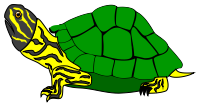
Microtopography Development

Wisconsin Biology Technical Note No. 2



Natural Resources Conservation Service (NRCS) - Wisconsin

This document, in conjunction with Technical Standard 657 - Wetland Restoration, is intended to be used as a tool to assist in the planning of wetland restorations on flat landscapes and where the natural undulating topography of the site has been eliminated. The planner is encouraged to be creative when developing the restoration plan. These concepts can also be used wherever **microtopography** features are desired.

WHAT IS MICROTOPOGRAPHY DEVELOPMENT?

Background - Unaltered wetland systems in Wisconsin often consist of a diversity of topographic relief such as very shallow areas with minor ridges (microtopography) to deeper wetland habitats that include some upland characteristics (macrotopography). When these wetlands are drained or altered and farmed, they normally lose most of their micro and macro topographic relief through land leveling or other agricultural activities.

Macrotopography features create irregular or "rough" landscape features where the wetlands and uplands have varying depths and heights. The basin areas are normally from 0.1 acre to 5 acres in size with depths running from 0-36". These types of wetlands can be constructed in a multitude of shapes ranging from simple circular basins, to complex amoeba-like outlines, to meandering scours. Ridges (linear), mounds (circular or elliptical), and undulating landscape features make up the "upland" component and should not exceed 24" in height. These "upland" features are to be built in existing non-wetland areas or severely degraded wetlands. Together, these features form a complex of wetland types that could pond water from only a few weeks to the entire year.

Microtopography features are normally thought of as those very shallow depressions less than 6 inches deep. Examples of microtopography can be seen in flat fields where shallow "sheet" water stands for short durations after a rain. Within the scope of this document, **microtopography** will be assumed to also include **macrotopography** features.

WHY IS THE DEVELOPMENT OF MICROTOPOGRAPHY IMPORTANT?

The development of microtopography relief creates a diversity of water regimes (hydroperiods) which can increase water quality, provide flood storage, and enhance the development of a more diverse vegetative community. This results in greater overall wildlife benefits through the development of a variety of habitats. The dispersal, germination, and establishment of plant species, and the life cycles of many amphibians, reptiles, and other wildlife species are dependent on variations in the timing, depth, and duration of flooding.

Pickerel Frog

Food - In the spring, ephemeral or seasonal wetlands are an important seasonal food source for waterfowl and shorebirds, as well as for other wildlife and nonmigratory bird species. These type of wetlands produce significant amounts of protein and calcium rich invertebrates and crustaceans including snails, isopods, spiders, backswimmers, diving beetles, dragonflies, and damselflies. Organic (woody) debris, roots, leaves, and tubers from aquatic vegetation are additional sources of food and provide substrates for the macroinvertebrates.

Habitat - Wetland restoration plans that include undulating landscape features create a diversity of habitat types. Swales, oxbows, potholes, and other microtopography basins provide varying hydroperiods from short-term ponding to seasonal and semi-permanent water. A wetland complex, with multiple hydroperiods, can support a variety of habitat zones. Examples of wetland plant communities include: scrub swamps, seasonally flooded basins, fresh (wet) meadow, wet/wet-mesic prairies, and shallow and deep marshes. A diverse wetland plant community benefits numerous species of wildlife including many fur-bearing mammals, waterfowl, shorebirds, wading birds, amphibians, and reptiles.

Low-level mounds or ridges (maximum 24") are considered to be a component of microtopography, and combined with basins of varying depths, can greatly increase the biological diversity of wetland restoration and enhancement sites. Amphibians, for example, tend to have small home ranges. Thus, having a diversity of wetland types in close proximity to terrestrial habitats within the project area will support the greatest populations.

PLANNING

Reptiles and Amphibians

Tiger Salamander

A primary focus of microtopography development is the creation of habitat for frogs, toads, salamanders, newts, turtles, and snakes. These amphibians and reptiles are known as herpetofauna or commonly called "herps". Amphibians are an especially diverse group and require wetlands with differing hydroperiods and/or habitat types. Because microtopography basins are often completely dry by summer or early fall, they are normally free of fish. Occasionally pools do retain water year round, but due to warm water conditions that create low oxygen levels, they still do not support fish populations. This is important because fish are a primary predator of amphibians in both their adult and tadpole stages. The timing and duration of flooding are important factors that dictate which amphibians will use a particular wetland. In general, sites flooded for longer periods will have more predators of amphibians. The planner should review historic aerial photography, when available, to determine the appropriate microtopographic features to include in the restoration project.

When planning a site for amphibian and reptile habitat, microtopography features should make up approximately 30-50% of the area. The water (swale, meander, etc.) and the upland habitat (mound) acreage are combined to get the percent of microtopography features. It can be assumed that for every acre of water created, an additional acre of mound is created. Where practicable, the excavated spoil not used for mounds should be used in other restoration practices (ditch fills, embankments, etc.) or hauled to adjacent uplands. **Table 1** can be used to record the planned microtopography features.

Where restoration sites have a designed water level, such as those with embankments and water control structures, approximatey 30% of the area should have microtopography features. Consider concentrating microtopography features in and near the more shallow water reaches.

Where restoration sites <u>do not</u> have a designed water level, such as broad muck flats or floodplains, approximatey 50% of the area should have microtopography features. Note that in these landscapes, especially muck flats, the microtopographic basins may provide the only standing water on the restoration site. Consider concentrating the deeper microtopography features in the lower elevations of the site, and shallower features in the higher elevations.

Table 1

Field Number	Field Size (acres)	Basin Number	Basin Amount (acres)	Microtopography Description	Associated Habitat Mounds (height(#))

Soils

It is important for the planner to identify those portions of the restoration site which have hydric soils or soils that will most likely respond to microtopography development. Look for soils that have low permeability, a restrictive under-lying layer, or high water tables. Drained muck flats should be priority sites for microtopography development due to the high likelihood that monotypic reed canary grass will overtake the saturated-only soil. Soils that are hydric due only to flooding may not be appropriate if the soils are well drained and are not frequently flooded. In these cases, it may not justify the expense of creating microtopography. If it is unclear whether or not there is sufficient hydrology to maintain the needed water levels within the basin areas, a water budget should be calculated.

MICROTOPOGRAHIC BASINS

The microtopograhic basins are described in abreviated format as: shape/size/depth.

Where:

1) the shape is described below
2) the size is in acres
3) the depth is in feet.

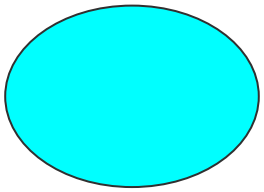
For example, a microtopograhic basin described as A/1.5/0.5-1.0-2.0:

1) has shape "A" below,
2) is 1.5 acres in size, and
3) is composed of 3 depths (0.5', 1.0' and 2.0')

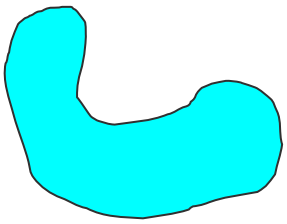
BASIN SHAPE DESCRIPTIONS

Basins should be irregular in shape. Irregular shapes increase edge and provide additional cover for waterfowl and other wildlife utilizing the site.

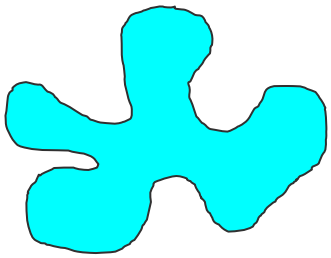
Shape A: Simple depression.
Description: Generally round or oval.



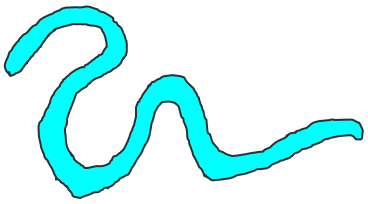
Shape B: Indented depression.
Description: Kidney shaped with 2 lobes.



Shape C: Amoeba depression.
Description: Multiple lobes with random shape, high perimeter to surface area ratio.



Shape D: Meander.
Description: Mimics an abandoned stream channel meander.

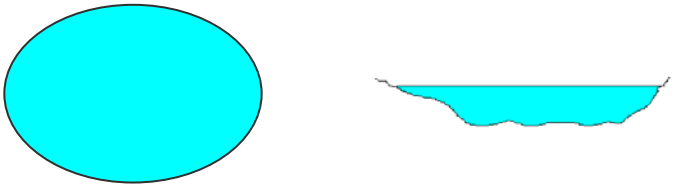


DEPTH DESCRIPTIONS

AERIAL VIEW **CROSS SECTION**

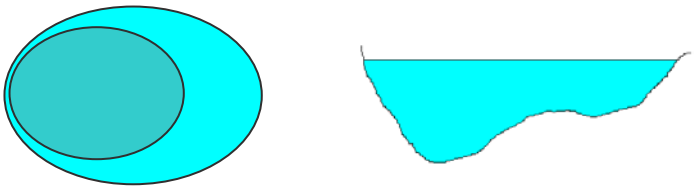
When <u>1 depth is indicated</u>:

- The basin is primarily 1 uniform depth



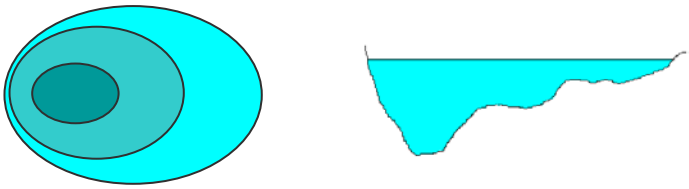
When <u>2 depths are indicated</u>:

- each depth composes "approximately" 50% of the area.



When <u>3 depths are indicated</u> the depths compose "approximately":

- deepest depth = 20% of the area
- middle depth = 30% of the area
- shallowest depth = 50% of the area



CONNECTING CHANNELS

Channels of varying depths and widths can connect basins to diversify a site. They provide additional cover for waterfowl as well as escape routes from predators. Connection channels may have 3:1 (or flatter) side slopes. In some cases, they can also be used for boat access to the site for hunting and recreational viewing, or to limit vehicular traffic on the site. In situations where amphibians are the primary species of concern and flooding from adjacent streams can occur, connecting channels should be limited because they provide access routes for predatory fish.

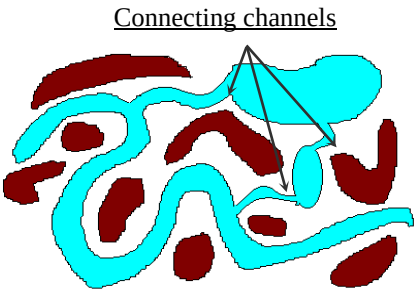


Figure 4

HABITAT MOUNDS

Fill excavated from the microtopograhy basins should be placed on adjacent uplands where practicable, or it can be used in other practices, such as ditch filling, embankments, nest islands or habitat mounds. Variations in the height, shape, and location design of habitat mounds will provide escape areas, denning sites, nesting opportunities, and greater plant diversity, as well as providing visual breaks within the wetland complex.

Where restoration sites have a designed water level, through a water control structure, habitat mounds should vary in elevation from above to below the expected normal waterline. Approxmately 1/3 of the mounds should be 6 to 12 inches below the normal water elevation, 1/3 should be 6 to 12 inches above, and 1/3 should be at the normal water elevation. Note that the borrow areas (i.e. the microtopograhy basins) will result in the basins being the deepest portions of the wetland complex. In ephemeral or seasonal wetlands, these areas provide a diversity of hydroperiods by holding surface water later into the year than the remainder of the wetland.

Where restoration sites do not have a designed water level, habitat mounds primarily provide upland habitat and tend to direct water flow during runoff or flood conditions. Approxmately 1/2 of the mounds should be 6 to 12 inches above average ground level, and 1/2 should be 1 to 2 feet above the normal ground elevation. Mounds should mimic the natural landscape as much as possible. For example, if the site is located on the interior of a river oxbow, ridge and swale design may be appropriate (see figure 3). When possible, place mounds in such a way as to increase meander distance by directing water flow in a path that meanders across the unit.

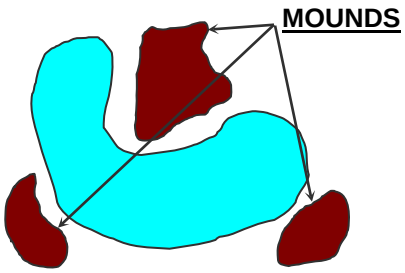


Figure 1

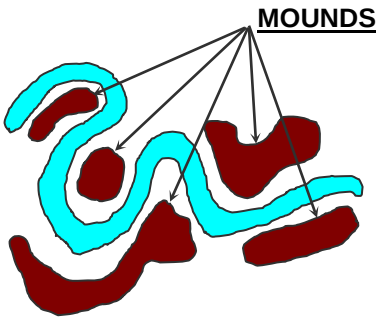


Figure 2

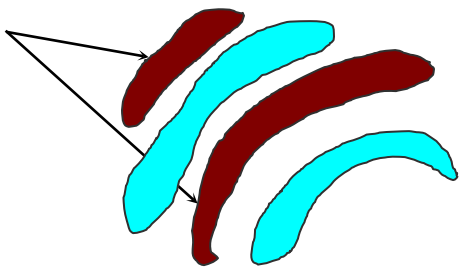


Figure 3

CONSTRUCTION

Creative borrowing - Borrow areas for ditch fills or embankments can be incorporated into the development of microtopography features. Potholes, swales, meanders, and other shallow water habitats can serve as borrow areas for needed fill. All side slopes for basins will have a minimum slope of 8:1. Note that, when feasible, slopes should be as flat as possible. Slopes exceeding 20:1 are not considered excessive for habitat purposes. Examples of this include situations where equipment operators randomly fill their scrapers leaving shallow, single-trip borrow sites. Even wheel ruts can provide habitat for some species. (Sample designs for a serpentine ridge and channel meander are attached.)

Woody debris:

- Provides sunning and resting areas for reptiles and amphibians
- Provides loafing sites for waterfowl
- Is a source for organic soil material
- Provides additional vertical and horizontal habitat
- Is an excellent substrate for invertebrates

Depending on water velocities the debris may or may not have to be anchored or partially buried. Use as needed.

Rough-finish grading - The desired microtopography features will have rough surfaces on all side slopes and top, an undulating bottom, and a meandering, ragged shoreline.

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