in existing utility ROW), within wetland	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-C5-036.000TR	i-50n26w4-bl	Cirsium arvense	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-C5-038.000TR	i-50n26w4-bj	Tanacetum vulgare	100s	some	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-C5-038.000TR	i-50n26w4-bk	Securigera varia (Syn. Coronilla varia)	100s	some	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-C5-040.000TR	i-50n26w4-bf	Tanacetum vulgare	100s	some	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-C5-040.000TR	i-50n26w4-bg	Securigera varia (Syn. Coronilla varia)	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-C5-040.000TR	i-50n26w4-bh	Phragmites australis	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road; pre-treatment Is most successful in summer to early fall so if pre-treatment occurs in spring these populations may not be treated until restoration/post construction monitoring	aquatic glyphosate or imazapyr in summer/early fall
Aitkin	MN-AI-C5-040.000TR	i-50n26w4-bi	Cirsium arvense	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Aitkin	MN-AI-C5-042.000TR	i-50n26-be	Tanacetum vulgare	100s	some	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-C5-044.000TR	i-50n26w4-ba	Tanacetum vulgare	100s	some	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-C5-044.000TR	i-50n26w4-bb	Securigera varia (Syn. Coronilla varia)	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-C5-045.000TR	i-50n26w10-bl	Securigera varia (Syn. Coronilla varia)	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-C5-045.000TR	i-50n26w10-bm	Tanacetum vulgare	100s	some	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Aitkin	MN-AI-C5-046.000TR	i-50n26w10-bj	Tanacetum vulgare	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-C5-046.000TR	i-50n26w10-bk	Securigera varia (Syn. Coronilla varia)	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-C5-047.000TR	i-50n26w10-bg	Securigera varia (Syn. Coronilla varia)	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-C5-047.000TR	i-50n26w10-bh	Tanacetum vulgare	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-C5-047.000TR	i-50n26w10-bi	Phalaris arundinacea	100s	some	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin	MN-AI-C5-048.000TR	i-50n26w10-bc	Securigera varia (Syn. Coronilla varia)	100s	many	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-C5-048.000TR	i-50n26w10-bd	Securigera varia (Syn. Coronilla varia)	100s	some	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin	MN-AI-C5-048.000TR	i-50n26w10-bf	Tanacetum vulgare	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-AI-C5-049.000TR	i-50n26w10-ba	Phalaris arundinacea	10s	few	Yes	wetland	1	High spread risk	AR701	wetland on either side of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Cass	MN-CA-C5-021.000	i-138n31w10-aa	Toxicodendron radicans	100s	Common	No	n/a	3	Safety		in mainline corridor	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Cass	MN-CA-C5-021.000	i-138n31w10-dd	Securigera varia	100s	Common	Y	wetland	3	Poor suppression potential		near Cardacan just outside CL in DNR TR43, near AR Temp	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Cass	MN-CA-C5-153.000	I-139n26w11-b	Tanacetum vulgare	0-100	Rare	No	n/a	1	High spread risk			metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Cass	MN-CA-C5-155.000	I-139n26w12-a	Tanacetum vulgare	101-500	Rare	No	n/a	1	High spread risk	AR391.4-f		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Cass	MN-CA-C5-155.000	i-139n26w12-aa	Tanacetum vulgare	1000s	Many	Yes	wetland	1	High Spread Risk	AR391.4-c	on AR Temp; large population	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Cass	MN-CA-C5-155.000	i-139n26w12-bb	Carduus acanthoides	100s	Common	No	n/a	1	High Spread Risk	AR391.4-d	on AR Temp	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Cass	MN-CA-C5-155.000	i-139n26w12-cc	Lotus corniculatus	100s	Common	No	n/a	1	High spread risk	AR391.4-d	on AR Temp	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Cass	MN-CA-C5-155.000	i-139n26w12-ff	Phalaris arundinacea	1000s	Many	Yes	wetland	1	High Spread Risk		at forestry road crossing ID30; near AR Temp entry into mainline corridor	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Cass	MN-CA-C5-155.000	i-139n26w12-gg	Toxicodendron radicans	100s	Common	Yes	wetland	3	Safety		in mainline corridor near haul route entry	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Cass	MN-CA-C5-156.000	i-139n25w7-aa	Toxicodendron radicans	100s	Common	No	n/a	1	High spread risk	AR393.1	on AR Temp and OHV trail	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Cass	MN-CA-C5-156.000	i-139n25w7-bb	Lotus corniculatus	100s	Common	No	n/a	1	High Spread Risk	AR393.1	on AR Temp and OHV trail	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Cass	MN-CA-C5-156.000	i-139n25w7-cc	Phalaris arundinacea	1000s	Many	Yes	wetland	1	High Spread Risk	AR393.1	on AR Temp; near forestry road crossing ID32	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Cass	MN-CA-C5-157.000	i-139n25w8-dd	Lotus corniculatus	10s	Few	Yes	wetland	1	High Spread Risk	AR394.1-c	on AR Temp and OHV trail	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Cass	MN-CA-C5-157.000	I-139n25w9-aa1	Phalaris arundinacea	1000s	Many	Yes	wetland	1	High spread risk	AR394.1-c	field assess further based on adjacent wetland composition/quality	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Cass	MN-CA-C5-157.000	I-139n25w9-bb1	Securigera varia (Syn. Coronilla varia)	100s	Common	No	n/a	1	High spread risk	AR394.1-c		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Cass	MN-CA-C5-158.000	i-139n25w9-cc	Securigera varia	10s	Few	Yes	wetland	3	Poor suppression potential			aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Cass	MN-CA-C5-161.000	I-139n25w4-a	Tanacetum vulgare	0-100	Rare	Yes	wetland	2	High control potential		0.16 mile from AR Temp	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Cass	MN-CA-C5-161.200	i-139n25w5-aa	Tanacetum vulgare	100s	Common	Yes	wetland	1	High spread risk	AR394.1-d	wetland south and west of occurrences, unnamed stream crosses access road just south	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Cass	MN-CA-C5-161.200	I-139n25w5-bb	Phalaris arundinacea	100s	Common	Yes	wetland	1	High spread risk	AR394.1-d	wetland south and west of occurrences, unnamed stream crosses access road just south	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Cass	MN-CA-C5-161.200	i-139n25w5-cc	Lotus corniculatus	10s	Few	Yes	wetland	1	High spread risk	AR394.1-d	wetland south and west of occurrences, unnamed stream crosses access road just south	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Cass	MN-CA-C5-161.200	i-139n25w5-ee	Toxicodendron radicans	100s	Common	No	n/a	1	High spread risk	AR394.1-e		triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Cass	MN-CA-C5-162.000	i-139n25w3-bb	Phalaris arundinacea	100s	Common	No	n/a	2	High control potential		Cir arv, Sec var, Tan vul just beyond CL	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Cass	MN-CA-C5-163.000	I-139n25w2-bb	Tanacetum vulgare	100s	Common	Yes	wetland	1	High spread risk	AR704		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Cass	MN-CA-C5-163.000	i-139n25w2-ee	Centaurea stoebe (Syn. Centaurea maculosa)	100s	Common	Yes	wetland	1	High spread risk	AR704		aminopyralid or clopyralid
Cass	MN-CA-C5-163.000	i-139n25w2-hb	Toxicodendron radicans	100s	Some	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Cass	MN-CA-C5-163.000	i-139n25w2-hc	Lotus corniculatus	100s	Some	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Cass	MN-CA-C5-163.000	i-139n25w2-hd	Ailanthus altissima	100s	Some	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1	Recommended herbicide treatment in summer to fall so would not be a pre-treatment candidate for spring	Basal bark: triclopyr ester or imazapyr (as oil mixture); Foliar: triclopyr amine or choline; glyphosate
Cass	MN-CA-C5-163.000	i-139n25w2-he	Tanacetum vulgare	10s	Few	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Cass	MN-CA-C5-163.000	i-139n25w2-hf	Phalaris arundinacea	10s	Few	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Cass	MN-CA-C5-163.000	i-139n25w2-hg	Lotus corniculatus	100s	Some	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Cass	MN-CA-C5-163.000	i-139n25w2-hh	Tanacetum vulgare	10s	Few	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Cass	MN-CA-C5-163.000	i-139n25w2-hi	Securigera varia (Syn. Coronilla varia)	10s	Few	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Cass	MN-CA-C5-163.000	i-139n25w2-hl	Phalaris arundinacea	100s	Some	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Cass	MN-CA-C5-163.000	I-139n25w2-aa	Centaurea stoebe	26-50		Yes	wetland	1	High Spread Risk	AR 704	on AR Temp; near Moose R crossing; Lot cor, Cir arv nearby	aminopyralid or clopyralid
Cass	MN-CA-C5-163.000	I-139n25w2-aa	Tanacetum vulgare	26-50	Intermittent	Yes	wetland	1	High Spread Risk	AR 704	on AR Temp; near Moose R crossing; Lot cor, Cir arv nearby	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Clearwater	MN-CL-C5-032.000	i-147n37w16-aa	Centaurea stoebe	100s		Yes	wetland	1	Popn Size/Extent		OHV trail through; will only treat portion of INS occurrence that overlaps with construction workspace	aminopyralid or clopyralid
Clearwater	MN-CL-C5-032.000	I-147n37w17-i	Carduus acanthoides	101-250		Yes	wetland	1	Cluster multiple spp		Dense population along existing pipeline; intercepts forestry crossing; population extends onto private land within ROW; population extends off ROW; will only treat portion that intersects with construction workspace on MDNR land; small portion overlaps with wetland off construction workspace	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Clearwater	MN-CL-C5-032.000	I-147n37w17-i	Cirsium arvense			Yes	wetland	1	Cluster multiple spp		Dense population along existing pipeline; intercepts forestry crossing; population extends onto private land within ROW; population extends off ROW; will only treat portion that intersects with construction workspace on MDNR land	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Clearwater	MN-CL-C5-032.000	I-147n37w17-i	Centaurea stoebe	1001-5000		Yes	wetland	1	Popn Size/Extent		Dense population along existing pipeline; intercepts forestry crossing; population extends onto private land within ROW; population extends off ROW; will only treat portion that intersects with construction workspace on MDNR land	aminopyralid or clopyralid
Clearwater	MN-CL-C5-032.000	I-147n37w17-j	Cirsium arvense	0-100	Rare	Yes	wetland	1	Cluster multiple spp			aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Clearwater	MN-CL-C5-033.000	i-147n37w16-cc	Carduus acanthoides	100s	Common	Yes	wetland	2	High control potential		treat w/ TR1; OHV trail through	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Clearwater	MN-CL-C5-033.000	i-147n37w16-dd	Toxicodendron radicans	100s	Common	Yes	wetland	3	Safety		in mainline corridor	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Clearwater	MN-CL-C5-035.000	I-147n37w21-bb	Tanacetum vulgare	100s	Common	Yes	wetland	1	Cluster multiple spp		near forestry road crossing ID2; cluster of invasive pts off CL, incl Centaurea stoebe	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Clearwater	MN-CL-C5-035.000	I-147n37w21-g	Cirsium arvense	0-100	Rare	Yes	wetland	1	Cluster multiple spp		near forestry road crossing ID2; cluster of invasive pts off CL, incl Centaurea stoebe	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Clearwater	MN-CL-C5-100.000	I-145n36w35-f	Cirsium arvense			Yes	wetland	1	Cluster multiple spp		0.26 mile through entire tract and into TR 8; up to edges of 1 wetland; will only treat portion that intersects with construction workspace	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Clearwater	MN-CL-C5-100.000	I-145n36w35-f	Tanacetum vulgare	5000+		Yes	wetland	1	Cluster multiple spp		0.26 mile through entire tract and into TR 8; up to edges of 1 wetland; will only treat portion that intersects with construction workspace	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Clearwater	MN-CL-C5-100.000	I-145n36w35-f	Centaurea stoebe	5000+		Yes	wetland	1	Popn Size/Extent		0.26 mile through entire tract and into TR 8; up to edges of 1 wetland; will only treat portion that intersects with construction workspace	aminopyralid or clopyralid
Clearwater	MN-CL-C5-100.000	i-145n36w36-aa	Centaurea stoebe (Syn. Centaurea maculosa)	100s	Common	No	n/a	1	High spread risk	AR312-a		aminopyralid or clopyralid
Clearwater	MN-CL-C5-100.000	i-145n36w36-aa, bb, cc	Centaurea stoebe	1000s	Many	No	n/a	1	Popn Size/Extent			aminopyralid or clopyralid
Clearwater	MN-CL-C5-100.000	i-145n36w36-aa, bb, cc	Tanacetum vulgare	1000s		No	n/a	1	Popn Size/Extent			metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Clearwater	MN-CL-C5-100.000	i-145n36w36-aa, bb, cc	Phalaris arundinacea			No	n/a	2	Cluster multiple spp			aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Clearwater	MN-CL-C5-100.000	i-145n36w36-bb	Tanacetum vulgare	1000s	Many	No	n/a	1	High spread risk	AR312-a		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Clearwater	MN-CL-C5-100.000	i-145n36w36-cc	Phalaris arundinacea	100s	Common	No	n/a	1	High spread risk	AR312-a		aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Clearwater	MN-CL-C5-100.000	i-145n36w36-dd	Lotus corniculatus	100s	Common	No	n/a	1	High spread risk	AR312-a		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Clearwater	MN-CL-C5-100.000	i-145n36w36-dd, ee, aa	Centaurea stoebe			No	n/a	1	Cluster multiple spp./Popn Size/Extent		Near large, extensive population of Centaurea stoebe, polygon I-145n36w35-f, probably part of same population	aminopyralid or clopyralid
Clearwater	MN-CL-C5-100.000	i-145n36w36-dd, ee, aa	Lotus corniculatus	100s	Common	No	n/a	1	Cluster multiple spp./Popn Size/Extent			aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Clearwater	MN-CL-C5-100.000	i-145n36w36-dd, ee, aa	Toxicodendron radicans	100s		No	n/a	1	Cluster multiple spp./Popn Size/Extent			triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Clearwater	MN-CL-C5-100.000	i-145n36w36-ee	Toxicodendron radicans	1000s	Many	No	n/a	1	High spread risk	AR312-b		triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Clearwater	MN-CL-C5-100.000	I-145n36w36-ab	Tanacetum vulgare	26-50	Intermittent	No	n/a	1	Popn Size/Extent/High Spread Risk	AR313	extensive full length mainline through TR; and on AR Temp	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Clearwater	MN-CL-C5-101.000	I-145n36w36-b	Cirsium arvense			Yes	wetland	1	Cluster multiple spp/ Popn Size/Extent		overlaps with wetland; portion extends outside of construction workspace, will only treat portion that intersects with construction workspace	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Clearwater	MN-CL-C5-101.000	I-145n36w36-b	Centaurea stoebe	501-1000		Yes	wetland	1	Cluster multiple spp/ Popn Size/Extent		overlaps with wetland; portion extends outside of construction workspace, will only treat portion that intersects with construction workspace	aminopyralid or clopyralid
Clearwater	MN-CL-C5-101.000	I-145n36w36-b	Tanacetum vulgare	5000+		Yes	wetland	1	Cluster multiple spp/ Popn Size/Extent		overlaps with wetland; portion extends outside of construction workspace, will only treat portion that intersects with construction workspace	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Carlton	MN-CR-087.000	I-48n17w16-k	Tanacetum vulgare	100s	Common	Yes	wetland	2	High control potential		wetland either side of Munger Trail parallel W Co Hwy 61	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Carlton	MN-CR-087.000	I-48n17w16-k1	Tanacetum vulgare	100s	Common	Yes	wetland	2	High control potential		wetland either side of Munger Trail parallel W Co Hwy 61	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Carlton	MN-CR-087.000	I-48n17w16-m1	Phalaris arundinacea	100s	Many	Yes	wetland	5	Reveg Cover Concerns		wetland either side of Munger Trail parallel W Co Hwy 61	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Hubbard	MN-HU-C5-041.000	I-143n35w32-m	Cirsium arvense	51-100		Yes	wetland	1	Cluster multiple spp/ Popn Size/Extent		plus Car aca; will only treat portion of occurrence that overlaps with construction workspace	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Hubbard	MN-HU-C5-041.000	I-143n35w32-m	Tanacetum vulgare			Yes	wetland	1	Cluster multiple spp/Popn Size/Extent		plus Car aca; will only treat portion of occurrence that overlaps with construction workspace	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Hubbard	MN-HU-C5-041.000	I-143n35w32-m	Centaurea stoebe	251-500		Yes	wetland	1	Cluster multiple spp/Popn Size/Extent		plus Car aca; will only treat portion of occurrence that overlaps with construction workspace	aminopyralid or clopyralid
Hubbard	MN-HU-C5-071.400	i-141n35w5-cc	Phalaris arundinacea	100s	Some	Yes	wetland	2	High control potential		wetland north and south of occurrences, land owned by City of Saint Paul	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Hubbard	MN-HU-C5-071.400	i-141n35w5-ha	Phalaris arundinacea	100s	Some	Yes	wetland	2	High control potential		wetland north and south of occurrences, land owned by City of Saint Paul	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Hubbard	MN-HU-C5-071.400	i-141n35w5-hb	Toxicodendron radicans	100s	Some	Yes	wetland	3	Safety		very near border of wetland, land owned by City of Saint Paul	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Hubbard	MN-HU-C5-165.000	i-139n35w34-gg	Carduus acanthoides	10s	Few	No	n/a	2	High control potential		mainline corridor, near valve road/valve site	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Hubbard	MN-HU-C5-177.000	i-139n35w36-ee	Toxicodendron radicans	100s	Common	No	n/a	3	Safety		in mainline corridor	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Hubbard	MN-HU-C5-178.000	I-139n35w36-a	Centaurea stoebe	101-500	Intermittent	No	n/a	2	High control potential		on roadside	aminopyralid or clopyralid
Hubbard	MN-HU-C5-178.000	I-139n35w36-b	Carduus acanthoides	0-100	Intermittent	No	n/a	2	High control potential		on roadside	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Hubbard	MN-HU-C5-178.000	I-139n35w36-c	Carduus acanthoides	0-100		No	n/a	1	Popn Size/Extent	AR348.1	roadside, 159th	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Hubbard	MN-HU-C5-178.000	I-139n35w36-c	Centaurea stoebe	101-500		No	n/a	1	Popn Size/Extent	AR348.1	roadside, 159th	aminopyralid or clopyralid
Hubbard	MN-HU-C5-178.000	I-139n35w36-c	Tanacetum vulgare	101-500	Intermittent	No	n/a	1	Popn Size/Extent	AR348.1	roadside, 159th	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin	MN-SL-001.001	i-51n21w18-dd	Phragmites australis	100s	Common	Yes	wetland	1	High spread risk	AR556	wetland on either side of access road, unnamed stream on north side of road, waterbody ID: s-51n21w8-a; pre-treatment Is most successful in summer to early fall so if pre-treatment occurs in spring these populations may not be treated until restoration/post construction monitoring	aquatic glyphosate or imazapyr in summer/early fall
Wadena	MN-WA-002.000	I-138n34w1-b	Cirsium arvense	0-100	Rare	No	n/a	2	High control potential		w/in 60 yds of HDD Discharge ESA	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Wadena	MN-WA-002.000	i-138n34w1-bb	Phalaris arundinacea	100s	Common	Yes	Shell River	5	Streambank Cover Concerns		waterbody ID: **WA002aWB** Bank Erosion Hazard Index = Moderate; Pfankuch Stability Rating = Good (stable)	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Wadena	MN-WA-002.000	i-138n34w1-ff	Cirsium arvense	100s	Common	No	n/a	2	High control potential		w/in 60 yds of HDD Discharge ESA	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Wadena	MN-WA-002.000	i-138n34w1-gg	Carduus acanthoides	100s	Common	No	n/a	2	High control potential		w/in 50 yds of HDD Discharge ESA; at forestry road crossing ID7	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Wadena	MN-WA-004.210	i-138n33w6-hi	Securigera varia (Syn. Coronilla varia)	10s	Few	No	n/a	1	High spread risk	HR-MN-WA-006-396TH ST-2		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Wadena	MN-WA-004.210	i-138n33w6-hj	Toxicodendron radicans	100s	Some	No	n/a	1	High spread risk	HR-MN-WA-006-396TH ST-2		triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Wadena	MN-WA-004.220	i-138n33w6-ha	Securigera varia (Syn. Coronilla varia)	10s	Few	No	n/a	1	High spread risk	HR-MN-WA-006-396TH ST-1		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Wadena	MN-WA-004.220	i-138n33w6-he	Tanacetum vulgare	10s	Few	No	n/a	1	High spread risk	HR-MN-WA-006-396TH ST-2		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Wadena	MN-WA-004.220	i-138n33w6-hf	Securigera varia (Syn. Coronilla varia)	10s	Few	No	n/a	1	High spread risk	HR-MN-WA-006-396TH ST-2		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Wadena	MN-WA-004.220	i-138n33w6-hg	Carduus acanthoides	10s	Few	No	n/a	1	High spread risk	HR-MN-WA-006-396TH ST-2		selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Wadena	MN-WA-004.220	i-138n33w6-hk	Tanacetum vulgare	10s	Few	No	n/a	1	High spread risk	HR-MN-WA-006-396TH ST-2		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Wadena	MN-WA-006.000	i-138n33w5-dd	Phalaris arundinacea	100s	Common	Yes	wetland, Crow Wing River	5	Streambank Cover Concerns		waterbody ID **WA006aWB**; Bank Erosion Hazard Index = Moderate to High; Pfankuch Stability Rating = Good (stable)	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Wadena	MN-WA-006.000	i-138n33w5-ee	Cirsium arvense	100s	Common	No	n/a	2	High control potential		in mainline corridor, in route to HDD site (W side Crow Wing River)	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Wadena	MN-WA-009.000	i-138n33w4-cc	Securigera varia	100s	Common	No	n/a	3	Poor suppression potential		in mainline corridor, in route to HDD site (E side Crow Wing River)	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Wadena	MN-WA-009.000	i-138n33w4-ff	Carduus acanthoides	100s	Common	No	n/a	2	High control potential		associated with HDD site (E side Crow Wing River)	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Wadena	MN-WA-010.000	i-138n33w9-hc	Toxicodendron radicans	100s	Some	No	n/a	1	High spread risk	HR-MN-WA-006-FR-0359/390TH ST-1	edge of haul route improvement	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Wadena	MN-WA-010.100	i-138n33w9-ha	Securigera varia (Syn. Coronilla varia)	10s	Few	No	n/a	1	High spread risk	HR-MN-WA-006-FR-0359/390TH ST-1		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Wadena	MN-WA-010.100	i-138n33w9-hd	Lotus corniculatus	10s	Few	No	n/a	1	High spread risk	HR-MN-WA-006-FR-0359/390TH ST-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Wadena	MN-WA-010.100	i-138n33w9-he	Toxicodendron radicans	100s	Some	No	n/a	1	High spread risk	HR-MN-WA-006-FR-0359/390TH ST-1		triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Wadena	MN-WA-010.100	i-138n33w9-hf	Securigera varia (Syn. Coronilla varia)	10s	Few	No	n/a	1	High spread risk	HR-MN-WA-006-FR-0359/390TH ST-1		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Wadena	MN-WA-011.000	i-138n33w4-ll	Securigera varia	100s	Common	No	n/a	3	Poor suppression potential		Centaurea stoebe just beyond CL	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Wadena	MN-WA-014.000/MN-WA-O10.100	i-138n33w9-aa	Securigera varia (Syn. Coronilla varia)	100s	Common	No	n/a	1	High spread risk	HR-MN-WA-006-FR-0359/390TH ST-1		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Wadena	MN-WA-014.000/MN-WA-O10.100	i-138n33w9-hg	Toxicodendron radicans	100s	Some	No	n/a	1	High spread risk	HR-MN-WA-006-FR-0359/390TH ST-1		triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Wadena	MN-WA-015.000	I-138n33w3-a	Cirsium arvense	0-100	Rare	No	n/a	2	High control potential		good access	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Wadena	MN-WA-015.000	i-138n33w3-aa	Securigera varia	100s	Common	No	n/a	1	High spread risk	HR-MN-WA-006-FR-0359/390TH ST-1	haul route	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Wadena	MN-WA-015.000	I-138n33w3-b	Carduus acanthoides	0-100	Rare	No	n/a	2	High control potential		good access	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Wadena	MN-WA-015.000	i-138n33w3-bb	Carduus acanthoides	1000s	Common	No	n/a	2	Popn Size/Extent		good access	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Wadena	MN-WA-015.000	i-138n33w3-ee	Cirsium arvense	100s	Common	No	n/a	2	High control potential		230 yds from haul route and forestry road crossing ID12	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Wadena	MN-WA-015.000	i-138n33w3-hc	Securigera varia	10s	Few	No	n/a	1	High spread risk	HR-MN-WA-006-FR-0359/390TH ST-1	haul route	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Wadena	MN-WA-015.000	i-138n33w3-hd	Toxicodendron radicans	10s	Few	No	n/a	1	High spread risk	HR-MN-WA-006-FR-0359/390TH ST-1	haul route	triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Wadena	MN-WA-015.000	i-138n33w3-he	Carduus acanthoides	10s	Few	No	n/a	1	High Spread Risk	HR-MN-WA-006-FR-0359/390TH ST-1	haul route	selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Wadena	MN-WA-017.000	I-138n33w2-a	Cirsium arvense	0-100	Rare	No	n/a	2	High control potential		good access, near 259th	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Wadena	MN-WA-017.000	i-138n33w2-aa	Cirsium arvense	100s	Common	No	n/a	2	High control potential		good access, near 259th	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Wadena	MN-WA-018.000	i-138n33w11-aa	Phalaris arundinacea	1000s	Many	Yes	wetland	1	High spread risk	AR353.4-d	wetland north and south of access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Wadena	MN-WA-018.000	i-138n33w11-cc	Centaurea stoebe (Syn. Centaurea maculosa)	10s	Few	Yes	wetland	1	High spread risk	AR353.4-d	wetland east of occurrence	aminopyralid or clopyralid

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Wadena	MN-WA-019.300	i-138n33w12-cc	Carduus acanthoides	100s	Common	No	n/a	1	High spread risk	AR353.4-d		selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Carlton	T-0097/T-0101	I-48n17w6-p719a	Phalaris arundinacea	251-500		Yes	wetland, unnamed stream	5	Low suppression potential/Streambank Cover Concerns		large population extends off construction workspace, will only treat portion that intersects with workspace; overlaps with wetland; extends over waterbody ID **s-48n17w6-a** Bank Erosion Hazard Index = High; Pfankuch Stability Rating = Good (stable)	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Carlton	T-0101	I-48n17w6-p804c	Phalaris arundinacea	101-250	Extension of 2018 polygon.	Yes	wetland	1	High spread risk	AR598-c	large population extends far of access road; population overlaps with wetland; occurrence had listed multiple other species - unclear how dense Phalaris arundinaceae is throughout entire polygon; population extends beyond MDNR land, will only treat portion on MDNR land that intersects with construction workspace or access road	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Carlton	T-0101	I-48n17w06-c719d	Phalaris arundinacea	501-1000	Intermittent	No	n/a	4	Poor suppression potential		large swathes to NW 65 yds (on private land) and SE 90 yds in TR in mainline corridor	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Carlton	T-0141-C/T-0141-D	I-49n19w1-p804a	Phalaris arundinacea	1001-5000		Yes	wetland	4	Poor suppression potential		population overlaps with wetland; population extends outside of construction workspace, will only treat portion that intersects with construction workspace	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Carlton	T-0141-D	I-49n19w1-804bs	Cirsium arvense	10-100		Yes	wetland	2	Cluster multiple spp		trail corridor parallel to north? Access may be difficult due to landlocked tract	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Carlton	T-0141-D	I-49n19w1-804bt	Cirsium arvense	10-100		No	n/a	2	Cluster multiple spp		trail corridor parallel to north? Access may be difficult due to landlocked tract	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Carlton	T-0141-D	I-49n19w1-804bu	Tanacetum vulgare	10-100		No	n/a	2	Cluster multiple spp		trail corridor parallel to north? Access may be difficult due to landlocked tract	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Carlton	T-0141-D	I-49n19w1-804bv	Cirsium arvense	10-100		Yes	wetland	2	Cluster multiple spp		trail corridor parallel to north? Access may be difficult due to landlocked tract	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Carlton	T-0141-D	I-49n19w1-804bw	Lotus corniculatus	10-100		No	n/a	2	Cluster multiple spp		trail corridor parallel to north? Access may be difficult due to landlocked tract	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Carlton	T-0141-D	I-49n19w1-804bx	Tanacetum vulgare	1-10		No	n/a	2	Cluster multiple spp		trail corridor parallel to north? Access may be difficult due to landlocked tract	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Carlton	T-0141-D	I-49n19w1-804by	Tanacetum vulgare	10-100		No	n/a	2	Cluster multiple spp		trail corridor parallel to north? Access may be difficult due to landlocked tract	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Carlton	T-0141-D	I-49n19w1-804ca	Tanacetum vulgare	10-100		No	n/a	2	Cluster multiple spp		trail corridor parallel to north? Access may be difficult due to landlocked tract	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Carlton	T-0141-D	I-49n19w1-804cc	Cirsium vulgare	1-10		Yes	wetland	2	High control potential		wetland to the north; numerous other species occurrences near this occurrence	aminopyralid, clopyralid, or metsulfuron-methyl
Carlton	T-0141-D	I-49n19w1-804cd	Cirsium arvense	10-100		Yes	wetland	2	Cluster multiple spp		trail corridor parallel to north? Access may be difficult due to landlocked tract	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands
Carlton	T-0141-D	I-49n19w1-c804ai	Galeopsis tetrahit	26-50		No	n/a	2	Cluster multiple spp		trail corridor parallel to north? Access may be difficult due to landlocked tract	No herbcide treatment recommended. Mowing recommended, but may be difficult due to limited access.
St.Louis	T-0157	I-50n19w16-b	Tanacetum vulgare	1000s		Yes	wetland	2	High control potential		spread contained by wetland; extends off construction workspace, will only treat portion that intersects with workspace	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
St.Louis	T-0157	I-50n19w16-a	Phalaris arundinacea	100s	Common	Yes	wetland	3	Poor suppression potential		field assess further based on wetland composition/quality	aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
St.Louis	T-0157	I-50n19w16-b	Tanacetum vulgare	1000s	Many	Yes	wetland	2	High control potential		spread contained by wetland	metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
St.Louis	T-0157	I-50n19w16-c	Securigera varia	10s	Few	Yes	wetland	3	Poor suppression potential		small popn size; potential trt w/ Lot cor and Tan vul	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
St.Louis	T-0157	I-50n19w16-d	Lotus corniculatus	100s	Common	Yes	wetland	3	Poor suppression potential		spread contained by wetland	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
St.Louis	T-0157	I-50n19w16-e	Securigera varia	10s	Common	Yes	wetland	2	High control potential		spread contained by wetland	aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
St.Louis	T-0157	I-50n19w16-e	Lotus corniculatus	100s		Yes	wetland	3	Poor suppression potential		spread contained by wetland	aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Cass		i-140n25w35-hc	Securigera varia (Syn. Coronilla varia)	10s	Few	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.

County	DNR Tract Name	Invasive Occurrence ID*	Species	Population Estimate	Population Distribution	ESA within 100 ft	ESA Feature(s)	Priority Ranking	Priority Rationale	Access Road or Haul Route Name	Notes	Herbicide Treatment**
Cass		i-140n25w36-ha	Lotus corniculatus	100s	Some	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Cass		i-140n25w36-hb	Tanacetum vulgare	100s	Some	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Cass		i-140n25w36-hc	Toxicodendron radicans	100s	Some	No	n/a	1	High spread risk	HR-MN-CA-006-PIKUS FOREST RD-1		triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Cass		i-140n25w36-hd	Phalaris arundinacea	100s	Some	No	n/a	2	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin		i-51n27w16-ha	Toxicodendron radicans	10s	Few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin		i-51n27w16-hb	Phalaris arundinacea	10s	Few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin		i-51n27w16-hc	Lotus corniculatus	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin		i-51n27w16-hd	Tanacetum vulgare	10s	Few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin		i-51n27w16-he	Securigera varia (Syn. Coronilla varia)	10s	Few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		aminopyralid, clopyralid, or metsulfuron-methyl; triclopyr amine or choline in wetlands.
Aitkin		i-51n27w16-hh	Linaria dalmatica	10s	Few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		Chlorsulfuron (spring or fall) or imazapic (fall)
Aitkin		i-51n27w16-hj	Toxicodendron radicans	10s	Few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		triclopyr, glyphosate, imazapyr or aminocyclopyrachlor
Aitkin		i-51n27w16-hm	Carduus acanthoides	10s	Few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		selectively treat with aminopyralid, clopyralid, metsulfuron-methyl or triclopyr
Aitkin		i-51n27w16-hn	Tanacetum vulgare	100s	Some	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin		i-51n27w16-ho	Lotus corniculatus	10s	few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin		i-51n27w16-hp	Lotus corniculatus	10s	few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands
Aitkin		i-51n27w16-hr	Phalaris arundinacea	10s	few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		aquatic glyphosate (non-selective) in wetlands and riparian areas; clethodim or sethoxydim (grass-specific) to new growth and secondary fall growth in dry soils
Aitkin		i-51n27w16-hs	Tanacetum vulgare	10s	few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		metsulfuron-methyl or dicamba; aquatic glyphosate (non-selective) in wetlands, ditches, and riparian areas
Aitkin		i-51n27w16-ht	Lotus corniculatus	10s	few	No	n/a	1	High spread risk	HR-MN-AI-006-STATE FOREST RD 27-1		aminopyralid or clopyralid; triclopyr amine or choline in wetlands

* Includes both points and polygons

** Herbicide applications may occur from start of construction through post-construction, depending on construction timing. For more detailed treatment methodology and timing see Attachment C Treatment Methods for INS Plant Species Identified within Construction Limits on MDNR Land.

Attachment E

Pesticide Application Signage

Invasive Species Alert

Species:

Treated Date:

Do Not Disturb Marked Area Until:

Enbridge

Attachment F

Cleaning Log

Equipment Cleaning Log

Form Completed By: _____

Date: _____ Time: _____

Location of Equipment (tract & milepost): _____

Equipment Type and ID (e.g., company, unique ID number:

_____

_____

_____

_____

_____

_____

_____

_____

Cleaning Method: (check all that apply)

- ☐ Scrape Down
- ☐ Steam Wash Blow Down (compressed air)
- ☐ Power/Pressure Wash (water)
- ☐ Other (Describe): _____

Comments: _____

_____

_____

_____

Attachment G

NPDES Vegetative Pests and Algae Control Pesticide General Permit

STATE OF MINNESOTA

Minnesota Pollution Control Agency

Industrial Division

National Pollutant Discharge Elimination System (NPDES) /
State Disposal System (SDS) General Permit MNG87D000
Vegetative Pests and Algae Control Pesticide General Permit

ISSUANCE DATE: April 11, 2012 **EXPIRATION DATE: October 31, 2016**

The state of Minnesota, on behalf of its citizens through the Minnesota Pollution Control Agency (MPCA), **authorizes the Permittee to discharge a biological pesticide or chemical pesticide that leaves a residue for control of Vegetative Pests and Algae** in accordance with the requirements of this permit. If pesticides are applied by the Decision-makers listed in this permit in excess of the Threshold in Section 1.4, then a Notice of Intent (NOI) must be submitted.

The goal of this permit is to protect water quality in accordance with Minnesota and U.S. statutes and rules, including Minn. Stat. chs. 115 and 116, Minn. R. chs. 7001, 7050, 7052, and 7053; and the U.S. Clean Water Act (CWA).

This permit is effective on the issuance date identified above. This permit expires at midnight on the expiration date identified above.

Signature: _____

Jeff Stollenwerk, Manager *for* The Minnesota Pollution Control Agency
Land and Water Quality Permits Section
Industrial Division

Permit Required Submittals:

Submit Reports to:
Attention: WQ Submittals Center
Minnesota Pollution Control Agency
520 Lafayette Rd N
St Paul, MN 55155-4194

Questions on this permit?
- Contact:
  Elise M. Doucette
  Environmental Analysis and Outcomes Division
  elise.doucette@state.mn.us
  651-757-2316

Table of Contents

VEGETATIVE PESTS AND ALGAE CONTROL GENERAL PERMIT REQUIREMENTS

1. General Permit Applicability and Eligibility

1.1 This permit applies to individuals, groups, units of government, or other entities who discharge to waters of the state biological pesticides or chemical pesticides that leave a residue (hereinafter collectively "pesticides") when the application is to control **algae and aquatic and terrestrial vegetative pests in waters of the state**.

1.2 Individuals, groups, units of government, and other entities associated with the application of pesticides which result in a discharge to a water of the state under this permit are considered Decision-makers or Applicators. For the purpose of this permit, "Decision-maker" means any entity with control over the decision to perform pesticide applications, including the ability to modify those decisions. "Applicator" means any entity who performs the application of a pesticide or who has day-to-day control of the application (i.e., they are authorized to direct workers to carry out those activities). More than one entity (Decision-maker and/or Applicator) may be responsible for complying with this permit for any single discharge from the application of pesticides. A Decision-maker that self-applies pesticides is also considered an Applicator and must comply with applicable requirements imposed on both Applicators and Decision-makers.

1.3 For the purposes of this permit, both Decision-makers and Applicators are considered "Permittees" unless otherwise noted and regardless of whether a NOI is required to be submitted.

1.4 The following Decision-makers are required to submit a NOI under this general permit for discharges to waters of the state resulting from the application of pesticides (hereinafter "Thresholds"):

Threshold for Vegetative Pests and Algae	
Lakes ≥20 acres in size	Decision-makers that treat greater than 15% of the littoral zone[1]
	Decision-makers that treat the whole lake[1] (ex: algae control)
All other waters of the state	Decision-makers that apply to a treatment area[2] of 1200 acres or greater that have visible standing water at the time of application (see NOTE below).

[1] Littoral zone – means the surface area of a water body where the depth is 15 feet or less.

[2] The treatment area for a lake is the surface area where the application is intended to provide pesticidal benefits taking into effect wind and wave action.

[3] Treatment Area – The area to which pesticides are being applied and where the pesticide application is intended to provide pesticidal benefits. In some instances, the treatment area will be larger than the area where pesticides are actually applied. If aerially applying the pesticide, all waters of the state under that area should be added to the "treatment area." If spot spraying and a discharge to waters of the state is unavoidable, then the area that receives application should be added to the calendar year total to determine if the Threshold is exceeded. This Threshold is cumulative and based on a calendar year total. For example, treating the same 100-acre wetland three times a year would result in a treatment total of 300 acres.

NOTE: If you are treating an area that is intermittently wet, count it toward the threshold total only when visible standing water is present at the time of application.

1.5 The following discharges, consistent with the permit eligibility provisions in Section 1.1, are automatically authorized by the issuance date of this permit:

a. Eligible discharges made prior to the Notice of Intent submission deadline Section 4.2;
b. Eligible discharges that result from the application of a pesticide as part of pesticide research and development (defined in Section 6.39);
c. Eligible discharges for which submission of an NOI is not required.

However, these discharges are still required to comply with the minimum requirements of this permit as defined in Section 3 (Basic Requirements) and Section 5 (Standard Permit Requirements).

1.6 Consistent with the permit eligibility provisions of Section 1.1, dischargers that submit an application and are issued an Aquatic Plant Management (APM) permit through MN Rules 6280 by the Department of Natural Resources fulfill the requirements of this permit's NOI and are granted coverage under this NPDES/SDS general permit. Compliance with an APM permit satisfies the requirements of this NPDES/SDS permit, and no further reporting to MPCA is required.

1.7 Decision-makers required to submit a NOI, see Sections 4.1-4.5 for timing of submittal and authorization of discharge.

1.8 Decision-makers and Applicators covered under this permit that are not required to submit a NOI are terminated from permit coverage when they no longer have a discharge from the application of pesticides nor activities associated with the discharge required by this Permit, including, but not limited to monitoring, reporting and recordkeeping.

2. Exclusions / Limitations on Coverage

2.1 Decision-makers and Applicators are not eligible for coverage under this permit for discharges to:

a. Waters of the state identified as impaired for the pesticide or its degradates. Impaired waters are those which have been identified pursuant to Section 303(d) of the CWA as not meeting applicable state water quality standards.
b. Waters designated by the state as Prohibited Outstanding Resource Value Waters (ORVWs) for nondegradation purposes under Minn. R. 7050.0180 subp. 3 through 5 (Nondegradation for ORVWs).

2.2 Decision-makers and Applicators are not eligible for coverage under this permit due to other NPDES/SDS coverage in the following cases:

a. Discharges currently covered under another point source NPDES/SDS permit.

b. Discharges covered within five years prior to the effective date of this permit by an individual permit or alternative general permit that established numeric water quality-based limitations for the pesticide in question or its degradates. See Section 4.43 for submittal of an application for an individual permit or alternative general permit.
c. Discharges from activities where any NPDES/SDS permit has been or is in the process of being denied, terminated, or revoked by MPCA (this does not apply to the routine reissuance of permits every five years).

3. Technology-Based Effluent Limits for Pesticide Application

3.1 **Decision-makers' Responsibilities.** To meet the effluent limitations of this permit, all Decision-makers must minimize the discharge of pesticides to waters of the state from the application of pesticides, through the use of pest management measures (defined in Section 6.38).To the extent the Decision-maker determines the amount of pesticide or frequency of pesticide application, the Decision-maker must use the lowest effective amount of pesticide product per application and optimum frequency of pesticide application necessary to control the target pest, consistent with reducing the potential for development of pest resistance.

3.2 **Applicators' Responsibilities**. To meet the effluent limitations of this permit, all Applicators must implement the following requirements to minimize the discharge of pesticides to waters of the state from the application of pesticides, through the use of pest management measures:

a. To the extent not determined by the Decision-maker, use the lowest effective amount of pesticide product per application and optimum frequency of pesticide application necessary to control the target pest, consistent with reducing the potential for development of pest resistance, and apply pesticides in accordance with the product label or labeling and in a manner that will not cause unreasonable adverse effects to the environment. This includes using equipment and application procedures appropriate for this task.
b. Maintain pesticide application equipment in proper operation conditions, including requirement to calibrate, clean, and repair such equipment to prevent leaks, spills or other unintended discharges and to ensure the rate of pesticide application is calibrated (i.e. nozzle choice, droplet size, etc.) to deliver the precise quantity of pesticide needed to achieve the requirements outlined in Section 3.2.a. above.
c. Assess weather conditions (e.g. temperature, wind speed, and wind direction) in the treatment area to ensure application is consistent with all applicable federal requirements.

Water Quality-Based Effluent Limitations

3.3 Your discharge must be controlled as necessary to meet applicable numeric and narrative state water quality standards in accordance with Minn. R. 7000, 7050, 7052, and 7053 including the narrative standards governing nondegradation for all waters and ORVWs.

3.4 If at any time you become aware, or the MPCA determines, that your discharge causes or contributes to an exceedance of applicable water quality standards, you must take corrective action as required in Section 3.13 – 3.17 of this Permit (Corrective Action).

3.5 The MPCA may impose additional water quality-based limitations or require you to obtain coverage under an individual permit if information in your NOI, required reports, or other sources indicates that your discharges are not controlled as necessary to meet applicable water quality standards.

Site Monitoring

3.6 **Applicators Responsibilities.** All Applicators must, when considerations for safety and feasibility allow, visually assess the area to and around where pesticides are applied for possible and observable Adverse Incidents (defined in Section 6.4), caused by application of pesticides, including the unanticipated death or distress of non-target organisms and disruption of wildlife habitat, recreational or municipal water use.

3.7 **Decision-makers Responsibilities.** If any post-application surveillance occurs, Decision-makers must visually assess the area to and around where pesticides were applied for possible and observable Adverse Incidents caused by application of pesticides, including the unanticipated death or distress of non-target organisms and disruption of wildlife habitat, recreational or municipal water use.

Adverse Incident Notification and Reporting for both Decision-makers and Applicators

3.8 **Immediate Adverse Incident Notification.** If you observe or are otherwise made aware of an Adverse Incident that may have resulted from a discharge from your pesticide application, you must notify the Minnesota Public Safety Duty Officer at 800-422-0798 (651-649-5451 in the metro area) immediately. "Adverse Incident" means an incident that you have observed upon inspection or of which you otherwise become aware in which non-target organisms may have been exposed to a pesticide residue and suffered a toxic or adverse effect. See Section 6.4 for the full definition.

The Adverse Incident notification must include at least the following information:

a. The caller's name and telephone number.
b. Decision-makers and/or Applicators name and mailing address.
c. If covered by a NOI, the NPDES/SDS tracking number.
d. The name and telephone number of a contact person, if different than the person providing the 24-hour notice.
e. How and when you became aware of the Adverse Incident.
f. Description of the Adverse Incident identified and the location.
g. The U.S. Environmental Protection Agency (EPA) pesticide registration number for each product you applied in the area of the Adverse Incident. If not a pesticide, provide the chemical product name.
h. Description of any steps you have taken or will take to correct, repair, remedy, cleanup, or otherwise address any adverse effects, if applicable.

The Adverse Incident notification and reporting requirements are in addition to what the registrant is required to submit under Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) section 6(a)(2) and its implementing regulations at 40 CFR pt. 159.

3.9 Following Immediate Adverse Incident Notification in Section 3.8, submittal of an Adverse Incident Report per Section 3.10 is not required in situations identified in a. through d. below. However, documentation must be submitted to the MPCA either by electronic mail to the assigned MPCA staff or by letter to the Water Quality Submittals Center within fifteen (15) days of the Notification and must include justification as to why the Decision-maker and/or Applicator believes the Adverse Incident meets one or more of the situations identified below:

a. An Adverse Incident occurs to pests that are similar in kind to pests identified as potential targets on the FIFRA label. For example, herbicides used to control vegetative aquatic pests may also impact non-target organisms and if identified on the label, reporting is not required.
b. You are aware of facts that clearly establish that the Adverse Incident was not related to toxic effects or exposure from your application.
c. You have been notified in writing by the MPCA that the reporting requirement has been waived for this incident or category of incidents.
d. You receive information notifying you of an Adverse Incident but that information is clearly erroneous.

3.10 **Adverse Incident Report.** Within fifteen (15) days of a reportable Adverse Incident pursuant to Section 3.8 of this Permit, you must provide a written Adverse Incident Report to the MPCA Water Quality Submittals Center. Your Adverse Incident Report must include at least the following information:

a. Information required to be provided in Section 3.8.
b. Date and time you notified authorities, whom you spoke with, and any instructions you received.
c. Location of incident, including the names of any waters affected and appearance of those waters (sheen, color, clarity, etc).
d. A description of the circumstances, including species affected, estimated number of individual and approximate size of dead or distressed organisms.
e. Magnitude and scope of the affected area (e.g. aquatic square area or total stream distance affected).
f. Pesticide application rate, intended use site (e.g., banks, above, or direct to water), method of application, and name of pesticide, description of pesticide, and EPA registration number.
g. Description of the habitat and the circumstances under which the Adverse Incident occurred (including any available ambient water data for pesticides applied).
h. If laboratory tests were performed, indicate what test(s) were performed and when, and provide a summary of the test results within 5 days after they become available.
i. Actions to be taken to prevent recurrence of Adverse Incidents.
j. Signed and dated in accordance with Section 5.17 (Required Signatures).

3.11 **Adverse Incident to Threatened or Endangered Species or Critical Habitat.** Notwithstanding any of the other Adverse Incident notification requirements of Section 3.8 and 3.10, if you become aware of an Adverse Incident to a federally or state-listed threatened or endangered species or its federally-designated critical habitat, that may have resulted from your discharge, you must immediately notify the U.S. Fish and Wildlife Service (FWS) – Twin Cities Field Office (Ecological Services) at 612-725-3548 (TwinCities@fws.gov) or the Minnesota Department of Natural Resources (MDNR) Division of Ecological and Water Resources at 1 888-646-6367

(or 651-296-6157 in the metro area). This notification must be made by telephone immediately upon your becoming aware of the Adverse Incident and must include at least the following information:

a. The caller's name and telephone number.
b. Applicator name, mailing address, and telephone number (if different than above).
c. The name of the affected species.
d. How and when you became aware of the Adverse Incident.
e. Description of the location of the Adverse Incident.
f. Description of the Adverse Incident, including the EPA pesticide registration number for each product you applied in the area of the Adverse Incident. If not a pesticide, provide the chemical product name.
g. Description of any steps you have taken or will take to alleviate the adverse impact to the species.

Additional information on federal and state-listed threatened or endangered species and critical habitat is available from FWS (http://www.fws.gov/midwest/TwinCities/) and MDNR (http://www.dnr.state.mn.us/eco/index.html).

3.12 Where multiple entities are authorized for a discharge that results in an Adverse Incident, notification and reporting by any one of the entities (Decision-maker or Applicator) constitutes compliance for all of the entities, provided a copy of the written report required in Section 3.10 is also provided to all of the other authorized Decision-makers and/or Applicators within 30 days of the reportable adverse incident.

Corrective Action

3.13 If any site-monitoring activities conclusively indicate that you failed to meet the basic requirements in Section 3.1 through 3.4 of this Permit, you must review and, as necessary, revise the evaluation and selection of your pest management measures to ensure that the situation is eliminated and will not be repeated in the future.

3.14 If any of the following situations occur, Decision-makers and Applicators must review and, as necessary, revise the evaluation and selection of your pest management measures to ensure that the situation is eliminated and will not be repeated in the future:

a. An unauthorized release or discharge associated with the application of pesticides occurs (e.g., a spill, leak, or discharge not authorized by this or another NPDES/SDS permit consistent with Minn Stat. 115.061).
b. You become aware, or the MPCA concludes, that your control measures are not adequate/sufficient for the discharge to meet applicable water quality standards.
c. An inspection or evaluation of your activities by an MPCA official or local entity reveals that modifications to the control measures are necessary to meet the non-numeric effluent limits in this permit.
d. You observe, or are otherwise made aware of, a Reportable Adverse Incident.

3.15 If you determine that changes to your pest management measures are necessary to eliminate any situation identified in Section 3.13 and 3.14, such changes must be made before the next

pesticide application that results in a discharge if practicable, or if not, as soon as possible thereafter.

3.16 The occurrence of a situation identified in Section 3.13 and 3.14 may constitute a violation of the permit. Correcting the situation does not absolve you of liability for any original violation. However, failure to comply with Sections 3.13 and 3.14 constitute an additional permit violation. The MPCA will consider the appropriateness and promptness of corrective action in determining enforcement responses to permit violations.

3.17 The MPCA or a court may impose additional requirements and schedules of compliance, including requirements to submit additional information concerning the condition(s) triggering corrective action or schedules and requirements more stringent than specified in this permit. Those requirements and schedules will supersede those of Section 3.13 and 3.14 if such requirements conflict.

Recordkeeping

3.18 Decision-makers and Applicators must keep written records as required in this permit. These records must be accurate and complete and sufficient to demonstrate your compliance with the conditions of this permit. You can substitute records and documents developed for other obligations, such as requirements under FIFRA and state or local programs, provided all requirements of this permit are satisfied.

3.19 Decision-makers and Applicators shall keep records of acres or percentage of littoral zone receiving treatment for all activities covered under this general permit. The records must be kept up-to-date to help you determine if your permitted discharge meets the Thresholds as identified in Section 1.4.

3.20 Decision-makers and Applicators must keep the following records:
a. A copy of any Adverse Incident Reports (Section 3.10).
b. Your rationale for any determination that reporting of an identified Adverse Incident is not required consistent with allowances in Section 3.9.

3.21 Applicators must retain the following records when applying a pesticide. These records are required under authority of the Minnesota Department of Agriculture and when an application is performed by a for-hire Applicator, the Applicator is required to give a copy of the records to the Decision-maker (customer):

a. Name of Target pest.
b. Name of Applicator (individual and company), including license number and company address .
c. Pesticide application date(s) and time(s).
d. Brand name of the pesticide, the United States Environmental Protection Agency registration number, and dosage used.
e. Location of the site where the pesticide was applied, including number of units treated (acres or linear feet, or gallons of pesticide applied).
f. Temperature, wind speed, and wind direction at time of each pesticide application.
g. Documentation of equipment calibration.

h. Whether or not visual monitoring was conducted during pesticide application and if not, why not and whether monitoring identified any possible or observable adverse incidents caused by application of pesticides.

4. Requirements for Decision-makers that Must Submit a NOI

Authorization to Discharge under This Permit

4.1 To obtain authorization under this permit, a Decision-maker must meet the eligibility requirements identified in Section 1.1 and if so required, submit a NOI in accordance with Section 1.4 (Thresholds) of this Permit.

4.2 Decision-makers are authorized to discharge under this permit as follows:

Type	NOI Submission Deadline	Discharge Authorization Date
Any Decision-maker not required to submit an NOI	Not applicable	Immediately upon beginning the discharge
Decision-makers whose discharge begins before final permit issuance and that meet the criteria in Section 1.4 requiring submission of an NOI.	Due between April 30, 2012, and July 30, 2012.	Immediately upon beginning to discharge. Authorization granted until July 30, 2012. If MPCA receive a complete and accurate NOI on or before July 30, 2012, uninterrupted coverage continues.
Decision-makers whose discharges begin after final permit issuance and that meet the criteria in Section 1.4 requiring submission of an NOI.	Due prior to exceeding a Threshold.	Immediately upon beginning to discharge, until the discharge exceeds a Threshold. If a Decision-maker submits an NOI after July 30, 2011, they are reauthorized after MPCA notifies them of receipt of a complete and accurate NOI.
Decision-makers whose discharge is in response to a declared pest emergency situation, as defined in Section 6.15 for which that activity triggers the NOI requirement identified in Section 1.4.	No later than 30 days after beginning discharge but no earlier than April 30, 2012.	Immediately, for activities conducted in response to declared emergency situation. A complete and accurate NOI shall be submitted within 30 days of the declared emergency. Coverage is reauthorized after MPCA notifies them of receipt of a complete and accurate NOI.
Any Decision-makers requiring permit coverage for a treatment area not within the pest management area identified on a previously submitted NOI. (If the Decision-maker cannot determine whether a revised NOI is needed, the Decision-maker may contact the MPCA.)	At least 10 days before beginning to discharge in that newly identified area unless discharges are in response to a declared pest emergency, in which case not later than 30 days after beginning discharge.	After MPCA notifies the Decision-maker of receipt of a complete and accurate NOI, unless discharges are in response to a declared pest emergency. If a declared pest emergency, a complete and accurate NOI shall be submitted within 30 days of the declared emergency. Coverage is reauthorized after MPCA notifies the Decision-maker of receipt of a complete and accurate NOI.

4.3 Coverage is for the Decision-maker who filed a NOI, including its employees, contractors, subcontractors, Applicators (commercial/for-hire applicators) and other agents, for all activities identified on the NOI. Applicators that are not also Decision-makers do not need to submit a NOI.

4.4 Electronic reporting of the NOI (eNOI) will be available online beginning April 30, 2012. If required to submit an NOI, a Decision-maker must submit the NOI once, in accordance with the deadlines in Section 4.3. The Decision-maker must prepare and submit the NOI using MPCA's electronic Notice of Intent system (eNOI) available on MPCA's website (www.pca.state.mn.us/pesticidepermit) unless eNOI is otherwise unavailable or the Decision-maker has obtained a waiver from the requirement to use eNOI for submission of the NOI. Decision-makers waived from the requirement to use eNOI for NOI submission must certify on paper that use of eNOI will incur undue burden or expense over the use of a paper form and then provide a basis for this determination. MPCA will notify Decision-makers of complete and accurate NOIs received. Late NOIs will be accepted, but authorization to discharge will not be retroactive.

4.5 Based on a review of your NOI or other information, the MPCA may delay coverage for further review, notify you that additional effluent limitations are necessary, or may deny coverage under this permit and require submission of an application for an individual NPDES/SDS permit, as detailed in Section 4.39 – 4.42. In these instances, the MPCA will notify you in writing of the delay, of the need for additional effluent limits, or of the request for submission of an individual NPDES/SDS permit application.

Technology-Based Effluent Limits

Pest Management Measures

4.6 If you discharge pollutants as a result of the application of pesticides for the sole purpose of research and development (defined in Section 6.40), you are not required to fully implement Section 4.8 – 4.10 for such discharges, but you still must implement Sections 3.1 – 3.5 to the extent that its requirements do not compromise the research design.

4.7 Decision-makers that submit a NOI are required to evaluate, select, and implement site-specific control measures that reduce and/or eliminate discharges of pesticides to waters of the state to the extent technologically available and economically practicable and achievable to meet the effluent limits in Sections 3.1 -3.5 and Sections 4.8 – 4.10 of the permit. Control measures can be actions (including processes, procedures, schedules of activities, prohibitions on practices, and other management practices), or structural or installed devices to minimize discharges of pesticides to waters of the state.

Part 1: Identify the Problem

4.8 Prior to the first pesticide application covered under this permit after the Threshold is reached, and at least once each year thereafter during which you will have a discharge, you must do the following for each pest management area:

a. Identify areas with vegetative pest or algae problems and **characterize the extent of the problems**, including, for example, water use goals not attained (e.g. wildlife habitat, fisheries, vegetation, and recreation).
b. Identify **target vegetative pest species**.
c. Identify possible factors **causing or contributing to the vegetative pest or algae problem** (e.g., nutrients, invasive species, etc).

d. Establish past or present vegetative pest or algae densities to serve as pest **action threshold(s)** for implementing pest management strategies. The action threshold is a point at which pest populations or environmental conditions indicate that pest control action must be taken.
e. In the event there are no data for one or more proposed pest management area(s) in the past calendar year, use other data as appropriate to meet the permit conditions a - d above.

Part 2: Pest Management Strategies

4.9 Prior to the first pesticide application covered under this permit after the Threshold has been reached, and at least once each year thereafter during which you will have a discharge, you must select and implement for each pest management area efficient and effective means of pest management strategies that most successfully minimize discharges resulting from application of pesticides to control vegetative pests and algae, including the use of pesticide and non-pesticide methods. In developing your pest management strategies, you must evaluate the following management options considering impact to water quality, non-target organisms, pest resistance, feasibility, and cost effectiveness:

a. No action.
b. Prevention.
c. Mechanical/physical methods.
d. Cultural methods.
e. Biological control agents.
f. Pesticides.

Part 3: Pesticide Use

4.10 If a pesticide is selected for managing pests and application of the pesticide will result in a discharge to waters of the state, after the Threshold has been reached, you must:

a. Conduct surveillance prior to each pesticide application to assess the pest management area and to determine when the action threshold is met that necessitates the need for pest management.
b. Reduce the impact on the environment and non-target organisms by applying the pesticide only when the action threshold has been met.

Pesticide Discharge Management Plan (PDMP) for Large Entities

4.11 Decision-makers who submit a NOI, apply pesticides, and are a Large Entity (defined in Section 6.25) must prepare a Pesticide Discharge Management Plan (PDMP) for discharges from all treatment areas covered under this permit. The PDMP does not contain effluent limitations; the limitations are contained in Sections 3.1 – 3.6 and Sections 4.8 – 4.10 of this Permit. One PDMP may cover one or more treatment areas for each pesticide application activity.

4.12 The PDMP is intended to document the evaluation and selection of control measures. The additional documentation requirements (see Adverse Incidents and Recordkeeping Sections of this permit) are intended to document the implementation (including inspection, maintenance, monitoring, and corrective action) of the permit requirements. In your PDMP, you may refer to

procedures in other documents that meet the requirements of this permit. If you reference other documents, you must keep a copy of relevant portions of those documents with your PDMP and make it available for review consistent with Sections 4.24 and 4.26 (PDMP Availability).

4.13 Your PDMP must contain the following elements:

a. Pesticide Discharge Management Team.
b. Problem Description.
c. Control Measures Description.
d. Schedules and Procedures
    1) Spill Response Procedures.
    2) Adverse Incident Response Procedures.
e. Signature Requirements.

PDMP – Team

4.14 You must identify the persons (by name or title) that comprise the team as well as their individual responsibilities, including:

a. Person(s) responsible for managing pests in the treatment area described below.
b. Person(s) responsible for developing and revising the PDMP.
c. Person(s) responsible for taking corrective actions where required.
d. Person(s) responsible for pesticide applications, or Applicators. If the Applicator is unknown at the time of plan development, indicate whether or not a for-hire Applicator will be used.

4.15 Identification of team members must include any written agreement(s), such as a for-hire pesticide Applicator, that specify the division of responsibilities between Decision-makers and Applicators as necessary to comply with the provisions of this permit.

PDMP – Problem and Pest Management Area Description

4.16 You must document the pest problem in your pest management area as required in Section 4.8 of this permit, including, but not limited to, identification of the target pest(s), source of the pest problem, and source of data used to identify the problem, action thresholds, and how they were determined.

4.17 You must include a general location map (e.g., USGS quadrangle map, a portion of a city or county map, or other map) that identifies the geographic boundaries of the area to which the plan applies and location of the waters of the state.

4.18 You must document any waters identified as impaired by a substance which either is an active ingredient or a degradate of such an active ingredient.

PDMP – Control Measures Description

4.19 You must document your evaluation of control measures for your pest management area. You must document the control measures you will implement to comply with the effluent limitations

required in Sections 3.1 – 3.5 and Sections 4.8 – 4.10. Include in the description the active ingredient(s) evaluated.

PDMP –Schedules and Procedures

4.20 You must document schedules and procedures in your PDMP pertaining to control measures and pest management used to comply with the Effluent Limitations in Section 3.1 – 3.5 and Sections 4.8 – 4.10 of this Permit, including:

a. Spill Response Procedures – At a minimum, Decision-makers must have:

1) Procedures for expeditiously stopping, containing, and cleaning up leaks, spills, and other releases to Waters of the United States. Employees who may cause, detect, or respond to a spill or leak must be trained in these procedures and have necessary spill response equipment available. If possible, one of these individuals should be a member of the PDMP team.
2) Procedures for notification of appropriate facility personnel, emergency response agencies, and regulatory agencies.

b. Adverse Incident Response Procedures – At a minimum, Decision-makers must have:

1) Procedures for responding to any adverse incident resulting from pesticide applications;
2) Procedures for notification of the adverse incident, both internal to the Decision-maker's agency/organization and external. Contact information for state/federal permitting agency, nearest emergency medical facility, and nearest hazardous chemical responder must be in locations that are readily accessible and available.

PDMP – Signatures and Modifications

4.21 You must sign, date, and certify your PDMP in accordance with Section 5.17 (Required Signatures).

4.22 You must modify your PDMP whenever necessary to address any of the triggering conditions for corrective action in Section 3.13 and 3.14 (Corrective Actions) or when a change in pest control activities significantly changes the type or quantity of pollutants discharged.

4.23 Changes to your PDMP must be made before the next pesticide application that results in a discharge, if practicable, or if not, as soon as possible thereafter. The revised PDMP must be signed and dated in accordance with Section 5.17.

4.24 You must review your PDMP at a minimum once per calendar year and whenever necessary to update the pest problem identified and pest management strategies evaluated for your pest management area.

PDMP – Availability

4.25 You must retain a copy of the current PDMP, along with all supporting maps and documents, at the address provided in the NOI. The PDMP and all supporting documents must be readily available, upon request, and copies of any of these documents provided, upon request, to the

MPCA or agencies governing discharges or pesticide applications within their respective jurisdictions.

4.26 The MPCA may provide copies of your PDMP or other information related to this permit that is in its possession to members of the public. Any Confidential Business Information (CBI), as defined in Minn. Stat. § 116.075 (40 CFR pt. 2), may be withheld from the public provided that a claim of confidentiality is properly asserted and documented in accordance with Minn. R. 7000.1300 (40 CFR pt. 2). However, CBI must be submitted to the MPCA if requested, and may not be withheld from those staff within the MPCA or local/federal agencies cleared for CBI review (See Section 5.19, Confidential Information).

Corrective Action Documentation

4.27 Decision-makers required to submit an NOI, for situations identified in Section 3.13 and 3.14 that do not include Adverse Incidents, must document the situation triggering corrective action and the planned corrective action within fifteen (15) days of becoming aware of the situation and retaining a copy of this documentation. This documentation must include, but is not limited to the following information:

a. Identification of the condition triggering the need for corrective action review, including any ambient water quality monitoring that assisted in determining that discharges did not meet water quality standards.
b. Brief description of the situation.
c. Date the problem was identified.
d. Brief description of how the problem was identified, how you learned of the situation, and date you learned of the situation.
e. Summary of corrective action taken or to be taken including date initiated and date completed or expected to be completed.
f. For large entities, whether PDMP modifications are required as a result of the problem.

Recordkeeping

4.28 In addition to the recordkeeping requirements under Section 3.18 through 3.21 of this permit, Decision-makers who submit a NOI are required to keep records listed below at the address provided on the NOI. This includes recordkeeping requirement under Section 3.21, which is required by Minnesota Department of Agriculture to be recorded by any for-hire Applicators and copied to the Decision-maker (customer):

a. A copy of the NOI submitted to the MPCA, any correspondence exchanged between you and the MPCA specific to coverage under this permit, and your assigned permit tracking number.
b. Documentation of any equipment cleaning, calibration, and repair (only if Decision-maker is also the Applicator)
c. Description of pest management measures(s) implemented prior to the first pesticide application.
d. Target pest(s) and pest density prior to pesticide application.
e. Identification of any waters, either by name or by location, to which you discharged any pesticide(s).
f. Quantity of each pesticide product applied to each treatment area.

g. Whether or not visual monitoring was conducted during pesticide application and/or post-application and if not, why not and whether monitoring identified any possible or observable adverse incidents caused by application of pesticides.

Recordkeeping for Pesticide Application by Large Entities

4.29 In addition to Section 4.28, any Decision-maker required to submit an NOI and is a Large Entity (defined in Section 6.25) must retain the following records at the address provided on the NOI:

a. A copy of the PDMP, including any modifications made to the PDMP during the term of this permit.
b. Copy of Annual Reports submitted to MPCA.
c. Action Thresholds.
d. Method and/or data used to determine that action threshold(s) has been met.

4.30 All required records must be documented as soon as possible but no later than 15 days following pesticide application. You must retain any records required under this permit for at least 5 years after the date of pesticide application. You must make available to the MPCA, including an authorized representative of the MPCA, all records, including electronic records, kept under this permit upon request and provide copies of such records, upon request.

Annual Reporting

4.31 If you submitted a NOI and are considered a Large Entity, you must submit an Annual Report to the MPCA by February 15 for all pesticide activities covered under this permit occurring during the previous calendar year. You must retain a copy for your records. The report shall be completed on MPCA's Annual Report form. The first Annual Report is due February 15, 2013, for facilities that discharged during 2012

4.32 Once you meet the obligation to submit an Annual Report, you must submit an Annual Report each calendar year thereafter for the duration of coverage under this general permit. If pesticide application does not occur in a subsequent calendar year, you may check the "No Discharge" box on the Annual Report form for that year.

4.33 The Annual Report must include information for the calendar year. The first annual report must include activities for the portion of the calendar year after the effective date of the posting of a NOI. If the effective date is after November 1, you are not required to submit an Annual Report for that first partial year but must submit annual reports thereafter, with the first Annual Report submitted also including information from the first partial year.

4.34 When you terminate permit coverage, as specified in Sections 4.36 – 4.38, you must submit an Annual Report for the portion of the year up through the date of your termination. The Annual Report must be postmarked no later than 45 days after your termination date, or February 15 of the following year, whichever is earlier.

4.35 The Annual Report must contain the following information:

a. Decision-maker's name.

b. NPDES/SDS permit tracking number(s).
c. Contact person name, title, e-mail address (if any), and phone number.
d. For each treatment area, report the following information:

    1.) Identification of any waters or other treatment area either by name or by location, including size, Latitude and Longitude (if known), and Public Water Inventory number (if known), to which you discharged any pesticide(s).
    2.) Pesticide use pattern(s) and target pest(s).
    3.) Total amount of each pesticide product applied for the reporting year listed by the EPA registration number(s), if applicable, and by application method (e.g., aerially by fixed-wing or rotary aircraft, broadcast spray, etc.).
    4.) Whether this control activity was addressed in your PDMP prior to pesticide application, if applicable.
    5.) If applicable, a Report of any Adverse Incidents as a result of these treatment(s).
    6.) A description of any corrective action(s), including spill responses, resulting from pesticide application activities and the rationale for such action(s).

Terminating Coverage

4.36 Decision-makers covered by the posting of a NOI must submit a complete and accurate Permit Change Request form to terminate permit coverage. Authorization to discharge under this permit terminates after the Decision-maker receives either written or electronic notification by the MPCA that permit coverage has been terminated. You are responsible for meeting the terms of this permit until your authorization is terminated.

4.37 You must submit a Permit Change Request form within 30 days after one of the following conditions has been met:

a. You have ceased all discharges from the application of pesticides for which you obtained permit coverage and you do not expect to discharge during the remainder of the permit term for the activity identified in Section 1.1 including, but not limited to monitoring, reporting and recordkeeping; or
b. You have obtained coverage under an individual permit or an alternative general permit for all discharges required to be covered by an NPDES/SDS permit, unless you obtained coverage consistent with Section 4.39 – 4.42 below, in which case no Permit Change Request form is required.

    If you submit a Permit Change Request form without meeting one of the above conditions, your form is not valid.

4.38 Decision-makers are required to submit Annual Reports pursuant to Section 4.31 – 4.35 and must file an Annual Report for the portion of the year up through the date of your termination. The Annual Report is due no later than 45 days after your termination date.

Individual or Alternative General Permits

MPCA Requiring Coverage under an Individual or Alternative General Permit

4.39 The MPCA may require you to obtain authorization to discharge under either an individual NPDES/SDS permit or an alternative NPDES/SDS general permit in accordance with 40 CFR § 122.64 and § 124.5, and Minn. R. ch. 7001.

4.40 If the MPCA requires you to apply for an individual NPDES/SDS permit, the MPCA will notify you in writing that a permit application is required. This letter will include a brief statement of the reasons for this decision and will provide application information, including a deadline to file the permit application. The MPCA may grant additional time to submit the application if you submit a request setting forth reasonable grounds for additional time.

4.41 If you are covered under this permit and fail to submit an individual NPDES/SDS permit application as required by the MPCA, then the this permit's coverage to you is terminated at the end of the day specified by the MPCA as the deadline for application submittal. The MPCA may take appropriate enforcement action for any unpermitted discharge.

4.42 If during the course of this general permits' term the water of the state being discharged to is listed as Impaired pursuant to Section 303(d) of the CWA for a pesticide or its degradates, and general permit coverage is for the discharge of that specific pesticide or one of its degradates, you shall notify the MPCA whether you will retain coverage under the general permit and thus are required to change the pesticide being used, or obtain an individual permit or an alternative general permit by meeting the requirements of Sections 4.43 and 4.44. The listing of Impaired Waters can be found at http://www.pca.state.mn.us/index.php/view-document.html?gid=8262

Decision-maker Requesting Coverage under an Individual or Alternative General Permit

4.43 You may request to be excluded from coverage under this general permit by applying for an individual permit. In such a case, you must submit an individual permit application in accordance with the requirements of Minn. R. 7001.0050 with reasons supporting the request. The request may be granted by issuance of an individual permit or authorization of coverage under an alternative general permit if your reasons are warranted.

4.44 When an individual NPDES/SDS permit or an alternative NPDES/SDS general permit is issued, authorization to discharge under this permit is terminated on the effective date of the individual permit or the date of authorization of coverage under the alternative general permit.

5. Standard Permit Requirements

5.1 Incorporation by Reference. The following applicable federal and state laws are incorporated by reference in this permit, are applicable to the Permittee, and are enforceable parts of this permit: 40 CFR §§ 122.41, 122.42, pts. 136, 403 and 503; Minn. R. chs. 7001, 7041, 7045, 7050, 7052, 7053, 7060, and 7080; and Minn. Stat. chs. 115 and 116.

5.2 Other federal and state laws. Permittees must comply with all other applicable federal and state laws and regulations that pertain to the application of pesticides. For example, this permit does not negate the requirements under the FIFRA and its implementing regulations to use registered pesticides consistent with the product's labeling. In fact, applications in violation of certain FIFRA requirements could also be a violation of the permit and therefore a violation of the CWA (e.g. exceeding label application rates).

5.3 Permittee Responsibility. The Permittee shall perform the actions or conduct the activity authorized by the permit in compliance with the conditions of the permit and, if required, in accordance with the plans and specifications approved by the Agency (Minn. R. 7001.0150, subp. 3, item E).

5.4 Toxic Discharges Beyond Impact to Target Species Prohibited. Whether or not this permit includes effluent limitations for toxic pollutants, the Permittee shall not discharge a toxic pollutant that will impact non-target species except according to 40 CFR pts. 400 to 460 and Minn. R. chs. 7050, 7052, 7053 and any other applicable MPCA rules (Minn. R. 7001.01090, subp. 1, item A).

5.5 Nuisance Conditions Prohibited. The Permittee's discharge shall not cause any nuisance conditions including, but not limited to floating solids, scum and visible oil film, acutely toxic conditions to non-target aquatic life, or other adverse impact on the receiving water (Minn. R. 7001.0210, subp. 2).

5.6 Property Rights. This permit does not convey a property right or an exclusive privilege (Minn. R. 7001.0150, subp 3. item C).

5.7 Liability Exemption. In issuing this permit, the state and the MPCA assume no responsibility for damage to persons, property, or the environment caused by the activities of the Permittee in the conduct of its actions, including those activities authorized, directed, or undertaken under this permit. To the extent the state and the MPCA may be liable for the activities of its employees, that liability is explicitly limited to that provided in the Tort Claims Act (Minn. R. 7001.0150, subp. 3, item O).

5.8 Agency Obligations. The MPCA's issuance of this permit does not obligate the MPCA to enforce local laws, rules, or plans beyond what is authorized by Minn. Stat. (Minn. R. 7001.0150, subp. 3, item D).

5.9 Liabilities. The MPCA's issuance of this permit does not release the Permittee from any liability, penalty or duty imposed by Minnesota or federal statutes or rules or local ordinances, except the obligation to obtain the permit (Minn. R. 7001.0150, subp. 3, item A).

5.10 More Stringent Rules. The issuance of this permit does not prevent the future adoption by the MPCA of pollution control rules, standards, or orders more stringent than those now in existence and does not prevent the enforcement of these rules, standards, or orders against the Permittee (Minn. R. 7001.0150, subp. 3, item B).

5.11 Severability. The provisions of this permit are severable, and if any provisions of this permit, or the application of any provision of this permit to any circumstance, are held invalid, the

application of such provision to other circumstances and the remainder of this permit shall not be affected thereby.

5.12 Compliance with Other Rules and Statutes. The Permittee shall comply with all applicable air quality, solid waste, and hazardous waste statutes and rules.

5.13 Inspection and Entry. When authorized by Minn. Stat. §§ 115.04; 115B.17, subd. 4; and 116.091, and upon presentation of proper credentials, the agency, or an authorized employee or agent of the agency, shall be allowed by the Permittee to enter at reasonable times upon the property of the Permittee to examine and copy books, papers, records, or memoranda pertaining to the construction, modification, or operation of the facility covered by the permit or pertaining to the activity covered by the permit; and to conduct surveys and investigations, including sampling or monitoring, pertaining to the construction, modification, or operation of the facility covered by the permit or pertaining to the activity covered by the permit (Minn. R. 7001.0150, subp. 3, item I).

5.14 Completing Reports. The Permittee shall submit the results of the required sampling and monitoring activities on the forms provided, specified, or approved by the MPCA. The information shall be recorded in the specified areas on those forms and in the units specified (Minn. R. 7001.1090, subp. 1, item D; Minn. R. 7001.0150, subp. 2, item B).

Required forms may include:

a. Adverse Incident Report
c. Annual Report

5.15 **Submitting Reports. Forms shall be submitted to:**

MPCA
Attn: Pesticide NPDES/SDS Permitting Reports
520 Lafayette Road North
St. Paul, Minnesota 55155-4194

Forms shall be submitted as specified in this permit. Annual Reports shall be submitted for each event even if no discharge occurred during the reporting period (Minn. R. 7001.0150, subp. 2 item B and 3, item H).

5.16 Incomplete or Incorrect Reports. The Permittee shall immediately submit an amended report to the MPCA upon discovery by the Permittee or notification by the MPCA that it has submitted an incomplete or incorrect report. The amended report shall contain the missing or corrected data along with a cover letter explaining the circumstances of the incomplete or incorrect report (Minn. R. 7001.0150, subp. 3, item G).

5.17 Required Signatures. All forms, reports, and other documents submitted to the MPCA shall be signed by the Permittee or the duly authorized representative of the Permittee. Minn. R. 7001.0150, subp. 2, item D. The person or persons that sign the forms, reports, or other documents must certify that he or she understands and complies with the certification requirements of Minn. R. 7001.0070 and 7001.0540, including the penalties for submitting false information.

5.18 Records. The Permittee shall, when requested by the Agency, submit within a reasonable time the information and reports that are relevant to the control of pollution regarding the construction, modification, or operation of the facility covered by the permit or regarding the conduct of the activity covered by the permit (Minn. R. 7001.0150, subp. 3, item H).

5.19 Confidential Information. Except for data determined to be confidential according to Minn. Stat. § 116.075, subd. 2, all reports required by this permit shall be available for public inspection. In order to maintain data for confidential use of the MPCA, pursuant to Minn. Stat § 116.075, or as nonpublic data not on individuals or private data as it relations to individuals, pursuant to Minn. Stat. § 13.37, a person must affirmatively request such recognition by providing the Commissioner a written request setting forth the statutory grounds and the reasons that justify the classification of the records or other information as not public (Minn. R. 7001.1300, subp. 1). Effluent data shall not be considered confidential. To request the Agency maintain data as confidential, the Permittee must follow Minn. R. 7000.1300.

Noncompliance and Enforcement

5.20 Subject to Enforcement Action and Penalties. Noncompliance with a term or condition of this permit subjects the Permittee to penalties provided by federal and state law set forth in section 309 of the CWA; United States Code, title 33, section 1319, as amended; and in Minn. Stat. §§ 115.071 and 116.072, including monetary penalties, imprisonment, or both (Minn. R. 7001.1090, subp. 1, item D).

5.21 Criminal Activity. The Permittee may not knowingly make a false statement, representation, or certification in a record or other document submitted to the Agency. A person who falsifies a report or document submitted to the Agency, or tampers with, or knowingly renders inaccurate a monitoring device or method required to be maintained under this permit is subject to criminal and civil penalties provided by federal and state law (Minn. R. 7001.0150, subp. 3[G]).

5.22 Noncompliance Defense. It shall not be a defense for the Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this permit (40 CFR § 122.41 [c]).

5.23 Civil and Criminal Liability. Nothing in this permit shall be construed to relieve the Permittee from civil or criminal penalties for noncompliance with the terms and conditions provided herein. Nothing in this permit shall be construed to preclude the initiation of any legal action or relieve the Permittee from any responsibilities, liabilities, or penalties to which the Permittee is or may be subject to under Section 311 of the CWA and Minn. Stat. chs. 115 and 116, as amended; and any rules adopted thereunder.

5.24 Noncompliance. If the Permittee discovers, through any means, including notification by the MPCA, that noncompliance with a condition of the permit has occurred, the Permittee shall take all reasonable steps to minimize the adverse impacts on human health, public drinking water supplies, or the environment resulting from the noncompliance (Minn. R. 7001.1090, subp. 3[J]).

5.25 Unauthorized Releases of Wastewater Prohibited. Except for conditions specifically described in Minn. R. 7001.1090, subp. 1, items J and K, all unauthorized bypasses, overflows, discharges,

spills, or other releases of wastewater or materials to the environment, whether intentional or not, are prohibited. However, the MPCA will consider the Permittee's compliance with permit requirements, frequency of release, quantity, type, location, and other relevant factors when determining appropriate action (40 CFR § 122.41 and Minn. Stat. § 115.061).

5.26 Discovery of a Release. Upon discovery of a release, the Permittee shall:

a. Immediately take all reasonable action necessary to minimize or abate the incident and to recover any pesticides involved in the incident.
b. Notify the Minnesota Department of Public Safety Duty Officer at 800-422-0798 (toll free) or 651-649-5451 (metro area) immediately upon discovery of the release. In addition, you may also contact the MPCA during business hours at 800-657-3864.
c. Recover as rapidly and as thoroughly as possible all substances and materials released or immediately take other action as may be reasonably possible to minimize or abate pollution to waters of the state or potential impacts to human health caused thereby. If the released materials or substances cannot be immediately or completely recovered, the Permittee shall contact the MPCA. If directed by the MPCA, the Permittee shall consult with other local, state or federal agencies (such as the MDNR and/or the Wetland Conservation Act authority) for implementation of additional clean-up or remediation activities in wetland or other sensitive areas.
d. If directed by the MPCA, the Permittee shall collect representative samples of the release. The Permittee shall sample the release for parameters of concern immediately following discovery of the release. The Permittee may contact the MPCA during business hours to discuss the sampling parameters and protocol. If the release cannot be immediately stopped, the Permittee shall consult with MPCA regarding additional sampling requirements. Samples shall be collected at least, but not limited to, two times per week for as long as the release continues.
e. Submit the sampling results as directed by the MPCA. At a minimum, the results shall be submitted to the MPCA within 15 days of the release.

5.27 Upset Defense. In the event of temporary noncompliance by the Permittee with an applicable effluent limitation resulting from an upset of the Permittee's activity due to factors beyond the control of the Permittee, the Permittee has an affirmative defense to an enforcement action brought by the Agency as a result of the noncompliance if the Permittee demonstrates by a preponderance of competent evidence:

a. The specific cause of the upset.
b. That the upset was unintentional.
c. That the upset resulted from factors beyond the reasonable control of the Permittee and did not result from operational error, improperly designed treatment facilities, inadequate treatment facilities, lack of preventative maintenance, or increases in production which are beyond the design capability of the treatment facilities.
d. That at the time of the upset the facility was being properly operated.
e. That the Permittee properly notified the Commissioner of the upset in accordance with Minn. R. 7001.1090, subp. 1, item I.
f. That the Permittee implemented the remedial measures required by Minn. R. 7001.0150, subp. 3, item J.

5.28 The Permittee shall at all times properly operate and maintain the equipment and systems of treatment and control, and the appurtenances related to them, which are installed or used by the Permittee to achieve compliance with the conditions of the permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures.

5.29 Report Changes. The Permittee shall give advance notice as soon as possible to the MPCA of any substantial changes in operational procedures, activities that may alter the nature or frequency of the discharge, and/or material factors that may affect compliance with the conditions of this permit (Minn. R. 7001.0150, subp. 3, item M).

5.30 The MPCA Initiated Permit Modification, Suspension, or Revocation. The MPCA may modify or revoke and reissue this permit pursuant to Minn. R. 7001.0170. The MPCA may revoke without reissuance this permit pursuant to Minn. R. 7001.0180.

5.31 TMDL Impacts. Facilities that discharge to an impaired surface water, watershed or drainage basin may be required to comply with additional permits or permit requirements, including additional restrictions as authorized by the CWA 303(d)(4)(A) and 40 CFR § 122.44 (l)(2)(i) necessary to ensure consistency with the assumptions and requirements of any applicable EPA approved wasteload allocations resulting from Total Maximum Daily Load (TMDL) studies.

5.32 Permit Transfer. The permit is not transferable to any person without the express written approval of the Agency after compliance with the requirements of Minn. R. 7001.0190. A person to whom the permit has been transferred shall comply with the conditions of the permit (Minn. R. 7001.0150, subp. 3, item N).

5.33 Permit Reissuance. If the Decision-maker desires to continue permit coverage beyond the date of permit expiration, the Decision-maker shall submit an application for reissuance at least 180 days before permit expiration. If the Decision-maker does not intend to continue the activities authorized by this permit after the expiration date of this permit, the Decision-maker shall notify the MPCA in writing at least 180 days before permit expiration.

If the Decision-maker has submitted a timely application for permit reissuance, the Permittee may continue to conduct the activities authorized by this permit, in compliance with the requirements of this permit, until the MPCA takes final action on the application, unless the MPCA determines any of the following (Minn. R. 7001.0040 and 7001.0160):

a. The Permittee is not in substantial compliance with the requirements of this permit, or with a stipulation agreement or compliance schedule designed to bring the Permittee into compliance with this permit.
b. The MPCA, as a result of an action or failure to act by the Permittee, has been unable to take final action on the application on or before the expiration date of the permit.
c. The Permittee has submitted an application with major deficiencies or has failed to properly supplement the application in a timely manner after being informed of deficiencies.

6. Permit Specific Definitions

6.1 "Act" means the federal CWA, as amended, 33 U.S. Code 1251 et seq.

6.2 "Action Threshold" means the point at which pest populations or environmental conditions can no longer be tolerated, necessitating that pest control action be taken based on economic, human health, aesthetic, or other effects. Sighting a single pest does not always mean control is needed. Action Thresholds help determine both the need for control actions and the proper timing of such actions.

6.3 "Active Ingredient" means any substance (or group of structurally similar substances if specified by the Agency) that will prevent, destroy, repel, or mitigate any pest, or that functions as a plant regulator, desiccant, or defoliant within the meaning of FIFRA sec. 2(a) (40 CFR § 152.3). Active ingredient also means a pesticidal substance that is intended to be produced and used in a living plant, or in the produce thereof, and the genetic material necessary for the production of such a pesticidal substance (40 CFR § 174.3).

6.4 "Adverse Incident" means an incident that you have observed upon inspection or of which you otherwise become aware, in which (1) Non-target organism may have been exposed to a pesticide residue, and (2) The non-target organism suffered a toxic or adverse effect.

The phrase "toxic or adverse effects" includes effects that occur within waters of the U.S. on non-target plants, fish, or wildlife that are unusual or unexpected (e.g., effects are to organisms not otherwise described on the pesticide product label or otherwise not expected to be present) as a result of exposure to a pesticide residue, and may include:

a. Distressed or dead juvenile and small fishes.
b. Washed up or floating fish.
c. Fish swimming abnormally or erratically.
d. Fish lying lethargically at water surface or in shallow water.
e. Fish that are listless or nonresponsive to disturbance.
f. Stunting, wilting, or desiccation of non-target submerged or emergent aquatic plants.
g. Other dead or visibly distressed non-target aquatic organisms (amphibians, turtles, invertebrates, etc.).

The phrase, "toxic or adverse effects," also includes any adverse effects to humans (e.g., skin rashes) or domesticated animals that occur either directly or indirectly from a discharge to waters of the state that are temporally and spatially related to exposure to a pesticide residue (e.g., vomiting, lethargy).

6.5 "Agency" means the Minnesota Pollution Control Agency (MPCA).

6.6 "Applicator" means a person or commercial business that applies pesticides or other chemicals covered by this permit to a water of the state. Applicators are required to be licensed if hired or to apply registered pesticides. See Minn. Stat. § 18B.29 through 18B.35 for specifics on certification and licensing.

6.7 "Best Management Practices" or "BMPs" means practices to prevent or reduce the pollution of waters of the state, including schedules of activities, prohibitions of practices, and other management practices, and also includes treatment requirements, operating procedures, and practices to control plant site runoff, spillage or leaks, sludge or waste disposal or drainage from raw material storage (Minn. R. 7001.1020, subp 5).

6.8 "Biological Control Agents" mean agents that are organisms that can be introduced to your sites, such as herbivores, predators, parasites, and hyperparasites (Source: FWS IPM Guidance, 2004).

6.9 "Biological Pesticides" (also called biopesticides) include microbial pesticides, biochemical pesticides, and plant-incorporated protectants (PIP). Microbial pesticide means a microbial agent intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant, or dessicant, that: (1) is a eucaryotic microorganism including, but not limited to, protozoa, algae, and fungi; (2) is a procaryotic microorganism, including, but not limited to, Eubacteria and Archaebacteria; or (3) is a parasitically replicating microscopic element, including but not limited to, viruses (40 CFR § 158.2100[b]). Biochemical pesticide mean a pesticide that: (1) is a naturally-occurring substance or is structurally-similar and functionally identical to a naturally-occurring substance; (2) has a history of exposure to humans and the environment demonstrating minimal toxicity, or in the case of a synthetically-derived biochemical pesticides, is equivalent to a naturally-occurring substance that has such a history; and (3) has a non-toxic mode of action to the target pest(s) (40 CFR § 158.2000[a][1]). Plant-incorporated protectant means a pesticidal substance that is intended to be produced and used in a living plant, or in the produce thereof, and the genetic material necessary for production of such a pesticidal substance. It also includes any inert ingredient contained in the plant, or produce thereof (40 CFR §174.3).

6.10 "CFR" means the Code of Federal Regulations.

6.11 "Chemical Pesticides" means all pesticides not otherwise classified as biological pesticides.

6.12 "Commissioner" means the commissioner of the Minnesota Pollution Control Agency or a designated representative.

6.13 "Control Measures" refers to any BMP or other method used to meet the effluent limitations. Control measures must comply with manufacturer specifications, industry standards and recommended industry practices related to the application of pesticides, and relevant legal requirements. Additionally, control measures could include other actions that a prudent operator would implement to reduce and/or eliminate pesticide discharges to waters of the state to comply with the effluent limitations in Sections 3 and 4 of this permit.

6.14 "Cultural Methods" means manipulation of the habitat to increase pest mortality by making the habitat less suitable to the pest.

6.15 "Decision-maker" means any entity associated with the application of pesticides which results in a discharge to waters of the state and that has control over the decision to perform pesticide applications, including the ability to modify those decisions. This does not include local, state or other units of government that may provide instruction or control documents based on their

authority over pests or the use of pesticides by another party (i.e. the Lake Association is considered the Decision-maker even if the DNR may direct the Lake Association to use a specific pesticide product or limit the amount to be applied).

6.16 "Declared Pest Emergency Situation" means an event defined by a public declaration by a federal agency, state, or local government of a pest problem determined to require control through application of a pesticide beginning less than ten days after identification of the need for pest control. This public declaration may be based on:

a. Significant risk to human health.
b. Significant economic loss.
c. Significant risk to:
    1) Endangered species.
    2) Threatened species.
    3) Beneficial organisms.
    4) The environment (40 CFR pt. 166).

6.17 "Discharge" when used without qualification, means the "discharge of a pollutant" (40 CFR § 122.2).

6.18 "Duty Officer" means the Minnesota Duty Officer, Department of Public Safety, Division of Emergency Management.

6.19 "Facility or Activity" means any NPDES "point source" (including land or appurtenances thereto) that is subject to regulation under the NPDES program (40 CFR § 122.2).

6.20 "Federal Facility" means any buildings, installations, structures, land, public works, equipment, aircraft, vessels, and other vehicles and property, owned, operated, or leased by, or constructed or manufactured for the purpose of leasing to, the federal government.

6.21 "For-Hire Applicator" includes persons who make contractual pesticide applications for which they or their employer receives compensation (e.g., lawn care firms, pest control companies). This includes "Commercial Applicators" as defined in Minn. Stat. ch. 18B.

6.22 "General Permit" means a permit issued under Minn. R. 7001.0210 to a category of permittees whose operations, emissions, activities, discharges, or facilities are the same or substantially similar.

6.23 "Impaired Water" or "Water Quality Impaired Water," for the purposes of this permit, means a water identified by the state pursuant to Section 303(d) of the CWA as not meeting applicable state water quality standards (these waters are called "water quality limited segments" under 40 CFR § 130.2(j). Impaired waters include both waters with approved or established TMDLs, and those for which a TMDL has not yet been approved or established.

6.24 "Inert Ingredient" means any substance (or group of structurally similar substances if designated by the Agency), other than an active ingredient, that is intentionally included in a pesticide product (40 CFR §152.3). Inert ingredient also means any substance, such as a selectable marker, other than the active ingredient, where the substance is used to confirm or ensure the

presence of the active ingredient, and includes the genetic material necessary for the production of the substance, provided that genetic material is intentionally introduced into a living plant in addition to the active ingredient (40 CFR § 174.3).

6.25 **"**Large Entity" means any: (a) public entity that serves a population greater than 10,000 or (b) private enterprise that exceeds the Small Business Administration size standard as identified at 13 CFR § 121.201.

6.26 "Littoral zone" means the surface area of a water body where the depth is 15 feet or less (Minn. R. 6280.0100, subp.9).

6.27 "Mechanical/Physical Methods" means mechanical tools or physical alterations of the environment, for pest prevention or removal.

6.28 "Minimize" means to reduce and/or eliminate pesticide discharges to waters of the state through the use of "control measures" to the extent technologically available and economically practicable and achievable.

6.29 "MPCA" means the Minnesota Pollution Control Agency, or Minnesota Pollution Control Agency staff as delegated by the Minnesota Pollution Control Agency.

6.30 "Non-target Organisms" includes the plant and animal hosts of the target species, the natural enemies of the target species living in the community, and other plants and animals, including vertebrates, living in or near the community that are not the target of the pesticide.

6.31 "NPDES" means National Pollutant Discharge Elimination System which is the program for issuing, modifying, revoking, reissuing, terminating, monitoring, and enforcing permits and imposing and enforcing pretreatment requirements under sections, 307, 318, 402, and 405 of the CWA: 33 U.S.C. §§ 1317, 1328, 1342, and 1345.

6.32 "Outstanding Resource Value Waters" are waters within the Boundary Waters Canoe Area Wilderness, Voyageur's National Park, and Department of Natural Resources designated scientific and natural areas, wild, scenic, and recreational river segments, Lake Superior, those portions of the Mississippi River from Lake Itasca to the southerly boundary of Morrison County that are included in the Mississippi Headwaters Board comprehensive plan dated February 12, 1981, and other waters of the state with high water quality, wilderness characteristics, unique scientific or ecological significance, exceptional recreational value, or other special qualities which warrant stringent protection from pollution (Minn. R. 7050.0180 subp. 2(A), including any updates).

6.33 "Permittee" means any entity associated with the application of pesticides which results in a discharge to waters of the state regardless of whether a NOI is required to be submitted.

6.34 "Person" means an individual, association, partnership, corporation, municipality, State or Federal agency, or an agent or employee thereof.

6.35 "Pest" means an insect, rodent, nematode, fungus, weed, terrestrial or aquatic plant, animal life, virus, bacteria, or other organism designated by rule as a pest, except a virus, bacteria, or

other microorganism on or in living humans or other living animals (Minn. Stat. § 18B.01, subd. 17).

6.36 "Pest Management Area" means the area of land, including any water, for which you are conducting pest management activities covered by this permit.

6.37 "Pest Management Measure" means any practice used to meet the effluent limitations that comply with manufacturer specifications, industry standards and recommended industry practices related to the application of pesticides, relevant legal requirements and other provisions that a prudent Permittee would implement to reduce and/or eliminate pesticide discharges to waters of the state.

6.38 "Pesticide" means a substance or mixture of substances intended to prevent, destroy, repel, or mitigate a pest, and a substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant. (Minn. Stat. 18B.01, subd. 18)

Under FIFRA Section 2(u), "Pesticide" means: (1) any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest, (2) any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant, and (3) any nitrogen stabilizer, except that the term ''pesticide'' shall not include any article that is a "new animal drug" within the meaning of section 201(w) of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 321[w]), that has been determined by the Secretary of Health and Human Services not to be a new animal drug by a regulation establishing conditions of use for the article, or that is an animal feed within the meaning of section 201(x) of such Act (21 U.S.C. 321[x]) bearing or containing a new animal drug. The term "pesticide" does not include liquid chemical sterilant products (including any sterilant or subordinate disinfectant claims on such products) for use on a critical or semi-critical device, as defined in section 201 of the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 321). For purposes of the preceding sentence, the term "critical device" includes any device that introduced directly into the human body, either into or in contact with the bloodstream or normally sterile areas of the body and the term ''semi-critical device'' includes any device that contacts intact mucous membranes but which does not ordinarily penetrate the blood barrier or otherwise enter normally sterile areas of the body.

The term "pesticide" applies to insecticides, herbicides, fungicides, rodenticides, and various other substances used to control pests. The definition encompasses all uses of pesticides authorized under FIFRA including uses authorized under sections 3 (registration), 5 (experimental use permits), 18 (emergency exemptions), 24(c) (special local needs registrations), and 25(b) (exemptions from FIFRA).

Note: drugs used to control diseases of humans or animals (such as livestock and pets) are not considered pesticides; such drugs are regulated by the Food and Drug Administration. Fertilizers, nutrients, and other substances used to promote plant survival and health are not considered plant growth regulators and thus are not pesticides. Biological control agents, except for certain microorganisms, are exempted from regulation under FIFRA. (Biological control agents include beneficial predators such as birds or ladybugs that eat insect pests, parasitic wasps, fish, etc).

This permit uses the term "pesticide" when referring to the "pesticide, as applied." When referring to the chemical in the pesticide product with pesticidal qualities, the permit uses the term "active ingredient."

6.39 "Pesticide Product" means a pesticide in the particular form (including composition, packaging, and labeling) in which the pesticide is, or is intended to be, distributed or sold. The term includes any physical apparatus used to deliver or apply the pesticide if distributed or sold with the pesticide.

6.40 "Pesticide Research and Development" **–** Activities undertaken on a systematic basis to gain new knowledge (research) and/or the application of research findings or other scientific knowledge for the creation of new or significantly improved products or processes (experimental development). These types of activities are generally categorized under the four-digit code of 5417 under the 2007 NAICS.

6.41 "Pesticide Residue" – includes that portion of a pesticide application that is discharged from a point source to waters of the U.S. and no longer provides pesticidal benefits. It also includes any degradates of the pesticide.

6.42 "Point source" means any discernible, confined, and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel, or other floating craft from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture or agricultural stormwater runoff. (40 CFR § 122.2)

6.43 "Pollutant" means any sewage, industrial waste, or other wastes, as defined in Minnesota Statutes chapter 115.01, discharged into a disposal system or to waters of the state, and includes dredged spoil, solid waste, incinerator residue, filter backwash, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. For purposes of this definition, a "biological pesticide" is considered a "biological material," and any "pesticide residue" resulting from use of a "chemical pesticide" is considered a "chemical waste." [excerpted from 40 CFR § 122.2]

6.44 "Release" means any bypass, overflow, discharge, spill, or other release of wastewater or materials to the environment.

6.45 "SDS" means State Disposal System and generally describes a permit issued by the state of Minnesota that is non-surface water discharging or land application facilities.

6.46 "Small Entity" means any: (a) public entity that serves a population of 10,000 or less or (b) private enterprise that does not exceed the Small Business Administration size standard as identified at 13 CFR § 121.201.

6.47 "Target Pest" is the organism toward which pest control measures are being directed.

6.48 "Technology-based effluent limitation, standard, or prohibition" means an effluent limitation, standard, or prohibition promulgated by the EPA at 40 CFR pts. 400 to 460; under sections 301 and 306 of the CWA; 33 U.S.C. §§ 1311 and 1316. (Minn. R. 7010.0120, subp. 29).

6.49 "Total maximum daily load" or "TMDL" means the sum of the individual wasteload allocations for point sources and load allocations for nonpoint sources and natural background, as more fully defined in 40 CFR §130.2(i). A TMDL sets and allocates the maximum amount of a pollutant that may be introduced into a water of the state and still assure attainment and maintenance of water quality standards. (Minn. R. 7052.0010 subp. 42).

6.50 "Upset" means an exceptional incident in which the permit discharge limits are unintentionally and temporarily exceeded due to factors beyond the reasonable control of the Permittee.

6.51 "Waters of the State" means all streams, lakes, ponds, marshes, wetlands, watercourses, waterways, wells, springs, reservoirs, aquifers, irrigation systems, drainage systems and all other bodies or accumulations of water, surface or underground, natural or artificial, public or private, which are contained within, flow through, or border upon the state or any portion thereof. (Minn. Stat. 115.01, subp. 22).

6.52 “You” and “Your,” as used in this permit are intended to refer to the permittee as the context indicates and that party’s activities or responsibilities.

Attachment D

Minnesota Department of Transportation
Minnesota Noxious Weeds Guide

Minnesota Noxious Weeds

Includes Native and Nonnative Look-alike Species for Comparison

DEPARTMENT OF TRANSPORTATION

Dalmatian toadflax

Black swallow-wort

Grecian foxglove

Oriental bittersweet

Japanese hops

Cutleaf teasel

Poison hemlock

Brown knapweed

Minnesota State Listed Noxious Weeds

	Page	Common Name	Scientific Name	Family
Prohibited: Eradicate	5	Black swallow-wort	*Cynanchum louiseae* Kartesz & Gandhi	Asclepiadaceae
	6-7	Common / cutleaf teasel	*Dipsacus fullonum* L. and *D. laciniatus* L.	Dipsacaceae
	8	Dalmatian toadflax	*Linaria dalmatica* (L.) Mill.	Scrophulariaceae
	9	Giant hogweed	*Heracleum mantegazzianum* Sommier & Levier	Apiaceae
	10	Grecian foxglove	*Digitalis lanata* Ehrh.	Scrophulariaceae
	11	Japanese honeysuckle	*Lonicera japonica* Thunb.	Caprifoliaceae
	12	Japanese hops	*Humulus japonicus* Siebold & Zucc.	Cannabaceae
	13-14	Knapweed, brown	*Centaurea jacea* L.	Asteraceae
		Knapweed, diffuse	*Centaurea diffusa* Lam.	Asteraceae
		Knapweed, meadow	*Centaurea* x *moncktonii* C.E. Britton [*jacea* × *nigra*]	Asteraceae
	15	Oriental bittersweet	*Celastrus orbiculatus* Thunb.	Celastraceae
	16	Palmer amaranth	*Amaranthus palmeri* S. Watson	Amaranthaceae
	17	Poison hemlock	*Conium maculatum* L.	Apiaceae
	18	Tree-of-heaven	*Ailanthus altissima* (Mill.) Swingle	Simaroubaceae
	19	Yellow starthistle	*Centaurea solstitialis* L.	Asteraceae
Prohibited: Control	20	Barberry, common	*Berberis vulgaris* L.	Berberidaceae
	21	Canada thistle	*Cirsium arvense* (L.) Scop.	Asteraceae
	22	Common tansy	*Tanacetum vulgare* L.	Asteraceae
	23	Knapweed, spotted	*Centaurea stoebe* L. subsp. *micranthos* (Gugler) Hayek	Asteraceae
	24-25	Knotweed, Japanese	*Polygonum cuspidatum* Siebold & Zucc.	Polygonaceae
		Bohemian and giant	*Polygonum sachalinense* F. Schmidt ex Maxim.	Polygonaceae
	26	Leafy spurge	*Euphorbia esula* L.	Euphorbiaceae
	27	Narrowleaf bittercress	*Cardamine impatiens* L.	Brassicaceae
	28	Plumeless thistle	*Carduus acanthoides* L.	Asteraceae
	29	Purple loosestrife	*Lythrum salicaria* L. and *Lythrum virgatum* L.	Lythraceae
	30	Wild parsnip	*Pastinaca sativa* L.	Apiaceae


Black swallow-wort


Cut leaved teasel


Dalmatian toadflax


Brown knapweed


Poison hemlock


Tree-of-heaven


Common tansy


Japanese knotweed


Purple loosestrife


Wild parsnip

Minnesota State Listed Noxious Weeds

Restricted Noxious Weeds

Page	Common Name	Scientific Name	Family
31	Asian bush honeysuckles	*Lonicera* spp.	Caprifoliaceae
32	Black locust	*Robinia pseudoacacia* L.	Fabaceae
33	Buckthorn, common	*Rhamnus cathartica* L.	Rhamnaceae
34	Buckthorn, glossy	*Frangula alnus* Mill.	Rhamnaceae
35	Crown vetch	*Securigera varia* (L.) Lassen	Fabaceae
36	European alder	*Alnus glutinosa* (L.) Gaertn.	Betulaceae
37	Garlic mustard	*Alliaria petiolata* (M. Bieb.) Cavara & Grande	Brassicaceae
38-39	Japanese barberries	*Berberis thunbergii* DC. and listed hybrids and cultivars.	Berberidaceae
40	Multiflora rose	*Rosa multiflora* Thunb.	Rosaceae
41	Nonnative Phragmites	*Phragmites australis* (Cav.) Trin. Ex Steud. subsp. *Australis*	Poaceae
42	Porcelain berry	*Ampelopsis brevipedunculata* (Maxim) Trautv.	Vitaceae
43	Siberian peashrub	*Caragana arborescens* Lam.	Fabaceae
44	Wild carrot	*Daucus carota* L.	Apiaceae

Specially Regulated

45	Amur maple	*Acer ginnala* Maxim.	Aceraceae
46	Norway maple	*Acer platanoides* L.	Aceraceae
47	Poison ivy - western	*Toxicodendron rydbergii* (Small) Green	Anacardiaceae
	Poison ivy - common	*T. radicans* (L.) Kuntze subsp. *negundo* (Greene) Gillis	Anacardiaceae
48	Winged burning bush	*Euonymus alatus* (Thunb.) Siebold	Celastraceae

Each Specially Regulated species is subject to unique restrictions. See restrictions on page 82.


Bell's honeysuckle


Black locust


Wild carrot


Siberian peashrub


Amur maple


Winged burning bush

Scientific names (genus and species) were sourced from : USDA Plants Database

Web links verified December 2019.

Miscellaneous Images:
Dave Hanson, MnDOT
Cover: Selected eradicate species
Index pages 2, 3 and 4.

Page 79: Dave Hanson, MnDOT
Biological control images including: spotted knapweed root weevil, purple loosestrife beetle, leafy spurge flea beetle and spotted knapweed seed head weevil.

Page 79:
MnDOT
Herbicide application.
Ken Graeve, MnDOT
Mowing and prescribed fire.

Page 83: Dave Hanson, MnDOT
Oriental and American bittersweet.

Plant descriptions provided for comparison: nonnative and native Minnesota plants.

Following are plants, commonly misidentified as a species on the noxious weed list. It is important to identify and protect the native plants, while at the same time managing the State listed noxious weeds. As for the nonnatives listed here, while these plants may be aggressive on some sites, management is usually not a high priority.

Nonnative Plants
Provided for comparison

Page	Common Name	Scientific Name	Family
49	Alfalfa	*Medicago sativa* L.	Fabaceae
	Hairy vetch	*Vicia villosa* Roth	Fabaceae
50	Balkan catchfly	*Silene csereii* Baumgarten	Caryophyllaceae
51	Carrot look-alikes	Various genus and species of the carrot family	Apiaceae
52	Chervil, wild	*Anthriscus sylvestris* (L.) Hoffm.	Apiaceae
53	Musk or nodding thistle	*Carduus nutans* L.	Asteraceae
54	Yellow rocket	*Barbarea vulgaris* W.T. Aiton	Brassicaceae

Minnesota Native Plants
Provided for comparison

Page	Common Name	Scientific Name	Family
55	American bittersweet	*Celastrus scandens* L.	Celastraceae
56	American vetch	*Vicia americana* Muhl. Ex Willd.	Fabaceae
	Canadian milkvetch	*Astragalus canadensis* L.	Fabaceae
57	Cherries / wild plum	*Prunus* spp.	Rosaceae
58	Common hops	*Humulus lupulus* L.	Cannabaceae
59	Cow-parsnip	*Heracleum maximum* W. Bartram	Apiaceae
60	Cucumber, wild and bur	*Echinocystis lobata* Michx. and *Sicyos angulatus* L.	Cucurbitaceae
61	Fireweed	*Chamerion angustifolium* (L.) Holub subsp. *angustifolium*	Onagraceae
62	Golden alexanders	*Zizia* spp.	Apiaceae
63	Goldenrods	*Solidago* spp.	Asteraceae
64	Grape, riverbank	*Vitis riparia* Michx.	Vitaceae
65	Honeysuckles, native	*Diervilla lonicera* and *Lonicera* spp.	Caprifoliaceae
66	Native phragmites	*Phragmites australis* subsp. *americanus* Saltonstall	Poaceae
67	Speckled alder	*Alnus incana* (L.) Moench ssp. *rugosa* (DuRoi) Clausen	Betulaceae
68	Sugar maple	*Acer saccharum* Marshall	Aceraceae
69	Sumacs	*Rhus typhina* L. and *R. glabra* L.	Anacardiaceae
70	Swamp thistle	*Cirsium muticum* Michx.	Asteraceae
71	Virginia creeper / Woodbine	*Parthenocissus quinquefolia* (L.) Planch. *P. vitacea* (Knerr) Hitch.	Vitaceae
72	Water hemlock	*Cicuta maculata* L.	Apiaceae
73	Yarrow, common	*Achillea millefolium* L.	Asteraceae


Alfalfa


Burnett saxifrage


American bittersweet


Common hops


Wild honeysuckle


Stiff goldenrod


Swamp thistle


Common yarrow

Prohibited: Eradicate

Black swallow-wort : *Cynanchum louiseae* Kartesz & Gandhi

Identification: Synonyms: *C. nigrum* (L.) Pers., non Cav.; *Vincetoxicum nigrum* (L.) Moench

Plant: A perennial, herbaceous vine with a twining habit reaching heights of 3-8 feet. Only milkweed family member in Minnesota that vines. Also, plants have clear sap, not milky.
Leaves: Opposite, shiny and dark green foliage has a smooth (toothless) edge terminated by a pointed tip. Leaves are somewhat oval at 3-4 inches long by 2-3 inches wide.
Flower: Clustered, small (1/4 inch) dark purple flowers with five downy, thickened petals.

Bloom time is June to July.

Fruit and seed: Slender pods, taper to a point at about 1½-3 inches. Pods are described as milkweed-like and at maturity split open to release flattened seeds carried on the wind by downy, filamentous fibers.

Life History: Herbaceous vine that dies back to the ground every winter. Below ground rhizomes sprout to create a group of stems. With more stems, plants in full sun will produce more flowers and set more seed (up to 2,000/meter square). Long distance wind dispersal of seeds can begin in late July. Seeds contain one to four embryos which helps to ensure germination. Seed viability is potentially 5 years.

Habitat: Prefers full sun in upland soils. Disturbances, natural or human caused, provide an opening in which black swallow-wort can gain a foothold. Old fields, grasslands, road or rail corridors, quarries and other disturbed areas provide excellent habitat.

Management: Goals should be to control seed production and stimulate competitive plant cover. **Manual** removal and destruction of plants and root crowns will meet these goals.

Repeated mowing or **cutting** can impact plants, but will not eradicate a population. After early season mowing or cutting, plans must be in place to monitor and repeat the process as necessary. Black swallow-wort if cut early in the season can still produce seed that year and the goal of cutting is to eliminate seed production. If seeds are present, clean equipment before moving offsite.

Prescribed fire can be used in conjunction with other management efforts to encourage stands of native grasses that will compete with black swallow-wort for resources. Monitoring will be necessary to control resprouting and seedlings that germinate after burns are completed.

Herbicide applications should target plants at or beyond flowering stage. As plants reach maturity, foliar applications of glyphosate or triclopyr ester cover enough surface area to potentially deliver a lethal dose to the root system. Timing the application prior to pod formation may limit the production of viable seed that season. Applying herbicide to early emerging plants with limited foliar area will likely result in roots remaining viable and plants resprouting.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn									
Herbicide	Foliar				Treat actively growing plants - once flowering has begun. Treat plants having enough foliage to carry a lethal dose to the root system.					
	Cut stem									
	Mow		Mow to prevent flowering							
	Don't mow				Follow-up mowing to control seed production.					
Flowering Period										

Prohibited: Eradicate

Common teasel : *Dipsacus fullonum* L.

Above: Bracts may be longer than flower head

Image right: common teasel (L), cutleaf teasel (R).

Identification: *Compare to Cutleaf teasel (next page) flower bracts and leaves.*

Plant: Herbaceous, monocarpic perennial (plant dies after bearing fruit), first identifiable as a basal rosette. At maturity 2-7 feet tall with erect, ridged and prickly stems.

Leaves: On upright stems - opposite, stalkless (sessile), cup-forming, up to 12 inches long by 3 inches wide, hairless, yellowish to reddish-green, *lance-shaped with a wavy edged margin*. Central leaf vein forms a whitish line on top with stout prickles below.

Flower: Many irregular, 4-parted and white to lavender flowers. Densely, cylindrically clustered heads up to 4 inches tall and 1½ inches wide.

Stiff and spiny flower bracts are very narrow (linear) and may be taller than flower clusters.

Bloom time is June to October.

Fruit and seed: Each floret or small flower produces one capsule containing a grayish-brown, slightly hairy seed.

Life History: During the rosette stage, which may extend beyond one season, the plant creates a substantial tap root, up to 24 inches long by 1 inch wide at the crown.

Each flower head can produce upwards of 2000 seeds with germination success of 30-80%. Seed on immature heads may still ripen. Seed is viable for approximately two years with typical dispersal up to 50 feet. Seed may be transported longer distances via water.

Habitat: Disturbed, open sunny site with moist to dry soils. Common on roadsides and disturbed areas.

Management:

Cutting of roots below ground and removal of as much as possible will limit sprouting. Accomplish cutting and removal of either life stage with tools such as dandelion pullers or a sharp shovel.

Mowing of the rosette stage does not kill the plant, however mowing of the flowering stalks can disrupt seed production. After mowing or cutting of flowering plants monitor for new flower heads. Preferably, propagating plant parts should be disposed of onsite or when necessary contained (e.g., bagged) and removed to an approved facility. For more information on these disposal options, please read MDA's guide on removal and disposal.

Prescribed fire can be used to increase competition from native warm season grasses, if they are present. Fire can also be used in combination with follow-up herbicide treatments. Keep in mind, high density infestations (large numbers of plants) will not burn well.

Herbicides such as metsulfuron methyl, clopyralid, triclopyr or 2,4-D amine are broadleaf specific herbicides that work on teasel at the rosette stage. Glyphosate is applicable but care must be exercised since it is not broadleaf specific.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
Herbicide	Burn									
	Foliar									
	Mow		Mowing is not recommended: mowing does not kill the plant and flowering may still occur. Seed dispersal can occur if mature plants are mowed. Mower scalping creates a good seed bed.							
	Don't mow									
Flowering Period										

Prohibited: Eradicate

Cutleaf teasel : *Dipsacus laciniatus* L.

Identification: *Compare to common teasel (previous page) flower bracts and leaf shape.*

Plant: Herbaceous, monocarpic perennial (plant dies after bearing fruit), first identifiable as a basal rosette. Matures to 2-7 feet tall with erect, ridged and prickly stems.

Leaves: On upright stems - opposite, stalkless (sessile), cup-forming, up to 12 inches long by 3 inches wide, hairless, *lance-shaped, lobed with sinuses cut almost to the midrib*. Prominent leaf vein with stout prickles below.

Flower: Many irregular, 4-parted and white to lavender flowers. Dense, cylindrically clustered heads up to 4 inches tall and 1½ inches wide.

Spiny, stiff flower bracts are not taller than flower cluster and are wider than cutleaf teasel.

Bloom time is July to September.

Fruit and seed: Each floret or small flower produces one capsule containing a grayish-brown, slightly hairy seed.

Life History: During the rosette stage, which may extend beyond one season, the plant creates a substantial tap root, up to 24 inches long by 1 inch wide at the crown.

Each flower head can produce upwards of 2000 seeds with germination success of 30-80%. Seed on immature heads may reach viability. Seed is viable for approximately 2 years with typical dispersal up to 50 feet. Seed may be transported longer distances via water.

Habitat: Disturbed, open sunny site with moist to dry soils. Common on roadsides and disturbed areas.

Management:

Cutting of roots below ground and removal of as much as possible will limit sprouting. Accomplish cutting and removal of either life stage with tools such as dandelion pullers or a sharp shovel.

Mowing of the rosette stage does not kill the plant, however mowing of the flowering stalks can disrupt seed production. After mowing or cutting of flowering plants monitor for new flower heads. Preferably, propagating plant parts should be disposed of onsite or when necessary contained (e.g., bagged) and removed to an approved facility. For more information on these disposal options, please read MDA's guide on removal and disposal.

Prescribed fire can be used to increase competition from native warm season grasses, if they are present. Fire can also be used in combination with follow-up herbicide treatments. Keep in mind, high density infestations (large numbers of plants) will not burn well.

Herbicides such as metsulfuron methyl, clopyralid, triclopyr or 2,4-D amine are broadleaf specific herbicides that work on teasel at the rosette stage. Glyphosate is applicable but care must be exercised since it is a non-selective herbicide.

Left: teasel flowering on short stems after being mowed.

Right: Prickles underside of leaf.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
Herbicide	Burn									
	Foliar									
	Mow		Mowing is not recommended: mowing does not kill the plant and flowering may still occur. Seed dispersal can occur if mature plants are mowed. Mower scalping creates a good seed bed.							
	Don't mow									
Flowering Period										

Prohibited: Eradicate

Dalmatian toadflax : *Linaria dalmatica* (L.) Mill.

Identification: *Compare to introduced Balkan catchfly (Silene csereii). See page 50.*

Plant: A short-lived herbaceous perennial up to 4 feet tall. Base may be woody and plant is often branched. Waxy stems and leaves have a bluish-gray color.

Leaves: Alternate leaves 1-3 inch in length clasp stems, are wider and more heart-shaped than similarly flowered butter-and-eggs (*Linaria vulgaris*).

Flower: Erect, spike-like racemes of yellow flowers with orangey center markings. Flowers are 1-1½ inches long with slender spurs extending downward from the back.

Bloom time is May to September.

Fruit and Seed: On average 140-250 seeds are contained in ½ inch long pods. Seeds are dark in color, flattened, angular and 3-edged with a slight, narrow wing on each edge. Mature plants produce up to 500,000 seeds with soil viability up to 10 years.

Life History: Reproduction is primarily by seed that is viable in the seedbank up to 10 years, but the plant also forms colonies via vegetative reproduction from roots.

Habitat: Rapidly colonizes disturbed sites such as roadsides, rail right-of-way, and other locations including cultivated ground. Prefers a drier site in coarse, well-drained soils.

Management: Recommendation - identify and treat early.

Eradication is the goal in Minnesota; therefore, biological control is not a compatible option at this time.

Prescribed fire can set plants back and drain some energy while **mowing** can prevent or delay seed production. However, both stimulate vegetative reproduction, thus potentially increasing stem counts. Monitor the infestation and consider follow-up treatments of periodic mowing and / or herbicide treatments.

Manual methods including, **cutting**, **hand pulling** or **tillage** if done repeatedly and in conjunction with other treatments may control infestations. **Grazers** eat the flowers, but may also carry the seeds.

Herbicide formulations of chlorsulfuron, dicamba, imazapic or picloram have had reported success. Also, combinations of picloram and chlorsulfuron or imazapic and chlorsulfuron or diflufenzopyr and picloram and chlorsulfuron are being used in some areas. Re-treatment is likely necessary.

Below center: early season regrowth.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	Fire does not kill rhizomes. Result is likely an increased stem count.								
Herbicide	Foliar	■	■				■	■		
	Mow	Mowing can prevent seed production, but forces vegetative reproduction.								
	Don't mow	Therefore, after mowing, monitoring and repeating the process is necessary.								
Flowering Period										

Prohibited: Eradicate | Giant hogweed : *Heracleum mantegazzianum* Sommier & Levier

Caution Use protective clothing, consider goggles or a face mask. Caution

Phytophotodermatitis,

contacting stiff hairs or sap (i.e., phyto) followed by exposure to sunlight (i.e., photo)

can cause severe blistering and swelling (i.e., dermatitis).

Identification: *Compare to native cow-parsnip (Heracleum lanatum). See page 59.*

Plant: Herbaceous, often stated to be biennial but is a monocarpic perennial (plant dies after bearing fruit), giant at 10-15 feet tall (potentially to 20 feet). When enough energy is stored, flowering will take place on a 2-4 inch diameter hollow stalk that is mottled reddish-purple and is covered with sturdy bristles.

Leaves: Alternate, up to 5 feet across, compound leaves with 3 deeply incised (cut) leaflets which may be further divided. The spotted leaf stalks, underside of leaves and stems are covered with coarse white hairs.

Flower: Flat umbels of small white florets create massive displays up to 2½ feet in diameter.

Bloom time is June to July.

Fruit and Seed: Seed is large, flattened, with visible brown resin canals.

Life History: A single flower head can produce upwards of 1500 seeds. First season basal rosette foliage can be 1-5 feet across with flower stalks typically appearing in the second season. When plants die a large bare patch of soil results which creates a good seed bed and potential erosion problems.

Habitat: Moist soils of woodlands and riparian zones with partial shade as found on woodland edges.

Management:

Manual methods including cutting and removal by hand are effective on small infestations. The focus of this method is to prevent seed production. Preferably, propagating plant parts should be disposed of onsite or when necessary contained (e.g., bagged) and removed to an approved facility. For more information on these disposal options, please read MDA's guide on removal and disposal.

Root systems can be weakened by repeated cutting but consider removal for best results. After cutting, monitor sites for follow-up treatment needs.

Herbicide applications of triclopyr or glyphosate are effective when applied early season to basal rosettes. If manual methods such as cutting are used early in the season, plan on returning to chemically treat re-sprouts.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	Use fire to improve native plant community.								
Herbicide	Foliar	Before the plant flowers.						Treat rosettes		
	Mow		Mow to prevent flowering							
	Don't mow		Cut and remove roots and			or seeds by hand for disposal.				
Flowering Period										

Prohibited: Eradicate

Grecian foxglove : *Digitalis lanata* Ehrh.

Caution All plant parts contain a cardiac glycoside that is ***poisonous to humans*** and **livestock**. It is reported that the toxin can be absorbed through bare skin. Wear appropriate PPE.

Identification:

Plant: Herbaceous, perennial beginning its first year as a basal rosette with a single flowering stalk from 2-5 feet tall in subsequent years.

Leaves: Alternate, smooth, stalk-less upper leaves with toothless edges are narrow (lance-shaped). Basal leaves are more oval with rounded tips and are densely woolly.

Flower: Many tubular flowers attached to a central stalk (raceme) with bloom progression from the bottom to the top of the stalk. Flowers have a brown or purple veined upper hood and a creamy-white, elongated lower lip.

Bloom time is June to July.

Fruit and seed: Seed capsules are 2-parted and split to release tiny reddish-brown seed with 3-4 year viability. The hook (stiff, persistent style of the flower) on the seed pods are easily caught on clothing or fur and transported to new locations.

Life History: A perennial plant that blooms following its first year as a basal rosette. Each flower produces numerous seeds that are viable for up to 4 years. Small wingless seeds are easily transported by birds, animals, human activity as well as wind and water.

Habitat: Minnesota sites are in full sun to partial shade along roads, woodland edges and in open fields.

Management: Do not pull or handle this plant without protective clothing, in particular, rubber gloves and long sleeves are highly recommended.

Repeated mowing or **cutting** to prevent flowering throughout the year and over several years can drain plants of energy and help control an infestation. Since flowering can occur on mowed, short stems follow-up treatments with herbicide may be necessary.

Prescribed fire, there is no research information available at this time.

Herbicide applications in May and again in July are beneficial to knock down plants before flowering can occur. A fall application is also recommended to kill basal rosettes that were missed earlier or that developed during the season. Metsulfuron-methyl formulations are recommended for good control.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	Use fire to improve native plant community.								
Herbicide	Foliar									
	Mow		Mow to prevent flowering							
	Don't mow				When seed is present					
Flowering Period										

Prohibited: Eradicate | Japanese honeysuckle : *Lonicera japonica* Thunb.

Above: white blossoms fading to yellow.
Below: (left) foliage variation on a young stem and (right) smooth leaf edges on mature stem with black berries.

Identification: *Compare to Asian bush honeysuckle and native honeysuckles, pages 31 and 65 respectively.*

Plant: Perennial twining vine potentially reaching 30-45 feet in length. Climbing nearby trees / shrubs or structures for vertical support or sprawling, forming a low, dense ground cover. Stems are pubescent when young but become woody and glabrous (not fuzzy) over time, stems up to 2 inches in diameter.

Leaves: Opposite, simple, up to 2 inches across and 3 inches long. Leaves on younger stems may be lobed or have toothed edges (lower left) while leaves on older stems have smooth edges with an ovate form (upper right).

Flower: Fragrant, pure white initially, becoming yellowish with age. Approximately 1 to 1½ inch tubular flowers develop in pairs from leaf axils. Lower lip droops downward while upper lip, divided into 4 parts, extends upward. Five white stamens and a white pistil extend forward of each flower. Paired leafy bracts, approximately 2 inches in length, are located at flower bases.

Bloom time is June into July.

Fruit and seed: Paired *black berries* approximately ⅛ to ¼ inch across replace each flower pair. Each berry holds 2-3 flattened, oval seeds. *Compare to native honeysuckle vine species with red to orange berries.*

Life History: Late season berries are readily eaten by birds, potentially spreading seed long distances. Additionally, rhizomes below ground and stems contacting ground can root at nodes (runners) increasing spread of infestations.

Habitat: Prefers part-shade but will do well in full sunlight such as abandoned fields or powerline corridors and areas of low maintenance. Plants invade woodlands and floodplain woods often thriving along edge habitats. Fertile soils with moist to mesic conditions produce best growth. Growth is limited by deep shade and droughty conditions. Japanese honeysuckle has a high potential to displace native species.

Management: **Cutting or manual** removal provides good control of small infestations. It is a palatable browse, **grazing** is an option. **Mowing** for control of seedlings or ground mats must be accomplished twice or more per year to be effective. Propagating plant parts (seed) must be contained / controlled. For more information on options, please read MDA's guide on removal and disposal.

Prescribed fire, where applicable, to reduce dense ground mats. However, rhizomes will likely resprout following fire so follow-up with herbicide. Goal with fire is to remove excess vegetation to allow more effective herbicide application.

Herbicide formulations of metsulfuron-methyl, triclopyr or glyphosate are effective for **foliar applications** on smaller plants. For **Cut stem** treatments make cuts as close to the ground as possible prior to treatments with glyphosate or triclopyr. Additionally, **basal bark** treatments with triclopyr formulations may be effective when treating larger stems.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn						Monitor and follow-up.			
Herbicide	Foliar			When fully leafed out and active growth.						Prior to hard freeze
	Basal Bark	Any time. Used for larger stems.								
	Cut stem	Any time except during heavy sap flow. Use to treat larger stems.								
	Mow		Mow frequently to control seedlings.							
	Don't mow									
Flowering Period										

Prohibited: Eradicate | Japanese hops : *Humulus japonicus* Siebold & Zucc.

Below left: Male flower structure.
Below right: Female flower structure.

Caution - Stem prickles are known to irritate the skin, long clothing and gloves are recommended.

Identification: *Compare to native common hops (Humulus lupulus). See page 58.*
Compare to native cucumbers, wild and bur (Echinocystis lobata and *Sicyos angulatus). See page 60.*
Compare to native Virginia creeper/woodbine (Parthenocissus spp.*). See page 71.*

Plant: Herbaceous, annual vine trailing on the ground or climbing vegetation and infrastructure. Stems are covered with downward pointing prickles.

Leaves: Opposite, 2-5 inches long and almost as wide, with 5-7 (maybe 9) palmate lobes. *Compare to common hops: typically 3-lobed occasionally 5.* Japanese hops leaves are rough and edges are toothed. Two bracts (stipules) are at leaf stalk bases and the leaf stalks (petioles) are as long or longer than the leaves.

Flower: Male flowers and female flowers are on separate plants (dioecious). Flowers are small and greenish to reddish, not showy. Male flowers are branched clusters (panicles) while the female flowers are drooping structures that are rather plump and composed of overlapping reddish bracts or scales (hops).

Bloom time is July into August.

Fruit and Seed: Each cluster of female flowers produces flattened seeds that mature in September.

Life History: An annual plant germinating early spring and growing quickly as summer progresses. Vines quickly cover small trees and shrubs weighing them down to the point of breakage and limiting their sunlight. Japanese hops flower in July-August, seeds mature in September. Soon after a killing frost, fragile vines fall apart dispersing their seed.

Habitat: Tolerant of disturbed roadside conditions if there is moist soil. Species prefers conditions found in riparian areas including full sunlight and exposed soils that are moist and rich.

Management:

Manual methods including **cutting** and **pulling**, while labor intensive, can be successful on small infestations. Efforts should be focused on early season work when plants are small and limited entanglement with surrounding vegetation or structures has occurred.

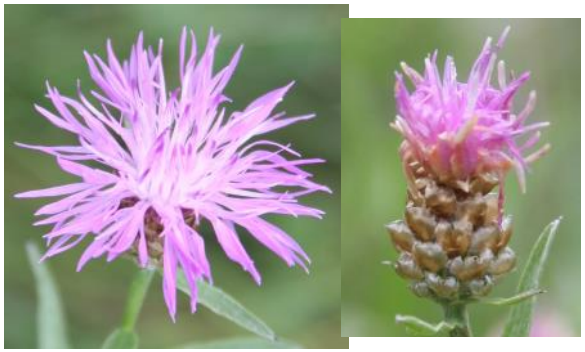
If the area is accessible to **mowers** and vines have limited structure for climbing, such as trees and fences, then **mowing** is an effective method to control maturity and seed production.

Herbicides include pre-emergent and post-emergent applications. Both are useful since this is an annual plant with prolific seed production capabilities. Pre-emergent should be applied prior to the growing season beginning in late March or early April. Once germination has occurred a switch to foliar applications should be made in an effort to keep plants from maturing and producing seed.

Below: Stem prickles

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	Use fire to improve native plant community.								
Herbicide	Post-emerge									
	Pre-emerge									
	Mow		Mow to prevent flowering							
	Don't mow					If seed is present				
Flowering Period										

Prohibited: Eradicate | Knapweed complex : *Centaurea* spp.



Top: Brown Knapweed
Middle: Meadow knapweed, images T. Jacobson
Below: *Spotted* (left), Diffuse (center), *Russian* (right)
Image: Bugwood.org.

Prohibited: Eradicate Brown knapweed: *Centaurea jacea* L.
Prohibited: Eradicate Diffuse knapweed: *Centaurea diffusa* Lam.
Prohibited: Eradicate Meadow knapweed: *Centaurea* x *moncktonii* C. E. Britton [*jacea* × *nigra*]
Not listed *Russian knapweed*: *Acroptilon repens* (L.) DC. - synonym: *Centaurea repens* L.
Prohibited: Control Spotted knapweed: *Centaurea stoebe* L. ssp. *micranthos* (Gugler).

Advice, spotted knapweed is established in Minnesota. Learn to identify it and recognize when something is different. Please report infestations that are not easily identified as spotted knapweed to Early Detection and Distribution Mapping System EDDMaps or Minnesota Department of Agriculture's Arrest the Pest.

Compare knapweeds on pages 13, 14 and 23. Compare to thistles (pages 21, 28, 53 and 70) and alfalfa / vetches (pages 49 and 56).

Identification:

Species / Characteristic	Brown	Diffuse	Meadow	*Russian* (Not Listed in Minnesota)	*Spotted* (Prohibited: Control)
Root Types	Short-lived perennial,	Short-lived perennial, tap root	Short-lived perennial,	*Long-lived perennial, creeping perennial, root spread horizontal.*	*Short-lived perennial, tap root.*
Bracts	Brown , with a tan papery tip (edge)	Rigid, spine-like tips	Long fringed (insect-like) Coppery, shiny (mature).	*Rounded bracts, smooth papery transparent tips*	*Darkened tip, short fringe.*
Flowers	Rose to Purplish, 1-1¼ inch wide.	Variable - white to rose Occasionally purplish	Rose to purplish ¾ inch wide.	*Pink to lavender ⅜ to ½ inch*	*Pinkish, cream is rare Approximately 1 inch*
Leaves	Not as deeply lobed as spotted knapweed	Basal leaves deeply and finely, divided with wide lobes.	Basal leaves mostly unlobed, smooth.	*Basal leaves are seldom divided, roughly fuzzy.*	*Gray-green, Deeply lobed leaves, roughly fuzzy*
Habitats	Prefers moist cooler soils.	Dry soils, disturbed sites	Moist soils, wet prairies	*Dry to moist soils, saline soils, disturbed sites*	*Dry to moist soils, disturbed sites*

Table adapted from sources: http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/Brochures/knapweed.pdf
http://bugwoodcloud.org/mura/mipn/assets/File/KnapweedBrochure072814WEB.pdf

Plants: Herbaceous, typically short-lived perennials or biennial. Knapweeds ascend from woody root crowns and reach heights of 8 to 32 inches. Typically, multi branched with solitary, terminal disk flowers.
Leaves: Simple, alternate, green foliage. *Spotted* knapweed has foliage with fine hairs and a blue-gray color, while *meadow* knapweeds foliage is smooth and a green color. Some species are deeply lobed (*spotted*) while others like *brown knapweed* may not be lobed. In all species, basal leaves tend to be larger than the lance-shaped leaves above.
Flower: Flower colors varying from white to purplish make color a less reliable species identifier. Typically flowers are solitary, terminal to branches, purplish disk flowers that are surrounded by 5-petaled florets. Bracts that cover the bulb-like bases of flowers are 2-parted and the bract characteristics are diagnostic to species, especially the bract tips. Refer to the table above for comparison.

Prohibited: Eradicate

Knapweed complex : *Centaurea* spp.

Top: Brown knapweed
Images: Bugwood.org

Middle: Meadow knapweed
Images: Tom Jacobson, MnDOT.

Bottom left: Diffuse knapweed
Image: Bugwood.org

Caution - gloves and long sleeves are recommended, knapweeds have defenses known to irritate skin.

Bloom time is June to September.

Fruit and seed: Small (less than ⅛ inch) (2-3 mm), some have short, bristly hairs (pappus) at the top. A typical achene (seed) of the Aster family but pappus is limited and wind will not carry seeds.
Life History: Reproduction is by seed which can be moved by water, animals, and birds. Human activities are significant transporters of seed in products like mulch, soil or hay and straw. Seed is also potentially moved on construction or farm equipment, recreational vehicles, as well as on personal automobiles, clothes and recreational gear. Depending on species, seed viability can be up to eight years.

Currently unlisted and not known to be in Minnesota, Russian knapweed is a long-lived perennial with deep roots, potentially to 20 feet. Its roots are dark colored and scaley. Russian knapweeds foliage is blue-gray and has fine hairs, similar to spotted knapweed. It is reported that seed production of Russian knapweed is 'limited' but infestations spread aggressively by roots.

Habitat: *Brown and Meadow knapweeds* prefer moist soil types found along water, wet grasslands or meadows, irrigation ditches, roadsides and openings in woodlands. In contrast, other knapweeds tolerate drier sites such as old fields, road and rail right-of ways, gravel pits or similar disturbed areas.

All prefer full sun locations with the exception of *brown knapweed being tolerant of partial shade*.

Threat to Minnesota: potential development of hybrids that can take advantage of intermediate niches.

Management: **Hand pulling** or **digging** while time consuming can be an effective step when coupled with chemical treatments. Preferably, propagating plant parts should be disposed of onsite or when necessary contained (e.g., bagged) and removed to an approved facility. For more information on these disposal options, please read MDA's guide on removal and disposal.
Repeated mowing or **cutting** can reduce seed production, but sites must be monitored and applications likely repeated or followed up with herbicide treatments.
Prescribed fire can be used to encourage stands of native grasses that will compete with knapweeds. However, monitoring is needed to check for knapweed germination in bare soil soon after burns are completed.

Herbicide foliar applications with formulations including aminopyralid, clopyralid, or picloram have proven effective in controlling knapweeds.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn			Use fire to improve native plant community.						
Herbicide	Foliar		Foliar treatments target rosettes.							
	Mow	Mow to prevent flowering								
	Don't mow			Do not mow when seed is present						
Flowering Period										

Prohibited: Eradicate | Oriental bittersweet : *Celastrus orbiculatus* Thunb.

Above: location of fruit is in leaf axils (where leaves attach to stem).

Identification: *Compare to native American bittersweet (Celastrus scandens). See page 55.*

Plant: Woody, twining, perennial vines up to 60 feet long, reaches tree tops and covers fences. Stem diameters of 4 inches documented in Minnesota.

Leaves: Alternate, fine rounded teeth on the leaf edge, dark green and shiny turning yellow in autumn. Typically, elliptical with a blunt leaf tip and nearly as wide as long at 2-5 inches.

Flower: Female flowers are small, inconspicuous, greenish clumped (3-7) in leaf axils along stems. Dioecious species, male and female flowers on separate plants. Male flowers are also axial but may be terminal. Compare white pollen on male flowers to *yellowish pollen on American bittersweet flowers*. *Also, American bittersweet flowers are similar in size and color but are found **only terminal** on vine branches (on the ends).*

Bloom time is May to June.

Fruit and Seed: Along the vine in leaf axils are potentially 3-7 yellowish, 3-parted capsules enclosing reddish-colored, 3-parted, berry-like arils. Each part contains 1-2 seeds; therefore, potential total of 3-6 seeds per fruit. Dioecious, separate fruiting (female) and non-fruiting (male) plants. *American bittersweet's 3-parted fruit is more red, the 3-parted capsules more orange and fruits are terminal on the vine branches (on the ends).*

Life History: Vegetative reproduction occurs from below-ground rhizomes, above-ground stolons and suckering of roots. Birds will eat the fruits (arils) during the winter and disperse the seeds. Seeds germinate late spring.

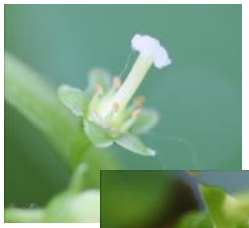
Habitat: Readily invades disturbed, open, sunny sites, yet Oriental bittersweet is moderately tolerant of shade allowing it to grow in open woodlands.

Management:

Prescribed fire research has shown that basal sprouting is stimulated and stand density increases dramatically.

Cutting of stems can be used to kill above ground portions of plants especially if the infestation is covering large areas or is climbing high into forest canopy. Preferably, propagating plant parts should be disposed of onsite or when necessary contained (e.g., bagged) and removed to an approved facility. For more information on these disposal options, please read MDA's guide on removal and disposal. Combine with herbicide applications for best results.

Herbicides that act systemically such as formulations of triclopyr or glyphosate can be applied as foliar, basal bark or cut stem applications. Foliar applications are reserved for easy to reach foliage, re-sprouting or along fence lines. Once foliage is out of reach, application to cut stems or basal bark will yield the best results.



Left above: greenish, female flower.
Left below: greenish male flower, note white pollen grains on anthers of the upper flower.

Right: Light brown seeds. Each structure is 3 parted and each part contains 1-2 seeds. Image shows 5 seeds from a single fruit.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
Herbicide	Burn		Burning is not recommended							
	Basal Bark	Any time.								
	Foliar		When fully leafed out and active growth.							
	Cut stem				Any time except during heavy sap flow.					
Mowing	Mow		Mowing is not recommended.							
	Don't mow									
Flowering Period										

Prohibited: Eradicate | Palmer amaranth : *Amaranthus palmeri* S. Watson

Above: male plants have soft flower spikes, female flower spikes have sharp bracts (below - upper right).

Below: poinsettia-like foliage, white V-shaped markings (inset), and thick stems.

Identification: Palmer amaranth is one of several native pigweeds and is native to southwestern deserts of the United States. Link: Pigweed Identification, a pictorial guide.

Plant: Herbaceous, annual plant, a potential growth rate of 2-3 inches per day. Plants attain heights of 6-8 feet, potentially 10 feet. Stems are stout, up to 2 inches thick and without hairs (smooth). Top-view of plants as foliage develops resembles a poinsettia.

Leaves: Alternate, green color, some plants with white V-shaped markings on leaves. Elliptical to diamond-shaped leaf blades terminated by a small spine. Petioles up to 2-3 times longer than leaves, image at right.

White petiole bent back over a green leaf blade.

Flower: Plants are dioecious with male and female flowers on separate plants. Flowers are not showy, but flower spikes are significant and useful in positive identification.

Bloom time is June to Sept. Flowers can occur 8 weeks post-emergence to end of season.

Fruit and seed: Seeds are dark colored and extremely small. Research shows pigweeds including palmer amaranth can produce upwards of 250,000 or more seeds per plant.

Life History: Seedling emergence can occur throughout the growing season; thus, flowering and seed set can persist late into the season. **Monitoring** is a necessary activity for control efforts. Seeds germinate in spring if within an inch of soil surface. Research on pigweeds suggests if seed is buried deeper than 3 inches viability is decreased annually with a potential longevity of approximately 3 years. Research on redroot pigweed (*A. retroflexus*) and waterhemp (*A. rudis*) suggests longevity can be as short as 3-4 years in Mississippi/Illinois or as long as 12 years in Nebraska.

Habitat: Native habitat is desert climate, species performs well during heat of summer. Pigweeds are shade intolerant.

Management: Preventing establishment is key. Proper identification and frequent scouting to limit seed production. **Repeated mowing** or **cutting** are not effective at controlling Palmer amaranth infestations. Continue monitoring and consider alternative methods such as cultivation, manual methods like hand-pulling or herbicide applications.

Prescribed fire has the potential to kill seedlings and drain energy from maturing plants, but fire should be considered as a tool to strengthen the health and competitive advantage of the desirable plant community.

Biotypes have shown resistance to **herbicides** in groups 2, 3, 5, 9 and 27 (Group number - check herbicide labels). Yet, **herbicide** applications both pre- and post- emergent are possible. Roger Becker (Univ. of MN, Agronomist) provided the following comment: "There are many products that will control the pigweed group across the different labeled sites, but the challenge will be knowing what the resistance of the particular biotype is that gets here (Minnesota), if at all. Many of the standard ROW (right-of-way) broadleaf materials will control non-resistant palmer."

Useful herbicides in group 4 include 2,4-D, aminocyclopyrachlor, aminopyralid, clopyralid, and dicamba. Group 2 herbicides include imazapyr, imazapic, metsulfuron and sulfometuron. Nonselective glyphosate, group 9 and glufosinate, group 10 can be used depending on crop tolerance traits or desired vegetation outcomes for non-cropland sites.

For best results, treat plants when they are small, under 1 foot tall.

As plants mature, use approved higher rates of herbicides.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	Use fire to improve native plant community.								
Herbicide	Post-emerge									
	Pre-emerge									
	Mow		Mow to prevent flowering							
	Don't mow				Follow-up mowing to control seed production.					
Flowering Period										

Prohibited: Eradicate

Poison hemlock : *Conium maculatum* L.

Caution All plant parts are ***poisonous to humans*** and livestock. Caution

It is reported that toxin can be absorbed through bare skin. Wear appropriate PPE.

Identification: *Compare to wild carrot and native water hemlock on pages 44 and 72. Also compare to carrot look-alikes, wild chervil and common yarrow on pages 51, 52 and 73.*

Plant: Herbaceous, biennial, first year as a basal rosette and second year poison hemlock is a branched, 3-7 feet tall, robust plant. Stems are smooth (no hairs), hollow, appear ridged due to veins and are light green, mottled (spotted) with purplish spots.

Leaves: Alternate, generally triangular in form. Doubly or triply pinnately compound up to 18 inches long by 12 inches wide. Leaflets are fern-like, deeply divided and typically twice as long (2 inches) as wide (1 inch). Basal leaves tend to be larger and have longer petioles than upper stem leaves. Petiole to stem attachments are covered by a sheath.

Flower: Flat or slightly dome-shaped open compound umbels of 3-16 umbellets with 12-25 five-petaled, white florets. There are small ovate-lanceolate bracts with elongated tips under main umbels. Bracts are also present under umbellets.

Bloom time is variable - June to August.

Fruit and Seed: Paired seeds are ⅛ inch tall schizocarps, these split at maturity becoming two carpels . Each carpel is a seed, flattened on 1 side and lined vertically by broken ridges described as wavy ribs. There are no hairs.

Habitat: Partial shade is tolerated but preference is full sun with moist fertile soils. Often found near water or in riparian zones. Can tolerate drier conditions.

Management:

If performed frequently **cutting** or **mowing** are effective control methods to prevent seed production. Same is true for hand pulling, however roots and root fragments remaining in soil may resprout. Monitor and plan additional treatments.

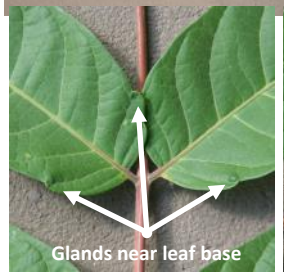
Prescribed fire as a tool should be used to improve the health of surrounding native vegetation. Fire will kill seedlings and top kill other plants; however, after the fire healthy root systems will likely resprout.

Foliar herbicide applications to plants at rosette stage or during active growth (before flowering). Herbicide formulations with 2,4-D or 2,4-D including dicamba or triclopyr have produced good results. Nonselective herbicides such as glyphosate (concentration of 41% or greater) formulations can also produce results.

Other potential herbicide choices include aminopyralid, chlorsulfuron, clopyralid, dicamba, imazapic, imazapyr, metsulfuron-methyl or 2,4-D plus picloram.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn		Use fire to improve native plant community.							
Herbicide	Foliar		Target pre-flower.							
					Target rosette					
	Mow		Mowing must be repeated to prevent flowering							
	Don't mow				Do not mow when seed is present					
Flowering Period										

Prohibited: Eradicate | Tree-of-Heaven : *Ailanthus altissima* (Mill.) Swingle



Synonyms: *A. glandulosa* Desf. and *Toxicodendron altissimum* Mill.

Identification: *Compare to native sumacs* (*Rhus typhina* and *R. glabra*). *See page 69.*

Plant: Tree, woody perennial plant that can attain heights of 70 feet. Very thick twigs with dime-sized leaf scars aid winter identification. Cutting twigs reveals a soft white pith.

Leaves: Alternate, 1-4 feet long, odd-pinnate compound with 11-25 (up to 40) leaflets. Leaflets are 3-5 inches long by up to 2 inches wide, smooth edged with 1-5 distinct glands (bumps) near leaflet bases. **Key difference:** *leaflets are smooth edged, unlike toothy sumac leaflets.*

Flower: Clusters of small yellowish-green flowers are showy due to the sheer number of flowers per cluster. Species is predominantly dioecious (male and female flowers on separate trees).

Bloom time is June.

Fruit and Seed: Clusters of 1-1½ inch long twisted samaras develop mid-summer. A pinkish hue develops, then maturing to light tan. Samaras are documented to wind disperse up to 300 feet.

Life History: Trees sprout vigorously from stumps when cut or broken and there is also strong root sprouting potential. Trees in the 12 to 20 year age class produce lots of seed. Seed bank capability is reported to be low, but initial seed viability is high. Allelopathic (chemical) effects prevent germination of other plants near tree-of-heaven.

Habitat: Tolerant of urban stresses including pollution, soil disturbance, nutrient poor soils, drought conditions (once established), compaction, salty roadside soils and prefers full sun.

Management: Prevention is key - early detection and removal is required.

Cultural methods like **Cutting** or **mowing** are beneficial but should be followed up with good monitoring. Goal with these methods is to prevent flower and seed.

Prescribed fire, where applicable, can top kill seedlings and or saplings. The goal would be to strengthen the native plant community.

Herbicide applications of glyphosate during July through September are effective when applied to **cut stumps**. Other active ingredients would include triclopyr, dicamba, and imazapyr. Stumps should be cut as low as possible to minimize surface area from which potential resprouts occur.

Hack-and-squirt applications with dicamba, glyphosate, imazapyr, picloram or triclopyr formulations are effective. In addition, **basal bark** treatments with triclopyr or imazapyr active ingredients in oil are also recommended.

At full leaf-out during active growth, **foliar** applications with 2,4-D, glyphosate, imazapyr, picloram or triclopyr are also effective when targeting smaller trees and resprouts.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn						Monitor and follow-up.			
Herbicide	Foliar			When fully leafed out and active growth.						
	Basal Bark	Any time.								
	Cut stem	Any time except during heavy sap flow.								
	Mow		Mow frequently to control seedlings.							
	Don't mow									
Flowering Period										

Prohibited: Eradicate

Yellow starthistle : *Centaurea solstitialis* L.

Caution - Gloves and long sleeves are recommended.
Knapweeds have chemical and in some species physical defenses. These are known skin irritants.

A member of the knapweeds, genus *Centaurea*.

Identification:

Plant: Herbaceous, annual with heights of 6 to 36 inches. Plants start as a biennial or winter annual with a basal rosette the first season. Mature plants are described as bushy with a grayish or bluish cast to otherwise green color.

Leaves: Basal leaves are lobed, dandelion-like at about 8 inches. Basal leaves may not persist as plants bolt to flower. Stem leaves are alternate, narrow to oblong and an extended leaf attachment provides a winged appearance to stems.

Flower: Approximately 1 inch long flowers with substantial ¾ inch yellowish spines emanating from bracts beneath flowers. Flowers are terminal and solitary on stems.

Bloom time is June to August.

Fruit and Seed: Each terminal flower produces between 35 to 80 plumeless or plumed seeds.

Life History: Yellow starthistle is a strong invader. Due to a lack of tufting on some seeds, reliance is on animals and humans for movement any distance from parent plants.

Habitat: Periods of summer drought favor infestations on disturbed sites such as roadsides. Also an invader of prairies, fields, woodlands and pastures where spines can cause injury to grazing animals.

Management: Limit movement of seed on grazing animals, mowing equipment and vehicles.

Eradication is the goal in Minnesota; therefore, biological control agents are not a compatible option at this time.

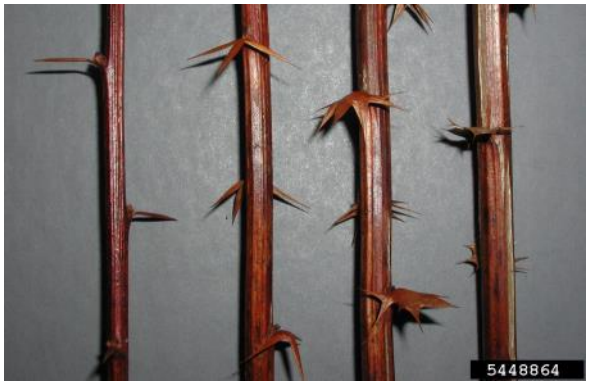
Mowing, monitor infestations and time mowing at early flowering stages, soon after spine development.

Herbicide formulations of aminopyralid, clopyralid or picloram applied as foliar applications early in the growing season appear to be most effective.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	Use fire to improve native plant community.								
Herbicide	Foliar									
	Mow		Mow to prevent flowering							
	Don't mow					Do not mow when seed is present				
Flowering Period										

Prohibited: Control

Common barberry : *Berberis vulgaris* L.



Above: common barberry spine variations.

Above: common barberry leaf variations.

Identification: *Compare to Japanese barberry on pages 38-39 and Korean barberry on page 39.*

Plant: Deciduous shrub reaching 8-10 feet in height and up to 6 feet in width. Slender branches are straight between nodes, strongly grooved and common barberry may have single or multi-branched spines, usually 3-branched possibly 5.

Bark on second year stems is gray as opposed to reddish second year branches of Korean barberry.

Key difference - *Japanese barberry spines, usually single maybe 3-branched. Korean has 1-5 (7), often 3, flat spines.*

Leaves: Alternate, but clustered not appearing alternate, simple leaves are ovate, narrow near the base, toothed on the edges, described as finely serrate, as few as 8, often 16 to 30 spiny teeth. In particular, young shoots have spiny leaves.

Key difference - *Japanese barberry leaves have smooth edges (no teeth). Korean barberry has toothed leaf edges.*

Flower: Drooping, 1-2 inch long clusters (racemes) of 10-20 yellow, ½ inch long flowers. Flowers are somewhat showy, however; fragrance is not described as pleasant.

Key difference - *Japanese barberry has 1-4 flowers hanging in loose clusters. Korean barberry has 10-25 flowers.*

Bloom time is May to June.

Fruit and Seed: Fruit is an oblong berry, up to ½ inch long, bright red and fleshy. Berries persist into and through winter. Each fruit contains 1-3 seeds. Based on studies in Minnesota and North Dakota the US Forest Service fire effects database indicates seed viability of 7-9 years in soil.

Key difference - *Japanese barberry berries are ¼ to ⅜ inch long with dry flesh. Korean barberry has ¼ inch fleshy berries and fruits are more rounded - not as oblong.*

Life History: Most propagation is by seed dispersal. Birds are a primary disperser. Vegetative reproduction is important to persistence. Mainly through sprouting from rhizomes and lower branches may root at points of ground contact.

Habitat: Typically, found in open or lightly shaded woods. Also found in pastures, fencerows and roadsides in full sun.

Management:

Cutting or **mowing** can be effective once mature shrubs are removed. Follow-up with frequent mowing to control regeneration or utilize other treatments as needed.

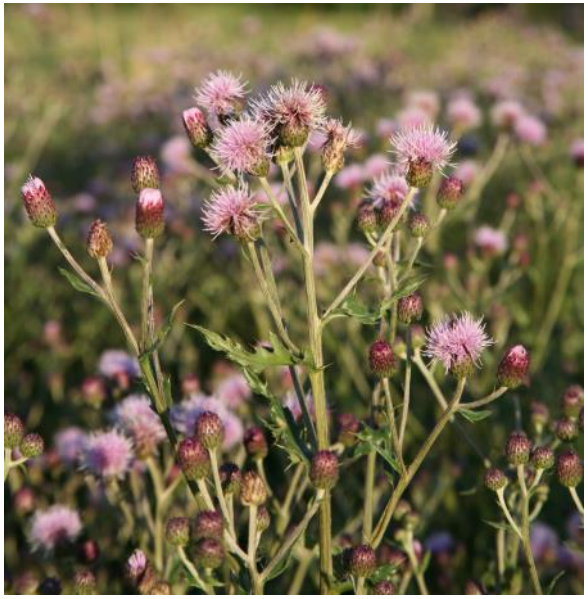
Repeated **prescribed fire** can damage above ground parts and drain energy from shrubs; however, resprouting will likely occur. Monitor after fire and follow up as necessary with additional treatments.

As with most woody species, there are several methods to apply **herbicide. Foliar** applications should be made when plants are fully leafed out and for best effect while plants are fruiting. Active ingredients include dicamba + 2,4-D, glyphosate, metsulfuron-methyl and triclopyr. **Cut stump** treatments using glyphosate or triclopyr will likely be successful and **basal bark** treatments with triclopyr or imazapyr formulations are also effective.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn				Use fire to improve native plant community.					
Herbicide	Foliar			When fully leafed out and when in fruit.						
	Basal Bark	Any time.								
	Cut stem	Any time except May-June during heavy sap flow.								
	Mow		Mow frequently to control seedlings.							
	Don't mow				Do not mow when seed is present					
Flowering Period										

Prohibited: Control

Canada thistle : *Cirsium arvense* (L.) Scop.



Identification: *Compare to nonnative plumeless thistle (Carduus acanthoides), page 28.*
Compare to native swamp thistle (Cirsium muticum). See page 70.
Compare to nonnative musk thistle (Carduus nutans). See page 53.
Compare to nonnatives alfalfa and hairy vetch. See page 49.
Compare flower similarities to spotted knapweed, page 23.

Plant: Herbaceous, perennial with grooved, non-spiny, hairy and typically upright stems to a height of 2-6+ feet tall.

Leaves: Alternate, simple, pinnately lobed leaves that are generally lance-shaped. The leaves are irregularly lobed, with toothed, spiny edges. The leaves are stalkless (sessile) and at maturity are downy or hairy on the underside.

Flower: Male and female (dioecious) ¾ inch flowers occur singly on the end of branches. The disk or composite inflorescence is comprised of numerous purple to pinkish small florets. Bracts below the inflorescence do not have spines on the tips.

Bloom time is June to October.

Fruit and Seed: Tufted light brown seeds are easily dispersed by wind. Do not mow after seed has developed as this strongly aids seed dispersal.

Life History: Reproduction can occur from seed, root cuttings and from rhizomes. Clonal stands are common and spread significant from roots that can grow horizontally 10-12 feet per year.

Habitat: A successful inhabitant of disturbed areas such as roadsides and old fields but will also move into open woodlands and prairies. This species is also found where water levels fluctuate such as in wet meadows, along stream banks and ditches.

Management:

A **biological control** is under investigation, stem-mining weevil (*Ceutorhynchus litura*). This insect is available from commercial vendors and is acceptable for distribution in Minnesota.

Cutting or **mowing** should target plants that are approximately 3 inches tall and the process must be repeated throughout the season to maintain the plants at 3 inches or less in height. Continuing this approach for several years can drain the plants of reserves.

Repeated **prescribed fire** can be used to encourage stands of native grasses that will outcompete thistle. However, monitoring is needed to check for thistle that germinates in bare soil soon after burns are completed.

Herbicide foliar sprays with formulations of clopyralid, aminopyralid, or metsulfuron-methyl. These foliar applications are made as the plants bolt, prior to flower set, or in late summer/early autumn to rosettes.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	Monitor and follow-up.			Use fire to improve native plant community.					
Herbicide	Foliar									
	Mow		Mow to prevent flowering							
	Don't mow				Do not mow when seed is present					
Flowering Period										

Prohibited: Control

Common tansy : *Tanacetum vulgare* L.

Caution - Alkaloids contained in common tansy are toxic to humans and livestock if consumed in quantity. Toxins are potentially absorbed through skin, gloves are recommended when handling this plant.

Identification: *Compare to native goldenrods (Solidago* spp.*). See page 63.*

Plant: Herbaceous, perennial reaching 2-5 feet in height. Stems appear woody, are slightly hairy to smooth and at the base are purplish-red.

Leaves: Alternate, pinnately divided, toothed on edges and 2-12 inches long, typically smaller near the top of plants. Leaves are strongly aromatic when crushed.

Flower: Single stems support multi-branched, flat clusters of bright yellow button-like flowers. Each ¼-½ inch wide button is comprised of many small florets and the flower heads, like the leaves, are strongly aromatic.

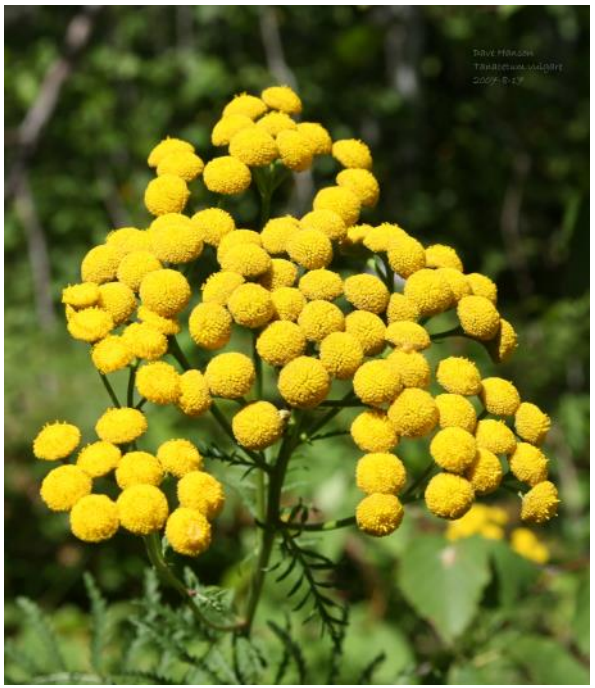
Key difference - *Note the lack of ray petals surrounding the flower heads. Compare to native goldenrods which have ray petals.*

Bloom time is July to October.

Fruit and seed: Small, yellowish-brown, dry, 5-toothed crowned seeds.

Life History: Reproduction is both vegetative from rhizomes and root fragments or by seed. Seeds are dispersed by wind, water and human activities such as vehicle traffic and mowing.

Habitat: Found most often in open, disturbed areas typical of stream and river banks, trail edges, roadsides, gravel pits and old farmsteads or pastures. Can be found in riparian areas, but most often in dry, well drained soils in full sun.



Management:

Mechanical methods like **tilling** can spread common tansy by spreading small root segments. **Pulling** also may leave root segments in the ground which may resprout.

Cutting or **mowing** to prevent seed production can be effective and should be timed just prior to flowering.

Prescribed fire can eliminate competition and create favorable conditions for common tansy by opening the canopy and preparing bare soil. Thus, fire can make an infestation worse; however, fire can be used to remove dead material to improve follow-up herbicide application providing better contact and potentially better control.

Herbicide formulations of metsulfuron-methyl, imazapyr, glyphosate or 2,4-D provide good control when applied as foliar applications in spring.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	Use fire to improve native plant community.								
Herbicide	Foliar		Foliar treatments target rosettes.							
	Mow		Mow to prevent flowering							
	Don't mow				Do not mow when seed is present					
Flowering Period										

Prohibited: Control

Spotted knapweed : *Centaurea stoebe* L. ssp. *micranthos* (Gugler) Hayek

Above: basal rosette, Middle right: basal foliage, Middle Left: linear foliage near top of plant, Bottom right: flowers.

Caution - gloves and long sleeves are recommended, knapweeds have defenses known to irritate skin.

Identification: *Compare to knapweed complex members. See pages 13 and 14.*
Compare to nonnatives alfalfa and hairy vetch. See page 49.
Spotted knapweed is widely established in Minnesota.
Learn to identify it and recognize when something is different.

Compare flower similarities to Canada thistle, page 21.

Plant: Herbaceous, short-lived perennial living 1-4 years. Initial stage is a rosette before the plant produces 1-6 stems ranging from 1-4 feet tall.
Leaves: Simple, alternate, grayish-green basal rosette leaves up to 6 inches long have deep sinuses. Alternate leaves on mature stems vary from smaller, 1-3 inch, versions of the basal leaves to very small linear leaves near the top.
Key difference: *meadow / brown knapweed - green leaves, lacking lobes.*
Flower: Strongly resemble the flowers of thistles in their pink to purple color (rarely white) and multi-parted texture. Below the petals, flowers are held together by bracts that are stiff and tipped with darkened hairs (see image above).
Compare *bract tips; brown - brown, tan papery edge; diffuse - rigid, sharp spines - terminal spine can be ⅛ inch long; meadow - long fringed; Russian - rounded, opaque with transparent tips; and spotted - dark tip, short fringe.*
Bloom time is July to September.
Fruits and Seed: Small (⅛ inch long), brownish, tufted, seeds.
Life History: Allelopathic properties (chemicals exuded by the plant) can suppress the germination of seeds of other plants nearby. Plant removal can lead to bare patches of soil subject to erosion.
Seeds are the primary means of reproduction and a mature plant produces thousands of seeds that may remain viable for up to 5 years. Wind disperses seeds short distances while animal and human activity disperse it far and wide.
Habitat: In contrast to meadow knapweed's preference to moist sites, spotted knapweed prefers disturbed sites with gravely or sandy dry soils. Roadsides, abandoned lots, old fields and gravel pits are habitat that support infestations.
Management:
Biological control agents approved for use in Minnesota are seedhead weevils (*Larinus minutus* and *L.* obtusus) and a root-boring weevil (*Cyphocleonus achates).* Weevils are collected July through September and released on infestation sites larger than 1/3 acre. When a combination of seedhead and root boring weevils work together, infestations can be reduced over a number of years. Contact Minnesota Department of Agriculture.
While **cutting, mowing** and **prescribed fire** can encourage competition from native grasses and help reduce the extent of an infestation they will likely not eradicate it. Early spring prescribed fire is compatible with biological control.
Herbicide formulations including aminopyralid, clopyralid, glyphosate, imazapyr, aminocyclopyrachlor or picloram have demonstrated control with foliar applications.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn			Use fire to improve native plant community.						
Herbicide	Foliar		Foliar treatments target rosettes.							
	Mow		Mow to prevent flowering							
	Don't mow				Do not mow when seed is present					
Flowering Period										

Prohibited: Control | Knotweed complex : Japanese, Bohemian and giant

Three knotweeds, often referred to as bamboo, are described here. They are large perennial plants with non-woody stems. Stems are smooth, green with reddish-brown blotches and hollow between swollen nodes where leaves attach. All three have branched flower structures at these leaf attachments holding many small, creamy white to greenish flowers.

Giant knotweed has perfect flowers. Japanese and Bohemian are gynodioecious.

Bloom time (all 3 knotweeds discussed) is August to September.

Seeds: Small, black, 3-sided. Reported as not commonly produced on Japanese knotweed.

Japanese knotweed Identification: *Polygonum cuspidatum* Siebold & Zucc.

Synonyms: *Fallopia japonica* (Houtt.) Ronse Decr. , *Reynoutria japonica* Houtt.

Plant: Height *5-8 feet* (*10 feet*), potentially multiple branches. Typically, only female flowers.

Leaves: Alternate, simple, can be *2 to 7 inches long* with a *truncate base* (mostly straight across). *Tips of leaves are acuminate* (narrowed to an abrupt point) and *undersides of leaves along veins* may have *brown, fuzzy ridges*.

Flowers: Typically, plants with female flowers only. If male flowers present - reported to be sterile. Japanese knotweed's branched *flower structures are longer than nearby leaves*.

Above: Bohemian knotweed.

Bohemian knotweed Identification :

Polygonum ×bohemicum (J. Chrtek & Chrtková) Zika & Jacobson [*cuspidatum* × *sachalinense*]

Synonym: *Fallopia* × *bohemica* (Chrtek & Chrtková) J.P. Bailey

Synonym: *Reynoutria* × *bohemica* Chrtek & Chrtková

Bohemian: an intermediate hybrid with characteristics of both parents, Japanese and Giant.

Plant: Heights from *6 to 16 feet*. Typically few, but potentially several branches.

Leaves: Alternate, simple, can be 2 to 12 inches long and width about ⅔ of length. Leaf bases may be straight across (see Japanese) or rounded (heart-shaped like Giant). Leaf tip may be blunt, gradually tapered or pointed. *Few to no hairs on the leaf edges* (margin) and *veins under leaves may have stiff, broad-based, small hairs*.

Flowers: Fertile female flowers. Male flowers, also fertile, consist of anthers attached to long stamens extending beyond a flower's petals. Structure is branched with variable length.

Above: Extended male stamens and anthers of Bohemian.

Below: Female flowers of Japanese knotweed.

Giant knotweed Identification : *Polygonum sachalinense* F. Schmidt ex Maxim.

Synonym: *Fallopia sachalinensis* (F. Schmidt ex Maxim.) Ronse Decr.

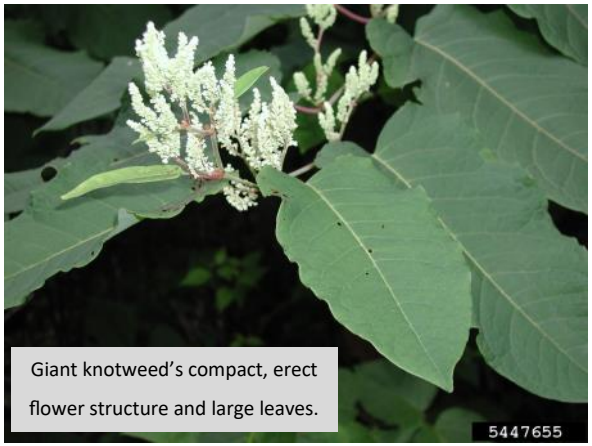
Synonym: *Reynoutria sachalinensis* (F. Schmidt ex Maxim.) Nakai

Plant: Larger plant attaining heights of *9 to 20 feet*. Typically few or no branches.

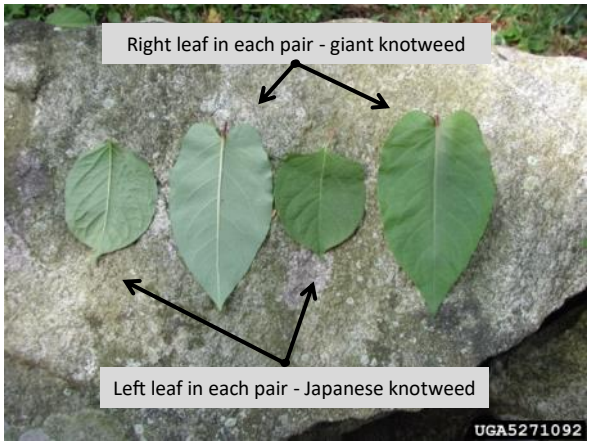
Leaves: Alternate, simple, can be up to *12 inches across* and *6-14 inches long* (width about ⅔ of length) with *rounded lobes at the base* (heart-shaped). *Tips of leaves are blunt* and *undersides of leaves may have scattered* (segmented) *hairs* early in the season.

Flowers: Perfect flowers (male + female) and fertile. Branched, flower structures of giant knotweed are compact, *shorter than nearby leaves*.

Prohibited: Control | Knotweed complex : Japanese, Bohemian and giant



Giant knotweed's compact, erect flower structure and large leaves.



Common Name	Plant form	Leaves	Leaves, underside	Flowers
Japanese knotweed	5-10 feet multiple branches	1-4 inches long, ⅔ as wide leaf base - straight across	along veins, scabers brownish, ridges, fuzzy	branched, loose female, sterile male
Bohemian knotweed (*hybrid*)	6-16 feet, few to several branches	2-12 inches long, ⅔ as wide leaf base - variable	along veins, short, triangular hairs	branched, variable form fertile female and male
Giant knotweed	9-20 feet few or no branches	7-16 inches long, ⅔ as wide leaf base - heart shaped	along veins, hairs scattered, segmented	branched, compact perfect and fertile

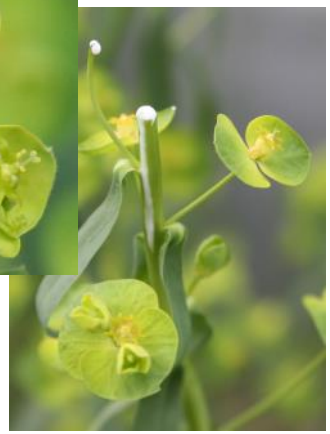
Life History: It is believed that seed production is limited (especially, *Japanese*) and most reproduction is vegetative. Even small rhizome parts will re-sprout after plants are manually removed or moved. Stem fragments resulting from mowers or other machinery can sprout if nodes are present and in contact with moist soil. Plants or rhizomes uprooted by flooding, digging or other mechanical means will likely re-root if left in contact with moist soil.
Seeds, if produced, are said to be viable four to five years if near the soil surface and up to 15 years if buried.
Habitat: Prefers moist soils in full sun to partial shade. Plants readily inhabit moist roadside ditches, wetlands, and areas along rivers and streams. However, plants will thrive on dry soils.
Management: Much of the research has been performed on *Japanese knotweed*. Develop a four to five year plan. **Prescribed fire** in spring can set plants back and drain some energy while **mowing** can prevent or delay seed production. However, both can stimulate vegetative reproduction, thus potentially increasing stem counts. After treatments, monitor approximately 60 feet beyond original infestations and utilize follow-up treatments of periodic mowing and/or herbicide. Reasoning, rhizomes can spread outward to 60 feet or more.
Manual methods including **cutting, digging, hand pulling, grazing** or **tarping** should not be considered eradication tools. If done repeatedly **and in conjunction** with other treatments infestations may be controlled. Monitor and consider supplemental herbicide treatments. All plant parts should be disposed of onsite or contained (e.g., bagged) and removed to an approved facility. For more information on disposal options, read MDA's guide on removal and disposal.
Option 1) **Foliar** treatments with non-selective **herbicides,** imazapyr or glyphosate, are recommended for mid to late summer applications performed as flowering ends and prior to first frost.
Option 2) Prior to **foliar** treatments with **herbicides,** aminopyralid, glyphosate, imazapyr, triclopyr, or 2,4-D, it is recommended that plants be cut or bent down twice during the growing season when 3 feet tall. Cutting or bending (breaking) forces regrowth. Follow with a fall **foliar application** when regrowth is 3 feet tall and prior to first frost.
Cut stem applications with glyphosate, triclopyr or triclopyr + 2,4-D can be made at anytime during active growth when the plants are over 3 feet tall. **Stem injection** treatments with glyphosate can be made anytime during active growth periods. See glyphosate's supplemental label for hollow stem injection.

Any management efforts will likely result in bare ground; therefore, all treatment planning should include revegetation.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
Herbicide	Inject			During active growth, treat when 3' tall.						
	Foliar	Mow / cut twice - fall treatment.								
	Cut stem			During active growth, treat when 3' tall.						
	Mow	Mowing is not recommended. If used, collect cuttings, monitor and repeat. Follow-up with herbicide treatments at 3 feet of regrowth in fall.								
	Don't mow									
Flowering Period										

Prohibited: Control

Leafy spurge : *Euphorbia esula* L.



Above: Flower and bracts.
Right: Cut stem exuding white latex.

Squares = ¼ inch.

Caution - Some people develop skin rashes after pulling or handling plants, so gloves and long clothing are recommended. Additionally, the milky sap is toxic to cattle and horses.

Left: Leafy spurge
Right: Cypress spurge.

Identification: *Similar to invasive cypress spurge (E. cyparissias). Due to bloom period overlap confused with introduced yellow rocket (Barbarea vulgaris). Compare to yellow rocket, page 54.*

Plant: Herbaceous, perennial to 3 feet tall. *Cypress spurge is 8-14 inches tall.* Broken stems of many *Euphorbia* spp. produce a milky sap (latex) that is a good identification characteristic.

Leaves: Alternate, linear to lance-like, bluish-green and 1-4 inches in length. *Cypress spurge leaves are about 1 inch in length, alternate or whorled and narrower than leafy spurge leaves.*

Flower: There are no petals or sepals on the small yellowish-green flowers. Upper stem leaves or bracts develop just below flowers and are yellow-green in color providing the appearance of yellowish petaled flowers. The bracts develop before the true flowers.

Bloom time is May to August.

Fruit and Seed: Three-celled capsules that expel seeds up to 20 feet. Each cell contains a seed.

Life History: Leafy and cypress spurge reproduction can be vegetative from buds on roots, rhizomes and root cuttings. The ability to reproduce vegetatively makes these plants difficult to control. Deep roots to 21 feet and extensive horizontal roots allow plants to store vast reserves providing the ability to recover after removal attempts. Seed production is significant with plants producing on average 140 seeds per stem. Seeds can remain viable in the soil up to 8 years.

Habitat: Leafy and cypress spurge readily invade dry sites in full sun, but tolerance of a range of conditions allows them to invade moist, rich soils as well.

Management:

Biological control agents are available for controlling leafy spurge. Flea beetles (*Aphthona lacertosa*) are widely used in Minnesota. Flea beetles are collected late May to early June and released on infested sites larger than 1/3 acre. Additionally in Minnesota, stem and root boring beetles (*Oberea erythrocephala*) provide some control. Early spring prescribed fire is compatible with biological control on this plant species. Contact Minnesota Department of Agriculture.

Cutting or **mowing** if timed before flower development can reduce or limit seed production. Grazing goats and sheep can effectively limit the spread of infestations.

Prescribed fire is another tool that helps drain plants of reserve energy. Control of spurges typically requires a multi-tactic approach - eliminate or reduce seeding, exhaust seed banks, and drain reserves of existing plants while attempting to encourage native plants for competitive cover. So, consider spring mowing or fire with a fall application of imazapic.

Herbicide controls are applied as foliar applications and usually involve formulations of aminocyclopyrachlor, picloram, 2,4-D, glyphosate, dicamba, or imazapic. Repeated applications are likely necessary.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn									
Herbicide	Foliar									
	Mow	Mow to prevent flowering								
	Don't mow			Do not mow when seed is present						
Flowering Period										

Prohibited: Control | Narrowleaf bittercress : *Cardamine impatiens* L.

Identification:

Plant: Herbaceous, annual or biennial starting its first season as a basal rosette and in the second season sending up a smooth flower stem to approximately two feet in height.

Leaves: Basal rosette leaves are pinnately compound with 3-11 round lobed leaflets. Alternate leaves on flowering stems, while still pinnately compound, likely will not have rounded lobes but 6-20 lance or arrowhead shaped leaflets. Edges of flowering stem leaves may be smooth or sharply toothed.

An important differentiation from other plants can be found at the point where leaves attach to stems, look for narrow pointed ears or auricles that grasp and may extend beyond stems.

Flower: Small (0.1 inch), white 4-parted flowers. White petals may not be present.

Bloom time is May to August.

Fruit and Seed: Similar to other mustard family members, seed pods are long (0.6 - 0.8 inch) and slender. Seed ripens from May to September and is dispersed short distances from plants.

Life History: Reproduction is by seed. Seed pods average 10-24 seeds and individual plants can produce thousands of seeds. Movement of seeds is aided by water, animals and human activities.

Habitat: Moist woodlands, forested areas and on margins of thickets. River bottom sites, streambanks and other moist areas are very good habitat and provide avenues for dispersal. This species can tolerate a variety of conditions and has been reported in areas such as roadsides, vacant lots, as well as yards and gardens.

Management: Recommendations at this time focus on hand pulling infestations.

Good advice from the Minnesota Department of Agriculture in reference to controlling narrowleaf bittercress;

"Following guidelines for controlling other biennial mustards such as garlic mustard, *Alliaria petiolata*, may be helpful."

Hand pulling timed to prevent flower and/or seed production is recommended. Preferably, propagating plant parts should be disposed of onsite or when necessary contained (e.g., bagged) and removed to an approved facility. For more information on these disposal options, please read MDA's guide on removal and disposal. Subsequent re-treatments will be required due to germination and recruitment from the seedbank. If infestations are large or dense, consider the need for ground cover to prevent erosion and to provide competing vegetation.

Prescribed fire in spring to top-kill basal rosettes and seedlings. Follow-up treatment with **herbicide** is imperative after seedling germination to further slow growth of infestations.

Herbicide applications to foliage with formulations of triclopyr, metsulfuron-methyl, or imazapic.
Use glyphosate or 2,4-D after native plants have entered dormancy and narrowleaf bittercress is still active.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn			Use fire to improve native plant community.						
Herbicide	Foliar									
	Mow	Mow to prevent flowering								
	Don't mow			Do not mow when seed is present						
Flowering Period										

Prohibited: Control

Plumeless thistle : *Carduus acanthoides* L.

Identification: *Compare to nonnative Canada thistle (Cirsium arvense). See page 21.*
Compare to native swamp thistle (Cirsium muticum). See page 70.
Compare to nonnative musk thistle (Carduus nutans). See page 53.
Compare to nonnatives alfalfa and hairy vetch. See page 49.

Plant: Herbaceous, biennial reaching heights of 1-4 feet. Unlike native thistles, the stems of plumeless thistle are winged and spiny.

Leaves: Edges of rosette leaves are wavy with yellowish spines. Stem leaves are alternate, attached directly to stems and typically have hairs on bottoms along mid-veins.

Flower: Numerous stem branches support terminal, single, composite flowers that are ½ to 1½ inches wide. Linear or narrow bracts with short spines are found immediately below pink to purple flowers.

Bloom time is July to October.

Fruit and Seed: Small seeds approximately 1/16 inch long described as straw colored and tufted with fibers on the terminal end. The fibers aid in wind dispersal.

Life History: Reproduction is by seed and seeding is prolific building a large seed bank in a short period of time. Thus, control measures should focus on eliminating seed production and exhaustion of seed banks. Movement is greatly increased by animal and/or human activities such as mowing or haying.

It is reported that musk thistle (*Carduus nutans*) and plumeless thistle hybridize.

Habitat: Found on dry to moist soils in pastures, woodlands, waste areas, along roadsides, ditches and stream banks.

Management:

Cutting taproots 1-2 inches below ground is effective but time consuming for large numbers of plants. **Mowing** should be timed at flower bud stage to prevent seed production and should be repeated 2-3 times per season to be effective. Avoid spreading seed with hay or straw and with mowing and vehicle movement through infestations.

Prescribed fire can be used to encourage stands of native grasses that will outcompete thistle. However, monitoring is needed to check for thistle that germinates in bare soil soon after burns are completed.

Herbicide applications timed at the early bolting phase are foliar applications of 2,4-D ester or dicamba formulations. For foliar applications at the budding to flower stage or fall applications to basal rosettes turn to formulations of aminopyralid, clopyralid, metsulfuron-methyl or triclopyr.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	Monitor and follow-up.					Fire supports native plant communities			
Herbicide	Foliar									
	Mow	Mow to prevent flowering								
	Don't mow				Do not mow when seed is present					
Flowering Period										

Prohibited: Control

Purple loosestrife : *Lythrum salicaria* L.

Listing includes European wand loosestrife (*Lythrum virgatum* L.).

Identification: *Compare to native fireweed (Chamerion angustifolium). See page 61.*

Plant: Herbaceous, wetland perennial, 4-7 feet tall with a 4 to 6 sided wood-like stem.

Leaves: Opposite, sometimes whorled, lance-shaped, and downy with a slightly wavy yet smooth edge. Leaf pairs are positioned at right angles to the leaf pairs above and below.

Flower: Each plant can have from one to many spikes of pinkish-purple flowers. Center of the flower is yellowish and surrounded by 5-7 petals that have a wrinkled appearance.

Bloom time is July to September.

Fruit and seed: Tiny seeds are released from 2-parted capsules.

Life History: Reproduction by seeds and rhizomes produce large monoculture infestations.

Habitat: Purple loosestrife can be found on upland sites but is best known as an invader of wetlands or aquatic habitats such as ditches, wet meadows, ponds, marshes, river and stream banks as well as lake shores. Purple loosestrife disrupts aquatic habitats as it displaces wetland emergent species.

Management:

Biological control agents in the form of two leaf feeding beetles of the same genus (*Galerucella calmariensis* and *G. pusilla*) have been very effective in Minnesota. For more information visit Minnesota Dept. of Natural Resources.

Mowing is seldom an option due to wet environments. **Cutting** of flower spikes can be an effective control of seed production. **Hand pulling** or **digging** of plants can also be effective but care should be taken to remove entire root systems if possible. Resprouting can occur from roots and root segments left in the ground or on the site. Preferably, propagating plant parts should be disposed of onsite or when necessary contained (e.g., bagged) and removed to an approved facility. For more information on these disposal options, please read MDA's guide on removal and disposal.

Herbicide formulations labeled for use on rights-of-way and near water; 2,4-D, glyphosate, imazamox, metsulfuron-methyl+aminopyralid, triclopyr, imazapyr and aminocyclopyrachlor.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	Use fire to improve native plant community.								
Herbicide	Foliar									
	Cut stem									
	Mow		Mow to prevent flowering							
	Don't mow					Do not mow when seed is present				
Flowering Period										

Prohibited: Control

Wild parsnip : *Pastinaca sativa* L.

Caution - Use protective clothing, goggles or face mask. Contact with the sap of the plant (i.e., phyto) when combined with exposure to sunlight (i.e., photo) can cause severe blistering and swelling (i.e., dermatitis) - phytophotodermatitis. See MnDOT factsheet: Work Safely Around Wild Parsnip.

Identification: *Compare to golden alexanders (Zizia aurea) and heart-leaved golden alexanders (Z. aptera), both native.* *See page 62.*

Plant: Herbaceous, often stated to be biennial but is classed as a monocarpic perennial (plant dies after bearing fruit). Early life form is a basal rosette with mature stems developing a hollow, grooved flowering stalk potentially reaching 5 feet.

Leaves: Basal rosette leaves can be 6 inches in height and are pinnately compound with 5-15 leaflets. Flowering stalk leaves are alternate, 2-5 leaflets that become smaller near the top of the stem. Leaflets are coarsely toothed, sinuses cut to varying depths creating lobes of various sizes. The base of the leaf stalks wrap or clasp the grooved stem.

Flower: 12-35, 5-petaled, small yellow flowers on wide, flat umbels of 15-25 umbellets approximately 2 to 6 inches across.

Bloom time is June to July.

Fruit and Seed: Flattened, yet ridged, oval seeds.

Life History: Typical life span is two years, first year a basal rosette. One of the first plants to green up in spring and one of the last to brown down in autumn providing good opportunities for scouting and treating. Mid to late summer, mature second-year plants will bolt, flower and set dozens of seed per plant. Seeds are moved off infested sites by animal and human activity or wind and water movement. Seed is reported to be viable in soil for up to 4 years.

Habitat: Disturbed sites such as roadsides and abandoned fields or lots. Can occur in wet meadows but dry to mesic soils are more typical. Full to partial sun is a must for this species.

Management: See Minnesota Department of Agriculture web for Lifecycle and Treatment Timing poster.

When possible plan early **mowing** at first inflorescence, then monitor and repeat as plants will likely re-sprout, bolt and flower. If **cutting** or **mowing** after seed set, clean equipment to leave seeds on the infested site. Preferably, propagating plant parts should be disposed of onsite or when necessary contained (e.g., bagged) and removed to an approved facility. For more information on disposal options, please read MDA's guide on removal and disposal.

Prescribed fire can be used to encourage stands of native grasses for competition. However, follow-up treatments (herbicide or cutting) are still required to prevent seed production.

Herbicide controls include foliar applications of 2,4-D or metsulfuron-methyl to the rosette stage during May and June and again in September or October. If glyphosate is to be applied to rosettes, it is recommended to hold off until late fall to prevent damage to desirable plants that should then be dormant.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	Use fire to improve native plant community.								
Herbicide	Foliar		■	■			■	■		
	Mow		Mow to prevent flowering							
	Don't mow				Do not mow when seed is present					
Flowering Period				▒	▒					

Restricted

Asian bush honeysuckles : *Lonicera* spp.

Top: Honeysuckle in sunlight, on the forest edge.

Center: Honeysuckle leaf and flower color variations.

Bottom: Fruit - Tatarian, Bella or Morrow's and Amur.

Tatarian honeysuckle (*L. tatarica* L.),
Morrow's honeysuckle (*L. morrowii* Gray),
Bell's or 'Bella' honeysuckle (*L.* × *bella* Zabel [*morrowii* × *tatarica*]),
Amur honeysuckle (*L. maackii* [Rupr.] Herder) - As of 01/2020 not known in Minnesota.

Identification: *Compare to Japanese honeysuckle and native honeysuckles, pages 11 and 65.*
Plant: Perennial woody shrubs, multi-stemmed and ranging in heights of 6-15 feet tall (Bell's to 20 feet, Amur to 30 feet). All nonnative bush honeysuckles have hollow stems with a brownish pith (image upper right).
Leaves: Opposite, egg-shaped to lanceolate (*Amur has lance-shaped with drawn out tips*). Other species have rounded to acute leaf tips with tapered, straight or heart-shaped leaf bases. Surfaces range from smooth and hairless on Tatarian to pubescent (hairy) on Amur and Morrow's. Leaf lengths are 1 to 2½ inches.
Flower: Fragrant pairs of tubular flowers approximately ¾ to 1 inch across. Color ranges from cream to white (Amur and Morrow's) or pink (Bell's) fading to yellow. Tatarian produces white, pink or red to crimson not fading to yellow.
Bloom time is mid May to early June.
Fruit and Seed: Most species bright red, Tatarian red to orange. The ¼ inch berries are in clusters of 2-4, mature in late summer and are readily eaten by birds that then disperse the oval, flattened seeds. *Amur honeysuckle fruit can be dark red to purplish, persists into winter and is held on stalks (peduncles) shorter than the leaf stalks (petioles).*
Life History: Vegetative sprouting aids renewal of shrubs. As mentioned above, seed dispersal is mainly by birds.
Habitat: Shade-intolerant plants often found along the forest edges (image upper left). Also found in disturbed, open upland sites such as roadsides, and abandoned pastures or fields.

Management: **Prescribed fire** can be useful to kill seedlings, and drain energy from mature plants . **Mowing (cutting)** can prevent or delay seed production but typically is not considered an eradication method. Monitor the infestation and utilize follow-up treatments of additional mowing and/or herbicide.
For small numbers of plants, **manual methods** including **cutting, digging, or hand pulling** if done repeatedly **and in conjunction** with other treatments can control infestations. Monitor and consider supplemental herbicide treatments. When pulling and digging suspend roots above ground to ensure they dry out. Plants should be disposed of onsite or contained (e.g., bagged) and removed to an approved facility.
Foliar herbicide treatments with formulations of metsulfuron, dicamba, picloram + 2,4-D, triclopyr + 2,4-D , imazapyr or glyphosate at full leaf out during the active growing season.
Cut stem or basal bark applications at any time with 2,4-D, imazapyr, or triclopyr formulations. Additionally, for **cut stem** options include picloram or glyphosate and for **basal bark** treatments options also include aminopyralid.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn				Follow-up with other treatments as necessary.					
Herbicide	Foliar			When fully leafed out and when in fruit.						
	Basal Bark	Any time.								
	Cut stem	Any time except May-June during heavy sap flow.								
	Mow		Mow frequently to control seedlings. Monitor for follow-up.							
	Don't mow				Do not mow when seed is present					
Flowering Period										

Restricted

Black locust : *Robinia pseudoacacia* L.

Identification:

A native of eastern US, an aggressive, introduced invader in Minnesota.

Plant: Woody perennial, large trees attaining heights ranging from 40-60 feet tall (potentially 80 feet). Bark is dark gray-brown with deep furrows between flat-topped ridges. Vigorous sprouts and young shoots are green-ish-colored and have paired spines up to 1 inch long at the base of leaves.

Leaves: Alternate, pinnately compound with 11-19 leaflets creating leaves 3-8 inches long. Oblong leaflets about ¾ to 2¼ inches long by ¼ to 1¼ inches wide. Leaf surfaces are dull dark green to blue-green and paler beneath.

Flower: Before leaves reach full expansion, showy racemes of ¾ inch long white to creamy white, pea-like flowers appear. Fragrant flowers attract early season pollinators.

Bloom time is June.

Fruit and Seed: Flat pods about 2-4 inches long by ½ inch wide turning brown at maturity. Pods contain 4-8 seeds.

Life History: A nitrogen fixing legume that produces a shallow root system. Most reproduction is vegetative, the species sprouts vigorously from roots and stumps. Many stands of trees are clonal stands. It is reported that while black locust produces seed they seldom germinate.

Habitat: Performs well in full sun on well drained soils where there is little competition. Does well in disturbed areas such as roadsides, abandoned fields and woodland sites that are degraded. Has been used in the past for mine soil (spoils) reclamation due to its tough nature and nitrogen fixing capability.

Management:

Mechanical methods such as **cutting** or **mowing** are seldom worth the time or effort since the plants are strong sprouters from root and stump. All of these mechanical methods can have limited effects, but eradication or even good control is unlikely. The same is true of **prescribed fire**.

Basal bark or cut stump herbicide applications with either aminopyralid or clopyralid formulations including bark oil are effective. Other formulations for **cut stump** might include dicamba, glyphosate, imazapyr, triclopyr or combinations of picloram + 2,4-D, triclopyr + 2,4-D, or aminopyralid + triclopyr. Growing season **foliar** applications can be made with the same active ingredients; aminopyralid and clopyralid. Additionally, metsulfuron, picloram + 2,4-D, glyphosate and imazapyr are labeled for use.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn						Monitor and follow-up.			
Herbicide	Foliar			When fully leafed out and actively growing.						
	Basal Bark	Any time.								
	Cut stem	Any time except May-June during heavy sap flow.								
	Mow		Mow frequently to control seedlings.							
	Don't mow									
Flowering Period										

Restricted

Common buckthorn : *Rhamnus cathartica* L.

Identification: *Compare to the native cherries and wild plum (Prunus spp.). See page 57.*

Plant: Tall shrub at 20-26 feet with potential to become a small tree reaching 36 feet. Often one to a few stems with diameters up to 5-6 inches and occasionally larger. Light-colored lenticels on shiny gray to brown bark leads to confusion with young native cherries and plums (*Prunus* spp.). Many twigs are terminated by a small ***thorn-like spine between dark colored, scale covered buds.***.

Leaves: **Sub-opposite**, at times appearing opposite and on fast growing sprouts alternate. Shiny green, 1-2½ inches, oval with tiny teeth on leaf edges. Veins curving to the tip of the leaf (arcuate venation) provide a strong identification characteristic and green leaves persisting into autumn.

Flower: **Dioecious**, male and female flowers on separate plants, small, 4-parted and green.

Bloom time is May to June.

Fruit and Seed: Fruit on female plants only. At maturity a purplish-black, small (¼ inch), berry-like fruit held close to the stem in clusters. Strong identification characteristic are these blackish fruits held close to twigs late into winter. Typically, 3-4 seeds per fruit.

Life History: Reproduction is by seed and dispersal is often aided by birds. Heavy seed production combined with stems and stumps that sprout vigorously when damaged make control difficult.

Habitat: A strong competitor on upland sites in a variety of soil types and moisture regimes. Common buckthorn thrives in the understory, on the forest edge or in full sun often to complete exclusion of other species.

Management:

Keep in mind, if funds and/or time are limited female plants are the fruit producers and should be targeted first. Caution should be exercised to avoid creating large bare patches and/or extensive soil disturbance. Both scenarios lead to soil erosion and create good seed beds for common buckthorn regeneration.

Hand pulling or the mechanical advantage provided by a **weed-wrench** can help control small infestations. **Cutting** of stems must be accompanied by herbicide treatments or resprouting will occur. **Mowing** is typically not an option in sensitive wetland areas, but on upland sites may be a useful tool in seedling and small diameter stem control.

Prescribed fire is used to control seedlings and small diameter stems and if used consistently can drain larger plants of reserves and provide control. However, sprouting will occur and a follow-up herbicide application should be considered.

Herbicide formulations of triclopyr, imazapyr, metsulfuron-methyl, 2,4-D, glyphosate or picloram are used as foliar applications. Herbicides include triclopyr or glyphosate for late autumn into winter applications to basal bark, cut stumps or frill cuts.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn						Monitor and follow-up.			
Herbicide	Foliar			When fully leafed out and actively growing.						
	Basal Bark	Any time.								
	Cut stem	Any time except May-June during heavy sap flow.								
	Mow		Mow frequently to control seedlings.							
	Don't mow									
Flowering Period										

Restricted

Glossy buckthorn : *Frangula alnus* Mill.

Identification: *Compare to the native cherries and wild plum (Prunus spp.). See page 57.*

Plant: Shrub or small tree at 20 feet in height, often multi-stemmed with prominent light-colored lenticels on dull grayish to dark brown bark. Heartwood may be orange to pinkish and sapwood may be yellowish, both can facilitate identification. ***No thorns or spines!*** There are no bud scales protecting overwintering buds - referred to as naked buds.

Leaves: **Alternate**, glossy, 2-3 inch length with prominent parallel veins terminating near a smooth edge. Undersides are slightly hairy and dull. Leaves will likely persist longer in autumn than native deciduous shrubs, but they will turn yellow and drop.

Flower: **Monoecious,** male and female parts present in flowers. Therefore, all shrubs can fruit. Not showy, small, 5-petaled, yellowish and borne in clusters in the leaf axils.

Bloom time is May to July.

Fruit and Seed: Clustered in leaf axils along the stem, initially reddish maturing to purplish-black in late summer into autumn. Each fruit contains 2-3 seeds, dispersed by birds.

Life History: Reproduction is by seed and while birds disperse the seed, dense thickets suggest many seeds drop close. Shades out native shrubs and forbs creating monocultures in sites that typically support very diverse flora.

Habitat: An invader of wetlands, including sedge meadows, sensitive acidic bogs and calcareous fens. Tolerant of shade, yet will perform well in full sun on upland sites.

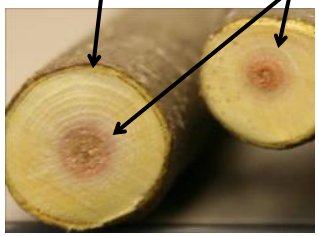
Management:

Caution should be exercised to avoid creating large bare patches and/or extensive soil disturbance. Both scenarios lead to soil erosion and create good habitat for glossy buckthorn regeneration.

Hand pulling or the mechanical advantage provided by a weed-wrench can help control small infestations. **Cutting** of stems must be accompanied by herbicide treatments or resprouting will occur. **Mowing** is typically not an option in sensitive wetland areas, but on upland sites may be a useful tool in seedling and small diameter stem control.

On upland sites **prescribed fire** can be used to control seedlings and small diameter stems and if used consistently can drain larger plants of reserves and provide control. However, sprouting will occur and a follow-up herbicide application should be considered.

Herbicide formulations of triclopyr, imazapyr, metsulfuron-methyl, 2,4-D, glyphosate or picloram are used as foliar applications. Herbicides include triclopyr or glyphosate for late autumn into winter applications to basal bark, cut stumps or frill cuts.



		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn						Monitor and follow-up.			
Herbicide	Foliar			When fully leafed out and actively growing.						
	Basal Bark	Any time.								
	Cut stem	Any time except May-June during heavy sap flow.								
	Mow		Mow frequently to control seedlings.							
	Don't mow									
Flowering Period										

Restricted

Crown vetch : *Securigera varia* (L.) Lassen

Synonym: *Coronilla varia* L., also known as purple crown vetch.

Identification: *Compare to nonnatives alfalfa, hairy vetch. See page 49. Compare to native American vetch and Canadian milkvetch. See page 56.*

Plant: Erect, perennial plant at 1-2 feet tall that forms dense tangled masses of reclining 2-6 feet long stems.
Leaves: Alternate, compound leaves, odd-pinnate with 11-25 oval, smooth-edged leaflets often with a minutely pointed tip. Leaves are stalkless.

Flower: Up to 6 inch long, erect flower stalks support dense umbels or crown-like clusters of 10-25, 5-parted, ⅛-½ inch long pinkish flowers.

Bloom time is May to September.

Roadside infestation being held in check by mowing and herbicide applications.

Fruit and Seed: Erect, narrow, multi-segmented, pointy-tipped, angular pods containing up to 12 seeds are clustered at ends of upright stalks. See seed pod images lower left.

Life History: Colonies develop rapidly as plants produce lots of seed and also spread aggressively via vegetative rhizomes. Seed is reported to remain viable for as long as fifteen years. Unattractive, large brown patches in winter and early spring help identify crown vetch infestations.
Habitat: Old fields, pastures and roadsides. Crown vetch has been planted extensively for forage products and along roadsides and steep embankments for erosion control.

Management:
Cutting or **mowing** will reduce vigor but not eliminate an infestation. Plan to mow several times a season and monitor to time operations with a goal to prevent seed set. Mow cautiously as large infestations often conceal erosion.

Prescribed fire can be used with other management tactics to encourage stands of native grasses that will compete for resources. However, monitoring is necessary as crown vetch will resprout after burns.

There is a long list of active ingredients applied as a **foliar herbicide** applications. Active ingredients include, but may not be limited to, 2,4-D, aminopyralid, clopyralid, dicamba, glyphosate, metsulfuron-methyl, sulfometuron, picloram and triclopyr. Recommendation is to apply aminopyralid before flower while others are recommended for application during active growing periods.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn		Late Spring		Use fire to improve native plant community.					
Herbicide	Foliar		During active growth periods.							
	Mow		Mowing must be repeated to prevent flowering							
	Don't mow					Do not mow when seed is present				
Flowering Period										

Restricted

European alder : *Alnus glutinosa* (L.) Gaertn.


Doubly serrate leaf edge

Identification: *Compare to native Speckled alder and green alder on page 67.*
Plant: In North America a medium sized tree around 50 feet tall with a narrow, upright crown. Bark is initially smooth and greenish with prominent whitish lenticels. With age bark becomes grayish-brown and broken into small patches.
Leaves: Alternate, simple, oval to almost circular at 2 to 3 inches wide with a rounded to slightly notched tip. The edge or margin is doubly serrate and the color is dark green above. The veins are markedly parallel, 7 or fewer per side, with some hairs in vein axils on the underside.
Flower: Trees are monoecious with male and female catkins on each tree. Male catkins are reddish-brown, slender, about 1 to 1½ inches long and present summer through winter. In spring male catkins extend to release pollen. Female catkins are egg shaped, ¾ inch long, green in summer maturing to a brown cone-like structure that persists into winter.


Female catkins - new current season left, old previous season to the right.

Bloom time is late March into May.

Fruit and Seed: Female catkins mature to a brown, woody, cone-like structure that opens in winter to release small winged nutlets (samaras). The cone-like structures persist all winter and into the next season in some cases.
Life History: Wind dispersed seed is released from the cone-like structures in late autumn and winter. Since plants are often in riparian zones , seed can be further distributed by water. Germination takes place the following spring. Alders are nitrogen fixing species allowing them to alter the environment in their favor.
Habitat: Prefers moist habitats such as those found in riparian zones where European alder will dominate the system. While the species prefers moist soils, a range of soil types and periods of drought can be tolerated.

Management:
Prescribed fire may not be the right tool for control of woody vegetation. In forested settings, if conditions are right to carry a fire - seedlings/saplings can be damaged or killed, but so is true of regenerating desirable woody species.

Manual methods include **hand pulling** when soils are moist. Or repeated **cutting of stems** can be effective. But the site must be monitored for potential resprouts and for seed germination in disturbed soils. These resprouts and seedlings require additional treatments or subsequent follow-up with an applicable **herbicide**.

Smaller trees can be controlled with **foliar applications** of triclopyr or glyphosate formulations. For **Cut stem** treatments make cuts as close to the ground as possible and apply glyphosate or triclopyr formulations to the cut surface. Additionally, **basal bark** treatments with triclopyr formulations may also be effective.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	May not be applicable					Monitor and follow-up.			
Herbicide	Foliar			When fully leafed out and actively growing.						
	Basal Bark	Any time.								
	Cut stem	Any time except May-June during heavy sap flow.								
	Mow		Mow frequently to control seedlings.							
	Don't mow									
Flowering Period										

Restricted

Garlic mustard : *Alliaria petiolata* (M. Bieb.) Cavara & Grande

Identification:

Plant: Herbaceous, biennial with first year plants being basal rosettes. Second year flowering plants can attain heights of 4 feet and can produce more than one flowering stem.

Leaves: Basal rosettes with coarsely toothed, kidney-shaped foliage remains green through winter. Foliage on flowering stems is alternate, triangular, coarsely toothed and stalked. Foliage has the odor of garlic when crushed.

Flower: Clustered, 4-parted, white flowers are approximately ⅓ inch across.

Bloom time is April to June.

Fruit and Seed: The 1-2½ inch long slender seed pods are very recognizable and contain numerous black, shiny seeds.

Life History: Reproduction is by seed that matures June into July and can be dispersed about 6 inches when pods burst at maturity. Seed remains viable in soil for up to 5 years.

Habitat: An invader of shady, moist forests or woodland settings but also invades oak savannas and disturbed areas in full sun. It is reported that garlic mustard will inhibit the growth of beneficial fungi associated with native plants thus causing a decline in herbaceous cover.

Management: **Biological control agents** are under investigation, but none are approved for release at this time. One insect being studied is *Ceutorhynchus scrobicollis*, a crown and stem-mining weevil.

Manual methods include pulling plants in early spring prior to flowering (seed set is almost coincidental with flowering) and cutting plants back to the ground as they bolt for flowering, prior to flower opening. Monitor the site as cutting may need to be repeated. If mature flowers (or seed pods) are present, plants should be disposed of onsite or contained (e.g., bagged) and removed to an approved facility.

Prescribed fire in spring to top-kill basal rosettes and seedlings. Follow-up treatment with **herbicide** is imperative after seedling germination to further slow growth of infestations.

Herbicide applications to foliage with formulations of triclopyr, metsulfuron-methyl, or imazapic. Use glyphosate or 2,4-D after native plants have entered dormancy and garlic mustard is still active.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn			Use fire to improve native plant community.						
Herbicide	Foliar		Best when native plants are dormant.							
	Mow	Mow to prevent flowering								
	Don't mow			Do not mow when seed is present						
Flowering Period										

Restricted

Japanese barberry : *Berberis thunbergii* DC.

Above: *B. thunbergii* in flower late May.
Below left: *B. thunbergii* 'Erecta'
Below right: *B. thunbergii* 'Rose Glow' (top) and
B. thunbergii 'Sparkle' (bottom)

Identification: *Compare to nonnative common barberry (B. vulgaris) on page 20.*
More images and regulated cultivars next page.

Plant: Perennial woody shrubs, multi-stemmed, typically 3-6 feet tall (potentially to 8 feet tall). Stems are grooved or angular and ranging in color from gray to reddish-brown. Single (possibly 3 branched) ½ inch long spines occur at nodes where leaves attach. Lateral spine branches if present may be very small.

Leaves: Alternate, typically clustered so not appearing alternate. Leaves are simple, narrow near the twig and described as obovate (wider towards the end). The leaf edge or margin is smooth (*B. koreana* and *B. vulgaris* have teeth) and occasionally there is a minute spine tip or point at the ends of leaves.

Flower: Small (¼ to ⅓ inch) yellowish flowers suspended under the foliage. Therefore not considered showy. Japanese barberry flowers are typically individual but flowers may be in clusters of 2-4 while Korean barberry (*B. koreana*) may have up to 20 flowers per raceme (cluster). See fruit of Korean barberry in upper right-hand image on next page.
Bloom time is May to early June.

Fruit and Seed: Bright red, dry flesh, a true berry that persists into and through winter (image next page, bottom right: fruit at leaf out in April). The ⅓ inch long ellipsoidal berries, like the flowers, will be solitary or in clusters of 2-4.

Life History: Seed production is strong and this special regulation targets species and cultivars producing on average more than 600 seeds. Seed bank viability (longevity) is not well understood; although, a report on *B. thunbergii* 'Beth' states that the seed remain viable up to 10 years. Reproduction can also be vegetative via root sprouts and shrub branches may root if in contact with the ground.

Habitat: Prefers well drained soils in full sun to partial or deep shade. Forest edges, open forests and other woodlands yet also found in old fields, areas of disturbance and can survive in wetland soils.

Management: **Prescribed fire** (or direct flame from a propane torch) can be useful to kill seedlings, and drain energy from mature plants. **Mowing (cutting)** can prevent or delay seed production but typically is not considered an eradication method. Monitor the infestation and utilize follow-up treatments of mowing and/or herbicide.

For small numbers of plants **manual methods** including **cutting, digging, and hand pulling** if done repeatedly **and in conjunction** with other treatments can control infestations. Monitor and consider supplemental herbicide treatments. When pulling and digging suspend roots above ground to ensure they dry out. Preferably, propagating plant parts should be disposed of onsite or when necessary contained (e.g., bagged) and removed to an approved facility. For more information on these disposal options, please read MDA's guide on removal and disposal.

Foliar herbicide treatments with metsulfuron products at full leaf out during the active growing season. Additionally, dicamba + 2,4-D, triclopyr or glyphosate at full leaf out while the plants are fruiting during the growing season.

Cut stem applications at any time with glyphosate or triclopyr formulations can also be useful.

Basal bark treatments at any time with imazapyr or triclopyr products have proven effective.

Wild type, single and paired flowers.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn						Monitor and follow-up.			
Herbicide	Foliar			When fully leafed out and actively growing.						
	Basal Bark	Any time.								
	Cut stem	Any time except May-June during heavy sap flow.								
	Mow		Mow frequently to control seedlings.							
	Don't mow									
Flowering Period										

Restricted

Japanese barberry : *Berberis thunbergii* DC.



Above: 'Tara' (Emerald Carousel®; *B. koreana* × *B. thunbergii* hybrid)
Above left: Grooved, reddish-brown stem, single spines at nodes. Above center: Foliage and racemes of fruits. Above right: Form

Left: *B. thunbergii*
'Bailone'
Ruby Carousel®

Right: *B. thunbergii*
'Bailtwo'
Burgundy Carousel®

Japanese barberry cultivars prohibited from sale.

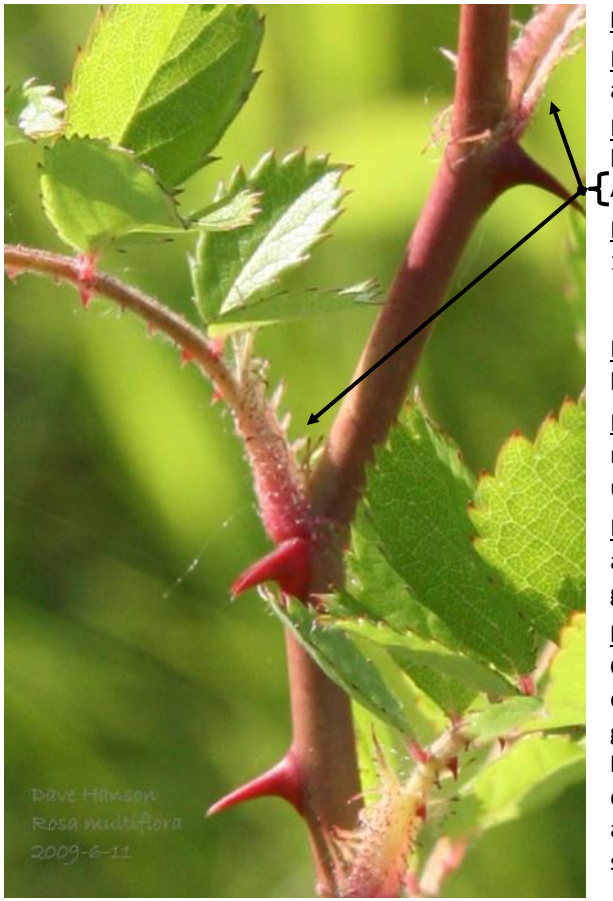
These plants average greater than 600 seeds per plant.

'Angel Wings' 'Antares' 'Anderson' (Lustre Green™) var. atropurpurea
'Crimson Velvet' 'Erecta' 'Gold Ring' 'Inermis' 'Kelleris' 'Kobold'
'Marshall Upright' 'Painter's Palette' 'Pow Wow' 'Red Rocket' 'Rose Glow'
'Silver Mile' 'Sparkle'
'JN Redleaf' (Ruby Jewel™) 'JN Variegated' (Stardust™) 'Monomb' (Cherry Bomb™)
'Bailgreen' (Jade Carousel®) 'Bailone' (Ruby Carousel®) 'Bailtwo' (Burgundy Carousel®)
'Bailsel' (Golden Carousel®; *B. koreana* × *B. thunbergii* hybrid)
'Tara' (Emerald Carousel®; *B. koreana* × *B. thunbergii* hybrid) Wild Type (parent species - green barberry)

Above: *B. koreana* **images for comparison**.
Toothy foliage (serrulate margin) and more than 10 *rounded* fruits per raceme
Inset: Close-up of Korean barberry leaf edge.
Below: Unknown *Berberis* species / cultivar holding fruit at leaf out in April.

Restricted

Multiflora rose : *Rosa multiflora* Thunb.



Identification:

Plant: Shrub with 6-13 feet long, wide arching canes reaching 6-15 feet tall. Canes armed with stiff, downward curved prickles (thorns) form an impenetrable thicket.

Leaves: Alternate, pinnately compound, 5-11 sharply-toothed leaflets. The oval leaflets are nearly smooth on the topside and are covered with short hairs below. A unique feature are fringed stipules where leaves attach to stems.

Flower: Numerous, showy flowers. Five-parted, fragrant, white to slightly pink, ½-1½ inches across.

Bloom time is May to July.

Fruit and Seed: Numerous rose hips, ¼ inch diameter, bright red to orange-red, hairless or smooth. Hips are on a wide branched structure and persist into winter.

Life History: Plants reproduce by seed and by cane tips with ground contact taking root. The plants are prolific seed producers and seeds are viable in seed banks for up to 20 years.

Habitat: Readily invades disturbed areas such as woodlands, prairies, roadsides, along streams and has become a problem in pastures where the thorns discourage grazing.

Management:

Cutting or **mowing** frequently during the growing season (3-6 times) for 2-4 years can achieve good control of infestations. **Prescribed fire** in the spring will provide good control of small stems and seedlings.

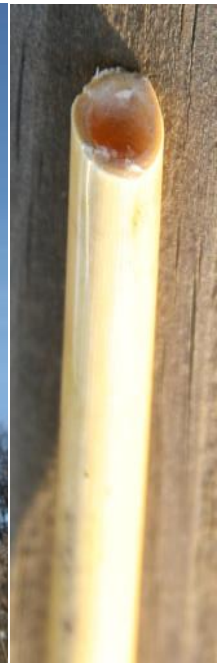
Herbicide applications to cut stems and to resprout stems with systemic herbicides such as glyphosate have proven successful. As with most species, late season applications of herbicides are effective as plants are moving photosynthates to storage in root systems.

Images clockwise order: Iowa (IA) and Illinois (IL)
UR: White, five-parted flower (IA, 2009-6-11).
LR: Wide branched, maturing ¼ in. hips (IL, 2015-10-16).
LL: Compound leaves (IA). Thorns, stipules and hips (IL).
UL: Fringed stipules and downward curved thorns (IA).

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn				Use fire to improve native plant community.					
Herbicide	Foliar			When fully leafed out and actively growing.						
	Cut stem				Avoid period of heavy sap flow.					
	Mow	Mowing, when possible, must be repeated								
	Don't mow									
Flowering Period										

Restricted

Nonnative Phragmites or common reed (nonnative subspecies)



Phragmites australis* (Cav.) Trin. Ex Steud. subsp. *australis

Compare to native Phragmites (P. australis subsp. *americanus), page 66.*

Identification:

Plant: A perennial grass reaching heights of 15 feet. Dense stands develop from rhizomatous root systems with live stems and dead stems intermingled. Hollow stems are green in summer and yellow in winter.

Leaves: Dark green, grass-like elongated foliage that is at most 1½ inches wide. Leaf sheaths are typically retained on culms (stems) into winter even if leaves drop from dead culms. *Compare to native phragmites that sheds leaves and leaf sheaths.*

Flower: Bushy panicles of purplish or golden flowers appear in July. Bloom time is July to September.

Fruit and Seed: Large, dense seed heads become gray-brown. Hairy seeds give heads a fuzzy, fluffed appearance.

Life History: Rhizomes, rhizome fragments, root runners and copious amounts of seed provides common reed a strong competitive edge. It forms such dense stands and thick root systems that all native plants can be forced out. Rhizome segments can break free and coupled with seed production plants readily move into and take over new areas.

Habitat: Shorelines of lakes and rivers as well as pond edges and freshwater marshes. Disturbed areas and roadsides can support common reed very well.

Management: Once established, chemical treatments are recommended as a first step in restoration efforts.

Cutting or **mowing** will not kill plants or eradicate infestations, but can be effective at slowing the spread.

Prescribed fire after the plant has flowered. Used prior to herbicide treatments, fire (or mowing) removes biomass improving herbicide application to regrowth. Do not burn prior to flowering, as this timing may only encourage growth.

Herbicide applications, aquatic formulations of imazapyr or glyphosate are effective, even on established stands. Rapid recognition of infestations and treatments soon after increase effectiveness. Late summer/early autumn herbicide applications to foliage or to cut stems are best and repeat treatments in subsequent seasons are likely necessary.

Glumes or seed covers vary in length. Upper and lower glumes are longer on the native subspecies. Best analyzed under a microscope.

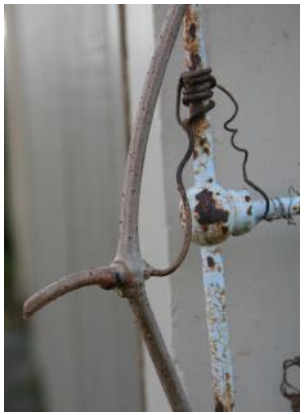
For additional information visit: Phragmites Research at MAISRC, University of Minnesota (MAISRC).

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn					After flower				
Herbicide	Foliar				After Flower					
	Cut stem					After Flower				
	Mow		Mowing must be repeated							
	Don't mow						When seed is present			
Flowering Period										

Restricted

Porcelain berry : *Ampelopsis brevipedunculata* (Maxim) Trautv.


Image by: Paul Kortebein



Another common name: Amur peppervine. Family: Vitaceae, same genus as *Vitis* (grapes).
Synonyms: *A. brevipedunculata* (Maxim.) Trautv. var. *maximowiczii* (Regel) Rehder
A. glandulosa (Wall.) Momiy. var. *brevipedunculata* (Maxim.) Momiy.
A. heterophylla (Thunb.) Siebold & Zucc.
A. heterophylla (Thunb.) Siebold & Zucc. var. *brevipedunculata* (Regel) C.L. Li

Identification: *Compare to native riverbank grape (Vitis riparia). See page 64.*
Plant: Perennial, woody vines that climb trees or structures with assistance of tendrils. Like riverbank grape, tendrils occur opposite leaves. Bark of porcelain berry is gray and retains smoothness with age and the pith is white.
Key differences - *Riverbank grape has dark brown bark that peels in narrow, vertical strips.*
Leaves: Alternate, simple leaves with a cordate (heart-shaped) base and 3-5 palmate coarsely toothed lobes separated by deep sinuses. Some leaves may resemble wild grape leaves.
Key differences - *Riverbank grape has shallow sinuses between 3 distinct palmate, coarsely toothed lobes.*
Flower: Inconspicuous, panicles of greenish flowers occur opposite leaves .
Bloom time is June to August.
Fruit and Seed: Shiny, brightly colored berries in hues of blue to purple mature in September and October. Each berry contains 2-4 seeds and seed viability is reported to be 'several' years.
Life History: Water may play a small part in seed movement but predominant means of dispersal is by birds and small mammals that have fed on the colorful berries. Vegetative reproduction is also possible. Vines have strong root systems and will resprout after cutting.
Habitat: When found, typically in riparian (floodplain) areas that are not permanently wet. Full sun to partial shade on forest edges, stream banks, thickets and other such places.
Management:
Acceptable control can be attained with **mechanical** methods such as **hand pulling** or **cutting** (possibly **mowing**). However, after cutting, plants will resprout so there should be a plan to monitor and follow up cutting treatments with additional cutting or herbicide treatments. Follow-up to monitor for new seedlings will also be required.
For large infestations **herbicide** applications are likely the most cost effective approach. Systemic herbicides for woody brush control such as glyphosate and triclopyr have been used effectively as **foliar** or **basal bark / cut stem** treatments.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
Herbicide	Foliar		During active growth or cut and treat resprouts.							
	Basal bark					Basal bark (with oil) or cut stem				
	Mow		Mowing, when possible, must be repeated							
	Don't mow						When seed is present			
Flowering Period										

Restricted

Siberian peashrub : *Caragana arborescens* Lam.

Exemption: Seedless selection Green Spires® Caragana - *Caragana* 'Jefarb'.

Identification:

Plant: Oval, often a multi-stemmed shrub 15-20 feet in height and 12 to 18 feet in width. Occasionally a single stemmed tree. Stems are greenish, shiny, becoming gray and can have paired spines at nodes. Spur shoots develop on some older branches.

Leaves: Alternate, compound with an even number of pinnate leaflets (8-12). Each leaflet is approximately ½ to 1 inch long, elliptic-oblong in shape. Quite fuzzy at emergence, later much less so and bright green.

Flower: Pea-like flowers are bright yellow and about ½ to 1 inch long. Flowers are arranged in clusters or as singles.

Bloom time is mid May to early June.

Fruit and Seed: Slender, cylindrical, sharply pointed pods (peapod like) 1½ to 2 inches long. Yellow-green changing to brown, splitting (audibly) and curling to release 3-5 seeds. Split, empty pods persist on the shrub (lower right).

Life History: Seed is released late July into August. Seed is forcibly ejected as pods audibly pop to expel seeds.

Habitat: Like many members of the Fabaceae family this plant fixes nitrogen. Prefers full sun (tolerates some shade) and is tolerant of poor growing conditions such as poor dry soils, cold temperatures, windy sites and tolerates salt.

Management:

Prescribed fire may not be the right tool for control of woody vegetation. In forested settings, if conditions are right to carry a fire - seedlings/saplings can be damaged or killed, but so is true of regenerating desirable woody species.

Manual methods include **hand pulling** when soils are moist. Or repeated **cutting of stems** can be effective. But the site must be monitored for potential resprouts and for seed germination in disturbed soils. These resprouts and seedlings require additional treatments or subsequent follow-up with an applicable **herbicide**.

Smaller shrubs can be controlled with **foliar applications** of triclopyr or glyphosate formulations. For **cut stem** treatments make cuts as close to the ground as possible and apply glyphosate or triclopyr formulations to cut surfaces. Additionally, **basal bark** treatments with triclopyr formulations may also be effective.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	May not be useful					Monitor and follow-up.			
Herbicide	Foliar			When fully leafed out and actively growing.						
	Basal Bark	Any time.								
	Cut stem	Any time except May-June during heavy sap flow.								
	Mow		Mow frequently to control seedlings.							
	Don't mow									
Flowering Period										

Restricted

Queen Anne's Lace (wild carrot) : *Daucus carota* L.

Identification: *Compare to nonnative poison hemlock , carrot look-alikes and wild chervil.*
Compare to native water hemlock. See pages 17, 51, 52 and 72.

Plant: Herbaceous, biennial, first year as a basal rosette. Basal leaves are clustered, up to 5 inches long and arch away from a central location. Second year flowering plants attain heights of 3-4 feet on hollow stems that are hairy to sparsely hairy and striped with light colored lines.

Leaves: Alternate, fern-like, finely divided leaves are widely spaced on upper stems and up to 4 inches across by 2 inches wide. Stem and basal leaves are fern-like, finely divided, narrowly lobed described as bipinnate-pinnatifid. Underside of leaves may be slightly hairy along veins. Leaves are attached to stems with sheaths, also a trait of family members.

Flower: Similar to other family members - many small (1/8 inch), 5-petaled, white flowers (florets) make up a flat-topped compound umbel 2-5 inches across. Compound umbels are dense with 20-90 umbellets of which each has 15-60 flowers. Often, outer flower petals are large in comparison to others and a central flower (or flowers) of the compound umbel is purplish (not always present).

Another distinguishing characteristic in this family are bracts beneath flower umbels. Some family members have few if any bracts, wild carrot has very prominent often branched bracts under main umbels and smaller sometimes linear (unbranched) bracts under umbellets making up the larger floral display.

Bloom time is June to September. For about two months various bloom stages within infestations.

Fruit and Seed: Each floret produces 2 seeds (a schizocarp splits into carpels). Seeds are flat and bristly to catch passing fur or clothing. Entire seed clusters may break off plants in winter to roll across the snow distributing seed.

Life History: Infestations spread mainly by seed. Seeds are reported to be viable for as long as seven years. Deep tap roots are difficult to remove and provide strong energy reserve for resprouting.

Habitat: Preferred habitat is dry to moist, disturbed soils in full sunlight. Tolerant of a variety of soils and partial shade

Management:

If performed frequently **cutting** or **mowing** are effective control methods. Same is true for hand pulling, roots and root fragments remaining in the soil may resprout. Monitor infestations and plan on additional treatments.

Prescribed fire as a tool should be used to improve the health of surrounding native vegetation. Wild carrot will likely not outcompete healthy vegetation and will decline on its own.

Foliar herbicide applications to plants at rosette stage with 2,4-D or 2,4-D formulations including dicamba or triclopyr have produced good results. Nonselective herbicides such as glyphosate formulations can also produce results.

Use herbicides wisely, 2,4-D **resistant** wild carrot populations have been identified in Michigan.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn		Use fire to improve native plant community.							
Herbicide	Foliar			Target seedlings or rosettes						
	Mow		Mowing must be repeated to prevent flowering							
	Don't mow				Do not mow when seed is present					
Flowering Period										

Specially Regulated
See page 82

Amur maple : *Acer ginnala* Maxim.

Identification: *Compare to native sugar maple (Acer saccharum) on page 68.*
Plant: Woody perennial, large shrub or small tree up to 20 feet in height. Mature bark is faint gray developing thin vertical stripes.
Leaves: Opposite, 1-3 inch long simple leaves are three lobed with center lobe extending past shorter side lobes and edges (margins) are doubly toothed. Bright green early in the season and producing brilliant fall colors in hues of red, yellow and gold-orange.
Flower: Fragrant, but not showy, loose clusters of pale yellow to creamy white flowers appear in early spring.

Bloom time is mid May to early June.

Fruit and Seed: Approximately ¾ to 1 inch long, paired, winged seed structures called samaras. The samara pair hang at close to a right angle almost parallel to one another. Initially, seed is very red in color, maturing to a light brown.
Life History: Species is a prolific seed producer. Small animals or birds may spread seeds but wind is likely the force behind most seed dispersal. Species stump sprouts but reproduction by vegetative means is not a strong characteristic.
Habitat: Preferences are to full sun or partial shade in well drained moist soils. However, the species is considered tough and specimens will tolerate dry conditions, salt and pH range of 6.1 to 7.5. A frequent invader of savannas, prairies and open forests where native shrubs, trees and forbs can be displaced.

Management: **Prescribed fire** will set back plants and may top kill seedlings but plants will likely resprout. **Manual methods** including **hand pulling or cutting** can eliminate small infestations of seedlings and saplings while **digging or cutting** larger material can be effective. Monitor and follow up with additional treatments as necessary.

Small plants or resprouting stumps can be treated with **foliar applications** of triclopyr formulations or glyphosate. **Cut stem** treatments with glyphosate or triclopyr are effective as well as **basal bark** treatments with triclopyr.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn						Monitor and follow-up.			
Herbicide	Foliar			When fully leafed out and actively growing.						
	Basal Bark	Any time.								
	Cut stem	Any time except May-June during heavy sap flow.								
	Mow		Mow frequently to control seedlings.							
	Don't mow									
Flowering Period										

Specially Regulated
See page 82

Norway maple : *Acer platanoides* L.

Rounded buds of Norway maple.

Identification: *Compare to native sugar maple (Acer saccharum) on page 68.*
Unique identifying feature – torn leaves, petioles, cut buds—all exude milky sap.
Plant: Medium sized trees that can attain heights of 50 to 80 feet. Bark becomes grayish black with shallow furrows at maturity. Stout olive-brown twigs with lenticels have purplish, terminal, rounded buds that are significantly larger than other species at ¼ to ⅜ inch.
Leaves: Opposite, simple, 4 to 7 inches wide with palmate veins leading out to 5 or 7 sharply toothed lobes. Color by variety ranges from dark green to purple.
Flower: Yellowish to greenish-yellow flowers appear just before leaf emergence. Due to large numbers of ⅛ inch flowers the display is showy (image to left).
Bloom time is late April to early May.

Fruit and Seed: Paired, winged samaras are widely separated. The wings are almost straight across from one another. Each samara is approximately 1½ to 2 inches in length. Seed matures in late summer and some may persist on the tree into winter.
Life History: Trees produce many seeds that are primarily wind dispersed often landing within 165 feet of the parent tree. Seeds are further dispersed by animals, birds or water. Viable seeds will spring germinate after cold stratification.
Habitat: Seedlings and saplings are very tolerant of shade and will alter the forest floor species composition excluding spring ephemerals and other tree/ shrub species.

Management:
Prescribed fire may not be the right tool for control of woody vegetation. In forested settings, if conditions are right to carry a fire - seedlings/saplings can be damaged or killed, but so is true of regenerating desirable woody species.
Manual methods include **hand pulling** when soils are moist. Or repeated **cutting of stems** can be effective. But the site must be monitored for potential resprouts and for seed germination in disturbed soils. These resprouts and seedlings require additional treatments or subsequent follow-up with an applicable **herbicide**.
Smaller trees can be controlled with **foliar applications** of triclopyr or glyphosate formulations. For **cut stem** treatments make cuts as close to the ground as possible and apply glyphosate or triclopyr formulations to the cut surface. Additionally, **basal bark** treatments with triclopyr formulations may also be effective.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn						Monitor and follow-up.			
Herbicide	Foliar			When fully leafed out and actively growing.						
	Basal Bark	Any time.								
	Cut stem	Any time except May-June during heavy sap flow.								
	Mow		Mow frequently to control seedlings.							
	Don't mow									
Flowering Period										

Specially Regulated
See page 82

Poison ivy : *Toxicodendron radicans* (L.) Kuntze

Caution - Use protective clothing, contact with oily sap (urushiol) from broken plant parts can cause blistering, even during winter months. Do not compost, urushiol may persist in compost. Urushiol can stay on and be transferred from pets, tools, toys and other objects for long periods. Do not burn, urushiol can adhere to smoke particles from burning poison ivy and be taken into airways and lungs. See MnDOT factsheet : Work Safely Around Poison Ivy.

Poison ivy, although irritating to humans, is a native plant that benefits wildlife by providing a food source to birds, small mammals and large browsers.

Identification: **Common poison ivy** [*T. radicans* (L.) Kuntze subsp. *negundo* (Greene) Gillis] is potentially a larger shrub (up to 10 feet) or a vine in southeastern Minnesota's riparian areas.

While both species are subject to regulation, information provided below focuses on **western poison ivy** [*T. rydbergii* (Small) Green] which is a frequently occurring shrubby plant with an extensive natural range across Minnesota.

Plant: A 1-2 foot **native** shrub with gray to tan bark and little if any branching.

Leaves: Alternate, compound leaves, 3 shiny or dull surfaced leaflets. Leaflet edges are variable from smooth to very coarsely toothed. Lower leaf surfaces are pale and often hairy.

Flower: Small, greenish flowers on erect spikes (panicles). Flower spikes are borne in leaf axils on new or current years growth with male and female flowers on separate plants (dioecious).

Bloom time is June to July.

Fruit and Seed: Creamy white to tannish berry-like drupes, approximately ¼ inch diameter. Drupes mature in August through September and persist through the winter providing a good identification characteristic on female plants.

Life History: Forms dense colonies by seed and through vegetative reproduction from surface or subsurface rhizomes.

Habitat: Invades disturbed areas such as roadsides, trail sides, fencerows, parks and can also be found in prairie (full sun) and forested settings (partial shade).

Management: **Grazing, cutting** or **mowing** can inhibit flowering but must be continued in order to deplete energy reserves and to deplete seed banks. When **mowing or weed whipping** wear proper personal protective equipment (PPE).

Prescribed fire generates potentially harmful smoke, see cautionary note above. So, while prescribed fire can provide control and often does control infestations of poison ivy, this tool should not be the first choice.

Herbicide formulations of triclopyr, 2,4-D, glyphosate, imazapyr or aminocyclopyrachlor applied to foliage or to cut stems are effective. Repeat applications will be required to exhaust seed banks.

Above and right: Common poison ivy - vine form climbing trees.
Left: Western poison ivy - 3 foot tall shrubby form.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn			Use fire to improve native plant community.						
Herbicide	Foliar									
	Cut stem									
	Mow	Mow frequently to prevent flower and seed production.								
	Don't mow									
Flowering Period										

Specially Regulated
See page 82

Winged burning bush : *Euonymus alatus* (Thunb.) Siebold

Identification:
Plant: Form is typically a rounded, multi-stemmed shrub up to 10 feet tall. Young stems are very green and develop significant ¼ inch tall, thin, corky, brown wings. After the first season bark matures to grayish-brown and wings may persist.
Leaves: Opposite, simple, elliptical to obovate (wider above the middle). Length is about 1½ to 3 inches and the edge of the leaf is finely serrate (little teeth). Brilliant scarlet to red fall color.
Flower: Clusters of three pale yellow-green, ½ inch flowers with rounded petals.

Bloom time is mid May to June.

Fruit and Seed: Fruit husk is a dark red ¼ to ⅓ inch capsule that splits to reveal a reddish-orange aril (a berry-like fruit).
Life History: Most seeds fall close to the parent plant but some may be distributed to new locations by birds. Adding to the number of stems may be vegetative reproduction from root suckers.
Habitat: Full sun to part shade prefers moist, well drained soil. A shrub that is very adaptable to poor soil conditions and tolerates; compaction, wide pH range, heat, drought and pollution. Described as very urban tolerant. Will tolerate full shade as a spindlier plant with less brilliant fall color.

Management: **Prescribed fire** may not be the right tool for control of woody vegetation. In forested settings, if conditions are right to carry a fire - seedlings/saplings can be damaged or killed, but so is true of regenerating desirable woody species.
Manual methods include **hand pulling** when soils are moist. Or repeated **cutting of stems** can be effective. But the site must be monitored for potential resprouts and for seed germination in disturbed soils. These resprouts and seedlings require additional treatments or subsequent follow-up with an applicable **herbicide**.

Smaller shrubs can be controlled with **foliar applications** of triclopyr or glyphosate formulations. For **cut stem** treatments make cuts as close to the ground as possible and apply glyphosate or triclopyr formulations to the cut surface. Additionally, **basal bark** treatments with triclopyr formulations may also be effective.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn	May not be useful					Monitor and follow-up.			
Herbicide	Foliar			When fully leafed out and actively growing.						
	Basal Bark	Any time.								
	Cut stem	Any time except May-June during heavy sap flow.								
	Mow		Mow frequently to control seedlings.							
	Don't mow									
Flowering Period										

Nonnative

Alfalfa : *Medicago sativa* L.

Identification: *Provided for comparison to crown vetch and purple flowered weeds such as thistles or knapweeds. Return to crown vetch (page 35).*
Return to knapweed complex (pgs. 13 and 14) or spotted knapweed (pg. 23).
Return to Canada or plumeless thistles (pgs. 21, 28).
Plant: **Fabaceae** family, 4-sided stem supports a 1-3 foot tall plant.
Leaves: Alternate, 3-parted, compound leaves with individual leaflets measuring ⅜ to 1⅜ inches long, stipulate (leaf-like appendages where leaves attach to stems).
Key difference - *Thistles and knapweeds have simple leaves not compound.*
Flower: 5-parted, purplish to blue (occasionally cream colored) and approximately ¼ to ½ inch long. Alfalfa has a clustered, somewhat conical flower head.
Key difference - *Thistles and knapweeds are disk flowers with ray flowers on the edges.*
Bloom time is June to September.
Fruit and Seed: Coiled pods, mature to a brown color.

Habitat: Introduced to North America for livestock forage and is an agriculture crop. Common in roadside ditches, and similar disturbed areas.

Nonnative

Hairy vetch : *Vicia villosa* Roth.

Identification: *Provided for comparison to crown vetch and purple flowered weeds.*
Also compare to American vetch, a Minnesota native. See page 56.
Return to crown vetch (pg. 35), knapweeds (pgs. 13, 14, 23) or thistles (pgs. 21, 28).
Plant: **Fabaceae** family, hairy vetch is a nonnative, short-lived perennial (biennial) with a spreading, viny form and has tendrils that assist climbing nearby plants up to 3 feet.
Leaves: Alternate, compound leaves, pinnately divided. Hairy vetch has 5-10 pairs of leaflets and tendrils are often found terminal on the compound leaves.
Key difference - *Crown vetch has no stipules, no leaf stalk and no tendrils.*
Flower: Hairy vetch has 10-40, 5-parted, pink to purple flowers about ¾ inch in length in a one-sided cluster.
Key difference - *Crown vetch has a dense cluster (crown-like) - not one-sided or spike-like.*

Bloom time is May to September.

Fruit and Seed: Pea-like pods, ½-¾ inch long, that hang.
Key difference - *crown vetch's pods stand erect, they are angled, and multi-segmented.*

Habitat: Old fields, pastures and roadsides.

Nonnative

Balkan catchfly : *Silene csereii* Baumgarten

Identification: *Provided for comparison to Dalmatian toadflax on page 8.*

Strongly resembles Dalmatian toadflax's gray-green foliage color and form as well as habitat preference.

Plant: Similar to and often confused with bladder-campion (*Silene vulgaris*). Classed as a biennial/perennial that stands as tall as 40 inches. Stems are smooth, pale grayish-green.
Leaves: Opposite, simple leaves have entire margins (no teeth on leaf edges), smooth, waxy and grayish-green.

Key difference - *Leaves of Dalmatian toadflax are alternate on the stem, not opposite.*

Flower: Flowers are five-parted, white with petals that are often rolled. The flower typically has purple tinged stamens extending forward and behind the petals is a smooth bladder-like calyx or cup that will hold the seeds. The calyx is light green, tapers at the ends and has parallel veins.

Key difference - *Flowers are significantly different. Dalmatian toadflax has yellow snapdragon like flowers, while Balkan catchfly has creamy-white, 5-parted flowers.*

Bloom time is May to October.

Fruit and Seed: Held in the calyx or bladder behind the petals. At maturity the bladder turns light tannish-brown and the five tips curl backward.

Habitat: Full sun, dry, disturbed sites such as roadsides, abandoned lots, fields and gravel pits.

Above: Calyx tapered both ends, parallel veins.

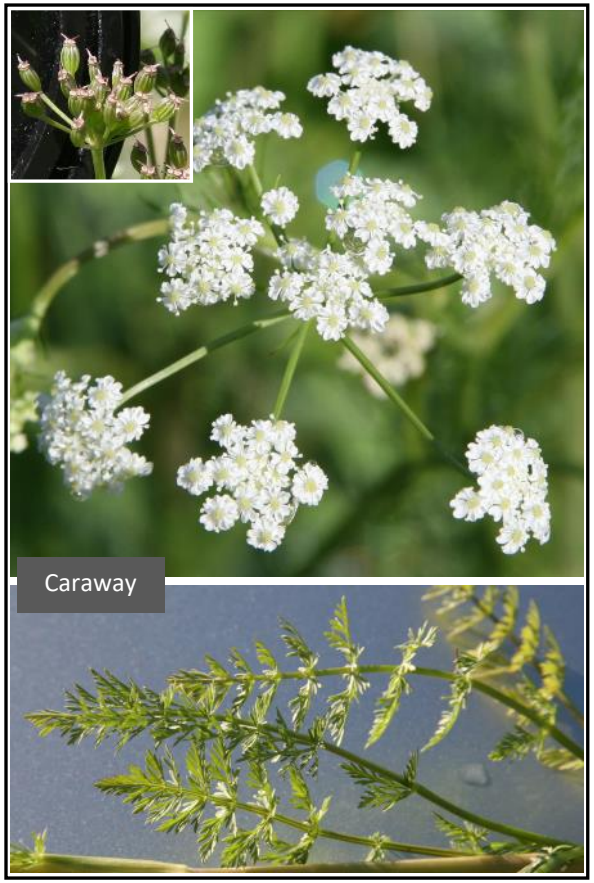
Below: Curled petals, purplish stamens.

Opposite, simple leaves, clasping and blue-gray.

Form, opposite foliage, and plants are blue-gray.

Nonnative

Carrot look-alikes : *Apiaceae* family examples



Caraway	(*Carum carvi* L.)	[biennial, 1-4 feet tall forb]	pictures upper left,
Burnett saxifrage	(*Pimpinella saxifraga* L.)	[perennial, 2-3 feet tall forb]	pictures lower left,
Japanese hedge parsley	(*Torillis japonica* [Houtt.] DC.)	[annual, 2-6 feet tall forb]	pictures lower right,

Identification: *Provided for comparison to poison hemlock and wild carrot (Queen Anne's lace) on pages 17 and 44.*

Plant: Herbaceous, life cycles and heights provided above. All examples on this page and including wild carrot are smaller statured members of the family. Compare floral structures, foliage, seeds and in particular bracts (presence or lack of) under the flower umbels and umbellets as defining characteristics.

Leaves: All have alternate foliage. Caraway has compound leaves that are deeply divided into very linear narrow segments. Burnet saxifrage has pinnately compound leaves - basal leaves in particular have oval, toothed leaflets. As leaves ascend the stem they become smaller and deeply lobed (pinnatifid). Of these three plants, Japanese hedge parsley foliage is closest in resemblance to wild carrot and basal leaves are divided in 3-5 parts.

These members of the carrot family have leaves that are smaller near the top of the plant.

Flower: Five-petaled, all are white and all are held as flat or slightly dome-shaped clusters (compound umbels). All have loose, open umbels unlike wild carrots tighter, denser umbel. Caraway has 5-15 umbellets.

Key differences - *Wild carrot has obvious, showy, branched bracts beneath umbels. The three plants listed on this page have few if any narrow, linear bracts. Caraway may have up to 4, Burnet saxifrage may have 1 bract while Japanese hedge parsley may have 2 or more narrow bracts at bases of compound umbels and up to 8 tiny bracts under umbellets.*

Bloom time is variable - June to September.

Fruit and Seed: All are described as schizocarps splitting at maturity to two carpels (individual seeds). Caraway has elongated ridged seeds at about ¼ inch long, Burnett saxifrage seeds are about ⅛ inch in length, flattened, rounded with slight ridges while seeds of Japanese hedge parsley are about ⅛ inch long and bristly with hooked hairs.

Key difference - *Wild carrot seeds are also about ⅛ inch with ridges covered by stiff bristles (not hooked). At maturity wild carrot folds its seed structure into what is often described as a bird's nest.*

Habitat: All prefer at least partial shade to full sun with caraway preferring full sun. All take advantage of disturbance to become established and all do well on roadsides. Japanese hedge parsley thrives along woodland edges.

Nonnative

Wild chervil : *Anthriscus sylvestris* (L.) Hoffm.

Above: Disturbed woodland edge and ribbed, hairy stems with a clasping leaf attachment.
Below: Bract-like appendages at umbel base and Bracts at umbellet bases. Inset: appendages may not persist.

Identification: Also a member of the Carrot, Parsley family (Apiaceae).
Provided for comparison to poison hemlock and wild carrot, pages 17 and 44 respectively. Compare to Carrot look-alikes and water hemlock, pgs. 51, and 72.

Plant: Herbaceous, often stated to be biennial but is a monocarpic perennial (plant dies after bearing fruit), that stands as tall as 5 feet (2-5 feet). Stems are hollow, ribbed, and mostly green with fine hairs, especially along the ribs.
Key difference - *Poison hemlock stems are smooth and spotted purple, not hairy or ridged.*

Leaves: Alternate, doubly pinnately compound leaves are smooth and shiny on upper surfaces with short hairs below. Vein patterns are more pronounced than on poison hemlock.
Key difference - *poison hemlock leaves have no hairs and venation is not as pronounced.*

Flower: Structure of the inflorescence is a compound umbel. Each umbel is comprised of 4-15 umbellets each with 3-10 white, 5-parted, florets.

Bloom time is April to June.

Fruit and Seed: Like other carrot family members, compound umbels of 2-parted seeds. In this species the styles persist resulting in a "beaked" seed (a pointed tip). Seed matures to ⅜ inch long and develops a dark brown color.

Habitat: Part shade to full sun, moist soils, disturbed sites such as roadsides, abandoned lots, fields and gravel pits.

Above: Hollow, ribbed stem with fine hairs.

Above: Seedlings.

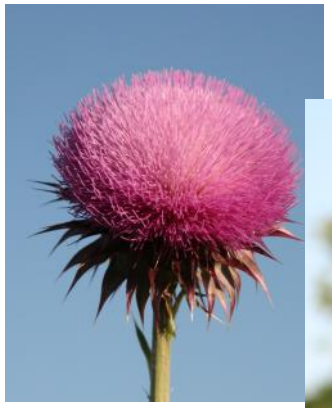
Grooved rachis.

Doubly, pinnately compound leaves with distinct venation.

A single umbellet of 2-parted, beaked seeds.

Nonnative

Musk or nodding thistle : *Carduus nutans* L.



Identification: *Provided for comparison to Canada and plumeless thistles on pages 21 and 28.*

Compare to native swamp thistle (Cirsium muticum). See page 70.
Compare to nonnatives alfalfa and hairy vetch. See page 49.

Plant: Herbaceous, biennial thistle, basal rosette in its first season. Second season, mature flowering stalks 1-7 feet tall.

Leaves: Rosettes can be twenty inches or more in diameter with rosette foliage deeply lobed, a light colored midrib and leaf edges that are light colored and spiny. Foliage on flowering stalks is alternate with spiny wings from leaf bases onto the stem and both surfaces are without hairs. *Compare to plumeless thistle foliage that is hairy below.*

Flower: Large at 1½-3 inches wide and deep pinks to purple. Composite flowers are solitary on branch ends, often nodding with large dark-colored spiny bracts beneath. *Compare to plumeless thistle's flowers that are ½ to 1½ inches wide with short spiny bracts and winged, spiny stems.*

Bloom time is June to August.

Fruit and Seed: Seeds are tufted with feathery plumes that are easily wind dispersed and most are deposited within 160 feet of plants. Do not mow after seed has developed as this strongly aids dispersal.

Life History: Plants have thick taproots but no rhizomes; thus, musk thistle is not clonal. Seed production is high with individual plants producing thousands of seed which can persist in seed banks up to 10 years.

Habitat: Infestations are found on dry to moist soils in woodlands, waste areas, roadsides, ditches and stream banks.

Management:

Cutting taproots 1-2 inches below ground is effective but time consuming for large numbers of plants. **Mowing** should be timed at flower bud stage to prevent seed production and should be repeated 2-3 times per season to be effective. Care should be taken to avoid spreading seed with hay or straw and with mowing and vehicle movement through infestations.

Prescribed fire can be used to encourage stands of native grasses that will outcompete thistle. However, monitoring is needed to check for thistle that germinates in bare soil soon after burns are completed.

Herbicide applications timed at the early bolting phase are foliar applications of 2,4-D ester or dicamba formulations. For foliar applications at the budding to flower stage or fall applications to basal rosettes turn to formulations of aminopyralid, clopyralid, metsulfuron-methyl or triclopyr.

		April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.-Mar
	Burn									
Herbicide	Foliar									
	Cut stem									
	Mow									
	Don't mow									
Flowering Period										

Nonnative

Yellow rocket : *Barbarea vulgaris* W. T. Aiton

Identification: *Provided for comparison to leafy spurge on page 26.*

Plant: Yellow rocket (a.k.a. winter cress, garden yellowrocket) was introduced from Eurasia and is common in Minnesota. A biennial plant (also described as perennial) that forms a basal rosette its first year. Subsequent growing seasons, flower stalks are erect at 8 to 36 inches tall, typically multi-branched and terminated by clusters of bright yellow flowers.

Leaves: Basal leaves and some stem leaves are pinnately lobed to deeply toothed and up to 6 inches in length. Often the terminal end of leaves is a larger rounded lobe in addition to 1-4 lesser side lobes. Leaves near the top of the plant are alternate, typically smaller, oval and often stalkless.

Key difference - *Leaves of leafy spurge are simple (not lobed) and narrowly linear at 1-4 inches in length.*

Flower: Crowded, rounded clusters of bright yellow stalked flowers. Flower clusters are terminal to branch ends.

Individual flowers range from ⅛ to ½ inch wide and have 4 bright yellow petals. As flower clusters elongate, flowers are produced above with seed pods produced below.

Key difference - *Leafy spurge has greenish-yellow flowers without petals. The greenish-yellow bracts beneath the true flowers provide the appearance of a petaled flower. Confusion occurs due to overlap in bloom periods.*

Bloom time is April to June.

Fruit and Seed: Slender pods develop along stems as flower clusters stretch upwards. The roundish pods are approximately 1 inch long, upward curved and contain small brown seeds at maturity.

Habitat: Considered a weed of lawns, gardens and agricultural fields. Often along roadsides and other disturbed sites. An infestation of yellow rocket indicates a disturbed site on which ground cover of native forbs and grasses is thin.

Minnesota Native | American bittersweet : *Celastrus scandens* L.

Oriental bittersweet, yellowish husks, fruit in leaf axils

American bittersweet, orange husks and bright red arils

Identification: *Provided for comparison to Oriental bittersweet on page 15.*

Plant: Woody vine, twining, no tendrils or aerial roots to assist in climbing.
Leaves: Alternate, elliptic to oblong or obovate, typically twice as long as wide. At bud break, leaf edges unroll in a scroll-like fashion.
Flower: Terminal panicles of numerous 5-parted flowers. Dioecious plants (male and female) producing small, rather inconspicuous whitish flowers.
Key difference - *terminal panicles. Flower location is observable on early growth.*

Bloom time is May to June.

Fruit and Seed: Like the flowers, ***terminal*** panicles. ***Orange*** colored husks covering bright red 3-parted arils (fleshy, berry-like fruits) containing 1-2 seeds each. Fruits persist into late winter.
Key differences - *terminal clusters, orange colored husks, bright red 3-parted arils.*
Habitat: Typically found in rich soil, full to partial sun often along roadsides and woodland edges.

Terminally clustered fruits, orange husks and bright red arils.

Foliage typically twice as long as wide. Oriental tends toward oval. Note the drawn out leaf tip.

Staminate (male) flowers with yellow pollen.

Pistillate (female) flowers clustered at branch ends

Minnesota Native

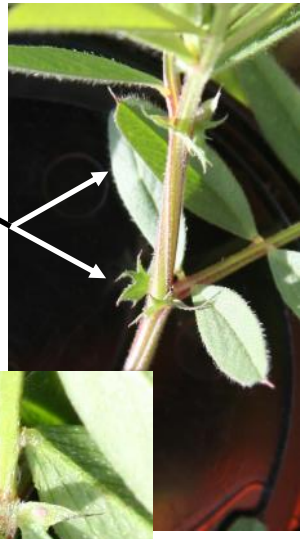
Canadian milkvetch : *Astragalus canadensis* L.

Identification: *Provided for comparison to crown vetch on page 35.*
Plant: **Fabaceae** family, 1-3 feet tall perennial with ridged, pubescent stems.
Leaves: Alternate, odd-pinnate, compound leaves with 21-31 oblong leaflets, about 1½ inches long. Leaves measure 5 to 9 inches long and there are no tendrils.
Key difference - *crown vetch has 11-25 oval leaflets.*
Flower: 5-parted, cream colored and approximately ¾inch long. Milkvetch has a tall, spike-like, clustered, conical flower head with as many as 75 flowers.
Key difference - *Crown vetch has a purple to pink short, dense cluster (crown-like).*
Bloom time is June to September.
Fruit and Seed: Thickened, fuzzy, 2-parted pods with a pointed tip, mature to a brown color.
Habitat: Used for livestock forage and as an agriculture crop. Common in roadside ditches, and similar disturbed areas.

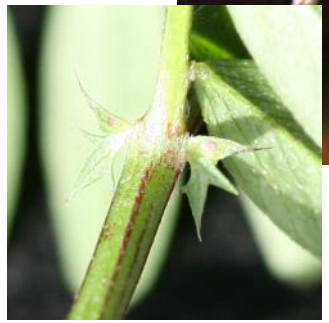
Minnesota Native

American vetch : *Vicia americana* Muhl. Ex Willd.

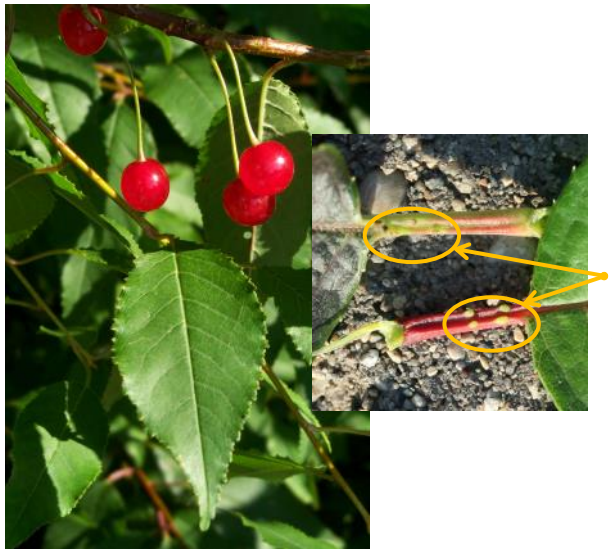
Identification: *Provided for comparison to crown vetch and purple flowered weeds.*
Also compare to alfalfa and hairy vetch, nonnative family members.
Plant: **Fabaceae** family, American vetch is a native perennial with a spreading, viny form and typically has tendrils that assist in climbing nearby plants up to 3 feet.
Leaves: Alternate, compound leaves, pinnately divided. American vetch has 4-8 pairs of leaflets and tendrils terminal on the compound leaves. American vetch has toothed stipules at the base of its compound leaves.
Key difference - *Crown vetch has no stipules, no leaf stalks and no tendrils.*
Flower: American vetch has 2-9 flowers in a one-sided cluster. Flowers are 5-parted, pink to purple and about ¾ inch in length.
Key difference - *Crown vetch has a dense crown-like flower cluster.*
Bloom time is May to September.



Fruit and Seed: Pea-like pods that hang. American vetch's pods are about 1 inch long. Similar to hairy vetches pea-like pod.
Key difference - *crown vetch's pods stand erect, they are angled, and multi-segmented.*
Habitat: Old fields, pastures and roadsides.



Minnesota Native | Cherries and American plum : *Prunus* spp.



Above: Mature, bright red, solitary or paired fruit and foliage of pin cherry.
Below: Flower of black cherry and maturing fruit of chokecherry.

Black cherry (*P. serotina* Ehrh.) Pin cherry (*P. pensylvanica* L. f.)
Choke cherry (*P. virginiana* L.) American plum (*P. americana* Marshall)

Identification: *Provided for comparison to common and glossy buckthorn on pages 33 and 34.*

Plant: Plums, chokecherry and fire or pin cherry are small sized trees. Black cherry may be a small tree, but reaches medium to large tree status. All have smooth, gray to brown bark that is often shiny and lenticeled. Couple that bark and American plum's thorn-like twigs and it is no surprise that these species are frequently confused with buckthorn.
Leaves: Alternate, elliptic to oblong or ovate, typically finely toothed with acuminate or drawn out leaf tips.
Key difference - *Prunus species have glands on the leaf petioles. Additionally, arcuate venation of common buckthorn.*
Flower: Numerous 5-parted, white, fragrant flowers are fairly showy or obvious. Cherries have panicles of white fragrant flowers while the plum's white flowers are clustered along the stem. In Minnesota American plum (wild plum) is one of the earliest trees to bloom, typically small groups of trees clumped along forest edges.
Key difference - *5-parted, white, fragrant flowers are fairly showy or obvious.*
Bloom time is May to June.
Fruit and Seed: Choke and black cherries panicles (loose, hanging clusters) of black fruit are readily taken by birds. Pin or fire cherry fruits mature to a bright red. Plums have a ¾-1 inch, reddish to purplish fruit that contains a large seed.
Key difference - *birds eat fruits of cherries and plums after ripening. Buckthorn fruits remain on shrubs into late winter.*
Habitat: Typically found in rich soil, full to partial sun often along roadsides and woodland edges.

Below: Thorns of wild plum on dead branches. Wild plum flowers and fruit.

Minnesota Native | Common hops : *Humulus lupulus* L.

Hooked stem hairs early spring (May).

Male flowers, 3-lobed, opposite leaves.

Identification: *Provided for comparison to Japanese hops on page 12.*
Also compare to wild and bur cucumber on page 60 and woodbine on page 71.

Plant: Herbaceous, perennial vine, rhizomatous (spreads by rhizomes). Leaf petioles and annual stems with stout hooked hairs. Image at left is of developing, hooked hairs in May.

Leaves: Opposite, for the most part 3 lobed (up to 5 lobes), higher on the vine leaves may be unlobed. Typically, a cordate (heart shaped) base to the leaf and leaves nearly as broad as long.

Key difference - *3 (maybe 5) lobed leaves, higher on the vine leaves may be unlobed*.

Flower: Inconspicuous, wind pollinated and dioecious (male and female) plants.

Bloom time is July to August.

Fruit and Seed: Fruiting structure is cone like, comprised of papery bladders covering individual seeds. Fragrant when crushed. Fruit persists into late winter (see image at right).

Key difference - *native common hops fruit structure is fragrant when crushed.*

Habitat: Moist soils, disturbed sites in woodlots and along fencerows.

Opposite leaves.

Winter fruit, fragrant.

Fruit, 3-lobed and un-lobed leaves.

Male flowers, 3-lobed, opposite leaves.

Female flowers, 3-lobed, and un-lobed opposite leaves.

5-lobed, 3-lobed, opposite leaves.

Minnesota Native | Cow-parsnip : *Heracleum maximum* W. Bartram

Caution - Although to a lesser extent, cow parsnip can cause blistering rashes similar to giant hogweed. Again, plant sap reacting with sunlight - phytophotodermatitis.

Synonym: Common cow-parsnip (*Heracleum lanatum* Michx.)

Identification: *Provided for comparison to giant hogweed on page 9.*

Plant: Perennial, single-stemmed large plants at 3-10 feet tall. Fuzzy stems are hollow and described as foul smelling. **Key difference** - *hogweed has purplish stems with coarse hairs.*

Leaves: Alternate, compound, 3-parted with toothed, palmate leaflets. The petiole or leaf stalk has an enlarged base that clasps the stem.

Key difference - *hogweed has strongly dissected leaves up to 5 feet wide.*

Flower: 8-30 small, white, 5-parted flowers with notched petals, in a 4-8 inch flat umbel, 8-30 umbellets. *Cow parsnips outer flower petals are often larger, irregular, and notched.*

Bloom time is June to July.

Fruit and Seed: Many flattened fruits that when dry split into 2 seeds. See left-hand image.

Habitat: Often found in rich, moist soils along streams or river bottoms in full to partial sun.

Clasping, 3-parted leaf, fuzzy stems.

Outer flowers, larger, notched and irregular.

Minnesota Native | Cucumbers : *Echinocystis lobata* Michx. and *Sicyos angulatus* L.

Above: Bur cucumber foliage and flowers.
Below: Bur cucumber foliage and prickly seed structure.

Key difference - Both cucumber species have prickly seed structures.

Wild cucumber (*Echinocystis lobata*) and bur cucumber (*Sicyos angulatus*).

Identification: *Provided for comparison to Japanese hops on page 12.*
Compare to native common hops. See page 58.

Plant: Annual vines (non woody) with tendrils, often found covering shrubs and small trees to approximately 20 feet.
Leaves: Simple, alternate, 3-5 triangular lobed wild cucumber leaves have small teeth along the leaf edge. Bur cucumber differs with its 3-5 shallowly lobed leaves having hairy undersides as well as sticky hairs on its stems.
Flower: Wild cucumber has creamy white flowers with 6 strap-like petals. These are male flowers. One rarely noticed female flower is at the end of the flower spike. Bur cucumber has 5-petaled greenish-white male flowers clustered and separate from the female flowers clustered elsewhere on the plant.

Bloom time is July to September.

Fruit and Seed: Solitary, prickly bladders distinguish wild cucumber from bur's grouped, up to 10, prickly pods.
Habitat: Can be found growing side-by-side. Plants can be found in partial shade to full sun along the edge of the woods or in thickets or open areas with moist soils.

Above: Wild cucumber hanging on a fence in winter
Key difference - cucumber vines have tendrils.

Above: Bladder-like seed pod remaining in winter, seeds dispersed.
Below: Wild cucumber foliage and flowers.

Minnesota Native | Fireweed : *Chamerion angustifolium* (L.) Holub ssp. *angustifolium*

Synonym: *Epilobium angustifolium* L.

Identification: *Provided for comparison to purple loosestrife on page 29*.

Plant: Perennial, erect, rounded, single stems reaching 2-6 feet tall. **Key difference** - *rounded stem, not 4-6 sided.*

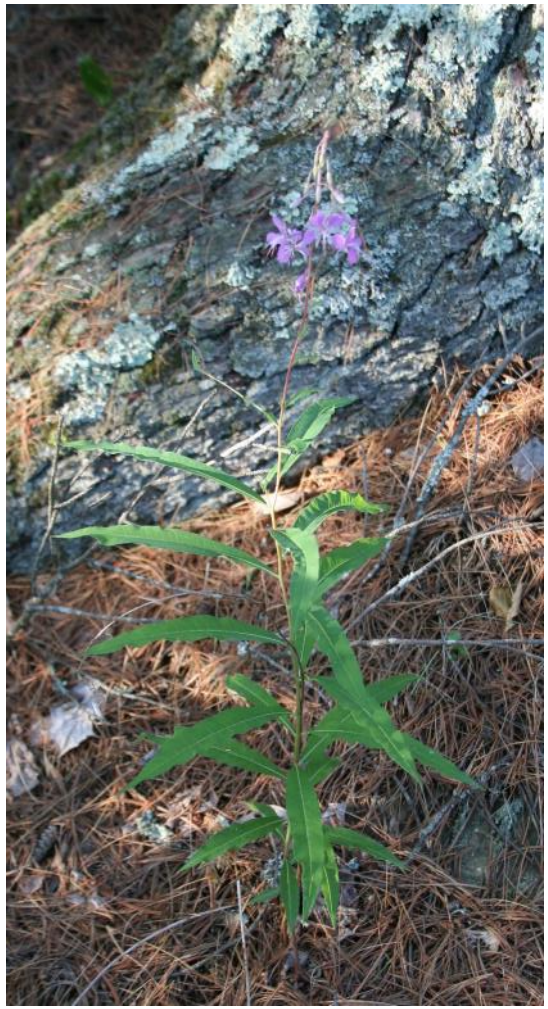
Leaves: Alternate, crowded leaves that are lance-like and stalkless. **Key difference** - *alternate (not opposite).*

Flower: Four-parted, colors range from pink to purple. The flowers are showy at ¾ to 1½ inches wide and arranged along a tall terminal spike. **Key difference** - *Fireweed has four-parted flowers (purple loosestrife has 5-parted flowers)*.

Bloom time is June to August.

Fruit and Seed: Long, slender capsules or pods that split to release small seeds with long tufted hairs.

Habitat: Often present following burns on moist soils at forest edges or in clearings.



Minnesota Native | Golden alexanders : *Zizia* spp.

Golden alexander [*Z. aurea (L.) W.D.J. Koch*] and
heart-leaved golden alexander [*Z. aptera (A. Gray) Fernald*].

Identification: *Provided for comparison to wild parsnip on page 30.*

Plant: Herbaceous, perennial reaching 1-2 feet tall.
Key difference - *golden alexanders smooth, shiny stems compared to the grooved stem of wild parsnip.*
Leaves: Alternate 2-3 inch stem leaves, mostly 3-parted with finely toothed edges. Basal leaves of heart-leaved golden alexanders are simple and oval (heart-shaped) while those of golden alexanders are compound like upper stem leaves. **Key difference -** *basal leaves of wild parsnip are pinnately compound with 5-15 leaflets.*
Flower: Compound umbels of numerous 5-parted, yellow flowers.
Key difference - *incurred yellow petals cover the flower center. Wild parsnips yellowish petals remain tightly curled against the sides of flowers.*
Bloom time is May to July.
Fruit and Seed: Not as flat as wild parsnip seeds. Ridged, slightly oval and when mature becomes tan, appears dry and splits into 2 parts.
Key difference - *wild parsnip seeds are typically larger and flatter.*
Habitat: Moderately moist to wet - sandy, loamy soils, full sun to shade.

Z. aptera heart-shaped basal leaves.

Ridged seed, few if any bracts.

Minnesota Native | Goldenrods : *Solidago* spp.

Pyramidal inflorescence of Canada goldenrod

Identification: *Provided for comparison to common tansy on page 22.*
In particular, compare common tansy to stiff goldenrod (*Solidago rigida* L.).

Plant: Perennial plants, often clumped, typically erect, single stems. Species typically ranges in height from 1-4 feet while species may reach heights of 7 feet.
Leaves: Alternate, simple, depending on species leaves are lance shaped, may or may not be toothed and may or may not be hairy.
Key difference - *tansy foliage is pinnately divided, toothed and aromatic when crushed.*
Flower: Yellow ray flowers typically arranged in branched clusters. Depending on species the inflorescence may be pyramidal, flat-topped or one-sided.
Key difference - *goldenrod flowers have **ray petals** surrounding central, disk-like florets.*
Bloom time is late July through September.

Ray petals of stiff goldenrod

Fruit and Seed: Dry, light seeds often tufted with light-colored to brownish hairs easily carried by wind.
Key difference - *Tansy seed is not tufted and persists into winter in the flower heads.*
Habitat: goldenrod species thrive in a variety of sites. They can be found in dry to wet prairies, dry to moist forests and on a variety of roadsides. Partial to full sun.

Flat-topped inflorescence of stiff goldenrod

One-sided inflorescence of gray goldenrod

Minnesota Native | Riverbank grape : *Vitis riparia* Michx.

Identification: *Provided for comparison to porcelain berry on page 42.*
Plant: Perennial, woody, vines climbing into trees and structures or spreading over low growing vegetation. Height can be variable and up to 80 feet. Tendrils opposite some leaves assist climbing and support. Stems of grape vines can attain diameters of 7-8 inches with bark maturing to dark brown and shredding from stems in narrow strips.
Key difference - *Porcelain berry's bark does not shed in vertical strips.*
Leaves: Alternate, simple, cordate (heart-shaped) leaves are sharply toothed and palmately lobed, often three distinct lobes. Leaves may be up to 6 inches long and 4 across. Upper leaf surface is typically dark green and smooth while underside may be whitish. There may or may not be hairs along the major veins.
Key difference - *Porcelain berry's leaves are often deeply divided by sinuses.*
Flower: Often dioecious, male and female flowers on separate plants, occasionally flowers are perfect (all reproductive parts). Hanging panicles of greenish-yellow, 5-parted flowers are not showy. Most are held opposite a leaf.

Bloom time is May to late June.

Fruit and Seed: Green berries (grapes), covered by a whitish film (glaucous), that mature to a purple color. Berries contain 1 to 4 seeds.
Key difference - *Porcelain berry has shiny, berries in hues of blue/purple.*
Habitat: Grapes prefer full sun but will tolerate partial shade. Preference is moist soils and as the name implies, riverbank grapes are often found in river bottoms climbing into trees where there is good sunlight at forest edges and in openings.

Above and below: June 13 - flowers, leaves and tendrils of grape on the Anoka sandplain.

Minnesota Native | Honeysuckles : *Diervilla lonicera* and *Lonicera* spp.

Above: Landscape use of northern bush honeysuckle.
Yellow tubular flowers, and serrated, lance shaped foliage.

Below:
Left 2 images - fly honeysuckle foliage, fruit and flower.
Second from right - rounded foliage of vining hairy honeysuckle and far right is red flower, fused foliage of wild honeysuckle.

Northern bush honeysuckle [shrub] (*Diervilla lonicera* Mill.) - pictures upper right and left,
fly honeysuckle [shrub] (*Lonicera canadensis* Marsh.) - pictures lower left,
swamp fly honeysuckle [shrub] (*L. oblongifolia* [Goldie] Hook.) - not pictured,
mountain fly honeysuckle [shrub] (*L. villosa* [Michx.] J. A. Schultes) - not pictured,
hairy honeysuckle [vine] (*L. hirsuta* Eat.) - picture second from lower right,
wild honeysuckle [vine] (*L. dioica* L.) - picture lower right.

Provided for comparison to Japanese and Asian bush honeysuckles on pages 11 and 31.

Above: northern bush honeysuckles beaked, capsule fruit.

Below: Vining honeysuckles fused terminal leaves.

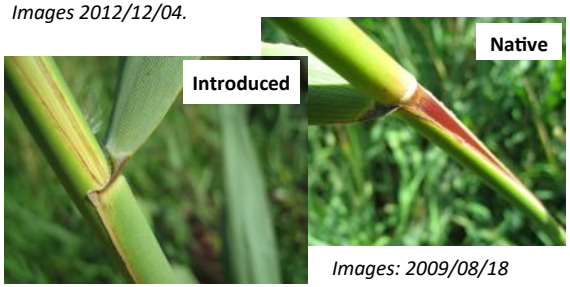
Identification: Plant: Shrubs range in heights up to 3 feet for northern bush honeysuckle on up to 6 feet for fly honeysuckles. Twining vines may be sprawling, standing weakly or climbing to heights of 9-15 feet (hairy and wild) on up to 24 feet for the uncommon grape honeysuckle.
Key difference - *Native bush honeysuckles have solid piths, typically white. Vine forms have hollow stems, white piths.*
Leaves: Opposite. It is difficult to generalize leaf types and shapes for these species. Bush honeysuckle has lance-shaped leaves with a long tip, serrated and ciliated margins with hairs possibly present on surfaces or mid-veins. Fly honeysuckles have elliptical to oblong shapes with blunt or acute tips. Vining honeysuckles tend to have rounded or ovate leaves except terminal leaf pairs tend to be fused (see image at right).
Key difference - *Northern bush honeysuckle has serrated, lance shaped foliage. Vining honeysuckles tend to have rounded foliage with the terminal pair fused.*
Flower: Tubular. Northern bush honeysuckles have a yellow flower (image left) while wild honeysuckles are red (image lower right). Others, like fly honeysuckle, vary from pale yellow to white.

Bloom time is typically May to July. Northern bush honeysuckle as late as September.

Fruit and Seed: Typically berry-like, typically red except for bush honeysuckles beaked, capsule with sepals attached.
Habitat: Woodland habitats with some species tolerant of deeper shade while others require partial sun. Swamp fly and mountain fly honeysuckles are typically found in moist soils such as forested swamps or bogs.

Minnesota Native | Native Phragmites : *Phragmites australis* ssp. *americanus* Saltonstall

Left: Introduced - diffuse fungal spots and leaf sheaths intact on yellow winter stems.
Right: Native - sharply defined fungal spots may be present on some stems and note the maroon to pink color.
Images 2012/12/04.



Images: 2009/08/18

Left: Introduced - green stems at the nodes.
Right: Native - maroon to pink color at the stem nodes.

Above: Introduced - larger, grayish, fuzzy seed head.
Right: Native - smaller, golden, some fuzziness to seed heads.

Complete nomenclature from USDA GRIN: *Phragmites australis* (Cav.) Trin. ex Steud. subsp. *americanus* Saltonstall

Identification: *Provided for comparison to nonnative phragmites on page 41.*
Plant: Perennial grass. Stand density can be similar to introduced common reed but, stands often have other native plants interspersed. In comparison to introduced form, native plants are typically shorter and foliage appears yellowish.
Leaves: Summer leaves are yellowish. Leaves and leaf sheaths will drop from plants in winter leaving bare reddish stems (photo at left). Ligule length determined under a dissecting microscope is diagnostic, typically > 1.0mm.
Flower: Approximately 3-4 months after spring growth begins.
Bloom time is June-September.
Fruit and Seed: Plumes are sparse and likely not persistent through winter. Glume lengths are diagnostic and as with ligules a dissecting microscope is useful for measurement and comparison.
Habitat: Native phragmites occurs near water sources such as rivers, streams, shorelines of ponds and lakes as well as within wetland systems including wet roadside ditches.

Native phragmites seed heads tend to be less dense, less fuzzy and typically not as large.

Left foreground: Introduced - dark green foliage with larger, grayish, seed heads.
Right background: Native - yellowish foliage with smaller, golden, seed heads.

Native phragmites has maroon stems at the nodes or segment joints. *Image 2009/11/02*

Minnesota Native | Speckled alder : *Alnus incana* (L.) Moench ssp. *rugosa* (DuRoi) Clausen

Synonym: *Alnus rugosa* (DuRoi) Spreng.
Identification: Provided for comparison to European alder on page 36.
Plant: Woody, perennial, multi-stemmed shrub or small trees often leaning into one another forming a tangle to walk through. Heights of 26 feet can be attained with typically small diameters of 6 inches or less.
Leaves: Alternate, simple with toothed shallow lobes. About 2 to 4 inches long and 1¼ to 2½ inches wide.
Flower: Male catkins are typically 1½ to 3½ inches when dormant and extend in spring to release pollen. Female catkins are less than ¼ inch long and typical bloom is March to early May.

Bloom time is March to early May.

Fruit and Seed: Female cones mature late summer and release tiny flattened samaras during the winter months. Dispersal is via wind and water.
Habitat: Typically found in wetlands. Often found along streams, lake shores and wetland margins. Preference, moderate acidity, full sun yet tolerates part shade.

Green alder (*A. viridis*), a Minnesota native shrub reaching 14 feet, is found in drier upland habitats.
Far right: 3 images of green alder [*Alnus viridis* (Vill.) DC. subsp. *crispa* (Ait.) Turrill.].
Top: Previous seasons cones in background with upright female flowers and pendulous male flowers in foreground. **Middle:** Note the vein pattern, fine serrations and lack of lobes. **Bottom:** maturing seed structure, "female cones", and foliage.

Above: Small wetland stand of speckled alder.

Below: Foliage + male catkins of speckled alder.

Below: Back of speckled alder leaf. Note leaf edge and vein pattern.

Below: Overwintering male and female catkins of speckled alder.

Minnesota Native

Sugar maple : *Acer saccharum* Marshall

Below: Top twig is sugar maple, bottom is silver maple.

Provided for comparison to Amur and Norway maple on pages. 45 and 46.

Identification: *Check the sap — Norway maple has milky sap.*
Native maples have sweet tasting, clear sap.

Images of red (A. rubrum) and silver (A. saccharinum) maples are included.

Plant: Woody perennial, large trees to 100 feet tall with trunk diameters to 38 inches. Bark is smooth gray to brown when young becoming darker and furrowed later.

Leaves: Opposite, simple, typically 5 lobed. Three of the lobes similar in size while the base lobes are much reduced in size. Sinuses are rounded cutouts between the lobes, U-shaped. *Compare to red and silver maples below.*

Flower: Flowers appear with leaf emergence. Clusters of eight to fifteen yellow-green drooping flowers.

Image at left is sugar maple in bloom at bud break.

Bloom time is mid April to early June.

Fruit and Seed: Double samaras mature in the autumn, U-shaped and each samara is approximately 1 inch long. Seeds fall in the autumn prior to the leaves and germinate the following spring. *Silver maple samaras are typically 2 inches long and red maple samaras are about ¾ inch long, both mature in spring.*

Habitat: Sugar maple prefers moist forest settings with loamy, well drained soils. Seedlings are very tolerant of deep shade. Saplings also tolerate shade, persisting in the understory for a long period before a gap opens to allow maturity.

Compare leaves of three native maples below; sugar, red and silver.
Sugar maple typically has 5 lobes with occasional teeth and U-shaped sinuses. Red maple is often 3 lobed, maybe 5 lobes, very toothy leaf edge with V-shaped sinuses.
Leaves of silver maple are 5 lobed, toothy with deep, narrow sinuses between lobes.

Both silver (image at right) and red maple have clustered, rounded flower buds.

Autumn - sugar maple

Autumn - red maple

Spring - silver maple

Minnesota Native

Sumacs : *Rhus typhina* L. and *R. glabra* L.

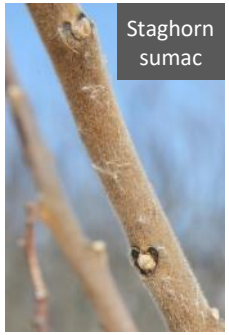
Staghorn sumac [shrub] (*R. typhina* L.) - pictures left.
Smooth sumac [shrub] (*R. glabra* L.) - pictures right,

Identification: *Provided for comparison to tree-of-heaven on page 18.*
Plant: Shrubs ranging in heights up to 18 feet for smooth sumac and staghorn sumac considered a shrub or small tree at heights up to 36 feet (or taller). Both smooth and staghorn sumac develop clonal, multi-stemmed, colonies. The names are indicative of the hairiness of the plants. Smooth sumac has smooth bark, fruits and foliage while staghorn has very fuzzy twigs, fruit and leaf parts.
Key difference - *Tree-of-heaven has smooth twigs similar to smooth sumac, but twigs and small branches of tree-of-heaven are very stout with very large leaf scars.*
Leaves: Alternate, odd pinnate compound. Smooth sumac has 9-23 hairless, sessile (no stalk) leaflets while staghorn sumac has 13-27 hairy, sessile leaflets. In particular the petioles (stalks that leaflets attach to) of staghorn sumac are fuzzy as is the midvein on the underside of the leaflet. Both species have serrated (toothed) leaflet edges. Leaflet color of the sumacs is darker green on top surface and pale green, almost whitish, on the bottom.
Key difference - *Tree-of-heaven has 11-25 or more smooth leaflets that have smooth edges and glands near leaf bases. Leaf color is a consistent green top and bottom.*
Flower: Dioecious species, male and female flowers on separate plants. Pyramidal multi-branched, stalks of greenish, 5-parted flowers. Many ¼ inch greenish flowers are somewhat showy as they are held on terminal, pyramidal structures that can be up to 15 inches tall by 9 inches wide.

Bloom time is typically late June into July.

Fruit and Seed: The pyramidal structure of female flowers will be replaced by red fruits called drupes, each contains a single seed. Individual fruits of smooth sumac are covered by very short red hairs while those of staghorn are covered by very noticeable fuzzy, reddish hairs. Fruits of both species while rounded are slightly flattened and will hold on through winter and potentially into the following summer.
Key difference - *Tree-of-heaven, clusters of slightly twisted, single-seeded samaras.*

Above: Greenish male flowers of smooth sumac. July 18, BWCAW.
Below: Smooth sumac fruit October 15th near Mankato.



Habitat: Both sumac species prefer full sun. Both are found along forest edges and in forest openings. However, they may also be found near lakes or rivers or even on the drier extremes of rocky outcrops, prairie and savanna habitats. Sumacs are a common sight along dry roadsides.

Minnesota Native | Swamp thistle : *Cirsium muticum* Michx.

Identification: *Provided for comparison to nonnative thistles; Canada and plumeless thistle on pages 21, 28.*

See also: BWSR Featured Plant: Minnesota's Thistles, Publication date 2013-3-6.

Plant: Biennial, mature plants from 2-7 feet tall with multiple-branches terminated by many heads. Stems are not spiny but woolly, especially lower portions of the plant.
Leaves: Alternate, deeply divided leaves have lance-like or oblong segments that are described as softly spiny.
Flower: Purples to pinks typically not white. Composite flowers are 1½ inches wide held together by whitish, woolly, non-spiny bracts that have a visible light-colored dorsal (central) ridge.

Bloom time is July to October.

Fruit and Seed: Tufted seed matures and is wind-dispersed late summer into autumn.
Habitat: Swamps, bogs and areas like wet meadows, moist woods and thickets.

Key difference - *Woolly, non-spiny bracts with a light colored dorsal ridge.*

Key difference - *Deeply divided foliage that is softly spiny. Stems are hairy or wooly, not spiny.*

Minnesota Native | Woodbine : *Parthenocissus* spp.

Woodbine, palmately compound leaves.

Virginia creeper [*Parthenocissus quinquefolia* (L.) Planch.] and
woodbine [*P. vitacea* (Knerr) Hitchc.], synonym: *P. inserta* (Kerner) K. Fritsch.

Identification: *Provided for comparison to Japanese hops on page 12.*
Compare to native common hops on page 58.

Plant: Woody, perennial vines, with tendrils that assist climbing into trees and onto structures (Virginia creeper and woodbine) or sprawling on the forest floor (woodbine). Virginia creeper may develop aerial roots while woodbine does not. Tendrils of Virginia creeper develop adhesive disks while tendrils of woodbine usually attach by wrapping around an object, seldom developing adhesive disks.

Leaves: Alternate, palmately compound with 4-5 leaflets (typically 5). Leaflet bases are tapered and the leaf edges are toothed (possibly doubly toothed).

Key difference - *Leaves of Japanese hops are simple not palmately compound*.

Flower: Both species have greenish flowers held on compound cymes (branched, flat-topped structures with terminal flowers opening first). Virginia creeper's structure has a central axis while woodbine's does not.

Bloom time is June to July.

Fruit and Seed: Fruits are berries, bluish at maturity and held on red structures.

Key difference - *Japanese hops does not produce berries.*

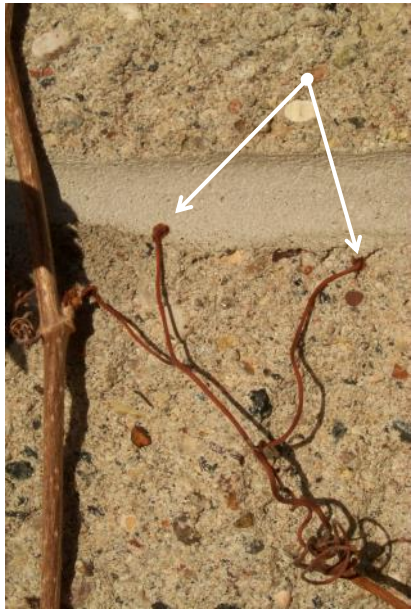
Habitat: Virginia creeper is often found in forest interiors where it climbs high into the canopy. Woodbine on the other hand will sprawl over the ground, on fences, rock piles unless it encounters a structure or tree suitable for climbing. Full sun to partial shade of the forest, moist soils, along fencerows or found growing on disturbed sites where animals and birds have dropped the seeds.

Woodbine climbing a fence post.

Virginia creeper, aerial roots holding onto elm bark.

Welby Smith (MN DNR) describes the flower petals as "Boat-shaped."

Fall foliage and blue berries.



Adhesive disks at tendril ends.

Minnesota Native | Water hemlock : *Cicuta maculata* L.

United States Dept. of Agriculture fact sheet states: "the most violently toxic plant that grows in North America."

Caution All plant parts (foliage, seeds, stems, roots) are ***poisonous to humans*** and livestock. Caution

Reported that toxin can be absorbed through bare skin! Wear appropriate PPE - gloves, long sleeves, and long pants.

Identification: *Provided for comparison to poison hemlock and wild carrot on pages 17 and 44, respectively.*

Plant: Herbaceous, biennial (short-lived perennial), first year as a basal rosette and second year water hemlock is a lightly branched, 3-6 feet tall, plant. Stems are smooth (no hairs), hollow (lower portion), appear ridged due to veins and are light green or pinkish or reddish purple.

Key difference - *wild carrot stems are hollow and sparingly hairy to hairy. Stems are not spotted, see poison hemlock.*

Leaves: Alternate, generally triangular in form. Compound leaves are pinnate or doubly pinnate with 3-7 leaflets. Leaflets are not fern-like. Leaflets are 1-4 inches long by ½- 1¼ inches wide. Leaflets are toothed and veins appear to terminate in the notch between teeth - not at the tip. Petiole to stem attachments are partially covered by a sheath.

Flower: Petals are notched at the tip and narrowed at the base. Flowers are five-petaled, white and held as flat or slightly dome-shaped, loose, open compound umbels. Each umbel is comprised of 10-20 domed umbellets each holding 12-15 flowers. Main branches (rays) of umbels are not subtended by bracts. Secondary branches of umbellets have lanceolate bracts with scarious (thin, dry, membranous) margins.

Key differences - *wild carrot has obvious, showy, branched bracts beneath flower umbels and umbellets.*

Bloom time is variable - June to August.

Fruit and Seed: Seeds are schizocarps splitting at maturity to two carpels (individual seeds). Seeds are ⅛ inch long and angular. There are no hairs.

Key difference - *Wild carrot seeds are also about ⅛ inch with ridges covered by stiff bristles. At maturity wild carrot folds its seed structure into what is often described as a bird's nest.*

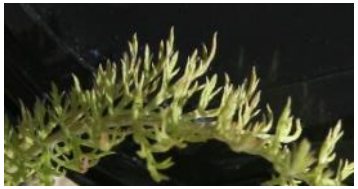
Habitat: Partial shade is tolerated but preference is full sun with wet to moist fertile soils with organic material. Often found in wet meadows and pastures and other similar sites like moist to wet roadside ditches. Prefers more moisture than poison hemlock and typically, does not compete or occur with poison hemlock.

Minnesota Native | Common yarrow : *Achillea millefolium* L.

Identification: *Provided for comparison to poison hemlock and wild carrot, pages 17 and 44 respectively. Compare to Carrot look-alikes, wild chervil and water hemlock, pgs. 51, 52, and 72.*
Plant: Perennial, herbaceous plant reaching heights of 1-2 (3) feet. Stems are pale green, hollow and typically covered with fine hairs. Plants are often unbranched except near the top.
Leaves: Alternate, narrow and finely divided - single or double pinnate - very fern like. Stem leaves are sessile (no leaf stalk) and near top of plants, typically smaller. Leaflets are longest at the middle of the rachis and shorter near the tip and base.
Flower: Terminal branched flower structures (compound corymb) of numerous 5-parted flower heads. Each flower head consists of 5 ray florets and 5 disk florets. Florets are typically whitish to pale cream. White flowers on a flat-topped structure brings about confusion with the carrot family.
Key difference - *terminal **branched** panicles or compound corymb versus carrot families compound umbels.*
Bloom time is June to September.

Fruit and Seed: Like the flowers, branched, terminal clusters. Florets are replaced by seeds (achenes) lacking hairs. Roots are rhizomatous - thus colonies can be formed.
Habitat: Mesic to dry soils, full to partial sun often in prairies, along roadsides and woodland edges.

Typical form with flowers terminal to branches. Branches may be few.



Leaf Bases to ----------> Leaf Tips

Images of pinnately, compound foliage. Very finely divided, very fern-like.

Top leaf - sessile stem leaf.
Bottom leaf - petioled basal leaf.

End of season, dry flower structure. Historically used in architectural modeling as trees.

Citations / Resources:

Prohibited: Eradicate

Black swallow-wort: *Cynanchum louiseae* Kartesz & Gandhi Page 5
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
https://www.invasive.org/weedcd/pdfs/wgw/blackswallowwort.pdf
http://www.invasive.org/browse/subinfo.cfm?sub=3398

Common teasel: *Dipsacus fullonum* L. Page 6
Image citations – Bugwood.org:
Flowering head close-up - David Cappaert, Michigan State University,
Flower group, basal rosettes, seed head - Steve Dewey, Utah State University.
Identification and management:
https://www.illinoiswildflowers.info/weeds/plants/teasel.htm
http://www.fs.fed.us/database/feis/plants/forb/dipspp/all.html
http://www.invasiveplantatlas.org/subject.html?sub=3018

Cutleaf teasel: *Dipsacus laciniatus* L. Page 7
Image citations: Dave Hanson and Tina Markeson, MnDOT.
Identification and management:
http://dnr.wi.gov/topic/Invasives/fact/CutLeavedTeasel.html
http://www.invasiveplantatlas.org/subject.html?sub=5545
http://www.missouriplants.com/Whiteopp/Dipsacus_laciniatus_page.html

Dalmatian toadflax: *Linaria dalmatica* (L.) Mill. Page 8
Image citation: all images - Dave Hanson, MnDOT
Identification and management: https://www.cabi.org/isc/datasheet/30827
https://cwma.org/weed-information/weed-list/dalmatian-toadflax/
http://wiki.bugwood.org/HPIPM:Dalmatian_toadflax
http://www.invasiveplantatlas.org/subject.html?sub=5939

Giant hogweed: *Heracleum mantegazzianum* Sommier & Levier Page 9
Image citations – Bugwood.org:
Flower - Leslie J. Mehrhoff, University of Connecticut,
Flower and pen - USDA APHIS PPQ Archive, USDA APHIS PPQ,
Leaf - Donna R. Ellis, University of Connecticut,
Foliage to human - Thomas B. Denholm, New Jersey Department of Agriculture.
Identification and management:
http://www.invasiveplantatlas.org/subject.html?sub=4536
http://dnr.wi.gov/topic/Invasives/fact/GiantHogweed.html

Grecian foxglove: *Digitalis lanata* Ehrh. Page 10
Image citations: Dave Hanson and Tina Markeson, MnDOT,
Identification and management:
http://www.minnesotawildflowers.info/flower/grecian-foxglove
http://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/noxiouslist/foxglove.aspx

Japanese honeysuckle: *Lonicera japonica* Thunb. Page 11
Image citations - Bugwood.org:
Smothered building - Chuck Bargeron, University of Georgia,
All other images - Leslie J. Mehrhoff, University of Connecticut.
Identification and management:
http://www.illinoiswildflowers.info/weeds/plants/jp_honeysuckle.htm
https://www.invasiveplantatlas.org/subject.html?sub=3039
https://www.invasive.org/eastern/srs/jh.html
https://www.invasive.org/alien/pubs/midatlantic/control-vines.htm

Japanese hops: *Humulus japonicus* Siebold & Zucc. Page 12
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
https://www.illinoiswildflowers.info/weeds/plants/jp_hops.htm
http://dnr.wi.gov/topic/Invasives/fact/JapaneseHops.html

Knapweed complex: Page 13-14
Identification and management: http://wiki.bugwood.org/Archive:Knapweed
http://www.ag.ndsu.edu/pubs/plantsci/weeds/w1146.pdf
http://your.kingcounty.gov/dnrp/library/water-and-land/weeds/Brochures/knapweed.pdf

Knapweed, Brown: *Centaurea jacea* L. Page 13-14
Image citations : Flower and bracts—Dave Hanson, MnDOT.
Foliage and form - Bruce Ackley, The Ohio State University, Bugwood.org
Identification and management:
http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=250066298
http://www.invasiveplantatlas.org/subject.html?sub=5278
http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/artmar06/bj-knapweed.html

Knapweed, Meadow: *Centaurea moncktonii* C. E. Britton Page 13-14
Image citation: all images - Tom Jacobson, MnDOT.
Identification and management:
http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=250068128
https://www.mda.state.mn.us/plants/. . . /weedcontrol/noxiouslist/meadowkw

Knapweed, Diffuse: *Centaurea moncktonii* C. E. Britton Page 13-14
Image citation: Steve Dewey, Utah State University, Bugwood.org
K. George Beck and James Sebastian, Colorado State University, Bugwood.org
Identification and management:
https://cwma.org/weed-information/weed-list/diffuse-knapweed/

Knapweed, Russian: *Acroptilon repens* (L.) DC. Page 13-14
Currently not listed in Minnesota.
Identification and management:
http://extension.colostate.edu/topic-areas/natural-resources/russian-knapweed-3-111/

Oriental bittersweet: *Celastrus orbiculatus* Thunb. Page 15
Image citations: Ken Graeve and Dave Hanson, MnDOT.
Identification and management: https://www.cabi.org/isc/datasheet/12009
https://www.invasive.org/weedcd/pdfs/wgw/orientalbittersweet.pdf
http://dnr.wi.gov/topic/Invasives/fact/OrientalBittersweet.html
http://www.invasive.org/browse/subinfo.cfm?sub=3012

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Palmer amaranth: *Amaranthus palmeri* S. Watson Page 16

Foliage images: Aaron Hager, University of Illinois at Urbana-Champaign.
Image citations from Bugwood.org:
Leaf/petiole and plant form - Ross Recker, University of Wisconsin - Madison,
Female seed spike and thick stem - Rebekah D. Wallace, University of Georgia.
Identification and management:
Becker, Roger. University of Minnesota. Herbicide recommendations. Email.
http://www.ksre.ksu.edu/bookstore/pubs/s80.pdf
http://www.extension.org/pages/65209/palmer-amaranth-amaranthus-palmeri
http://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/noxiouslist/palmeramaranth.aspx
https://store.extension.iastate.edu/product/Palmer-amaranth-identification

Poison hemlock: *Conium maculatum* L. Page 17

Image citation: all images - Dave Hanson, MnDOT.
Identification: http://www.illinoiswildflowers.info/weeds/plants/poison_hemlock.htm
https://gobotany.nativeplanttrust.org/species/conium/maculatum/?key=dichotomous#dkey

Tree-of-Heaven: *Ailanthus altissima* (Mill.) Swingle Page 18

Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
https://www.invasive.org/weedcd/pdfs/wgw/treeofheaven.pdf
http://www.ecolandscaping.org/05/invasive-plants/tree-of-heaven-an- . . .-fact-sheet
http://mipncontroldatabase.wisc.edu/

Yellow starthistle: *Centaurea solstitialis* L. Page 19

Image citations – Bugwood.org: Bolting stage - Cindy Roche,
Flower up-close - Peggy Greb, USDA Agricultural Research Service,
Mature foliage, basal rosette - Steve Dewey, Utah State University.
Identification and management:
https://www.invasive.org/weedcd/pdfs/wgw/yellowstarthistle.pdf
http://www.invasive.org/browse/subinfo.cfm?sub=4390
https://www.fs.fed.us/foresthealth/technology/pdfs/ . . . Biocontrol_Yellow_Starthistle.pdf

Prohibited: Control

Barberry, common: *Berberis vulgaris* L. Page 20

Image citations: Bugwood.org: Leslie J. Mehrhoff, University of Connecticut.
Identification and management:
https://gobotany.nativeplanttrust.org/species/berberis/vulgaris/?key=dichotomous#dkey
https://gobotany.nativeplanttrust.org/dkey/berberis/ (dichotomous key)
Japanese Barberry control information:
https://mipncontroldatabase.wisc.edu/search?name=Berberis thunbergii#plants

Canada thistle: *Cirsium arvense* (L.) Scop. Page 21

Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
http://www.minnesotawildflowers.info/flower/canada-thistle
http://dnr.wi.gov/topic/Invasives/fact/CanadaThistle.html

Common tansy: *Tanacetum vulgare* L. Page 22

Image citation: all images - Dave Hanson, MnDOT.
Images and good identification write-up: Minnesota wildflowers
http://www.minnesotawildflowers.info/flower/common-tansy
Identification and management:
http://dnr.wi.gov/topic/Invasives/fact/Tansy.html
http://www.fs.fed.us/database/feis/plants/forb/tanvul/all.html

Knapweed, Spotted: *Centaurea stoebe* L. ssp. *micranthos* (Gugler) Hayek Page 23

Image citation:
Flower top/side views, basal rosette, rosette foliage - Dave Hanson, MnDOT.
Image citations – Bugwood.org: Foliage - James H. Miller, USDA Forest Service.
Images and good identification write-up: Minnesota wildflowers
http://www.minnesotawildflowers.info/flower/spotted-knapweed
Discussion and management considerations:
http://www.efloras.org/florataxon.aspx?flora_id=1&taxon_id=250068126
http://dnr.wi.gov/topic/Invasives/fact/SpottedKnapweed.html
http://wiki.bugwood.org/Centaurea_stoebe_ssp._micranthos
http://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/noxiouslist/spottedknapweed.aspx

Knotweed, Bohemian: *Polygonum xbohemicum* (J. Chrtek & Chrtkova) Zika & Jacobson

Image citations: Dave Hanson, MnDOT and
see citations for Japanese and giant knotweeds, pages 24-25
Identification and management:
http://www.princerupert.ca/sites/. . . publicworks/invasive/Knotweed_key_BC_2007.pdf
http://www.kingcounty.gov/s. . . ./weed-identification/invasive-knotweeds/bohemian-knotweed.aspx
Download Montana State university Guide:
Biology, Ecology and management of the Knotweed complex (*Polygonum* species)

Knotweed, giant: *Polygonum sachalinense* F. Schmidt ex Maxim. Page 24-25

Image citation: - Bugwood.org: Leslie J. Mehrhoff, University of Connecticut,
Identification and Management: http://www.mipn.org/control.html
http://dnr.wi.gov/topic/Invasives/fact/GiantKnotweed.html
http://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/weed-identification/invasive-knotweeds.aspx

Knotweed, Japanese: *Polygonum cuspidatum* Siebold & Zucc. Page 24-25

Image citation: all images - Dave Hanson, MnDOT.
Identification and Management:
http://www.mipn.org/control.html
http://dnr.wi.gov/topic/Invasives/fact/JapaneseKnotweed.html
http://www.kingcounty.gov/services/environment/animals-and-plants/noxious-weeds/weed-identification/invasive-knotweeds/japanese-knotweed.aspx

Leafy spurge: *Euphorbia esula* L. Page 26

Image citation: all images - Dave Hanson, MnDOT.
Images and good identification write-up: Minnesota wildflowers
http://www.minnesotawildflowers.info/flower/leafy-spurge
http://www.mda.state.mn.us/plants/pestmanagement/weedcontrol/noxiouslist/leafyspurge.aspx

Citations / Resources continued:

Narrowleaf bittercress: *Cardamine impatiens* L. Page 27
Image citations – Bugwood.org: Leslie J. Mehrhoff, University of Connecticut.
Identification and management:
http://www.minnesotawildflowers.info/flower/narrow-leaf-bittercress
http://www.invasive.org/browse/subinfo.cfm?sub=11539

Plumeless thistle: *Carduus acanthoides* L. Page 28
Image citation: all images - Dave Hanson, MnDOT.
Images and good identification write-up: Minnesota wildflowers
http://www.minnesotawildflowers.info/flower/plumeless-thistle
Identification and management:
http://dnr.wi.gov/topic/Invasives/fact/PlumelessThistle.html
http://wiki.bugwood.org/HPIPM:Plumeless_thistle

Purple loosestrife: *Lythrum salicaria* L. and *Lythrum virgatum* L. Page 29
Image citation: all images - Dave Hanson, MnDOT.
Images and good identification write-up: Minnesota wildflowers
http://www.minnesotawildflowers.info/flower/purple-loosestrife
Write-up on identification and control options:
https://www.invasive.org/weedcd/pdfs/wgw/purpleloosestrife.pdf
http://wiki.bugwood.org/Archive:Loosestrife
http://dnr.wi.gov/topic/Invasives/fact/PurpleLoosestrife.html
http://www.dnr.state.mn.us/invasives/aquaticplants/purpleloosestrife/index.html

Wild parsnip: *Pastinaca sativa* L. Page 30
Image citation: all images - Dave Hanson, MnDOT.
Images and good identification write-up: Minnesota wildflowers
http://www.minnesotawildflowers.info/flower/wild-parsnip
Identification and management:
http://dnr.wi.gov/topic/Invasives/fact/WildParsnip.html
http://wiki.bugwood.org/Pastinaca_sativa

Restricted Noxious weeds:

Asian bush honeysuckles: *Lonicera* spp. Page 31
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
Dirr, Michael. 2009. *Manual of Woody Landscape Plants* (full citation page 79)
Smith, Welby R. 2008. *Trees and shrubs of Minnesota: the complete guide to species identification*. Minneapolis, MN: University of Minnesota Press.

Black locust: *Robinia pseudoacacia* L. Page 32
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
Dirr, Michael. 2009. *Manual of Woody Landscape Plants* (full citation page 79)
http://mipncontroldatabase.wisc.edu/
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_015112.pdf

Buckthorn, common: *Rhamnus cathartica* L. Page 33
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
http://dnr.wi.gov/topic/Invasives/fact/CommonBuckthorn.html
http://wiki.bugwood.org/Rhamnus_cathartica

Buckthorn, glossy (and all cultivars): *Frangula alnus* Mill. Page 34
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
http://dnr.wi.gov/topic/Invasives/fact/GlossyBuckthorn.html
http://wiki.bugwood.org/Frangula_alnus
http://www.fs.fed.us/database/feis/plants/shrub/fraaln/all.html

Crown vetch: *Securigera varia* (L.) Lassen Page 35
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
http://www.illinoiswildflowers.info/weeds/plants/crown_vetch.htm
http://mipncontroldatabase.wisc.edu/

European alder: *Alnus glutinosa* (L.) Gaertn. Page 36
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
Dirr, Michael. 2009. *Manual of Woody Landscape Plants* (full citation page 79)
Virginia Tech - http://dendro.cnre.vt.edu/dendrology/syllabus/factsheet.cfm?ID=157
https://www.invasive.org/alien/pubs/midatlantic/control-trees.htm

Garlic mustard: *Alliaria petiolata* (M. Bieb.) Cavara & Grande Page 37
Image citation: all images - Dave Hanson, MnDOT.
Images and good identification write-up: Minnesota wildflowers
http://www.minnesotawildflowers.info/flower/garlic-mustard
Management: http://www.ipm.msu.edu/invasive_species/garlic_mustard

Japanese barberry: *Berberis thunbergii* DC. Page 38-39
Image citation: all images - Dave Hanson, MnDOT.
Identification and Management: http://www.mipn.org/control.html
Dirr, Michael. 2009. *Manual of Woody Landscape Plants* (full citation page 79)
http://dnr.wi.gov/topic/Invasives/fact/JapaneseBarberry.html
Seed viability: http://www.invasive.org/weedcd/pdfs/srs/2008/barberry.pdf

Multiflora rose: *Rosa multiflora* Thunb. Page 40
Image citation: all images - Dave Hanson, MnDOT.
Identification and Management:
http://dnr.wi.gov/topic/Invasives/fact/MultifloraRose.html
http://wiki.bugwood.org/Rosa_multiflora#MANAGEMENT.2FMONITORING

Nonnative Phragmites: *Phragmites australis* (Cav.) Trin. Ex Steud. Page 41
Image citations: Ken Graeve and Dave Hanson, MnDOT.
Identification and Management:
http://dnr.wi.gov/topic/Invasives/fact/Phragmites.html
https://www.maisrc.umn.edu/identifying-phragmites
https://www.invasive.org/weedcd/pdfs/wgw/commonreed.pdf

Citations / Resources continued:

Porcelain berry: *Ampelopsis brevipedunculata* (Maxim.) Trautv. Page 42
Image citations: Foliage image - Paul Kortebein.
Other images - Dave Hanson, MnDOT.
Identification and management:
https://www.fws.gov/delawarebay/Pdfs/Porcelain-berry_Fact_Sheet%20.pdf

Siberian peashrub: *Caragana arborescens* Lam. Page 43
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
Virginia Tech - http://dendro.cnre.vt.edu/dendrology/syllabus/factsheet.cfm?ID=763
https://www.invasiveplantatlas.org/subject.html?sub=9925
https//www.invasive.org/alien/pubs/midatlantic/control-shrubsandsubshrubs.htm

Wild carrot: *Daucus carota* L. Page 44
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
https://www.minnesotawildflowers.info/flower/queen-annes-lace
Controlling Wild Carrot in Hay fields and Pastures
Controlling wild carrot

Specially Regulated Plants:

Amur maple: *Acer ginnala* Maxim. Page 45
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
http://www.invasiveplantatlas.org/subject.html?sub=3965
http://dnr.wi.gov/topic/Invasives/fact/AmurMaple.html

Norway maple: *Acer platanoides* L. Page 46
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
Virginia Tech - http://dendro.cnre.vt.edu/dendrology/syllabus/factsheet.cfm?ID=6
https://www.invasiveplantatlas.org/subject.html?sub=3002
https://www.invasive.org/alien/pubs/midatlantic/control-trees.htm

Poison ivy: western [*Toxicodendron rydbergii* (Small) Green] Page 47
common [*T. radicans* (L.) Kuntze ssp. *negundo* (Greene) Gillis]
Image citation: all images - Dave Hanson, MnDOT.
Identification and Management:
http://www.nps.gov/public_health/info/factsheets/fs_pivy.htm
https://mdc.mo.gov/trees-plants/problem-plant-control/nuisance-native-plants/poison-ivy-control
http://www.dnr.state.mn.us/trees_shrubs/deciduous/poisonivy.html

Winged burning bush: *Euonymus alatus* (Thunb.) Siebold Page 48
Image citation: all images - Dave Hanson, MnDOT.
Identification and management:
Virginia Tech - http://dendro.cnre.vt.edu/dendrology/syllabus/factsheet.cfm?ID=282
https://www.invasive.org/alien/pubs/midatlantic/eual.htm
https://www.invasive.org/alien/pubs/midatlantic/control-shrubsandsubshrubs.htm

Nonnative Plants:

Alfalfa: *Medicago sativa* L. Page 49
Image citations – Bugwood.org:
Foliage - Gerald Holmes, Valent USA Corporation,
Flower - Keith Weller, USDA Agricultural Research Service.
Identification:
http://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=4213

Hairy vetch: *Vicia villosa* Roth Page 49
Image citation: all images - Dave Hanson, MnDOT.
Identification:
http://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=5382
http://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=Coronilla%20varia

Balkan catchfly: *Silene csereii* Baumgarten Page 50
Image citation: Dave Hanson and Ken Graeve, MnDOT.
Identification:
http://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=5045
http://www.minnesotawildflowers.info/flower/balkan-catchfly

Carrot look-alikes: Various species of carrot family members Page 51
Image citation: all images - Dave Hanson, MnDOT.
Identification:
https://www.minnesotawildflowers.info/flower/caraway
https://www.minnesotawildflowers.info/flower/burnet-saxifrage
http://www.invasiveplantatlas.org/subject.html?sub=12275
https://www.minnesotawildflowers.info/flower/japanese-hedge-parsley

Chervil, wild: *Anthriscus sylvestris* (L.) Hoffm. Page 52
Image citation: all images - Dave Hanson, MnDOT.
Identification:
https://www.minnesotawildflowers.info/flower/wild-chervil

Musk or nodding thistle: *Carduus nutans* L. Page 53
Image citation: all images - Dave Hanson, MnDOT.
Other images and good identification write-up: Missouri Plants
http://www.missouriplants.com/Pinkalt/Carduus_nutans_page.html

Yellow rocket: *Barbarea vulgaris* W. T. Aiton. Page 54
Image citation: Dave Hanson and Tina Markeson, MnDOT.
Identification:
http://wisflora.herbarium.wisc.edu/taxa/index.php?taxon=2718
http://www.minnesotawildflowers.info/flower/garden-yellow-rocket

Citations / Resources continued:

Minnesota Native Plants:

American bittersweet: *Celastrus scandens* L. Page 55
Image citation: all images - Dave Hanson, MnDOT.
Identification:
http://dendro.cnre.vt.edu/dendrology/syllabus/factsheet.cfm?ID=913

American vetch: *Vicia americana* Muhl. Ex Willd. Page 56
Image citation: all images - Dave Hanson, MnDOT.
Identification:
https://www.minnesotawildflowers.info/flower/american-vetch

Canadian milkvetch: *Astragalus canadensis* L. Page 56
Image citation: all images - Dave Hanson, MnDOT.
Identification:
http://www.illinoiswildflowers.info/prairie/plantx/can_milkvetchx.htm
https://www.minnesotawildflowers.info/flower/canada-milkvetch

Cherries and wild plum: *Prunus* spp. Page 57
Image citation: all images - Dave Hanson, MnDOT.
Identification: http://wisflora.herbarium.wisc.edu/imagelib/index.php
Genera: Prunus

Common hops: *Humulus lupulus* L. Page 58
Image citation: all images - Dave Hanson, MnDOT.
Identification:
http://www.hort.purdue.edu/newcrop/duke_energy/humulus_lupulus.html

Cow-parsnip: *Heracleum lanatum* Michx. Page 59
Image citation: all images - Dave Hanson, MnDOT.
Identification: http://www.minnesotawildflowers.info/flower/common-cow-parsnip

Cucumbers, wild and bur: *Echinocystis lobata* Michx. and *Sicyos angulatus* L. Page 60
Image citation: all images - Dave Hanson, MnDOT.
Identification: http://www.minnesotawildflowers.info/flower/wild-cucumber
http://www.minnesotawildflowers.info/flower/bur-cucumber

Fireweed: *Chamerion angustifolium* (L.) Holub ssp. *angustifolium* Page 61
Image citation: all images - Dave Hanson, MnDOT.
Identification: http://www.minnesotawildflowers.info/flower/fireweed

Golden alexanders: *Zizia aurea* (L.) W.D.J. Koch and *Z. aptera* (A. Gray) Fernald Page 62
Image citation: all images - Dave Hanson, MnDOT.
Identification:
http://www.minnesotawildflowers.info/flower/golden-alexanders
http://www.minnesotawildflowers.info/flower/heart-leaved-alexanders

Goldenrods: *Solidago* spp. Page 63
Image citation: all images - Dave Hanson, MnDOT.
Identification: http://www.minnesotawildflowers.info/
Search plant name: solidago

Grape, riverbank:. *Vitis riparia* Michx. Page 64
Image citations: all images - Dave Hanson, MnDOT.
Identification:
Smith, Welby R. 2008. *Trees and shrubs of Minnesota.* (full citation page 79).

Native honeysuckles: *Diervilla lonicera* Mill. and *Lonicera* spp. Page 65
Image citation: all images - Dave Hanson, MnDOT.
Identification:
Smith, Welby R. 2008. *Trees and shrubs of Minnesota.* (full citation page 79).
Page 66

Native Phragmites: *Phragmites australis* (Cav.) Trin. ex Steud. ssp. *americanus* Saltonstall
Image citations: Ken Graeve and Dave Hanson, MnDOT.
Identification: https://www.maisrc.umn.edu/identifying-phragmites
https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmctn11494.pdf
http://greatlakesphragmites.net/basics/native-vs-invasive/

Speckled alder: *Alnus incana* and *A. viridis* Page 67
Image citation: all images - Dave Hanson, MnDOT.
Identification:
Smith, Welby R. 2008. *Trees and shrubs of Minnesota.* (full citation page 79).

Sugar maple: *Acer saccharum* Marshall Page 68
Image citation: all images - Dave Hanson, MnDOT.
Identification:
Smith, Welby R. 2008. *Trees and shrubs of Minnesota.* (full citation page 79).

Sumac, Staghorn and Smooth: *Rhus typhina* L. and *R. glabra* L. Page 69
Image citation: all images - Dave Hanson, MnDOT.
Identification:
Smith, Welby R. 2008. *Trees and shrubs of Minnesota.* (full citation page 79).

Swamp thistle: *Cirsium muticum* Michx. Page 70
Image citation: all images - Dave Hanson, MnDOT.
Identification: http://www.minnesotawildflowers.info/flower/swamp-thistle

Virginia creeper and woodbine: *Parthenocissus* spp. Page 71
Image citation: all images - Dave Hanson, MnDOT.
Identification:
Smith, Welby R. 2008. *Trees and shrubs of Minnesota.* (full citation page 79).

Water hemlock: *Cicuta maculata* L. Page 72
Image citation: all images - Dave Hanson, MnDOT.
Identification:
http://www.illinoiswildflowers.info/wetland/plants/water_hemlock.htm

Yarrow, Common: *Achillea millefolium* L. Page 73
Image citation: all images - Dave Hanson, MnDOT.
Identification:
https://www.minnesotawildflowers.info/flower/common-yarrow
http://www.illinoiswildflowers.info/weeds/plants/yarrow.htm

Additional Book and Web Resources:

Black Merel R., Emmet J. Judziewicz. 2009. *Wildflowers of Wisconsin and the Great Lakes Region: a comprehensive field guide*. Univ of Wisconsin Press. 275 pages.

Dirr, Michael. 2009. *Manual of woody landscape plants: their identification, ornamental characteristics, culture, propagation and uses*. Champaign, Ill: Stipes Pub.

Invasive.org – images at Bugwood. Online. http://www.invasive.org/species/forbs.cfm
Factsheets. Online. Weeds Gone Wild: Alien Plant Invaders of Natural Areas.

Midwest Invasive Plant Network. Online. http://www.mipn.org/
Education, identification, control and management.

Minnesota Department of Agriculture. Online.
- Noxious weed list and Fact sheets - Noxious weed law
- Biological control - Pest management

Minnesota Department of Transportation. 2011. *Herbicide Options for Vegetation Control on Mn/DOT Rights-of-Way*. Internal Document. herbicidepreseasontables.pdf

Mortenson, Carol. 2003. *Noxious Weeds of Minnesota*. Leech Lake Division of Resources Management.

PCA Alien Plant Working Group. 2010. *Least Wanted: Alien Plant Invaders of Natural Areas*. Factsheets. Online. https://www.invasive.org/weedcd/html/wgw.htm

Sarver, Matthew. et al. 2008. *Mistaken Identity? Invasive plants and their native look-alikes*. online. http://www.nybg.org/files/scientists/rnaczi/Mistaken_Identity_Final.pdf 12/2012.

Smith, Welby R. 2008. *Trees and shrubs of Minnesota: the complete guide to species identification*. Minneapolis, MN: University of Minnesota Press.

USDA Plants Database. https://plants.usda.gov/java/. United States Department of Agriculture, Natural Resources Conservation Service.

Wisconsin DNR. 2010. *A field Guide to Terrestrial Invasive Plants in Wisconsin*. Ed. Thomas Boos, Kelly Kearns, Courtney LeClair, Brandon Panke, Bryn Scrivner, and Bernadette Williams.

Wisconsin Department of Natural Resources factsheets:
Online. Terrestrial Invasive Species: List, Factsheets, Images

Virginia Tech Dendrology Factsheets. College of Natural Resources and Environment. https://dendro.cnre.vt.edu/dendrology/factsheets.cfm

Weblinks verified December, 2019.





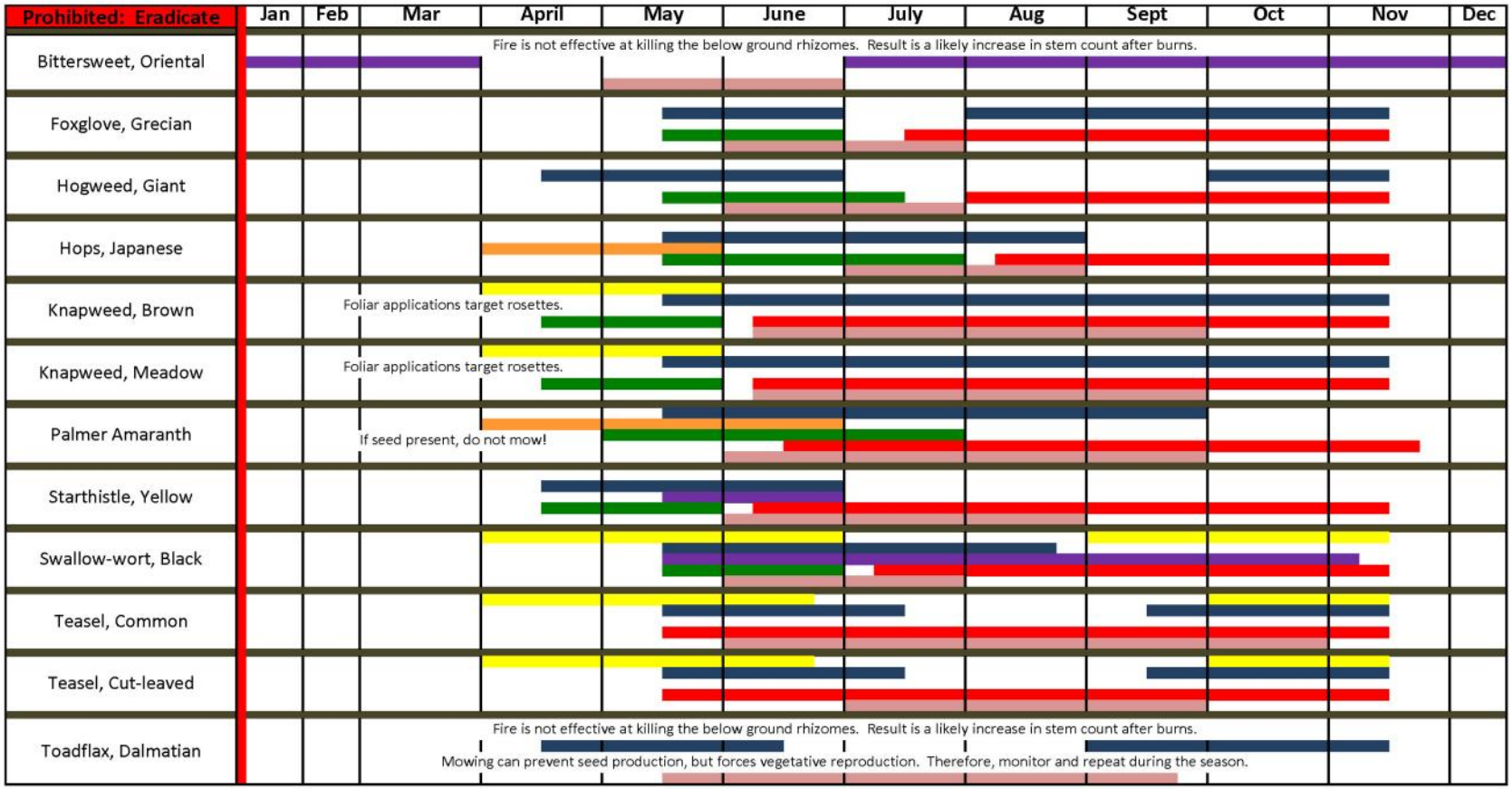


Biological Controls **Mowing or Other Mechanical Means** **Herbicide** **Prescribed Fire**

Management tactics can take many forms and should be based on predefined vegetation management goals.

Suggested timing of management tactics or control options can be found in graphical form on the following two pages.
Timings are based on recommendations described in the many resources listed on the previous pages.

Suggested Timing of Control Options for Minnesota Noxious Weed Species (2016)

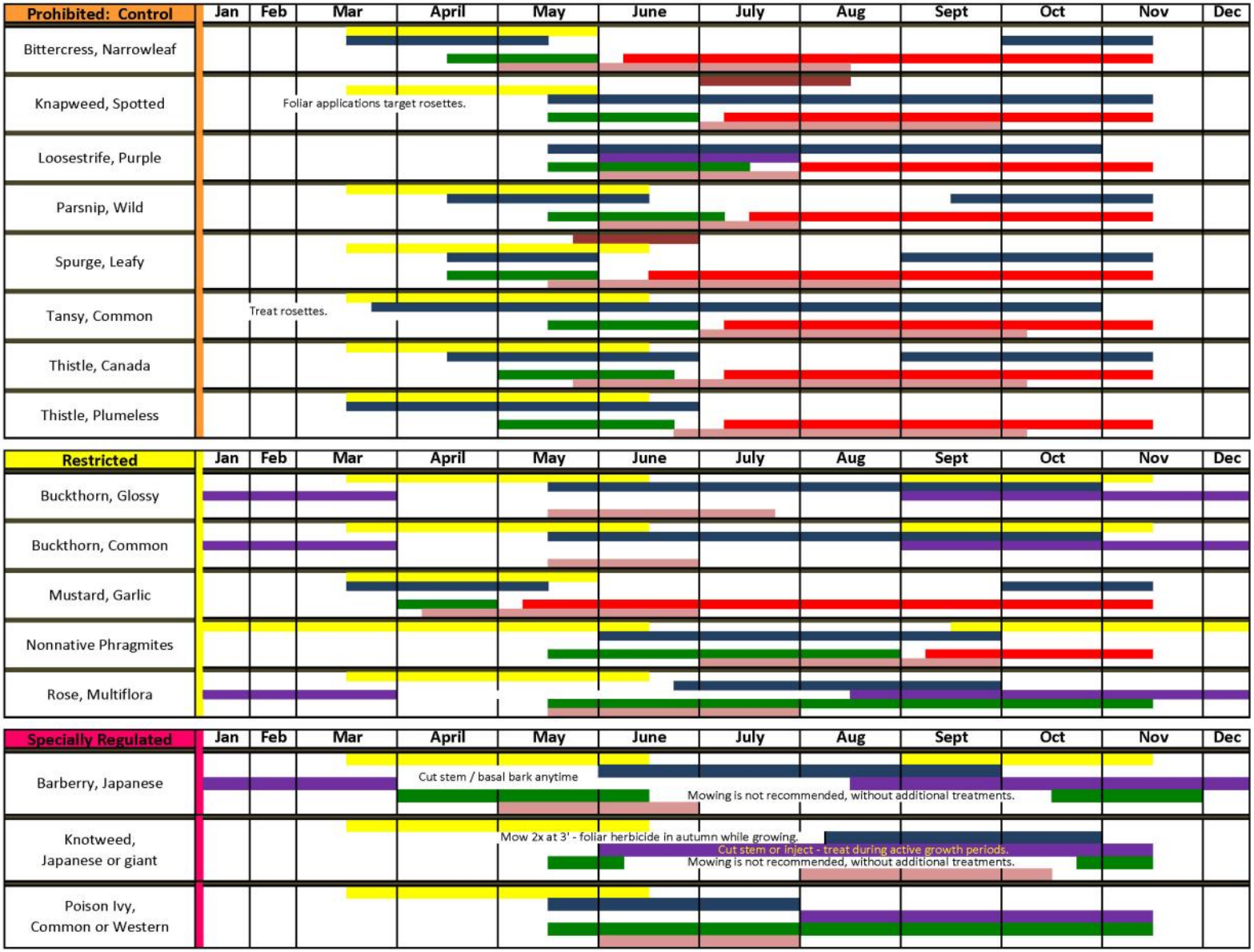


Herbicide: Foliar	Burn	Note: Suggested timings are approximate since weather and seasonal variations play a role in deciding how and when to control an infestation.
Herbicide: Stem or Stump	Mow	
Herbicide: Pre-emerge	Do Not Mow	
Biocontrol	Approximate Bloom	

N:_Programs\Roadside_Veg_Mngt\Pesticide\Herbicide-options-calendar\2016-Herbicide_tables-cheat-sheets\2016_Management-calendar.xlsx

dlh (March, 2016).

Suggested Timing of Control Options for
Minnesota Noxious Weed Species (2016)



N:_Programs\Roadside_Veg_Mngt\Pesticide\Herbicide-options-calendar\2016-Herbicide_tables-cheat-sheets\2016_Management-calendar.xlsx

dlh (March, 2016).

Definitions of the noxious weed categories from the Minnesota Department of Agriculture web page:
http://www.mda.state.mn.us/plants-insects/Minnesota-noxious-weed-list.aspx

State Prohibited Noxious Weeds

Prohibited noxious weeds are annual, biennial, or perennial plants that the commissioner designates as having the potential or are known to be detrimental to human or animal health, the environment, public roads, crops, livestock or other property. There are two regulatory listings for prohibited noxious weeds in Minnesota:

1. Eradicate List: Prohibited noxious weeds that are listed to be eradicated are plants that are not currently known to be present in Minnesota or are not widely established. These species must be eradicated, meaning all of the above and below ground parts of the plant must be destroyed, as required by Minnesota Statutes, Section 18.78. Additionally, no transportation, propagation, or sale of these plants is allowed. Measures must also be taken to prevent and exclude these species from being introduced into Minnesota.
2. Controlled List: Prohibited noxious weeds listed to be controlled are plants established throughout Minnesota or regions of the state. Species on this list must be controlled, meaning efforts must be made to prevent the spread, maturation and dispersal of any propagating parts, thereby reducing established populations and preventing reproduction and spread as required by Minnesota Statutes, Section 18.78. Additionally, transportation, propagation, or sale of these plants is prohibited.

Restricted Noxious Weeds

Restricted noxious weeds are plants that are widely distributed in Minnesota and are detrimental to human or animal health, the environment, public roads, crops, livestock or other property, but whose only feasible means of control is to prevent their spread by prohibiting the importation, sale, and transportation of their propagating parts in the state except as allowed by Minnesota Statutes, Section 18.82. Plants designated as Restricted Noxious Weeds may be reclassified if effective means of control are developed.

Specially Regulated Plants

Specially regulated plants are plants that may be native species or have demonstrated economic value, but also have the potential to cause harm in non-controlled environments. Plants designated as specially regulated have been determined to pose ecological, economical, or human or animal health concerns. Plant specific management plans and or rules that define the use and management requirements for these plants will be developed by the Minnesota Department of Agriculture for each plant designated as specially regulated. Measures must also be taken to minimize the potential for harm caused by these plants.

Amur maple: Sellers shall affix a label that advises buyers to only plant Amur maple and its cultivars in landscapes where the seedlings will be controlled by mowing or other means. Amur maple should be planted at least 100 yards from natural areas. Return to Amur maple.

Norway maple: Sellers shall affix a label that advises buyers to only plant Norway maple and its cultivars in landscapes where the seedlings will be controlled by mowing or other means. Norway maple should be planted at least 100 yards from natural areas. Return to Norway maple.

Poison ivy: Must be eradicated or controlled for public safety along rights-of-ways, trails, public accesses, business properties open to the public or on parts of lands where public access for business or commerce is granted. Must also be eradicated or controlled along property borders when requested by adjoining landowners. Return to poison ivy.

Winged burning bush: Winged burning bush will begin a three-year phase-out period in Minnesota starting January 1, 2020. At the end of the phase-out period (December 31, 2022), the listed species will become a Restricted Noxious Weed in Minnesota and will be illegal to sell and propagate.

Return to winged burning bush

Minnesota Noxious Weeds

http://www.dot.state.mn.us/roadsides/vegetation/pdf/noxiousweeds.pdf

This book has two parts; part 1 (index pg. 2-3) contains terrestrial noxious weeds and part 2 (index pg. 4) contains look-alike plants.

For example, compare:

Left: Noxious weed, Oriental bittersweet (*Celastrus orbiculatus*) that has flowers and fruits in leaf axils along its vine (white arrows).

Right: Native plant, American bittersweet (*Celastrus scandens*) has flowers and fruits only at the terminus of branches.

Indexes on page 2-3 contain terrestrial noxious weeds listed under:

Minnesota Noxious Weed Law:
Find more information at:
Minnesota Department of Agriculture.

Index on page 4 contains a list of terrestrial nonnative and native species often mistaken for the associated noxious weeds.

These terrestrial plant descriptions are provided in an effort to prevent mistaken identities.

Scientific names (genus and species) were sourced from : USDA Plants Database

Minnesota Noxious Weeds

http://www.dot.state.mn.us/roadsides/vegetation/pdf/noxiousweeds.pdf

Indexes on page 2-3 contain
terrestrial noxious weeds
listed under:

Minnesota Noxious Weed Law:
Find more information at:
Minnesota Department of Agriculture

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Edited by: Tina Markeson, MnDOT

February, 2020

DEPARTMENT OF TRANSPORTATION

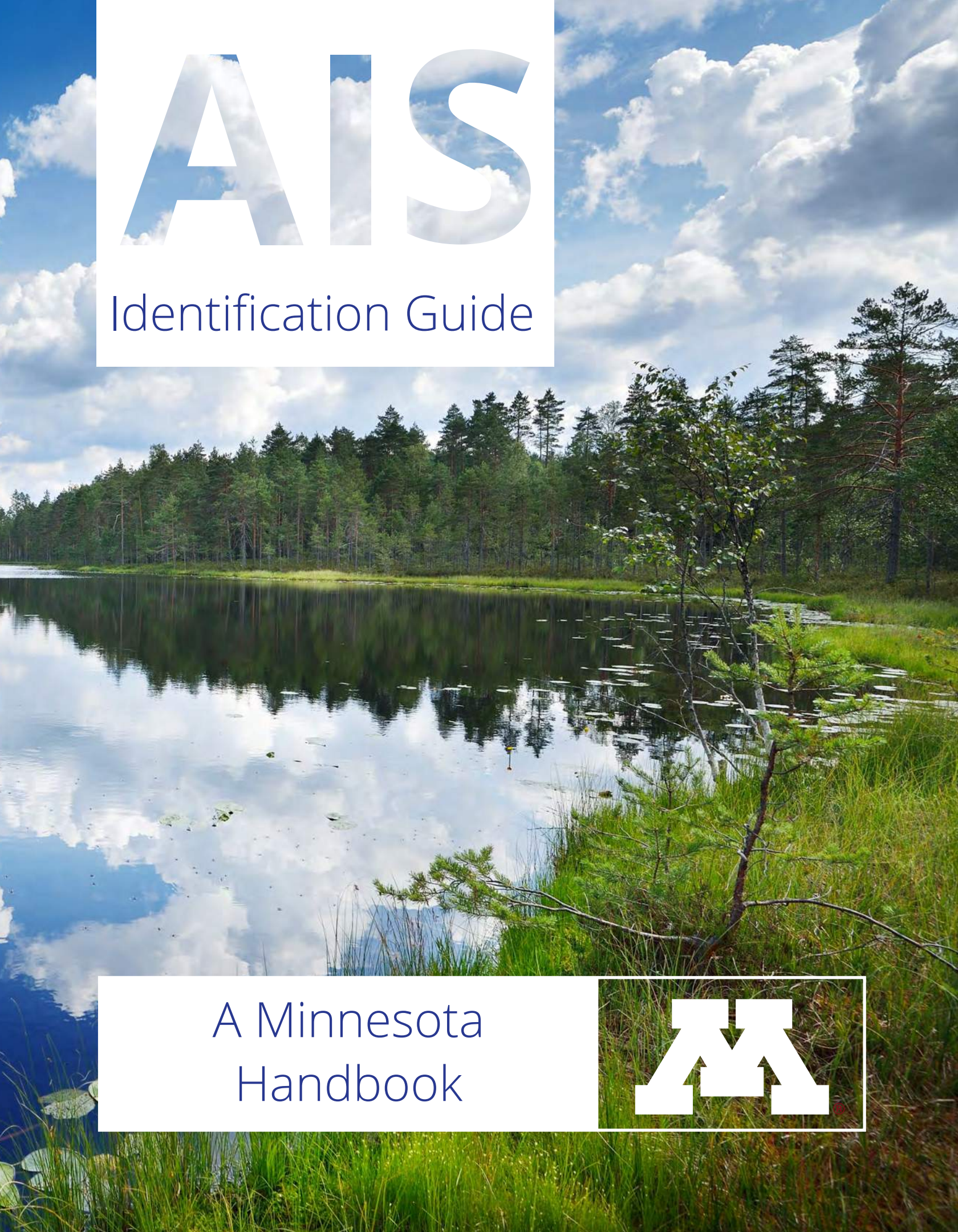
Play Clean Go
STOP INVASIVE SPECIES IN YOUR TRACKS.
PlayCleanGo.org

Attachment E

Minnesota Aquatic Invasive Species Guide

AIS

Identification Guide



A Minnesota Handbook


1
2
3
4
5
6
7
8
9
10

AIS Identification Guide

Second edition

MINNESOTA AQUATIC INVASIVE SPECIES RESEARCH CENTER *in partnership with* UNIVERSITY OF MINNESOTA | EXTENSION

Funding for the development of this book is provided in part by the Environment and Natural Resources Trust Fund, the Clean Water Fund, and private donations.

How to use this book

This ID book contains tips for identifying a number of aquatic invasive species (AIS) that are considered high-risk to Minnesota waters, as well as some common native lookalike species.

As you look at identifying characteristics and descriptions in the pages that follow, bear in mind that colors and sizes can be variable. These are general guidelines, not definitive taxonomic identification characteristics. Whenever possible, we highlighted key or unusual characteristics about a species, but specimens can often look very similar. They may also sometimes be found outside of the suggested habitats. If you are in doubt as to whether you have found an AIS, be sure to submit a report to the DNR using EDDMapS or the Great Lakes Early Detection Network (GLEDN) app, or by contacting a DNR AIS Specialist.

You will notice two different styles of maps in this book: for native species, we use watershed maps to highlight where species are generally found. Again, this can vary — these maps are a guideline. For invasive species, we use county maps to provide more localized distribution information. Maps are current using available data as of February 2018.

For more information on this book and AIS research, please visit www.maisrc.umn.edu.

If you find an AIS

If you find an aquatic invasive species occurrence, follow these steps:

1. Use EDDMapS to submit the report.

You can do this using the GLEDN app on your mobile device or on the EDDMapS website at www.eddmaps.org/Midwest. You should include:

- The date and time you made the observation.
- The species you believe you have found.
- The location you made the observation. Be specific.
- Photographs of the specimens.

2. Take photos of the AIS.

You should take multiple photos, including:

- Photos of the entire plant or animal (or as much as can clearly be captured in the frame).
- Close-ups of identifying features (such as leaves, fins, shape, colors, etc.).
- A photo that has an object in it for scale (such as a coin or a ruler).
- One photo of the general area where the AIS was found.

3. Collect a sample of the AIS.

- For animals such as invertebrates and fish, collect the entire animal.
- For smaller animals such as zebra mussels or spiny waterflea, you may want to include a few animals.
- For plants, you want to include as much of the plant as you reasonably can. Try to collect portions of the stem with leaves attached, any flowering structures if present, reproductive parts such as flowers or fruits, and organs such as tubers, turions, roots and rhizomes.
- Place the collected sample in a sealed container, something as simple as a Ziploc bag will do. If you have a large animal, like a carp, put it on ice in a cooler. You may also choose to wrap the plant or animal in a damp paper towel or newspaper prior to putting it into its container.
- Put a piece of paper with the location the sample was collected, the date of collection, and your name and contact information on it in the container with your sample. Be sure to write in pencil so that it doesn't bleed or run when wet.

4. Contact your local AIS specialist.

- Inform them that you have a sample of a suspected AIS and ask for further direction on what they would like you to do with it.
- The contact information for AIS Specialists is on the DNR's website: www.dnr.state.mn.us/invasives/ais/contacts.html

5. If you are using the GLEDN app, be sure to upload your report from the queue.

The DNR is responsible for confirming and communicating new AIS occurrences. Do not make public announcements of AIS findings.

If you are interested in learning more about AIS identification and citizen science, consider becoming an AIS Detector. Visit www.aisdetectors.org for more information.

Acknowledgements

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Paul Skawinski, University of Wisconsin Extension
Chris Taylor, Illinois Natural History Survey
Mike Verhoeven, Minnesota Aquatic Invasive Species Research Center

Quick reference guide

Eurasian watermilfoil

	Eurasian watermilfoil	Northern watermilfoil	Hybrid watermilfoil	Coontail	Water marigold	White water crowfoot	Bladderworts
Leaves alternate						X	X
Bladders present on leaves							X
Leaves whorled	X	X	X	X	X		
Leaflets on a central axis	X	X	X				
Leaves with <12 leaflets (4-11)		X					
Leaves with ≥12 leaflets (12-20)	X		X				

Hydrilla

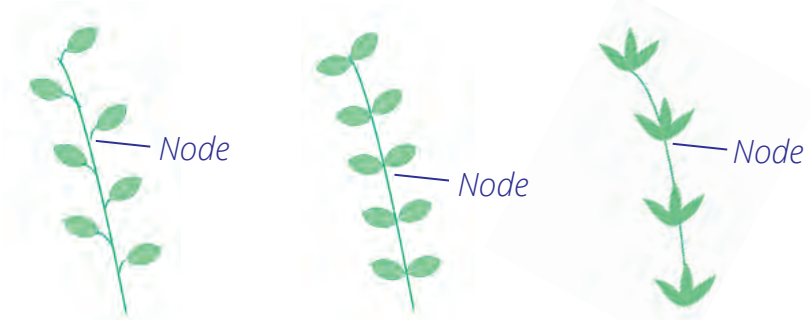
	Hydrilla	Brazilian waterweed	Elodea (waterweed)
≤ 3 leaves in a whorl			X
≥ 3 leaves in a whorl	X (usually 5)	X (usually 4)	
Showy white flowers		X	
Serrated leaf margins	X	X (under magnification)	
Produces tubers and turions	X		

Starry stonewort

	Starry stonewort	*Chara spp.*	*Nitella spp.*	Sago pondweed	Water stargrass
Alternate, flat leaves					X
Branching needle-like leaves				X	
Whorled branchlets, like stem	X	X	X		
Strong odor		Some species			
Rough stems		X			
Forked branchlets	X		X		
Forked tips symmetrical			X		
Stays rigid out of water	X				
Star-shaped bulbils	X				

Introduction to aquatic plants

Leaf arrangement:



Alternate *Opposite* *Whorled*

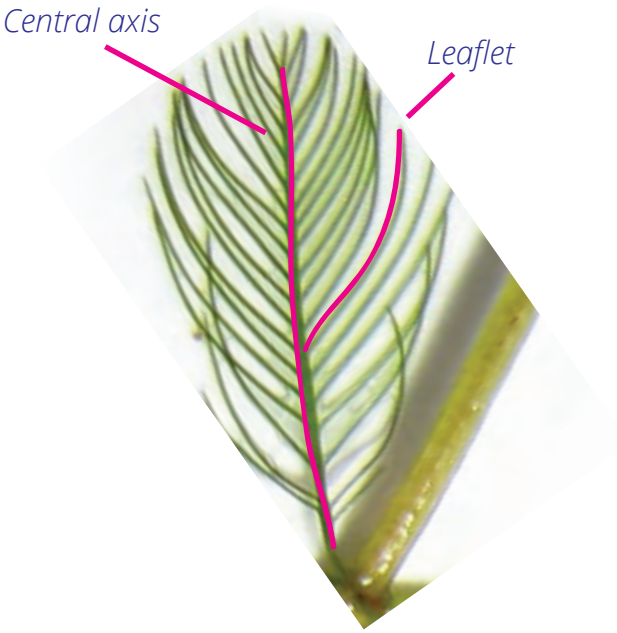
Leaf type:

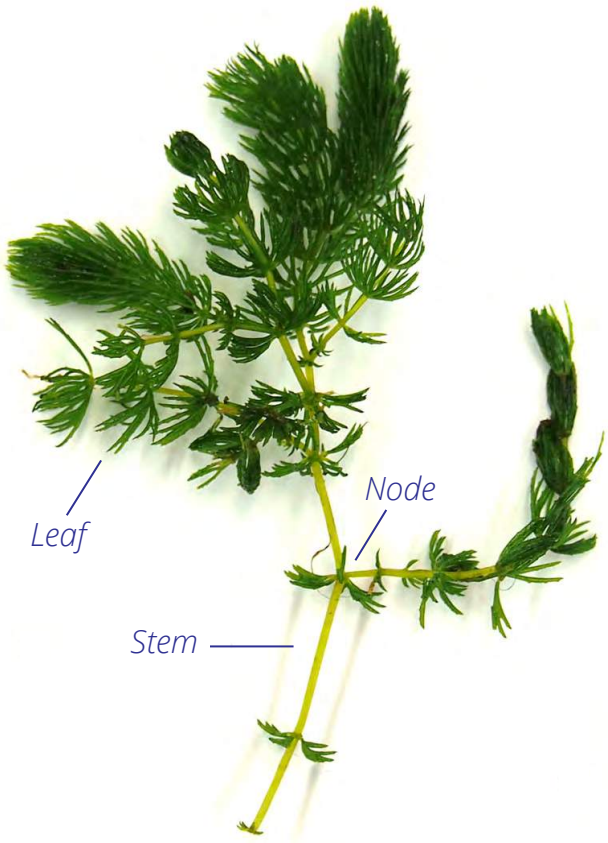
Simple (undivided)

Compound (divided into leaflets)

Leaf margins:

Entire *Serrate* *Undulate*





INVASIVE Eurasian watermilfoil

Myriophyllum spicatum

KEYS TO ID

- Feathery looking with four leaves per whorl
- Leaves have central axis with 12 – 20 leaflet pairs
- Can grow up to 10 feet long
- Produces pink and white flowers on spike above surface
- Leaves become limp when taken out of water

LOOKS SIMILAR TO

- Northern watermilfoil (native)
- Coontail (native)
- Bladderworts (native)
- White water crowfoot (native)
- Water marigold (native)

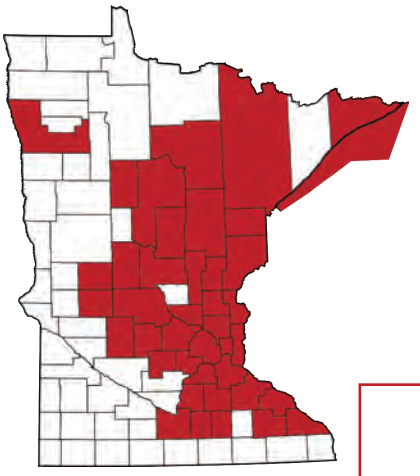
Note: Eurasian watermilfoil is known to hybridize with northern watermilfoil.

Hybrid watermilfoil is also considered invasive and should be reported.

WHERE TO LOOK

- In lakes, ponds, and slow-moving areas of rivers or streams
- Grows best in depths of 3 – 15 feet

CURRENTLY FOUND



Above-surface flowers

Four leaves per whorl with 12 – 20 leaflet pairs per leaf

NATIVE

Northern watermilfoil

Myriophyllum sibiricum

KEYS TO ID

- Four leaves per whorl
- Each leaf has between 4 – 11 leaflet pairs
- Leaves have a central axis and are rigid when taken out of water

LOOKS SIMILAR TO

- Eurasian watermilfoil (invasive)
- Coontail (native)
- Bladderworts (native)
- Water marigold (native)
- White water crowfoot (native)
- Minnesota has six native milfoil species; this is the most common

WHERE TO LOOK

- In depths of up to 20 feet

CURRENTLY FOUND

Four leaves per whorl with 4 – 11 leaflet pairs per leaf

NATIVE Coontail

Ceratophyllum demersum

KEYS TO ID

- Leaves have no central axis and are branching
- Can grow up to six feet long
- Often free-floating

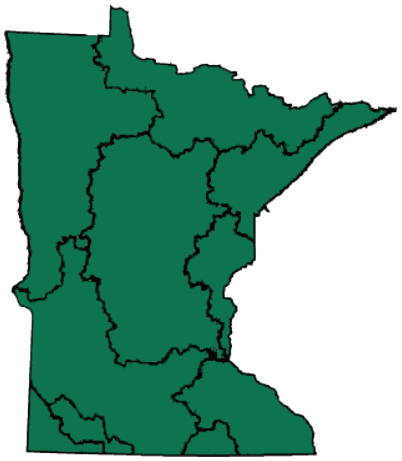
LOOKS SIMILAR TO

- Eurasian watermilfoil (invasive)
- Water marigold (native)
- Northern watermilfoil (native)
- Bladderworts (native)
- White water crowfoot (native)

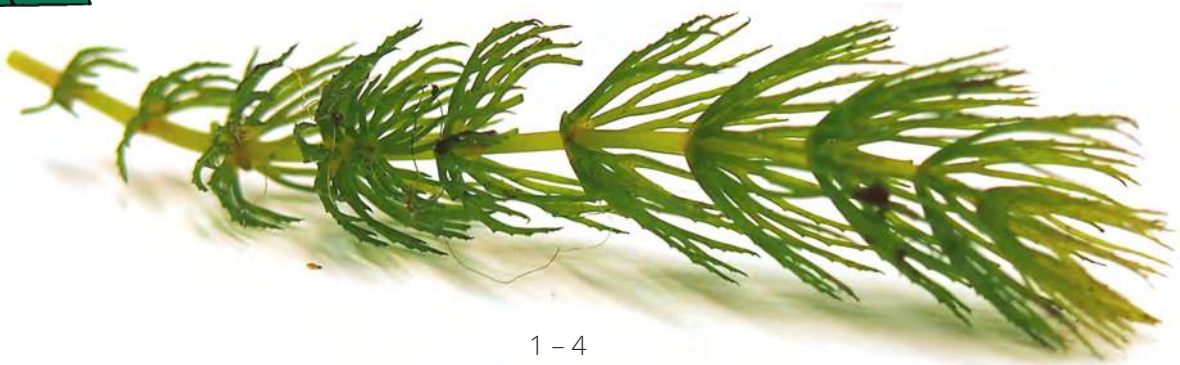
WHERE TO LOOK

- In water up to 20 feet deep
- Upper leaves may reach surface and form dense patches
- Can become highly abundant and form “oil slicks” when it dies back

CURRENTLY FOUND



Branching



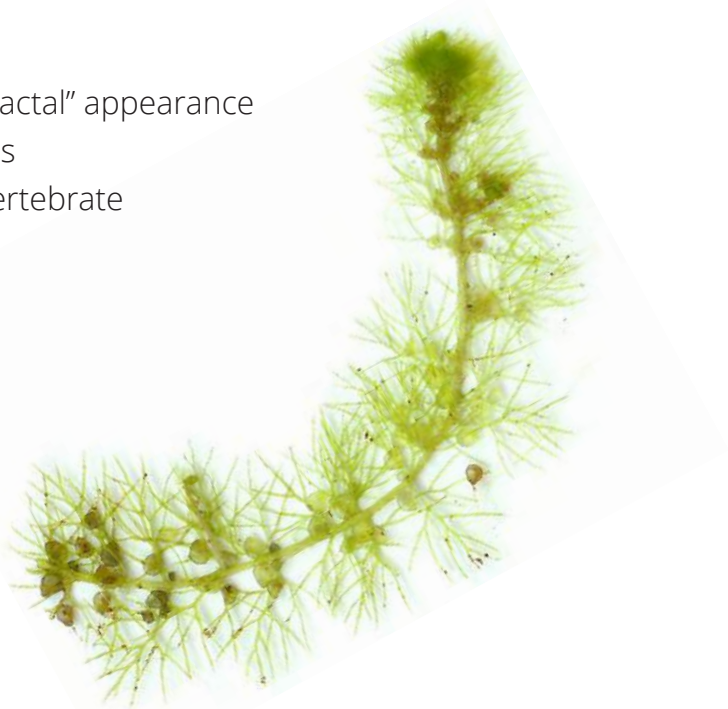
NATIVE

Bladderworts

Utricularia spp.

KEYS TO ID

- Thin leaves branching and zig-zagging can give a “fractal” appearance
- Leaves are highly dissected and have no central axis
- Has bladders, some of which may be filled with invertebrate victims of these carnivorous plants
- Has snapdragon-like flowers

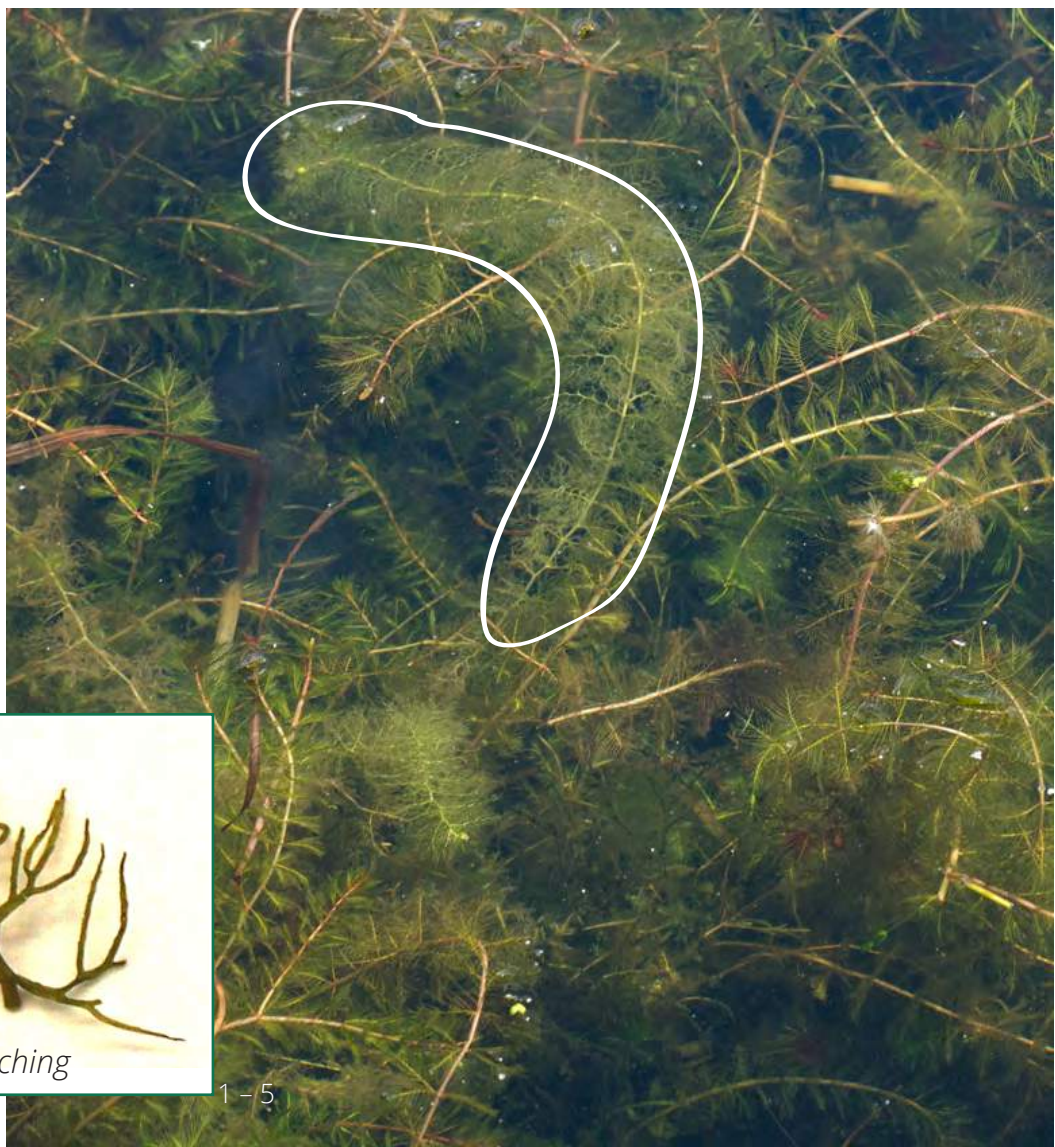


LOOKS SIMILAR TO

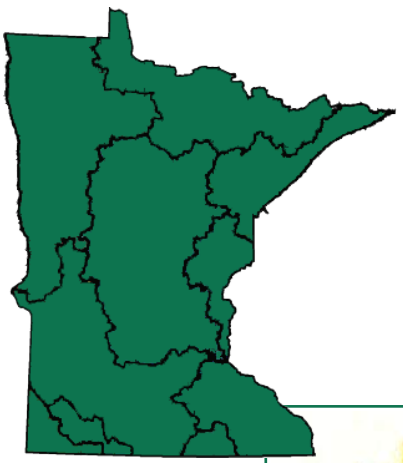
- Eurasian watermilfoil (invasive)
- Northern watermilfoil (native)
- Coontail (native)
- Water marigold (native)
- White water crowfoot (native)
- Minnesota has eight bladderwort species

WHERE TO LOOK

- Usually found in shallow waters
- Can be either free-floating or buried in the sediment



CURRENTLY FOUND



Branching

NATIVE

White water crowfoot

Ranunculus aquatilis

KEYS TO ID

- Grows in mats on the water's surface
- Alternating leaves are highly dissected
- Produces flowers with yellow centers and five white petals
- Often has modified leaves at surface

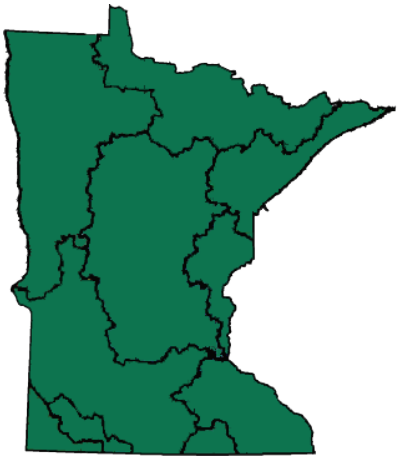
LOOKS SIMILAR TO

- Eurasian watermilfoil (invasive)
- Water marigold (native)
- Northern watermilfoil (native)
- Bladderworts (native)
- Coontail (native)

WHERE TO LOOK

- In ponds, slow-moving streams, and marshes
- Can grow up to 1 to 6 inches above water's surface

CURRENTLY FOUND



Branching leaves

1 – 6

NATIVE

Water marigold

Bidens beckii (formerly *Megalodonta beckii)*

KEYS TO ID

- Opposite to whorled, highly dissected leaves that are variable along stems
- Leaves do not have a central axis
- Produces yellow buttercup flowers with more than five petals in mid- to late-summer
- Has two simple emergent leaves under the flower that are serrated

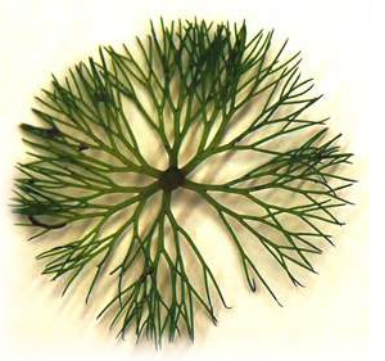
LOOKS SIMILAR TO

- Eurasian watermilfoil (invasive)
- Coontail (native)
- Northern watermilfoil (native)
- Bladderworts (native)
- White water crowfoot (native)

WHERE TO LOOK

- In water up to 12 feet deep
- Flowers are above water

CURRENTLY FOUND

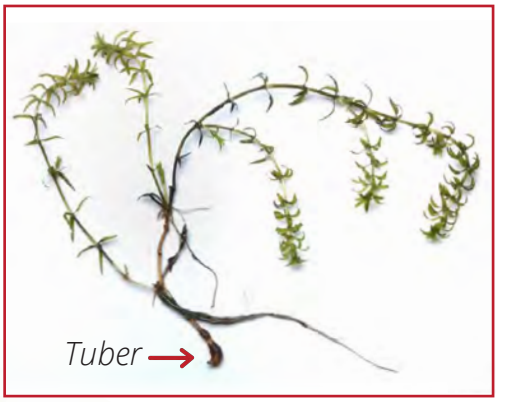


INVASIVE Hydrilla

Hydrilla verticillata

KEYS TO ID

- Submersed plant that grows into thick mats
- Leaves are bright green with a midvein down the center and are between 1/5 and 3/4 inches long
- Leaves directly attached to stem (stalkless) in whorls of 3 – 10; often 5
- Ascending stems can grow up to 30 feet long
- Tubers or turions may be present
- Leaves have sharply toothed serrated edges that may require a hand lens to see



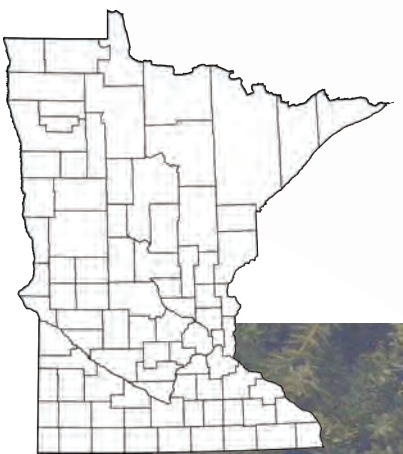
LOOKS SIMILAR TO

- *Elodea* (native)
- Brazilian waterweed (invasive)

WHERE TO LOOK

- Streams, lakes, and ponds
- In shallow or deep waters
- May invade deep waters where native plants can't grow
- Has not been found in Minnesota

CURRENTLY FOUND



NATIVE

Common waterweed

Elodea canadensis

KEYS TO ID

- Whorls of 3 oval-shaped leaves; whorls of 4 may occur
- Can grow up to three feet tall
- Leaves have smooth edges and are between ¼ and ⅔ inches long
- Small white flowers visible above water in the summer

Three leaves per whorl

LOOKS SIMILAR TO

- Hydrilla (invasive)
- Brazilian waterweed (invasive)
- Minnesota has three native *Elodea* species

WHERE TO LOOK

- In water up to 10 feet deep
- Near stream inlets
- May be free-floating

CURRENTLY FOUND

INVASIVE Brazilian waterweed

Egeria densa

KEYS TO ID

- Leaves in whorls of 4 to 6
- Leaves are between ⅖ and 1.5 inches long
- Small white flowers with 3 petals may be visible
- Can form dense mats that look bushy
- Serrated leaf margins may be visible under magnification

LOOKS SIMILAR TO

- *Elodea* (native)
- *Hydrilla* (invasive)

WHERE TO LOOK

- Submersed; can be free-floating or rooted
- Commonly used in home aquaria
- No established populations in Minnesota

INVASIVE Starry stonewort

Nitellopsis obtusa

KEYS TO ID

- Long, smooth branchlets are attached in whorls of 5 – 8 and branch asymmetrically at tips
- Stems are smooth
- Small, star-shaped bulbils form on clear threads at base of plant and may be found above or below the sediment surface
- Small, orange spheres called antheridia may be visible, these are male reproductive structures
- Branchlets typically several inches long, longer than *Chara* or *Nitella*
- Can fill water column and form surface mats

LOOKS SIMILAR TO

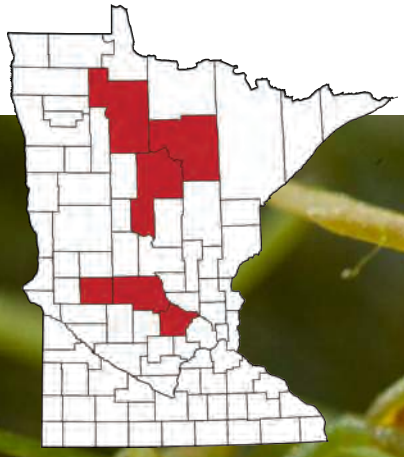
- Native *Chara* (native)
- Native *Nitella* (native)
- Sago pondweed (native)
- Water stargrass (native)

WHERE TO LOOK

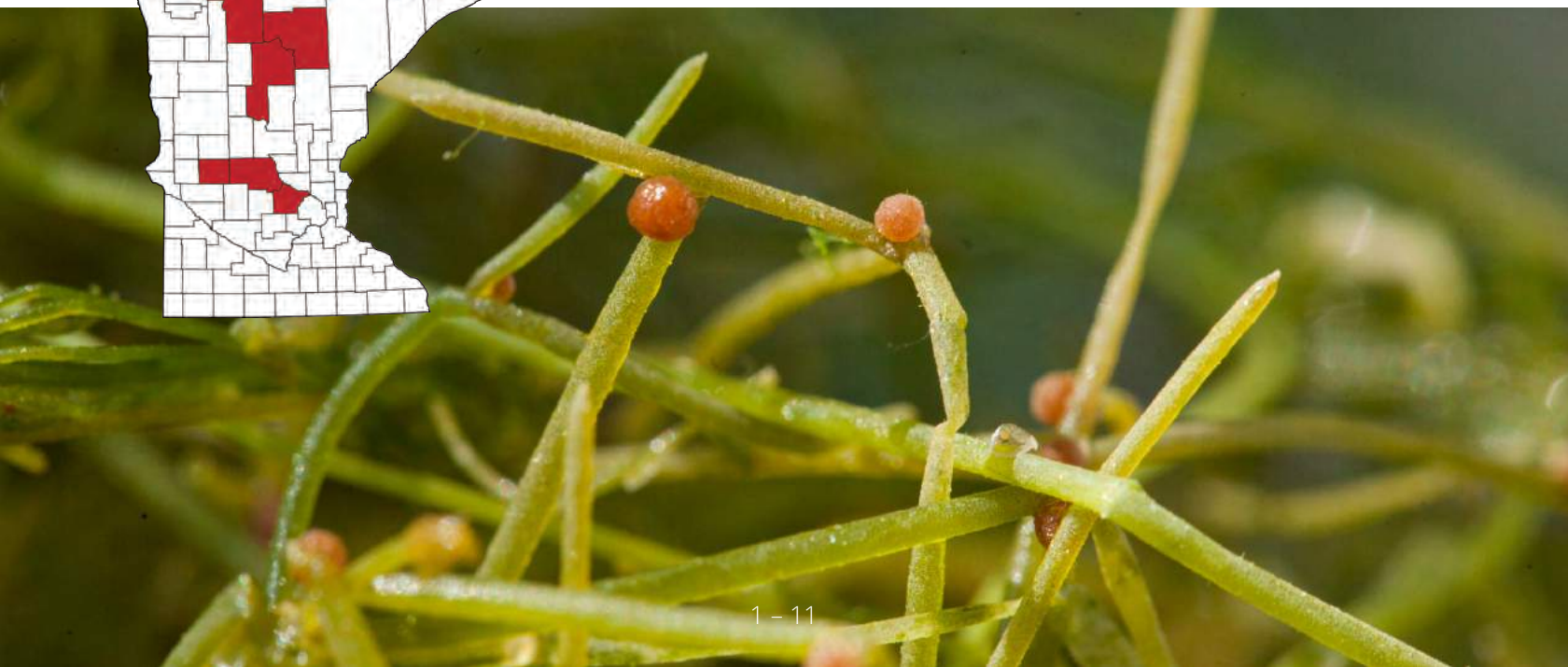
- In shallow, still water and near accesses

Actual size of bulbils

CURRENTLY FOUND



Below: orange antheridia



NATIVE

Muskgrasses

Chara spp.

KEYS TO ID

- Stems are typically rough and crunchy
- Thin branchlets form whorls around thin stems
- Branchlets are not forked at tips
- May produce bulbils, but not star-shaped
- May have musky odor

Whorled branchlets

LOOKS SIMILAR TO

- Starry stonewort (invasive)
- Native *Nitella* (native)
- Sago pondweed (native)
- Water stargrass (native)
- Minnesota has nine *Chara* species

WHERE TO LOOK

- Fully submerged
- Along lake bottoms forming patches called meadows

CURRENTLY FOUND

NATIVE Stoneworts

Nitella spp.

KEYS TO ID

- Stems are smooth
- Branchlets fork into two or three tips at end
- Unlike starry stonewort, forked tips are of equal length
- Typical branchlets are around an inch in length; much shorter than starry stonewort
- Becomes limp when out of water

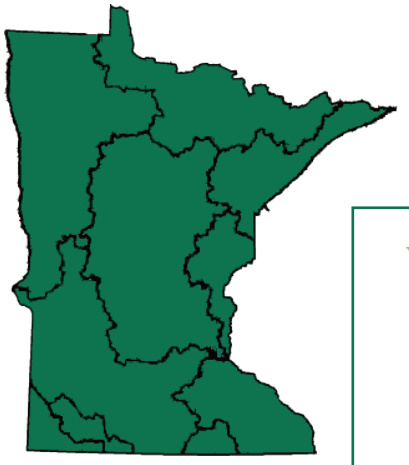
LOOKS SIMILAR TO

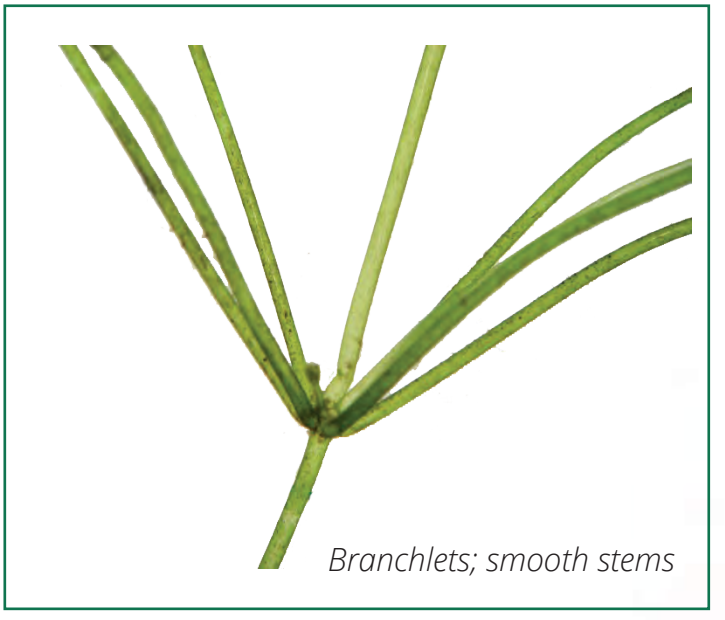
- Starry stonewort (invasive)
- Native *Chara* (native)
- Sago pondweed (native)
- Water stargrass (native)

WHERE TO LOOK

- Often in deeper zones of lake
- At depths up to 30 feet

CURRENTLY FOUND





Branchlets; smooth stems

NATIVE

Sago pondweed

Stuckenia pectinata

KEYS TO ID

- Has narrow, stiff leaves alternating off the slender stem
- The base of leaves are tightly attached to stem for about 1/4 of an inch before coming off the stem
- Produces clusters of egg-shaped fruits
- Leaves are very fine and almost look like pine needles
- Grows up to three feet tall

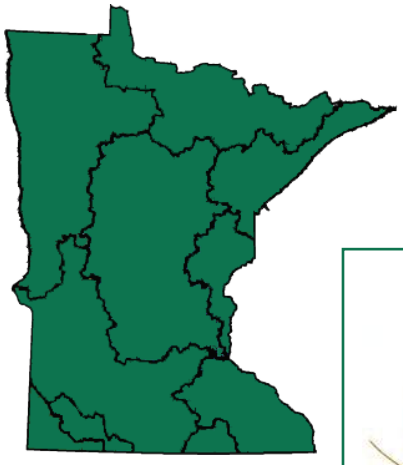
LOOKS SIMILAR TO

- Starry stonewort (invasive)
- Native *Chara* (native)
- Native *Nitella* (native)
- Water stargrass (native)

WHERE TO LOOK

- Usually in shallow waters up to six feet
- Entirely submersed in water

CURRENTLY FOUND



Alternating leaves

NATIVE

Water stargrass

Heteranthera dubia

KEYS TO ID

- Small yellow flowers visible above water in mid- to late-summer
- Leaves lack a visible midvein
- Slender and branching stems with alternating leaves
- Leaves are narrow and flat
- May create dense mats

LOOKS SIMILAR TO

- Starry stonewort (invasive)
- Native *Chara* (native)
- Sago pondweed (native)
- Native *Nitella* (native)

WHERE TO LOOK

- Mostly in shallow waters and near stream banks
- On sandy or muddy bottoms

CURRENTLY FOUND

Yellow flowers

INVASIVE Curly-leaf pondweed

Potamogeton crispus

KEYS TO ID

- Thin, submerged leaves have distinct "teeth" and wavy edges
- Produces turions that look like small, greenish-brown pinecones
- Generally the first pondweed to come up in the spring; dies back in midsummer
- Leaves do not clasp around stem where they connect

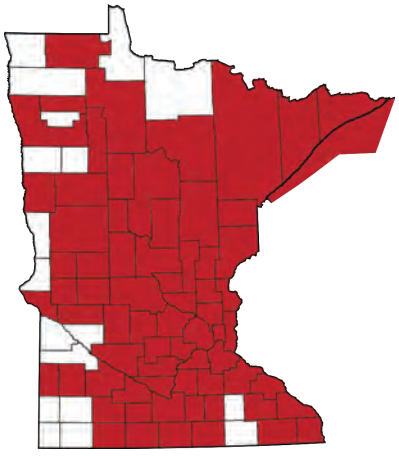
LOOKS SIMILAR TO

- Clasping-leaf pondweed (native)

WHERE TO LOOK

- Lakes, rivers, and streams in waters up to 15 feet deep

CURRENTLY FOUND



Teeth on edges

Turions

NATIVE

Clasping-leaf pondweed

Potamogeton richardsonii

KEYS TO ID

- Leaves alternate along the stem
- Leaves are wide and wavy, but don't have "teeth" like curly-leaf pondweed
- Leaves clasp around stem

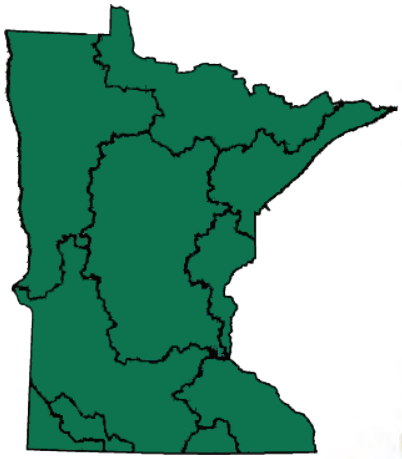
LOOKS SIMILAR TO

- Curly-leaf pondweed (invasive)
- Also called Richardson's pondweed

WHERE TO LOOK

- Fully submersed
- In water up to 12 feet

CURRENTLY FOUND



Leaves clasping stems

Quick reference guide

Rusty crayfish

	Rusty crayfish	Clearwater crayfish	Calico crayfish	Virile crayfish
Red spot on carapace	X			
Black band on pincers	X	X		
Dark v-shaped mark on abdomen		X		
Notched gap in pincers			X	
Orange tip on pincers	X	X	X	X
Blue tint & white bumps on claws				X
Oval gap when pincers closed	X	X		

Zebra and quagga mussels

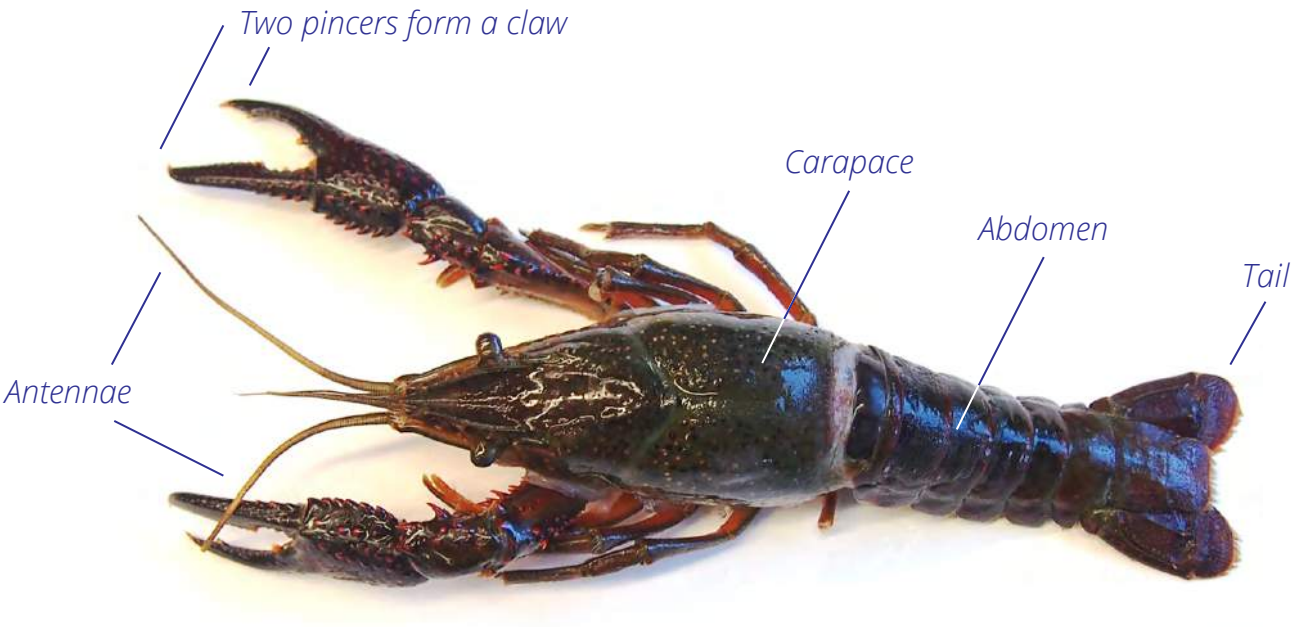
	Zebra mussels	Quagga mussels	Native mussels	Asian clam	Snails
Adults attach to hard surfaces	X	X			X
Two shells	X	X	X	X	
Symmetric shape				X	
Ridges on shell			Some species	X	
Spiral-shaped shell					X
Striped pattern	Zig-zags	Rings	Some species		
Flattened ventral edge	X		Some species		
Curved line where shells meet		X	Some species		
Coloration lightens toward hinge		X	Some species		

Spiny waterflea

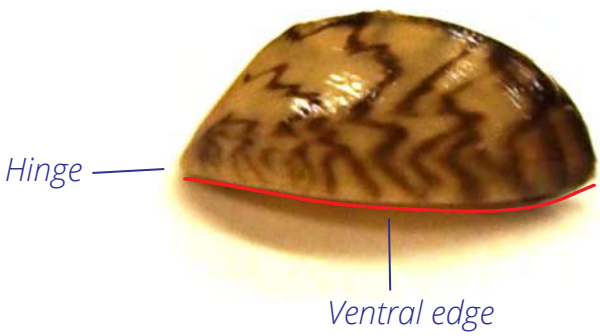
	Spiny waterflea	Fishhook waterflea	Other zooplankton
Long, spine-like tail	X	X	
Barbs on tail	X	X	
Black eyespot(s)	X	X	X
Egg sac (on females)	Round, bulbous	Long, pointed	
Hook at end of tail		X	
Can clump on angling gear	X	X	X

Introduction to invertebrates

Crayfish



Mussels and clams



Snails

INVASIVE Rusty crayfish

Orconectes rusticus

KEYS TO ID

- All crayfish resemble miniature lobsters with long antennae, a pair of claws, and eight legs
- Red spots on the sides of carapace
- Small black bands at the tip of each pincer on claws
- When claws close, there is an oval-shaped gap
- Can grow up to 5 inches long

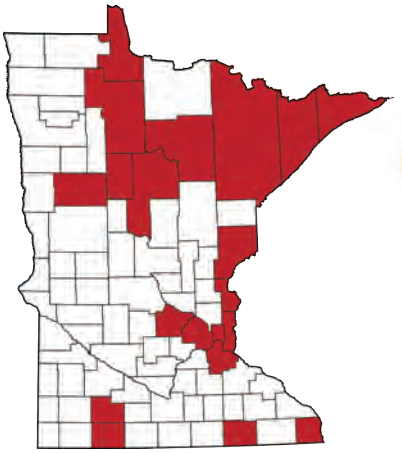
LOOKS SIMILAR TO

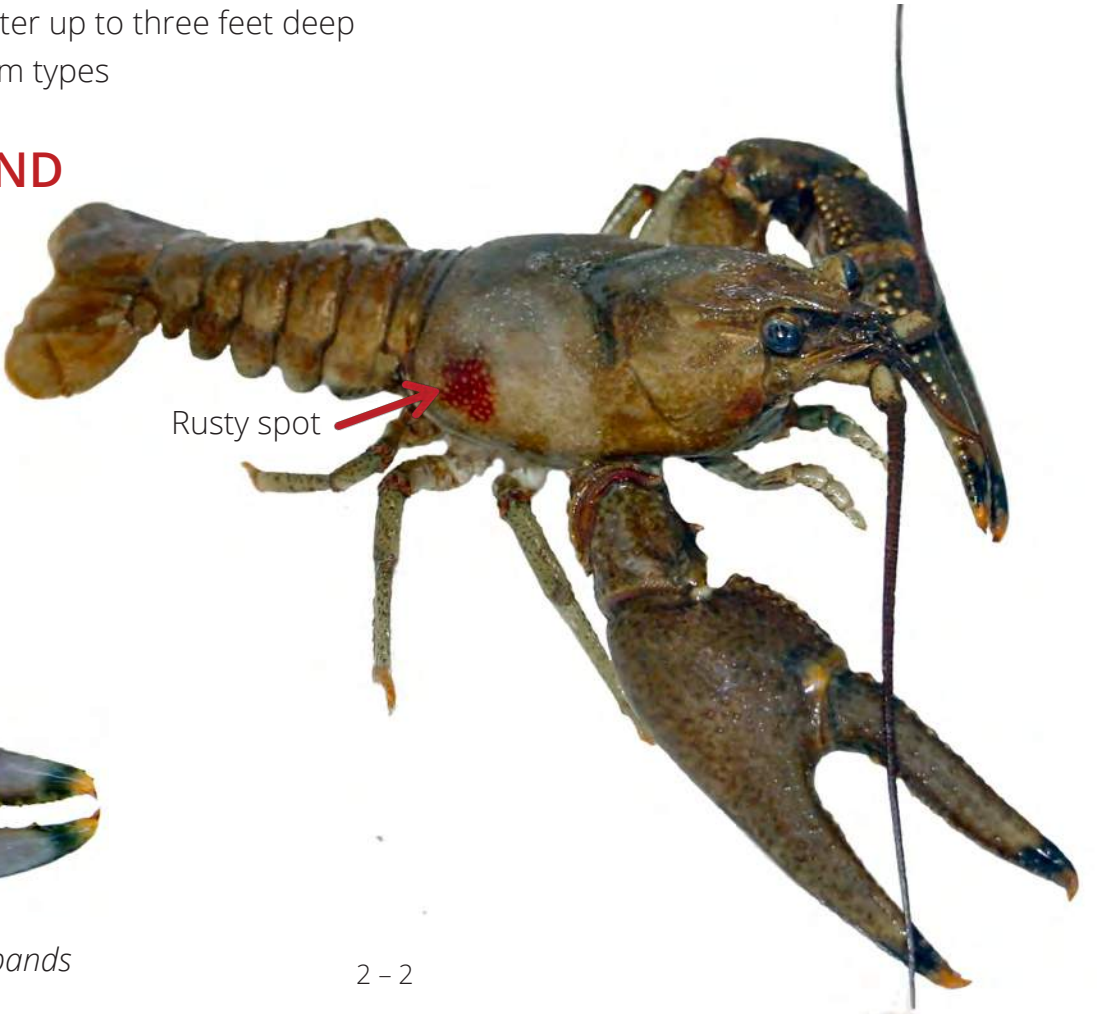
- Red swamp crayfish (invasive)
- Northern clearwater crayfish (native)
- Calico crayfish (native)
- Virile crayfish (native)
- Young or smaller specimens can often be difficult to tell apart

WHERE TO LOOK

- Often found in shallow water up to three feet deep
- On a wide variety of bottom types

CURRENTLY FOUND





Oval-shaped gap and black bands

INVASIVE Red swamp crayfish

Procambarus clarkii

KEYS TO ID

- All crayfish resemble miniature lobsters with long antennae, a pair of claws, and eight legs
- Can grow up to 5 inches
- Red bumps on claws
- Black wedge-shaped stripe on top of abdomen

LOOKS SIMILAR TO

- Rusty crayfish (invasive)
- Northern clearwater crayfish (native)
- Calico crayfish (native)
- Virile crayfish (native)
- Young or smaller specimens can often be difficult to tell apart

WHERE TO LOOK

- All types of freshwater
- Burrowed into bottoms of lakes, rivers, and ponds

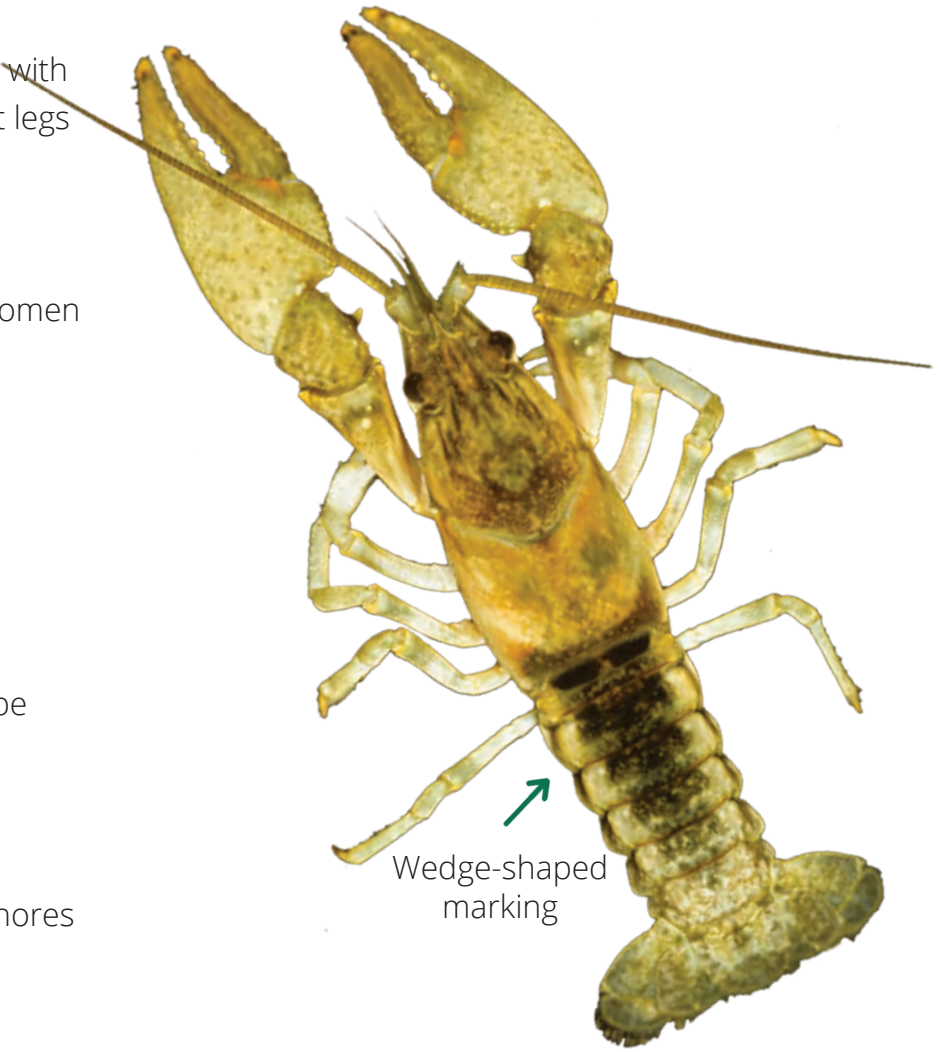
CURRENTLY FOUND

NATIVE Northern clearwater crayfish

Orconectes propinquus

KEYS TO ID

- All crayfish resemble miniature lobsters with long antennae, a pair of claws, and eight legs
- No red spot on side of carapace
- Claws are similar to rusty crayfish with black band at the tip
- Dark wedge-shaped marking down abdomen
- Can grow up to 4.5 inches



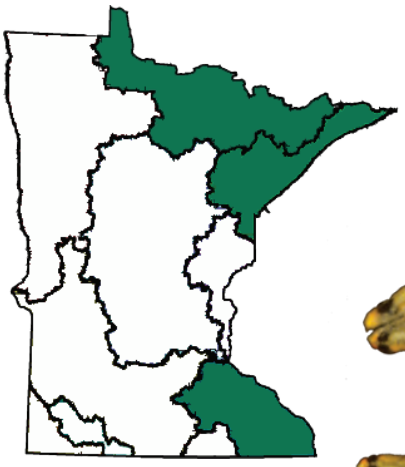
LOOKS SIMILAR TO

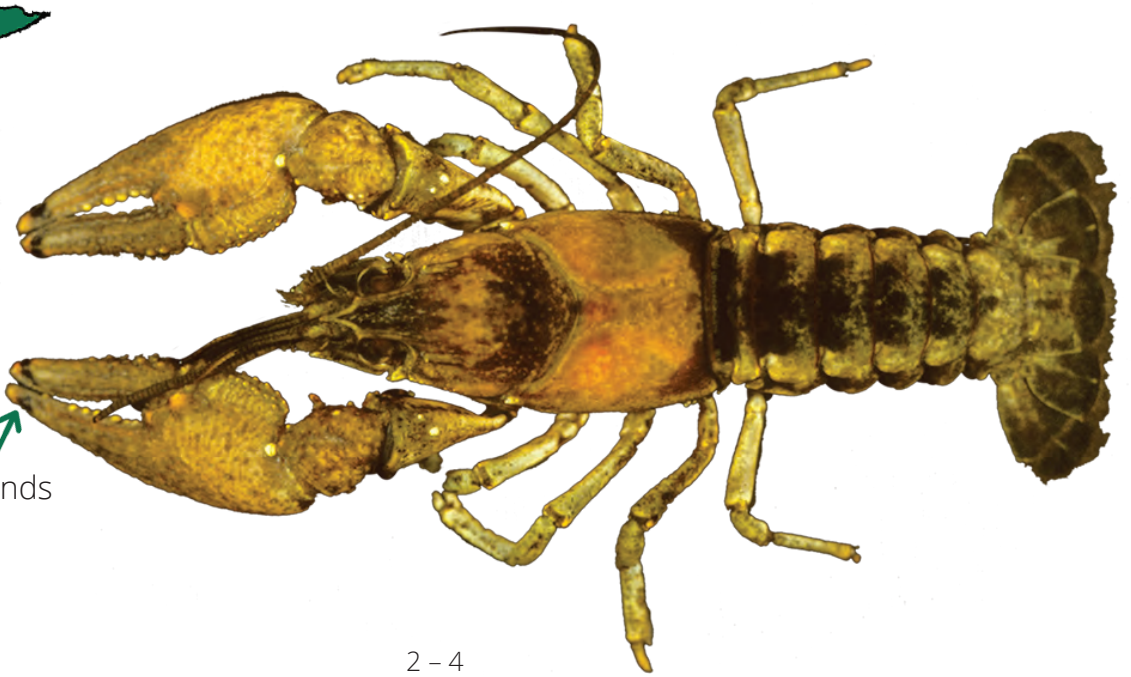
- Rusty crayfish (invasive)
- Red swamp crayfish (invasive)
- Calico crayfish (native)
- Virile crayfish (native)
- Young or smaller specimens can often be difficult to tell apart

WHERE TO LOOK

- In clear, rocky streams and rocky lake shores

CURRENTLY FOUND





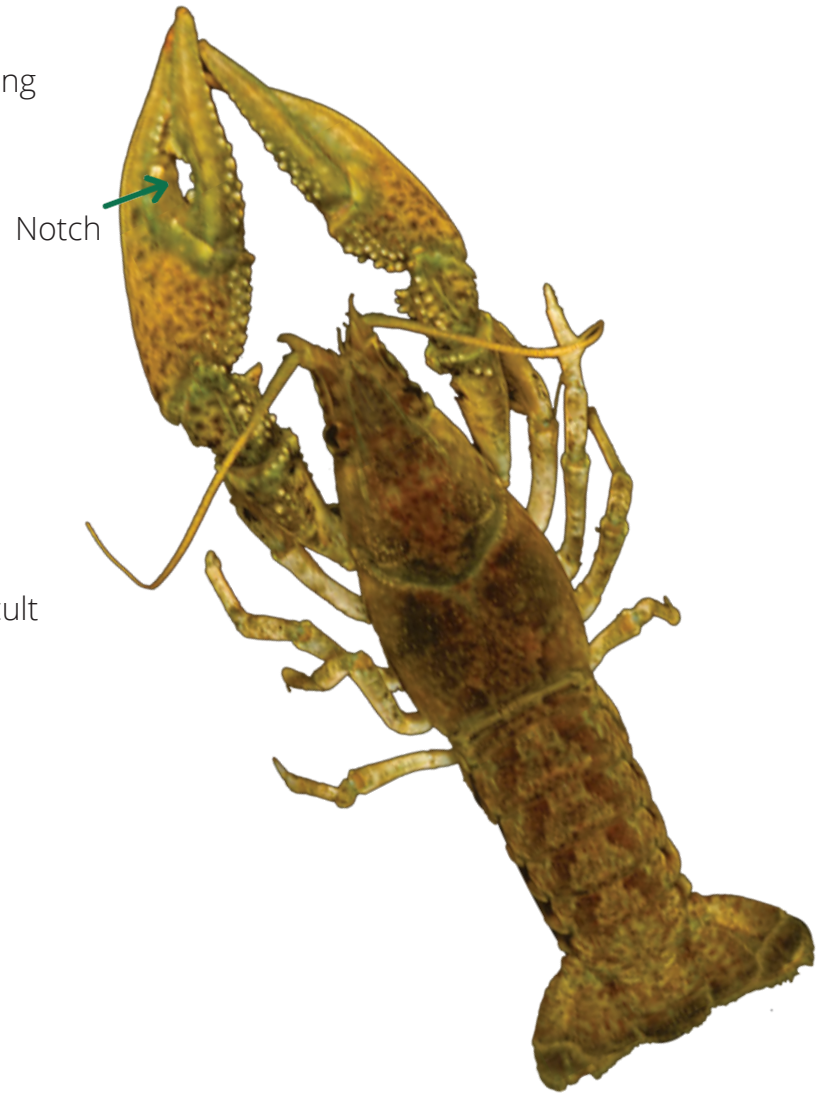
NATIVE

Calico crayfish

Orconectes immunis

KEYS TO ID

- All crayfish resemble miniature lobsters with long antennae, a pair of claws, and eight legs
- No red spot on carapace
- Distinctive notch in the pincers of their claws
- Can grow up to 3.5 inches



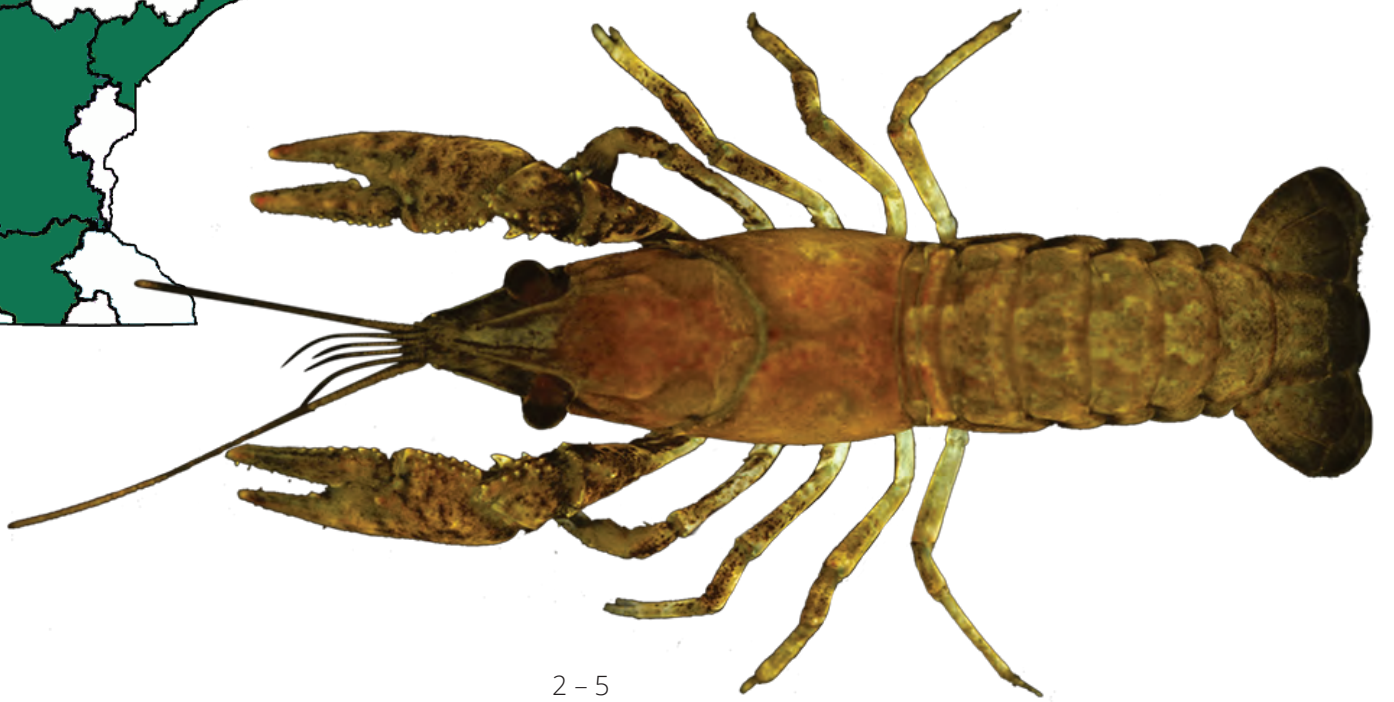
LOOKS SIMILAR TO

- Rusty crayfish (invasive)
- Red swamp crayfish (invasive)
- Virile crayfish (native)
- Northern clearwater crayfish (native)
- Young or smaller specimens can often be difficult to tell apart

WHERE TO LOOK

- In shallow waters under plants for cover
- Will burrow in muddy bottoms of ponds

CURRENTLY FOUND



NATIVE

Virile crayfish

Orconectes virilis

KEYS TO ID

- All crayfish resemble miniature lobsters with long antennae, a pair of claws, and eight legs
- No red spot on side of carapace
- Narrow claws with no black band
- Claws may have a blue tint with small white bumps
- Can grow up to 5 inches

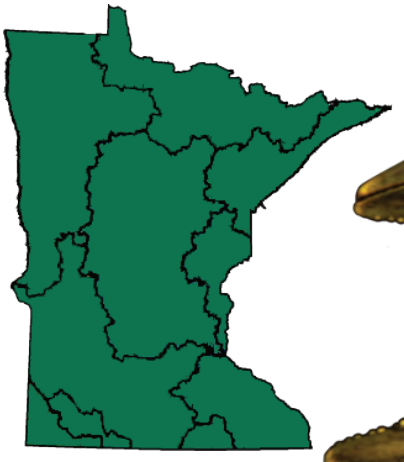
LOOKS SIMILAR TO

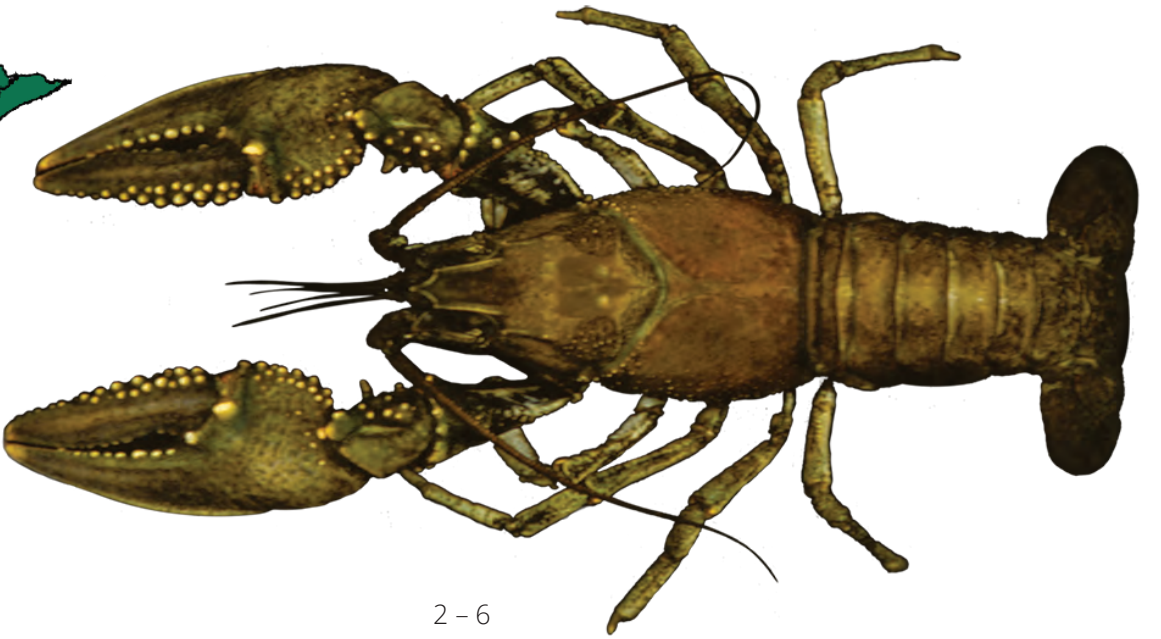
- Rusty crayfish (invasive)
- Red swamp crayfish (invasive)
- Calico crayfish (native)
- Northern clearwater crayfish (native)
- Young or smaller specimens can often be difficult to tell apart

WHERE TO LOOK

- In a wide variety of habitats
- Under stones in lakes, streams, and wetlands
- Not found in swift-moving waters

CURRENTLY FOUND





INVASIVE Zebra mussels

Dreissena polymorpha

KEYS TO ID

- Stripes are generally in zigzag pattern
- Pattern is variable; some may lack striping altogether and can be solid tan or brown
- Have a flat edge and won't topple over when set on it
- Shells form straight line when closed
- Range from ⅕ of an inch to 2 inches

Stripes are zigzag

Byssal threads

Straight line

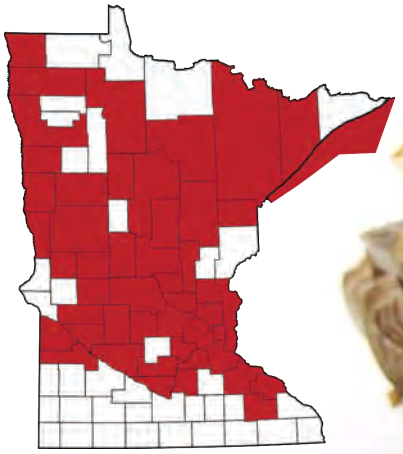
LOOKS SIMILAR TO

- Quagga mussels (invasive)
- Asian clam (invasive)
- Chinese mystery snail (invasive)
- Native snails (native)
- Native mussels (native)

WHERE TO LOOK

- Often found attached to submerged objects (such as boats and docks as well as plants and rocks)
- May leave behind byssal threads when removed
- Newly settled mussels are usually in shallow areas; adults are common in depths of 10 to 20 feet

CURRENTLY FOUND



Zebra mussels covering native mussel

INVASIVE Quagga mussels

Dreissena rostriformis "bugensis"

KEYS TO ID

- Stripes are in rings
- Wide range of coloration – some may appear to have almost no striping
- Will topple over when placed on ventral edge
- Shells form S-shape when closed
- Range from ⅛ of an inch to 2 inches

S-shape →

LOOKS SIMILAR TO

- Zebra mussels (invasive)
- Chinese mystery snail (invasive)
- Asian clam (invasive)
- Native mussels (native)
- Native snails (native)

WHERE TO LOOK

- Often found attached to submerged objects (such as boats and docks as well as plants and rocks)
- May leave behind byssal threads when removed
- May inhabit softer substrates (such as silt) and deeper water than zebra mussels

CURRENTLY FOUND

INVASIVE Asian clam

Corbicula fluminea

KEYS TO ID

- Bivalve that ranges from light to dark in color
- Symmetric shape; rounder than zebra mussels
- Shells have rigid concentric rings
- Can grow up to 2 inches

LOOKS SIMILAR TO

- Zebra mussels (invasive)
- Quagga mussels (invasive)
- Chinese mystery snail (invasive)
- Native snails (native)
- Native mussels (native)

WHERE TO LOOK

- In soft substrates like sand or mud

CURRENTLY FOUND

NATIVE Freshwater mussels

Family Unionidae

KEYS TO ID

- Have two shells (bivalves) with an asymmetrical shell shape
- Grow significantly larger than zebra mussels, quagga mussels, and Asian clam
- 48 different species live in Minnesota
- Often called clams

Top: Native mussel on its own.

Bottom: Native mussel being smothered by zebra mussels. The uncovered part of this mussel was buried in the river bottom.

LOOKS SIMILAR TO

- Zebra mussels (invasive)
- Chinese mystery snail (invasive)
- Asian clam (invasive)
- Quagga mussels (invasive)
- Native snails (native)
- Collectively called "unionids"

WHERE TO LOOK

- Embedded in the bottom of lakes and rivers throughout Minnesota

CURRENTLY FOUND

INVASIVE Chinese mystery snail

Cipangopaludina chinensis

KEYS TO ID

- Grow up to 2 inches long
- Light to dark brown
- Have an operculum ("trapdoor") covering opening which is missing when dead

Operculum

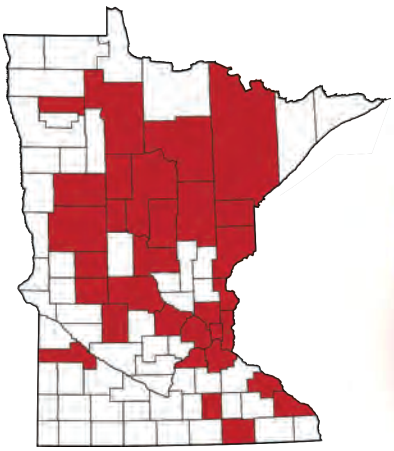
LOOKS SIMILAR TO

- Zebra mussels (invasive)
- Quagga mussels (invasive)
- Asian clam (invasive)
- Native mussels (native)
- Native snails (native)

WHERE TO LOOK

- In lakes and slow-moving rivers

CURRENTLY FOUND



NATIVE Snails

KEYS TO ID

- Single shell with spirals
- Generally under 2 to 3 inches

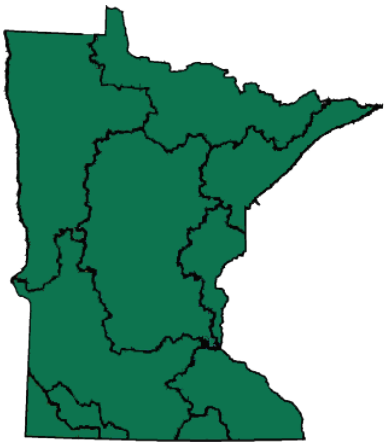
LOOKS SIMILAR TO

- Zebra mussels (invasive)
- Quagga mussels (invasive)
- Chinese mystery snail (invasive)
- Asian clam (invasive)
- Native mussels (native)

WHERE TO LOOK

- Most aquatic habitats (from woodland pools to streams, rivers, wetlands, ponds, and lakes) throughout the state

CURRENTLY FOUND



Pond snail

Ramshorn snail

Limpet snail

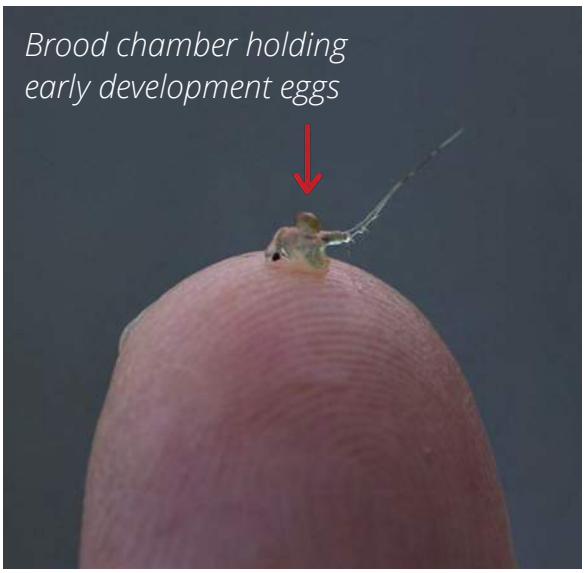
Limpet snails are native to Minnesota but do not have the typical spiraled shell, and can be found attached to other animals or objects — often leading to confusion with zebra or quagga mussels.

INVASIVE Spiny waterflea

Bythotrephes longimanus

KEYS TO ID

- Range from ¼ to ⅝ of an inch
- Have long, spiny tails with 1 – 4 pairs of barbs
- Have distinctive black eyespots
- Females may have bulbous brood chamber on back
- Most abundant during late summer and autumn



Brood chamber holding early development eggs

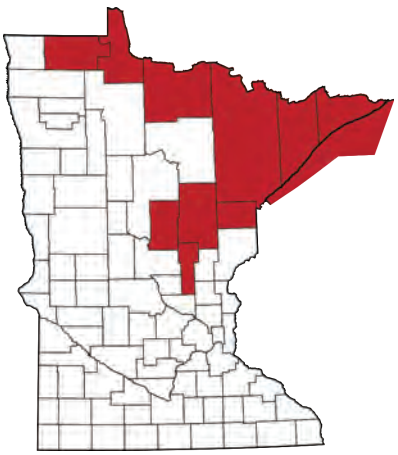
LOOKS SIMILAR TO

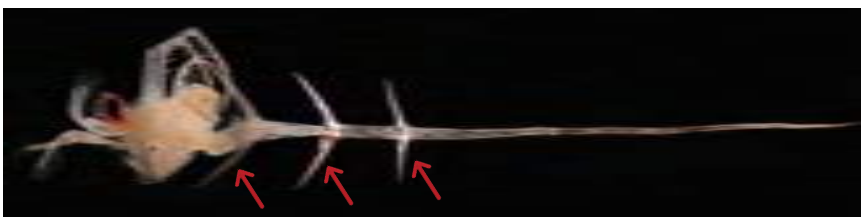
- Fishhook waterflea (invasive)
- *Leptodora* (native)
- *Chaoborus* (native)

WHERE TO LOOK

- Most often found on fishing line or other equipment in clumps that resemble a gelatinous blob
- Usually found in deep lakes but can establish in shallow lakes and rivers
- Suspended in water column

CURRENTLY FOUND





Spiny waterflea with three pairs of barbs

INVASIVE Fishhook waterflea

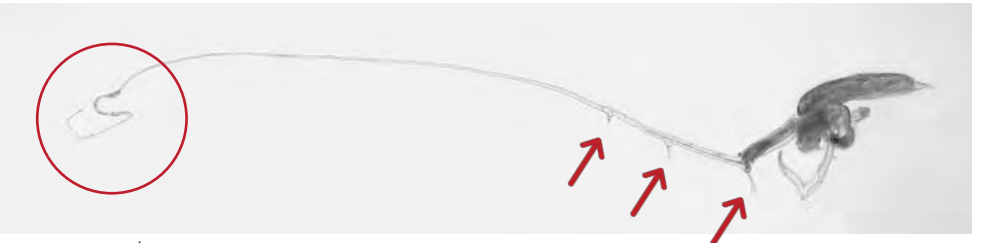
Cercopagis pengoi

KEYS TO ID

- Range from about ¼ to ½ inch
- Have long tail with up to three pairs of barbs and a characteristic "hook" near the end
- Have distinctive eyespot
- Females may have pointed brood chamber on back

LOOKS SIMILAR TO

- Spiny waterflea (invasive)
- *Leptodora* (native)
- *Chaoborus* (native)



Hook

Three pairs of barbs

WHERE TO LOOK

- Clogged on nets or other fishing gear
- Brackish and freshwater lakes
- Has not been found in Minnesota

Female with resting eggs

CURRENTLY FOUND

Fishhook waterflea (top)
Spiny waterflea (bottom)

NATIVE

Predatory zooplankton

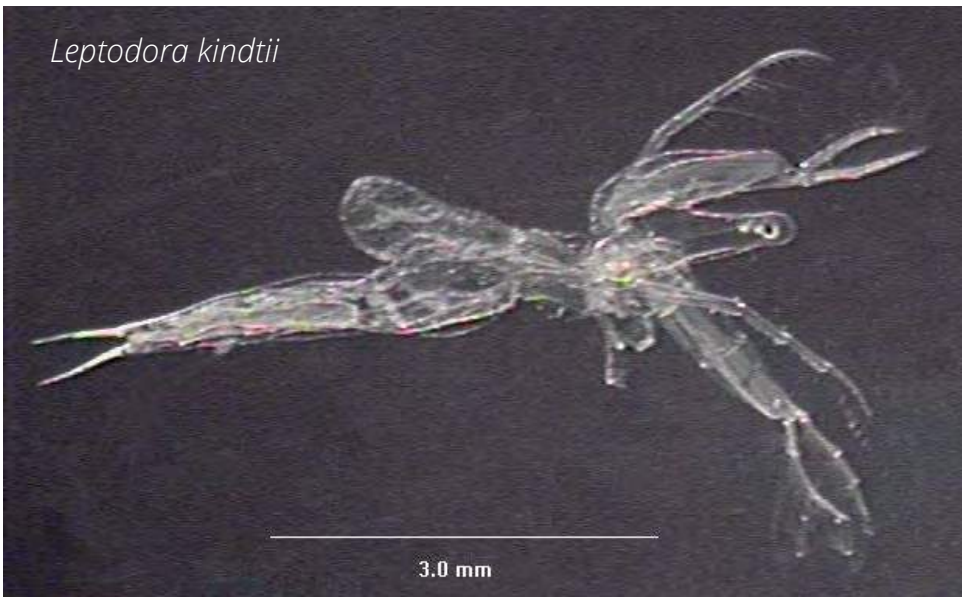
Leptodora sp. and larval *Chaoborus sp.*

KEYS TO ID

- No long, spine-like tail
- *Leptodora* grow up to 0.8 inches long with two antennae and one eye
- *Chaoborus* have two small eyes at the front of their bodies, lack spines on their tail, and also lack long antennae
- Both are almost entirely transparent

LOOKS SIMILAR TO

- Spiny waterflea (invasive)
- Fishhook waterflea (invasive)

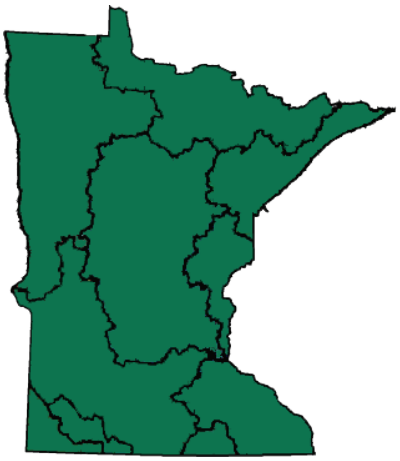


Leptodora kindtii

WHERE TO LOOK

- Collected on fishing line
- Very widespread throughout Minnesota

CURRENTLY FOUND




Larval *Chaoborus*

Quick reference guide

Bighead and silver carp

	Bighead carp	Silver carp	Gizzard shad	Mooneye	Shiners
Color	Gray with dark patches; silvery white underside	Silver; sometimes with a green hue	Silver-white	Silver	Varies
Eye location	Center below midline	Center below midline	Center above midline	Center above midline	Center above midline
Keel	Short	Long	Long	Short	
Shoulder spot			X		
Teeth				X	
Long final ray of dorsal fin			X		

Round goby

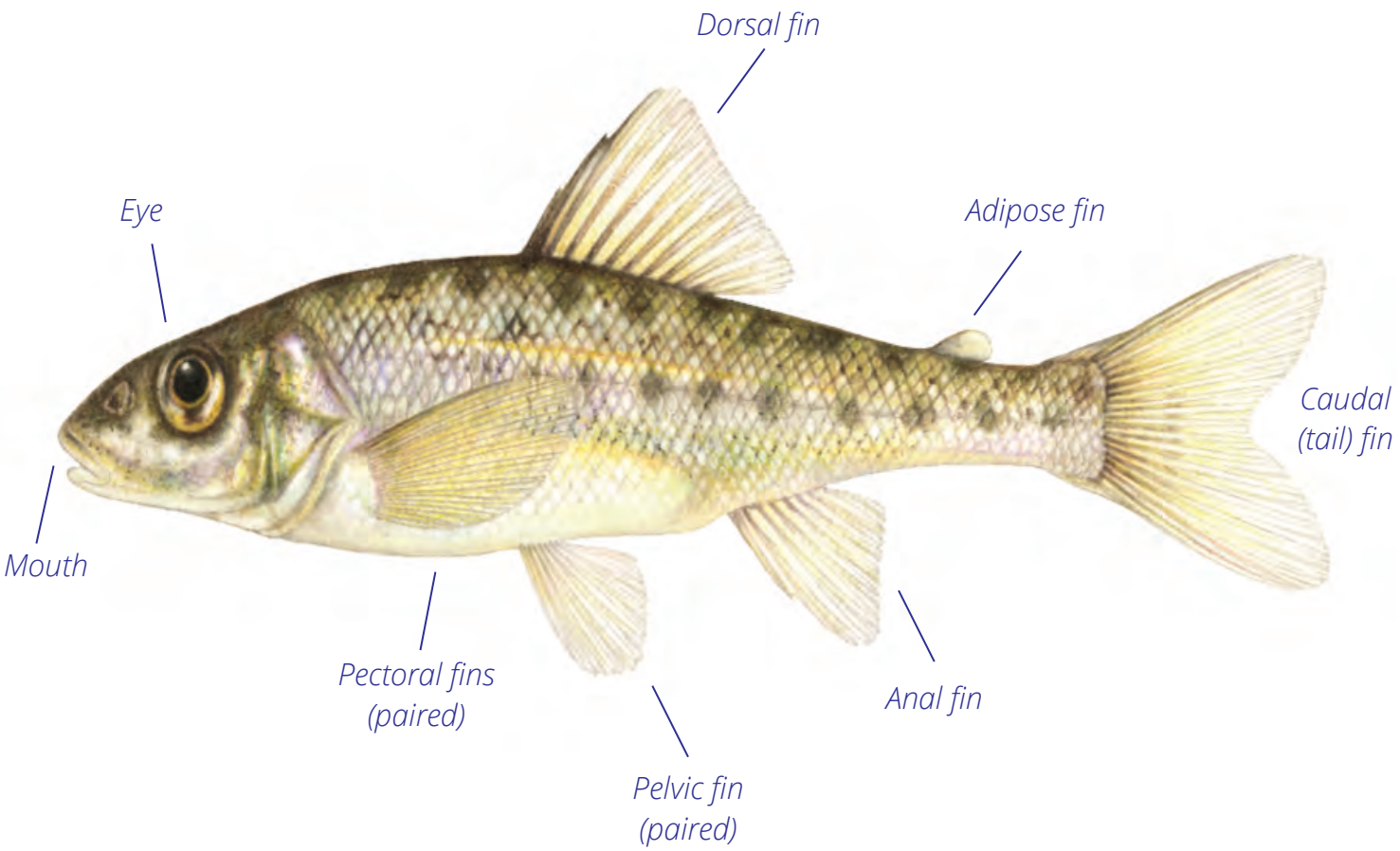
	Round goby	Tubenose goby	Sculpins
Color	Mottled browns, blacks, grays, and olives — white or cream underside	Mottled brown on light brown, olive, or tan — white or cream underside	Variable brown markings
Black spot on first dorsal fin	X		
Separated 1st and 2nd dorsal fins	X	X	
Fused pelvic fins	X	X	

Ruffe

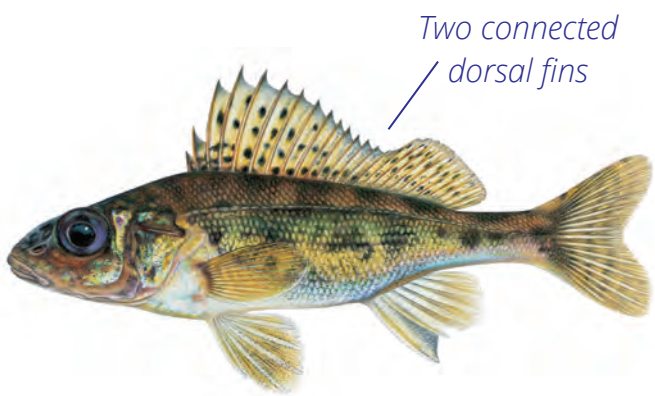
	Ruffe	Walleye	Yellow perch	Sauger
Color	Tans, grays, olive, and silvers with irregular dark blothces; white-cream	Brown/olive with mottling, white-cream underside	Brownish-green with dark vertical bars, white-cream underside	Brown/gray with mottling, white-cream underside
Mouth extends past front of eye		X	X	X
White tip at base of caudal fin		X		
Fused 1st and 2nd dorsal fins	X			

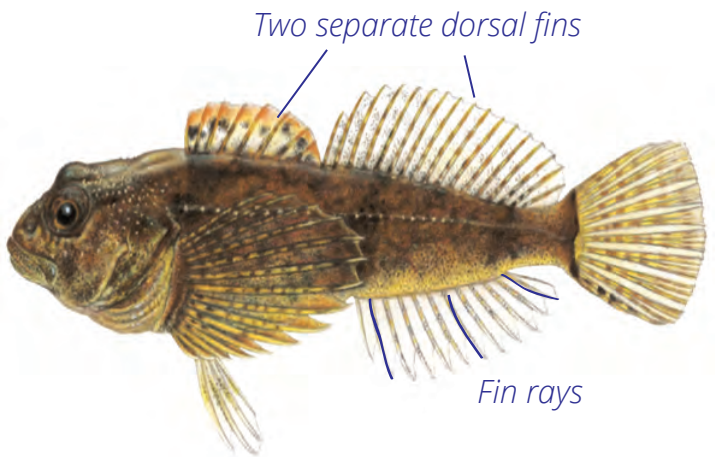
Introduction to fish

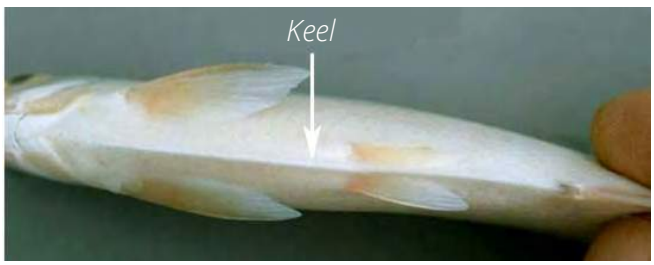
Fish characteristics



Variations in fins







INVASIVE Bighead carp

Hypophthalmichthys nobilis

KEYS TO ID

- Dark gray with black blotches on back and sides
- Eyes point downward; center of the eye is even with or below the midline
- No teeth in upper or lower jaw
- Short keel between pelvic and anal fins
- Average size of Bighead carp caught in Minnesota is nearly 40 inches; early life stage could be confused with minnows

Juvenile

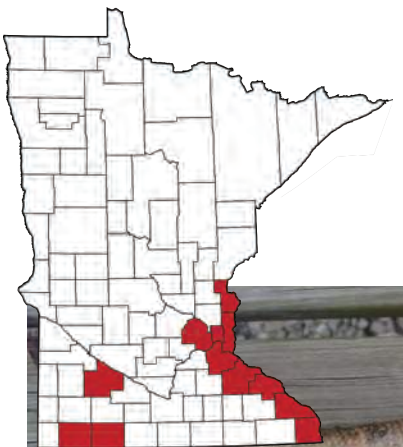
LOOKS SIMILAR TO

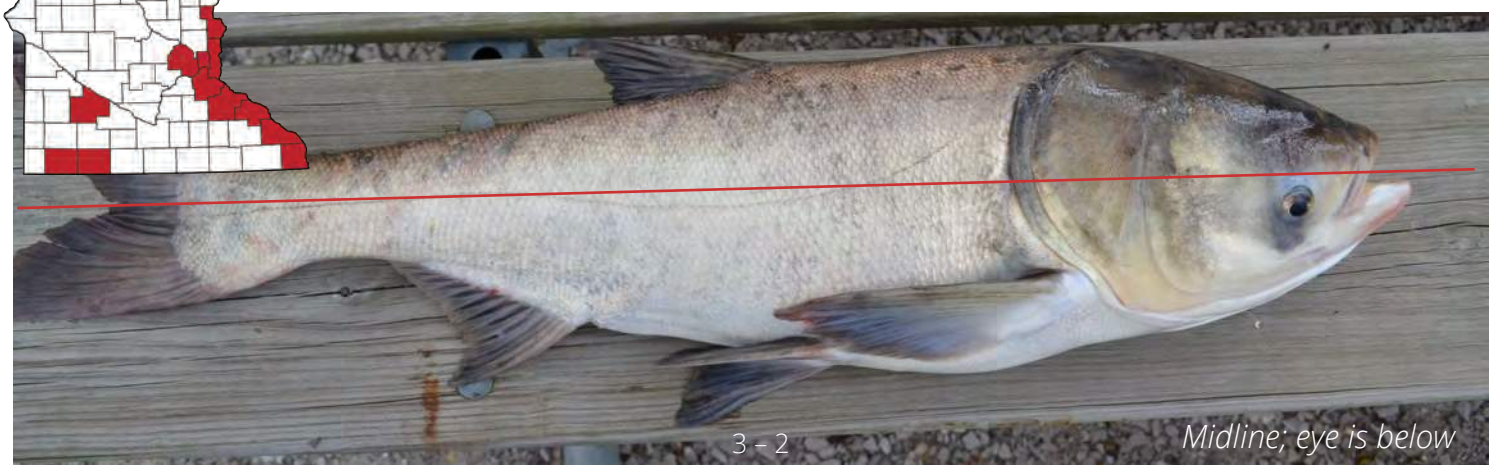
- Silver carp (invasive)
- Gizzard shad (native)
- Mooneye (native)
- Emerald shiner (native)

WHERE TO LOOK

- Prefer turbulent, nutrient-rich rivers
- Need flowing water to reproduce; will use backwaters and slow areas other times of the year
- No known established populations in Minnesota; individuals have been caught intermittently

CURRENTLY FOUND





Midline; eye is below

INVASIVE Silver carp

Hypophthalmichthys molitrix

KEYS TO ID

- Silver in color; can be greenish on back
- Eyes point downward
- Center of the eye is even with or below the midline
- No teeth in upper or lower jaw
- Long keel that extends in front and behind pelvic fins
- Average size of Silver carp caught in Minnesota is nearly 33 inches; early life stage could be confused with minnows

LOOKS SIMILAR TO

- Bighead carp (invasive)
- Gizzard shad (native)
- Mooneye (native)
- Emerald shiner (native)

Fry (top)
Adult (middle)
Juvenile (bottom)

WHERE TO LOOK

- Can jump up to ten feet in the air
- Prefer turbulent, nutrient-rich rivers; can tolerate a wide range of temperatures
- Need flowing water to reproduce; will use backwaters and slow areas other times of the year
- No known established populations in Minnesota; individuals have been caught intermittently

CURRENTLY FOUND

NATIVE

Gizzard shad

Dorosoma cepedianum

KEYS TO ID

- Silver to white with a distinguishing shoulder spot
- Last ray on dorsal fin much longer than the others
- Upper edge of the eye located above the tip of the upper lip
- No teeth in upper or lower jaw
- Generally grow about 8 – 12 inches

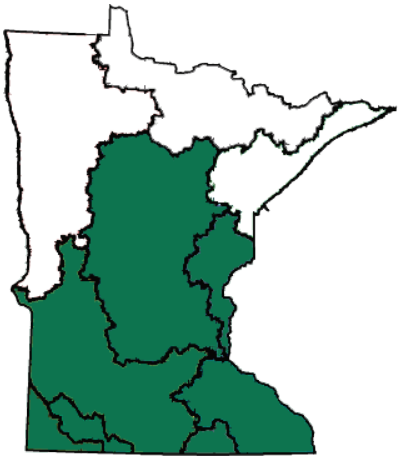
LOOKS SIMILAR TO

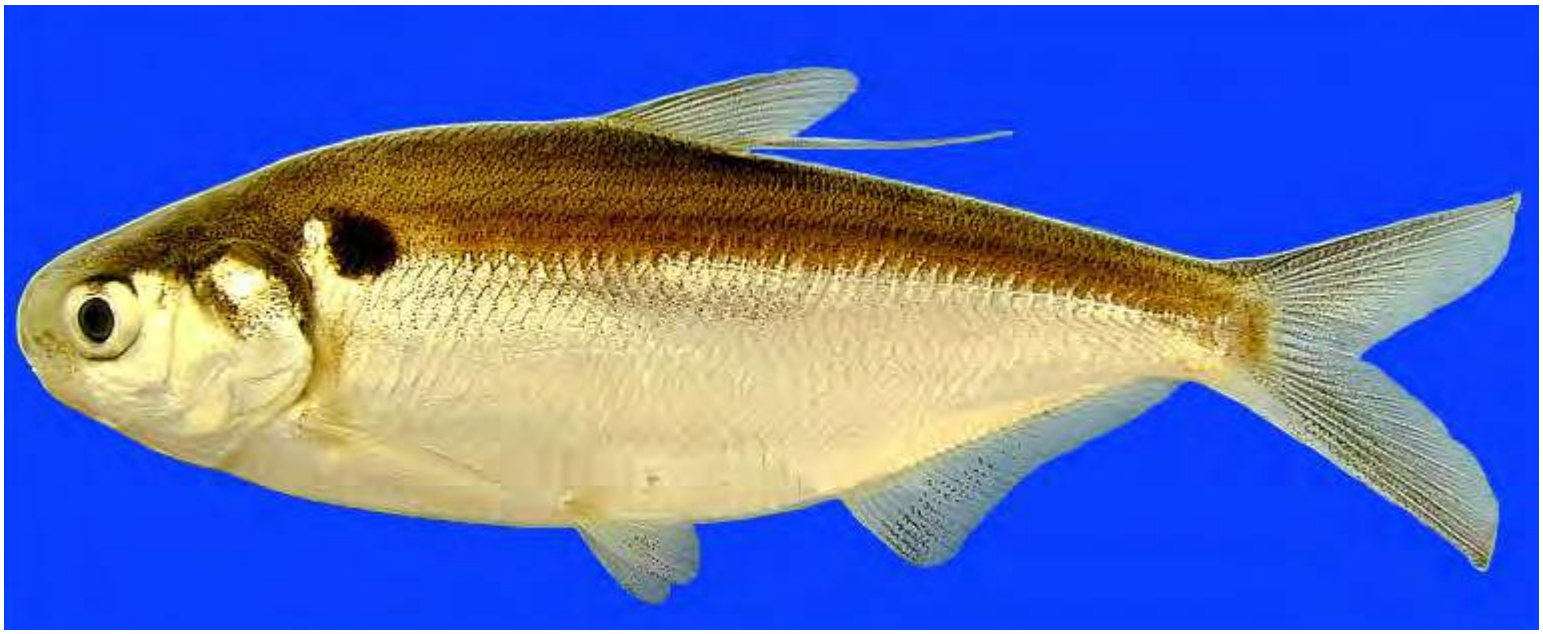
- Bighead carp (invasive)
- Silver carp (invasive)
- Mooneye (native)
- Emerald shiner (native)

WHERE TO LOOK

- Prefer shallow waters with soft, muddy bottoms
- Also found in slow-moving areas of rivers

CURRENTLY FOUND





NATIVE

Mooneye

Hiodon tergisus

KEYS TO ID

- Silver in color
- Keel extends from anal to pelvic fin
- Upper edge of the eye is located above the tip of the upper jaw
- Has teeth on both jaws and roof of mouth
- Grow up to 15 inches long

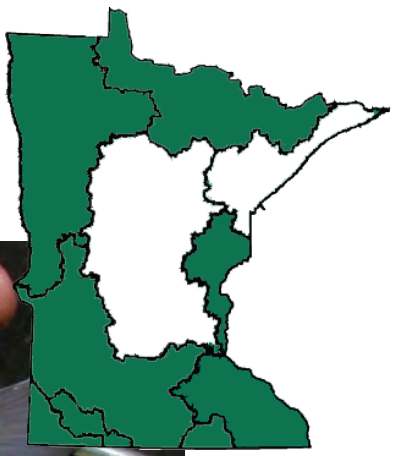
LOOKS SIMILAR TO

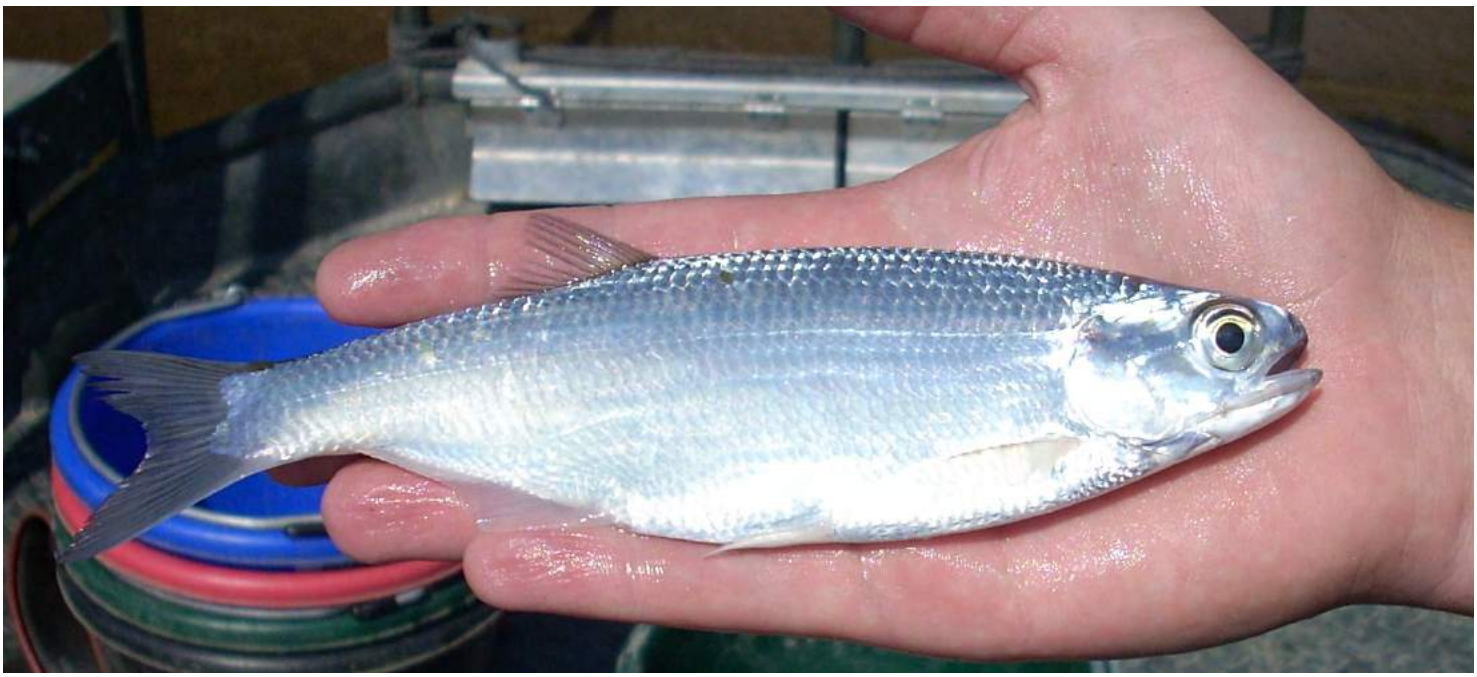
- Bighead carp (invasive)
- Silver carp (invasive)
- Gizzard shad (native)
- Emerald shiner (native)

WHERE TO LOOK

- Prefer large, clear lakes and rivers

CURRENTLY FOUND





NATIVE

Emerald shiner

Notropis atherinoides

KEYS TO ID

- Emerald-silver color on its sides
- Upper edge of the eye is located above the tip of the upper jaw
- No teeth on upper or lower jaw
- Generally grow about 3 – 4 inches

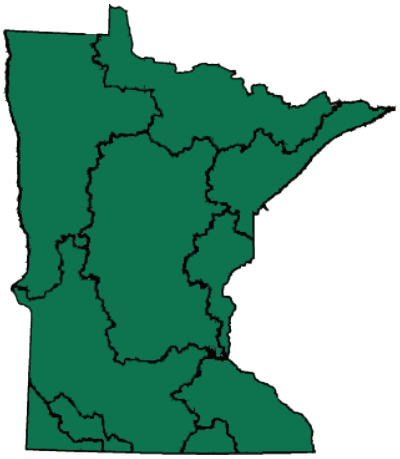
LOOKS SIMILAR TO

- Bighead carp (invasive)
- Silver carp (invasive)
- Mooneye (native)
- Gizzard shad (native)

WHERE TO LOOK

- Tend to shoal in large groups near surface of the water at dusk to feed

CURRENTLY FOUND



INVASIVE Round goby

Neogobius melanostomus

KEYS TO ID

- Young gobies are solid gray; older fish are light gray with dark blotches
- Fused pelvic fin – which no native fish have – can resemble a suction cup
- First and second dorsal fins are separate
- Prominent black spot on first dorsal fin
- Has fine scales on body
- Usually less than 6 inches

LOOKS SIMILAR TO

- Tubenose goby (invasive)
- Native Sculpins including mottled, slimy, spoonhead, and deepwater (native)

WHERE TO LOOK

- Lakes and slow-moving rivers
- Areas with vegetation cover and rocky bottoms
- Found in Lake Superior but not yet in inland lakes

CURRENTLY FOUND

Above: Fused pelvic fin
Below: Dark spot on dorsal fin

INVASIVE

Tubenose goby

Proterorhinus marmoratus

KEYS TO ID

- Has fused pelvic fins, which no native fish have
- Does not have black spot on dorsal fin
- First and second dorsal fins are separate
- Nostril extends beyond lower lip
- Has fine scales on body and grows to about 4 inches

LOOKS SIMILAR TO

- Round goby (invasive)
- Native Sculpins including mottled, slimy, spoonhead, and deepwater (native)

WHERE TO LOOK

- In slow-moving, shallow water less than 15 feet with lots of plant cover
- Found in Lake Superior but not in inland lakes

CURRENTLY FOUND

Note nostril extending beyond bottom lip and lack of black spot on dorsal fin.

NATIVE Sculpins

Cottus spp.

KEYS TO ID

- Vary from light tan to dark brown with mottled blotches
- Fused first and second dorsal fin
- Scaleless body
- Have two separated pelvic fins
- Grow between 4.5 and 6 inches long

LOOKS SIMILAR TO

- Round goby (invasive)
- Tubenose goby (invasive)
- Includes mottled, slimy, spoonhead, and deepwater sculpins

WHERE TO LOOK

- Usually found in rocky areas
- Sometimes found in headwaters of creeks or small rivers

Underside of a Slimy sculpin with separated pelvic fins (right)

CURRENTLY FOUND

Lateral view of a Mottled sculpin showing coloring (below)

INVASIVE

Ruffe

Gymnocephalus cernuus

KEYS TO ID

- Olive- to gold-brown on its back with yellow-white underside
- Fused dorsal fins with dark spots
- Small, downturned mouth that does not expand past the the front of the eye
- Sharp spines on gill cover
- Generally less than 6 inches long

LOOKS SIMILAR TO

- Walleye (native)
- Sauger (native)
- Yellow perch (native)

WHERE TO LOOK

- Prefer cooler waters
- Often in deep, offshore areas
- Lakes, reservoirs, and slow-moving rivers
- Found in Lake Superior but not in inland lakes

CURRENTLY FOUND

NATIVE

Walleye

Sander vitreus

KEYS TO ID

- Golden-brown to yellow in color; dorsal fin has dark blotches
- Separated first and second dorsal fins
- White spot on tip of tail
- Mouth extends past the eye
- Eyes point outward
- Grows larger than ruffe

LOOKS SIMILAR TO

- Ruffe (invasive)
- Sauger (native)
- Yellow perch (native)

WHERE TO LOOK

- In the shelter of aquatic vegetation

CURRENTLY FOUND

NATIVE

Sauger

Sander canadensis

KEYS TO ID

- Sandy to dark brown with 3 – 4 dark patches along back and sides
- Dorsal fins are separated and have rows of dark spots
- Mouth extends past the eye
- Grows larger than ruffe

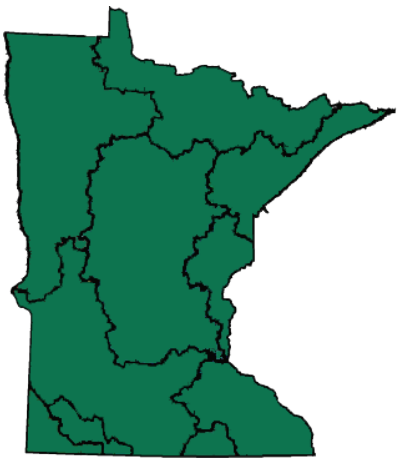
LOOKS SIMILAR TO

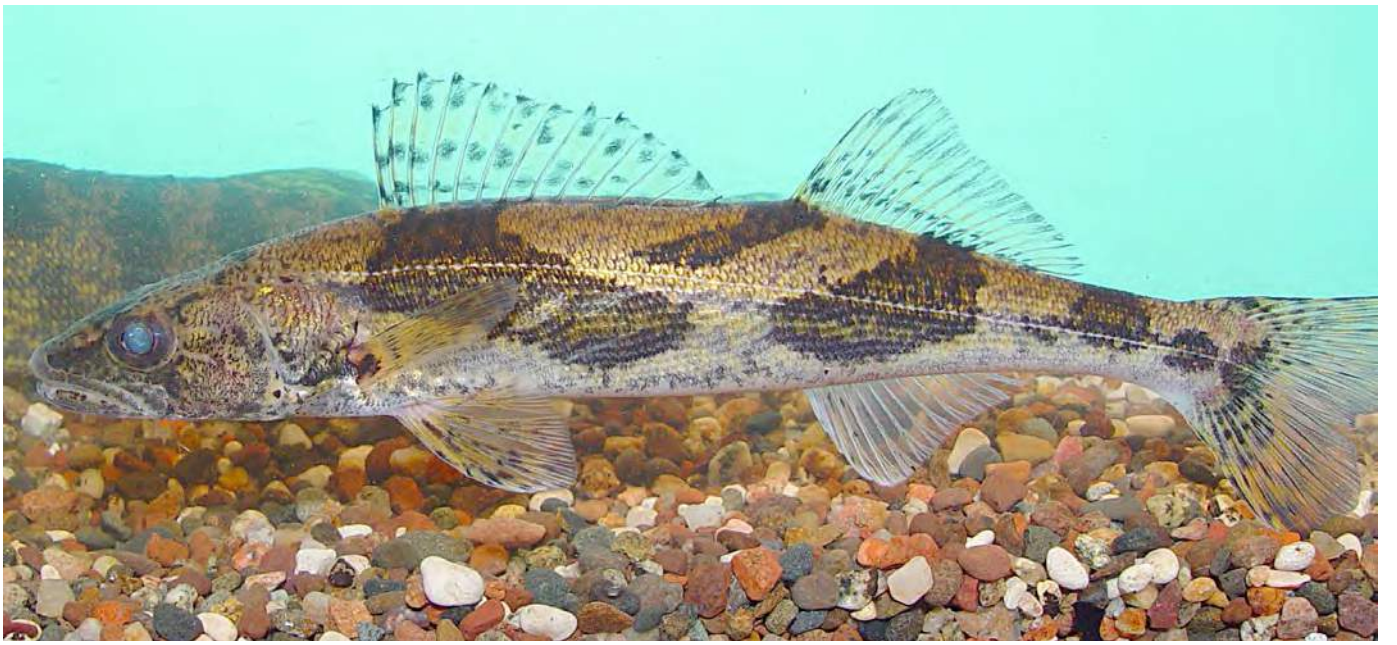
- Ruffe (invasive)
- Yellow perch (native)
- Walleye (native)

WHERE TO LOOK

- Likely to be found in deep pools
- Areas of high turbidity, low stream velocity, and deep water

CURRENTLY FOUND





NATIVE

Yellow perch

Perca flavescens

KEYS TO ID

- Green on top with 6 to 9 stripes down yellow sides
- Separated dorsal fins
- No distinct spots
- Grows larger than ruffe

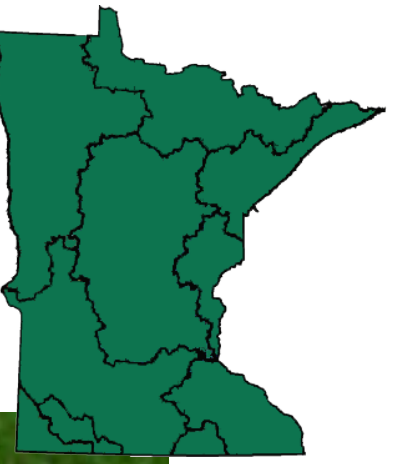
LOOKS SIMILAR TO

- Ruffe (invasive)
- Sauger (native)
- Walleye (native)

WHERE TO LOOK

- Abundant in lakes and backwaters of large rivers
- Prefer to be near vegetation

CURRENTLY FOUND



Yellow perch (top)
Invasive ruffe (bottom)

Glossary

Adipose fin: Located between the dorsal fin and caudal fin; have no spines or rays and are soft

Alternate leaves: Leaves are attached to the stem singly and on alternate sides

Anal fin: Located on the underside of a fish between the tail and pelvic fins, near the anus

Antheridia: Male reproductive structures that are small and orange to red on starry stonewort

Ascending stem: A stem growing upward

Axis: The main stem about which plant parts such as branches are arranged

Bivalve: An animal that has two shells that meet at a hinge

Branchlet: A small branch or a subdivision of a branch

Bulbil: Asexual reproductive structure found on some charophytes. Bulbils of starry stonewort are white and star-shaped

Byssal threads: A mass of strong, silky filaments which mussels use to attach to surfaces

Carapace: A hard shell on the backs of crayfish

Caudal fin: Also known as a tail fin, it is located at the end of the fish and propels and steers the fish

Dissected: Leaves that are deeply or repeatedly divided

Dorsal fin: Located on the top of a fish, it may be a single fin, with or without spines, or consist of two connected or unconnected parts — a sharp-spined part and a soft-rayed part

Fractal: When similar patterns recur at progressively smaller scales

Fry: Immature fish from the time they hatch to the time they become fingerlings

Gill cover: A flap of skin protecting a fish's gills

Hybridize: To produce hybrids; crossbreed

Invasive species: Species that are not native to a given ecosystem, and cause (or have high potential to cause) harm, whether economic, environmental, or harm to human health

Invertebrate: An animal that lacks a spine

Keel: A ridge on the belly of the fish which is present only in some species

Leaflet: A part or division of a compound leaf

Midvein: The vein in the center of a leaf

Mottled: Marked with spots or smears of color

Node: The place on the stem where a leaf or branch is attached (or has been attached)

Pectoral fins: Located on both sides of the fish near the gill; help with balance, steering, and controlling depth

Pelvic fins: Located on the bottom of the fish in front of the anal fin; help balance the fish and keep it level

Serrated: Having a saw-toothed edge or margin notched with toothlike projections

Shoal: When fish group together, for social purposes

Submersed/submerged: Submersed plants are usually found entirely underwater, but the flowers and fruits may rise above the water surface. They are rooted in the sediment and have underwater leaves

Substrate: The surface on which an organism lives, grows, or obtains its nourishment

Tubers: A short, thick stem that grows underground and can produce a new plant

Turbidity: A measure that provides an estimate of the cloudiness of water due to silt, organic and inorganic matter, plankton, and microscopic organisms

Turions: A vegetative bud that detaches from a parent plant and can produce new plants via asexual reproduction

Ventral edge: On a bivalve, the surface opposite the hinge

Water column: A conceptual column of water from lake surface to bottom sediments

Whorl: A ring of 3 or more similar structures radiating from a common point

Photo credits

PLANTS

Leaf arrangements: Cayte · Compound leaves: Evelyn Fitzgerald
Simple leaf: Benjamint444 · Leaf margins: Debivort
Whorled leaf with midvein: Christian Fischer
Eurasian watermilfoil flower and close-up: Paul Skawinski, UW-Extension Lakes
Bladderwort: Christa Rittberg
White water crowfoot: Trish Steel
Water marigold flower: Peter Dziuk
Hydrilla: Michael J. Grodowitz, U.S. Army Engineer Research and Development Center; Tim Krynak; J.M.Garg
Elodea stalk: Minnehaha Creek Watershed District
Brazilian waterweed: David Liu, Minnehaha Creek Watershed District; Lamiot; Lara Gudmundsdottir
Starry stonewort: Dave Hansen; Paul Skawinski, Aquatic Plants of the Upper Midwest
Native *chara*: Christian Fischer; Megan Weber
Native *Nitella*: Kristian Peters; Paul Skawinski, Aquatic Plants of the Upper Midwest
Sago pondwed fruit: Christian Fischer
Water stargrass: Paul Skawinski, Aquatic Plants of the Upper Midwest
Curly-leaf pondweed: Paul Skawinski, UW-Extension Lakes; Leslie J. Mehrhoff
Clasping leaf pondweed: Paul Skawinski, Aquatic Plants of the Upper Midwest

INVERTEBRATES

Rusty crayfish: Jeff Gunderson
Northern clearwater crayfish: Chris Taylor
Calico crayfish: Chris Taylor
Virile crayfish: Chris Taylor
Quagga mussels (in pile): Megan Weber
Freshwater mussels (in pile): U.S. Fish and Wildlife Service
Asian clam: Minnehaha Creek Watershed District; Böhringer Friedrich
Limpet snail: Alfredo Eloisa
Spiny waterflea: Donn Branstrator; Jeff Gunderson; Minnehaha Creek Watershed District
Fishhook waterflea: J. Liebig, NOAA GLERL; Mart Simm
Chaoborus: Piet Spaans
Leptodora: Great Lakes Environmental Research Laboratory

FISH

Illustrations of trout perch, sculpin, and ruffe: Joseph Tomelleri
Keel: John Lyons
Bighead carp: Asian Carp Regional Coordinating Committee
Juvenile silver carp: Michigan Sea Grant; Adult silver carp: Asian Carp Regional Coordinating Committee
Gizzard shad: Brian Gratwicke; Chad Thomas
Mooneye: Konrad Schmidt
Emerald shiner: Andrew Kornacki; Konrad Schmidt
Round goby: Peter van der Sluijs
Tubenose goby: John Lyons; Harka Ákos
Slimy sculpin: John Lyons
Ruffe: Tiit Hunt; USGS
Walleye in hand: John Lyons; Adult walleye: USFWS
Sauger: Konrad Schmidt
Yellow perch: USFWS; Yellow perch with ruffe: John Lyons

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Appendix C

Seed Mixes

21-111

Oats Cover Crop

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
Oats	*Avena sativa*	112.08	100.00	100.00%	44.54
	Totals:	**112.08**	**100.00**	**100.00%**	**44.54**
Purpose:	Temporary cover crop for spring and summer plantings				
Planting Area:	Statewide				

Winter Wheat Cover Crop

21-112

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
Winter Wheat	*Triticum aestivum*	112.09	100.00	100.00%	26.08
	Totals:	**112.09**	**100.00**	**100.00%**	**26.08**
Purpose:	Temporary cover crop for fall plantings				
Planting Area:	Statewide				

Soil Building Cover Crop

21-113

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
Field Pea	*Pisum sativum*	56.04	50.00	45.46%	3.44
	Total Forbs	**56.04**	**50.00**	**45.46%**	**3.44**
Oats	*Avena sativa*	67.25	60.00	54.54%	26.72
	Total Cover Crop	**67.25**	**60.00**	**54.54%**	**26.72**
	Totals:	**123.29**	**110.00**	**100.00%**	**30.16**
Purpose:	Temporary cover crop with soil building function.				
Planting Area:	Statewide				

Woodland Edge Northwest

36-411

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
big bluestem	*Andropogon gerardii*	0.56	0.50	1.42%	1.85
side-oats grama	*Bouteloua curtipendula*	1.12	1.00	2.81%	2.20
fringed brome	*Bromus ciliatus*	0.84	0.75	2.12%	3.04
kalm's brome	*Bromus kalmii*	2.24	2.00	5.64%	5.88
bluejoint	*Calamagrostis canadensis*	0.07	0.06	0.18%	6.40
poverty grass	*Danthonia spicata*	0.43	0.38	1.06%	3.46
nodding wild rye	*Elymus canadensis*	1.12	1.00	2.81%	1.91
slender wheatgrass	*Elymus trachycaulus*	1.12	1.00	2.81%	2.53
Virginia wild rye	*Elymus virginicus*	1.96	1.75	4.93%	2.70
little bluestem	*Schizachyrium scoparium*	0.07	0.06	0.18%	0.35
Indian grass	*Sorghastrum nutans*	0.56	0.50	1.40%	2.19
	Total Grasses	**10.09**	**9.00**	**25.36%**	**32.50**
common yarrow	*Achillea millefolium*	0.03	0.03	0.09%	2.00
blue giant hyssop	*Agastache foeniculum*	0.13	0.12	0.35%	4.10
lead plant	*Amorpha canescens*	0.03	0.03	0.09%	0.15
Tall Thimbleweed	*Anemone virginiana*	0.03	0.03	0.08%	0.30
columbine	*Aquilegia canadensis*	0.03	0.03	0.08%	0.40
prairie sage	*Artemisia ludoviciana*	0.03	0.03	0.09%	2.90
white prairie clover	*Dalea candida*	0.07	0.06	0.16%	0.40
purple prairie clover	*Dalea purpurea*	0.20	0.18	0.51%	1.00
flat-topped aster	*Doellingeria umbellata*	0.03	0.03	0.09%	0.80
ox-eye	*Heliopsis helianthoides*	0.04	0.04	0.12%	0.10
stiff goldenrod	*Oligoneuron rigidum*	0.07	0.06	0.17%	0.91
smooth wild rose	*Rosa blanda*	0.11	0.10	0.28%	0.10
black-eyed susan	*Rudbeckia hirta*	0.35	0.31	0.86%	10.35
upland white aster	*Solidago ptarmicoides*	0.07	0.06	0.16%	1.30
tall meadow-rue	*Thalictrum dasycarpum*	0.15	0.13	0.35%	0.92
American vetch	*Vicia americana*	0.15	0.13	0.37%	0.10
golden alexanders	*Zizia aurea*	0.15	0.13	0.36%	0.51
	Total Forbs	**1.68**	**1.50**	**4.21%**	**26.33**
Oats	*Avena sativa*	28.02	25.00	70.43%	11.14
	Total Cover Crop	**28.02**	**25.00**	**70.43%**	**11.14**
	Totals:	**39.79**	**35.50**	**100.00%**	**69.96**
Purpose:	Partly shaded grassland planting for native roadsides, reclamation, etc.				
Planting Area:	Tallgrass Aspen Parklands Province. Mn/DOT District 2(west).				

Woodland Edge Northeast

36-311

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
fringed brome	*Bromus ciliatus*	2.24	2.00	5.98%	8.10
bluejoint	*Calamagrostis canadensis*	0.15	0.13	0.37%	12.90
poverty grass	*Danthonia spicata*	0.56	0.50	1.50%	4.60
nodding wild rye	*Elymus canadensis*	1.40	1.25	3.72%	2.38
slender wheatgrass	*Elymus trachycaulus*	2.24	2.00	5.96%	5.06
fowl bluegrass	*Poa palustris*	0.98	0.87	2.59%	41.50
False Melic	*Schizachne purpurascens*	0.28	0.25	0.75%	2.90
	Total Grasses	**7.85**	**7.00**	**20.87%**	**77.44**
common yarrow	*Achillea millefolium*	0.03	0.03	0.09%	2.00
pearly everlasting	*Anaphalis margaritacea*	0.02	0.02	0.05%	1.30
flat-topped aster	*Doellingeria umbellata*	0.04	0.04	0.12%	1.00
tall cinquefoil	*Drymocallis arguta*	0.07	0.06	0.19%	5.30
large-leaved aster	*Eurybia macrophylla*	0.02	0.02	0.05%	0.18
stiff goldenrod	*Oligoneuron rigidum*	0.16	0.14	0.42%	2.10
smooth wild rose	*Rosa blanda*	0.18	0.16	0.47%	0.15
black-eyed susan	*Rudbeckia hirta*	0.29	0.26	0.77%	8.70
gray goldenrod	*Solidago nemoralis*	0.07	0.06	0.18%	6.80
upland white aster	*Solidago ptarmicoides*	0.04	0.04	0.13%	1.00
Lindley's Aster	*Symphyotrichum ciliolatum*	0.03	0.03	0.10%	1.00
smooth aster	*Symphyotrichum laeve*	0.16	0.14	0.43%	2.90
American vetch	*Vicia americana*	0.56	0.50	1.50%	0.38
	Total Forbs	**1.68**	**1.50**	**4.50%**	**32.81**
Oats	*Avena sativa*	28.02	25.00	74.63%	11.14
	Total Cover Crop	**28.02**	**25.00**	**74.63%**	**11.14**
	Totals:	**37.55**	**33.50**	**100.00%**	**121.39**
Purpose:	Partly shaded grassland planting for native roadsides, reclamation, etc in north-central and northeast MN				
Planting Area:	Laurentian Mixed Forest Province excluding Chippewa Plains, Pine Moraines & Outwash Plains, and Mille Lacs Uplands subsections. Mn/DOT Districts 1 & 2(east).				

Woodland Edge South & West

36-211

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
big bluestem	*Andropogon gerardii*	1.12	1.00	2.90%	3.68
side-oats grama	*Bouteloua curtipendula*	1.12	1.00	2.89%	2.20
kalm's brome	*Bromus kalmii*	1.68	1.50	4.34%	4.40
nodding wild rye	*Elymus canadensis*	1.40	1.25	3.61%	2.38
bottlebrush grass	*Elymus hystrix*	0.36	0.32	0.91%	0.88
slender wheatgrass	*Elymus trachycaulus*	1.40	1.25	3.64%	3.18
switchgrass	*Panicum virgatum*	0.07	0.06	0.17%	0.30
little bluestem	*Schizachyrium scoparium*	0.69	0.62	1.79%	3.40
Indian grass	*Sorghastrum nutans*	1.12	1.00	2.89%	4.40
	Total Grasses	**8.97**	**8.00**	**23.14%**	**24.82**
common yarrow	*Achillea millefolium*	0.03	0.03	0.09%	2.00
blue giant hyssop	*Agastache foeniculum*	0.11	0.10	0.28%	3.20
white snakeroot	*Ageratina altissima*	0.03	0.03	0.09%	1.70
white prairie clover	*Dalea candida*	0.19	0.17	0.50%	1.20
Canada tick trefoil	*Desmodium canadense*	0.16	0.14	0.42%	0.29
ox-eye	*Heliopsis helianthoides*	0.15	0.13	0.38%	0.30
wild bergamot	*Monarda fistulosa*	0.07	0.06	0.18%	1.60
stiff goldenrod	*Oligoneuron rigidum*	0.07	0.06	0.17%	0.90
Clayton's sweet cicely	*Osmorhiza claytonii*	0.07	0.06	0.17%	0.06
smooth wild rose	*Rosa blanda*	0.07	0.06	0.17%	0.06
black-eyed susan	*Rudbeckia hirta*	0.20	0.18	0.52%	6.10
Lance-leaved Figwort	*Scrophularia lanceolata*	0.06	0.05	0.14%	3.20
zigzag goldenrod	*Solidago flexicaulis*	0.02	0.02	0.05%	0.50
showy goldenrod	*Solidago speciosa*	0.07	0.06	0.18%	1.80
smooth aster	*Symphyotrichum laeve*	0.07	0.06	0.19%	1.30
American vetch	*Vicia americana*	0.20	0.18	0.52%	0.14
golden alexanders	*Zizia aurea*	0.12	0.11	0.33%	0.46
	Total Forbs	**1.68**	**1.50**	**4.38%**	**24.80**
Oats	*Avena sativa*	28.02	25.00	72.48%	11.14
	Total Cover Crop	**28.02**	**25.00**	**72.48%**	**11.14**
	Totals:	**38.67**	**34.50**	**100.00%**	**60.75**
Purpose:	Partly shaded grassland planting for native roadsides, reclamation, etc.				
Planting Area:	Tallgrass Aspen Parklands, Prairie Parkland, and Eastern Broadleaf Forest Provinces. Mn/DOT Districts 2(west), 3B, 4, Metro, 6, 7 & 8.				

Dry Prairie Northwest

35-421

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
side-oats grama	*Bouteloua curtipendula*	1.35	1.20	10.89%	2.64
blue grama	*Bouteloua gracilis*	0.84	0.75	6.81%	11.00
kalm's brome	*Bromus kalmii*	1.01	0.90	8.17%	2.64
nodding wild rye	*Elymus canadensis*	1.12	1.00	9.09%	1.91
slender wheatgrass	*Elymus trachycaulus*	1.12	1.00	9.11%	2.54
porcupine grass	*Hesperostipa spartea*	0.50	0.45	4.09%	0.11
junegrass	*Koeleria macrantha*	0.28	0.25	2.23%	18.00
little bluestem	*Schizachyrium scoparium*	1.68	1.50	13.63%	8.26
sand dropseed	*Sporobolus cryptandrus*	0.22	0.20	1.86%	15.00
	Total Grasses	**8.13**	**7.25**	**65.88%**	**62.10**
Prairie Wild Onion	*Allium stellatum*	0.03	0.03	0.27%	0.12
Canada milk vetch	*Astragalus canadensis*	0.08	0.07	0.61%	0.42
white prairie clover	*Dalea candida*	0.07	0.06	0.55%	0.42
purple prairie clover	*Dalea purpurea*	0.12	0.11	0.99%	0.60
Canada tick trefoil	*Desmodium canadense*	0.06	0.05	0.45%	0.10
stiff sunflower	*Helianthus pauciflorus*	0.03	0.03	0.31%	0.05
ox-eye	*Heliopsis helianthoides*	0.07	0.06	0.55%	0.14
rough blazing star	*Liatris aspera*	0.03	0.03	0.23%	0.15
dotted blazing star	*Liatris punctata*	0.02	0.02	0.18%	0.05
wild bergamot	*Monarda fistulosa*	0.03	0.03	0.27%	0.77
stiff goldenrod	*Oligoneuron rigidum*	0.03	0.03	0.27%	0.45
prairie coneflower	*Ratibida columnifera*	0.07	0.06	0.55%	0.93
black-eyed susan	*Rudbeckia hirta*	0.07	0.06	0.55%	2.03
gray goldenrod	*Solidago nemoralis*	0.02	0.02	0.17%	2.00
heath aster	*Symphyotrichum ericoides*	0.01	0.01	0.14%	1.10
smooth aster	*Symphyotrichum laeve*	0.03	0.03	0.27%	0.61
heart-leaved alexanders	*Zizia aptera*	0.06	0.05	0.50%	0.24
	Total Forbs	**0.84**	**0.75**	**6.86%**	**10.18**
Oats	*Avena sativa*	3.36	3.00	27.26%	1.34
	Total Cover Crop	**3.36**	**3.00**	**27.26%**	**1.34**
	Totals:	**12.33**	**11.00**	**100.00%**	**73.62**
Purpose:	Regional dry prairie reconstruction for wetland mitigation, ecological restoration, or conservation program plantings.				
Planting Area:	Tallgrass Aspen Parklands Province, Red River Prairie Section, Hardwood Hills subsection of the MN & NE IA Morainal Section, far western portions of the Laurentian Mixed Forest Province. Mn/DOT Districts 2(west) & 4(north).				

Dry Prairie General

35-221

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
big bluestem	*Andropogon gerardii*	0.78	0.70	1.92%	2.57
side-oats grama	*Bouteloua curtipendula*	3.36	3.00	8.22%	6.61
blue grama	*Bouteloua gracilis*	0.56	0.50	1.37%	7.35
kalm's brome	*Bromus kalmii*	0.82	0.73	2.00%	2.14
nodding wild rye	*Elymus canadensis*	1.12	1.00	2.74%	1.91
junegrass	*Koeleria macrantha*	0.28	0.25	0.69%	18.37
little bluestem	*Schizachyrium scoparium*	3.36	3.00	8.22%	16.53
Indian grass	*Sorghastrum nutans*	0.78	0.70	1.92%	3.09
prairie dropseed	*Sporobolus heterolepis*	0.13	0.12	0.34%	0.73
	Total Grasses	**11.21**	**10.00**	**27.42%**	**59.30**
blue giant hyssop	*Agastache foeniculum*	0.07	0.06	0.17%	2.07
lead plant	*Amorpha canescens*	0.10	0.09	0.26%	0.42
butterfly milkweed	*Asclepias tuberosa*	0.07	0.06	0.17%	0.10
Canada milk vetch	*Astragalus canadensis*	0.07	0.06	0.18%	0.40
bird's foot coreopsis	*Coreopsis palmata*	0.07	0.06	0.16%	0.21
white prairie clover	*Dalea candida*	0.07	0.06	0.15%	0.39
purple prairie clover	*Dalea purpurea*	0.21	0.19	0.51%	1.02
Canada tick trefoil	*Desmodium canadense*	0.07	0.06	0.18%	0.13
stiff sunflower	*Helianthus pauciflorus*	0.07	0.06	0.17%	0.09
rough blazing star	*Liatris aspera*	0.04	0.04	0.12%	0.25
wild bergamot	*Monarda fistulosa*	0.07	0.06	0.15%	1.42
stiff goldenrod	*Oligoneuron rigidum*	0.07	0.06	0.15%	0.83
large-flowered beard tongue	*Penstemon grandiflorus*	0.07	0.06	0.17%	0.32
black-eyed susan	*Rudbeckia hirta*	0.35	0.31	0.84%	10.32
gray goldenrod	*Solidago nemoralis*	0.04	0.04	0.10%	3.86
heath aster	*Symphyotrichum ericoides*	0.04	0.04	0.10%	2.58
smooth aster	*Symphyotrichum laeve*	0.07	0.06	0.17%	1.26
hoary vervain	*Verbena stricta*	0.15	0.13	0.34%	1.29
	Total Forbs	**1.68**	**1.50**	**4.09%**	**26.96**
Oats	*Avena sativa*	28.02	25.00	68.49%	11.13
	Total Cover Crop	**28.02**	**25.00**	**68.49%**	**11.13**
	Totals:	**40.91**	**36.50**	**100.00%**	**97.39**
Purpose:	General dry prairie mix for native roadsides, ecological restoration, or conservation program plantings.				
Planting Area:	Tallgrass Aspen Parklands, Prairie Parkland, and Eastern Broadleaf Forest Provinces. Mn/DOT Districts 2(west), 3B, 4, Metro, 6, 7 & 8.				

Mesic Prairie Northwest

35-441

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
big bluestem	*Andropogon gerardii*	1.12	1.00	9.08%	3.67
side-oats grama	*Bouteloua curtipendula*	1.35	1.20	10.89%	2.64
nodding wild rye	*Elymus canadensis*	1.12	1.00	9.09%	1.91
slender wheatgrass	*Elymus trachycaulus*	1.12	1.00	9.11%	2.54
porcupine grass	*Hesperostipa spartea*	0.47	0.42	3.82%	0.11
switchgrass	*Panicum virgatum*	0.20	0.18	1.59%	0.90
little bluestem	*Schizachyrium scoparium*	1.68	1.50	13.66%	8.28
Indian grass	*Sorghastrum nutans*	1.35	1.20	10.91%	5.29
	Total Grasses	**8.41**	**7.50**	**68.15%**	**25.33**
Prairie Wild Onion	*Allium stellatum*	0.03	0.03	0.27%	0.12
Canada milk vetch	*Astragalus canadensis*	0.07	0.06	0.54%	0.37
white prairie clover	*Dalea candida*	0.07	0.06	0.55%	0.42
purple prairie clover	*Dalea purpurea*	0.10	0.09	0.83%	0.50
Canada tick trefoil	*Desmodium canadense*	0.09	0.08	0.77%	0.17
ox-eye	*Heliopsis helianthoides*	0.07	0.06	0.55%	0.14
rough blazing star	*Liatris aspera*	0.03	0.03	0.28%	0.18
great blazing star	*Liatris pycnostachya*	0.07	0.06	0.54%	0.24
wild bergamot	*Monarda fistulosa*	0.03	0.03	0.27%	0.77
stiff goldenrod	*Oligoneuron rigidum*	0.03	0.03	0.27%	0.45
Virginia mountain mint	*pycnanthemum virginianum*	0.04	0.04	0.34%	3.00
prairie coneflower	*Ratibida columnifera*	0.07	0.06	0.55%	0.93
black-eyed susan	*Rudbeckia hirta*	0.08	0.07	0.59%	2.20
heath aster	*Symphyotrichum ericoides*	0.01	0.01	0.14%	1.10
smooth aster	*Symphyotrichum laeve*	0.03	0.03	0.27%	0.61
blue vervain	*Verbena hastata*	0.10	0.09	0.77%	2.91
golden alexanders	*Zizia aurea*	0.19	0.17	1.56%	0.70
	Total Forbs	**1.12**	**1.00**	**9.09%**	**14.81**
Oats	*Avena sativa*	2.80	2.50	22.76%	1.12
	Total Cover Crop	**2.80**	**2.50**	**22.76%**	**1.12**
	Totals:	**12.33**	**11.00**	**100.00%**	**41.25**
Purpose:	Regional mesic prairie reconstruction for wetland mitigation, ecological restoration, or conservation program plantings.				
Planting Area:	Tallgrass Aspen Parklands Province, Red River Prairie Section, Hardwood Hills subsection of the MN & NE IA Morainal Section, may extend into the far western portions of the Laurentian Mixed Forest Province. Mn/DOT Districts 2(west) & 4(north).				

BWSR DEPARTMENT OF TRANSPORTATION DEPARTMENT OF NATURAL RESOURCES

Mesic Prairie General

35-241

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
big bluestem	*Andropogon gerardii*	2.24	2.00	5.48%	7.35
side-oats grama	*Bouteloua curtipendula*	1.79	1.60	4.39%	3.53
kalm's brome	*Bromus kalmii*	0.56	0.50	1.37%	1.47
nodding wild rye	*Elymus canadensis*	1.31	1.17	3.20%	2.23
slender wheatgrass	*Elymus trachycaulus*	1.12	1.00	2.73%	2.53
switchgrass	*Panicum virgatum*	0.07	0.06	0.17%	0.32
little bluestem	*Schizachyrium scoparium*	1.79	1.60	4.39%	8.82
Indian grass	*Sorghastrum nutans*	2.24	2.00	5.48%	8.82
prairie dropseed	*Sporobolus heterolepis*	0.08	0.07	0.18%	0.39
	Total Grasses	**11.21**	**10.00**	**27.39%**	**35.46**
blue giant hyssop	*Agastache foeniculum*	0.07	0.06	0.15%	1.82
lead plant	*Amorpha canescens*	0.07	0.06	0.15%	0.25
common milkweed	*Asclepias syriaca*	0.04	0.04	0.10%	0.06
butterfly milkweed	*Asclepias tuberosa*	0.04	0.04	0.10%	0.06
Canada milk vetch	*Astragalus canadensis*	0.07	0.06	0.17%	0.39
white prairie clover	*Dalea candida*	0.07	0.06	0.17%	0.44
purple prairie clover	*Dalea purpurea*	0.21	0.19	0.51%	1.03
Canada tick trefoil	*Desmodium canadense*	0.07	0.06	0.18%	0.13
stiff sunflower	*Helianthus pauciflorus*	0.07	0.06	0.17%	0.09
ox-eye	*Heliopsis helianthoides*	0.15	0.13	0.34%	0.29
rough blazing star	*Liatris aspera*	0.03	0.03	0.08%	0.18
great blazing star	*Liatris pycnostachya*	0.03	0.03	0.09%	0.13
wild bergamot	*Monarda fistulosa*	0.07	0.06	0.17%	1.61
stiff goldenrod	*Oligoneuron rigidum*	0.07	0.06	0.17%	0.94
black-eyed susan	*Rudbeckia hirta*	0.35	0.31	0.86%	10.56
heath aster	*Symphyotrichum ericoides*	0.03	0.03	0.09%	2.30
smooth aster	*Symphyotrichum laeve*	0.07	0.06	0.17%	1.26
blue vervain	*Verbena hastata*	0.04	0.04	0.12%	1.50
hoary vervain	*Verbena stricta*	0.07	0.06	0.17%	0.64
golden alexanders	*Zizia aurea*	0.07	0.06	0.15%	0.23
	Total Forbs	**1.68**	**1.50**	**4.11%**	**23.89**
Oats	*Avena sativa*	28.02	25.00	68.50%	11.14
	Total Cover Crop	**28.02**	**25.00**	**68.50%**	**11.14**
	Totals:	**40.91**	**36.50**	**100.00%**	**70.49**
Purpose:	General mesic prairie mix for native roadsides, ecological restoration, or conservation program plantings.				
Planting Area:	Tallgrass Aspen Parklands, Prairie Parkland, and Eastern Broadleaf Forest Provinces. Mn/DOT Districts 2(west), 3B, 4, Metro, 6, 7 & 8.				

Emergent Wetland

34-181

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
American slough grass	*Beckmannia syzigachne*	0.78	0.70	14.07%	12.92
tall manna grass	*Glyceria grandis*	0.28	0.25	4.98%	6.40
rice cut grass	*Leersia oryzoides*	0.34	0.30	5.93%	3.70
	Total Grasses	**1.40**	**1.25**	**24.98%**	**23.02**
river bulrush	*Bolboschoenus fluviatilis*	0.85	0.76	15.20%	1.20
bristly sedge	*Carex comosa*	0.20	0.18	3.63%	2.00
lake sedge	*Carex lacustris*	0.07	0.06	1.19%	0.24
tussock sedge	*Carex stricta*	0.04	0.04	0.77%	0.75
least spikerush	*Eleocharis acicularis*	0.11	0.10	1.94%	2.50
marsh spikerush	*Eleocharis palustris*	0.11	0.10	2.03%	1.90
Torrey's rush	*Juncus torreyi*	0.04	0.04	0.85%	25.00
Three-square bulrush	*Schoenoplectus pungens*	0.26	0.23	4.54%	1.00
soft stem bulrush	*Schoenoplectus tabernaemontani*	0.49	0.44	8.78%	5.00
woolgrass	*Scirpus cyperinus*	0.06	0.05	1.02%	32.00
	Total Sedges and Rushes	**2.24**	**2.00**	**39.95%**	**71.59**
Sweet flag	*Acorus americanus*	0.31	0.28	5.53%	0.67
common water plantain	*Alisma triviale*	0.45	0.40	8.00%	9.70
marsh milkweed	*Asclepias incarnata*	0.31	0.28	5.67%	0.50
broad-leaved arrowhead	*Sagittaria latifolia*	0.34	0.30	6.07%	6.80
giant bur reed	*Sparganium eurycarpum*	0.55	0.49	9.80%	0.09
	Total Forbs	**1.96**	**1.75**	**35.07%**	**17.76**
	Totals:	**5.60**	**5.00**	**100.00%**	**112.37**
Purpose:	Emergent wetland restoration for use in wetland mitigation, shoreline restoration, wet stormwater ponds where emergent vegetation is desired.				
Planting Area:	Statewide				

Wet Meadow South and West

34-271

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
fringed brome	*Bromus ciliatus*	1.23	1.10	9.18%	4.45
bluejoint	*Calamagrostis canadensis*	0.06	0.05	0.41%	5.00
Virginia wild rye	*Elymus virginicus*	1.12	1.00	8.37%	1.55
rice cut grass	*Leersia oryzoides*	0.28	0.25	2.07%	3.10
tall manna grass	*Glyceria grandis*	0.17	0.15	1.26%	3.90
fowl manna grass	*Glyceria striata*	0.11	0.10	0.83%	3.30
fowl bluegrass	*Poa palustris*	0.39	0.35	2.88%	16.50
	Total Grasses	**3.36**	**3.00**	**25.00%**	**37.80**
bristly sedge	*Carex comosa*	0.24	0.21	1.78%	2.36
pointed broom sedge	*Carex scoparia*	0.06	0.05	0.43%	1.60
awl-fruited sedge	*Carex stipata*	0.19	0.17	1.40%	2.10
tussock sedge	*Carex stricta*	0.03	0.03	0.21%	0.50
fox sedge	*Carex vulpinoidea*	0.16	0.14	1.13%	5.00
path rush	*Juncus tenuis*	0.04	0.04	0.34%	15.00
dark green bulrush	*Scirpus atrovirens*	0.20	0.18	1.48%	30.00
woolgrass	*Scirpus cyperinus*	0.09	0.08	0.67%	50.00
	Total Sedges and Rushes	**1.01**	**0.90**	**7.44%**	**106.56**
marsh milkweed	*Asclepias incarnata*	0.27	0.24	2.03%	0.43
common boneset	*Eupatorium perfoliatum*	0.02	0.02	0.18%	1.30
grass-leaved goldenrod	*Euthamia graminifolia*	0.01	0.01	0.06%	1.00
spotted Joe pye weed	*Eutrochium maculatum*	0.02	0.02	0.18%	0.75
autumn sneezeweed	*Helenium autumnale*	0.03	0.03	0.23%	1.30
sawtooth sunflower	*Helianthus grosseserratus*	0.04	0.04	0.30%	0.20
great lobelia	*Lobelia siphilitica*	0.02	0.02	0.13%	2.90
blue monkey flower	*Mimulus ringens*	0.01	0.01	0.07%	6.80
Virginia mountain mint	*Pycnanthemum virginianum*	0.07	0.06	0.53%	5.10
giant goldenrod	*Solidago gigantea*	0.02	0.02	0.14%	1.50
eastern panicled aster	*Symphyotrichum lanceolatum*	0.03	0.03	0.22%	1.50
red-stemmed aster	*Symphyotrichum puniceum*	0.19	0.17	1.42%	5.00
tall meadow-rue	*Thalictrum dasycarpum*	0.01	0.01	0.12%	0.11
blue vervain	*Verbena hastata*	0.15	0.13	1.12%	4.61
bunched ironweed	*Vernonia fasciculata*	0.03	0.03	0.28%	0.30
Culver's root	*Veronicastrum virginicum*	0.01	0.01	0.12%	4.20
golden alexanders	*Zizia aurea*	0.28	0.25	2.06%	1.00
	Total Forbs	**1.23**	**1.10**	**9.19%**	**38.00**
Oats	*Avena sativa*	7.85	7.00	58.37%	3.12
	Total Cover Crop	**7.85**	**7.00**	**58.37%**	**3.12**
	Totals:	**13.45**	**12.00**	**100.00%**	**185.48**
Purpose:	Wet meadow / Sedge meadow reconstruction for wetland mitigation or ecological restoration projects				
Planting Area:	Tallgrass Aspen Parklands, Prairie Parkland, and Eastern Broadleaf Forest Provinces. Mn/DOT Districts 2(west), 3B, 4, Metro, 6, 7 & 8.				

BWSR DEPARTMENT OF TRANSPORTATION DEPARTMENT OF NATURAL RESOURCES

Wet Meadow Northeast

34-371

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
fringed brome	*Bromus ciliatus*	2.24	2.00	16.04%	8.10
Bluejoint	*Calamagrostis canadensis*	0.11	0.10	0.78%	10.00
Virginia wild rye	*Elymus virginicus*	1.68	1.50	11.99%	2.31
tall manna grass	*Glyceria grandis*	0.28	0.25	1.96%	6.30
fowl bluegrass	*Poa palustris*	0.73	0.65	5.19%	31.00
	Total Grasses	**5.04**	**4.50**	**35.96%**	**57.71**
tussock sedge	*Carex stricta*	0.04	0.04	0.35%	0.85
pointed broom sedge	*Carex scoparia*	0.06	0.05	0.39%	1.50
dark green bulrush	*Scirpus atrovirens*	0.22	0.20	1.56%	33.00
woolgrass	*Scirpus cyperinus*	0.07	0.06	0.51%	40.00
	Total Sedges and Rushes	**0.39**	**0.35**	**2.81%**	**75.35**
Canada anemone	*Anemone canadensis*	0.11	0.10	0.82%	0.30
marsh milkweed	*Asclepias incarnata*	0.27	0.24	1.95%	0.43
flat-topped aster	*Doellingeria umbellata*	0.11	0.10	0.81%	2.50
common boneset	*Eupatorium perfoliatum*	0.10	0.09	0.68%	5.00
grass-leaved goldenrod	*Euthamia graminifolia*	0.04	0.04	0.31%	5.00
spotted Joe pye weed	*Eutrochium maculatum*	0.16	0.14	1.15%	5.00
blue monkey flower	*Mimulus ringens*	0.03	0.03	0.24%	25.00
giant goldenrod	*Solidago gigantea*	0.03	0.03	0.20%	2.30
eastern panicled aster	*Symphyotrichum lanceolatum*	0.03	0.03	0.28%	2.00
	Total Forbs	**0.90**	**0.80**	**6.44%**	**47.53**
Oats	*Avena sativa*	7.68	6.85	54.79%	3.05
	Total Cover Crop	**7.68**	**6.85**	**54.79%**	**3.05**
	Totals:	**14.01**	**12.50**	**100.00%**	**183.64**
Purpose:	Wet meadow / Sedge meadow reconstruction for wetland mitigation or ecological restoration.				
Planting Area:	Laurentian Mixed Forest Province. Mn/DOT Districts 1, 2(east) and 3A.				

BWSR DEPARTMENT OF TRANSPORTATION DEPARTMENT OF NATURAL RESOURCES

Wet Prairie

34-262

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
big bluestem	*Andropogon gerardii*	1.12	1.00	6.89%	3.67
fringed brome	*Bromus ciliatus*	1.68	1.50	10.38%	6.08
bluejoint	*Calamagrostis canadensis*	0.04	0.04	0.27%	4.00
Virginia wild rye	*Elymus virginicus*	1.96	1.75	12.07%	2.70
tall manna grass	*Glyceria grandis*	0.17	0.15	1.02%	3.80
fowl manna grass	*Glyceria striata*	0.12	0.11	0.73%	3.50
switchgrass	*Panicum virgatum*	0.84	0.75	5.16%	3.85
fowl bluegrass	*Poa palustris*	0.22	0.20	1.39%	9.60
Indian grass	*Sorghastrum nutans*	0.56	0.50	3.44%	2.20
prairie cordgrass	*Spartina pectinata*	0.56	0.50	3.41%	1.20
	Total Grasses	**7.29**	**6.50**	**44.76%**	**40.60**
wooly sedge	*Carex pellita*	0.06	0.05	0.32%	0.47
tussock sedge	*Carex stricta*	0.02	0.02	0.17%	0.48
fox sedge	*Carex vulpinoidea*	0.11	0.10	0.66%	3.50
dark green bulrush	*Scirpus atrovirens*	0.11	0.10	0.72%	17.74
woolgrass	*Scirpus cyperinus*	0.03	0.03	0.18%	16.00
	Total Sedges and Rushes	**0.34**	**0.30**	**2.05%**	**38.19**
Canada anemone	*Anemone canadensis*	0.03	0.03	0.21%	0.09
marsh milkweed	*Asclepias incarnata*	0.09	0.08	0.55%	0.14
Canada tick trefoil	*Desmodium canadense*	0.56	0.50	3.41%	1.00
flat-topped aster	*Doellingeria umbellata*	0.06	0.05	0.34%	1.20
common boneset	*Eupatorium perfoliatum*	0.03	0.03	0.23%	2.00
grass-leaved goldenrod	*Euthamia graminifolia*	0.02	0.02	0.11%	2.00
spotted Joe pye weed	*Eutrochium maculatum*	0.04	0.04	0.30%	1.50
autumn sneezeweed	*Helenium autumnale*	0.06	0.05	0.35%	2.39
sawtooth sunflower	*Helianthus grosseserratus*	0.06	0.05	0.38%	0.30
great blazing star	*Liatris pycnostachya*	0.02	0.02	0.17%	0.10
great lobelia	*Lobelia siphilitica*	0.01	0.01	0.05%	1.40
blue monkey flower	*Mimulus ringens*	0.01	0.01	0.05%	6.40
Virginia mountain mint	*Pycnanthemum virginianum*	0.09	0.08	0.55%	6.50
red-stemmed aster	*Symphyotrichum puniceum*	0.09	0.08	0.56%	2.40
blue vervain	*Verbena hastata*	0.17	0.15	1.06%	5.25
bunched ironweed	*Vernonia fasciculata*	0.03	0.03	0.23%	0.30
Culver's root	*Veronicastrum virginicum*	0.02	0.02	0.14%	6.00
golden alexanders	*Zizia aurea*	0.28	0.25	1.76%	1.03
	Total Forbs	**1.68**	**1.50**	**10.45%**	**40.00**
Oats	*Avena sativa*	6.95	6.20	42.74%	2.76
	Total Cover Crop	**6.95**	**6.20**	**42.74%**	**2.76**
	Totals:	**16.25**	**14.50**	**100.00%**	**121.55**
Purpose:	Wet prairie reconstruction for wetland mitigation or ecological restoration.				
Planting Area:	Tallgrass Aspen Parklands, Prairie Parkland, and Eastern Broadleaf Forest Provinces. Mn/DOT Districts 2(west), 3B, 4, Metro, 6, 7 & 8.				

Riparian South and West

34-261

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
American slough grass	*Beckmannia syzigachne*	1.52	1.36	4.30%	24.90
riverbank wild rye	*Elymus riparius*	0.56	0.50	1.58%	0.53
Virginia wild rye	*Elymus virginicus*	1.96	1.75	5.56%	2.70
tall manna grass	*Glyceria grandis*	0.28	0.25	0.80%	6.50
fowl manna grass	*Glyceria striata*	0.10	0.09	0.29%	3.00
rice cut grass	*Leersia oryzoides*	0.18	0.16	0.51%	2.00
fowl bluegrass	*Poa palustris*	0.94	0.84	2.66%	40.00
prairie cordgrass	*Spartina pectinata*	0.34	0.30	0.96%	0.74
	Total Grasses	**5.88**	**5.25**	**16.66%**	**80.37**
tussock sedge	*Carex stricta*	0.04	0.04	0.13%	0.80
pointed broom sedge	*Carex scoparia*	0.07	0.06	0.21%	2.00
fox sedge	*Carex vulpinoidea*	0.22	0.20	0.65%	7.50
path rush	*Juncus tenuis*	0.03	0.03	0.09%	10.00
dark green bulrush	*Scirpus atrovirens*	0.13	0.12	0.38%	20.00
woolgrass	*Scirpus cyperinus*	0.06	0.05	0.15%	30.00
	Total Sedges and Rushes	**0.56**	**0.50**	**1.61%**	**70.30**
marsh milkweed	*Asclepias incarnata*	0.13	0.12	0.38%	0.21
common boneset	*Eupatorium perfoliatum*	0.03	0.03	0.11%	2.00
spotted Joe pye weed	*Eutrochium maculatum*	0.07	0.06	0.18%	2.00
autumn sneezeweed	*Helenium autumnale*	0.06	0.05	0.17%	2.50
giant sunflower	*Helianthus giganteus*	0.08	0.07	0.22%	0.25
spotted touch-me-not	*Impatiens capensis*	0.06	0.05	0.17%	0.08
great lobelia	*Lobelia siphilitica*	0.03	0.03	0.09%	5.00
blue monkey flower	*Mimulus ringens*	0.01	0.01	0.02%	5.07
Virginia mountain mint	*Pycnanthemum virginianum*	0.06	0.05	0.16%	4.00
tall coneflower	*Rudbeckia laciniata*	0.06	0.05	0.15%	0.25
giant goldenrod	*Solidago gigantea*	0.02	0.02	0.07%	2.00
blue vervain	*Verbena hastata*	0.17	0.15	0.46%	5.00
bunched ironweed	*Vernonia fasciculata*	0.07	0.06	0.18%	0.50
	Total Forbs	**0.84**	**0.75**	**2.36%**	**28.86**
Oats	*Avena sativa*	28.02	25.00	79.37%	11.14
	Total Cover Crop	**28.02**	**25.00**	**79.37%**	**11.14**
	Totals:	**35.31**	**31.50**	**100.00%**	**190.66**
Purpose:	Native riparian and floodplain plantings for wetland mitigation, ecological restoration, or general permanent cover after culvert or bridge work. Tolerates partial shade.				
Planting Area:	Tallgrass Aspen Parklands, Prairie Parkland, and Eastern Broadleaf Forest Provinces. Mn/DOT Districts 2(west), 3B, 4, Metro, 6, 7 & 8.				

Riparian Northeast

34-361

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
American slough grass	*Beckmannia syzigachne*	1.68	1.50	4.78%	27.64
Bluejoint	*Calamagrostis canadensis*	0.07	0.06	0.19%	6.00
riverbank wild rye	*Elymus riparius*	0.56	0.50	1.57%	0.53
Virginia wild rye	*Elymus virginicus*	2.24	2.00	6.33%	3.08
tall manna grass	*Glyceria grandis*	0.28	0.25	0.80%	6.50
fowl manna grass	*Glyceria striata*	0.10	0.09	0.29%	3.00
rice cut grass	*Leersia oryzoides*	0.17	0.15	0.49%	1.93
fowl bluegrass	*Poa palustris*	0.78	0.70	2.23%	33.50
	Total Grasses	**5.88**	**5.25**	**16.68%**	**82.18**
tussock sedge	*Carex stricta*	0.04	0.04	0.13%	0.80
pointed broom sedge	*Carex scoparia*	0.07	0.06	0.21%	2.00
fox sedge	*Carex vulpinoidea*	0.22	0.20	0.65%	7.50
path rush	*Juncus tenuis*	0.03	0.03	0.09%	10.00
dark green bulrush	*Scirpus atrovirens*	0.13	0.12	0.38%	20.00
woolgrass	*Scirpus cyperinus*	0.06	0.05	0.15%	30.00
	Total Sedges and Rushes	**0.56**	**0.50**	**1.61%**	**70.30**
marsh milkweed	*Asclepias incarnata*	0.13	0.12	0.38%	0.21
flat-topped aster	*Doellingeria umbellata*	0.04	0.04	0.13%	1.00
common boneset	*Eupatorium perfoliatum*	0.06	0.05	0.16%	3.00
grass-leaved goldenrod	*Euthamia graminifolia*	0.08	0.07	0.22%	9.00
spotted Joe pye weed	*Eutrochium maculatum*	0.12	0.11	0.34%	3.70
giant sunflower	*Helianthus giganteus*	0.08	0.07	0.22%	0.25
spotted touch-me-not	*Impatiens capensis*	0.03	0.03	0.11%	0.05
blue monkey flower	*Mimulus ringens*	0.02	0.02	0.05%	13.00
giant goldenrod	*Solidago gigantea*	0.02	0.02	0.05%	1.50
blue vervain	*Verbena hastata*	0.25	0.22	0.68%	7.35
	Total Forbs	**0.84**	**0.75**	**2.34%**	**39.06**
Oats	*Avena sativa*	28.02	25.00	79.37%	11.14
	Total Cover Crop	**28.02**	**25.00**	**79.37%**	**11.14**
	Totals:	**35.31**	**31.50**	**100.00%**	**202.67**
Purpose:	Native riparian and floodplain plantings for wetland mitigation, ecological restoration, or general permanent cover after culvert or bridge work. Tolerates partial shade.				
Planting Area:	Laurentian Mixed Forest Province. Mn/DOT Districts 1, 2(east) and 3A.				

Native Construction

32-241

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
big bluestem	*Andropogon gerardii*	1.40	1.25	3.30%	4.60
side-oats grama	*Bouteloua curtipendula*	1.12	1.00	2.64%	2.21
fringed brome	*Bromus ciliatus*	1.57	1.40	3.69%	5.67
nodding wild rye	*Elymus canadensis*	2.24	2.00	5.26%	3.82
slender wheatgrass	*Elymus trachycaulus*	2.80	2.50	6.57%	6.33
Virginia wild rye	*Elymus virginicus*	2.24	2.00	5.26%	3.09
switchgrass	*Panicum virgatum*	0.84	0.75	1.97%	3.85
fowl bluegrass	*Poa palustris*	0.67	0.60	1.57%	28.50
Indian grass	*Sorghastrum nutans*	1.12	1.00	2.63%	4.40
	Total Grasses	**14.01**	**12.50**	**32.89%**	**62.47**
Canada tick trefoil	*Desmodium canadense*	0.08	0.07	0.20%	0.15
partridge pea	*Chamaecrista fasiculata*	0.30	0.27	0.72%	0.27
wild bergamot	*Monarda fistulosa*	0.02	0.02	0.04%	0.39
black-eyed susan	*Rudbeckia hirta*	0.10	0.09	0.23%	3.00
hoary vervain	*Verbena stricta*	0.06	0.05	0.13%	0.50
	Total Forbs	**0.56**	**0.50**	**1.32%**	**4.31**
Oats	Avena sativa	28.02	25.00	65.79%	11.14
	Total Cover Crop	**28.02**	**25.00**	**65.79%**	**11.14**
	Totals:	**42.59**	**38.00**	**100.00%**	**77.91**
Purpose:	Mid-term soil stabilization using native species. Also suitable for sides of agricultural drainage ditches or low-diversity mesic prairie planting.				
Planting Area:	Tallgrass Aspen Parklands, Prairie Parkland, and Eastern Broadleaf Forest Provinces. Mn/DOT Districts 2(west), 3B, 4, Metro, 6, 7 & 8.				

July 5, 2018

BWSR Pilot Seed Mixes

PILOT SEED MIXES:

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Note: Oats cover crop is included as a component of these seed mixes with the exception of some wetland mixes where cover species are not necessary. Winter wheat (at a similar rate to oats) may be selected in some cases where germination is needed later in the fall, followed by further green-up the following spring (oats will not come back the follow spring unless it re-establishes from seed).

Finalized

Eroding Bank Stabilization Northwest & South

Function: Conservation

Intent: Stabilized steep eroding slopes with both early and later successional species.

Planting Area: NW & S

Specialization: NRCS 342

	Scientific Name	Common Name	Seeds/ sq ft	Rate (lb/ac)	% Mix (by sqft)	% Mix (by wt)
Cover						
	Avena sativa	Oats* (See Cover crop note)	11.14	37.91		
		Total Guild:	11.14	37.91	17.74%	76.6%
Forb						
	Achillea millefolium	Common Yarrow	0.7	0.01		
	Rudbeckia hirta	Black-eyed Susan	2.49	0.07		
	Verbena hastata	Blue Vervain	1.9	0.06		
		Total Guild:	5.09	0.14	8.11%	0.3%
Graminoid						
	Andropogon gerardii	Big Bluestem	5.5	1.50		
	Bromus ciliatus	Fringed Brome	3	0.82		
	Elymus canadensis	Canada Wild Rye	2.8	1.47		
	Elymus riparius	Riverbank Wild Rye	0.175	0.16		
	Elymus trachycaulus	Slender Wheatgrass	5.3	2.62		
	Elymus virginicus	Virginia Wild Rye	3	1.94		
	Panicum virgatum	Switchgrass	3.05	0.59		

	Poa palustris	Fowl Bluegrass	16	0.34		
	Sorghastrum nutans	Indian Grass	6.6	1.50		
		Total Guild:	45.425	10.94	72.34%	22.1%
Legume						
	Astragalus canadensis	Canada Milk Vetch	0.2	0.04		
	Chamaecrista fasciculata	Partridge Pea	0.2	0.20		
	Dalea purpurea	Purple Prairie Clover	0.5	0.09		
	Desmodium canadense	Canada Tick Trefoil	0.19	0.09		
	Vicia americana	American Vetch	0.051	0.07		
		Total Guild:	1.141	0.49	1.82%	1.0%
		Total Seed Mix:	62.796	49.48		

BWSR Pilot Seed Mixes

PILOT SEED MIXES:

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Note: Oats cover crop is included as a component of these seed mixes with the exception of some wetland mixes where cover species are not necessary. Winter wheat (at a similar rate to oats) may be selected in some cases where germination is needed later in the fall, followed by further green-up the following spring (oats will not come back the follow spring unless it re-establishes from seed).

Finalized

Sand Mine Reclamation South & West

Function: Grassland

Intent: Dry prairie establishment on disturbed sites with sandy soils

Planting Area: S & W

Specialization:

	Scientific Name	Common Name	Seeds/ sq ft	Rate (lb/ac)	% Mix (by sqft)	% Mix (by wt)
Cover						
	Avena sativa	Oats* (See Cover crop note)	11.13	37.88		
		Total Guild:	11.13	37.88	14.71%	79.4%
Forb						
	Asclepias tuberosa	Butterfly Milkweed	0.1	0.06		
	Asclepias verticillata	Whorled Milkweed	0.1	0.02		
	Coreopsis palmata	Bird's Foot Coreopsis	0.21	0.06		
	Geum triflorum	Prairie Smoke	0.1	0.01		
	Liatris aspera	Rough Blazing Star	0.25	0.04		
	Monarda punctata	Horsemint	1.42	0.04		
	Oligoneuron rigidum	Stiff Goldenrod	0.83	0.06		
	Penstemon grandiflorus	Large-flowered Beard Tongue	0.32	0.06		
	Rudbeckia hirta	Black-eyed Susan	10.32	0.31		
	Solidago speciosa	Showy Goldenrod	2	0.06		
	Symphyotrichum ericoides	Heath Aster	2.58	0.04		
	Symphyotrichum oolentangiense	Skyblue Aster	1.26	0.04		

Viola pedatifida	Bearded Birdfoot Violet	0.14	0.01		
Zizia aptera	Heart-leaved Alexanders	0.2	0.05		
	Total Guild:	19.83	0.86	26.21%	1.8%

Graminoid

Bouteloua curtipendula	Side-oats Grama	4	1.82		
Bromus kalmii	Kalm's Brome	4	1.36		
Koeleria macrantha	Junegrass	6	0.08		
Panicum virgatum	Switchgrass	8	1.56		
Schizachyrium scoparium	Little Bluestem	18	3.27		
Sporobolus cryptandrus	Sand Dropseed	1.8	0.02		
Sporobolus heterolepis	Prairie Dropseed	1	0.17		
	Total Guild:	42.8	8.28	56.56%	17.3%

Legume

Astragalus canadensis	Canada Milk Vetch	0.4	0.06		
Chamaecrista fasciculata	Partridge Pea	0.39	0.39		
Dalea purpurea	Purple Prairie Clover	1.1	0.20		
Lupinus perennis	Wild Lupine	0.018	0.04		
	Total Guild:	1.908	0.69	2.52%	1.5%
	Total Seed Mix:	75.668	47.71		

BWSR Pilot Seed Mixes

PILOT SEED MIXES:

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Note: Oats cover crop is included as a component of these seed mixes with the exception of some wetland mixes where cover species are not necessary. Winter wheat (at a similar rate to oats) may be selected in some cases where germination is needed later in the fall, followed by further green-up the following spring (oats will not come back the follow spring unless it re-establishes from seed).

Finalized

Conservation Grazing South & West

Function: Production

Intent: Native prairie conservation grazing for southern and western MN

Planting Area: S & W

Specialization: NRCS 643 & 512

	Scientific Name	Common Name	Seeds/ sq ft	Rate (lb/ac)	% Mix (by sqft)	% Mix (by wt)
Cover						
	Avena sativa	Oats* (See Cover crop note)	1.42	4.83		
		Total Guild:	1.42	4.83	2.69%	33.8%
Forb						
	Coreopsis palmata	Bird's Foot Coreopsis	0.15	0.04		
	Helianthus maximilianii	Maximilian's Sunflower	0.4	0.08		
	Liatris aspera	Rough Blazing Star	0.4	0.07		
	Monarda fistulosa	Wild Bergamot	1.4	0.05		
	Potentilla arguta	Prairie Cinquefoil	2.4	0.03		
	Ratibida pinnata	Gray-headed Coneflower	1	0.09		
	Rudbeckia hirta	Black-eyed Susan	10	0.30		
	Sisyrinchium campestre	Field Blue-eyed Grass	0.17	0.01		
	Symphyotrichum laeve	Smooth Aster	0.6	0.03		
	Verbena stricta	Hoary Vervain	1.5	0.15		
	Viola pedatifida	Bearded Birdfoot Violet	0.14	0.01		
	Zizia aurea	Golden Alexanders	0.8	0.20		

		Total Guild:	18.96	1.06	35.85%	7.4%
Graminoid						
	Andropogon gerardii	Big Bluestem	3	0.82		
	Bouteloua curtipendula	Side-oats Grama	4	1.80		
	Bromus kalmii	Kalm's Brome	0.9	0.31		
	Elymus canadensis	Canada Wild Rye	1	0.52		
	Elymus trachycaulus	Slender Wheatgrass	1	0.50		
	Elymus virginicus	Virginia Wild Rye	1	0.65		
	Koeleria macrantha	Junegrass	2	0.03		
	Panicum virgatum	Switchgrass	2	0.39		
	Schizachyrium scoparium	Little Bluestem	5	0.91		
	Sorghastrum nutans	Indian Grass	4	0.91		
	Sporobolus heterolepis	Prairie Dropseed	4	0.68		
		Total Guild:	27.9	7.52	52.76%	52.6%
Legume						
	Astragalus canadensis	Canada Milk Vetch	1.2	0.19		
	Chamaecrista fasciculata	Partridge Pea	0.1	0.10		
	Dalea candida	White Prairie Clover	1.3	0.19		
	Dalea purpurea	Purple Prairie Clover	1.7	0.31		
	Lespedeza capitata	Round-headed Bush Clover	0.3	0.10		
		Total Guild:	4.6	0.89	8.70%	6.2%
		Total Seed Mix:	52.88	14.30		

BWSR Pilot Seed Mixes

PILOT SEED MIXES:

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Note: Oats cover crop is included as a component of these seed mixes with the exception of some wetland mixes where cover species are not necessary. Winter wheat (at a similar rate to oats) may be selected in some cases where germination is needed later in the fall, followed by further green-up the following spring (oats will not come back the follow spring unless it re-establishes from seed).

Finalized

Native Forage Buffer Mix South & West

Function: Buffers

Intent: Native buffer seed mix that can be hayed once or twice a year

Planting Area: S & W

Specialization: NRCS 393

	Scientific Name	Common Name	Seeds/ sq ft	Rate (lb/ac)	% Mix (by sqft)	% Mix (by wt)
Cover						
	Avena sativa	Oats* (See Cover crop note)	11.14	37.91		
		Total Guild:	11.14	37.91	21.85%	74.6%
Forb						
	Helianthus maximilianii	Maximilian's Sunflower	0.3	0.06		
	Ratibida pinnata	Gray-headed Coneflower	2.15	0.20		
		Total Guild:	2.45	0.26	4.81%	0.5%
Graminoid						
	Andropogon gerardii	Big Bluestem	8	2.18		
	Bromus ciliatus	Fringed Brome	2	0.54		
	Bromus kalmii	Kalm's Brome	1	0.35		
	Elymus canadensis	Canada Wild Rye	3	1.57		
	Elymus trachycaulus	Slender Wheatgrass	4	1.98		
	Elymus virginicus	Virginia Wild Rye	3	1.94		
	Panicum virgatum	Switchgrass	7	1.36		
	Sorghastrum nutans	Indian Grass	6	1.36		

		Total Guild:	34	11.28	66.69%	22.2%
Legume						
	Chamaecrista fasciculata	Partridge Pea	0.99	0.99		
	Dalea candida	White Prairie Clover	1.3	0.19		
	Dalea purpurea	Purple Prairie Clover	1.1	0.20		
		Total Guild:	3.39	1.38	6.65%	2.7%
		Total Seed Mix:	50.98	50.83		

BWSR Pilot Seed Mixes

06-Jan-18

PILOT SEED MIXES:

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Note: Oats cover crop is included as a component of these seed mixes with the exception of some wetland mixes where cover species are not necessary. Winter wheat (at a similar rate to oats) may be selected in some cases where germination is needed later in the fall, followed by further green-up the following spring (oats will not come back the follow spring unless it re-establishes from seed).

Finalized

Beneficial Insects South & West

Function: Pollinator

Intent: Establishment of diverse vegetation for beneficial insects in agricultural areas

Planting Area: S & W

Specialization:

	Scientific Name	Common Name	Seeds/ sq ft	Rate (lb/ac)	% Mix (by sqft)	% Mix (by wt)
Cover						
	Avena sativa	Oats* (See Cover crop note)	11.14	37.91		
		Total Guild:	11.14	37.91	12.79%	82.3%
Forb						
	Achillea millefolium	Common Yarrow	2	0.03		
	Agastache foeniculum	Blue Giant Hyssop	2.1	0.06		
	Allium stellatum	Prairie Wild Onion	0.28	0.07		
	Amorpha canescens	Lead Plant	0.37	0.06		
	Asclepias syriaca	Common Milkweed	0.16	0.11		
	Asclepias tuberosa	Butterfly Milkweed	0.071	0.04		
	Asclepias verticillata	Whorled Milkweed	0.1	0.02		
	Coreopsis palmata	Bird's Foot Coreopsis	0.15	0.04		
	Drymocallis arguta	Tall Cinquefoil	5.3	0.06		
	Echinacea angustifolia	Narrow-leaved Purple Conefl	0.115	0.04		
	Helenium autumnale	Autumn Sneezeweed	2.98	0.06		
	Helianthus maximilianii	Maximilian's Sunflower	0.3	0.06		

Helianthus pauciflorus	Stiff Sunflower	0.074	0.05		
Heliopsis helianthoides	Ox-eye	0.9	0.39		
Liatris aspera	Rough Blazing Star	0.37	0.06		
Liatris ligulistylis	Northern Plains Blazing Star	0.19	0.05		
Monarda fistulosa	Wild Bergamot	1.2	0.05		
Monarda punctata	Horsemint	0.7	0.02		
Oligoneuron rigidum	Stiff Goldenrod	0.94	0.06		
Penstemon digitalis	Foxglove Beardtongue	2.98	0.06		
Penstemon grandiflorus	Large-flowered Beard Tongue	0.4	0.08		
Pycnanthemum virginianum	Virginia Mountain Mint	3.81	0.05		
Rudbeckia hirta	Black-eyed Susan	0.7	0.05		
Sisyrinchium campestre	Field Blue-eyed Grass	0.2	0.03		
Solidago speciosa	Showy Goldenrod	1.6	0.05		
Symphyotrichum ericoides	Heath Aster	1.7	0.02		
Symphyotrichum laeve	Smooth Aster	1.1	0.05		
Symphyotrichum novae-angliae	New England Aster	1	0.04		
Tradescantia bracteata	Bracted Spiderwort	0.23	0.06		
Verbena hastata	Blue Vervain	7	0.20		
Zizia aptera	Heart-leaved Alexanders	0.26	0.06		
Zizia aurea	Golden Alexanders	0.82	0.20		
	Total Guild:	40.10	2.28	46.04%	4.9%

Graminoid

Bouteloua curtipendula	Side-oats Grama	3	1.36		
Elymus canadensis	Canada Wild Rye	2	1.05		
Koeleria macrantha	Junegrass	17	0.23		
Schizachyrium scoparium	Little Bluestem	8	1.45		
Sporobolus heterolepis	Prairie Dropseed	1.85	0.31		
	Total Guild:	31.85	4.40	36.57%	9.6%

Legume

Chamaecrista fasciculata	Partridge Pea	1	1.01		

Dalea candida	White Prairie Clover	1.5	0.21		
Dalea purpurea	Purple Prairie Clover	1.5	0.27		
	Total Guild:	4	1.49	4.59%	3.2%
	Total Seed Mix:	87.09	46.08		

Wetland Rehabilitation

34-171

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
Virginia wild rye	*Elymus virginicus*	3.36	3.00	56.61%	4.63
fowl bluegrass	*Poa palustris*	1.12	1.00	18.89%	47.80
	Total Grasses	**4.48**	**4.00**	**75.50%**	**52.43**
fox sedge	*Carex vulpinoidea*	0.22	0.20	3.85%	7.50
path rush	*Juncus tenuis*	0.18	0.16	3.03%	59.00
dark green bulrush	*Scirpus atrovirens*	0.40	0.36	6.70%	60.00
woolgrass	*Scirpus cyperinus*	0.09	0.08	1.51%	50.00
	Total Sedges and Rushes	**0.90**	**0.80**	**15.09%**	**176.50**
nodding bur marigold	*Bidens cernua*	0.15	0.13	2.45%	1.00
Water Horehound	*Lycopus americanus*	0.37	0.33	6.29%	23.15
blue monkey flower	*Mimulus ringens*	0.04	0.04	0.67%	30.00
	Total Forbs	**0.56**	**0.50**	**9.41%**	**54.15**
	Totals:	**5.94**	**5.30**	**100.00%**	**283.08**
Purpose:	Interseeding into establishing wetlands after weed control spraying. Also suitable for two to five year short term soil stabilization for areas with saturated soils.				
Planting Area:	Statewide				

BWSR Pilot Seed Mixes

Finalized

Compacted Trail General

Function: Conservation

Planting Area: Statewide

Specialization:

Intent: Vegetation establishment on passive recreation trails. A couple species in this mix may be tender in some regions.

Scientific Name	Common Name	Seeds/ sq ft	Rate (lb/ac)	% Mix (by sqft)	% Mix (by wt)
Cover					
Avena sativa	Oats* (See Cover crop note)	11.13	37.88		
	Total Guild:	11.13	37.88	19.53%	97.3%
Forb					
Achillea millefolium	Common Yarrow	2	0.03		
Campanula rotundifolia	Harebell	7	0.02		
	Total Guild:	9	0.05	15.80%	0.1%
Graminoid					
Bouteloua gracilis	Blue Grama	10	0.68		
Festuca subverticillata	Nodding Fescue	1.85	0.25		
	Total Guild:	11.85	0.93	20.80%	2.4%
Sedge					
Juncus tenuis	Path Rush	25	0.07		
	Total Guild:	25	0.07	43.88%	0.2%
	Total Seed Mix:	56.98	38.93		

BWSR Pilot Seed Mixes

PILOT SEED MIXES:

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Note: Oats cover crop is included as a component of these seed mixes with the exception of some wetland mixes where cover species are not necessary. Winter wheat (at a similar rate to oats) may be selected in some cases where germination is needed later in the fall, followed by further green-up the following spring (oats will not come back the follow spring unless it re-establishes from seed).

Finalized

Forest Groundcover East

Function: Woodland

Intent: Soil stabilizing in forests following invasive species removal and other disturbance

Planting Area: NE & E

Specialization:

	Scientific Name	Common Name	Seeds/ sq ft	Rate (lb/ac)	% Mix (by sqft)	% Mix (by wt)
Cover						
	Avena sativa	Oats* (See Cover crop note)	11.14	37.91		
		Total Guild:	11.14	37.91	66.43%	96.4%
Forb						
	Eurybia macrophylla	Large-leaved Aster	0.2	0.02		
	Geranium maculatum	Wild Geranium	0.1	0.05		
	Hydrophyllum virginianum	Virginia Waterleaf	0.1	0.10		
	Osmorhiza claytonii	Clayton's Sweet Cicely	0.1	0.11		
	Rudbeckia laciniata	Tall Coneflower	0.22	0.04		
	Smilacina racemosa	False Solomons Seal	0.01	0.07		
	Solidago flexicaulis	Zigzag Goldenrod	1.3	0.04		
		Total Guild:	2.03	0.43	12.10%	1.1%
Graminoid						
	Elymus hystrix	Bottlebrush Grass	0.5	0.18		
	Elymus villosus	Downy Wild Rye	1	0.50		
	Festuca subverticillata	Nodding Fescue	1.8	0.25		

Total Guild:	3.3	0.93	19.68%	2.3%

Sedge

Total Guild:	0.3	0.08	1.79%	0.2%
Total Seed Mix:	16.77	39.35		

06-Jan-17

BWSR Pilot Seed Mixes

PILOT SEED MIXES:

These new "Pilot" seed mixes have been developed for a variety of restoration, conservation and stormwater uses. Goals were to meet the needs of common project types and to create direction for emerging topics such as biofuels, buffers, conservation grazing, and pollinators. All of the mixes were developed for specific functions and incorporate pollinator habitat to the extent possible. The mixes will remain as pilot mixes for a couple years until we understand how they are performing before we work to make them official state mixes. In many cases these mixes should be considered starting points for developing site specific mixes.

Note: Oats cover crop is included as a component of these seed mixes with the exception of some wetland mixes where cover species are not necessary. Winter wheat (at a similar rate to oats) may be selected in some cases where germination is needed later in the fall, followed by further green-up the following spring (oats will not come back the follow spring unless it re-establishes from seed).

Finalized

Early Successional Floodplain General

Function: Wetland

Planting Area: Statewide

Specialization: NRCS 342

Intent: Cover establishment in floodplains where natural colonization will add to diversity over time

	Scientific Name	Common Name	Seeds/ sq ft	Rate (lb/ac)	% Mix (by sqft)	% Mix (by wt)
Cover						
	Avena sativa	Oats* (See Cover crop note)	11.14	37.91		
		Total Guild:	11.14	37.91	23.99%	84.6%
Forb						
	Asclepias incarnata	Marsh Milkweed	0.1	0.06		
	Helenium autumnale	Autumn Sneezeweed	2	0.04		
	Rudbeckia laciniata	Tall Coneflower	0.1	0.02		
	Verbena hastata	Blue Vervain	3	0.09		
		Total Guild:	5.2	0.21	11.20%	0.5%
Graminoid						
	Elymus riparius	Riverbank Wild Rye	0.1	0.09		
	Elymus trachycaulus	Slender Wheatgrass	2	0.99		
	Elymus virginicus	Virginia Wild Rye	8	5.19		
	Poa palustris	Fowl Bluegrass	20	0.42		
		Total Guild:	30.1	6.69	64.81%	14.9%

Total Seed Mix:	46.44	44.81

Stormwater South and West

33-261

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
big bluestem	*Andropogon gerardii*	2.24	2.00	5.72%	7.35
fringed brome	*Bromus ciliatus*	2.24	2.00	5.73%	8.10
bluejoint	*Calamagrostis canadensis*	0.07	0.06	0.18%	6.40
slender wheatgrass	*Elymus trachycaulus*	1.12	1.00	2.85%	2.53
Virginia wild rye	*Elymus virginicus*	1.68	1.50	4.28%	2.31
switchgrass	*Panicum virgatum*	0.43	0.38	1.07%	1.93
fowl bluegrass	*Poa palustris*	1.19	1.06	3.03%	50.70
Indian grass	*Sorghastrum nutans*	0.13	0.12	0.36%	0.55
prairie cordgrass	*Spartina pectinata*	0.43	0.38	1.07%	0.91
	Total Grasses	**9.53**	**8.50**	**24.29%**	**80.78**
awl-fruited sedge	*Carex stipata*	0.28	0.25	0.71%	3.10
dark green bulrush	*Scirpus atrovirens*	0.21	0.19	0.54%	31.70
woolgrass	*Scirpus cyperinus*	0.07	0.06	0.18%	39.00
	Total Sedges and Rushes	**0.56**	**0.50**	**1.43%**	**73.80**
Canada anemone	*Anemone canadensis*	0.08	0.07	0.19%	0.20
marsh milkweed	*Asclepias incarnata*	0.12	0.11	0.32%	0.20
leafy beggarticks	*Bidens frondosa*	0.12	0.11	0.31%	0.20
flat-topped aster	*Doellingeria umbellata*	0.07	0.06	0.17%	1.50
spotted Joe pye weed	*Eutrochium maculatum*	0.07	0.06	0.18%	2.19
autumn sneezeweed	*Helenium autumnale*	0.15	0.13	0.36%	5.97
obedient plant	*Physostegia virginiana*	0.08	0.07	0.21%	0.30
tall coneflower	*Rudbeckia laciniata*	0.08	0.07	0.21%	0.37
New England aster	*Symphyotrichum novae-angliae*	0.08	0.07	0.19%	1.56
blue vervain	*Verbena hastata*	0.06	0.05	0.15%	1.85
golden alexanders	*Zizia aurea*	0.22	0.20	0.56%	0.79
	Total Forbs	**1.12**	**1.00**	**2.85%**	**15.13**
Oats	*Avena sativa*	28.02	25.00	71.43%	11.14
	Total Cover Crop	**28.02**	**25.00**	**71.43%**	**11.14**
	Totals:	**39.23**	**35.00**	**100.00%**	**180.85**
Purpose:	Stormwater pond edges, temporarily flooded dry ponds, and temporarily flooded ditch bottoms.				
Planting Area:	Tallgrass Aspen Parklands, Prairie Parkland, and Eastern Broadleaf Forest Provinces. Mn/DOT Districts 2(west), 3B, 4, Metro, 6, 7 & 8.				

Stormwater Northeast

33-361

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
fringed brome	*Bromus ciliatus*	4.09	3.65	10.43%	14.75
bluejoint	*Calamagrostis canadensis*	0.06	0.05	0.13%	4.80
nodding wild rye	*Elymus canadensis*	2.24	2.00	5.71%	3.82
Virginia wild rye	*Elymus virginicus*	2.24	2.00	5.73%	3.09
tall manna grass	*Glyceria grandis*	0.18	0.16	0.44%	4.00
fowl bluegrass	*Poa palustris*	0.72	0.64	1.82%	30.40
	Total Grasses	**9.53**	**8.50**	**24.26%**	**60.86**
porcupine sedge	*carex hystericina*	0.10	0.09	0.26%	1.00
pointed broom sedge	*Carex scoparia*	0.04	0.04	0.12%	1.30
dark green bulrush	*Scirpus atrovirens*	0.30	0.27	0.76%	45.00
woolgrass	*Scirpus cyperinus*	0.11	0.10	0.27%	60.00
	Total Sedges and Rushes	**0.56**	**0.50**	**0.27%**	**107.30**
Canada anemone	*Anemone canadensis*	0.11	0.10	0.29%	0.30
marsh milkweed	*Asclepias incarnata*	0.50	0.45	1.30%	0.80
flat-topped aster	*Doellingeria umbellata*	0.11	0.10	0.29%	2.50
common boneset	*Eupatorium perfoliatum*	0.06	0.05	0.15%	3.00
grass-leaved goldenrod	*Euthamia graminifolia*	0.04	0.04	0.11%	5.00
spotted Joe pye weed	*Eutrochium maculatum*	0.17	0.15	0.42%	5.10
blue monkey flower	*Mimulus ringens*	0.02	0.02	0.07%	20.00
giant goldenrod	*Solidago gigantea*	0.02	0.02	0.06%	2.00
eastern panicled aster	*Symphyotrichum lanceolatum*	0.02	0.02	0.05%	1.00
tall meadow-rue	*Thalictrum dasycarpum*	0.06	0.05	0.16%	0.40
	Total Forbs	**1.12**	**1.00**	**2.90%**	**40.10**
Oats	*Avena sativa*	28.02	25.00	71.43%	11.14
	Total Cover Crop	**28.02**	**25.00**	**71.43%**	**11.14**
	Totals:	**39.23**	**35.00**	**100.00%**	**219.40**
Purpose:	Stormwater pond edges, temporarily flooded dry ponds, and temporarily flooded ditch bottoms.				
Planting Area:	Laurentian Mixed Forest Province. Mn/DOT Districts 1, 2(east) and 3A.				

Dry Swale/Pond

33-262

Common Name	Scientific Name	Rate (kg/ha)	Rate (lb/ac)	% of Mix (% by wt)	Seeds/ sq ft
big bluestem	*Andropogon gerardii*	1.68	1.50	3.40%	5.50
American slough grass	*Beckmannia syzigachne*	1.68	1.50	3.42%	27.60
fringed brome	*Bromus ciliatus*	1.68	1.50	3.40%	6.05
nodding wild rye	*Elymus canadensis*	4.48	4.00	9.09%	7.64
slender wheatgrass	*Elymus trachycaulus*	4.48	4.00	9.10%	10.15
Virginia wild rye	*Elymus virginicus*	2.80	2.50	5.67%	3.85
switchgrass	*Panicum virgatum*	0.45	0.40	0.91%	2.05
fowl bluegrass	*Poa palustris*	1.79	1.60	3.64%	76.50
Indian grass	*Sorghastrum nutans*	1.68	1.50	3.40%	6.60
	Total Grasses	**20.74**	**18.50**	**42.03%**	**145.94**
marsh milkweed	*Asclepias incarnata*	0.07	0.06	0.13%	0.10
purple prairie clover	*Dalea purpurea*	0.10	0.09	0.21%	0.50
Canada tick trefoil	*Desmodium canadense*	0.10	0.09	0.21%	0.19
ox-eye	*Heliopsis helianthoides*	0.10	0.09	0.20%	0.20
black-eyed susan	*Rudbeckia hirta*	0.08	0.07	0.17%	2.49
blue vervain	*Verbena hastata*	0.11	0.10	0.23%	3.50
	Total Forbs	**0.56**	**0.50**	**1.15%**	**6.98**
Oats	*Avena sativa*	28.02	25.00	56.82%	11.14
	Total Cover Crop	**28.02**	**25.00**	**56.82%**	**11.14**
	Totals:	**49.32**	**44.00**	**100.00%**	**164.06**
Purpose:	Temporarily flooded swales in agricultural settings.				
Planting Area:	Tallgrass Aspen Parklands, Prairie Parkland, and Eastern Broadleaf Forest Provinces. Mn/DOT Districts 2(west), 3B, 4, Metro, 6, 7 & 8.				

Appendix D

Spill Reporting-Agency Contacts

Spill Reporting Contacts

Agency	Water	Soil	Notification Period	24-Hour Reporting Hotline	Regulation/Code	Comments
Federal Contacts						
National Response Center	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface	Release of a hazardous substance in an amount equal to or greater than its reportable quantity under CERCLA	Immediately	1-800-424-8802	40 CFR 302 – Designation, Reportable Quantities, and Notification	
Environmental Protection Agency Region V (MN / WI)	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface		Immediately	1-312-353-2000	40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances Clean Water Act § 311 – Oil and Hazardous Substance Liability	
Environmental Protection Agency Region VIII (ND)	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface		Immediately	1-303-312-6312	40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances Clean Water Act § 311 – Oil and Hazardous Substance Liability	
Tribal Contacts						
Bois Forte	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface		Immediately	1-218-742-9825	40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances Clean Water Act § 311 – Oil and Hazardous Substance Liability	St. Louis County dispatch

Agency	Water	Soil	Notification Period	24-Hour Reporting Hotline	Regulation/Code	Comments
Fond du Lac	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface	Release of a hazardous substance in an amount equal to or greater than its reportable quantity under CERCLA	Immediately	1-800-424-8802	Wetlands Protection and Management Ordinance #03/06 Fond du Lac Band of Lake Superior Chippewa Ordinance #04/06 Brownfield Oversight and Enforcement	For spills that have occurred in and/or adjacent to wetlands, notification of containment and clean-up is required within 3 days after commencement of activity.
Grand Portage	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface		Immediately	1-218-387-3030	40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances Clean Water Act § 311 – Oil and Hazardous Substance Liability	Cook County dispatch
Leech Lake	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface	Release of a hazardous substance in an amount equal to or greater than its reportable quantity under CERCLA	Immediately	1-888-622-9225 1-218-335-7400	40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances Clean Water Act § 311 – Oil and Hazardous Substance Liability	
Lower Sioux	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface		Immediately	1-507-637-4036	40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances Clean Water Act § 311 – Oil and Hazardous Substance Liability Water quality for Lower Sioux Jurisdictional Waters	Lower Sioux Police dispatch

Agency	Water	Soil	Notification Period	24-Hour Reporting Hotline	Regulation/Code	Comments
Mille Lacs	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface		Immediately	1-888-860-8250	40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances Clean Water Act § 311 – Oil and Hazardous Substance Liability	Mille Lacs County dispatch
Prairie Island	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface		Immediately	651-267-4000	40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances Clean Water Act § 311 – Oil and Hazardous Substance Liability	
Red Lake	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface		Immediately	1-218-679-3313	40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances Clean Water Act § 311 – Oil and Hazardous Substance Liability	
Shakopee	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface		Immediately	1-952-445-1411	40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances Clean Water Act § 311 – Oil and Hazardous Substance Liability	Scott County Emergency dispatch

Agency	Water	Soil	Notification Period	24-Hour Reporting Hotline	Regulation/Code	Comments
Upper Sioux	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface		Immediately	1-800-422-0798 (in State) or 651-649-5451	40 CFR 117 – Determination of Reportable Quantities for Hazardous Substances Clean Water Act § 311 – Oil and Hazardous Substance Liability	MN State Duty Officer hotline
White Earth	Any quantity of discharged oil that violates state water quality standards, causes a film or sheen on water's surface or leaves sludge or emulsion beneath the surface		Immediately	1-218-983-3281	W.E.E.C 200.00 Wetlands Code	
State Contacts						
Minnesota Pollution Control Agency	Any discharge of material which may cause pollution.	No minimum quantity for crude oil. Any spill >5 gallons of refined petroleum product. Spills of any quantity of all other chemicals or materials should be reported.	Immediately upon discovery.	Minnesota State Duty Officer 1-800-422-0798 (In State) or (651) 649-5451	Minnesota Statute 115.061	Follow up report established after initial response.

Agency	Water	Soil	Notification Period	24-Hour Reporting Hotline	Regulation/Code	Comments
North Dakota Department of Environmental Quality	Any incident or spill which may potentially result in pollution of waters of the state, either surface or groundwater or that may potentially have adverse effects to human health.	No minimum requirement. All spills that may potentially have adverse effects on human health and any historical contamination discovered during environmental investigations.	Immediately upon discovery.	North Dakota Department of Environmental Quality North Dakota Hazardous Materials Emergency Assistance and Spill Reporting 1-800-472-2121 (In State) 1-701-328-5210 (Out of State)	North Dakota Administrative Code NDAC 33-16-02.1-1	Follow up report established after initial response.
Wisconsin Department of Natural Resources	All spills are reportable if they adversely threaten or impact air, lands, and waters of the State as either a single discharge or an accumulation of past and present discharges or threaten or cause acute or chronic impacts to human health.	All spills are reportable unless they meet the following criteria: 1) spill is contained on an impervious surface; 2) <5 gallons of petroleum products onto a pervious surface or runs off an impervious surface; 3) <1 gallon of gasoline onto a pervious surface or runs off an impervious surface.	Immediately of any discharge not exempted by the statute.	24-hour WI DNR reporting number 1-800-943-0003	Chapter 292.11 of the Wisconsin Statutes, Chapter NR 706 Wisconsin Administrative Code	Follow up report established after initial response.
County Contacts – Minnesota						
Kittson County Emergency Management	As Needed			Scot Olson (218) 843-2113	Kittson County 2015 Hazard Mitigation Plan	
Marshall County Emergency Services	As Needed			Josh Johnston (218) 745-5841	Marshall County, MN Hazard Mitigation Plan 2016 Update	

Agency	Water	Soil	Notification Period	24-Hour Reporting Hotline	Regulation/Code	Comments
Pennington County Emergency Management	As Needed			Erik Beitel (218) 683-7087		
Wadena County Emergency Management	As Needed			Tyler Wheeler (218) 631-7795	Wadena County Multi-Hazard Mitigation Update 2015-2020	
Polk County Emergency Management	As Needed			Jody Beauchane, Director (218) 470-8263	Polk County, MN Hazard Mitigation Plan (July 2015)	
Red Lake County Emergency Management	As Needed			Mitch Bernstein (218) 253-2996		
Clearwater County Emergency Management	As Needed		8:00 AM – 4:30 PM Monday – Friday	(218) 694-6226		
Hubbard County Emergency Management	As Needed			Brian Halbasch (218) 732-2588		
Cass County Emergency Management	As Needed			Chad Emery (218) 547-7437	Cass County Hazard Mitigation Plan	
Crow Wing County Emergency Management	As Needed			Scott Goddard, Sheriff (218) 829-4749		
Aitkin County Emergency Management	As Needed			Dispatch (non-emergency) (218) 927-7400		
Carlton County Emergency Management	As Needed			Steve VanKekerix, Director (218) 384-9539		
St Louis County Emergency Management	As Needed			Sheriff's Office Emergency Management Division (218) 336-4340		

Agency	Water	Soil	Notification Period	24-Hour Reporting Hotline	Regulation/Code	Comments
County Contacts – North Dakota						
Pembina County Emergency Management	As Needed			Andrew Kirking (701) 265-4849		
County Contacts – Wisconsin						
Douglas County Emergency Management	As Needed		8:00 AM – 4:30 PM Monday – Friday	Dave Sletten, Director (715) 395-1497		

Appendix E

Emergency Response Contractors/ Disposal and Treatment Facilities

Emergency Response Contractors

The Contractor will dispose of all wastes according to applicable federal, state, and local requirements. Listings of potential Emergency Spill Response Contractors and waste disposal facilities are provided below. These lists were developed from state-wide databases and represent firms operating at the time the database was produced. The Contractor is responsible for verifying if a contractor or facility is currently operating under appropriate permits or licenses. The Contractor is responsible for ensuring wastes are disposed of properly.

Spill Response Contractors

Company	City/State	Phone Number
Minnesota		
Bay West Environmental	St. Paul, MN	(800) 279-0456 (651) 291-0456
West Central Environmental Consultants Inc.	Morris, MN	(800) 422-8356 (888) 923-2778
Minnesota Limited	Bemidji, MN	(218) 755-9595
OSI Environmental	Bemidji, MN	(800) 585-8838
OSI Environmental	Eveleth, MN	(800) 777-8542
Bay West Environmental	Duluth, MN	(800) 279-0456 (218) 740-0110
Charps	Clearbrook, MN	(218) 776-3080
Casper Construction	Grand Rapids, MN	(218) 326-9637
Four Star Construction	Superior, WI	(715) 394-9564

Waste Facilities – Minnesota

Facility ID	Facility (Minnesota)	Waste Type	Address	City	State	Zip	County	Contact Phone
Hazardous Waste Facilities								
1	Clean Harbors, Cannon Falls	Solid & Liquid - Haz	211 Holiday Avenue	Cannon Falls	MN	55009	Goodhue	(507) 263-0252
2	Safety-Kleen, Inc.	Solid & Liquid - Haz	1302 18th Street	Cloquet	MN	55720	Goodhue	(218) 879-2164
Waste Water Treatment Plant Facilities (WWTP)								
1	Aitkin Sewage Treatment Plant	Liquid -WWTP	120 1st Street Northwest	Aitkin	MN	56431	Aitkin	(218) 927-3406
2	GRPUC Wastewater Treatment Facility	Liquid -WWTP	1105 SE 23rd Avenue	Grand Rapids	MN	55744	Itasca	(218) 326-7024
3	Crookston Wastewater Treatment Facility	Liquid -WWTP	County Road 233	Crookston	MN	56716	Polk	(218) 281-5711
4	Hibbing Waste Treatment Plant	Liquid -WWTP	11669 Town Line Road	Hibbing	MN	55746	St. Louis	(218) 362-5999
5	Virginia Wastewater Treatment	Liquid -WWTP	1204 Southern Drive	Virginia	MN	55792	St. Louis	(218) 748-7519
6	WLSSD	Liquid -WWTP	2626 Courtland Street	Duluth	MN	55806	St. Louis	(218) 722-3336
7	Lepier Oil	Liquid - WWTP	320 1st St E	Fosston	MN	56542	Polk	(218) 435-1040
8	OSI Environmental	Liquid - WWTP	300 Fayal Rd	Eveleth	MN	55734	St. Louis	(800) 777-8542
Non-Hazardous Waste Facilities								
1	Pinebend Landfill (Republic Services)	Solid - NonHaz	2495 East 117th Street	Inver Grove Heights	MN	55077	Dakota	(651) 450-2155
2	Burnsville Sanitary Landfill (WM)	Solid - NonHaz	2650 West Cliff Road	Burnsville	MN	55337	Dakota	(952) 890-3248
3	Spruce Ridge Landfill (WM)	Solid - NonHaz	12755 137th Street	Glencoe	MN	55336	McLeod	(320) 864-5503
4	Elk River Landfill (WM)	Solid - NonHaz	22460 Highway 169	Elk River	MN	55330	Sherburne	(763) 441-2464
5	Canyon (Voyageur) (WM)	Solid - NonHaz	6830 Highway 53	Canyon	MN	55717	St. Louis	(218) 345-6302
6	SKB - Rosemount	Solid - NonHaz	13425 Courthouse Blvd	Rosemount	MN	55060	Dakota	(651) 438-1500
7	SKB - Environmental Landfill	Solid - NonHaz	52563 243rd Street	Austin	MN	55912	Mower	(507) 433-8131
8	SKB - Shamrock Landfill	Solid - NonHaz	761 MN Highway 45	Cloquet	MN	55720	Carlton	(218) 878-0112
9	MarKit Landfill	Solid-NonHaz	2650 290th Ave	Hallock	MN	56728	Kittson	(218) 754-4581
10	General Waste	Solid-NonHaz	35005 Co Rd 571	Keewatin	MN	55753	St. Louis	(218) 778-6600
11	VONCO V Landfill	Solid-NonHaz	1100 W Gary St	Duluth	MN	55808	St. Louis	(218) 336-5100
12	VONCO II Landfill	Solid-NonHaz	15301 Sherburne Ave	Becker	MN	55308	Sherburne	(763) 262-8662

Attachment E

Gully 30 Groundwater Modeling (December 2019)

resourceful. naturally.
engineering and environmental consultants

BARR

Technical Memorandum

To: Dr. Jim Arndt, Merjent
From: Adam Janzen, PE
Subject: Gully 30 Groundwater Modeling
Date: 12/20/2019
Project: 23/69-1768

This memorandum describes the development and application of a groundwater flow model to simulate summer trench dewatering within the Gully 30 calcareous fen as part of the proposed Line 3 replacement (L3R) project. The groundwater flow model was calibrated to pumping and drawdown data from the construction of the Alberta Clipper pipeline through the same area in 2009-2010.

The calibrated model was then used to simulate dewatering for the proposed summer L3R construction. A sensitivity analysis was conducted to evaluate the effects of parameter uncertainty on estimated dewatering rates and times. The model predicts that the proposed L3R dewatering system can completely dewater the proposed excavation in less than 2 days at an initial pumping rate of 1.4 gallons per minute per foot of excavation (gpm/ft). A worst-case pumping scenario was conducted at 0.7 gpm/ft; at this pumping rate the modeling predicted that the excavation could likely be completely dewatered in approximately 1.5 weeks but that complete dewatering might not be achieved under adverse conditions such as high initial water table and higher than expected sand aquifer permeability.

1.0 Previous Work

In 2009 Barr developed a cross-section groundwater flow model to estimate the necessary dewatering rate and duration for the Alberta Clipper pipeline construction through the Gully 30 fen (Barr, 2009). This evaluation was performed using mostly estimated parameters as little hydrogeologic data for the area was available at the time. This analysis predicted that the desired drawdown could be achieved in 1-3 days at a pumping rate of 2 gpm/ft.

2.0 Model Construction

The use of a cross-section model assumes a long, linear symmetry perpendicular to the cross section. This assumption is appropriate for simulating dewatering of a long pipeline excavation using a linear drain tile. Because the model lacks a third dimension, pumping rates must be expressed per foot of excavation (i.e., parallel to the pipeline).

The 2D cross-section model uses a generalized stratigraphic profile; it does not simulate any particular area within the fen. The model's representation of the general stratigraphy of the area is unchanged from the 2009 model. The uppermost 4 feet of the model represents 2 feet of surficial peat underlain by 2 feet of lacustrine sediments (i.e., silt and clay). The remainder of the model represents sand. The following updates were made to the 2009 cross-section model:

- The model domain was expanded to a total width of 250 feet. The model domain is centered on the existing Light Sour return (LSr) pipeline. The Alberta Clipper centerline is 25 feet west of LSr and the proposed L3R centerline is 25 feet east of LSr.
- The model depth was increased to 40 feet. Examination of well construction records from the Minnesota Well Index (MWI) database for wells in the vicinity of the Gully 30 fen indicated a clay layer at a depth ranging from 35-55 feet below ground surface.
- Grid discretization (e.g., row/column spacing, layer thicknesses) was adjusted as necessary to achieve sufficient resolution in dewatered areas and around pipelines. The updated model consists of 1 row, 323 columns, and 38 layers. The row (profile) is 1 foot wide, the column spacing ranges from 0.25 feet to 1 foot, and layer thicknesses range from 0.25 feet to 2 feet.
- The 20-inch diameter LSr pipeline cross-section was added to the model as no-flow cells. Backfill around this pipeline was assumed identical to the surrounding sand, lacustrine sediments, and peat.
- The 2009 model used specified head outer boundaries on the layers representing sand. These boundaries were converted to General Head Boundaries (GHB) in the updated model. The GHB package allows the effective location of the outer boundary (i.e., the distance to the point of zero drawdown) to be adjusted without changing the actual size of the model. This ability provides important flexibility in the calibration because (1) the most appropriate distance to the point of zero drawdown is generally not known a priori and (2) it is not practical to repeatedly change the size of the model (i.e., add or subtract columns).
- The groundwater flow modeling software was changed to MODFLOW-NWT (Niswonger et al., 2011), which is the most current version of the U.S. Geological Survey's MODFLOW software. MODFLOW-NWT has comparable capabilities as MODFLOW-SURFACT (used by the 2009 model; HydroGeoLogic, Inc., 1996) regarding simulation of dewatered cells.

3.0 Model Calibration

While the ultimate goal of this study is to simulate L3R trench dewatering in the Gully 30 fen during the summer, the best dataset available for model calibration was collected during the wintertime construction of the Alberta Clipper pipeline through the same area. The model was therefore calibrated to wintertime conditions as described in this section. Prior to using the model to simulate summertime construction of L3R, several parameter values (e.g., peat hydraulic conductivity, initial depth to water, and recharge from precipitation) were modified to reflect summer conditions. These modifications and the subsequent simulations of summer conditions are described in Section 4.0.

3.1 Alberta Clipper Data

Water levels were monitored at 19 piezometers during the dewatering of the Alberta Clipper pipeline excavation. Attachment A includes a figure of the Alberta Clipper piezometer locations, drain tile turn ups, and pump locations as well as a conceptual cross section figure of the piezometer depths and locations relative to the pipeline. Figure 1 (attached) shows drawdowns calculated from the piezometer data. An average initial depth to water of 0.5 feet below ground surface was calculated from the piezometer data.

A ground surface elevation of 1200 feet above mean sea level (ft MSL) was assumed for the model; therefore, the starting head in all cells was 1199.5 ft MSL.

Tables 1 and 2 below show the available estimates of pumped volumes (Arndt, 2016). These volume estimates are based on nominal pump capacities and times of operation. While not shown on the figure in Attachment A, pump numbering starts at 1 at the southern end and increases moving north and northwest.

Table 1 Estimated Dewatering Discharge

Date and Time	Cumulative Volume Pumped (gallons)
12/31/2009 12:00	1,000,000
01/02/2010 12:00	5,000,000
01/05/2010 12:00*	10,000,000
01/06/2010 12:00*	13,000,000

*No time given, assumed to be noon.

Table 2 Pumping Start Times

Pump	Date and Time of Pumping Initiation
1	12/30/2009 12:31
2	12/31/2009 16:45
3	01/02/2010 18:00
4	01/04/2010 09:05
5	01/04/2010 15:30

3.2 Model Pumping Setup

The model was set up to simulate the Alberta Clipper construction. The drain tile was simulated using the MODFLOW Well package. A well was added to the model at the Alberta Clipper centerline (25 feet west of LSr) at a depth of 8 feet below grade.

Piezometers PZ-1A and PZ-1D clearly responded to initiation of pumping at pumps 1, 2, and 3. Therefore, the transient MODFLOW simulation was divided into 3 stress periods with increasing pumping rates as shown below in Table 3. Many piezometers were abandoned on 1/10/2010, so the model simulation was truncated at midnight on 1/10/2010.

Table 3 Alberta Clipper Model Stress Periods and Pumping Rates

Stress Period	Start Date and Time	End Date and Time	Duration (days)	Pumping Rate (gpm/ft)*	Pumping Rate (ft^3/day/ft)*
1	12/30/2009 12:31	12/31/2009 16:45	1.18	0.47	91
2	12/31/2009 16:45	01/02/2010 18:00	2.05	0.93	178
3	01/02/2010 18:00	01/10/2010 00:00	7.25	1.39	267

*Assumes an approximate drain tile length of 1,500 feet.

3.3 Calibration Targets

Because the pumps were turned on sequentially as shown on Table 2, only the southernmost section of drain tile was pumped throughout the dewatering period. While all of the piezometers except the "C"-series and the PZ-7-series responded to Pump 1 turning on, the only piezometer data that satisfy the linear symmetry assumption of the cross section model throughout the simulation are those from PZ-1A and PZ-1D, which were located approximately midway along the southernmost section of drain tile. Therefore, only the drawdowns from PZ-1A and PZ-1D were used as calibration targets for the sand. To inform the conductivity of the lacustrine sediments, average drawdowns calculated from PZ-5C and PZ-6C were also used as calibration targets.

Parameters and Calibration Procedure

The following parameters were allowed to vary during the model calibration:

- Hydraulic conductivity of the peat and lacustrine sediments. These materials were assumed to be isotropic. The same conductivity was assumed for both materials.
- Sand specific yield (Sy).
- GHB distance. The GHB package requires a head and a conductance for each GHB cell. The initial starting head (1199.5 ft MSL) was assigned as the GHB head. The conductance is calculated from the following equation:

$$Conductance = \frac{Hydraulic\ conductivity * cell\ thickness}{Distance\ from\ cell\ face\ to\ fixed\ head}$$

  Prior to each model run, the GHB conductance was calculated for each GHB cell from that cell's hydraulic conductivity and thickness and the current value of the GHB distance. Note that the GHB distances are measured from the edges of the model, not one of the pipeline centerlines. Because the Alberta Clipper and L3R centerlines are off-center in the model, a separate distance parameter was used for each outer boundary.
- Pumping rates. Preliminary runs of the model indicated that the observed drawdown behavior could not be reproduced when using the observed pumping rates. The dewatering volumes presented in Table 1 were estimated based on pump capacities and times of operation. This method is less accurate than direct measurement with a flow meter and likely provides an

overestimate of the actual pumping rate. The model pumping rates were therefore reduced as necessary in the calibration. In order to maximize the modeled rates (i.e., minimize the reduction), the fraction of modeled pumping relative to estimated pumping through 1/6/2010 was included as a calibration target.

The following parameters were held fixed:

- Sand horizontal hydraulic conductivity (Kx). The sand Kx was fixed at 200 ft/day, the same value used in the 2009 modeling. This number was based on simulations of test pits filling with water. A horizontal to vertical hydraulic conductivity ratio of 10 was assumed. In a typical groundwater model calibration this hydraulic conductivity would be an adjustable parameter, but for this model it was held constant because the pumping rates and GHB distances were adjustable parameters. Uncertainty in the sand hydraulic conductivity was later evaluated in the forward run sensitivity analysis.
- Peat/lacustrine specific yield. For the calibration, these materials were assumed to be mostly or completely frozen and to therefore have little to no drainable porosity. Thus, a small value of 0.01 was assumed.
- Recharge. Given the frozen conditions at the surface during the Alberta Clipper construction, aquifer recharge via infiltration from the surface was assumed to be zero.

3.4 Calibration Results

The automated inverse optimization software PEST (Watermark Numerical Computing, 2010; 2012) was used in combination with manual methods to determine the optimum parameter set. Figure 2 below shows the best match obtained between the observed and modeled piezometer drawdowns. Table 4 lists the final calibrated parameter values.

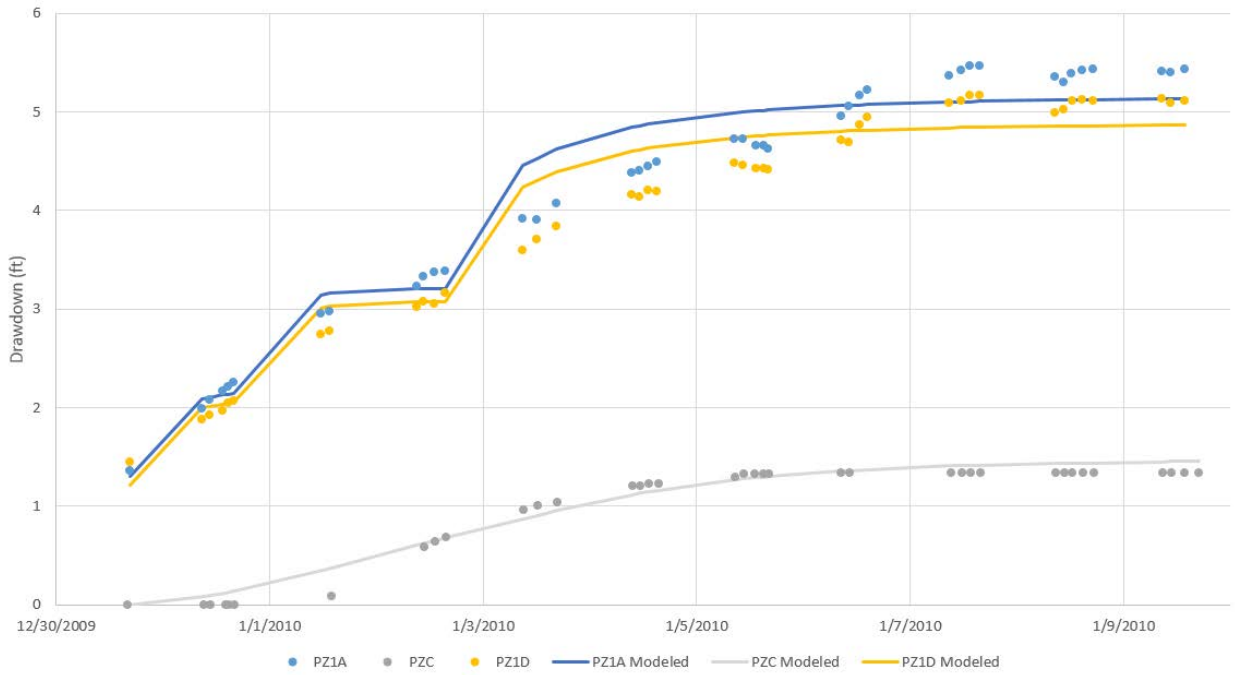

Figure 2 Calibrated Model Drawdown Response at Piezometers

Table 4 Final Calibrated Parameters (Winter Conditions)

Parameter	Value	Units
Peat/Lacustrine Kx	0.00044	ft/day
Peat/Lacustrine vertical hydraulic conductivity (Kz)	0.00044	ft/day
Sand Kx	200	ft/day
Sand Kz	20	ft/day
Peat/Lacustrine Ss	0.001	1/ft
Sand Ss	0.001	1/ft
Peat/Lacustrine Sy	0.01	-
Sand Sy	0.30	-
West GHB Distance	285.5	Ft
East GHB Distance	283.9	Ft
Recharge	0.00	ft/day
Stress Period 1 Pumping Rate	0.33	gpm/ft
Stress Period 2 Pumping Rate	0.48	gpm/ft
Stress Period 3 Pumping Rate	0.74	gpm/ft

Integrating the calibrated pumping rates from the start of pumping through noon on 1/6/2010 results in an approximate total volume pumped of 8,960,000 gallons for a 1,500 foot excavation; this is approximately 70% of the estimated 13,000,000 gallons pumped as of noon on 1/6/2010.

A non-unique solution exists from having both the pumping rates and GHB distances as adjustable parameters; i.e., multiple combinations of values for these parameters will produce acceptable solutions. The combination of parameters listed in Table 4 was considered to represent the best solution because it uses 70% of the estimated pumping and places the point of zero drawdown about 400 feet away from the Alberta Clipper pipeline. Better fits to the observed drawdowns were obtained by lowering the pumping rates to approximately 10% of the estimated rates and moving the point of zero drawdown approximately 1,000 feet from the pipeline; however, this combination of parameters was rejected as less realistic.

4.0 L3R Dewatering Simulations

In contrast to the wintertime Alberta Clipper construction, construction of L3R through the Gully 30 fen is planned for summer. Based on recommendations from a 1/16/2019 conference call with the Minnesota Department of Natural Resources (DNR), construction would begin in mid-August at the earliest, but would preferably take place in September in order to avoid plant disturbance during the growing season.

4.1 Forward Model Setup

As stated earlier in the introduction to Section 3.0, several modifications were made to the calibrated model in order to simulate the proposed summer L3R trench dewatering. These modifications included:

- Parameters such as peat and lacustrine hydraulic conductivity, peat and lacustrine specific yield, initial depth to water, and recharge were changed to values that represent summer conditions. The choice of parameter values is discussed further in the sensitivity analysis discussion below.
- The 36-inch diameter Alberta Clipper pipeline cross-section was added to the model as no-flow cells. Backfill around this pipeline was assumed identical to the surrounding sand, lacustrine sediments, and peat.
- The current plan for the L3R dewatering is to use 2 parallel drain tiles spaced 8 feet apart and located approximately 8 feet below grade. This was represented in the model using 2 wells offset 4 feet in either direction from the proposed L3R centerline in layer 21 of the model. Layer 21 extends from elevations 1192 ft MSL to 1191.5 ft MSL, or 8 to 8.5 feet below grade. The proposed base of the excavation is 6 feet below grade, or an elevation of 1194 ft MSL assuming a ground surface elevation of 1200 ft MSL.

As was done for the calibration, the Well package was used to simulate the drain tile for the forward runs. The Well package requires specified pumping rates. Two sets of forward runs were conducted using high and low estimated pumping rates based on the results of the model calibration:

- Low pumping scenario. The maximum calibrated pumping rate from the Alberta Clipper scenario was 0.7 gpm/ft. The low pumping scenario assumed this total pumping rate for the 2-tile L3R dewatering system (i.e., 0.35 gpm/ft from each tile). Presumably the 2-tile L3R system would be

able to produce more water than the 1-tile Alberta Clipper system; therefore, the low pumping scenario represents a worst case for L3R system performance. The low pumping scenario might approximate conditions if only one of the drain tiles were operable.

- High pumping scenario. This scenario assumed a pumping rate of 0.7 gpm/ft from each tile of the L3R system for a total pumping rate of 1.4 gpm/ft. Because the two closely-spaced tiles are likely to interfere with each other, the high pumping scenario represents a best case for L3R system performance.

MODFLOW-NWT will automatically reduce the pumping rate of a Well package cell if the saturated thickness of the grid cell containing the well falls below a specified threshold. Therefore, the model will indicate whether or not the applied pumping rate is sustainable.

4.2 Sensitivity Analysis

To account for parameter uncertainty, the forward simulations were conducted over realistic ranges of parameter values. This sensitivity analysis was conducted for both the high and low pumping scenarios. Table 5 below summarizes the ranges of parameter values tested in the sensitivity analysis. For each pumping scenario, a single run was conducted using the base parameter set and an additional run was conducted for each entry in the "Upper Bound" and "Lower Bound" columns in Table 5 using that value in place of the base value and the base values for all other parameters.

Table 5 Sensitivity Analysis Bounds

Parameter	Base Value	Upper Bound	Lower Bound	Units
Peat Kx	9.6	31.3	2.3	ft/day
Peat Kx/Kz	10	100	-	-
Lacustrine Kx and Kz	Same as peat	-	0.00044	ft/day
Sand Kx	200	276	113	ft/day
Peat/Lacustrine Sy	0.18	0.24	0.11	-
Sand Sy	0.30	0.33	0.29	-
Recharge	0.000899	0.00114	0.000567	ft/day
Initial Head	1198.19	1199.00	1197.00	ft MSL
West GHB Distance	285.5	-	50	ft
East GHB Distance	283.9	-	100	ft

Data sources for the ranges presented in Table 5 are discussed below:

- Peat hydraulic conductivity. Eight shallow piezometers (unique numbers 774052-774059) were installed in the Gully 30 fen in 2009. Barr conducted slug tests in four of these wells – MW-1B (774053), MW-2A (774054), MW-2B (774055), and MW-3B (774057) – soon after they were installed. Logs for these wells in the Minnesota Well Index indicate that all of them were completed in peat. A horizontal hydraulic conductivity range of 2.3 – 31.3 ft/day was obtained

from analysis of the slug test data. The geometric mean of 9.6 ft/day was used as the base value for the peat under summer conditions. Summaries of the slug test analyses are included in Attachment B.

- Peat Kx/Kz. A base value of 10 was assumed for the ratio of horizontal to vertical peat hydraulic conductivity. This is value is likely on the low end for peat, so only an upper bound of 100 was tested in the sensitivity analysis.
- Lacustrine K. Due to lack of site-specific data for the lacustrine sediments, the hydraulic conductivity of these materials was assumed equal to the peat values. The peat numbers seem high for a fine-grained material, however, so a sensitivity run using an isotropic lacustrine K of 0.00044 ft/day, the calibrated value for the Alberta Clipper conditions, was also tested.
- Sand hydraulic conductivity. The lower bound sand hydraulic conductivity of 113 ft/day was calculated using the Hazen method from grain size data (included in Attachment A) from a sand sample collected during the Alberta Clipper project. The upper bound of 276 ft/day was calculated using the TGuess method (Bradbury and Rothschild, 1985) from specific capacity data on the MWI log for irrigation well 124165, located approximately 2 miles west of the Gully 30 fen. A sand Kx/Kz ratio of 10 was assumed for all runs.
- Peat/lacustrine and sand specific yield. A relationship between hydraulic conductivity and specific yield (USBR, 1993) was used to calculate values of specific yield for the sand and the peat/lacustrine from the base, high, and low Kx values for those materials.
- Recharge. The base summertime recharge value of 8.99e-4 ft/day (10 cm/yr) is a 1971-2000 average derived from a recharge map of Minnesota (Delin et al., 2007). Average annual precipitation from 1971-2000 at Bemidji, MN (NOAA, 2016) was 25 inches with a maximum of 31.69 and a minimum of 15.76 inches during this period. High and low recharge bounds were calculated by scaling the base recharge value by ratios of max/average and min/average precipitation, respectively.
- Initial head. This model input affects the amount of water that has to be removed by pumping to dewater the trench. Representative summer water levels in the Gully 30 fen were calculated from 2010-2017 water level monitoring data from the eight piezometers discussed above. Attachment C contains a map of piezometer locations (Figure C1) and 2010-2017 hydrographs (Figure C2) for August 15 – September 30 (consistent with the expected construction timeframe). As indicated by the flat lines shown on the hydrographs, water levels in some of the shallow ("A") piezometers sometimes fell below the transducers, so only the data from the deep ("B") piezometers were used to determine representative initial head values for the model. Average depths to water below ground surface were calculated for each year for each well and the average of these values, 1.81 feet, was used to calculate the base initial head of 1198.19 ft MSL for the forward simulations. As shown on the hydrographs, depth to water in the deep piezometers is generally not greater than approximately 3 feet below ground surface, the exception being MW-4B in 2011. Therefore, a depth to water of 3 feet was used to calculate the lower bound of 1197.00 ft MSL for initial head. Construction is not to proceed unless the water table is at least 1 foot below ground surface, so an upper bound of 1199.00 ft MSL was used for the upper bound on initial head. The same initial heads were assumed throughout all layers of the model.

- GHB distance. Moving the point of zero drawdown closer to the pipeline moves the primary source of water closer to the drain tile and is thus a conservative test on the amount of pumping required to dewater the excavation. For one sensitivity run, the GHB distances were set to place the point of zero drawdown at 200 feet in either direction from L3R. Moving the point of zero drawdown farther from L3R would not be a conservative test and was therefore not simulated.

4.3 Results

Figure 3 (attached) shows the results from the forward runs using the high pumping rate of 1.4 gpm/ft. The upper and lower bounds on the shaded regions represent the maximum and minimum modeled heads, respectively, for each model time step considering all input variations from the sensitivity analysis. The results indicate that under best-case pumping conditions the excavation can be completely dewatered within 1-2 days. Note that the model determined that the applied 1.4 gpm/ft pumping rate could not be sustained for the entire duration of the forward runs. Final pumping rates after 1 week of pumping averaged approximately 0.8 gpm/ft and went as low as 0.6 gpm/ft. Pumps may need to be throttled back as the dewatering progresses past the first day to avoid the tiles collapsing from being pumped dry, instances of which were noted by field staff during the Alberta Clipper construction.

Figure 4 (attached) shows the results from the forward runs using the low pumping rate of 0.7 gpm/ft. The results indicate that under worst-case pumping conditions the 2-tile dewatering system may not be able to completely dewater the excavation. Most of the sensitivity runs conducted at the low pumping rate sufficiently lowered the water table, doing so within approximately 1-10 days. The dewatering target was not met for the runs with high initial head and lower GHB distance; the run with high sand hydraulic conductivity produced a stabilized head approximately equal to the excavation bottom elevation of 1194 ft MSL. As mentioned previously, the low pumping rate is conservative for 2 drain tiles and may approximate system performance under reduced capacity, for example, in the event that one or more of the pumps fails. These results indicate that if the initial water table is at the upper end of the expected range and/or the aquifer is more transmissive than believed, the dewatering system may struggle to completely dewater the excavation when operating at less than maximum capacity.

5.0 Pumped Volumes

A water appropriations permit must be obtained from the DNR for this dewatering. The model results were used to estimate total pumped volumes for the water appropriations permit application. Enbridge estimates that trenching and construction will require 20 days after the target dewatering elevation has been achieved (DeVera, 2019). Table 6 below summarizes the pumped volumes predicted by the model. At each timestep the model reports the cumulative volume (per foot) pumped by the Well package since the beginning of the simulation, accounting for variable pumping rates; this output is the source of the "Simulated Pumped Volume" numbers in Table 6 below. A length of 2,000 feet, the approximate length of the pipeline right-of-way within the Gully 30 fen boundary, was assumed to convert the modeled volumes per foot of excavation to absolute volumes in million gallons.

Table 6 Simulated Pumped Volumes

Pumping Scenario	Simulated Conditions[a]	Total Duration (days)[b]	Simulated Pumped Volume (ft^3/ft)[c]	Simulated Total Pumped Volume (Million gallons)[d]
High	Baseline	21	3,500	53
	Lowest Initial Water Table	21	2,900	43
	Longest Duration	22	4,200	63
Low	Baseline	24	3,200	48
	Lowest Initial Water Table	21	2,700	40
	Longest Duration	30	4,000	61

[a] For each pumping scenario, "Baseline" is the base sensitivity run and "Lowest Initial Water Table" is the upper bound on initial depth to water sensitivity run. "Longest Duration" is the sensitivity run for each pumping scenario that resulted in the longest time to achieve the target dewatering level.
[b] Time to achieve target dewatering level plus 20 days for setup and construction
[c] Raw model result
[d] Raw model result converted to million gallons per foot and multiplied by assumed 2,000-foot length

The high pumping scenario effectively simulates a higher average pumping rate over a shorter duration while the low pumping scenario simulates a lower average pumping rate over a longer duration; as shown on Table 6, the total pumped volumes are similar for both configurations. The simulated pumped volumes for L3R construction in Gully 30 ranged from 40 to 63 million gallons. The total reported pumping for the wintertime Alberta Clipper construction was 19.8 million gallons. While initial water table elevations are likely to be lower in late-August/September than during the winter, it is reasonable that the modeled volumes for L3R are larger for the following reasons:

- Longer duration. For Alberta Clipper, the pumps were on for approximately 11 days. Summer construction of L3R will take longer because mats can't be laid until the water level is drawn down far enough to ensure a stable surface. Stringing and welding of the pipe cannot take place until the mats are laid. With frozen ground conditions, the mats could be laid before dewatering began.
- Greater recharge. During the summer there are more potential sources of recharge to the aquifer and the excavation, including infiltration of precipitation to the aquifer and direct precipitation and runoff to the excavation during construction.
- Higher hydraulic conductivity and specific yield of shallow materials. For Alberta Clipper, freezing of water in the peat and lacustrine soils reduced or eliminated the ability of these materials to transmit water or yield water to gravity drainage. During the summer/fall, these materials will have much greater ability to transmit water toward the excavation and yield water to gravity drainage.

6.0 Conclusions

The groundwater model was used to simulate summertime dewatering of a 6-foot-deep excavation using 2 drain tiles installed 8 feet apart at a depth of 8 feet below grade. Based on the available information, it is expected that the proposed excavation can be dewatered within approximately 2 days if the dewatering system can produce an initial pumping rate of 1.4 gpm/ft. Pumping rates may have to be lowered after the first day to avoid dewatering the drain tiles themselves. A worst-case pumping scenario with the dewatering system operating at 0.7 gpm/ft generally still indicated it would be feasible to dewater the excavation in approximately 1.5 weeks but that it may not be feasible to completely dewater the excavation if the initial water table is high and/or the sand aquifer is more permeable than expected based on available information.

The model assumes that the dewatering takes place simultaneously along the full length of the trench. Turning pumps on sequentially over a period of several days, as was done for the Alberta Clipper pipeline, will lengthen the amount of time required to dewater the full length of the proposed excavation.

The dewatering system should be designed at minimum to produce a total pumping rate of 1.5 – 2.0 gpm/ft of cross section (i.e., 0.75 – 1.0 gpm/ft from each tile). This analysis did not specifically account for runoff or other effects of rainfall events except to the extent that such events occurring prior to construction would increase the initial heads.

The best estimates of pumped volumes for L3R construction in Gully 30 range from 40 to 63 million gallons.

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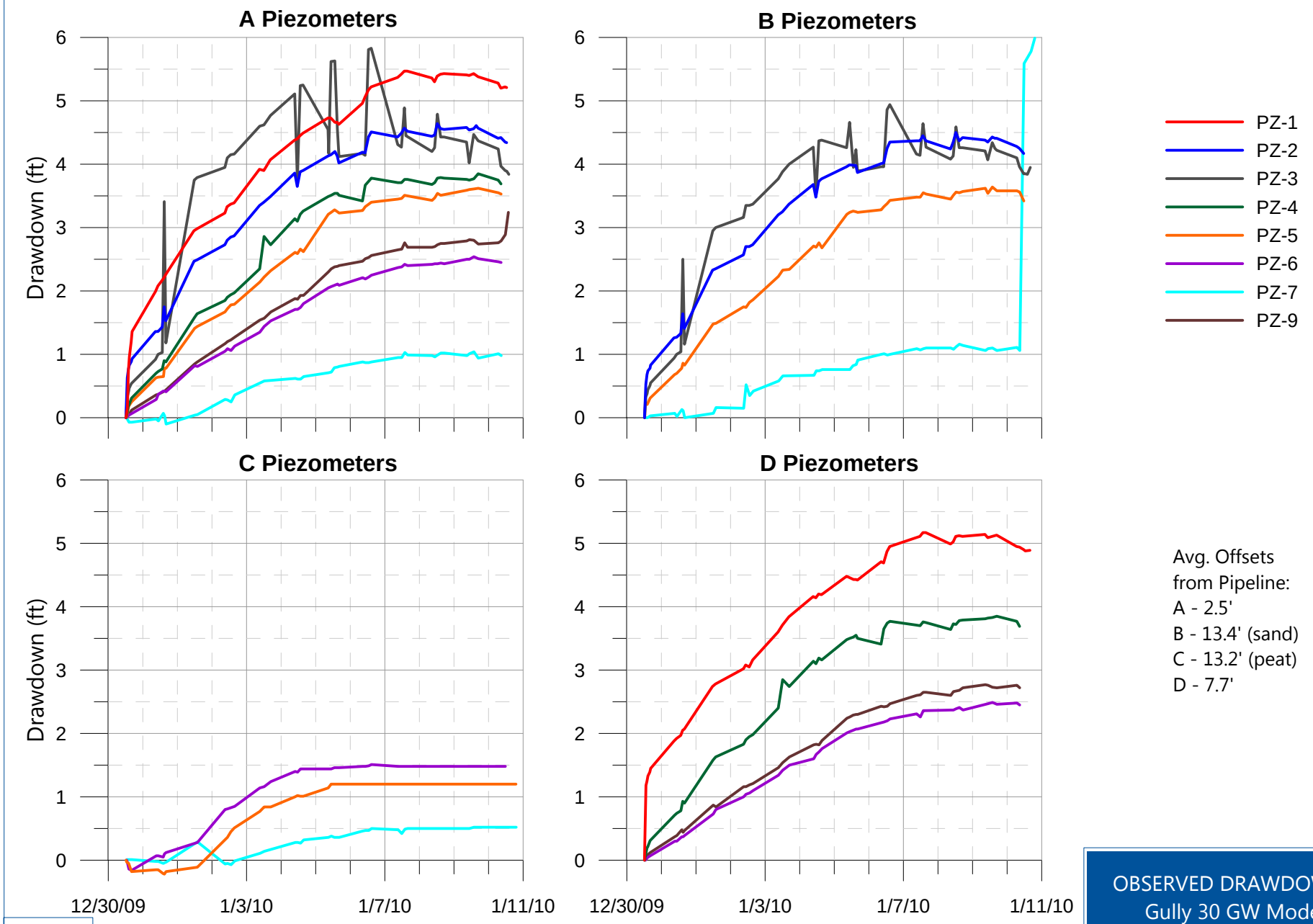
Certifications

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the state of Minnesota.

Adam K. Janzen
PE #: 53665

12/20/2019
Date



BARR

OBSERVED DRAWDOWNS
Gully 30 GW Model
Merjent

FIGURE 1

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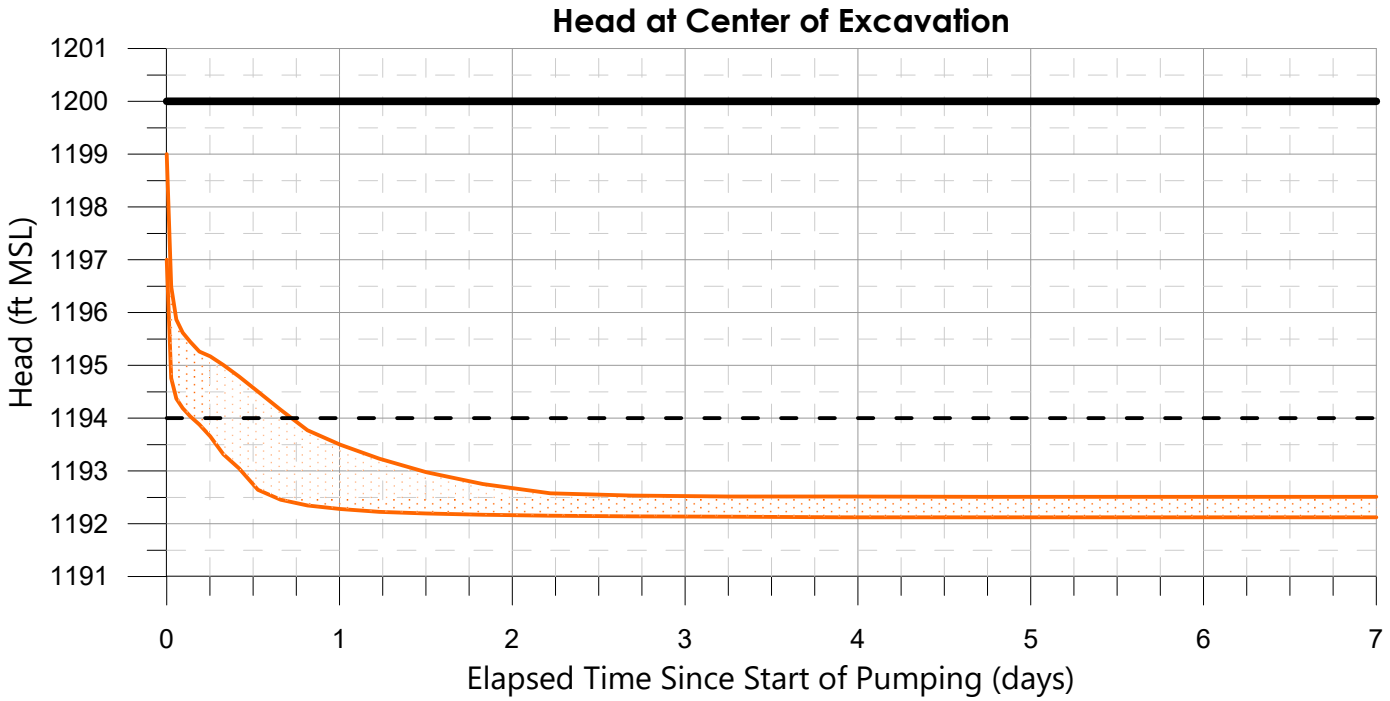
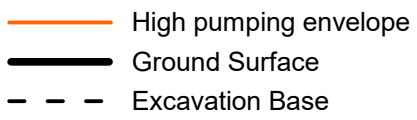
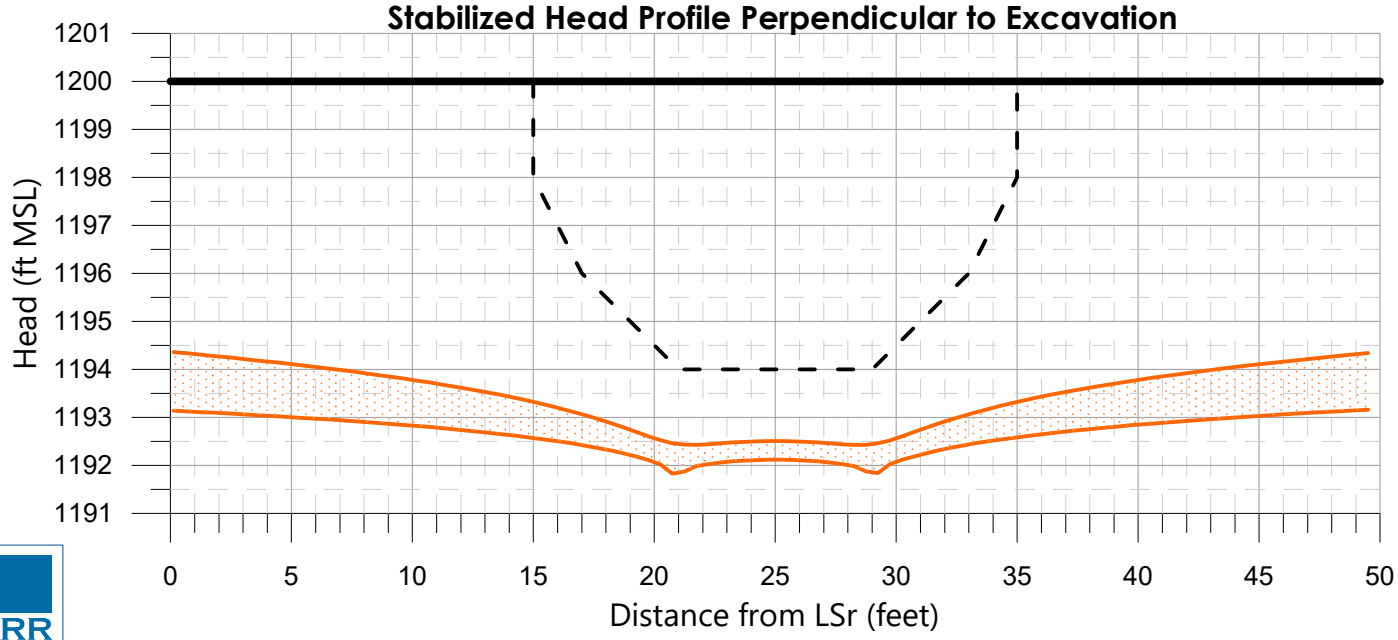


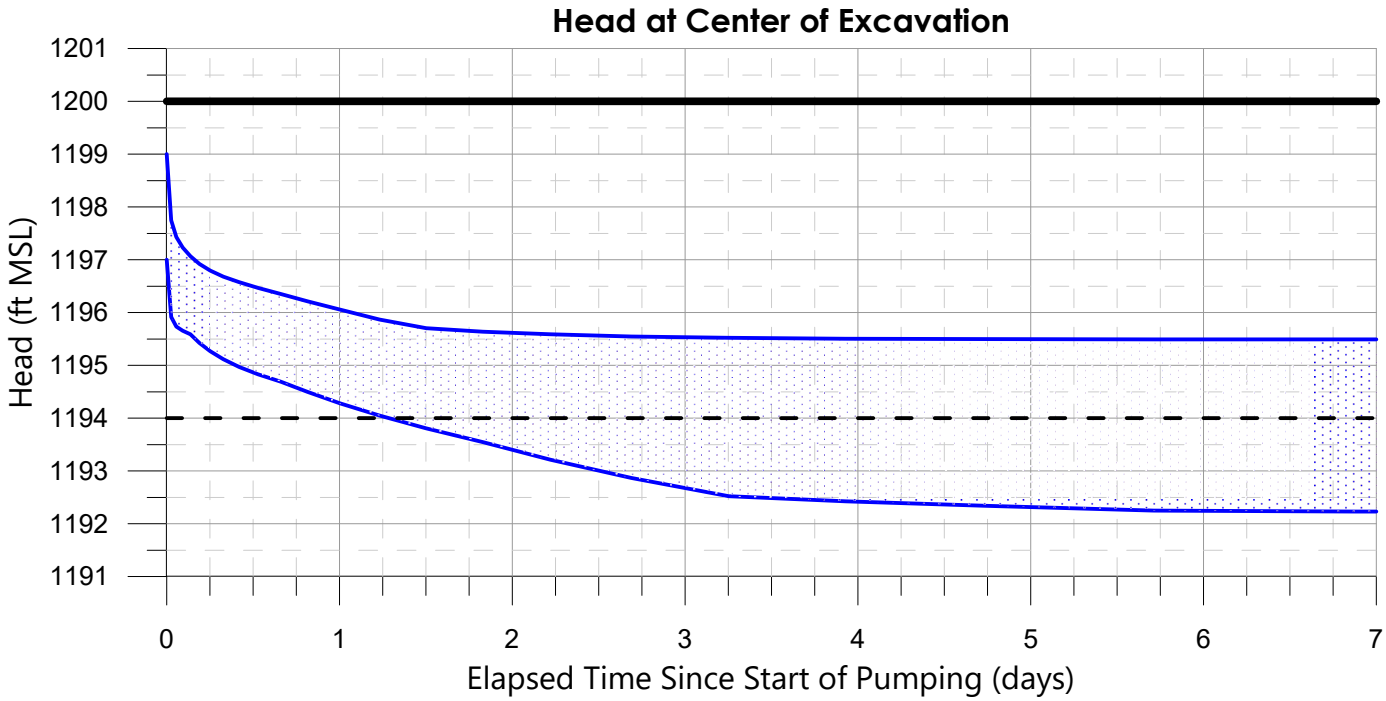


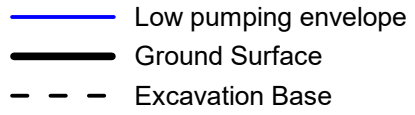


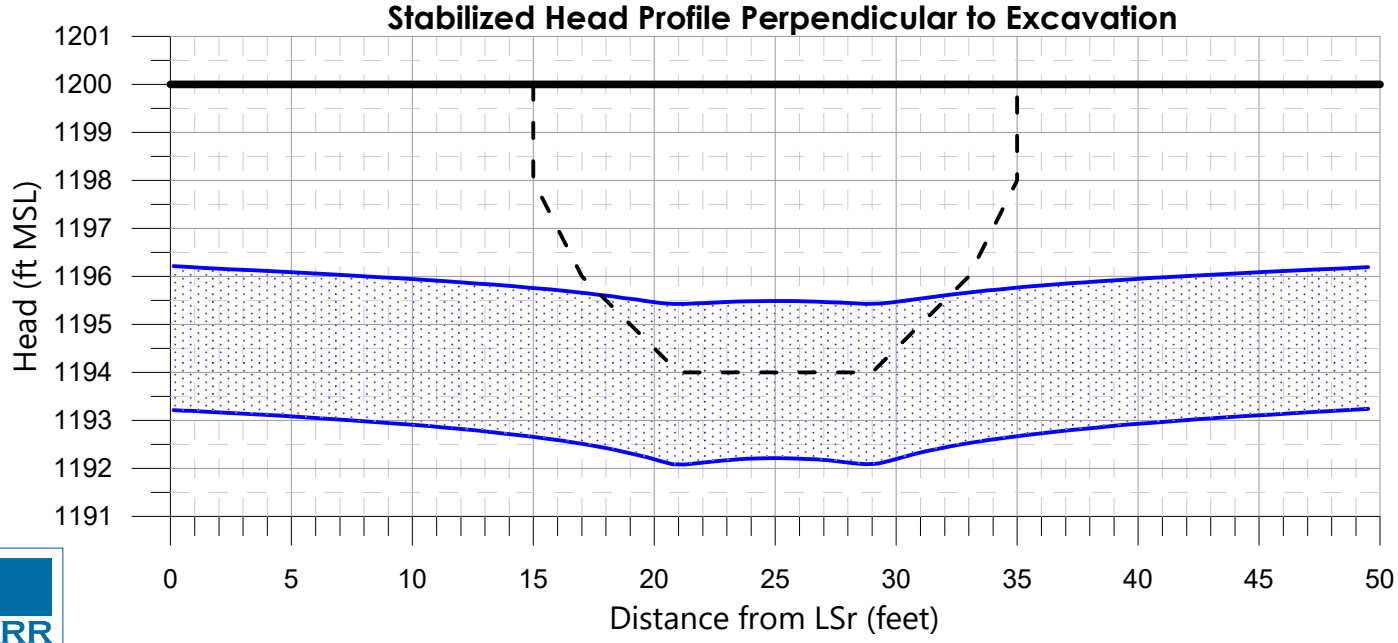
FORWARD SIMULATION RESULTS - HIGH PUMPING
Gully 30 GW Model
Merjent

FIGURE 3

P:\Duluth\23 MN\69\23691768 Gully 30 Fen GW and Geo Model\WorkFiles\GW Model Tech Memo\Figures\Figure 3 - High Forward Run Results.grf







BARR

FORWARD SIMULATION RESULTS - LOW PUMPING
Gully 30 GW Model
Merjent

FIGURE 4

P:\Duluth\23 MN\69\23691768 Gully 30 Fen GW and Geo Model\WorkFiles\GW Model Tech Memo\Figures\Figure 4 - Low Forward Run Results.grf

Attachment A

Alberta Clipper Information

Piezometer Row 7 - Sta 6423+04.2
Pz 7A - Sta 6410+10.8 - 1.7' Rt
- Top El = 1198.7
- Ground = 1195.4

Pz 7B - Sta 6410+06.4 - 14.6' Rt
- Top El = 1198.7
- Ground = 1195.5

Pz 7C Sta 6410+03.7 - 13.2' Rt
- Top El = 1199.6
- Ground = 1195.5

COUNTY DITCH #89

Piezometer Row 6 - Sta 6413+01.8
Pz 6A - 2.8' Rt
- Top El = 1200.2
- Ground = 1198.0

Pz 6C - 13.1' Rt
- Top El = 1202.3
- Ground = 1198.0

Pz 6D - 8.0' Rt
- Top El = 1201.4
- Ground = 1198.1

Piezometer Row 9 - Sta 6413+63.4
Pz 9A - 3.1' Rt
- Top El = 1198.4
- Ground = 1200.51

Pz 9D - 8.3' Rt
- Top El = 1201.8
- Ground = 1198.8

6410+00
6412+00
6414+00
6416+00
6418+00
6420+00
6422+00
6424+00
6426+00

w-1893h

T-754
T-754-1

SCALE : 1" = 200'

200 100 0 200

Piezometer Row 6
Pz 6A - Sta 6416+01.2 - 2.2' Rt
- Top El = 1201.5
- Ground = 1199.3

Pz 6B - Sta 6416+03.9 - 13.6' Rt
- Top El = 1201.4
- Ground = 1199.5

Pz 6D - Sta 6416+03.9 - 13.2' Rt
- Top El = 1204.0
- Ground = 1199.4

Piezometer Row 4 - Sta 6419+00.5
Pz 4A - 1.8' Rt
- Top El = 1202.2
- Ground = 1200.4

Pz 4B - 7.3' Rt
- Top El = 1203.2
- Ground = 1199.8

Piezometer Row 3 - Sta 6422+01
Pz 3A - 2.6' Rt
- Top El = 1202.5
- Ground = 1200.0

Pz 3B - 12.7' Rt
- Top El = 1203.4
- Ground = 1200.2

Piezometer Row 2 - Sta 6423+04.2
Pz 2A - 4.1' Rt
- Top El = 1203.5
- Ground = 1200.5

Pz 2B - 12.7' Rt
- Top El = 1203.4
- Ground = 1200.4

Piezometer Row 1 - Sta 6425+00
Pz 1A - 2.0' Rt
- Top El = 1204.5
- Ground = 1201.5

Pz 1D - 7.1' Rt
- Top El = 1204.2
- Ground = 1201.7

LEGEND

- Pump Location
- Piezometer Location
- Drain Tile Turn Up Location

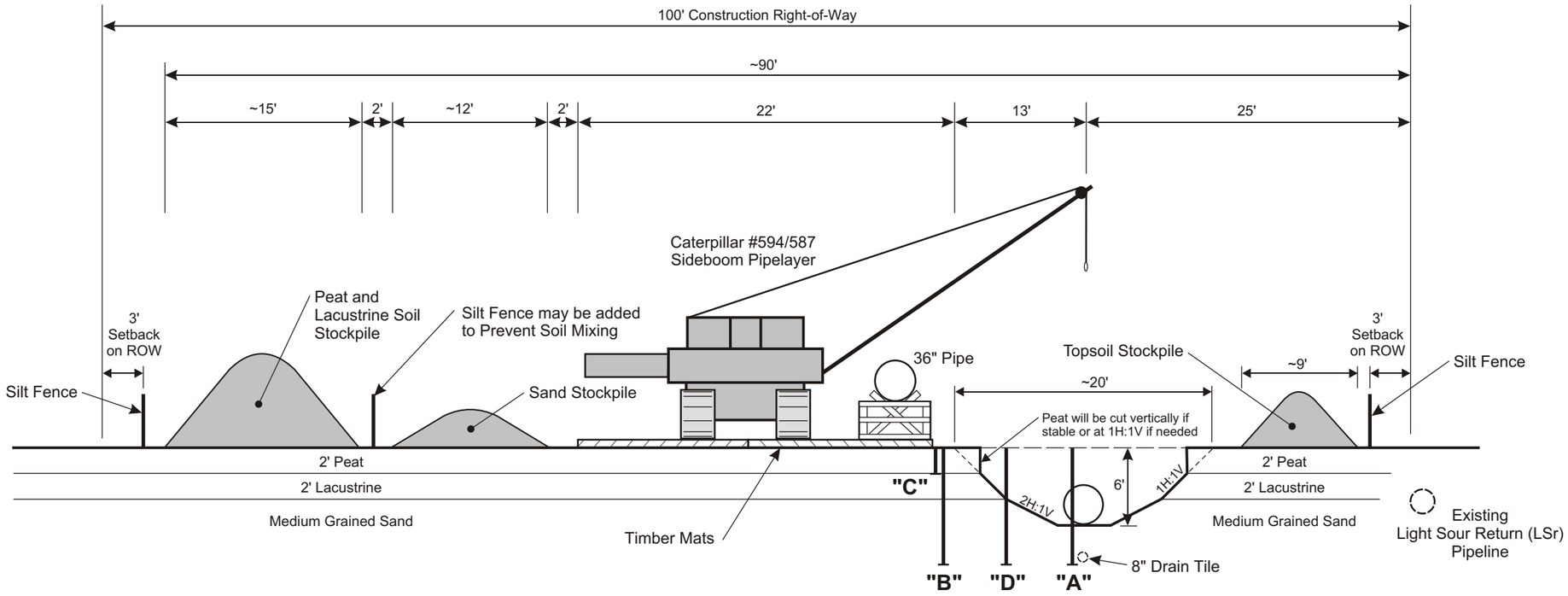
JOB NO. 304241-10R | DATE: 12/31/09 | BY: JRC

Pump, Piezometer, and Drain Tile Turn up Locations

ENBRIDGE™

SHAFER, KLINE & WARREN, INC.
2940 Main St., Kansas City, MO 64108
816/756-0444 FAX: 816/756-1763

OTHER OFFICE LOCATIONS:
Overland Park, KS
Ida, KS
Chillicothe, MO
Macon, MO
North Kansas City, MO
Columbia, MO

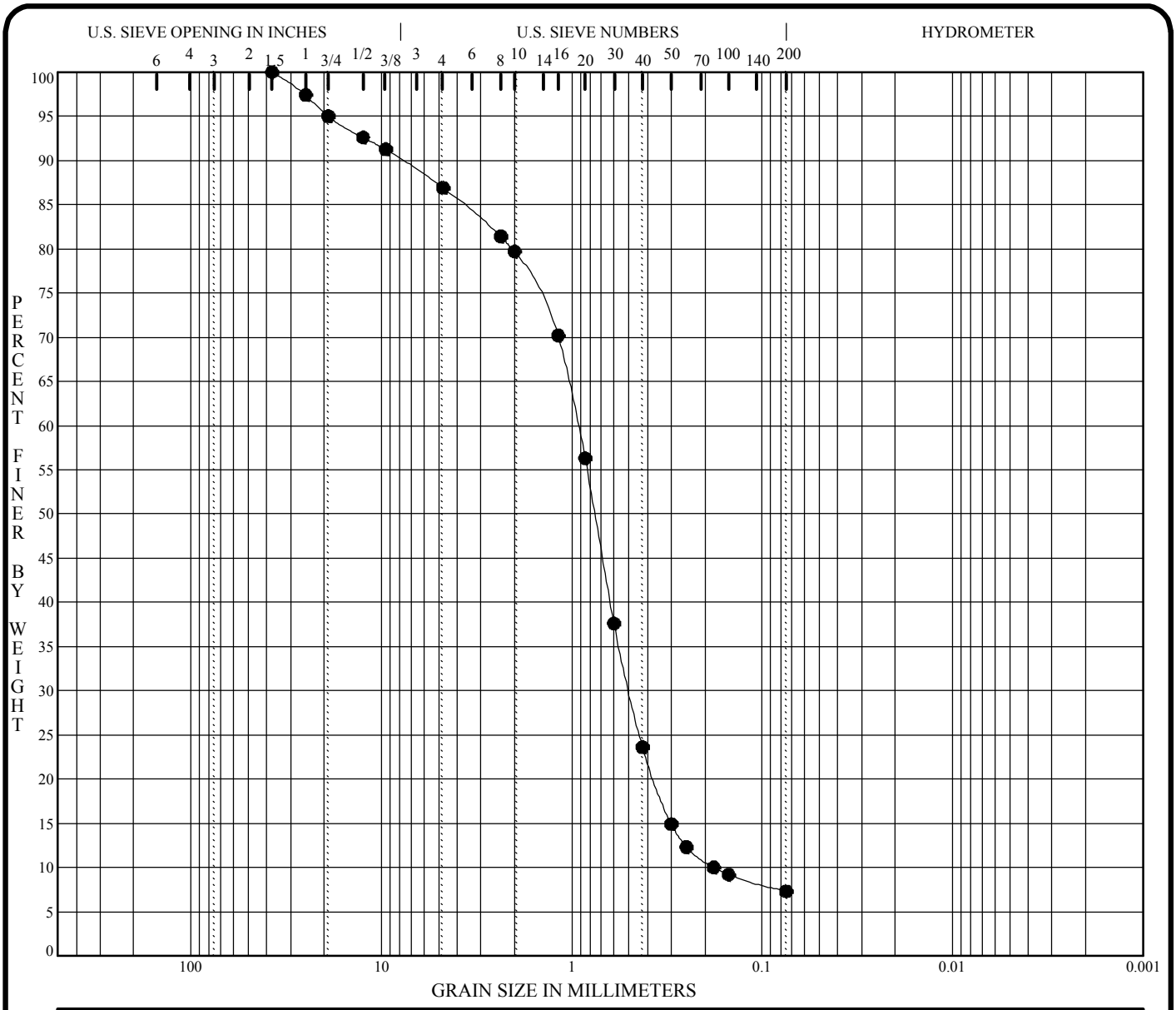


NOTE: The base dimension of the soil stock piles will be variable upon soil strength

Figure 6

PIEZOMETER LOCATION CROSS SECTION

P:\Mpls\49116\491670\WorkFiles\Figures_Graphics\Piezometer Location Cross Section.CDR RLG 11-18-09



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen Identification		Classification	MC%	LL	PL	PI	Cc	Cu
●	**1**	**0.0**	**Sand with Silt (SP-SM)**					**1.48**	**5.2**

	Specimen Identification		D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**1**	**0.0**	**37.50**	**0.93**	**0.498**	**0.1800**	**13.1**	**79.6**	**7.3**	

PROJECT **Barr Project # 49-16-0170-2009-800;**

JOB NO. **07-04480**

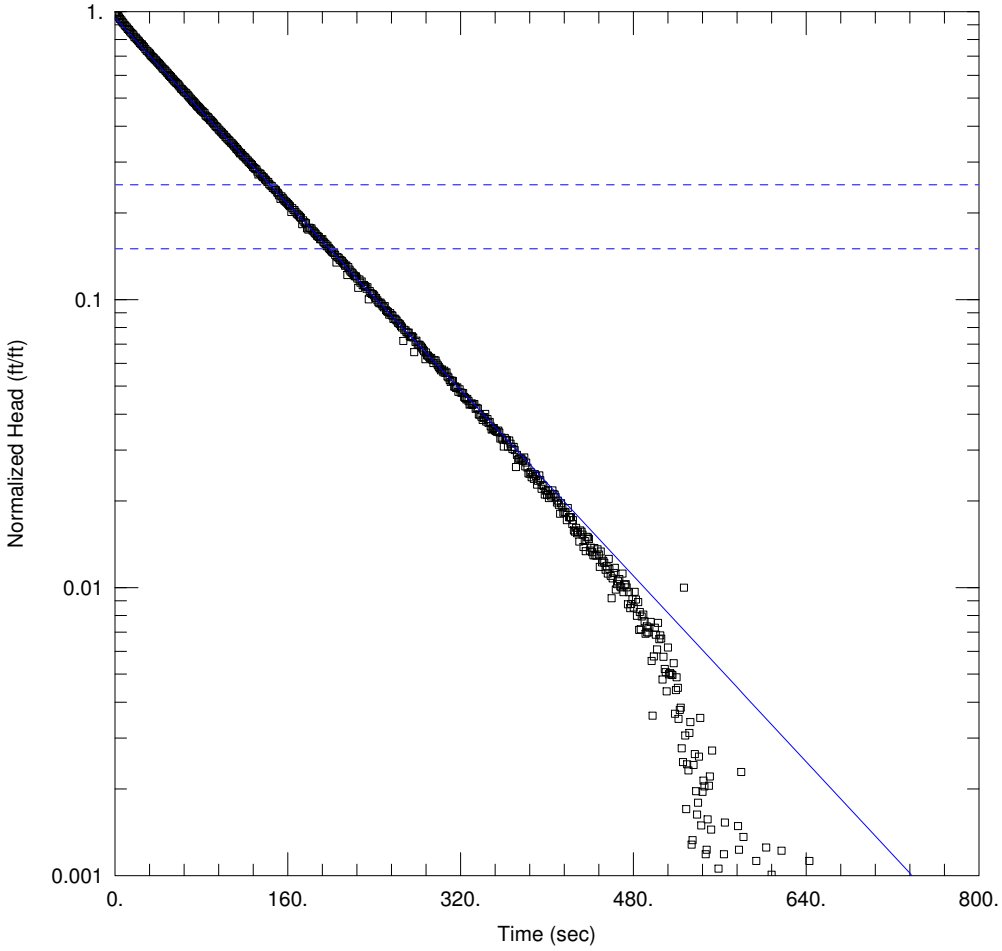
DATE **12/11/09**

AMERICAN ENGINEERING TESTING, INC.

GRADATION CURVES

Attachment B

Slug Test Analysis



WELL TEST ANALYSIS

Data Set: P:\...\MW-1B.aqt
Date: 01/30/19 Time: 13:46:59

PROJECT INFORMATION

Company: Barr Engineering Company
Client: Enbridge Energy
Project: 49160170.00-2009-400
Location: Gully 30 Fen
Test Well: MW-1B
Test Date: 12/4/09

AQUIFER DATA

Saturated Thickness: 0.5 ft Anisotropy Ratio (Kz/Kr): 1.

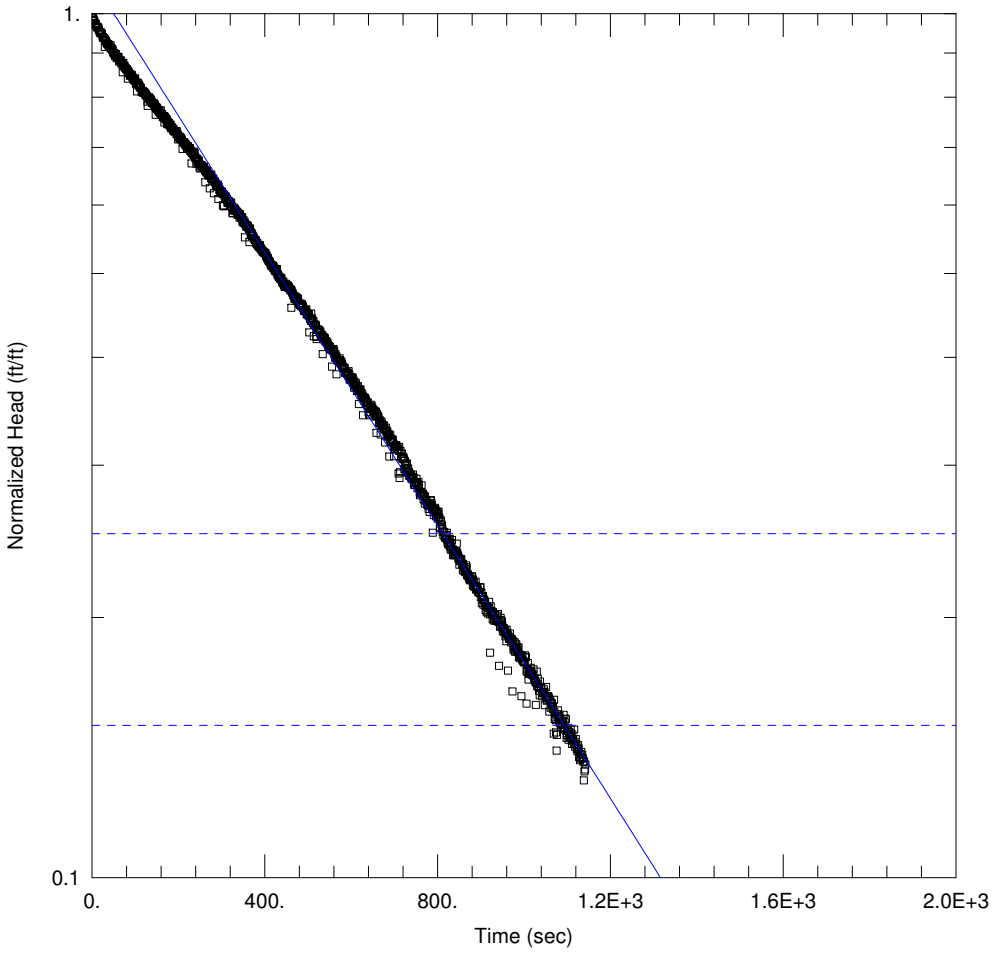
WELL DATA (MW-1B)

Initial Displacement: 3.04 ft Static Water Column Height: 5.48 ft
Total Well Penetration Depth: 0.5 ft Screen Length: 0.5 ft
Casing Radius: 0.052 ft Well Radius: 1. ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 11.5 ft/day y0 = 2.882 ft



WELL TEST ANALYSIS

Data Set: P:\...\MW-2A.aqt
Date: 01/30/19 Time: 13:47:28

PROJECT INFORMATION

Company: Barr Engineering Company
Client: Enbridge Energy
Project: 49160170.00-2009-400
Location: Gully 30 Fen
Test Well: MW-2A
Test Date: 12/4/09

AQUIFER DATA

Saturated Thickness: 0.5 ft Anisotropy Ratio (Kz/Kr): 1.

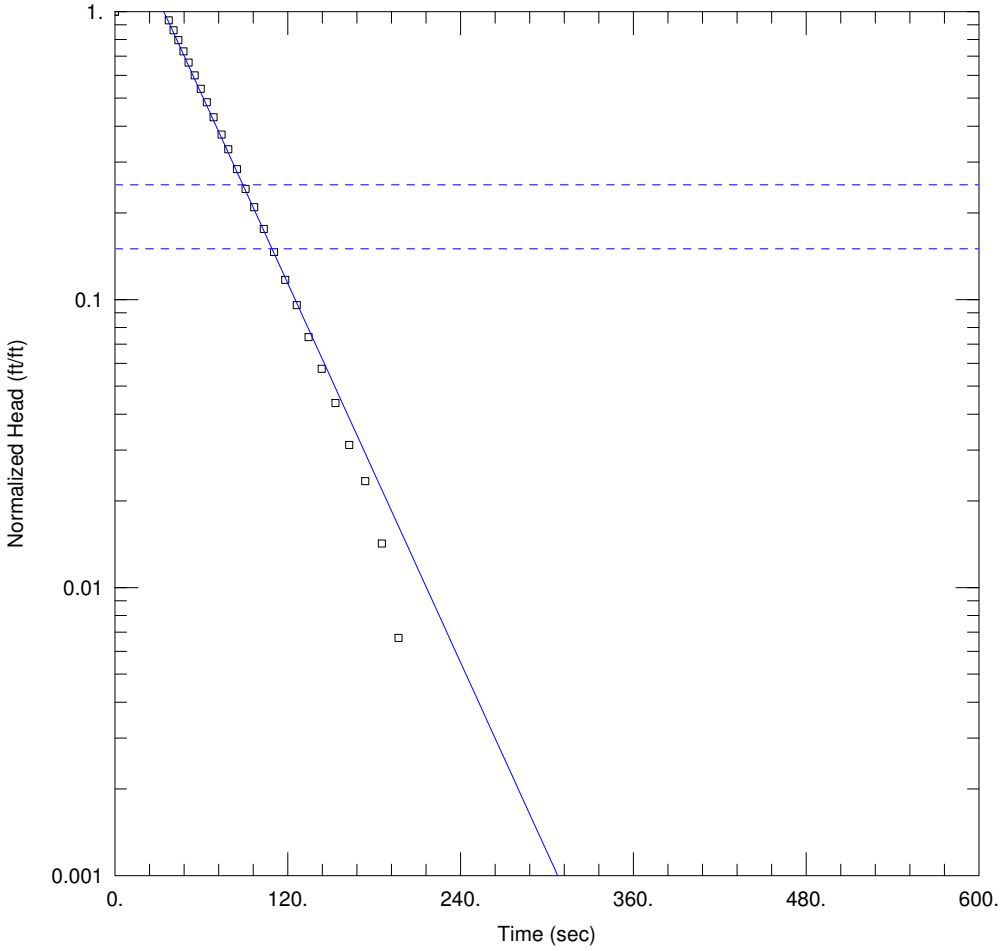
WELL DATA (MW-2A)

Initial Displacement: 1.11 ft
Total Well Penetration Depth: 0.5 ft
Casing Radius: 0.052 ft
Static Water Column Height: 3.51 ft
Screen Length: 0.5 ft
Well Radius: 1. ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 2.252 ft/day y0 = 1.216 ft



WELL TEST ANALYSIS

Data Set: P:\...\MW-2B.aqt
Date: 01/30/19 Time: 13:47:44

PROJECT INFORMATION

Company: Barr Engineering Company
Client: Enbridge Energy
Project: 49160170.00-2009-400
Location: Gully 30 Fen
Test Well: MW-2B
Test Date: 12/4/09

AQUIFER DATA

Saturated Thickness: 0.5 ft Anisotropy Ratio (Kz/Kr): 1.

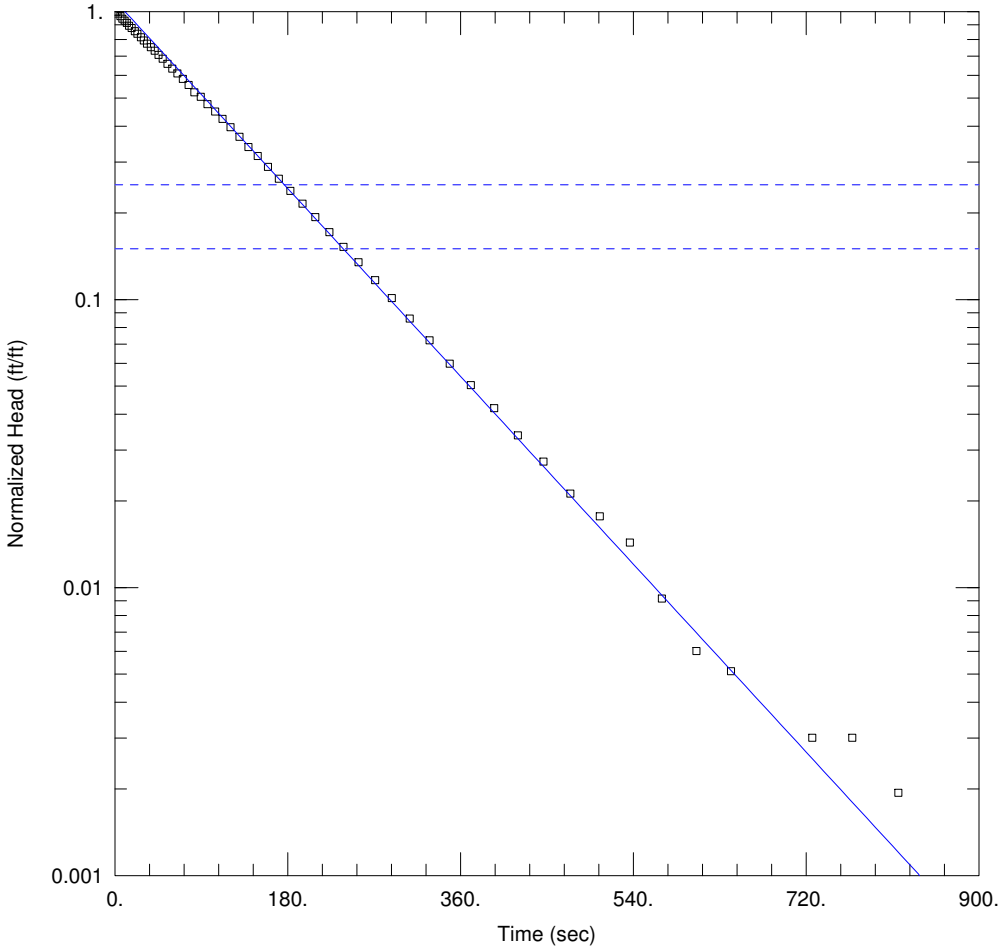
WELL DATA (MW-2B)

Initial Displacement: 2.09 ft Static Water Column Height: 6.2 ft
Total Well Penetration Depth: 0.5 ft Screen Length: 0.5 ft
Casing Radius: 0.052 ft Well Radius: 1. ft

SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 31.27 ft/day y0 = 4.926 ft



WELL TEST ANALYSIS

Data Set: P:\...\MW-3B.aqt
Date: 01/30/19 Time: 13:47:59

PROJECT INFORMATION

Company: Barr Engineering Company
Client: Enbridge Energy
Project: 49160170.00-2009-400
Location: Gully 30 Fen
Test Well: MW-3B
Test Date: 12/4/09

AQUIFER DATA

Saturated Thickness: 0.5 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-3B)

Initial Displacement: 3.16 ft Static Water Column Height: 5.09 ft
Total Well Penetration Depth: 0.5 ft Screen Length: 0.5 ft
Casing Radius: 0.052 ft Well Radius: 1. ft

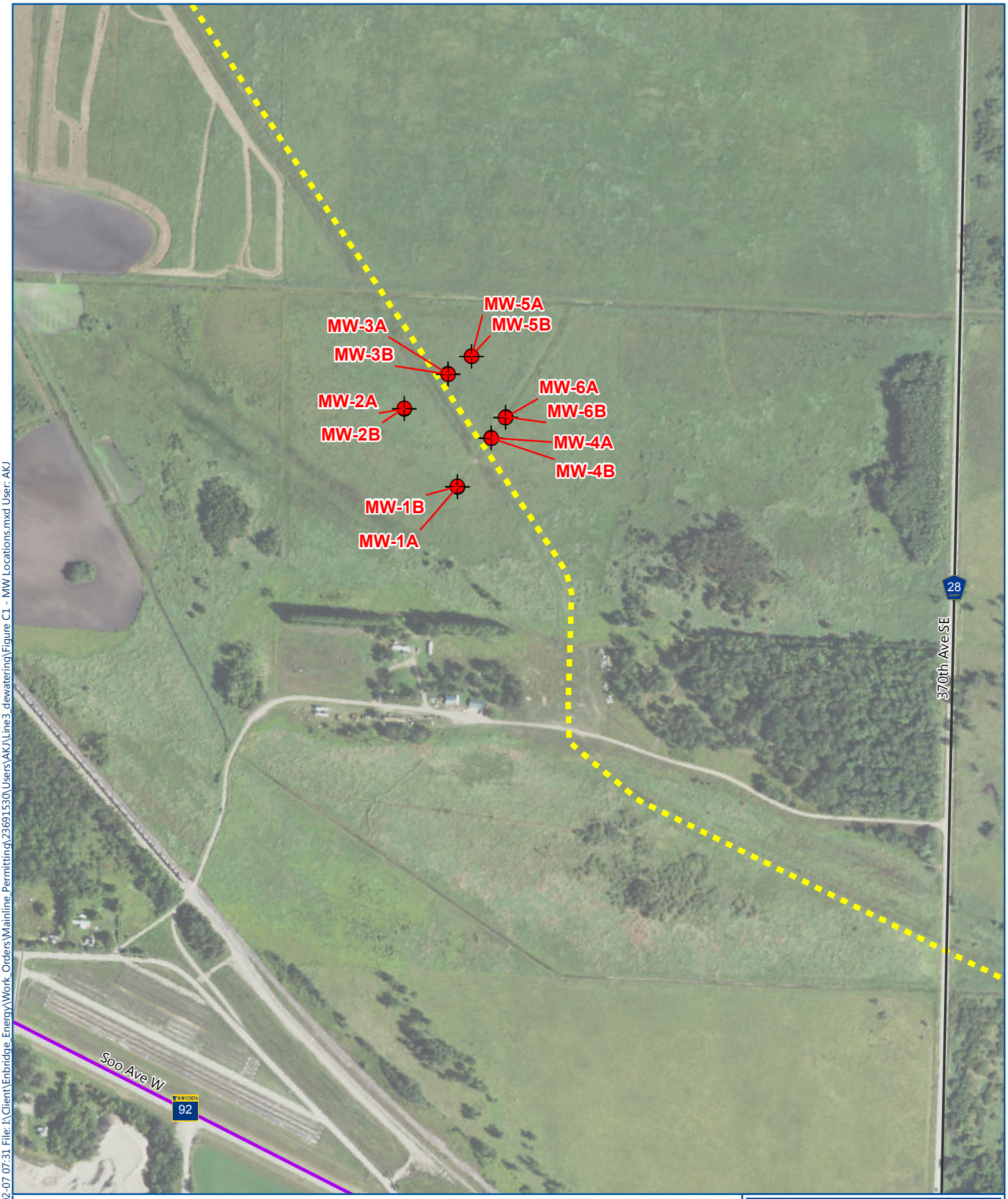
SOLUTION

Aquifer Model: Confined Solution Method: Hvorslev

K = 10.33 ft/day y0 = 3.446 ft

Attachment C

2010-2017 Gully 30 Monitoring Data



Monitoring Well

Proposed Line 3R Centerline

N

0 500

Feet

BARR

GULLY 30
MONITORING WELLS
Gully 30 GW Model
Merjent

FIGURE C1

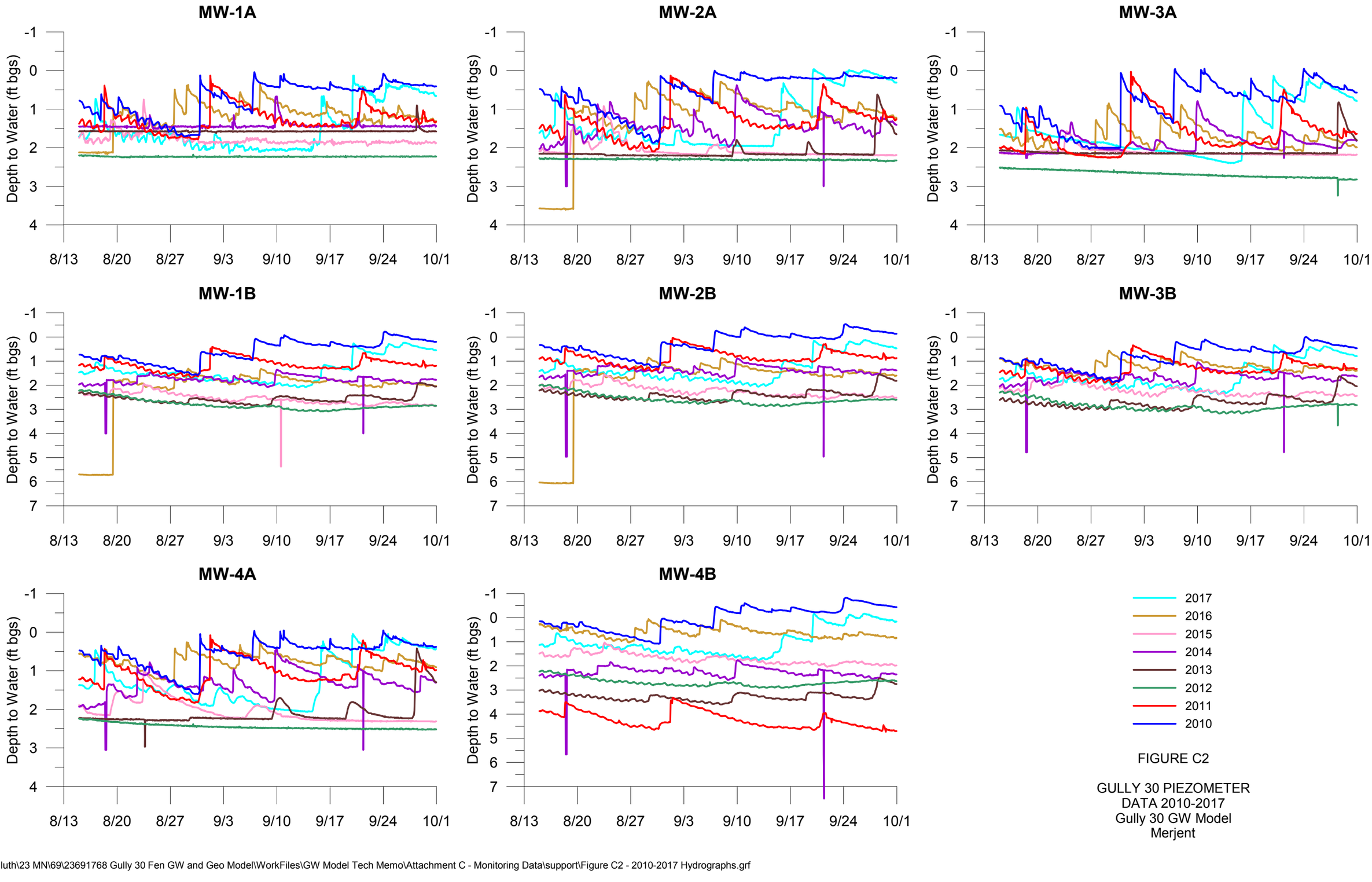


FIGURE C2

GULLY 30 PIEZOMETER
DATA 2010-2017
Gully 30 GW Model
Merjent

P:\Duluth\23 MN\69\23691768 Gully 30 Fen GW and Geo Model\WorkFiles\GW Model Tech Memo\Attachment C - Monitoring Data\support\Figure C2 - 2010-2017 Hydrographs.grf

Attachment F

Gully 30 Summer Conditions Geotechnical Modeling (December 2019)

(File provided separately)