(Photo from Kemp Natural Resources Station Archives)

# Management Implications

This section is not intended as a manual for specific management prescriptions, because these depend on management goals and objectives, which in turn, depend on ownership. However, it is intended as a tool to help identify ecological opportunities and limitations for management on specific sites.

## GENERAL CONSIDERATIONS

The hydrologic processes in a forested wetland include the movement and behavior of water through that wetland. Understanding landform, water source, water table position, the factors controlling it, and other factors in forest management will help with management considerations. While many wetland functions are unaffected or even enhanced by forest management, some functions can be compromised by land management activities. For some sites, potential water table rise or "swamping" is a concern following timber harvesting. There is also a lack of understanding about under what conditions and on what types of sites swamping is a problem.

(Photo from Kemp Natural Resources Station Archives)

Changes in water table dynamics can impact regeneration growth and survival leading to stand conversion, especially on very wet sites. The water table is the boundary between water saturated and unsaturated soil. The water table may vary seasonally due to changes in precipitation and evapotranspiration (ET) which includes both evaporation and transpiration. Evaporation is the movement of water to the air from sources such as soil, canopy interception and waterbodies. Transpiration is the movement of water within a plant from the soil and the subsequent loss of water vapor through leaf stomata.

Both transpiration and the precipitation processes can play a large role in water loss from wetlands. Since timber harvesting reduces total leaf biomass at the site, it reduces transpiration levels and may raise the water table. In other words, if the removal of trees reduces ET, and as a result, soil water depletion decreases, then the water table will rise. If the duration of time when water tables are near the soil surface is extended after harvesting, it can cause a shift in the vegetation community from facultative wetland species. It can also favor the establishment of herbaceous or shrub vegetation rather than trees. Soil characteristics that impede drainage, topographic positions that favor water collection, and increased levels of basal area removal are all known to increase the potential for the water table to rise following timber harvesting.

Forest hydrologists tend to identify the measurement of 30 cm (growing condition) because it is used to differentiate between wetland and upland sites. For wetlands, most of the rooting zone occurs within 30 cm of the surface and can affect the hydrologic response (Verry 1986, 1997, Slezak 2014). Sites with consistent water input are less likely to be influenced by management.

Hydroperiod, or the period of soil saturation, is known to vary greatly in wetland types and landscape positions. Wetlands fed by consistent groundwater sources have very little water table variability, while alluvial floodplain forests may have variations of several meters. Overall, forested wetlands in northern North America that occur on mineral soils and are dominated by precipitation inputs have intermediate water level variability characterized by frequent water level fluctuation and a large water table drop during the peak of ET that occurs in mid- to late summer *(Slesak et. al, 2014)*. These latter wetland types are most susceptible to management induced water table rise associated with reduced transpiration following harvesting.

Verry (1986, 1997) proposed a general consideration regarding mean water table depth and its relationship to swamping following harvesting in wetlands. If the water table is within 30 cm of the surface, harvesting will generally not cause a rise in the water table elevation because these wetlands typically have a consistent source of water input with less influence of evapotranspiration (ET). However, if the water table is more than 30 cm below the surface, then harvesting will raise the water table, especially on mineral soil wetlands where ET is the dominant water loss pathway.

Measuring the average annual depth of the water table without an onsite monitoring well can be difficult, but there are some options that can be used to estimate relative water table position. Foresters can refer to water table depth from the Natural Resource Conservation Service (NRCS) Web Soil Survey data. Soil types in the NRCS Survey with very poor and poor drainage classifications generally have water tables near the soil surface. In addition to soil survey data, soil augers can be used to extract a soil sample to check for mottling and gleyed color patterns, indicators of saturation and seasonally high water tables. Soil pits can also be used at some sites to directly observe water table position.

Other factors that can affect the hydrologic processes and increase ponding/swamping are vehicular traffic (rutting and compaction) and alteration or impeded drainage. In particular, rutting on organic soil wetlands can restrict shallow subsurface flow and cause ponding. Studies have shown that more than one pass by logging equipment in wetland soils can dramatically compact the area, thus affecting water movement. Harvesting during frozen conditions, use of logging mats and driving over tops/branches can minimize these affects. Road systems near or through wetland forests can impede water flow, and should be located away from wetlands whenever feasible.

(Photo from Department of Natural Resources Archives)

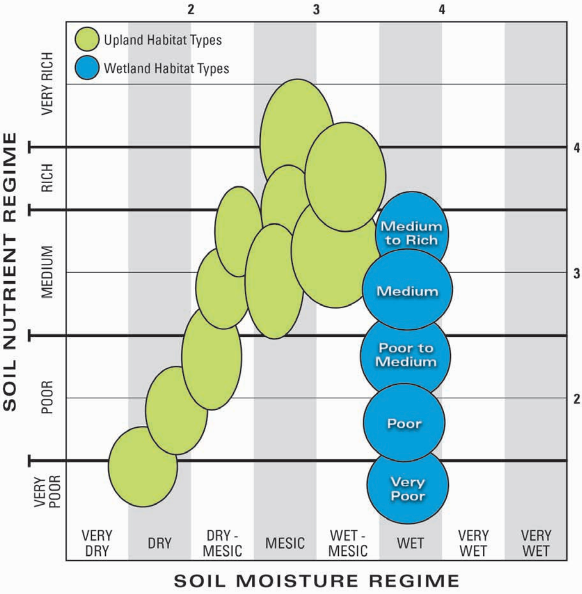
Installing adequate cross drainage structures such as culverts can maintain the hydrologic flow necessary to maintain these forest systems when properly designed. Failing to consider these practices may alter the hydrology and result in swamping, tree mortality, and site conversion to alder, cattails or other undesirable vegetation.

Infrastructure (roads, skid trails, and landings) development and maintenance can have both immediate and cumulative impacts on forest soils and wetland hydrology. Studies have correlated these impacts with changes in hydrologic regimes, surface drainage patterns, and soil moisture. The negative impacts of transportation systems are well studied at the fine scale or site-level, but have not been studied in an integrated manner on larger landscapes in the Great Lakes region. Roads and utility corridors have been implicated in the spread of non-native invasive species. They can also act as barriers to movement for some species, fragment habitat, create edge, and attract human disturbances.

Fortunately, the development of best management practices for water quality in Wisconsin is diminishing these problems. We also hope that applying wetland habitat type classification to research and management will help advance safe utilization of this valuable resource.

## HABITAT TYPE GROUPS

To simplify the description, analysis and discussion of ecologically-similar habitat types (those occupying the same position on the moisture-nutrient gradient) across the five regions, a total of 19 types were grouped into five relative productivity (or soil nutrient richness) groups: very poor, poor, poor to medium, medium, and medium to rich.




| | VERY POOR | POOR | POOR TO MEDIUM | MEDIUM | MEDIUM TO RICH |
|---|---|---|---|---|---|
| REGION 1 | PmLLe | PmLNe | LArIx | FnOn | |
| REGION 2 | PmLLe | PmLNe | ThAbFnIx | FnAbI | |
| REGION 3 | PmLLe | PmLNe | FnAbArOn<br>AbFnThOs<br>AbFnThIx<br>AbThArAsp | FnArI | |
| REGION 4 | PmLLe | PmLNe | ThAbFnC<br>AbThArAsp | FnThAbAt | FnUB |
| REGION 5 | PmLLe-An | PArGy | ArFnRh | FnArI-Ix | |

# HABITAT TYPE GROUP 1
# NUTRIENT — VERY POOR

## Site Characteristics

This group of treed peatlands, or acid bogs, represents the most nutrient poor wetland forests in their respective regions. These most often occur in strips along lakeshores, or as landscape depressions clearly showing evidence of filled-lake origin. Surface consists of a thick layer of hummocky sphagnum moss, which grades into substrate of progressively decomposed sphagnum peat. Depth of peat varies greatly, but generally exceeds five feet. These peatlands receive little or no stream or groundwater discharge and depend on precipitation for moisture, resulting in acidic and nutrient poor growing conditions.

## Principal Cover Types

Tamarack and black spruce are the only consistently present and best adapted species. Although jack pine, white pine and white birch also occur sporadically, they tend to display clearly an "offsite" condition. Most hardwoods require higher nutrient levels than these types provide.

## Regeneration

Black spruce and tamarack reproduce naturally via wind dispersed seed on suitable seed beds of moist sphagnum with limited competing vegetation. Hummock microsites with some drainage can be important for germination and seedling growth during wet periods. Extended droughts, on the other hand, can dry out the sphagnum and cause regeneration failures. Regeneration periods are typically long due to the difficult growing conditions and low productivity of these sites.

## Growth Potential

Growth potential is generally low, but tamarack and black spruce are well-suited for these types. Growth potential is very poor for other tree species.

(Photo from Kemp Natural Resources Station Archives)

## Other Management Considerations

Primarily even-aged methods are used to manage both black spruce and tamarack. The progressive strip clearcut regeneration method has been used successfully in Wisconsin to promote black spruce and tamarack seed dispersal and subsequent regeneration, while maintaining partial forest cover to reduce the risk of swamping (i.e., raising the water table). Uniform clearcut, followed by prescribed fire and broadcast direct seeding, is another commonly used method in the Lake States. Insect and disease threats, such as dwarf mistletoe in black spruce and larch sawfly and eastern larch beetle in tamarack, can be very damaging.

Hydrology and operational considerations are especially important in this group, due to the extremely saturated conditions and sensitive nature of the sites. Site damage due to rutting or poorly placed roads can impede water movement, increase swamping risks, and limit future site productivity. Raised sphagnum bogs sometimes have open water areas or "moats" adjacent to the upland, making access more difficult. Logging is almost always seasonally restricted to well frozen conditions, which may not occur every year. The use of slash mats can help minimize site disturbance. Consult Wisconsin's *Forestry Best Management Practices for Water Quality* for additional operational considerations.

# HABITAT TYPE GROUP 2
# NUTRIENT — POOR

## Site Characteristics

This group of treed peatlands or bogs are generally less acidic and somewhat less poor in available nutrients than Habitat Type Group 1. The more plant-favorable nutrient status is due to hydrologically elevated nutrient conditions. They most often occur in strips along lakeshores, or as landscape depressions clearly showing the evidence of filled-lake origin. Substrate profile is similar to that of Group 1. Surface consists of a thick layer of hummocky sphagnum moss, which grades into substrate of progressively decomposed sphagnum peat. Depth of peat varies greatly, but generally exceeds five feet. In contrast to Group 1, these peatlands receive some stream or groundwater discharge resulting in higher pH and improved growing conditions.

## Principal Cover Types

Tamarack and black spruce are consistently present and the best adapted species on these sites, but in contrast to types in Group 1, stands often contain other species, particularly balsam fir, northern white cedar, red maple, paper birch and sometimes white pine.

## Regeneration

Black spruce and tamarack are the dominant reproduction, however, balsam fir and red maple reproduction is often well represented. Black spruce and tamarack reproduce via wind dispersed seed on suitable seed beds of sphagnum. The moist sphagnum substrate is important for germination and seedling growth but can dry out during drought periods, causing regeneration failure. This habitat type group tends to have more vegetation competition from shrubs and other tree species. Opportunities for management of stands on these types are somewhat better than those in Group 1.

## Growth Potential

Growth potential is moderate for tamarack, black spruce and balsam fir; low for northern white cedar, red maple and paper birch.

## Other Management Considerations

Primarily even-aged methods are used to manage both black spruce and tamarack. The progressive strip clearcut regeneration method (with strips placed perpendicular to prevailing wind) is used to manage black spruce and tamarack. One important consideration during regeneration harvests is to leave tops and branches scattered throughout, primarily as a source of seed, and to maintain nutrient regimes. Uniform clearcut, followed by prescribed fire and broadcast direct seeding, is also a regeneration method used in the Lakes States. Insect and disease threats include dwarf mistletoe and spruce budworm in black spruce and several insects in tamarack (larch sawfly, larch casebearer, eastern larch beetle), periodically causing landscape-level mortality.

Hydrology and operational considerations are especially important due to the extremely saturated conditions and sensitive nature of the sites. Swamping can occur on these sites, especially if there is increased compaction and impeded drainage due to rutting from harvesting equipment and travel throughout the stand. Sphagnum bogs usually have open water areas or "moats" adjacent to the upland, making access more difficult. Logging is usually restricted to well frozen conditions, which may not occur every year. The use of slash mats can help minimize site disturbance. Consult Wisconsin's *Forestry Best Management Practices for Water Quality* for additional operational considerations.

*(Photo from Kemp Natural Resources Station Archives)*

## HABITAT TYPE GROUP 3
## NUTRIENT— POOR TO MEDIUM

### Site Characteristics

Habitat types in this group typically represent areas of glacial outwash, or pitted outwash, although they may also be found on other glacial landforms. Soil surfaces typically consist of a shallow (less than two feet) organic layer upon mineral soil of sandy and gravely texture. Mottling is found in the soil profile within two feet of the surface and, in some seasons, saturated conditions are found at the surface. In some instances, the organic layer is deeper than five feet, e.g., LArIx type in Region 1. Vernal ponding and lateral flow of groundwater strongly favors black ash on these types.

### Principal Cover Types

Because this group spans a relatively wide range of soil nutrient availability, species composition of stands on types in this group varies considerably. Balsam fir may be considered the “common denominator” on all types and northern white cedar is also a common component. Presence of black ash is an important characteristic. The importance of this species increases and that of conifers decreases toward the “rich” end of the scale. Other important species in some stands are red maple and paper birch, and sometimes eastern hemlock and yellow birch.

### Regeneration

Presence and species composition of advance regeneration is dependent on the composition of the overstory. However, balsam fir and black ash saplings are best represented in most stands in this group. Canopy gaps created by windthrow are a common natural disturbance within these stands, favoring black ash (and red maple) reproduction from seed and vegetative sprouts. Yellow birch and eastern hemlock also disperse their light seeds easily and recruit well in light conditions created by the windthrow gaps.

## Growth Potential

Growth potential is good for balsam fir and northern white cedar, moderate for black ash, paper birch and red maple. Maintenance of lateral flow of groundwater is important for good growth potential.

## Other Management Considerations

A variety of silvicultural methods have been used to manage black ash. The strip clearcut or strip shelterwood method has been a successful alternative by maintaining site hydrology while creating conditions for a variety of species to regenerate in the harvest strips. Coppice with reserves is limited to sites where there is potential for leaving larger reserve patches for seeding potential and maintaining hydrology; however, sometimes this method can raise the water table. Clearcutting has been less successful, mainly because of the risk for swamping the site.

Insect and disease threats in black ash are mainly emerald ash borer, which causes near complete mortality of ash in the stand. Recommendations to regenerate non-ash species on these habitat types are being developed.

Hydrology and operational considerations are particularly important due to seasonally saturated conditions. Site damage due to rutting and impeded water movement increase swamping risks and limit site productivity. Lateral flow of groundwater sustains these forests and can be dramatically altered by rutting, road construction, and the improper installation of drainage structures. Many of these sites have swamped and converted to tag alder as a result of altered hydrology. If road construction is developed near these stands, proper drainage features is recommended.

These forests are susceptible to invasive plant infestations and other competitive vegetation, including reed canary grass, Buckthorns *(Rhamnus* spp.*)*, prickly ash and tag alder. Since these plants can negatively impact habitats, minimize or avoid their spread.

# HABITAT TYPE GROUP 4
# NUTRIENT — MEDIUM

## Site Characteristics

Habitat types representing this group typically are found on glacial till. Surface of the soil profile typically consists of a relatively shallow layer (less than one foot) of organic material in varying degrees of decomposition, from fibric to sapric. Mineral soil in the upper two to three feet of the profile is of medium to fine texture (e.g., loam, silt loam or fine sand) and often is sandier below this depth. Saturated conditions are often found at two to three feet of depth. However, about 20 percent of study plots had well decomposed organic material reaching to depths greater than five feet.

## Principal Cover Types

Black ash typically is well represented, if not dominant, in all habitat types of this group. There are, however, some regional differences. Balsam fir is sometimes a strong associate in Region 2, red maple in Regions 3 and 5, and balsam fir and northern white cedar in Region 4. Other minor associates in some types include paper birch, (formerly) American elm, sugar maple, basswood, yellow birch, quaking aspen and eastern hemlock.

## Regeneration

Presence and species composition of advance regeneration is to a large extent dependent on composition of the overstory. However, black ash, red maple or balsam fir saplings are best represented in most stands in this group. Canopy gaps created by windthrow are a common natural disturbance within these stands, favoring black ash and red maple reproduction from seed and vegetative sprouts. Northern white cedar, yellow birch, and eastern hemlock also recruit well in light conditions created by the windthrow gaps.

## Growth Potential

Growth potential is good for black ash, northern white cedar, balsam fir and red maple. Maintenance of lateral flow of groundwater is important for good growth potential.

*(Photo from Department of Natural Resources Archives)*

## Other Management Considerations

A variety of silvicultural methods have been used to manage black ash. The strip clearcut or strip shelterwood method has been a successful alternative by maintaining site hydrology while creating conditions for a variety of species to regenerate in the harvest strips. Coppice with reserves is limited to sites where there is potential for leaving larger reserve patches for seeding potential and maintaining hydrology, however, sometimes this method can raise the water table. Clearcutting has been less successful, mainly because of the risk for swamping the site.

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These forests are susceptible to invasive plant infestations and other competitive vegetation, including reed canary grass, Buckthorns *(Rhamnus* spp.*)*, prickly ash and tag alder. Since these plants can negatively impact habitats, minimize or avoid their spread.

## HABITAT TYPE GROUP 5
## NUTRIENT — MEDIUM TO RICH

***NOTE: Only one habitat type, FnUB in Region 4, fits into this category.***

### Site Characteristics

Primarily on glacio-lacustrine deposits associated with the Green Bay lobe (see page 8-2, "Glacial Deposits" map). Most often mineral soil of varying texture, but typically containing significant proportions of clay and silt in the upper profile and coarser materials below. Saturation zone typically within three feet of the surface. Substrate on about 30 percent of study plots consisted entirely of well decomposed organic matter (black muck) to a depth of greater than five feet.

### Principal Cover Types

Black or green ash are a predominant species in most stands. Common associates are (formerly) red elm and silver maple. Conifers almost entirely lacking in this type.

### Regeneration

Black ash saplings are best represented in most stands. Green ash, silver maple and (formerly) red elm occurred in approximately one-third of the study stands. Black and green ash reproduce naturally through gaps from windthrow. The seed bank can stay viable for up to seven years. Both species are prolific stump sprouters with rapid growth rates. Silver maple is a prolific seeder with good seed crops every two years. (Formerly) Red elm reproduces in large gaps from windthrow and the seed is wind dispersed with good seed crops every two to four years. Like all elms, this species is subject to Dutch elm disease.

### Growth Potential

Representing one of the most nutrient rich wetland habitat types, growth potential is good for black ash and silver maple; possibly also good for northern white cedar and other swamp conifers, although these rarely occur naturally on this type.

(Photo from Department of Natural Resources Archives)

## Other Management Considerations

A variety of silvicultural methods have been used to regenerate the predominant tree species of ash and silver maple on this type. Strip clearcut and group selection may be the appropriate methods. Selection and shelterwood can also be applied but increases the number of harvest entries over a period of time. Some sites are located near or on lacustrine deposits near Green Bay, and may encounter periodic water table fluctuation associated with the lake, while others are depressional wetlands affected by runoff.

Hydrology and operational considerations are particularly important due to seasonally saturated conditions, particularly due to spring runoff. Site damage due to rutting and impeded water movement increases swamping risks and limits site productivity. Lateral flow of groundwater sustains these forests and can be dramatically altered by road construction and improper installation of drainage structures. If road construction is developed adjacent to the site, proper drainage structures will have to be installed.

These forests are susceptible to invasive plant infestations and other competitive vegetation, including reed canary grass, Buckthorns *(Rhamnus* spp.*)*, prickly ash and tag alder. Since these plants can negatively impact habitats, minimize or avoid their spread.

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