NATURAL RESOURCES COMMISSION

Information Bulletin #17 (Fifth Amendment)

SUBJECT: Habitat Mitigation Guidelines

I. Purpose

The purpose of this bulletin is to provide guidance for developing compensatory mitigation plans associated with applications for permits and remediation of violations under IC 14-26 (the "Lakes Preservation Act"), IC 14-28-1 (the "Flood Control Act") or IC 14-29-1 (the "Navigable Waterways Act"). The bulletin is intended as guidance to identify when mitigation is necessary and to determine the type of mitigation required for the site conditions. The bulletin will be considered by the Department of Natural Resources (DNR) when evaluating permit applications, considering remediation plans associated with violations as well as in other instances when site remediation is necessary. The regulated public should consider the bulletin during the development of projects. The bulletin provides flexible standards to be considered with an understanding that each site is unique and presents a variety of challenges and opportunities.

The mitigation guidelines are directed most notably to projects under the Flood Control Act. Mitigation associated with the Navigable Waterways Act will generally be addressed contemporaneously with or in a manner similar to mitigation under the Flood Control Act. The mitigation guidelines will also be considered with respect to remediation under the Lakes Preservation Act. Because mitigation involving public freshwater lakes is rare and highly variable, detailed discussion of mitigation under the Lakes Preservation Act is not included in the bulletin.

II. Floodway Identification

The DNR's authority within a "floodway" is defined by 312 IAC 1-1-16. For purposes of this information bulletin, the "floodway" is limited to where a river or stream has a drainage area of at least one square mile. 312 IAC 10-1-2(c). Information regarding the location and delineation of a floodway for a particular river or stream may be obtained from the DNR at:

Division of Water
Department of Natural Resources
402 W. Washington St., Rm. W264
Indianapolis, IN 46204
Telephone: 1-877-928-3755
https://www.in.gov/dnr/water/

III. Mitigation

Mitigation provides for the development and preservation of resources on-site or at an alternative site that are similar to or better than the resources originally found within the impacted area. In the context of violation remediation, mitigation is intended to restore or enhance the resources within an impacted site. In some instances, participation in the In-Lieu Fee Program, Information Bulletin #79 *[20200603-IR-312200289NRA]*, may be beneficial to achieving the desired mitigation results.

To obtain a permit, an applicant must prove to the DNR that regulated activities (such as filling, excavating, or building) would not result in "unreasonably detrimental effects upon the fish, wildlife, or botanical resources". IC 14-28-1-22(e).

> Unreasonably detrimental effects upon fish, wildlife, or botanical resources means damage to fish, wildlife, or botanical resources that is found likely to occur by the director based upon the opinion of a professional qualified to assess the damage and:
> (1) creates a condition where recovery of the affected resources is not likely to occur within an acceptable period; and
> (2) cannot be mitigated through the implementation of a mitigation plan approved by the director.
> 312 IAC 10-2-39.

Mitigation is generally focused on impacts to a stream or other body of water and to the associated riparian area. The riparian area is the land adjacent to a stream or other body of water that transitions into an upland habitat. Riparian areas vary in composition based on site conditions, however, common components include wetlands, forests, and open and herbaceous areas. Although riparian areas are often a small percentage of the total land

area, they serve many valuable functions and provide vital elements in the overall landscape. They offer corridors for a wide range of wildlife and important feeding and nesting areas as well as providing both a buffer and an ecological link between water-based and land-based ecosystems.

When mitigation is required, a mitigation plan must be submitted to the Division of Water for review by a Division of Fish and Wildlife biologist for DNR approval.

IV. Mitigation Steps

Before initiating mitigation, the resources in the impact site must be evaluated. The types, diversity, and density of vegetation, stream characteristics, and proximity to other habitats are examples of the characteristics to be identified during the evaluation. Existing ecological condition and performance standards of the mitigation site are based on the best available science that can be measured or assessed in a practicable manner. In some instances, formal habitat evaluation may be necessary. The Floristic Quality Assessment ("FQA"), Quality Habitat Evaluation Index ("QHEI"), and Headwater Habitat Evaluation Index ("HHEI") are common evaluation tools.

Once a site is evaluated, a strategy is developed following these steps:
(1) Avoidance of impacts to the resources.
(2) Minimization of impacts to the resources.
(3) Compensatory mitigation to offset unavoidable impacts.

During design, seeking avoidance of impacts is the first step. Avoidance is critical if a listed species has been recorded near the project site. Obtaining a list of threatened and endangered species from the DNR's Division of Nature Preserves early in the project development phase can help avoid impacts. For example, avoiding tree cutting at certain times of the year is a means to avoid impacts to the state and federally endangered Indiana bat.

Minimization can occur through a variety of ways. Impacting the edge of forested habitat instead of fragmenting the forest is an example of minimization through choice of location. Conducting in-stream work outside the fish spawning season is another form of minimization based on scheduling.

Compensatory mitigation should be the last step in mitigation after appropriate and practical steps have been taken to avoid and minimize impacts. Compensatory mitigation typically involves site restoration but can also include creation, enhancement, and preservation.

A. Restoration

Restoration is the preferred method of compensatory mitigation and involves restoring habitat in areas that at one time likely contained habitat. Planting native trees, shrubs, forbs, and grasses, and installing in-stream habitat features are common forms of restoration. Restoration is expected to have a higher success rate than new habitat creation, and restoration options should be considered before pursuing alternative mitigation methods. Additionally, restoration adjacent to existing habitat is beneficial for the local environment.

B. Enhancement

Enhancement generally involves adding natural habitat features within an area containing some natural features but not possessing all the desired qualities. Like restoration, enhancement should result in a significant increase in overall habitat quality. Inter-planting within an area containing some woody vegetation, or removing non-native, invasive species are examples of enhancement. In some areas, the addition of a habitat feature may have a negative impact on current natural conditions. These instances typically require close scrutiny and detailed explanation of net benefits.

C. Creation

Creation is the construction of new habitat where the proposed habitat did not previously exist. Habitat creation may be a difficult and complex endeavor. Understanding the soils, hydrology, and topography of a site proposed for habitat creation will improve the likelihood of successful habitat creation. This form of mitigation must be pursued with caution.

D. Preservation

Preservation requires setting aside land having existing habitat to avoid impacts by future actions.

Preservation is typically part of a mitigation package that includes restoration or enhancement because by itself preservation results in a net loss of habitat. Preservation and creation are typically considered for mitigation only if no other option is available. Preservation is mainly considered in one of the following situations:

(1) Using another form of compensatory mitigation is impracticable at the approved ratio, and preservation would protect tracts with better than average quality that contain at least 10 acres.
(2) Preservation would protect an outstanding resource.
(3) A threat is demonstrated to the resource proposed for protection that is outside the control of the applicant.

V. Mitigation Site Location

Mitigation sites must be located within the jurisdictional area of the DNR and within the same HUC as the impact site. The mitigation should occur along the same waterbody as the impact site, when possible, or, alternatively, at another site as close to the impact site as possible. Ideally, a mitigation site should be adjacent to existing habitat of a similar type. Factors to consider in site location include:

(1) Proximity to the impact.
(2) Easements.
(3) Suitability for protection and maintenance.
(4) Current and probable future surrounding land uses.
(5) Relationships to other natural areas.
(6) Hydrology and soils.
(7) Local fish and wildlife populations.

Although mitigation within or near the impact site is most appropriate**,** mitigation at a different location, but within the same HUC, can be beneficial. For example, a different location may result in better restoration of lost functions and values or may afford a higher level of protection.

VI. Mitigation Ratios

The amount of compensation compared to the amount of impact is the mitigation ratio. The typical unit for the ratio is stated in acres, although linear feet or the numbers of trees may be used. Because mitigation is to offset temporal losses of functions and values and includes a risk of failure, mitigation ratios are generally greater than 1:1. The mitigation ratios presented in this bulletin are based on restoration and should be considered standard minimum ratios. The DNR may authorize exceptions based upon the impacted habitat. If creation, enhancement, or preservation is used instead of restoration, the DNR would likely seek higher ratios, with preservation typically at 10:1 or higher.

Habitat Category	Standard Minimum Mitigation Ratio
Palustrine Emergent Wetland	2:1
Palustrine Scrub-Shrub Wetland	3:1
Palustrine Forested Wetland	4:1
Non-wetland forest (at least one acre of disturbance)	2:1
Non-wetland forest (less than one acre of disturbance in a rural area)	1:1
Non-wetland forest (less than one acre of disturbance in an urban area)	5:1 based on trees at least ten (10) inches in diameter-at-breast-height ("dbh") OR 1:1 based on area

Standard minimum mitigation ratios typically increase by at least 0.5 if the impact area is of high quality or is largely undisturbed. Increases of 1.0 to 2.0 are typical when the impact is to a previous mitigation site, there are cumulative effects, or if there are extended temporal delays in implementing the mitigation plan. Ratios can increase if projects continue to fall out of compliance with rules, regulations, and permits. The ratio would be applied on a case-by-case basis. Some habitat types may be difficult to mitigate due to uniqueness, rarity, high quality, or difficulty in properly compensating. For example, fens are unique and very difficult to recreate, making mitigation more complicated. Habitat quality can be measured by several site assessment tools, such as FQA, QHEI, and HHEI. The DNR may not approve mitigation if an impact site is of very high quality, such as one with a FQA score of 35 or greater or a mean C-value of 3.5 or greater.

VII. Riparian Habitat Mitigation

The level of mitigation for removing trees from a non-wetland riparian area depends on the size of the area impacted, the number and size of the trees being removed, and the type and quality of the overall habitat being impacted. Impacts under 0.1 acres typically do not require mitigation or additional plantings beyond seeding and stabilizing disturbed areas, though there are exceptions, mostly for urban areas. Additional mitigation may be warranted if the impact is to a special or unique habitat or ecosystem type. The following consider some particular circumstances:

A. At least one acre of non-wetland tree removal

Projects that remove at least one acre of trees in a floodway from a non-wetland riparian area would typically result in a minimum mitigation ratio of 2:1. For example, one and one-half (1.5) acres of impact would warrant three acres of mitigation. Restoring wooded riparian habitat is slow and difficult. Typical mitigation includes restoring wooded riparian habitat in areas lacking woody vegetation or increasing the size of a current buffer. The DNR may require a restrictive covenant or other agreement to protect the site and ensure the success of mitigation.

B. Less than one acre non-wetland tree removal in a rural area

In most cases, a project that impacts less than one acre of trees in a floodway from a rural non-wetland riparian area would result in mitigation at a ratio of 1:1 based on area. The amount of appropriate mitigation may increase if the site is located near a sensitive area or other unique conditions exist. A rural area is generally the area outside:

(A) the corporate boundaries of a consolidated city or an incorporated city or town; and
(B) the territorial authority for comprehensive planning established under IC 36-7-4-205(b).

Often mitigation can be accomplished by replanting the disturbed area. If this approach is impracticable, mitigation can be moved off site in coordination with the Division of Fish and Wildlife biologist.

Mitigation would be initiated as soon as practicable and include a mixture of native grasses, sedges, wildflowers, shrubs, and trees suitable to the same region of Indiana (north, central, south) as the mitigation site. Additional details are found in Section X.

C. Less than one acre non-wetland tree removal in urban area

Urban floodways can consist of mowed grass to entire forests and all gradients in between. In order to address this variation, mitigation for impacts of less than one acre of urban non-wetland riparian area tree removal depends on what is impacted. If the impact site consists of scattered trees in a park-like setting, mitigation normally consists of replacing the larger trees only. For each tree removed that is at least ten inches in diameter-at-breast-height ("dbh"), five trees at least one to two inches in dbh would be planted. Mitigation trees are to be selected from the Woody Riparian Vegetation List (Appendix A) and should be planted along the stream corridor, if practicable. If impracticable, a Division of Fish and Wildlife biologist would work with an applicant to devise an acceptable planting plan.

If the area impacted is less than one acre but includes a forest with more than one vegetation layer (e.g., herbaceous, understory, overstory vegetation), mitigation is typically the same as with rural areas, at a 1:1 ratio based on area.

D. Early successional habitat

Early successional non-wetland riparian habitat typically includes annual and perennial grasses and forbs, and it may include scattered shrubs and small saplings. An example of an early successional riparian habitat includes a one-to-five-year-old abandoned farm field. Areas where farming has recently ceased and are fallow for less than a year do not generally require mitigation. Aerial photography or other methods may be used to indicate recent farming activity.

Early successional riparian habitat disturbed by temporary impacts warrants replanting the disturbed area. Mitigation at a ratio of 1:1 would be needed for a permanent impact to early successional riparian habitat. A native herbaceous riparian seed mixture is planted with at least 10 species of native grasses, sedges, and wildflowers selected from the Herbaceous Riparian Vegetation List in Appendix A. If the area contains

scattered shrubs or tree saplings, mitigation includes woody species native to the region.

VIII. In-Stream Habitat and Mitigation

Stream relocations, stream crossings, stream enclosures (e.g., culverts and pipes), and other similar projects typically result in impacts upon in-stream habitat that require in-stream mitigation. Because in-stream impacts vary widely, in-stream mitigation is considered on a case-by-case basis. An early coordination meeting with a Division of Fish and Wildlife biologist is highly recommended to review alternatives.

Impacts to less than 50 feet of stream typically do not require in-stream mitigation. Mitigation may be needed if impacts result to important resources, such as mussel beds. Impacts from 50 feet to 300 feet through a single project or an accumulation of projects are typically mitigated at a 1:1 ratio. Impacts over 300 feet often warrant 2:1 mitigation. Exceptions to this ratio may be requested based on the quality of the habitat and the fish and wildlife resources impacted. Mitigation may be reviewed in coordination with the U.S. Army Corps of Engineers (USACE) and Indiana Department of Environmental Management (IDEM).

Mitigation for in-stream impacts includes various measures. These measures include the installation of in-stream habitat features, such as boulders; riparian plantings to increase the woody buffer adjacent to a stream (50 feet or greater is a common-sized buffer); bioengineering along the streambank to reduce erosion; improving a nearby crossing structure for the benefit of fish and wildlife; or restoring riffle-run-pool assemblages. Mitigation at a 1:1 ratio involves replacing lost functions and values along a length of stream equal to the impact. For 2:1 mitigation, lost functions and values are replaced along a length of the stream or a nearby stream that is twice the length of impact.

A complete mitigation plan for impacts to in-stream habitat includes the following:

(1) A plan view of the proposed project.
(2) The materials proposed to be used.
(3) Typical cross-sections.
(4) Typical details for each type of practice used.
(5) The time of year work would be performed.

Stream relocation projects are complex, difficult to design and construct, and have a high risk of failure. All reasonable alternatives should be considered first. If relocation appears to be the best option, a mitigation plan will be required. An applicant is encouraged to discuss a stream relocation project with a Division of Fish and Wildlife biologist before submitting a permit application. Hydraulic modeling of a relocated channel would be calculated with mature trees, shrubs, grasses, and other similar features. Additional mitigation, such as planting trees along a stream, may affect hydrologic modeling, so mitigation and engineering design need to be coordinated.

Stream relocation requires replacement of lost qualities and characteristics on the relocated segment, which are at least equal to the original segment, and which fit the surrounding landscape. Natural channel design is applied to the relocated segment, including elements needed to complement upstream and downstream conditions. To the extent practicable, the relocated segment should have a similar cross-section, substrate, in-stream features, and riparian corridor and channel morphology when compared to the original segment. The USDA's Natural Resources Conservation Service, among others, provide helpful information on channel design.

For the relocation of a medium or large trapezoidal channel, a two-stage design may be needed in which there is a low flow channel that is allowed to meander within the new channel. The overbank shelf, or bench is planted with woody vegetation when appropriate. The Woody Riparian Vegetation List in Appendix A includes species appropriate for site conditions.

All stream crossings need to consider the ability of fish and wildlife to pass through the structure. Crossings must not create conditions that are less favorable for passage through the area compared to pre-disturbance conditions. To ensure fish passage is not obstructed, material should not be placed on the streambed above the existing flowline. Wildlife passage typically requires retention of a dry, flat area free of riprap and other material incompatible with wildlife movement all the way through the structure, and must be designed to promote the passage of deer. DNR encourages the use of a bridge or a three-sided culvert instead of a full stream enclosure to assist in maintaining the natural stream bottom, which provides better fish and wildlife movement, maintains essential habitat features, and provides resting and feeding locations. Use of a full stream enclosure, such as a pipe or four-sided culvert that contains a stream on all sides is discouraged due to the detrimental effect on fish and wildlife. If a stream crossing requires the use of a full stream enclosure, fish and wildlife passage must still be

provided. A full stream enclosure that is sumped below the existing streambed elevation, to approximate a natural stream bottom, may, in some situations, be acceptable.

IX. Wetlands

A. Differing agency responsibilities for mitigation

Mitigation is required for impacts of 0.1 acre or more to wetlands. The DNR, the USACE, and IDEM have differing statutory responsibilities for wetlands. The USACE and IDEM are responsible for issues associated with water quality while the DNR's responsibility is primarily focused on impacts to fish, wildlife, and botanical resources. As a result, different factors may be addressed within a single mitigation plan to meet the requirements of the three agencies. Common concerns addressed by DNR consider whether wetland mitigation sites have an appropriate suite of native plant species, replace the same type of wetlands as those impacted, and provide appropriate fish and wildlife resources. DNR will also seek to ensure that implementation of mitigation plans does not create adverse effects to existing mitigation site resources. The DNR recommends coordinating with all three agencies when developing a mitigation plan.

B. Forested wetlands

Forested wetlands are characterized by woody vegetation that is at least 20 feet tall. Forested wetlands normally have an overstory of canopy trees, an understory consisting of trees and shrubs, and an herbaceous layer. They are often inundated with floodwater from nearby streams and may be covered by many feet of slow moving or standing water. The numerous benefits provided by forested wetlands, and time needed to successfully mitigate the habitat, warrants a mitigation ratio of 4:1.

C. Scrub-shrub wetlands

Scrub-shrub wetlands may represent a successional stage leading to a forested wetland, or they may be relatively stable communities. Scrub-shrub wetlands are dominated by woody vegetation less than 20 feet tall. They may include shrubs, young trees, and trees or shrubs that are small or stunted because of environmental conditions. These types of wetlands also take time to develop, can be difficult to restore, and typically have a mitigation ratio of 3:1.

D. Emergent wetlands

Emergent wetlands are characterized by erect, rooted, herbaceous hydrophytes (water-loving plants), excluding mosses and lichens. This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants and are frequently or continually inundated with water. Marsh, meadow, and slough are types of emergent wetlands. Since some overall loss of function and value is likely to occur through impacts to an emergent wetland, and there are temporal losses, emergent wetland mitigation is at a ratio of 2:1.

X. Mitigation Plans

A. General information

Most mitigation involves planting vegetation. Appropriate mitigation may only require planting canopy trees but more commonly includes planting understory herbaceous vegetation; a layer consisting of shrubs and small trees, and a canopy layer of larger trees. Mitigation plans typically require the following elements:

(1) The location of the mitigation site on a topographic or aerial map.
(2) A list of species of native trees, shrubs, and herbaceous plants to be planted.
(3) The number, size, and location of plantings, identified on maps or aerial photographs.
(4) The spacing of plants.
(5) The season for planting.
(6) Planting techniques.
(7) Success criteria.
(8) To help meet success criteria, a monitoring plan that extends for at least three years.
(9) If applicable, a plan view and cross-section details of proposed mitigation practices.

Plant species are selected based on local conditions. Planting near adjacent habitat of a similar type is generally preferred. If an area is prone to flooding, flood-tolerant species are selected that include larger

specimens. The taller height of containerized stock increases the probability a portion of a tree would remain above prolonged floodwaters and increases the likelihood of plant survival. Even species with high flood tolerance cannot survive extended periods with their crowns underwater. Areas in the floodway that are less prone to flooding are often suitable to a larger suite of species. An applicant should consider a diversity of trees that produce nuts (e.g., oak, hickory and walnut), and berries (e.g., dogwood, hawthorn, and gum) preferred by wildlife.

Only species native to the county may be used for mitigation. No hybrids, cultivars, or genetically modified plants are used. Lists that include suitable species are in Appendix A. Even though a species may be listed for use within a region of Indiana, local conditions may cause the species to be unsuitable for planting. Species may not be widespread within a region and may have specific habitat requirements. In addition, species may volunteer on a site and do not need to be planted.

The species approved by the DNR in a mitigation plan become part of the permit. If modifications become necessary to the approved species, a Division of Fish and Wildlife biologist would provide recommendations.

B. Woody revegetation

These guidelines apply to designing a mitigation plan that includes woody vegetation. The Woody Riparian Vegetation List in Appendix A includes species native to Indiana that are generally suitable for mitigation.

The spacing of trees is intended to optimize the use of the site by wildlife and create conditions suitable for the development of a mature riparian forest. Canopy tree spacing depends on the size of stock used. To the extent feasible, woody riparian vegetation is planted with random spacing to simulate natural stocking. By adding or subtracting one foot to the planting distance between every other tree, an offset grid can help give the appearance of random spacing. This approach should be used only with container stock to avoid overcrowding trees. Planting trees and shrubs in rows supports easier mowing and weed management but appears less natural than random planting or use of an offset grid. Tree seedlings or whips should be planted ten feet apart within each row and ten feet apart between each row. Ten-foot-by-ten-foot spacing yields 435 trees per acre. If container-grown stock (for example, three or five gallon trees that are typically four to six feet tall) is used, tree spacing can be twelve feet apart (12-foot-by-12-foot spacing yields 302 trees per acre). Balled and burlapped trees are spaced 15 feet apart, resulting in 194 trees per acre. These larger specimens often have higher survival rates and restore lost functions at a quicker rate. At one-half the density of the canopy trees, shrubs and understory trees must also be included in the woody revegetation plan. See the table below for an outline of these requirements.

Type	Spacing	Number Per Acre
Seedlings and whips	10 feet by 10 feet	435
3 and 5 gallon stock (including 1 inch to 2 inch dbh container stock)	12 feet by 12 feet	302
Balled and Burlapped	15 feet by 15 feet	194
Shrubs and Understory Trees	Between every other canopy tree	One-half of the canopy tree spacing

Additional planting principles include:

(1) At least five canopy tree species and at least five shrub/understory tree species (with a minimum one understory tree species) are selected from the Woody Riparian Vegetation List that are suitable to the region of Indiana where the project is located.
(2) Not more than one maple and at least one hickory and one oak species are selected.
(3) At least ten percent (10%) of trees are oak and hickory species.
(4) Clumping a single species in an area is avoided.
(5) A single species comprises not more than twenty percent (20%) of the canopy or understory trees planted for mitigation, with seedlings of selected species planted in approximately equal numbers.
(6) Shrubs and understory trees are planted between every other canopy tree and their species are mixed.
(7) Trees and shrubs are planted randomly by species to simulate natural stocking, but including appropriate consideration of wetlands indicator statuses.
(8) Some trees and shrubs are placed within ten feet from the proposed project limits (such as a fence or access road) to allow canopy closure over time.
(9) Species with a facultative upland ("FACU") status are planted in the floodway farthest from the stream or within dryer areas.
(10) Species with a facultative ("FAC") or a facultative wetland ("FACW") status are placed in the floodway closest to the stream or within wetter areas.

(11) Species with an indicator status of obligate wetland ("OBL") are placed in the wettest areas of the floodway.
(12) Plants and seeds are obtained from sources within American National Standards Institute ("ANSI") Plant Hardiness Zones 4, 5, or 6.
(13) Saplings are planted between either:
(A) September 15 to the earlier of December 15 or until the ground has frozen; or
(B) the latter of March 1 or when the frost leaves the ground in spring to June 1.
(14) Plantings are performed according to sound horticultural practices, including proper planting depth and soil compaction following planting.
(15) Saplings are planted so the root collar is not deeper than one-half (1/2) inch below the ground surface.
(16) The planting area is mowed:
(A) to a height of not more than six inches to provide a suitable planting area generally free of vegetative competition; and
(B) not more than ten days before saplings are planted.
(17) If the planting area exists as pasture or turf grass, the area should be treated at least once with an herbicide, preferably twice with roughly two weeks between treatments, to control vegetation.
(18) Contingency plantings (i.e., increasing the number of trees planted per acre) are not considered appropriate as it can cause overcrowding and decrease the wildlife value of a site. Increasing the number of acres planted as a contingency would be evaluated on a case-by-case basis.

Results of planting bare-root stock vary depending on site conditions. Spring planting is generally preferred, but the stock may not survive flooding. Planting in the fall may be successful, but frost heaving may displace and kill newly planted seedlings, reduce survival rates, and require replanting. As long as bare-root stock is handled properly, survival and growth can be similar to container-grown stock. Planting rates are reduced and wildlife resources tend to be provided more quickly with container grown stock. The use of mulching blankets, erosion control blankets, or turf reinforcement mats helps vegetation become established and reduces erosion during establishment. Summer planting of any size of stock can result in drought stress and mortality if there is no supplemental watering.

Fertilizing is not recommended because fertilizer often benefits weedy species. To help protect a mitigation site from unintended disturbance, "Do Not Mow or Spray" or other similar signs may be erected around the perimeter.

If planting trees is part of mitigation, periodic maintenance may be needed to select and maintain the desired species composition. During the first few years after mitigation plantings, mowing when weeds reach twelve to 18 inches can enhance the establishment of trees and shrubs. Mowing should not occur if the area was seeded with a native seed mixture. Tilling around trees should be avoided and herbicides should be used only if necessary and applied according to directions. In areas with high deer density, maintaining taller weeds may prevent seedlings from being eaten. However, this can result in slower seedling growth and increased damage by mice and other small herbivores.

C. Herbaceous revegetation

Almost all mitigation plans require establishing a native, herbaceous layer. A native herbaceous seed mixture includes at least ten species of grasses, sedges, and wildflowers, with a balance of plant types so no single group dominates. These may be selected from the Herbaceous Riparian Vegetation List in Appendix A. They tolerate full sun early in restoration development and persist to form a native understory in forested areas. Tall fescue is not used in a mitigation plan. Tall fescue is toxic to wildlife and many other plant species, including seedling trees. A native herbaceous seed mixture is compatible with native trees and shrubs and eventually promotes a diversity of food and habitat types for wildlife. If seeding along a slope of 3:1 or steeper, erosion control blankets and similar products provide immediate erosion control and help establish vegetation. Erosion control blankets and similar products need to be biodegradable and net free or use loose-woven / Leno-woven netting to minimize the entrapment and snaring of small-bodied wildlife such as snakes and turtles.

Areas to be seeded that exist as turf or other landscaping grasses should be mowed and sprayed to eliminate the grass and improve survival conditions of native plants. Seed may be applied as a total mix or in several passes if species are not compatible during mixing or application. Fertilizer or amended fillers are not to be used. Seed may be drilled or sliced into the seedbed, or broadcast mechanically or by hand. Areas that are broadcast seeded need light raking for adequate seed-to-soil contact. Seeds are not be placed more than one-eighth (1/8) inch deep. Seeds are to be treated appropriately. Legumes require scarification and others

require exposure to cold temperature, also called stratification.

No idle area is left exposed for more than seven days following grading. An area needing temporary cover should be seeded with a temporary annual grass that does not interfere with the growth of permanent vegetation, or if exposed during the winter, the soil can be stabilized with erosion control blankets or with a bonded fiber matrix hydro-mulch until seeding occurs.

XI. Mitigation Performance

A. Monitoring report

For a mitigation plan, annual submission to the DNR of a monitoring report is a permit condition. Most mitigation projects include three or five years of monitoring beginning after a full growing season elapses from the last planting. Ten years of monitoring may be needed for projects that are complex or develop slowly, such as forested wetland restorations. A report may state that mitigation has not begun. A monitoring report is sent to the Division of Water so a Fish and Wildlife biologist may review the initiation, progress, and success of mitigation. If success is not reached by the end of the monitoring period, a new mitigation plan is submitted that includes an extended monitoring period. Action for a mitigation site that has not succeeded may include regrading, replanting, relocation, and any other reasonable initiative to achieve its purposes.

An annual submission for a monitoring report includes:
(1) At least ten photographs of vegetation.
(2) Identification of the acres planted.
(3) The number of stems planted.
(4) A list of species on-site, including volunteer species.
(5) The estimated survival rates of planted species.
(6) A narrative of the project accomplishments.
(7) Goals achieved.
(8) Plans for the completion of successful mitigation.

A monitoring report submitted to the U.S. Army Corps of Engineers or IDEM may also be submitted as the DNR monitoring report. If the submission does not already include each of the eight elements immediately above, the applicant provides an attachment to include them.

B. Success criteria

Success is based on how effectively a site meets the terms of a mitigation plan. The annual monitoring report describes progress toward meeting the goals, mitigation that is not yet complete, and if there are deficiencies and what is being done to correct them. If the site meets expectations at the end of the monitoring period, the mitigation is deemed successful. The DNR would require additional mitigation and monitoring to correct deficiencies. Success criteria are set forth in the approved mitigation plan.

Measures of success depend on the type of vegetation community and mitigation requirements. Non-wetland forest mitigation success may be measured in the percent survival of planted trees and shrubs. Typical success criteria are seventy-five percent (75%) survival of bare-root and container stock and eighty percent (80%) or greater for one inch to two inches dbh trees up to balled and burlapped stock. Because different impacts and locations result in different spacing requirements between trees, success is based on the percent of the required plant material that survives. Success can be measured by multiplying the number of trees planted by the percentage of survival. For instance, using 3-gallon container canopy trees at 12-foot spacing results in planting 302 trees per acre. The shrub/understory tree component is half of the canopy trees density, which in this example would be 151 shrubs/understory trees per acre. Seventy-five percent (75%) survival would be 227 canopy trees and 113 shrubs/understory trees per acre.

Wetland success criteria involve greater variables, such as:
(1) Density of trees. The DNR would typically seek seventy-five percent (75%) survival of bare-root and container stock, and eighty percent (80%) or greater for larger stock.
(2) The mean vegetative cover after the first year. The DNR would typically seek eighty percent (80%).
(3) The dominance of native perennial species after five years. The DNR would typically seek eighty percent (80%).
(4) The absence of highly invasive species such as purple loosestrife (Lythrum salicaria) and common reed (Phragmites australis).

(5) The minimal presence of other nonnative or invasive plant species. The DNR would typically seek coverage not exceeding ten percent (10%), including cattails (Typha spp.) and reed canary grass (Phalaris arundinacea).
(6) The percentage of cover of open water or bare ground. The DNR would typically seek less than twenty percent (20%).
(7) Restoration of the appropriate number of wetland acres determined from a wetland delineation by the U.S. Army Corps of Engineers.
(8) The DNR would typically also seek a native floristic index value of at least twenty (20) and a native mean coefficient of conservatism value (mean C) of at least 3 to 3.5.

XII. Restrictive Covenants

A mitigation site not located on public property may need protection of a restrictive covenant to provide a reasonable period for successful plant establishment. The DNR may seek agreement for a restrictive covenant that provides ten years of protection.

XIII. Glossary

Avoidance: Adverse impacts are avoided altogether through alteration of project location, design, or other related aspects.

Bioengineered: The combined use of biological elements (plant materials) and structural or mechanical reinforcements for stabilization, revetment, or erosion control. Biological and mechanical elements must function together in an integrated and complementary manner.

Buffers: Habitat, typically native plant communities, that separates riparian habitats and wetlands from surrounding land uses.

Canopy tree: Large trees that upon maturity occupy the highest levels of the forest, typically 60 to 80 feet high or more, and whose branches and leaves shade the lower forest levels.
Compensatory mitigation: The establishment, restoration, enhancement, or protection of ecological functions and values meant to offset those lost through human activity.

Diameter at breast height (dbh): The height of a tree measured at four and one-half (4.5) feet above ground.

Enhancement: The manipulation of the physical, chemical, or biological characteristics of a habitat to heighten, intensify, or improve specific functions or to change the growth stage or composition of the vegetation present. This does not include the increase in habitat acreage and can result in impacts to current conditions.

Floristic Quality Assessment (FQA): Tool to identify the quality of a habitat based on assigned coefficient of conservatism (C) of all plant taxa encountered. The coefficients are ranks of species behavior and represent a confidence level for a taxon's correspondence to anthropogenic disturbances. Coefficients for Indiana taxa have been developed. See Rothrock, June 2004.

Headwater Habitat Evaluation Index (HHEI): A rapid habitat evaluation procedure designed for headwater streams and includes physical and biological assessments to determine stream quality.

Hydrologic Unit Code Area (HUC): Refers to the 8-digit Hydrologic Unit Code Area.

Minimization: In situations where adverse impacts are inevitable, the reduction of impacts to the greatest possible extent through alteration of project location, design, or other related aspects.

Mitigation: Taking action to eliminate, lessen, or replace the loss of environmental benefits and ecological functions where those benefits and functions are disturbed by human activities.

Mitigation Ratio: The ratio of values gained per unit area to values lost per unit area. For example, a ratio of 5 to 1 is equal to five mitigation acres for each acre impacted.

Native: A species known to be historically natural and present at the location and habitat prior to European settlement. Regionally native species that naturally spread into the state following European settlement may also be considered native.

Preservation: The protection of ecologically important habitat in perpetuity through the implementation of appropriate legal and physical mechanisms.

Qualitative Habitat Evaluation Index (QHEI): Tool that combines six metrics based in-stream habitat and surrounding land to gauge a stream's ability to support fish and macroinvertebrate communities.

Restoration: The return of an ecosystem to a close approximation of its condition prior to disturbance; the reestablishment of pre-disturbance functions and related physical, chemical, and biological characteristics; a holistic process not achieved through the isolated manipulation of individual elements.

Understory trees: Trees that upon maturity remain below the larger canopy trees.

XIV. References

Cowardin et al., Classification of Wetlands and Deepwater Habitats of the United States, 1979. Michigan Floristic Quality Assessment

Mushet, David M., Ned H. Euliss, Jr., and Terry L. Shaffer. 2002. Floristic quality assessment of one natural and three restored wetland complexes in North Dakota, USA. Wetlands 22(1):126-138. Jamestown, ND: Northern Prairie Wildlife Research Center.

Rothrock, Paul E. June 2004. Floristic Quality Assessment in Indiana: The Concept, Use, and Development of Coefficients of Conservatism. Final Report for ARN A305-4-53, EPA Wetland Program Development Grant CD975586-01.

Swink, F. and G. Wilhelm. 1994. Plants of the Chicago Region. 4th edition. Indiana Academy of Science, Indianapolis, IN.

XV. History

This information bulletin was first published on September 1, 1997, at 20 IR 3546. The Commission reviewed and affirmed the bulletin with formatting changes and the addition of a history section on November 14, 2006. Legislative Services Agency posted the First Amendment at 20061213-IR-312060562NRA. On July 17, 2012, the Commission approved as the Second Amendment**,** a complete rewriting of the bulletin, which was posted in the Indiana Register at 20120801-IR-312120434NRA. On July 15, 2014, the Commission approved the Third Amendment, posted in the Indiana Register at 20140806-IR-312140295NRA, which made additional refinement and clarification regarding the planting rates and spacing of understory and canopy vegetation and the determination of the success of those plantings. For consistency with the requirements of another government agency, requirements for in-stream mitigation were altered. Additional technical amendments were made for clarity. On January 15, 2019, the Commission approved the Fourth Amendment, posted in the Indiana Register at 20190130-IR-312190041NRA, and these amendments made clarifications throughout. The most notable amendments included the ability to adjust mitigation ratios based on various factors, a revision to mitigation for urban impacts, broken web links, and updates to the plant lists using current information. On May 19, 2020, the Commission approved this Fifth Amendment, making miscellaneous stylistic changes, expressly recognizing the practice of considering the content of the bulletin in the context of the Lakes Preservation Act and in the remediation of violations.

Appendix A -- Mitigation Plant Species

Woody Riparian Vegetation List

Common name	Scientific name	Region 3 status	Type of plant	Tree, Shrub, Vine	Region (N, C, S)	Coefficient of Conservatism	Comment
Box Elder	Acer negundo	FAC	Large Understory Tree	T	N, C, S	1	Only occasionally recommended
Black Maple	Acer nigrum	FACU	Large Canopy Tree	T	N, C, S	6	
Red Maple	Acer rubrum	FAC	Large Canopy Tree	T	N, C, S	5	

Silver Maple	Acer saccharinum	FACW	Large Canopy Tree	T	N, C, S	1	Only occasionally recommended
Sugar Maple	Acer saccharum	FACU	Large Canopy Tree	T	N, C, S	4	
Ohio Buckeye	Aesculus glabra	FAC	Large Understory Tree	T	N, C, S	5	
Indigobush	Amorpha fruticosa	FACW	Medium Shrub	S	S	3	FACW
Common Paw Paw	Asimina triloba	FAC	Small Understory Tree	T	N, C, S	6	
River Birch	Betula nigra	FACW	Small Canopy Tree	T	N, S	2	
American Hornbeam	Carpinus caroliniana	FAC	Medium Understory Tree	T	N, C, S	5	
Bitternut Hickory	Carya cordiformis	FACU	Large Canopy Tree	T	N, C, S	5	
Pecan	Carya illinoensis	FACW	Large Canopy Tree	T	S*	4	Extreme southwestern counties
Shellbark Hickory	Carya laciniosa	FACW	Large Canopy Tree	T	N, C, S	8	
Shagbark Hickory	Carya ovata	FACU	Large Canopy Tree	T	N, C, S	4	
Sugarberry	Celtis laevigata	FACW	Large Understory Tree	T	S	7	
Hackberry	Celtis occidentalis	FAC	Large Canopy Tree	T	N, C, S	3	
Buttonbush	Cephalanthus occidentalis	OBL	Medium Shrub	S	N, C, S	5	
Redbud	Cercis canadensis	FACU	Small Understory Tree	T	N, C, S	3	
Alternate-leaf Dogwood	Cornus alternifolia	FAC	Small Understory Tree	T	N, C, S	8	
Roughleaf Dogwood	Cornus drummondii	FAC	Medium Shrub	S	N, C, S	2	
Flowering Dogwood	Cornus florida	FACU	Small Understory Tree	T	N, C, S	4	Susceptible to dogwood anthracnose
Pale Dogwood (formerly Silky Dogwood)	Cornus obliqua	FACW	Medium Shrub	S	N, C, S	5	
Gray Dogwood	Cornus racemosa	FAC	Medium Shrub	S	N, C, S	2	
Red-osier Dogwood	Cornus sericea (aka (C. alba))	FACW	Medium Shrub	S	N	4	
Hazelnut	Corylus americana	FACU	Medium Shrub	S	N, C, S	4	
Cockspur Hawthorn	Crataegus crus-galli	FAC	Small Understory Tree	T	N, C, S	4	
Downy Hawthorn	Crataegus mollis	FAC	Small Understory Tree	T	N, C, S	2	
Dotted Hawthorn	Crataegus punctata		Small Understory Tree	T	N, C, S	2	Okay in floodplains; not in extreme southwestern counties
Persimmon	Diospyros virginiana	FAC	Medium Understory Tree	T	S	2	
American Beech	Fagus grandifolia	FACU	Large Canopy Tree	T	N, C, S	8	
Honey Locust	Gleditsia triacanthos	FACU	Small Canopy Tree	T	N, C, S	1	

Kentucky Coffeetree	Gymnocladus dioicus		Large Canopy Tree	T	N, C, S	4	
Witch Hazel	Hamamelis virginiana	FACU	Medium Shrub	T	N, C, S	5	
Smooth Hydrangea	Hydrangea arborescens	FACU	Small Shrub	S	N, C, S	7	
Common Winterberry	Ilex verticillata	FACW	Medium Shrub	S	N, C, S	8	
Butternut (White Walnut)	Juglans cinerea	FACU	Small Canopy Tree	T	N, C, S	5	Scattered within range; susceptible to butternut canker
Black Walnut	Juglans nigra	FACU	Large Canopy Tree	T	N, C, S	2	
Spicebush	Lindera benzoin	FACW	Medium Shrub	S	N, C, S	5	
Sweet Gum	Liquidambar styraciflua	FACW	Large Canopy Tree	T	S	4	
Tuliptree	Liriodendron tulipifera	FACU	Large Canopy Tree	T	N, C, S	4	
Wild Sweet Crabapple	Malus coronaria		Medium Understory Tree	T	N, C, S		
Black Gum	Nyssa sylvatica	FAC	Medium Canopy Tree	T	N, C, S	5	
Hop Hornbeam	Ostrya virginiana	FACU	Medium Understory Tree	T	N, C, S	5	
Purple Chokeberry	Photinia floribunda (formerly Aronia prunifolia)	FACW	Medium Shrub	S	N	8	
Black Chokeberry	Photinia melanocarpa (formerly Aronia melanocarpa)	FACW	Medium Shrub	S	N, C, S	8	
Common Ninebark	Physocarpus opulifolius	FACW	Small Shrub	S	N, C, S	7	
American Sycamore	Platanus occidentalis	FACW	Large Canopy Tree	T	N, C, S	3	
Eastern Cottonwood	Populus deltoides	FAC	Large Canopy Tree	T	N, C, S	1	Only occasionally recommended
Swamp Cottonwood	Populus heterophylla	OBL	Large Canopy Tree	T	N, S	8	Scattered within its range
Quaking Aspen	Populus tremuloides	FAC	Small Canopy Tree	T	N	2	
American Plum	Prunus americana	UPL	Small Understory Tree	T	N, C, S	4	Also along riverbanks
Black Cherry	Prunus serotina	FACU	Small Canopy Tree	T	N, C, S	1	
Common Hop-tree	Ptelea trifoliata	FACU	Medium Shrub	S	N, C, S	4	
White Oak	Quercus alba	FACU	Large Canopy Tree	T	N, C, S	5	
Swamp White Oak	Quercus bicolor	FACW	Large Canopy Tree	T	N, C, S	7	
Southern Red Oak	Quercus falcata	FACU	Med.-Lg. Canopy Tree	T	S*	5	Far southern and southwestern counties
Shingle Oak	Quercus imbricari	FACU	Medium Canopy Tree	T	N, C, S	3	
Overcup Oak	Quercus	OBL	Medium Canopy	T	S*	7	Extreme

	lyrata		Tree				southwestern counties
Bur Oak	Quercus macrocarpa	FAC	Large Canopy Tree	T	N, C, S	5	
Swamp Chestnut Oak	Quercus michauxii	FACW	Med.-Lg. Canopy Tree	T	S*	7	Far southern and southwestern counties
Chinkapin Oak	Quercus muehlenbergii	FACU	Med.-Lg. Canopy Tree	T	N, C, S	4	Also along well-drained riverbanks
Pin Oak	Quercus palustris	FACW	Small Canopy Tree	T	N, C, S	3	
Northern Red Oak	Quercus rubra	FACU	Large Canopy Tree	T	N, C, S	4	
Shumard Oak	Quercus shumardii	FACW	Large Canopy Tree	T	C, S	7	
Post Oak	Quercus stellata	FACU	Sm.-Med. Canopy Tree	T	S*	5	Seasonally swampy woods in SW counties
Staghorn Sumac	Rhus typhina		Large Shrub	S	N	2	
Pasture Gooseberry	Ribes cynosbati	FAC	Small Shrub	S	N, C, S	4	
Carolina Rose	Rosa carolina	FACU	Small Shrub	S	N, C, S	4	
Peachleaf Willow	Salix amygdaloides	FACW	Small Understory Tree	T	N	4	
Sandbar Willow	Salix interior	FACW	Medium Shrub	S	N, C, S	1	
Black Willow	Salix nigra	OBL	Large Understory Tree	T	N, C, S	3	
Elderberry	Sambucus canadensis (or S. nigra ssp canadensis)	FAC	Medium Shrub	S	N, C, S	2	
American Bladdernut	Staphylea trifolia	FAC	Medium Shrub	S	N, C, S	5	
Bald Cypress	Taxodium distichum	OBL	Large Canopy Tree	T	S*	10	Only in portions of Vanderburgh, Posey, Warrick, Knox, Gibson Co.
American Basswood	Tilia americana	FACU	Large Canopy Tree	T	N, C, S	5	
Nannyberry	Viburnum lentago	FAC	Medium Shrub	S	N	5	
Black Haw	Viburnum prunifolium	FACU	Medium Shrub	S	N, C, S	4	
Prickly ash	Zanthoxylum americanum	FACU	Medium Shrub	S	N	3	

Herbaceous Riparian Vegetation List

Common Name	Scientific Name	Size / Class	Indicator
White Snakeroot	Ageratina altissima	wildflower	FACU
Hog-Peanut	Amphicarpaea bracteata	herbaceous vine	FAC
Ground-Nut	Apios americana	herbaceous vine	FACW
False Nettle	Boehmeria cylindrica	wildflower	OBL
Blue-Joint Grass	Calamagrostis canadensis	grass	OBL
Emory's Sedge	Carex emoryi	sedge	OBL
Shoreline Sedge	Carex hyalinolepis	sedge	OBL

Lakebank Sedge	Carex lacustris	sedge	OBL
Larger Straw Sedge	Carex normalis	sedge	FACW
Hairy-Fruit Sedge	Carex trichocarpa	sedge	OBL
Fox Sedge	Carex vulpinoidea	sedge	FACW
Wild or Streambank Chervil	Chaerophyllum procumbens	wildflower	FACW
Wood-Reed	Cinna arundinacea	grass	FACW
Honewort	Cryptotaenia canadensis	wildflower	FAC
Wild Cucumber	Echinocystis lobata	herbaceous vine	FACW
Canada Wild Rye	Elymus canadensis	grass	FACU
Bottlebrush Grass	Elymus hystrix	grass	FACU
Riverbank Wild Rye	Elymus riparius	grass	FACW
Virginia Wild Rye	Elymus virginicus	grass	FACW
Boneset	Eupatorium perfoliatum	wildflower	OBL
Spotted Joe-Pye-Weed	Eutrochium maculatum	wildflower	OBL
White Avens	Geum canadense	wildflower	FAC
Fowl Manna Grass	Glyceria striata	grass	OBL
False Sunflower	Heliopsis helianthoides	wildflower	FACU
Orange Jewelweed	Impatiens capensis	wildflower	FACW
Yellow Jewelweed	Impatiens pallida	wildflower	FACW
Soft Rush	Juncus effusus	rush	OBL
Wood Nettle	Laportea canadensis	wildflower	FACW
Rice Cut Grass	Leersia oryzoides	grass	OBL
White Grass	Leersia virginica	grass	FACW
Great Blue Lobelia	Lobelia siphilitica	wildflower	OBL
American Bugleweed	Lycopus americanus	wildflower	OBL
Virginia Blue Bells	Mertensia virginica	wildflower	FACW
Hairy Sweet-Cicely	Osmorhiza claytonii	wildflower	FACU
Switch Grass	Panicum virgatum	grass	FAC
Wild Blue Phlox	Phlox divaricata	wildflower	FACU
Clearweed	Pilea pumila	wildflower	FACW
Green-Headed Coneflower	Rudbeckia laciniata	wildflower	FACW
Brown-Eyed Susan	Rudbeckia triloba	wildflower	FACU
Clustered Black-Snakeroot	Sanicula odorata	wildflower	FAC
River Bulrush	Schoenoplectus fluviatilis	bulrush	OBL
Soft-Stem Bulrush	Schoenoplectus tabernaemontani	bulrush	OBL
Dark Green Bulrush	Scirpus atrovirens	bulrush	OBL
Wool-Grass	Scirpus cyperinus	bulrush	OBL
Drooping Bulrush	Scirpus pendulus	bulrush	OBL
Cup-Plant	Silphium perfoliatum	wildflower	FACW
Late Goldenrod	Solidago gigantea	wildflower	FACW
Prairie Cordgrass	Spartina pectinata	grass	FACW
Panicled Aster	Symphyotrichum lanceolatum	wildflower	FAC
Side-Flowering Aster	Symphyotrichum lateriflorum	wildflower	FACW
American Germander	Teucrium canadense	wildflower	FACW
Blue Vervain	Verbena hastata	wildflower	FACW
Wingstem	Verbesina alternifolia	wildflower	FACW

Plant names and wetland status from Midwest 2016 Regional Wetland Plant List: Lichvar, R.W., D.L. Banks, W.N. Kirchner, and N.C. Melvin. 2016. The National Wetland Plant List: 2016 wetland ratings. Phytoneuron 2016-30: 1-17. Published 28 April 2016. ISSN 2153 733X.

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