

CHAPTER
5

5. Environmental Impacts and Mitigation Strategies for Transmission Line Projects

This chapter provides general background information about the range of analyses used to evaluate proposed electric transmission projects. It discusses how impacts are assessed and how they might be mitigated,⁶⁰ including specific statutory rights of landowners. It also describes phases of construction of a transmission line. The majority of the chapter is a discussion of the environmental and community effects that might occur during construction or operation of a transmission line. The list of potential environmental and community issues is organized alphabetically. For each issue, the most common methods to minimize and mitigate the associated impacts are discussed.

5.1. ASSESSING TRANSMISSION LINE IMPACTS

5.1.1. Quantifying potential impacts

The impact from the construction of a transmission line can be measured in several different ways. Useful measurements of impacts may be area (acreage), distance (miles or feet), or the number of transmission structures.

The effect of a new transmission line on an area may depend on the topography, land cover, and existing land uses. In forested areas for example, the entire ROW width is cleared and maintained free of tall-growing trees for the life of the transmission line. The result is a permanent change to the ROW land cover. In agricultural areas, heavy construction vehicles traverse the ROW and temporarily suspend the use of the land for crop production. After construction ends and the fields are properly restored, however, the land beneath the line can be cropped or pastured. For this reason, the area permanently affected by the line is usually much smaller than the area temporarily affected during construction. Where transmission lines are routed through areas that are valued for their scenic qualities, the visual impacts of the line (the area affected) may extend well beyond the ROW.

⁶⁰ Mitigation is a common term used in utility construction reviews. It means to lessen an impact's force or intensity, to moderate the impact, or to make the impact less severe.

5.1.2. Determining the degree of potential impacts

In general, the degree of impact of a proposed transmission line is determined by the quality or uniqueness of the existing environment along the proposed route. The quality of the existing environment is influenced by several factors.

- **The degree of disturbance that already exists**
The significance of prior disturbances can be evaluated by determining how closely the place resembles pre-settlement conditions. Many areas have been substantially altered by logging, the installation of drain tiles, residential developments, or conversion to cropland.
- **The uniqueness of the resource**
Proposed transmission line routes are reviewed for the presence of species or community types that are uncommon or in decline in the region or state. The environmental review evaluates whether the land along a proposed route possesses features that would make it unique, such as its size, species diversity, or whether it plays a special role in the surrounding landscape.
- **The threat of future disturbance**
The land along a proposed route can be compared to surrounding lands and land uses to determine whether they may affect the quality of the existing resources over time. Ownership and current management practices can also be used to evaluate whether the existing resources and quality of the land is likely to be preserved.

5.1.3. Identifying the duration of potential impacts

The construction of a transmission line involves both long-term and temporary impacts.

Long-term impacts can exist as long as the line is in place and might include land use restrictions, loss of woodland, and aesthetic impacts. Avoiding or mitigating potential long-term impacts is especially important.

Temporary impacts occur during construction or at infrequent intervals such as during line repair or ROW maintenance. They can include noise or crop damage during construction of a line. Short-term impacts can become long-term impacts if not properly managed or mitigated.

Both short-term and long-term impacts are considered in this draft EIS.

5.2. MITIGATING POTENTIAL IMPACTS

5.2.1. General

It may be possible to lessen or mitigate potential environmental, landowner, and community impacts by adjusting the proposed route, choosing a different type of pole structure, using different construction methods, or implementing any number of post-construction practices. The Commission can require the project applicants to incorporate specific mitigation methods into the project design, construction process, and/or maintenance procedures. Examples of common mitigation techniques are listed in Table 5.2-1.

Table 5.2-1 Examples of mitigation strategies

Project Phase	Feature	Example Design Phase Mitigation Methods
Design Phase	Route	Using corridor-sharing to minimize new ROW requirements.
	Transmission Structure	Choosing a different transmission pole with different construction requirements and aesthetic appeal. <ul style="list-style-type: none"> • H-frame structures have longer span widths which may make it easier to cross rivers, wetlands, or other resources with fewer impacts. • The darker color of oxidized steel structures may blend-in better with forested backgrounds. • Low profile poles can be used near airports to avoid interference with flight approaches.
	Pole Placement	Making minor adjustments in pole locations to avoid archeological sites or minimize effects on agricultural operations.
	Add-ons	Adding flight diverters to conductors to minimize bird collisions with the wires.
Construction Phase	Timing	<ul style="list-style-type: none"> • Constructing when the ground is frozen and vegetation is dormant to minimize impacts to wetland habitat. • Delaying construction in agricultural areas until after harvest to minimize crop damage.
	Specific Construction Equipment	Using wide-track vehicles and matting to reduce soil compaction and rutting in sensitive soils and natural areas.
	Erosion Control	Installing and maintaining proper erosion controls during construction to minimize run-off of top soil and disturbances to natural areas.
Post-Construction Phase	Invasive Species Management	Annual surveying for new populations of invasive species (e.g. purple loosestrife) caused by construction disturbances. Early detections of invasive species increase the likelihood of successful outcomes.
	Restoration	<ul style="list-style-type: none"> • De-compacting agricultural soils so that impacts to crop yields are minimized. • Re-vegetate ROWs in natural areas with WDNR-approved seed mixes.

Three of the above features are discussed in more detail in the subsections below: corridor sharing, structure design, and construction timing. The other features are discussed below in particular categories of impacts, or in particular route chapters of this EIS where they might apply.

5.2.2. Corridor sharing

As delineated in Section 1.2.2.3 of this draft EIS, it is the policy of the state to site new transmission lines, to the greatest extent feasible that is consistent with economic and engineering considerations, reliability of the electric system, and protection of the environment, utilizing corridors in the following order of priority: (a) existing utility corridors; (b) highway and railroad corridors; (c) recreational trails with limitations; and (d) new corridors. When properly evaluated as part of routing decisions, corridor sharing can be a useful method in mitigating environmental, property, and community impacts of a new transmission line. Transmission line ROW can be shared all or in part with other electric transmission lines, roads or highways, gas or oil pipelines, or railroad corridors. ROW-sharing with some of these types of corridors has more advantages than others. The more the ROW overlaps an existing ROW, the more benefits are possible. Side by side placement of ROWs with no overlap has fewer benefits than true corridor sharing. Some types of corridor sharing are not beneficial in reducing impacts, and some actually can create additional impacts.

Sharing corridors with existing facilities may reduce impacts by:

- Reducing the amount of new ROW required;
- Concentrating linear land uses and reducing the number of new corridors that fragment the landscape;
- Creating an incremental rather than new impact.

Often, the most preferred type of corridor sharing is with an existing transmission line. An existing line may be double-circuited with a new transmission line and therefore require little or no expansion of the existing ROW. However, in some situations corridor sharing has drawbacks. Some examples of these disadvantages are described below in Table 5.2-2.

Table 5.2-2 Examples of possible disadvantages of corridor sharing

Existing ROW	Examples of Corridor Sharing Drawbacks
Railroads	<ul style="list-style-type: none"> • Some railroad ROWs have long distances between road crossings, and additional access roads would be needed for the construction of a transmission line. • Railroad corridors that pass through wetlands are generally berms that are too narrow to support transmission structures. Structures would have to be located off the berm, resulting in additional impacts to wetlands. • Some railroad companies require corridor-sharing transmission to be located at the edge or outside of the railroad ROW, which might be wide enough to put structures so far away that they create a new corridor environment (possibly eliminating the potential benefits of corridor sharing).
Gas Pipelines	<ul style="list-style-type: none"> • Pipeline ROWs often run cross-country with little or no visual or agricultural effects. However, transmission lines constructed cross-country can interfere with farm operations and produce a negative visual impact. • For reasons of safety, gas pipelines often require a transmission line ROW to parallel the pipeline ROW with no or very minimal overlap. This minimizes the potential benefits of corridor sharing.
Rural Roads	<ul style="list-style-type: none"> • Along local roads, large trees may form a scenic canopy over the road. The construction of a transmission line ROW that overlaps the road ROW would require the clear cutting of these trees and negatively impact aesthetic views and residential properties. • Where wind-blown soil is a problem, a transmission ROW requiring clear cutting of windbreak trees could lead to soil loss and traffic hazards from "brown-outs."
Existing Transmission Lines	<ul style="list-style-type: none"> • Locating a new transmission line ROW parallel with an existing line on separate structures can increase impacts to agricultural operations. • New double-circuited structures may be taller than the existing transmission structure and create increased hazards for bird or airport flyways. • Increasing the width of an existing corridor can increase edge effects and barriers to wildlife.

Corridor-sharing with an existing utility may require some modification to the proposed transmission structures resulting in additional costs to the project. For example, corridor sharing with a railroad may require the installation of underground communication circuits for the railroad. Sharing a corridor with a gas pipeline may require the installation of cathodic protection to prevent pipeline corrosion caused by induced currents. Transmission structures located within a highway ROW must be moved at the ratepayers' expense if the highway is modified.

One additional drawback to corridor sharing is that landowners who have agreed to an easement for one facility may be unfairly burdened by the addition of more facilities. Additional utility easements may further limit their rights and the use of their property. The property owner would then be responsible for negotiating a new easement contract in order to receive proper compensation from the utility.

5.2.3. Structure design

Transmission line structures can be designed with alternate designs, heights, materials, and colors. Different design solutions will result in different costs and impacts.

Structures can consist of a single pole or multiple poles (such as an H-frame with two poles). Single-pole structures are generally taller than two-pole structures for similarly sized conductors. Two-pole structures with the conductors mounted in a single plane can be used in situations where structure height is a concern, such as near an airport or along important bird migratory flight paths. Single-pole structures may be more desirable when crossing agricultural fields or in wetlands because two-pole structures disturb and take up more surface area than single-pole structures. See Figures Vol. 2-13 and 2-14.

The pole material (*i.e.*, wood, laminated wood, steel) and the type of insulators and conductors used can affect the appearance of the transmission line. Steel poles can be unpainted galvanized steel (gray), painted (often light blue), or unpainted steel that is designed to oxidize to a brown color. Poles can be directly embedded into the soil surface or bolted onto buried concrete foundations.

The spacing of the conductors on a pole can affect the magnetic field levels produced by the line and how quickly those levels dissipate with distance.

5.2.4. Construction timing

The seasonal timing of construction can determine the severity of construction impacts on cropland, wetlands, high-quality natural areas, endangered and threatened species, and the potential spread of invasive species and plant diseases (*e.g.* oak wilt). Limiting construction to winter months or to times of year when plants are dormant and the ground is frozen can reduce many adverse impacts. On the other hand, the urgency of some projects, the need to perform construction during scheduled electric outages, and the availability of skilled labor cannot always accommodate winter scheduling, especially on long or complex projects.

Some limitations on construction activity, however, may still be necessary. One way to avoid impacts to threatened or endangered species is to avoid construction during the active nesting or spawning period. To protect fish habitat during spawning seasons, activities such as bridge placement or dredging that would occur below the ordinary high water mark are restricted for trout streams and navigable tributaries to trout streams. WDNR has developed construction protocols that minimize or eliminate construction-related impacts on certain protected species. These measures include seasonal restrictions, movement barriers, and other methods. Each project and each species must be evaluated in the context of the entire project and project schedule to ensure protection of resources.

5.3. LANDOWNERS' STATUTORY RIGHTS

5.3.1. Rights specified in Wisconsin statutes

Landowners whose property is directly affected by the construction of high-voltage transmission lines greater or equal to 100 kV, longer than one mile, and built after 1976 have rights which are specified in Wis. Stat. § 182.017(7)(c) through (h). Many of these rights relate to potential mitigation measures to reduce impacts and are expressed as utility requirements.

The applicable statute is as follows:

- (c) In constructing and maintaining high-voltage transmission lines on the property covered by the easement, the utility shall:
 - 1. If excavation is necessary, ensure that the topsoil is stripped, piled, and replaced upon completion of the operation.
 - 2. Restore to its original condition any slope, terrace, or waterway which is disturbed by the construction or maintenance.
 - 3. Insofar as is practicable and when the landowner requests, schedule any construction work in an area used for agricultural production at times when the ground is frozen in order to prevent or reduce soil compaction.
 - 4. Clear all debris and remove all stones and rocks resulting from construction activity upon completion of construction.
 - 5. Satisfactorily repair to its original condition any fence damaged as a result of construction or maintenance operations. If fence cutting is necessary, a temporary gate shall be installed. Any such gate shall be left in place at the landowner's request.
 - 6. Repair any drainage tile line within the easement damaged by such construction or maintenance.
 - 7. Pay for any crop damage caused by such construction or maintenance.
 - 8. Supply and install any necessary grounding of a landowner's fences, machinery or buildings.
- (d) The utility shall control weeds and brush around the transmission line facilities. No herbicidal chemicals may be used for weed and brush control without the express written consent of the landowner. If weed and brush control is undertaken by the landowner under an agreement with the utility, the landowner shall receive from the utility a reasonable amount for such services.
- (e) The landowner shall be afforded a reasonable time prior to commencement of construction to harvest any trees located within the easement boundaries, and if the landowner fails to do so, the landowner shall nevertheless retain title to all trees cut by the utility.
- (f) The landowner shall not be responsible for any injury to persons or property caused by the design, construction or upkeep of the high-voltage transmission lines or towers.
- (g) The utility shall employ all reasonable measures to ensure that the landowner's television and radio reception is not adversely affected by the high-voltage transmission lines.
- (h) The utility may not use any lands beyond the boundaries of the easement for any purpose, including ingress to and egress from the right-of way, without the written consent of the landowner.

5.3.2. Waiving landowner rights during easement negotiations

Easements are private contracts between the utility and the property owner. As contracts, they should be written in legally precise language. The landowners' statutory rights listed above are generally included by the utility as part of the offered contract and labeled as an "Exhibit." The offered contract may state that marked or crossed out rights are "waived." When negotiating the easement contract, a landowner may agree to waive one or more of these rights but is not required to do so. All parts of the easement contract except those required by law are negotiable. The landowner may negotiate additional stipulations from the utility which may include specific clearing or remediation obligations, notifications, timing of activities, or payments.

5.4. CONSTRUCTION PHASES

This section describes in general the construction phases of a transmission line. The figures referenced in this section are contained in Volume 2, Figures 13 through 43. Specific conditions of routes proposed for this project are described in later, route-specific chapters of this draft EIS.

5.4.1. Pre-construction activities

Different locations and soil conditions will require different construction equipment and techniques as well as a variety of mitigation measures. Soil conditions and stability are tested prior to the start of actual construction using preliminary bore holes. Local variations in some conditions, such as the depth to bedrock, depth to the water table, or volume of rainfall, may require specific engineering or environmental solutions and mitigation measures during project construction.

Most state and federal permits must be acquired prior to the start of construction. Conditions of these approvals usually require a number of pre-construction environmental surveys. Environmental surveys include the finalization of wetland boundaries, the presence or absence of specific protected species, the presence or absence of invasive species, or archeological site boundaries that are likely to be impacted by construction activities.

To ensure that the company has a complete and intact route, most negotiations with landowners will have to be concluded prior to the start of construction.

5.4.2. ROW marking and clearing

All erosion control measures needed to maintain stable site conditions (*e.g.* silt fences, slope breakers) are installed. ROW boundaries are staked and any special land use or environmental features, (*e.g.* recreational trails, streams, wetlands, and general locations of protected species or other sensitive resources) are flagged prior to the start of clearing activities. Clearing in upland shrubby grasslands and cropped fields is done with a mower. ROW in sedge meadows and shrub/scrub wetlands might also be mowed as needed to provide a stable work surface.

In upland and wetland forests, several types of equipment might be used to clear the ROW. Whole tree processors that are capable of cutting a standing tree at its base, removing all limbs, and sawing the tree trunk into consistent log lengths or poles are a very efficient way to clear open mature woodlands (Figure Vol. 2-15). In woodlands that have a thick cover of immature or understory trees, hand clearing with chainsaws may be done to open the forest and provide space for the tree processors to clear the larger trees. Chainsaws may also be used to clear smaller diameter trees adjacent to stream channels as shown in Figure Vol. 2-16.

Generally, any pole timber or saw logs are stacked on the edge of the ROW in upland locations, and the smaller diameter limbs and branches (often referred to as slash) are chipped or burned on the ROW. These activities are illustrated in Figures Vol. 2-17 and 2-18. According to the landowner's wishes, the wood chips may be spread on the ROW,⁶¹ piled to allow transport by the landowner to specific locations, or chipped directly into a truck and hauled off the ROW. Local permits may be required for burning slash on the ROW.

During the clearing process, matting may be installed, as needed, to ensure stable work conditions in wetlands or to provide temporary bridges across waterways.⁶² Timber mats are the most common type of matting used, although new plastic composite mats are also available. The mats are portable and can be installed and picked up as needed. In many cases, these mats would be left in place through all phases of construction, *i.e.* ROW clearing, foundation installation, tower erection, and wire stringing. The matting

⁶¹ Except in wetland areas unless approved by WDNR and USACE.

⁶² Examples of mats can be viewed in the illustrations in Figures Vol. 2-16, Vol. 2-18, Vol. 2- 20, Vol. 2- 24, Vol. 2- 25, Vol. 2-32, Vol. 2-40, and Vol. 2-41.

would be removed at the completion of the project. After re-contouring the ground as necessary, the underlying perennial vegetation usually reestablishes within one growing season.

If the new transmission line follows an existing transmission ROW, existing transmission structures might need to be removed before new ones can be installed. The construction company would utilize bucket trucks, cranes or digger derricks, backhoes, pulling machines, pole trailers, or dumpsters as needed. Existing wood poles would be cut into segments. On uplands, the underground portions of the poles would be pulled from the ground and the holes backfilled. In wetlands, these holes would normally close as the pole is removed or after a freeze/thaw cycle. Sometimes in sensitive or high quality wetlands, the old poles are cut off even with the ground to avoid the additional disturbance caused by equipment needed to remove the pole bases. Pulled or cut poles would be removed from the site and either recycled, taken to a landfill, or given to the landowner with a waiver of liability. Steel structures would be removed in a similar way. If the steel structures have concrete foundations, the foundations would be removed down to a depth of about two feet.

5.4.3. Augering and blasting

In most soils, the excavation for the transmission line pole can be augered using a standard drilling rig (Figure Vol. 2-19). The augered soils are temporarily piled off to the side of the excavation. In wetlands and agricultural fields, the topsoil is segregated from the subsoils. In wetland locations, the subsoils are often piled on timber matting, as shown in Figure Vol. 2-20, or on a geotextile fabric for disposal at a later time. In cropped agricultural fields, the subsoils are often placed on a layer of straw or geotextile fabric separating them from the topsoil below. This enables easier removal and disposal without the potential for disturbing or removing topsoil. After a foundation is completed, the excavated topsoil is spread around the base of the foundation to ensure optimal conditions for re-vegetation.

If the water table is encountered during the augering process, de-watering may be needed. Options for dewatering include pumping the water from the excavation to a suitable upland area and allowing it to slowly percolate into the soil, pumping water into silt-cells or bags to allow silt to drop out, or pumping the water directly into a tanker truck and transporting it to a suitable upland for release onto the soil surface.

When subsurface soils consist of unconsolidated materials, such as gravel or cobbles, the excavation might need to be continually flooded to prevent the side walls from collapsing (Figure Vol. 2-21). The water pressure keeps the walls of the excavation intact during the augering process. When the appropriate depth is reached, a casing is inserted into the excavation and the water is pumped out. Depending on the location of the excavation and the soil characteristics, the water may be slowly released into a drain field and left to percolate into the soil surface, pumped into silt-cells or bags to allow silt to drop out, or pumped into a tanker truck and removed to an upland location where it would be allowed to slowly percolate into the ground. It should be noted that, in agricultural fields, flooding can have long-lasting adverse effects and should be avoided or specifically controlled.

When bedrock is close to the soil surface or when subsoils primarily consist of large boulders and large cobbles, blasting might be required to complete the tower excavation. Explosives are placed in holes drilled into the rock and the tower site is covered with blasting mats to keep the rock and debris loosened by the blast from scattering over a wide area. Following the blast, the blasting mats and loosened debris are removed and the drilling rig is used to auger through the broken rock until the appropriate depth is reached. In cropped agricultural fields and wetlands, the topsoil would be stripped from the area around the tower site and stockpiled off to the side. When the excavation was completed and the foundation poured, the topsoil would be replaced around the tower site. This practice would prevent the subsoil from

mixing with topsoil and would preserve the rootstocks of native vegetation, enhancing the success of post-construction restoration in wetland locations. Photographs in Figures Vol. 2-22 through 2-24 illustrate some of the steps in the blasting process.

5.4.4. Foundation installation

The excavated hole might be cased and a rebar framework installed to stabilize and strengthen the concrete that fills the hole (Figures Vol. 2-25 through 2-27). Depending on the depth and diameter of the excavation, multiple loads of concrete might be needed. After the concrete is poured, a series of bolts are embedded in the foundation to secure the tower structure when it is installed on top of the foundation.

When the foundation is completed, the tower site is cleaned up (Figure Vol. 2-28). If the tower is in a cropped agricultural setting or a wetland site, the spoils are moved to an upland location designated by the landowner or to a suitable upland site where permission to dispose of the soils has been obtained by the contractor. In other upland locations, subsoils may be spread across the soil surface around the tower site and graded to ensure drainage away from the tower. In non-agricultural upland areas, the disturbed soils are usually mulched and/or seeded with annual oats or rye grass which germinate quickly and help to stabilize the soil surface giving native vegetation an opportunity for reestablishment (Figure Vol. 2-29).

5.4.5. Tower erection and wire stringing

The tower sections are transported to the foundation locations from a staging site in the project area where they are initially stored. The establishment of staging and laydown sites along the approved ROW is a typical step in the construction of a transmission line. Often these sites are on agricultural lands that are temporarily taken out of production (with compensation to the landowner) for the purpose of temporarily storing tower sections, reels of conductor, and other necessary components.

Steel transmission structures are erected in sections (Figures Vol. 2-30 through 2-32). Cranes are used to lift the tower sections into place. First, the lower section is lifted into place and bolted onto the concrete foundation. The upper sections of the tower, with the arms already attached, are then lifted onto the lower tower section. Sometimes large pulleys that facilitate wire stringing are also attached to the tower arms before they are raised into position. Alternatively, the pulleys can be attached after the tower erection is completed.

Large reels of rope are staged on the ROW, and the individual ropes are drawn through the pulleys from tower to tower. The wire conductor is then attached to the ropes and pulled into place. The pulleys are removed and the conductors are attached to the insulators and properly tensioned. If the conductors are double-bundled, spacers may be inserted at appropriate distances along the wires.

Sometimes when it is necessary to maintain reliability during construction, temporary transmission lines and poles may be constructed on one side of an existing ROW. Temporary lines are typically supported by wood poles directly embedded into the ground, with post insulators. These lines are removed when the new line construction is complete and they are no longer needed.

5.4.6. Site restoration

During site restoration disturbed soils are graded so that pre-construction contours, slopes, and topography are restored. All ruts and depressions are restored. Stockpiled topsoils and subsoils are put back in place wherever soils had been stripped and segregated. New topsoil is brought in and spread at agricultural locations where topsoil has been lost or seriously mixed with subsoils. Compacted agricultural soils are decompacted to return the soil structure to its original condition.

Areas where crops are not present, such as roadsides, pastures, old fields, upland woods, and wetlands, may be seeded with native seed mixes (or other appropriate seed mixes approved by the landowner) and mulched with certified weed-free mulch. In some cases, where it is reasonable to allow the natural ground cover to re-establish itself, annual grasses may be sown to minimize the potential for erosion while re-establishment is occurring. In wetlands, excavated surface soils or the organic layer containing the plant parts and rootstocks of native wetland vegetation might be spread around the foundation enhancing the re-establishment of the original wetland vegetation.

Any drainage tiles or other agricultural features that were damaged by the construction activities need to be repaired, replaced, or the landowner compensated. Also, all landowner protections listed in Wis. Stat. § 182.017(7)(c) must be met unless waived by the landowner in the easement contract (see Section 5.3).

In residential and urban areas where all vegetation has been removed, negotiated easements may require replacing the vegetation with landscaping and low-growing trees and shrubs. This could enhance the appearance of the property and reduce the potential for property value impacts related to the new transmission line. These plantings need to comply with the utilities vegetation management plans, however, and must not impede maintenance activities for the new line. Any driveways, curbs, or roads damaged during the construction of the line need to be repaired or replaced.

Erosion control and ROW monitoring continues until there is sufficient vegetative growth in the ROW. Following completion of restoration and re-establishment of vegetation within the ROW, all temporary restoration erosion control devices not designed to be left in place (*e.g.*, erosion control blankets, silt fencing) are removed and properly disposed. All temporary bridges are removed. All construction-related materials are removed.

5.4.7. Vegetative maintenance of ROW

North American Electric Reliability Council (NERC) has established a reliability standard for ROW vegetation management on transmission systems. This standard applies to all transmission owners in North America. NERC is also responsible for compliance review and enforcement. Because of the NERC reliability standards, the type of vegetation allowed to regrow in the new ROW will be based on its potential for interference with the conductors. Typically, the ROW under the conductors and any additional ROW width that is deemed necessary for wire maintenance and repair is maintained in low growing plants and grasses. The remaining ROW width may be allowed to contain shrubs and trees, though the plants maximum mature height must not exceed 15 feet. See Figure 4.1-1 in Chapter 4 of this draft EIS.

5.5. IMPACTS ASSOCIATED WITH TRANSMISSION LINES

This section describes many of the usual environmental, landowner, and community impacts related to the construction and operation of transmission lines. The issues are listed in alphabetical order. This section is meant to provide background information for the route-specific impacts described in later chapters of this draft EIS and may be referenced in some of those chapters.

5.5.1. Aesthetics

5.5.1.1. Potential aesthetic impacts

The overall aesthetic effects of a high-voltage transmission line are likely to be negative to most people, especially where proposed new lines would cross natural landscapes and private properties. New tall steel or wide H-frame structures may seem out of proportion and not compatible with agricultural landscapes

or residential neighborhoods. Landowners who have chosen to bury the electrical distribution lines on their property may find transmission lines bordering their property particularly disruptive to scenic views.

Some people, however, do not notice transmission lines or do not find them objectionable from an aesthetic perspective. To some, the lines or other utilities may be viewed as part of the infrastructure necessary to sustain everyday lives and activities.

Aesthetic impacts depend on:

- The physical relationship of the viewer and the transmission line (distance and sight line);
- The activity of the viewer (*e.g.*, living in the area, commuting through, sightseeing);
- The contrast between the transmission structures and the surrounding environment, such as whether the line stands out or blends in.

The transmission line can affect aesthetics by:

- Removing a resource, such as clearing fencerows;
- Degrading the surrounding environment (*e.g.*, intruding on the view of a landscape);
- Changing the context of the view shed (*e.g.*, evoking an image of development in a previously rural area).

5.5.1.2. Mitigation of aesthetic impacts

Electric transmission lines sometimes can be routed to avoid areas considered scenic. Routes can be chosen that pass through commercial/industrial areas or along land use boundaries.

The form, color, or texture of a line can be modified to somewhat minimize aesthetic impacts. There are some choices available in transmission structure color and/or construction material. Structures constructed of wood or of rust brown oxidized steel may blend better with wooded landscapes. Stronger conductors can minimize line sag and provide a sleeker profile.

ROW management can also mitigate some of the visual impacts of transmission lines. Some of these techniques include planting vegetative screens to block views of the line, leaving the ROW in a natural state at road or river crossings, and placing or piling brush from the cleared ROW so that it provides wildlife habitat. The Wisconsin Public Trust Doctrine identifies natural scenic beauty as viewed from a waterway. Wisconsin Stat. ch. 30 allows for the analysis of impact to natural scenic beauty as viewed from a navigable waterway.

In the end, aesthetics are to a great extent based on individual perceptions. Siting, design, construction materials, and ROW management can mitigate some of the adverse aesthetic effects of a line. It is in the interest of the applicant and the affected landowners to discuss and consider these measures early in the planning and design process. Comments by local residents or visitors during EIS preparation or public hearings can help decision-makers understand local concerns about the existing landscape and potential aesthetic impacts.

5.5.2. Agricultural lands

5.5.2.1. Potential impacts to agricultural lands

Transmission lines can affect farm operations and increase costs for the farm operator. Potential impacts depend on the design of the transmission line and the type of farming. Transmission lines can affect field

operations, irrigation, aerial spraying, wind breaks, and future land uses. For new transmission lines 100 kV or greater and longer than one mile, state law requires the utility to repair much of the damage that can occur during construction and/or provide monetary compensation (see Section 5.3).

The placement of transmission structures can cause the following agricultural impacts:

- Create problems for turning field machinery and maintaining efficient fieldwork patterns;
- Increase soil erosion by requiring the removal of windbreaks that were planted along field edges or between fields;
- Create opportunities for weed and other pest encroachment;
- Compact soils and damage drain tiles;
- Result in safety hazards due to pole and guy wire placement;
- Hinder or prevent aerial spraying or seeding activities by planes or helicopters;
- Interfere with moving irrigation equipment;
- Hinder consolidation of farm fields or residential development of the farmland.

In recent years there has been discussion about the potential for construction projects to spread farm pests and diseases or to otherwise affect the health of farming operations. Concerns have been raised about John's disease, soybean cyst nematode, the spreading of ginseng diseases to plots reserved for future ginseng production, and pesticide contamination of soils on organic farms. Issues of biosecurity can be a concern to many farm operators.

Soil mixing, erosion, rutting, and compaction are interrelated impacts commonly associated with transmission construction and can greatly affect future crop yields. Soils may be mixed during the excavation of pole foundations or during the undergrounding of electrical lines. The excavation depth for transmission structure foundations can vary greatly, but in some projects may be more than 50 feet deep. Excavated parent material or subsoils should not be mixed with topsoils and spread on the surface of the ROW. Significant rutting can occur when soils become saturated or in areas of sensitive soils. This may impact agricultural lands by increasing the mixing of soils, eroding topsoils during rain events, and compacting soils. The degree to which soils are compacted by heavy construction equipment again depends on the type of soil and its saturation level. Ineffective erosion controls may wash valuable topsoils downhill and impact wetlands and waterways. Agricultural soils that have been improperly protected or mitigated may suffer decreased yields for several years after the construction of the transmission line is completed.

5.5.2.2. Agricultural Impact Statement

An AIS is required when the builders of a public construction project have the power to condemn property (eminent domain) and will acquire more than five acres of land from any farm operation. Wisconsin Stat. § 32.035 specifies what WDATCP is required to include in an AIS. The AIS is prepared to help farmers determine appropriate compensation for their losses. Easement agreements should include a discussion of anticipated damages and mutually agreed-upon reparation.

5.5.2.3. Mitigation of agricultural impacts

The utility should work with agricultural landowners as early in the design process as is appropriate to help identify potential impacts, well in advance of construction. Landowners and utilities may work out solutions that include minor changes in pole heights, specific pole locations, construction timing, and other significant land use concerns. By incorporating these solutions in written agreements, agricultural impacts can be prevented or minimized.

A utility working with landowners can:

- Avoid or minimize construction through sensitive farmland;
- Identify, address, and document concerns before construction begins;
- Find resolutions for anticipated impacts (*e.g.*, payments to temporarily suspend farming activities or the installation of a temporary fence).

Problems with pole placement can be mitigated to some extent if the utility works with farmers to determine optimal pole locations. The following approaches might be useful:

- Using single-pole structures instead of H-frame or other multiple-pole structures so that there is less interference with farm machinery, less land impacted, and fewer weed encroachment issues.
- Locating the transmission line along fence lines, field lines, or roadsides to minimize field impacts.
- Using transmission structures with longer spans to clear fields;
- Orienting the structures with the plowing pattern to make farm equipment less difficult to use.
- Minimizing the use of guy wire but, where necessary, keeping the guy wires out of crop and hay lands and placing highly visible shield guards on the guy wires.
- Minimizing pole heights and installing markers on the shield wires above the conductors in areas where aerial spraying and seeding are common.
- Locating new transmission lines along existing transmission line corridors.
- Using special transmission designs to span existing irrigation systems or, if necessary, reconfiguring the irrigation system at the utility's expense.

Problems with the spread of farm pests or diseases and contamination of soils can be reduced by:

- Having the farmer avoid spreading manure or pasturing livestock in the transmission line ROW prior to construction. (This is the most cost-effective method to prevent the spread of animal disease.)
- Avoiding access through or construction in areas that may contain manure.
- Learning about individual farm activities such as planting, tillage, and crop rotations so that construction methods and timing can be adapted to the timing of crop work.
- Installing exclusion fencing to keep livestock away from construction activities or installing markers to identify where construction is occurring, in consultation with the farmer, so that field activities and construction do not overlap.
- Putting barriers between equipment and manure or disease-contaminated soil.
- Physically removing manure or contaminated soil from equipment in compliance with existing farm disease control efforts.

Protection of organic farm certifications requires critical communication with the farmer and a thorough understanding of his operations along the ROW.⁶³

Mitigation of farm impacts includes prevention of mixing topsoils with subsoils and the underlying parent material. Wisconsin Stat. § 182.017(7)(c) requires utilities that construct transmission lines that are 100 kV

⁶³ An organic farmer is also protected during ROW maintenance by the requirements in Wis. Stat. § 182.017(7)(c) through (h), particularly those related to soil management and pesticide use.

or larger and longer than one mile to ensure that topsoil is stripped, piled, and replaced upon completion of the construction operation (see Section 5.3).

If construction activity occurs during wet conditions and soils are rutted, repairing the ruts as soon as possible can reduce the potential for impacts. However, if improperly timed, mitigation work on rutted soil could compound the damage already present. Allowing a short time for the soil to begin drying and then using a bulldozer to smooth and fill in the ruts is a common mitigation approach. The Atterberg field test should be used to determine when the soil is friable enough to allow rutting to be remediated safely. Figures Vol. 2-33 through Vol. 2-36 illustrate how ruts made by heavy equipment can be repaired.

To minimize soil compaction during construction in low-lying areas, saturated soils, and/or sensitive soils, low-impact machinery with wide tracks can be used. WDATCP has recommended that such machinery and tires also be used across agricultural land if it must be worked during wet conditions.

When construction of the line is complete, the soil in the ROW in fields that were accessed by heavy construction traffic should be checked for compaction with a soil penetrometer and compared to penetrometer readings on soils outside of the ROW. If compaction within the ROW is detected, appropriate equipment should be used to restore the soil tilth. A soil with good tilth has large pore spaces for adequate air infiltration and water movement. (Roots only grow where the soil tilth allows for adequate levels of soil oxygen.) WDATCP can provide guidance on the best methods or equipment to be used.

Problems with potential damage to soil productivity impacts of soil mixing, soil compaction, and soil erosion can be lessened by:

- Identifying site-specific soil characteristics and concerns from the landowner and farm operator before construction begins.
- Avoiding areas where impacts might occur by altering access routes to the construction sites.
- Using existing roads or lanes utilized by the landowner.
- Using construction mats, ice roads, or low ground pressure or tracked equipment to minimize compaction, soil mixing, rutting, or damage to drainage systems.
- Segregating top soils or soil horizons during excavation and construction to minimize soil mixing.
- De-compacting soils following construction with appropriate equipment until the degree of soil compaction levels on the ROW is similar to soils off the ROW.
- Avoiding construction and maintenance activities during times when soils are saturated.
- Avoiding the removal of critical windbreaks and replanting windbreaks with lower growing woody species to minimize soil erosion due to wind.

5.5.2.4. Wisconsin Stat. § 182.017(7)(c)

This statute describes a number of restoration practices that the utility must employ when building a high-voltage transmission line on private property (see Section 5.3). This statute includes requirements, such as: removing rock and all construction debris; restoring all disturbed slopes, terraces, and waterways to their original condition; repairing drainage tile lines and fences damaged by construction; and paying for crop damage. Unless landowners waive their rights in an easement agreement, the utility is required to implement these mitigation practices. If a route that passes primarily through agricultural land is selected, WDATCP has recommended that, to aid enforcement of the statute requirements, detailed Best Management Practices (BMP) should be incorporated into the project construction manuals and

agricultural specialists should be available to consult with the environmental monitors employed to oversee the contractors and ensure that these protections are implemented.

5.5.2.5. USDA Conservation Reserve Program lands

There are farmlands in Wisconsin enrolled in USDA National Resource Conservation Service (NRCS) programs established to preserve wetlands, grasslands, and farmlands. Federal easements on these lands maybe have restrictive land uses not consistent with the construction of a transmission line. For example, a finding of incompatibility by the NRCS could affect Conservation Reserve Program (CRP) payments to the landowner. In these situations, utilities may negotiate with representatives of NRCS or avoid these properties and find alternative routes for the transmission line. CRP is a federal voluntary program established to protect cropland that is vulnerable to erosion. CRP provides participants with an annual per-acre rent plus half the cost of establishing a permanent land cover (usually grass or trees). In exchange, the participant retires highly erodible or environmentally sensitive cropland from farm production for 10 to 15 years. Sensitive lands would also include land converted from crops to wildlife habitat or special shallow water areas, filter strips along surface waters, and grass covers for erosion control.

Federal funding for the program is limited. Offers for CRP contracts are ranked according to an index which includes the following factors:

- Wildlife habitat benefits resulting from covers on contract acreage;
- Water quality benefits from reduced erosion, runoff, and leaching;
- On-farm benefits from reduced erosion;
- Benefits that will likely endure beyond the contract period;
- Air quality benefits from reduced wind erosion;
- Cost.

These federal easements may have restrictive land uses not consistent with the construction of a transmission line. A finding of incompatibility by the NRCS could affect CRP payments to the landowner. In these situations, utilities can negotiate with representatives of the NRCS or avoid these properties and find alternative transmission line routes.

5.5.3. Airports and airstrips

Transmission lines are a potential hazard to aircraft during takeoff and landing. To ensure safety, local ordinances and FAA guidelines limit the height of objects in the vicinity of the runways. Utilities can route transmission lines outside of the safety zone, use special low-profile structures, construct a portion of the line underground, or install lights or other attention-getting devices on the conductors.

Large brightly colored balls or markers may be installed on overhead transmission line conductors to improve their visibility to pilots and lessen the risk of collision. These markers are often employed near airports or airstrips, in or near fields where aerial applications of pesticides or fertilizers occur, and in areas where tall machinery, such as cranes, are frequently operated.

5.5.4. Archeological and historic resources

Archeological and historical sites are protected resources. They are important and increasingly rare tools for learning about the past. They may have religious significance. Transmission line construction and maintenance can damage sites by digging, crushing artifacts with heavy equipment, uprooting trees,

exposing sites to erosion or the elements, or by making the sites more accessible to vandals. Impacts can occur wherever soils will be disturbed, at pole locations, or where heavy equipment is used.

WHS has the primary responsibility for protecting archeological/historical resources. WHS manages a database that contains the records of all known sites and is updated as new information becomes available. The database is searched for any sites that might be located along any of the proposed transmission line facilities.

The PSCW is required to notify WHS if the construction of a transmission line has the potential for encountering any site. Archeological surveys might be required in these areas. The results of the surveys are reported to WHS. WHS will then make recommendations for avoiding and minimizing impacts to the sites. It is the responsibility of the PSCW to ensure that construction practices follow all WHS recommendations. Route changes are seldom necessary. Judicious transmission pole placement can often be used to span resources and avoid impacts to the sites.

If during construction an archeological site is encountered, construction at the site must immediately stop and WHS and the PSCW must be notified by the utility. WHS will then make recommendations on how construction should proceed so that impacts to the resource are managed or minimized.

5.5.5. Cultural concerns

Protection of archeological and historic resources is often discussed in terms of “cultural resource” impacts. However, there are other cultural factors that occasionally surface during a transmission project review. A cultural concern can occur when an identifiable group or community has practices or values that may conflict with a new transmission line.

An example of a cultural concern that has been addressed in past transmission line cases is the routing of a proposed transmission line through an Amish community. Because the Amish do not use electric service, wish to remain non-confrontational, and tend not to become involved in government processes, a concerted effort was made to avoid impacts on this community.

Cultural impacts may also be related to property impacts and general social concerns such as fairness. These issues are discussed under “Property Owner Issues” in Section 5.5.10.

5.5.6. Electric and magnetic fields

5.5.6.1. Sources of fields

Electric and magnetic fields (EMF) occur whenever and wherever electricity is used. A magnetic field is created when electric current flows through any line or wire including the electrical wiring in a home. Sources of magnetic fields include electrical appliances such as power tools, vacuum cleaners, microwaves, computers, electric blankets, fluorescent lights, and electric baseboard heat. Because there are so many common sources of EMF, everyone is exposed to a wide range of magnetic fields every day.

5.5.6.2. Results of EMF research

Starting in the late 1970s, researchers began to investigate the possibility that exposure to magnetic fields might have an adverse effect on human health. Since then, scientists have conducted many studies designed to determine whether or not exposure to EMF affects human health. Scientists have uncovered only weak and inconsistent epidemiological associations between exposure to transmission line EMF and adverse health effects. Several epidemiological studies have shown a weak statistical association with the risk of childhood leukemia. However, other epidemiological studies have found no link to leukemia.

Cellular studies and studies exposing test animals to EMF have shown no link between EMF and disease. Taken as a whole, the biological studies conducted to-date have not been able to establish a cause-and-effect relationship between exposure to magnetic fields and human disease, nor have scientists been able to identify any plausible biological mechanism by which EMF exposure might cause human disease. More recently, there is a growing consensus within the scientific community that exposure to EMF is not responsible for human disease.

A more detailed review of EMF research and human health can be found in Appendix B. Details about the expected EMF levels associated with the proposed transmission line project can be found in later, route-specific chapters of this draft EIS.

5.5.6.3. Pacemakers and implantable medical devices

Implantable medical devices are becoming increasingly common. Two such devices, pacemakers and implantable cardioverter defibrillators (ICD), have been associated with problems arising from interference caused by EMF. This is called electromagnetic interference (EMI).

EMI can cause inappropriate triggering of a device or inhibit the device from responding appropriately. Documented sources of EMI include radio-controlled model cars, slot machines, car engines, cell phones, anti-theft security systems, radiation therapy, and high-voltage electrical systems. It has been estimated that up to 20 percent of all firings of ICDs are inappropriate, but only a very small percentage are caused by external EMI.

ICD manufacturers' recommended threshold for modulated magnetic fields is 1 gauss. One gauss is five to ten times greater than the magnetic field likely to be produced by a high-voltage transmission line. Research shows a wide range of responses for the threshold at which ICDs and pacemakers responded to an external EMI source. The results for each unit depend on the make and model of the device, the patient height, build, and physical orientation with respect to the generated field.

Transmission lines are only one of a number of external EMI sources. Exposure to magnetic fields produced by the proposed power line generally will not affect pacemakers and implantable defibrillators. All pacemakers and ICD patients are informed of potential problems associated with exposure to EMI and must adjust their behavior accordingly. Moving away from a source is a standard response to the effects of exposure to EMI. Patients can shield themselves from EMI with a car, building, or the enclosed cab of a truck.

Refer to the discussion on pacemakers and defibrillators in Appendix B.

5.5.7. Endangered/threatened and protected species

The state's Endangered Species Law, Wis. Stat. § 29.604, makes it illegal to take, transport, possess, process, or sell any wild animal that is included on the Wisconsin Endangered and Threatened Species List. In addition, it is illegal to remove, transport, carry away, cut root up, sever, injure or destroy a wild plant on the Wisconsin Endangered and Threatened Species List on public lands. Forestry, agricultural, and utility practices are exempted from the taking prohibitions of listed plant species.

The Wisconsin Endangered Species law allows WDNR to authorize the taking of a protected species if the taking is not for the purpose of, but will be only incidental to, the carrying out of an otherwise lawful activity. Authorization generally occurs through an Incidental Take Permit. If the activity is conducted by WDNR itself or if another state agency conducts, funds, or approves the activity, authorization would occur through an Incidental Take Authorization.

Endangered species are any species whose continued existence is in jeopardy. Threatened species are species that are likely to become endangered. Special Concern species are those species about which some problem of abundance or distribution is suspected but not yet proved. The main purpose of the Special Concern category is to focus attention on certain species before they become threatened or endangered. Special concern species are not covered by Wisconsin's Endangered Species Law, but they may be protected by other state and federal laws.

The WDNR Bureau of Endangered Resources manages the Natural Heritage Inventory (NHI) database, which lists current and historical occurrences of rare plants, animals, and natural communities. The database includes the location and status of these resources. However, some areas of the state have not been surveyed extensively or recently, so the NHI database cannot be relied upon as a sole information source for rare species.

5.5.7.1. Potential impacts to rare species and their habitats

Construction and maintenance of transmission lines might destroy individual plants and animals or might negatively alter their habitat so that it becomes unsuitable. Potential impacts may include:

- Destroying individual plants or animals or their habitat by crushing or digging with heavy equipment, blasting for construction of foundations, surface disturbance of soil and vegetation during clearing, drilling, or from traffic.
- Degrading water quality through soil erosion and siltation into rivers and wetlands that provide habitat for rare plants or animals.
- Introducing and encouraging the growth of invasive or common species resulting in a reduction in species diversity.
- Clearing trees used as perching or nesting sites by rare birds.
- Disturbing habitats during the active nesting or spawning period of protected species.
- Degrading woodland or wetland quality through removal of trees and brush and increasing edge effects, making the area unsuitable for rare plants or animals.

5.5.7.2. Pre-construction surveys

If preliminary research and field assessments indicate that rare species or natural communities may be present in the project area, specific, appropriately-timed surveys may be conducted prior to construction. Pre-construction surveys may be used to make relative comparisons of the nature and magnitude of impacts to rare species among different routes. They may also be used to identify whether a particular species is present in the affected area or to what extent suitable habitat for a species is present along a route. If a threatened or endangered species is observed during the surveys, measures such as those described in the next section may be employed to avoid or minimize impacts to the species and its habitat. These strategies may include, among others, altering the construction schedule to avoid critical life-cycle events, relocating or modifying the width of the ROW at that location, or installing exclusionary devices.

5.5.7.3. Mitigation of impacts to rare species and their habitats

Impacts to rare and protected species can usually be avoided or minimized by modifying the route, changing the design of the transmission line, reducing the workspace at a particular location, employing special construction techniques, or utilizing exclusionary devices. The PSCW has the authority to order transmission construction applicants to conduct surveys, require an expert be present during construction activities, and implement mitigation measures.

An example of a common mitigation measure is turtle fencing in areas where habitat is likely to support rare turtles, snakes, or salamanders. During times when the animal may be present or enter into the

construction zone, fencing is installed to exclude these animals. The fencing prevents the animal from entering into harm's way. Immediately before work begins in suitable turtle habitat, a ground survey is conducted and any turtles found in the area are relocated to a nearby suitable habitat. When the area is known to be clear of turtles, plastic fencing is placed around the work area to keep rare turtles out. Figure Vol. 2-37 shows an area fenced to keep rare turtles away from the construction zone. This fencing is removed when construction and restoration in the area is completed.

Bird flight diverters (BFD) are another common mitigation method used to mitigate impacts to protected species. BFDs may be installed on shield wires when overhead transmission lines are built in areas heavily used by rare birds or large concentrations of birds or in specific areas within known migratory flyways. The purpose of BFDs is to make the line more visible, so birds can see it and fly around or over the conductors to avoid colliding with them. Several designs of BFDs are available. They are typically attached to either the conductors or the static wire. See Figure Vol. 2-38. Ideally, BFDs should be noticeable by birds, but should not draw unwanted attention by people. Installed BFDs need to be inspected periodically and replaced when necessary.

An applicant can also apply for an Incidental Take Permit if it is possible that construction activities could result in the harm or “take” of a threatened or endangered species. If granted, the permit would allow the applicant to take certain actions that may be harmful to a threatened or endangered species, within the conditions and limitations of the permit.

The utility should consult with WDNR so that the appropriate methods to avoid impacts to rare species are incorporated into an avoidance plan and properly conducted during construction. If impacts to a species cannot be avoided using construction practices or timing, the applicant may be required to undergo additional consultation to minimize impacts as part of the Incidental Take Authorization process.

5.5.7.4. Positive impacts to habitats

In some limited cases, transmission line ROWs have been managed to provide or improve habitat for some rare species or communities. For example, some ROWs in Wisconsin are being actively managed to provide habitat for the Karner blue butterfly, a federally-listed species. Close cooperation between the utility and WDNR is necessary to protect listed species and their habitat.

5.5.8. Highway impacts

Wisconsin Stat. § 86.16 allows utilities to locate their facilities along and across highway ROW with the written consent of the highway jurisdiction.

Wherever the line would need to share ROW or cross a state or federal highway, a permit must be obtained from WisDOT. The line would need to comply with the WisDOT Highway Maintenance Manual Utility Accommodation Policy.⁶⁴ The policy emphasizes that permitted use and occupancy of highway ROW for non-highway purposes like an electric transmission line is subordinate to the primary interests and safety of the traveling public. WisDOT could permit utility facilities on a STH if the following three conditions were met:

1. Such use and occupancy would not adversely affect the primary functions of the highway or materially impair its safety, or operational or visual qualities.

⁶⁴ WisDOT Bureau of Highway Maintenance. Highway Maintenance Manual, December 2010. Chapter 9, “Right-of-Way Use and Permits.” Section 15, “Utility Accommodation.”

2. There would be no conflict with the provisions of federal, state or local laws or regulations.
3. The occupancy would not significantly increase the difficulty or future cost of highway construction or maintenance.

A WisDOT ROW permit is required for working within a state road ROW. Work would be defined as surveying, excavating, placement of fill material, grading, installation of the line, or blocking traffic. Utility construction would be any use of labor or materials to install or provide for the installation of a new or upgraded utility line or to replace a significant portion of an existing line.

The Federal Highway Administration allows location of transmission facilities in interstate and freeway ROW under state procedures if they do not adversely affect the safety, efficiency, and aesthetics of the highway, interfere with its present use or future expansion, or require access for future maintenance directly from the highway lanes or shoulder.

5.5.9. Invasive species

5.5.9.1. Potential impacts by invasive species

Non-native plants, animals, and microorganisms found outside of their natural range can become invasive. Many non-native species are harmless because they do not reproduce or spread abundantly in their new surroundings. Some non-native species have been introduced intentionally, such as the Norway maple for landscaping and the ring-necked pheasants for hunting. However, a small percentage of non-native species are able to become quickly established, are highly tolerant of a wide range of conditions, and are easily dispersed. The diseases, predators, and parasites that kept their populations in check in their native range may not be present in their new locations. Over time, non-native, invasive species can overwhelm and eliminate native species, reducing biodiversity and negatively affecting both ecological communities and wildlife habitats.

Human actions are the primary means of invasive species introductions. Transmission line construction causes disturbance of ROW soils and vegetation through the movement of people and vehicles along the ROW, access roads, and laydown areas. These activities can contribute to the spread of invasive species. Parts of plants, seeds, and root stocks can contaminate construction equipment and essentially “seed” invasive species wherever the vehicle travels. Infestation of invasive species can also occur during periodic transmission ROW maintenance activities, especially if these activities include mowing and clearing of vegetation. Once introduced, invasive species will likely spread and impact adjacent properties with the appropriate habitat.

Some common invasive species and their habitats are listed in Table 5.5-1.

Table 5.5-1 Common exotic and invasive plant species found in Wisconsin

Common Name	Scientific Name	Habitat
Bella Honeysuckle	<i>Lonicera x bella</i>	Forest Savanna Prairies
Bull Thistle	<i>Cirsium vulgare</i>	Disturbed Areas
Common Reed	<i>Phragmites australis</i>	Wetlands
Common Buckthorn	<i>Rhamnus cathartica</i>	Disturbed Areas, Forests, and Prairies
Common Tansy	<i>Tanacetum vulgare</i>	Sunny Disturbed Areas
Garlic Mustard	<i>Alliaria petiolata</i>	Forests and Savanna Prairies
Glossy Buckthorn	<i>Rhamnus frangula</i>	Forests and Wetlands
Morrow's Honeysuckle	<i>Lonicera morrowii</i>	Forest Savanna Prairies
Multiflora Rose	<i>Rosa multiflora</i>	Varied
Purple Loosestrife	<i>Lythrum salicaria</i>	Wetlands
Reed Canary Grass	<i>Phalaris arundinacea</i>	Wetlands
Spotted Knapweed	<i>Centaurea maculosa</i>	Sunny Disturbed Areas
Tartarian Honeysuckle	<i>Lonicera tatarica</i>	Forest Savanna Prairies
Wild Parsnip	<i>Pastinaca sativa</i>	Varied - Prefers Sunny Areas

5.5.8.2 Best management practices

To better address control of invasive species, an Advisory Committee for the Wisconsin Council on Forestry was formed in 2008 and included representatives from public and private organizations, including highway departments, electric and gas utilities and pipelines, and state technical staff. They produced in 2010, the “Invasive Species Best Management Practices for Transportation and Utility Rights-of-Way.” This BMP guidelines can be found online at:

<http://council.wisconsinforestry.org/invasives/transportation> and identifies effective and realistic voluntary practices that can be integrated into ROW activities.

As of September 2009, Wis. Admin. Code ch. NR 40 became effective. It establishes a classification system for invasive species and prohibits activities that result in the spread of invasive species in certain categories. It also establishes preventive measures to help minimize the spread of invasive species. Using the practices consistent with the BMP manual will assist utilities in complying with the “reasonable precaution” requirements under Chapter NR 40.

5.5.8.2.1 During construction

The BMP manual identifies many methods that can be used during construction to limit the introduction and spread of invasive species. These measures include:

- Surveys and avoidance of areas populated with invasive species by identifying and marking their location in the field, prior to the start of construction.
- Removal or control of isolated populations of invasive species, prior to construction.
- Scheduling construction activities during periods of the year when invasive species are less likely to be encountered or spread.
- Planning construction access points and staging areas to minimize new ground disturbances.
- Properly disposing of woody material from ROW clearing to avoid spreading any invasives.
- Cleaning equipment to prevent inadvertent spreading of invasive species.
- Proper disposal of soils, seeds, plant parts or invertebrates found during inspection and cleaning.
- Using soil and aggregate material from sources free of invasive species.
- Using effective erosion control and storm water management practices to stabilize exposed soils, as soon as possible.

- Using non-invasive or native seed cover crops for the re-vegetation of areas disturbed by construction activities.

5.5.8.2.2. Post-construction

Because construction measures may not be completely effective in controlling the introduction and spread of invasives, post-construction activities are required. Sensitive areas such as wetlands and high quality forests and prairies should be surveyed for invasive species following construction and site re-vegetation. If new infestations of invasive species are discovered, then measures should be taken to control the infestation. Each exotic or invasive species requires its own protocol for control or elimination. Techniques to control exotic/invasive species include the use of pesticides, biological agents, hand pulling, controlled burning, and cutting or mowing. DNR should be consulted to determine the best methods for control of encountered invasive species.

5.5.10. Noise and light impacts

5.5.10.1. During construction

During each phase of construction of the transmission line, noise will be generated by the construction equipment and activities. Initially, vegetation in the ROW is mowed or cut using whole tree processors and/or chainsaws. Wood brush and logs may be chipped or burned in the ROW. Trucks are used to haul away material that can't be stockpiled or disposed of on-site and to bring in necessary construction materials. Typical construction vehicles include bucket trucks, cranes or digger derricks, backhoes, pulling machines, pole trailers, or dumpsters.

Transmission structures are constructed by first using a standard drill rig to bore a hole to the required depth. If water is encountered, pumps will be used to move the water to either adjacent upland areas or to waiting tanker trucks for proper disposal. When bedrock is close to the surface or when subsoils primarily consist of large boulders and large cobbles, blasting may be required. Concrete trucks carry concrete to the boreholes to construct the foundations of the transmission structures. Cranes then erect the towers on the foundations. Finally, the wire is strung between the towers using large pulleys. After the construction is completed, the ROW is graded, agricultural soils are de-compacted, and the ROW cleaned up.

All of these operations produce noise that may impact adjacent landowners. However, normal work schedules and local ordinances usually restrict noise producing activities to daytime hours.

5.5.10.2. During operation

Vibrations or humming noise can be noticeable and is most often associated with older transmission lines. It is usually the result of conductor mounting hardware that has loosened slightly over the years and can be easily repaired by the utility. This is a maintenance issue that can be identified and repaired.

The other types of sounds that are caused by transmission lines are sizzles, crackles, or hissing noises that occur during periods of high humidity. These are usually associated with high-voltage transmission lines and are very weather dependent. They are caused by the ionization of electricity in the moist air near the wires. Though this noise is audible to those very close to the transmission lines, it quickly dissipates with distance and is easily drowned out by typical background noises.

Ionization of transmission lines in foggy conditions can also cause a corona, which is a luminous blue discharge of light usually where the wires connect to the insulators.

Residential properties located in in close proximity to a substation could be impacted by the noise and light associated with the operation of a new or enlarged substation.

5.5.11. Property owner issues

5.5.11.1. ROW easements

Property owner issues are often raised by individuals or communities along proposed transmission line routes. One concern relates to how some property owners bear the burden so that everyone else can use the electricity, pitting property owner rights versus public good. Another concern relates to who should be considered as affected by the new line.

There is often a feeling of unfairness between those that use electricity and those that bear the impacts of the facilities required to support that use. The money paid to landowners for ROW easements is meant to compensate them for having a transmission line cross their property. These easement payments are negotiated between the landowner and the utility. Some landowners do not regard the payments as sufficient to truly compensate for the aesthetic impacts and the loss of full rights to their own land. This is especially true if the landowner is not compensated for the “highest and best use” of the affected parcel.

The policy of corridor sharing favors the placement of new transmission lines within or next to existing infrastructure, causing some landowners to be burdened by multiple easements. These individual hardships must be balanced against the additional environmental or social impacts caused by the development of new transmission corridors.

Property owners who live near the line but not on the ROW might be affected but are not compensated. Subsequent owners of the property in the ROW, although they purchased the property knowing that the easement already existed, would not be compensated directly either because the easement payment is most commonly a one-time payment paid at the time of the easement acquisition.

Compensation is paid to towns, municipalities, and counties through which a 345 kV or higher voltage transmission line is constructed via payment of one-time environmental and/or annual impact fees. Wis. Stat. § 196.491(3g)(a). The amount can be considerable and is proportional to the percentage of the line constructed within a specific political subdivision and the cost of the project. No portion of it, however, would go directly to the property owner.

5.5.11.2. Property value studies

The potential change in property values due to the proximity to a new transmission line has been studied since the 1950s by appraisers, utility consultants, and academic researchers. It is very difficult to predict how a specific transmission line will affect the value of a specific property. Of issue are changes to the “fair market” value of a property and not the “assessed” value. To date, no study has shown how the construction of a new transmission line negatively affects the “assessed” value of a property. Additionally, studies have been conducted mostly on residential or undeveloped properties and not commercial properties.

A power line may increase, decrease, or have no effect on an individual’s perception of a property’s worth. This perception is indicative of how much one is willing to pay for the property (the fair market value) when it is put up for sale. The marketability of a property includes the final sale price and the amount of time required to sell the property.

Initial property value studies were primarily surveys or attitudinal studies of small numbers of homeowners. However, substantial differences could exist between people's perceptions about how they would behave and their actual behavior when confronted with the purchase of property supporting a power line.

Because of this uncertainty, attitudinal studies were replaced by "valuation" studies involving the comparison of sales prices for properties similar in most respects, except for proximity to a power line. There are two major shortcomings in conducting this type of study: (1) the subjective nature of identifying a pair of properties that were considered "identical" for the purpose of the study; and (2) the restrictive nature of finding "identical" property pairs, which would result in a data set too small for meaningful statistical analysis.⁶⁵

A third type of research involves large sample sizes, a high number of variables, and multiple regression analysis. These studies, which can better account for numerous variables that affect sales, provide the best information to-date on the effects of power lines on property values. Individuals buying property are likely to consider many factors, such as schools, community services, scenic beauty, recreational opportunities, or distance to work. The relative importance of each of these factors varies greatly among individuals. Likewise, the importance of a nearby power line varies greatly among people. The presence or potential presence of a transmission line could lead potential buyers to perceive a decrease in the property's value or have no affect at all. The statistical analyses might help illustrate which factors best predict differences in marketability.

5.5.11.3. Potential impacts to property values

In some situations, value can be increased. In rural areas, especially in the vicinity of large wooded parcels, a utility ROW might provide improved access to large land tracts for hunting, snowmobiling, or other recreational activities. White-tailed deer and some other animals often use forest openings for foraging and travel. In urban or suburban residential areas, lots on or adjacent to power line corridors are often sized larger than neighboring lots but are similarly priced, allowing residents to benefit from the added buffer and space the ROW provides. Integrating the open space of the utility corridor into a neighborhood and developing it as usable space can also diminish or avoid adverse effects on property values.⁶⁶

Conversely, the perceived value of property may decrease in value because of:

- Concern or fear of possible health effects from electric or magnetic fields.
- The potential noise and visual unattractiveness of the transmission line.
- Potential interference with farming operations or foreclosure of present or future land uses.

While there is no conclusive evidence of the effects of EMF on health, it is recognized that people's concerns about EMF can influence their decisions related to the purchase of a property. In *Criscuola v. Power Authority of the State of New York*,⁶⁷ the New York State Court of Appeals ruled that whether the danger of EMF is a scientifically genuine or verifiable fact should be irrelevant to the central issue of its market value impact. The visual profile of transmission line structures and wires can also decrease the

⁶⁵ Kinnard, W. Jr. and S. A. Dickey. 1995. A Primer on Proximity Impact Research: Residential Property Values Near High-Voltage Transmission Lines. *Real Estate Issues* 20(1):23-29.

⁶⁶ Ignelzi, Patrice and Thomas Priestley. A Statistical Analysis of Transmission Line Impacts on Residential Property Values in Six Neighborhoods. Southern California Edison, 1991.

⁶⁷ *Criscuola v. Power Authority of the State of New York*, 81 NY2d 649, 602 NYS2d 588, 621 NE2d 1199 (1993).

perceived aesthetic quality of property. These conclusions have been cited in several court cases and legal opinions.

On farmed properties, installation of a transmission line can remove portions of the land from production, interfere with equipment operation, create safety hazards, and foreclose the opportunity to consolidate farmlands or develop the land for another use. The greatest impact on farm property values is likely to occur on intensively managed agricultural lands, where the new line would interfere with farm operation and management.

5.5.11.4. Research results

While the data from many of the studies reviewed are often inconclusive, some general conclusions among the studies have been made. In 2003, the Electric Power Research Institute (EPRI) conducted an assessment of the researched relationship between electric transmission facilities and property values.⁶⁸ Their conclusions do not differ substantially from previous analyses.

- The potential reduction in sale price for single-family homes in the U.S. may range from 0 to 14 percent. For states within the Midwest (Minnesota, Wisconsin, and the Upper Peninsula of Michigan), the average decrease appears to be between 4 and 7 percent. EPRI reported a potential overall decrease between 0 and 6.3 percent.
- Higher-end properties are more likely to experience a reduction in selling price than lower-end properties.
- Adverse effects on the sale price of smaller properties could be greater than effects on the sale price of larger properties.
- Amenities such as proximity to schools or jobs, lot size, square footage of a house, and neighborhood characteristics tend to have a much greater effect on sale price than the presence of a power line.
- The degree of opposition to an upgrade project may affect the size and duration of the sales-price effects. Furthermore, adverse effects on price and value appear to be greatest immediately after a new transmission line is built and appear to diminish over time and generations of property owners.
- Effects on sale price are most often observed for property crossed by or immediately adjacent to a power line, but effects have also been observed for properties farther away from a line. Homes not directly adjacent to the ROW or beyond 200 feet from the ROW, however, were affected to a much lesser degree than those abutting the line or ROW.^{69 70}
- Setback distance, ROW landscaping, shielding of visual and aural effects, and integration of the ROW into the neighborhood can significantly reduce or eliminate the impact of transmission structures on sales price.
- Where appreciation of property does not appear to be affected, proximity to a transmission line can sometimes result in increased time the property takes to sell.
- The value of agricultural property is likely to decrease if the power line structures are placed in an area that inhibits farm operations.

⁶⁸ Goodrich-Mahoney, J. Transmission Line and Property Values: State of the Science. EPRI, November 2003.

⁶⁹ Kung, H. and C. Seagle, "Impact of Power Transmission Lines on Property Values: A Case Study," Appraisal Journal, July 1992.

⁷⁰ Hamilton, S. and G. Schwann. 1995. Electric Transmission Lines and Property Value. Land Economics 71(4):436-444.

5.5.12. Radio and television reception

Transmission lines do not usually interfere with normal television and radio reception. In some cases, interference is possible at a location close to the ROW due to weak broadcast signals or poor receiving equipment. If interference occurs because of the transmission line, the electric utility is required to remedy problems so that reception is restored to its original quality.

5.5.13. Recreation

Recreation areas include parks, trails, lakes, waterways, or other designated areas where public recreational activities occur. Transmission lines can affect recreation areas in several ways:

- Limiting the location of buildings;
- Repelling potential users of recreational areas whose activities depend on the aesthetics of natural surroundings (*e.g.*, backpackers, canoeists, hikers, birdwatchers);
- Altering the types of wildlife found in an area by creating more edge habitat or additional mortality risks to birds;
- Providing paths or better access to previously inaccessible areas for those who snowmobile, ski, bicycle, hike, or hunt;
- Posing potential safety risks by locating new poles or wires in the path of recreational vehicles such as snowmobiles and ATVs without adequate markings.

Some of these effects can be mitigated by locating lines along property edges, using pole designs that blend into the background and reduce aesthetic impacts, or designing recreation facilities to take advantage of already cleared ROWs.

5.5.14. Safety

5.5.14.1. Safety standards

Transmission lines must meet the requirements of the Wisconsin State Electrical Code.⁷¹ The code establishes design and operating standards, and sets minimum distances between wires, poles, the ground, and buildings. While the Wisconsin State Electrical Code represents the minimum standards for safety, the electric utility industry's construction standards are generally more stringent than the Wisconsin State Electrical Code requirements.

The minimum horizontal clearance required between a building and a 345 kV conductor is approximately 19 feet, but many other factors, such as displacement of the conductors by the wind, determine good engineering design distances. Wisconsin Admin. Code § PSC 114.2394(a)(4) prohibits the construction of transmission lines over occupied residential dwellings or residential dwellings intended to be occupied. Although they may not be prohibited by code, building other structures within a transmission line ROW is strongly discouraged.

5.5.14.2. Contact with transmission lines

The most significant risk of injury from any power line is the danger of electrical contact between an object on the ground and an energized conductor. Generally, there is less risk of contact with higher voltage transmission lines as opposed to low-voltage lines due to the height of the conductors.

⁷¹ Wisconsin adopts the most recent edition of the National Electrical Safety Code with certain changes, deletions, and additions. Volume 1 of the Wisconsin State Electrical Code is found in Wis. Admin. Code. ch. PSC 114, which is administered primarily by the Commission.

When working near transmission lines, electrical contact can occur, even if direct physical contact is not made, because the electricity can arc across an air gap. The most important safety practice is to avoid placing yourself or any object you may contact too close to a high-voltage overhead line. As a general precaution, no one should be on an object or in contact with an object that is taller than 15 to 17 feet while under a high-voltage electric line. Individuals with specific concerns about whether it is safe to operate their vehicles or farm equipment near an electric transmission line should contact their electric provider.

5.5.14.3. Fallen lines

Transmission lines are designed to automatically trip out-of-service (become de-energized) if they fall or contact trees. This is not necessarily true of distribution lines. However, transmission lines are not likely to fall unless hit by a tornado or a vehicle.

5.5.14.4. Lightning

New transmission lines are built with a grounded shield wire placed along the top of the poles, above the conductors. Typically, the shield wire is bonded to ground at each transmission structure. This protects the transmission line from lightning. Transmission poles, like trees or other tall objects, are more likely to intercept lightning strikes, but do not attract lightning. Lightning is not more likely to strike houses or cars near a transmission line. Shorter objects under or very near a line may actually receive some protection from lightning strikes.

5.5.14.5. Induced voltages

Landowners in both rural and urban settings often express concerns about shocks from metal objects in the immediate vicinity of an overhead transmission line. An ungrounded metal object (*e.g.* a tractor or a fence) under or very near an energized transmission line may become charged with low-level voltage caused by an electrostatic induction process. When a person or animal touches the object, a shock may be felt, similar to that felt after crossing a carpet and then touching a metal object. The voltage discharge can be a painful nuisance. Dissipation of such charges occurs when contact is made with the ground. This might happen when people, livestock, or some other conductive material makes an effective electrical contact between ground and the charged object. The magnitude and strength of the charge is directly related to the mass of the ungrounded metal object and its orientation to the line.

Concerns have most often been addressed by grounding the objects in question. For example, fences located directly under and parallel to transmission lines should be grounded to earth. This can be achieved through the use of a simple ground rod with an insulated lead and a wire clamp attached. Energized electric fences with a properly installed fence grounding electrode system should continue to function properly even when subjected to induced voltage. Energized electric fences directly under or parallel to a transmission line may also have filters installed to discharge the induced voltage to earth.

When it is necessary to move or work on such fences, the fences should remain solidly grounded while the work is being done. Additional protection may be obtained by installing an approved lightning protection system on the fence that also provides a means for the discharge of induced voltage. More information may be obtained from a Midwest Rural Energy Council publication, *“Installation and Operation of Electric Fences, Cow Trainers and Crowd Gates”* (<http://www.mrec.org/pubs.html>).

Tractors or other equipment operated under a transmission line can drag a short metal chain to “ground it” to earth. This is a very low-cost, effective mitigation technique. An equally low-cost alternative is to attach a chain to the metal frame of the equipment and drop that chain to the ground before getting off of the equipment. The chain can be pulled up while the vehicle is moving to reduce the risk of a broken

chain causing damage to the equipment. The most direct mitigation measure is to avoid parking this type of equipment under high-voltage power lines.

Refueling vehicles directly under a high-voltage transmission line is not a good practice. A spark from a discharging metallic structure with induced voltages to earth could ignite the fuel. The risk of such ignition is higher with gasoline-powered vehicles than for diesel-powered vehicles.

WDATCP's AIS for this project will provide additional information regarding safety issues when farming near transmission lines. WDATCP AIS staff can provide general published information and references as well. Individuals with specific concerns regarding the operation of equipment or placement of fences under an electric transmission line should contact their electricity provider.

5.5.15. Stray voltage and dairy livestock

5.5.15.1. Causes of stray voltage

Stray voltage and its impacts on livestock and other confined animals have been studied in detail by state and federal agencies, universities, electric utilities, and numerous scientists since the late 1970s. The PSCW has opened investigations, encouraged the upgrade of rural distribution systems, established measurement protocols, and compiled a stray voltage database to track investigations, all in order to develop successful strategies for minimizing stray voltage in farm operations.⁷² Over the decades, significant resources have been allocated to understand this issue.

Electrical systems, including farm systems and utility distribution systems, are grounded to the earth to ensure safety and reliability, as required by the NESC and the National Electrical Code (NEC). Because of this, some current flows through the earth at each point where the electrical system is grounded and a small voltage develops. This voltage is called neutral-to-earth voltage (NEV). When NEV is measured between two objects that are simultaneously contacted by an animal, a current will flow through the animal. Animals may then receive a mild electrical shock that can cause a behavioral response. At low voltages, an animal may flinch with no other noticeable effect. At higher levels, avoidance or other negative behaviors may result. Stray voltage may not be noticeable to humans.

Low levels of alternating current (AC) voltage on the grounded conductors of a farm wiring system are a normal and an unavoidable consequence of operating electrical farm equipment. Some levels of stray voltage will always be found on a farm. For example, a dairy cow may feel a small electric shock when it makes contact with an energized water trough. The issue of concern is stray voltage that occurs at a level that negatively affects an animal's behavior, health, and more specifically, milk production.

Stray voltage can be caused by a combination of on-farm and off-farm causes. One off-farm contributor to stray voltage is the operation of transmission lines in close proximity and parallel to a distribution line. As a means to minimize new transmission line impacts, new lines are often co-located near a distribution ROW or the distribution line is underbuilt on the new transmission poles. This configuration can contribute to stray voltage issues. To minimize the likelihood of stray voltage occurrences, utilities sometimes propose to relocate these paralleling distribution lines further away from the transmission line and/or burying the distribution line underground. Additionally, the PSCW may require the utility to conduct pre-construction and post-construction testing of potentially impacted farms and lines.

⁷² Commission stray voltage information can be found on its web site at <http://psc.wi.gov/utilityinfo/electric/strayvoltage.htm>.

5.5.15.2. Potential impact of stray voltage

Herd problems can be difficult to diagnose. There are many factors to consider such as the herd's environment, diet, and health. Dairy cow behaviors that may indicate the presence of stray voltage include nervousness at milking time, increased milking time, decreased milk production, increased defecation or urination during milking, hesitation in approaching waterers or feeders, or an eagerness to leave the barn. Some of these symptoms are interrelated. For example, a dairy cow that does not drink sufficient water due to shocks may have decreased milk production. However, these same symptoms can be caused by other factors that are unrelated to stray voltage such as increased mastitis or milk-withholding problems for farms with milking parlors or in barns with milk pipelines. If stray voltage is suspected to be the cause of herd problems, the farm should be tested.

In 1996, the PSCW established a stray voltage "level of concern" of two milliamps (PSCW docket 5-EI-115).⁷³ This level of concern is not intended as a "damage" level, but a very conservative, below the injury level, below the point where moderate avoidance behavior is likely to occur, and well below where a cow's behavior or milk production would be affected. WDATCP and PSCW consider that at this level of current, some form of mitigative action should be taken on the farmer's behalf.

The level of concern is further defined with respect to how it should be reduced. If a utility distribution system contributes one milliamp or more to stray voltage on a farm, the utility must take corrective action to reduce its contribution to below the one milliamp level. If the farm electrical system contributes more than one milliamp, the farmer may want to consider taking corrective measures to reduce the level below one milliamp.

5.5.15.3. Mitigation of stray voltage

When stray voltage is a concern, electrical measurements in confined livestock areas should be done using established PSCW-approved testing procedures with the appropriate equipment. These testing protocols have been developed to collect a reasonable set of data useful in the analysis of the quantity and quality of stray voltage that may be present under a variety of conditions, and the source (including on-farm versus off-farm sources) of the stray voltage.

Field research shows that cow contact current is often dependent on both on- and off-farm electrical power systems. A common on-farm source of stray voltage is the inappropriate interconnection of equipment grounding conductors with the neutral conductors of the farm wiring system. Mitigation of stray voltage can be achieved through a variety of proven and acceptable methods, such as additional grounding or the installation of an equipotential plane.

Farm operators may receive technical assistance from the Wisconsin Rural Electric Power Services (REPS) program (as defined and authorized by Wis. Stat. §§ 93.41 and 196.857). The REPS program is jointly managed by PSCW and WDATCP.⁷⁴ WDATCP provides an ombudsman, veterinarian, an energy technical advisor, and a program assistant to the REPS program. REPS staff provides information about stray voltage and power quality issues; work to answer regulatory questions; conduct on-farm and distribution system investigations that can assist farmers in working with the utility or electrician to resolve a power quality concern; provide a format for dispute resolution; and continue to research electrical issues.

⁷³ The level of concern was established at 2 milliamps, AC rms (root mean squared), steady state or 1 volt AC rms steady state across a 500 ohm resistor in the cow contact area. Steady state is defined by the Institute of Electrical and Electronics Engineers as the value of current or voltage after all transients have decayed to negligible value.

⁷⁴ WDATCP REPS and stray voltage information can be found on its website under the Wisconsin Farm Center page, http://datcp.wi.gov/Farms/Wisconsin_Farm_Center/Farm_Rewiring/Stray_Voltage/

REPS staff also works with farmers, their veterinarians, and nutritionists to resolve herd health and production problems.

5.5.16. Water resources

5.5.16.1. Potential impacts to rivers and streams

Waterways in the form of creeks, streams, rivers, and lakes are abundant throughout Wisconsin. Many of the rivers have been designated as special resources that have state, regional, or national significance. Construction and operation of transmission lines across these resources may have both short-term and long-term effects. The type and significance of the impact is dependent on the characteristics of the water resource and the transmission line design. Waterway use, physical features such as channel width, herbaceous plant cover, and water quality, and the scenic quality of the river and its surrounding landscape are important factors in assessing potential impacts.

Water quality can be impacted not only by work within a waterway but also by nearby vegetation clearing and construction activities. The removal of adjacent vegetation can cause river water temperatures to rise and negatively affect aquatic habitats, especially cold-water systems. It can also increase erosion of adjacent soils causing sediment to be deposited into the waterway, especially during rain events. Construction often requires the building of temporary bridges that, if improperly installed, may damage banks and cause erosion or be overtopped or dislodged, and back up water. Overhead transmission lines across major rivers and streams may have a visual impact for river users and pose a potential collision hazard for waterfowl and other large birds, especially when located in a migratory corridor.

5.5.16.2. Areas of special natural resource interest

Certain waters of the state possess significant scientific value and are identified by WDNR as Areas of Special Natural Resource Interest (ASNRI) for their protection (Wis. Admin. Code § NR 1.05).

ASNRI-identified waters include:

- State natural areas (Wis. Stat. §§ 23.27 through 23.29);
- Trout streams (Wis. Admin. Code § NR 1.02(7));
- Outstanding resource waters (ORW) or exceptional resource waters (ERW) (Wis. Stat. § 281.15);
- Waters or portions of waters inhabited by an endangered, threatened, special concern species or unique ecological communities identified in the NHI;
- Wild rice waters as identified by WDNR and the Great Lakes Indian Fish and Wildlife Commission;
- Waters in areas identified as special area management plan or special wetland inventory study (Wis. Admin. Code § NR 103.04);
- Waters in ecological significant coastal wetlands along lakes Michigan and Superior as identified in the coastal Wetlands of Wisconsin;
- Federal or state waters designated as wild or scenic rivers (Wis. Stat. §§ 30.26 and 30.27).

There are approximately 100,000 miles of trout streams in Wisconsin categorized as Class 1, 2, or 3. High-quality trout streams (Class 1) have sufficient natural reproduction to sustain populations of wild trout, at or near carrying capacity. These streams are often small and may contain small or slow-growing trout, especially in the headwaters. Approximately 40 percent of the trout streams are Class 1 trout streams. Class 2 trout streams may have some natural reproduction but not enough to utilize available food and space, and stocking is required to maintain a desirable sport fishery. However, these streams have good survival and carryover of adult trout, often producing some fish larger than average size. Class 2 trout streams comprise about 45 percent of Wisconsin's total trout stream mileage. Class 3 waters are

marginal trout habitat with no natural reproduction occurring. They require annual stocking of trout to provide trout fishing. Generally, there is no carryover of trout from one year to the next. Class 3 trout streams comprise 15 percent of Wisconsin's total trout stream mileage. Degradation of trout habitat is caused by siltation from erosion, decreased groundwater flow from irrigation, drained wetlands, and poor watershed management. High oxygen demand from organic pollution, channelization, cattle grazing, and increased temperatures from both man-made (*i.e.* stormwater discharges) and natural sources are other common causes of trout habitat deterioration. State laws protect trout streams from pollution and other harmful effects.

ORWs and ERWs are characterized as being valuable or unique for various features including fisheries, hydrology, geology, and recreation. Regulations require that these shall not be lowered in quality without good justification. By assigning these classifications to specific streams, high quality waters receive additional protection from point source pollution. Of the some 42,000 stream/river miles in the state, over 3,000 stream miles or approximately 8 percent have been designated as ORW and more than 4,500 stream miles or approximately 11 percent have been designated as ERW.

5.5.16.3. Mitigation of impacts to waterways

Techniques for minimizing adverse effects of constructing transmission lines in river and stream environments, especially in the vicinity of ASNRI-designated waterways include avoiding impacts, minimizing impacts, and/or effective remediation of the impacts. Impacts to waterways can be avoided by rerouting the line away from the waterway, adjusting pole placements to span the resource overhead, constructing the line under the resource, or constructing temporary bridge structures across the resource. Methods to minimize impacts include avoiding pole placements adjacent to the resource, using WDNR-approved erosion control methods, using alternative construction methods such as a helicopter construction, landscaping to screen the poles from the view of river users, and maintaining shaded stream cover. After construction, some impacts can be remediated.

There are several methods and cable types for constructing a transmission line under a resource. While potentially feasible for the construction of lower-voltage and distribution lines, at higher voltages, there are substantial engineering, cost, and operational hurdles that would need to be overcome to be a feasible alternative to overhead construction.

The use of properly designed temporary bridge structures avoids the necessity of driving construction equipment through streams (see the example in Figure Vol. 2-39). Temporary bridges consist of timber mats that can allow heavy construction traffic to cross streams, creeks, and other drainage features without damaging the banks or increasing the potential for soil erosion. Temporary bridges should be located to avoid unique or sensitive portions of these waterways, *i.e.*, riffles, pools, spawning beds, etc. They span from top-of-bank to top-of-bank and may include a support structure under the bridge, placed on the bed of the waterway, to support heavy vehicle use.

Proper WDNR-approved erosion control is necessary for all construction activities, especially those that may affect water resources. WDNR BMPs should be employed before, during, and immediately after construction of the project to reduce the risk of excess siltation into streams. Erosion controls must be regularly inspected and maintained throughout the construction phase of a project until exposed soil has been adequately stabilized.

Woodlands and shrub/scrub areas along streams are a valuable buffer between adjacent land uses such as farm fields and corridors of natural habitats. The vegetation maintains soil moisture levels in stream banks, helps stabilize the banks, filters nutrient-laden sediments and other runoff, maintains cooler water

temperatures, and encourages a diversity of vegetation and wildlife habitats. The removal of vegetative buffers from ASNRI-designated shoreland zones will raise the temperature of the water temperature. Cool water temperatures are necessary for good trout stream habitat. Existing vegetative buffers should be left undisturbed or minimally disturbed, whenever possible. For areas where construction impacts cannot be avoided, low-growing native tree and shrub buffers along these streams should be allowed to regrow and/or should be replanted so as to maintain the pre-construction water quality in the streams.

5.5.16.4. Permitting for river and stream crossings

WDNR is responsible for regulating public waterways, including stream crossings. For certain protected areas, USACE and/or USFWS might require additional permits and approvals. The discussion below outlines these legal protections and the permitting requirements for activities affecting streams.

- Wisconsin Stat. § 30.29 prohibits motor vehicle crossings of navigable waters (below the ordinary high water mark) but allows WDNR to issue permits for special purposes.
- Wisconsin Stat. § 30.025 describes the process for permitting utility projects with respect to wetlands, navigable waterways and stormwater management.
- Wisconsin Stat. § 30.12 requires permits for structures placed on the bed of navigable waterways.
- Wisconsin Stat. § 30.123 requires permits for bridges or culverts in, on, or over navigable waters.
- 33 USC § 403 Section 10 of the Rivers and Harbors Act of 1899 prohibits the unauthorized obstruction or alteration of any navigable waters of the U.S.
- 16 USC §§ 1271-1287 prohibit federal agencies from authorizing a water resources project that would have a direct and adverse effect on the values for which a river protected by the Wild and Scenic Rivers Act was established.

CPCNs granted by the Commission are contingent upon the applicant's ability to secure all necessary permits from state and federal agencies. Likewise, any permit granted by WDNR or USACE could be contingent on the implementation of all mitigation procedures ordered by the Commission in its CPCN authorization.

5.5.17. Wetland resources

5.5.17.1. Types and functions of wetlands

There are many different types of wetlands. Some wetland meadows and marshes consist primarily of grasses, sedges, reeds, and cattails. Some wetlands may contain permanent areas of open water or are wet for only a portion of the year. Shrub-carr wetlands support a mixture of grasses and sedges interspersed with shrubs, such as willows, alders, or dogwood, and may or may not have any open water. Wooded wetlands consisting of conifers or deciduous hardwoods represent another type of wetland common in Wisconsin. Tamarack, cedar, and black spruce swamps and bogs occur in many isolated low-lying areas in northern Wisconsin. These swamps are particularly sensitive to disturbance because conditions do not support rapid growth or recruitment. Forested wetlands of deciduous hardwoods, such as black ash, black willow, elm, and silver and red maple, tend to occur along creeks, rivers, and streams throughout southern Wisconsin, and are also highly sensitive to disturbance because they take significant time to grow and mature. Calcareous fens are one of the rarest wetland plant communities in Wisconsin and often have a disproportionate number of rare, threatened, and endangered plant species.

Wetlands provide vital functions that benefit society. Wetlands detain stormwater runoff, enabling the slow recharge of groundwater resources and lowering downstream peak flood levels. Wetlands filter sediments and pollutants from the air, precipitation, and upstream sources which results in higher water quality downstream. Wetlands provide food, cover, and nesting habitat for many species of fish and

wildlife. It is estimated that between one-quarter and one-third of all rare species in Wisconsin are found in wetlands. Wisconsin has lost almost 50 percent of its original 10 million acres of wetlands. Avoidance and minimization of impacts to wetlands followed by proper mitigation is necessary to preserve the remaining 5.3 million acres of Wisconsin wetlands.

Certain wetlands are considered sensitive if they are within the boundary of an ASNRI waterway or have a direct hydrologic connection to an ASNRI waterway (Wis. Admin. Code § NR 103.04). Sensitive wetlands include wetlands that are part of:

- Cold water communities including all trout streams and their tributaries and trout lakes;
- Lakes Michigan and Superior and the Mississippi River;
- State- and federally-designated wild and scenic rivers, designated state riverways, and state designated scenic urban waterways;
- Environmentally sensitive areas or environmental corridors identified in an area-wide water quality management plan, special area management plan, special wetland inventory study, or an advanced delineation and identification study;
- Calcareous fens;
- Habitats used by state- or federally-designated threatened or endangered species;
- State parks, forests, trails, and recreation areas;
- State and federal fish and wildlife refuges and fish and wildlife management areas;
- State- and federal-designated wilderness areas;
- State natural areas;
- Wild rice waters;
- ORWs and ERWs.

5.5.17.2. Potential impacts to wetlands

5.5.17.2.1. Long-term versus short-term impacts

The degree and nature of impacts to wetlands depend on the type of wetland, weather conditions at the time of construction, soil type, and the type of construction activities. Short-term wetland impacts can become long-term impacts if the construction phase is not well managed or mitigation techniques are not properly applied. Examples of long-term impacts include the loss of wetland acres due to the placement of transmission structures in wetlands, the unintended spread of invasive species due to inadequate cleaning of construction equipment, the conversion of forested wetland complexes to sedge meadow complexes, and the fragmentation of wetland types.

Certain wetland types are more susceptible to long-term impacts due to transmission line construction. They can have a more fragile habitat (such as a calcareous fen) that is difficult to re-create, or the requirements of the ROW prevent full mitigation efforts. Forested wetlands are an example of a type of wetland that can never fully recover from the construction process. Line construction and future maintenance operations require that transmission ROWs be maintained free of trees. Following construction of the line, the forested wetlands are most often remediated as wet meadows with full sun. This permanently changes the vegetation and species diversity of the wetland in the ROW.

More in-kind recovery is probable for deciduous shrub-scrub wetlands (supporting willows, alders, and sedges) and wet meadows.⁷⁵ In a 10-year study of three wetland types following construction of a transmission line in Massachusetts, species diversity and richness were similar to pre-construction levels within one year in a cattail marsh but took several years to rebound in a wooded swamp with a red maple and alder canopy. Damage caused by ROW construction was still apparent after 10 years in a bog dominated by leatherleaf shrubs and sphagnum moss.⁷⁶

Commission analyses of transmission line impacts to wetlands are measured in acres because the entire ROW width could be affected by construction activities. This provides a conservative estimate of impact that, while likely to be on the high side, provides a good estimate of the maximum impact potential. New access roads that require clearing in wetlands may also have long-term impacts as described above.

5.5.17.2.2. Impacts to function and wetland habitats

Construction and maintenance of transmission lines can damage the ability of wetlands to function as they should. Heavy machinery used for clearing trees and brush, drilling holes, hauling cement, and setting poles can crush wetland vegetation and compact wetland soils. Soil compaction reduces the water-holding capacity of the soil and may result in increased runoff. Wetland soils consist of primarily organic matter (decomposed plant material) which forms very slowly. If disturbed by digging, filling, and compaction, these soils do not readily recover and are not easily repaired. Proper segregation of topsoil and subsoil is essential to minimizing long-term impacts and allowing natural vegetation and hydrologic conditions to recover.

Changes in hydrology (the vertical and horizontal movement of water through the soil) caused by trenching, drilling holes, de-watering soils, installing foundations, and compacting soils can alter the vegetation, reduce plant diversity, and promote the growth of invasive species. Driving equipment in wetlands can stir up sediments, endangering amphibians and other aquatic life. In large wetland areas where access is limited, soil compaction and hydrologic function can be further affected if fill is deposited in the wetland for the construction of roads or bridges.

In wetlands with large areas of open water, such as shallow marshes, or that have floating mats of vegetation, construction equipment access can be very difficult. Movement of construction vehicles within the wetland can result in significant rutting. Rutting and compaction of soils can permanently alter the wetland's soil structure and hydrologic function.

Large open water areas or wetlands with extensive organic matter emit methane, and may not fully freeze during winter months (a result of thermal loading). Construction during winter months in these environments can be dangerous and cause significant damage to the resource and the equipment. Ice and snow that may be used to construct roads may thaw from underneath, leading to equipment getting stuck, delays in construction sequencing, and the need to relocate access roads.

5.5.17.3. Mitigation of impacts to wetlands

Techniques for minimizing adverse effects on wetlands especially in ASNRI-designated wetlands include avoiding impacts, minimizing impacts, and/or effective remediation of the impacts. After construction, some impacts can be remediated.

⁷⁵ Grigal, D. F. 1985. Impact of Right-of-Way Construction on Vegetation in the Red Lake Peatland, Northern Minnesota. *Jour. Envir. Mgmt.* 9(5):pp. 449-454.

⁷⁶ Nickerson, N. H., R.A. Dobbertein, and N.M. Jarman, 1989. Effects of Power-Line Construction on Wetland Vegetation in Massachusetts, USA. *Jour. Envir. Mgmt.* 13(4): pp. 477-483.

Impacts to wetlands can be avoided, for example, by:

- Rerouting the line away from the wetland.
- Adjusting pole placements to span the resource overhead. This technique will still have long-term adverse impacts if the wetland was forested or if ROW maintenance continues to create impacts.
- Directionally boring the line under the resource.

There are several methods and cable types for constructing a transmission line under a resource to avoid it. While potentially feasible for the construction of lower-voltage and distribution lines, at higher voltages, there are substantial engineering, cost, and operational hurdles that would need to be overcome for such underground construction to be a feasible alternative to overhead construction.

Methods to minimize impacts include:

- Avoiding placement of poles directly adjacent to a wetland.
- Reducing the number of poles placed in wetlands.
- Using WDNR-approved erosion control methods on adjacent lands.
- Using specific construction methods.

Construction methods that can reduce impacts to wetlands include:

- Conducting construction activities when wetland soils and water are frozen or stable and vegetation is dormant.
- Using construction matting to minimize rutting.
- Using small tracked vehicles.
- Careful cleaning of construction equipment and mats after working in areas infested by invasive species.

Matting (see Figure Vol. 2-40) can provide a safe, stable work surface and travel lane for cranes, cement trucks, and other equipment needed during transmission line construction. Mats provide protection by spreading the weight of the equipment over a broader area to reduce compaction and prevent deep ruts from forming. While the mats may cause some depression of the underlying soils and crushing of the perennial vegetation, this impact is less than if matting is not used. Matting generally preserves native plant rootstocks so that the pre-construction vegetation can reestablish more quickly after construction is completed. Figure Vol. 2-41 shows a wide track vehicle placing mats in a wooded wetland. Tracked vehicles and high flotation tires can be used in some instances in lieu of mats.

Alternative construction equipment such as marsh buggies and helicopters can be used to further reduce the impact of construction in wetlands. Helicopters have been used for both the construction of the poles and for wire stringing in Wisconsin.

Ice roads can provide some of the same benefits as matting when used in wetlands. Ice roads are intended to create a stable surface for driving heavy equipment. They are usually created by clearing the initial layer of snow. This allows for frost to accumulate deep into the soil. A track vehicle (bombardier, bulldozer, etc.) is repeatedly driven across the ROW to drive the frost deeper into the soil. Sometimes the ROW can be flooded with water to provide an additional ice layer to the surface. Snow that falls on an ice road is usually cleared. However, compressing snow on top of the road can serve as insulation to keep the frost in the soil. See Section 5.5.16.2.2.

When a construction project requires the replacement of existing transmission structures in wetlands, minimization of impacts requires a review of the pole type, construction timing, and the type of wetland. While the holes left in wetland soils normally close as the existing transmission pole is removed, it is sometimes more appropriate to cut the pole off at, or just below the ground surface. The utility would need permission from the landowner before leaving a pole stub in the ground.

If a steel structure on a concrete foundation needs to be removed from a wetland, the concrete would be removed to a depth of about two feet and wetland soils from adjacent new foundation locations would be used to backfill the old foundation holes. The wetland soils would then be graded to approximate the original wetland contours.

5.5.17.4. Permitting process for wetlands

Local, state, and federal laws regulate certain activities in wetlands. When filling, grading, or excavating in a federal wetland is to occur, a permit is required from USACE under the Clean Water Act (CWA), Section 404.

When a CWA Section 404 permit is required, WDNR must determine if the proposed activity is in compliance with applicable state water quality standards. The state's wetland water quality standards are found in Wis. Admin. Code chs. NR 103 and 299. If the proposal is found to be in compliance with state standards, WDNR provides a "water quality certification" to the applicant. Without this state certification, a federal permit is not valid. In the event that fill material is proposed to be placed in non-federal wetlands (those without connections with navigable waters), WDNR must determine if the activity is in compliance with the Wisconsin Nonfederal Wetlands Water Quality Certification General Permit.

If the project would result in impacts to wetlands associated with waters of the state, then WDNR may have primary authority under Wis. Stat. ch. 30. In such cases, compliance with state law is considered compliance with federal law.

The general process for obtaining a permit is:

1. The applicant submits a permit application to USACE and WDNR.
2. USACE reviews the project according to federal guidelines and determines their jurisdiction including consideration of potential impacts on endangered species, cultural resources, and tribal trust concerns.
3. USACE determines if the project is exempt from the CWA, or issues a permit decision contingent on WDNR providing water quality certification.
4. WDNR reviews the project for compliance with state water quality standards. The project-specific review may require field work to assess wetland function and values (including surveys for threatened and endangered species, hydrologic conditions, invasive species, etc.) in order to avoid and/or minimize potential impacts from the proposed project.

Both the federal and state processes allow for legal challenge of decisions.

In addition to the protections for water resources provided by law that are described above, the Commission has the authority, in its final order, to require avoidance of specific streams or wetlands, mitigation procedures for specific streams or wetlands, and independent monitoring of construction in all or specific streams and wetlands.

5.5.17.5. Wetlands Reserve Program lands

The Wetlands Reserve Program (WRP) is a voluntary program overseen by NRCS of USDA. Farmers are provided the opportunity to retire marginal agricultural lands, and reap the economic and social benefits of having wetlands on their property. The program offers a landowner payment for restoring, protecting, or enhancing wetlands on the property in consultation with NRCS, USFWS, WDNR, and local conservation districts.

The law allows the purchase of permanent easements, 30-year easements, or 10-year cost-share agreements (without an easement). The landowner maintains ownership of the land and is responsible for taxes on easement lands. Public access is not allowed unless desired by the landowner. Eligibility for enrollment into the program is granted according to: (1) duration of the easement offer; (2) hydrology restoration potential; (3) habitat value for migratory birds and other wildlife; (4) wetland functions and values; (5) location significance; (6) wetland management requirements; (7) physical site condition; and (8) overall cost. Applications with the most environmental benefits and least cost are selected.

After WRP easements are established, use of the land is limited to those uses that would not diminish or degrade the wetland values. WRP easements have significant restrictions. Acceptable uses may include hunting, fishing, timber harvesting, haying, or grazing, depending upon the situation. Cropping or other alterations that would harm the wetlands are not allowed.

WRP easements or cost-share agreements do not necessarily prohibit the construction of a transmission line across a wetland. A biologist or the central NRCS office in Washington would likely decide if a proposed line or access road were a “compatible” use. Landowners can make “compatible use” requests throughout the life of the easement or agreement.

5.5.18. Woodlands

5.5.18.1. Potential impacts to woodlands

Wisconsin forests provide recreational opportunities, wildlife and plant habitats, and timber. Building a transmission line through woodlands requires that all trees and brush be cleared from the ROW. One mile of 100-foot ROW through a forest results in the loss of approximately 12 acres of trees. Transmission construction impacts can include forest fragmentation and the loss and degradation of wooded habitat, a reduction of aesthetic enjoyment of the resource, and/or the loss of income.

Different machines and techniques are used to remove trees from the transmission ROW depending on whether the woodlands consist of mature trees, have large quantities of understory trees, or are in sensitive environments such as a wooded wetland. These can range from large whole tree processors which can cause rutting and compaction of the forest floor to hand clearing with chainsaws in more sensitive environments. These activities are illustrated in Figures Vol. 2-15 and 2-16.

Wisconsin statutes (Wis. Stat. § 182.017(7)(e)) state that all timber removed for construction of a high-voltage transmission line remains the property of the landowner. Thus, the landowner should discuss with the ROW agent at the time of easement negotiations (see Section 5.3) the disposition of all timber to be cut. Larger timber might be stacked on the edge of the ROW for the owner. Smaller diameter limbs and branches are often chipped or burned. According to the landowner’s wishes, wood chips may be spread on the ROW, piled to allow transport by the landowner to specific locations, or chipped directly into a truck and hauled off the ROW. See Figures Vol. 2-17 and 2-18.

5.5.18.2. Forest fragmentation

Forest fragmentation occurs when large unbroken areas of natural forest are cut into increasingly smaller woodlands. Corridors are cleared for infrastructure such as highways, pipelines, and power lines. Wooded parcels are increasingly cut into smaller pieces and converted to agricultural, urban, and commercial uses. Forest fragmentation results in the increase of linear edge relative to the area of internal forest. As fragmentation continues, a forest will suffer a permanent reduction in its vegetative and wildlife diversity and its ability to function as an ecological unit.

Fragmentation makes interior forest species more vulnerable to predators, parasites, competition from edge species, and catastrophic events. It also causes a permanent reduction in species diversity and suitable habitat for some species which require large undisturbed blocks of interior forest habitat for necessary activities such as nesting or breeding. Because large blocks of undisturbed forest are relatively rare, many of these species are also rare. Further loss of interior habitat and creation of increasingly smaller patches of suitable habitat can greatly affect the long-term survival of some species. For example, in Wisconsin, the pileated woodpecker will not breed in woodlands smaller than 250 acres and the cerulean warbler has been shown to avoid forest blocks smaller than 340 acres.^{77 78} Species that require forest interior for long-term survival include fishers, pine martens, timber wolves, red-shouldered hawks, many passerine birds, such as warblers and flycatchers, and a number of woodland plants.

New clearings alter the vegetation and animal life both within the ROW and up to several hundred feet outside of the ROW. Studies of transmission ROW in forested habitat show a decrease in the density of interior forest species with increasing proximity to the ROW, while the density of edge species increased along the forest-edge interface.⁷⁹ Increased sunlight and wind penetrate the forest edge and create conditions that favor plant species more tolerant of light and drier conditions. Many of the plants and the animals that prefer edge habitat are very common species that can readily out-compete native plants and animals because of their opportunistic behaviors and greater tolerance to a wide range of environmental conditions. In bird populations, the increase in forest edge has been correlated with increases in nest predators such as blue jays, raccoons, and skunks and an increased nest parasitism from brown-headed cowbirds. Examples of species which proliferate in edge habitat include raccoons, skunks, cowbirds, blue jays, crows, white-tail deer, garlic mustard, buckthorn, and boxelder trees.

Cleared corridors may also create a barrier to movement for some species. This eventually leads to a decrease in genetic variability, leaving the remaining species and populations more susceptible to disease and less able to respond to change.

5.5.18.3. Other types of woodland impacts

Three other woodland impact examples are notable enough to mention here.

The activities associated with clearing trees and constructing a transmission line through or along the edge of forested areas can destroy and degrade forest habitat. Seeds and other propagating parts of non-native plants may be carried into a forest inadvertently by construction equipment. Disturbance caused by construction can then encourage aggressive growth of these invasive species (see Section 5.5.9). Habitat providing food and cover for local wildlife may be altered or lost if these invasive species out-compete existing native plants, resulting in a loss of plant and animal diversity.

⁷⁷ Ambuel, B. and S. A. Temple. 1983. Area-Dependent Changes in the Bird Communities and Vegetation of Southern Wisconsin Forests. *Ecology* 64:1057-1068.

⁷⁸ Robbins, C. S., and B. A. Dowell. 1989. Habitat Area Requirements of Breeding Forest Birds of the Middle Atlantic States. *Wildl. Monogr.* 103. 34 pp.

⁷⁹ Kroodsma, R.L. 1982. Edge Effect on Breeding Forest Birds along a Power-line Corridor. *J. Applied Ecol.* 19:361-370.

Trimming and clearing oak trees at certain times of the year can also contribute to the spread of oak wilt disease. Red oak, black oak, and northern pin oak are especially susceptible to the disease and will often die within one year of infection. The cause of the disease is a fungus that is carried by sap-feeding beetles or spread through common root systems. In the upper Midwest, pruning or removal of oaks should be avoided from late spring to midsummer, when the fungus most commonly produces spores.

Trimming or removing riparian woodlands along streams and wetlands can adversely affect water quality and trout habitat. Removal of trees would result in the loss of cooling shade and cause an increase in water temperature. Loss of the buffering woodlands would also eliminate some wildlife and herbaceous plant habitat in the riparian area. Riparian woodlands also serve as a buffer or filter and may prevent stormwater from carrying soil or chemical contaminants to the stream.

5.5.18.4. Pulp and timber losses

The production of trees for pulp and timber use is an important industry, occurring mostly on land owned by corporations associated with the pulp and paper industry and also on privately held lands. Because transmission line ROWs must be kept clear of tall woody vegetation, the area within a ROW is permanently lost as a site for pulp and timber production.

5.5.18.5. Mitigation of impacts to woodlands

Impacts to woodlands can be minimized by a variety of methods. Example methods include:

- Avoiding routes that fragment major forest blocks.
- Adjusting pole placement and span length to minimize the need for tree removal and trimming along forest edges.
- Allowing tree and shrub species that reach a maximum height of 12 to 15 feet to grow within the ROW.
- Following WDNR guidelines for preventing the spread of exotic invasive plant species and diseases such as oak wilt.

5.5.18.6. Managed forest program lands

The Managed Forest Law (MFL) program and the Forest Crop Law (FCL) program work to encourage sustainable forestry on private woodlands in exchange for reduced property taxes. The FCL program was enacted in 1927 and enrollment was closed in 1986. The MFL program was enacted in 1985 and is the only forest tax law program that is now open to enrollment. Both programs encourage healthy and productive management of forest properties through a written management plan which incorporates landowner objectives, timber management, wildlife management, water quality, and the environment as a whole.

When a transmission line is constructed through woodland, all trees within a ROW are removed. Eligibility for the MFL program requires that no more than 20 percent of the land be in a non-productive state (not growing trees). If the amount of productive woodland falls below 20 percent, the property might be dropped from the program when the contract expires, and the property owner may suffer a monetary loss. Participants in these forest programs along a transmission route would therefore be permanently affected by the line. Loss of MFL eligibility could also have a long-term adverse effect on recreation, since landowners that receive the largest property taxes deferrals must open their land for hunting, fishing, hiking and cross-country skiing.