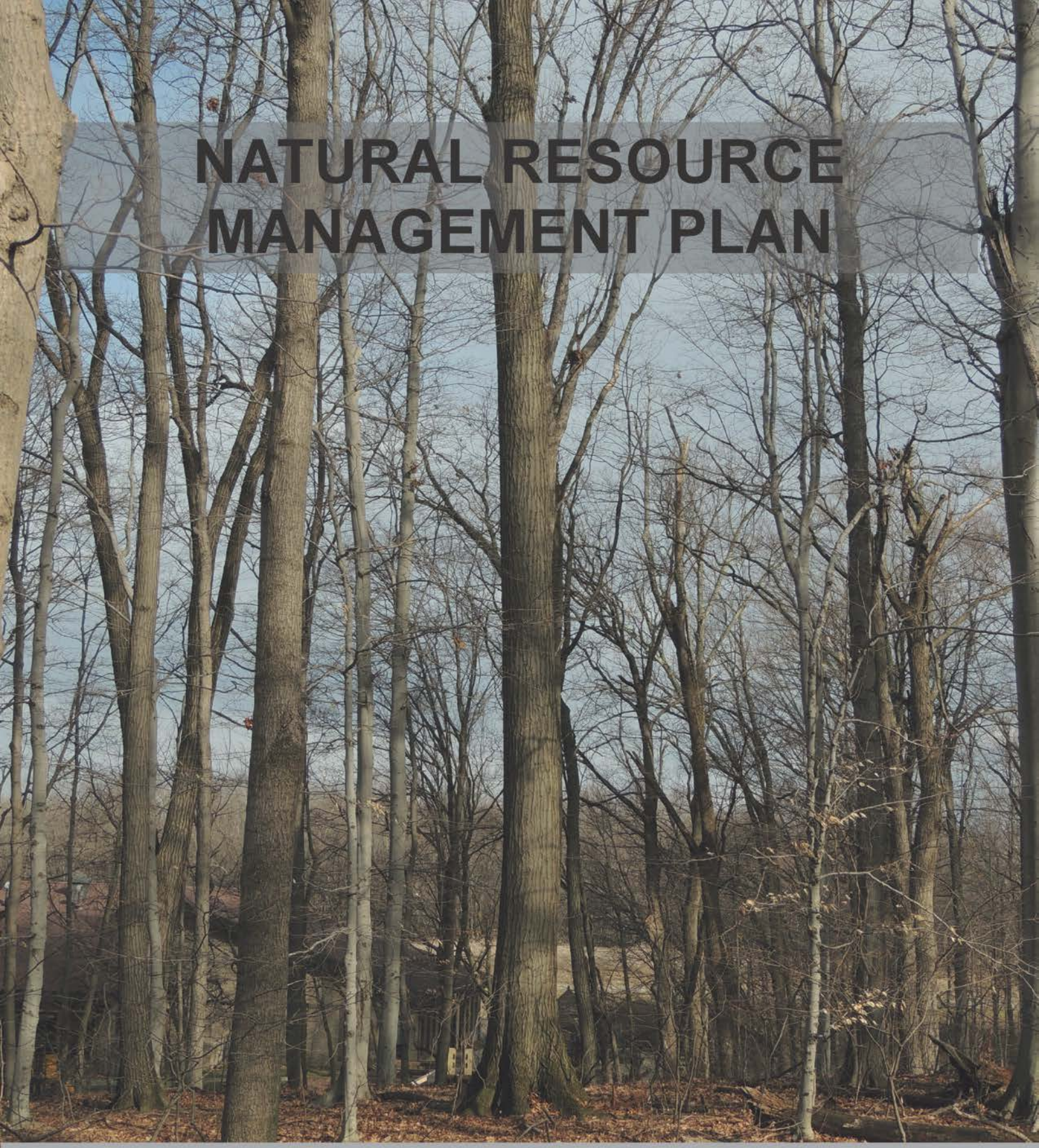

NATURAL RESOURCE MANAGEMENT PLAN

THE OHIO STATE UNIVERSITY

THE OHIO STATE UNIVERSITY AT MANSFIELD

COLLEGE OF FOOD AGRICULTURAL AND ENVIRONMENTAL SCIENCE

SCHOOL OF ENVIRONMENT AND NATURAL RESOURCES

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Data from ENR 4900.02 students of May 2013, May 2014 and May 2015

November 2015

The Ohio State University – Mansfield Campus

Introduction

The Ohio State University Mansfield campus is a 640 acre plot of mostly forested land in Richland County, Ohio. It is a regional campus for The Ohio State University located about five miles northwest of the city of Mansfield. It is bordered on the west by the city of Ontario and North Lexington-Springmill Road and bordered to the north and east by Springmill Road (SR 39).

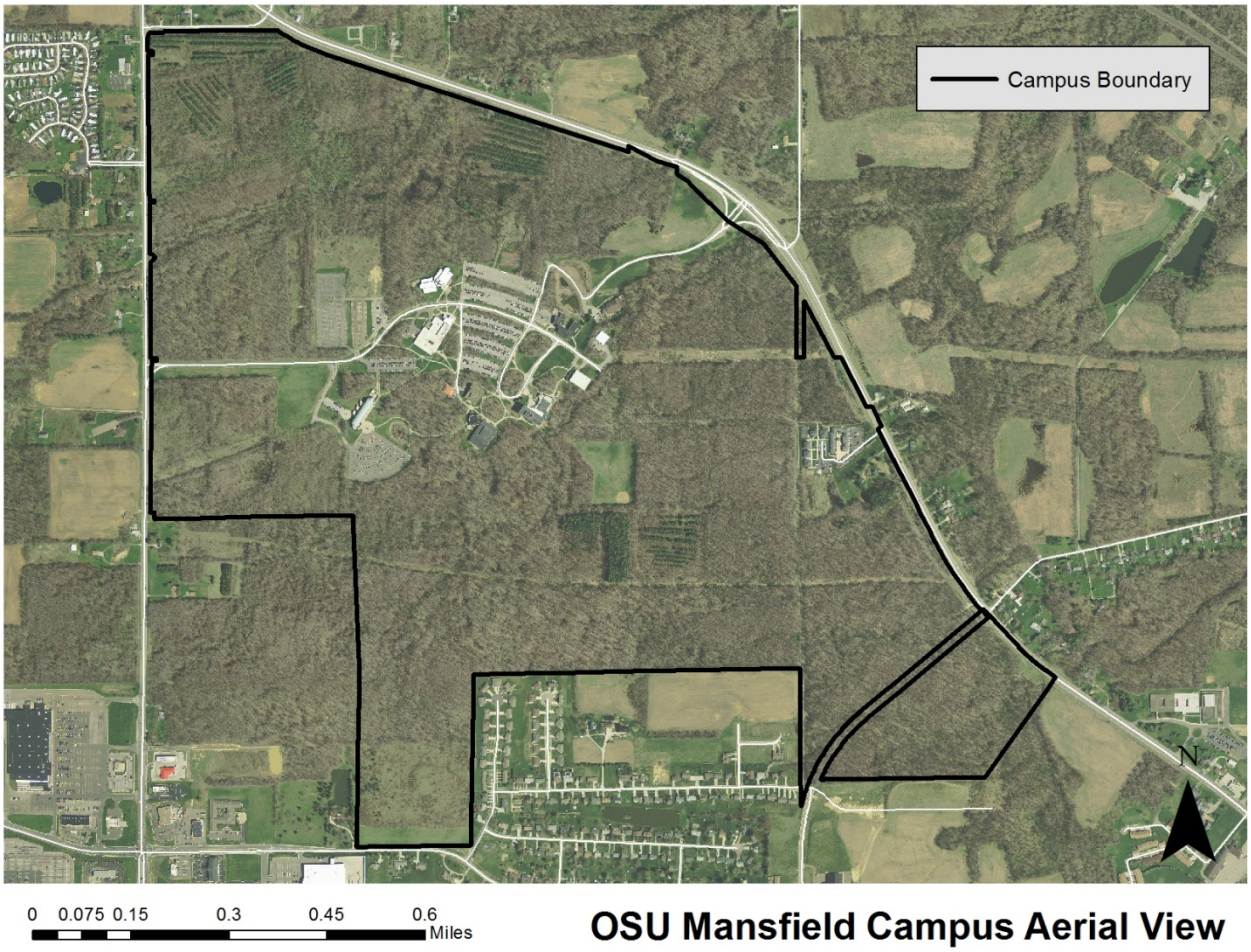


Figure 1: Aerial View of The Ohio State University Mansfield campus.

Work to establish OSU Mansfield began in the early 1960's with the campus opening for classes in October 1966. The overall campus consists of a variety of wooded acres that contain unique features such as planted trees, natural regeneration, several streams and the corresponding streamside forested areas, vernal pools and a constructed wetland. As with any woodland parcel, some defined goals and objectives for the acreage as a whole need to be established

along with perhaps specific parcel goals and objectives since there are differences across this wooded landscape.

The Ohio Department of Natural Resources', Division of Forestry, Service Forester provided aerial imagery of the land from 1950 and 1964. The 1950 image shows that approximately 60% of the land (492 acres) was utilized for row crops and pasture for grazing livestock leaving 40% in woody vegetation (128 acres). The 1964 aerial shows the beginning of natural succession on many of the fields that were either no longer being farmed or actively pastured. This natural succession from field to forest took place during the time of the designation of the campus and continues today.

Figure 2: Aerial images of the property from the Ohio Division of Forestry files. 1950 image on the left and a 1964 image on the right.

The Ohio State University Mansfield campus was founded in 1958 as a land-grant college. A college land-grant university is a higher education institution that arose from the Morrill Acts, whose goal was to grant federal lands to states to sell or develop for the purpose of raising funds for higher education in, but not limited to, the disciplines of practical agriculture and mechanical arts (United States 1996). In October of 1966, the campus offered coursework in areas of language, business, the arts, and natural and mathematical sciences.

Strata	Acres
Wetlands/Vernal Pools	6.11
Legacy Forest	2.83
Mature Forest	126.50
Young Forest	325.40
Plantation Forest	28.00
Early Successional	34.44
Open land	23.98
Developed	73.56

Table 1: Acreage breakdown for the different strata

Today the Mansfield campus contains approximately 600 acres of woodlands that are in various growth stages – from young forest to more mature trees. The other 40 acres make up the campus core with buildings, parking lots and roadways. The wooded acreage largely consists of naturally

occurring vegetation but also contains some acreage that was planted over the years. The stands as a whole are dominated by a variety of maple trees along with beech and some mixed oak species. Table 1 shows in detail how the different habitat strata break out over the entire acreage and Figure 3 shows that data in map form.

From records obtained from the Ohio Division of Forestry, Service Forester office there were 31.8 acres planted to trees under the USDA's Conservation Reserve Program. The plantings were installed in the spring of 1990 and consisted of a mixture of red and white pine, yellow poplar and red oak seedlings.

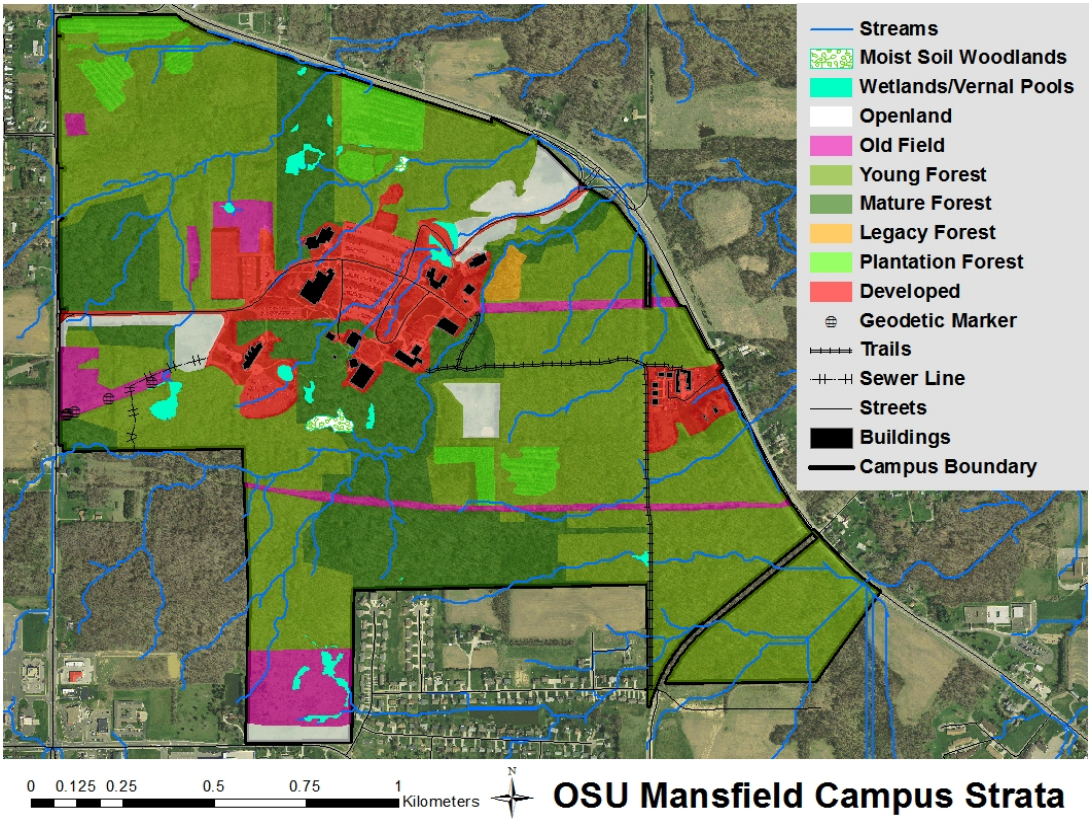


Figure 3: Campus map with the various strata as identified by the ENR 4900.02 class in 2013

Data Collection

In order to create an extensive baseline of information for the property the ENR 4900.02 class spent May of 2013, 2014 and 2015 surveying and collecting data that can be utilized to create a land management plan. This plan will be used to make land management decisions across the campus landscape. The students collected data in the forested areas on tree species and volume and non-native invasive species. The vernal pools, wetlands and streams were also surveyed and data was collected. The 2015 class mapped invasive species and looked at other things such as the impact of the deer on vegetation, where key trails should be placed and where some woodland management demonstrations should be placed.

The plans from all of the student teams working on data collection for the ENR 4900.02 class will be archived for any future reference.



Historical Feature – Ohio Standard Baseline

The Ohio Standard Baseline was established in 1967 as part of a research project during the early days of the use of light wave technology for distance measurement. At the time it was the only baseline of its kind in North America. It was used for research and development of distance measuring technology – today's laser technology. The site eventually fell into disuse. Some highlights of the project:

- It is described in detail in OSU Geodetic Science Report No. 107, "OHIO STANDARD BASELINE", by T. J. Kukkamaki, October 1968. It is about 60 pages. The Department has additional copies available and there may also be copies available through the OSU library system.
- Kukkamaki was assisted by Sol Cushman, John Snowden, Dean Merchant, Prof Uotila, and others. The attached photos are courtesy of John Snowden. The project was funded with a $22,000 grant from the National Science Foundation.
- There are a series of marks a 0, 1, 5, 25, 125, 250 and 500 metres.
  The position of the zero mark is approximately Lat 40 47.70 Long 82 35.35 The baseline extends toward the ENE from the zero point.
- The markers are 1 meter deep, 0.5 meter square, and recessed below grade. Concrete pedestals, etc. were constructed above the subsurface markers. There do not appear to be any local reference measurements in the report that would be useful in locating the markers.

Figure 4: Left - historical photo of the Ohio Standard Baseline that was established on campus in 1967. Right – what the baseline looks like today (2013).

Soils and Geology:

The OSU Mansfield campus is comprised of a network of complex water and soil systems. Richland County is located within the Killbuck-Glaciated Pittsburg Plateau. Generally, the physiographic description of this area is composed of ridges and flat uplands above 1200 feet that are covered with thin drift. Steep valleys and valley segments alternate between broad drift filled and narrow rock-walled reaches (Ohio Division of Geologic Survey 2002). The bedrock of this area formed during the Mississippian era. This geologic timescale dates the bedrock formation from 322 to 359 million years ago. During this time the area experienced widespread erosion. As a result, the main bedrock types include sedimentary materials such as shale, sandstone, siltstone, conglomerates and minor limestone (Ohio Division of Geologic Survey 2006). With the Mansfield campus sitting on such a large area, the soil type will be an important factor for current and future land use.

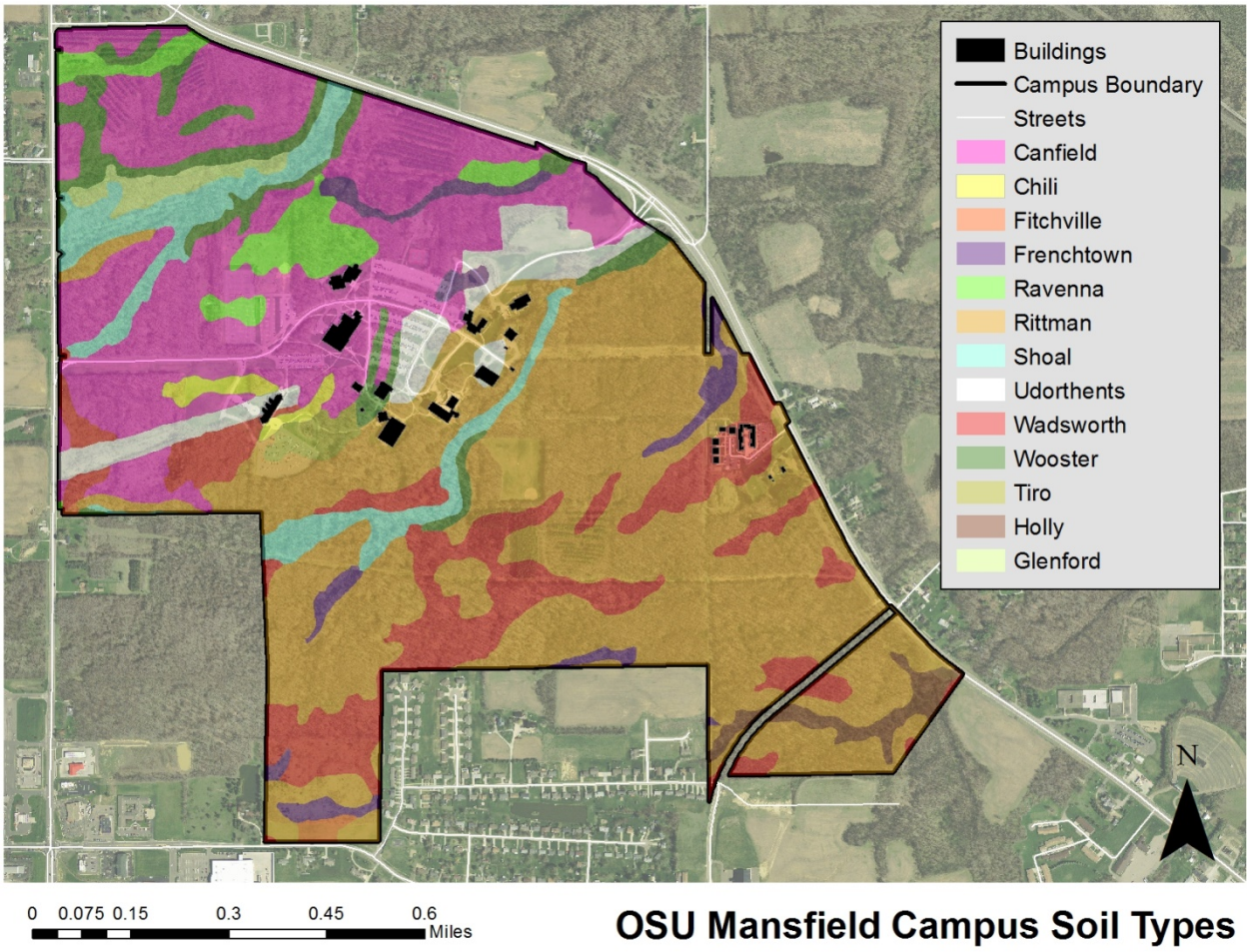


Figure 5: Soils map for OSU Mansfield - 2013

The USDA's Natural Resources Conservation Service web soil survey provides a wealth of data regarding the soils within the site. The web soil survey indicates that the majority of the soil types are comprised of Rittman silt loam (26.2%) and Canfield silt loam (20.9%) (United States

Department of Agriculture 2012). Soil textures are divided into three, broad groups of sand, silt and clay. Silt particles are the second largest of these three types. The term loam refers to the mixture of sand, silt, and clay particles. The silt loams of the site indicate that silt is the dominant component of the loam mixture. The properties and structure of loam soils determines factors such as water-holding capacities, slopes and vulnerabilities to erosion.

The USDA's web survey designate Rittman and Canfield silt loam soils as vulnerable to erosion with a water-holding capacity of roughly 3.5 to 3.9 inches. The erosion factor, K, is one of six factors used to estimate the average annual rate of soil loss due to water. The K scale ranges from .02 to .69. The higher the value, the more easily a soil may erode. Both the Rittman and Canfield loams have a rating of .43 (Unites States Department of Agriculture 2012). Although this rating may appear high, erosion events are only likely to occur during extreme flooding events.

Streams

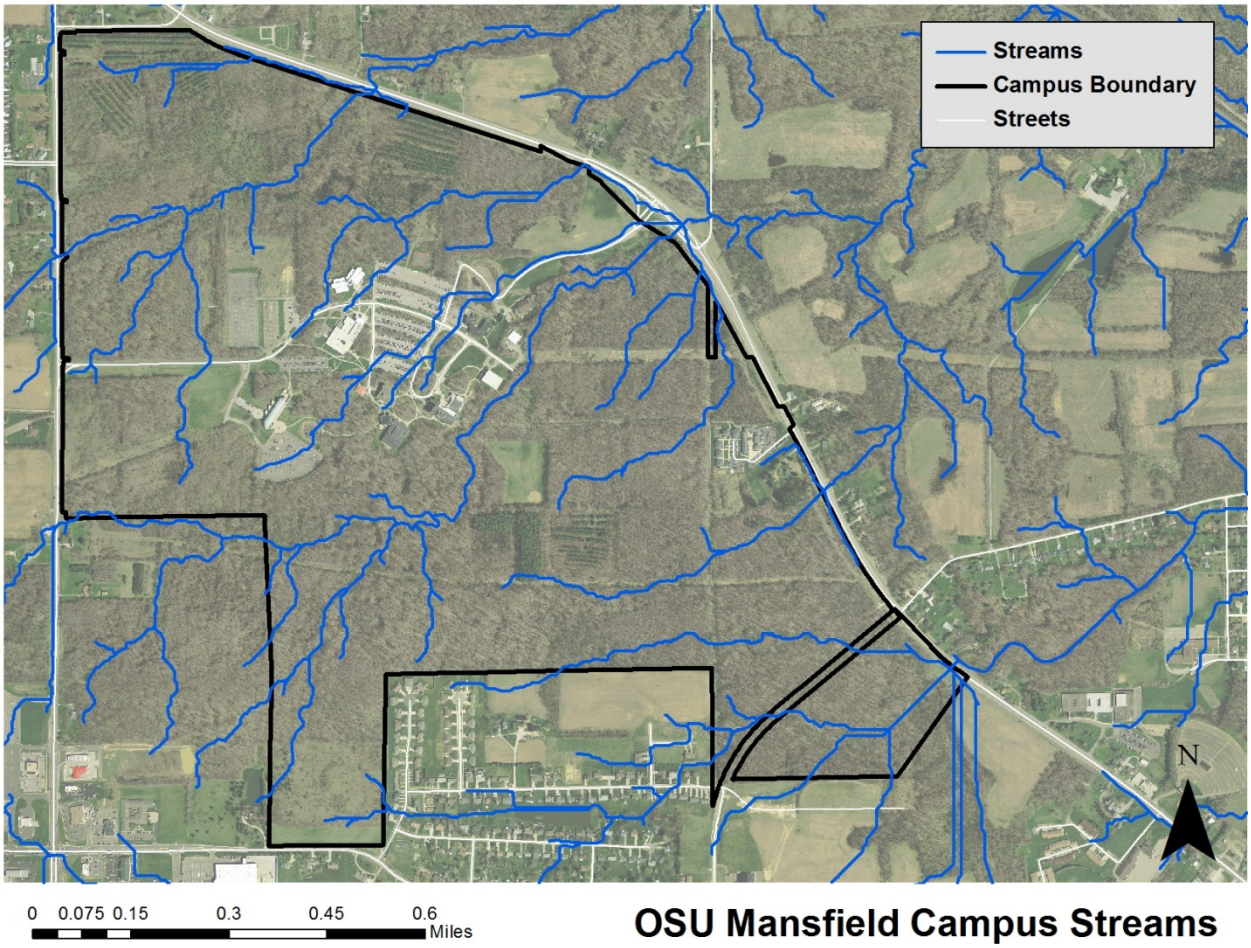


Figure 6: Streams of the Mansfield campus - 2013

Six primary watersheds drain surface water runoff from the property. The campus has approximately 8.5 km of stream within its boundaries. The streams are mostly primary headwater streams that sustain low or no flow during dry periods. Nearly all of the streams predominantly flow through deciduous forests, creating riparian zones that are crucial to the health of the stream ecosystem and the watersheds through which they flow. Nearly all of the streams originate outside the property, draining residential and commercial areas with impervious surfaces that contribute to "flashy" flow patterns where water levels rise and fall quickly with local precipitation events. The flashy flows appear to be causing incision of stream beds and bank erosion in some reaches, especially in the larger streams.

Rapid geomorphic assessments and habitat evaluations conducted by SENR students during May 2013-2015 indicate that the streams are mostly rated in "good" condition with a few streams rated as "fair" and those conditions generally improve downstream. Sensitivity to disturbance or environmental stressors was rated as moderate or high for several stream segments. The streams support aquatic invertebrates such as mayflies (*Ephemeropta*) and caddisflies (*Trichoptera*) that are indicative of good water quality. Four species of amphibians

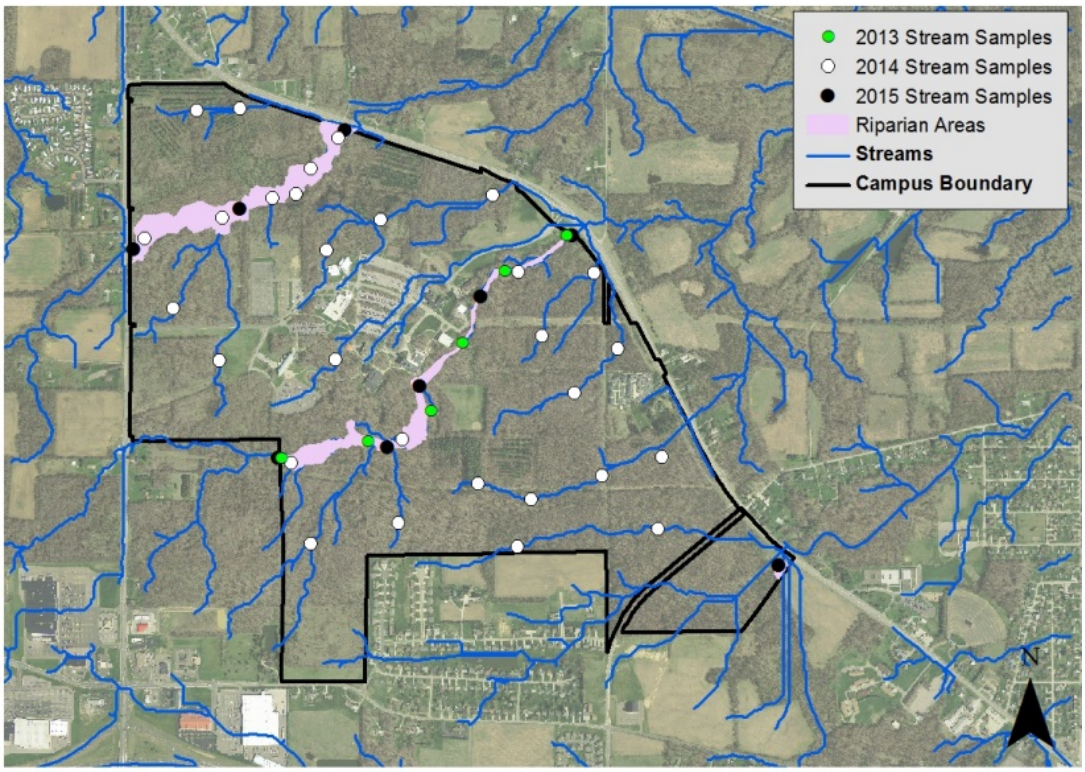
including small mouth salamander, northern dusk salamander, redback salamander, southern two-lined salamander, green frog and possibly gray treefrog were found within the riparian zones of streams. Fish, such as sculpins or creek chubs and sunfish are generally absent except on the two largest streams or near where the streams exit the property through road bridges or culverts. Smaller proportions of invertebrate taxa such as Diptera (flies), Gastropoda (snails), and Hirudinea (leeches) that indicate poor water quality when abundant were far less numerous.

Floodplains are typically poorly developed, although at least three streams have distinct bottlomland forests where the terrain is more level. Riparian zones and bottomland forests with good forest cover play an important role in the food webs and habitat quality of stream communities. Riparian vegetation cover also plays an important role in mitigating or controlling nonpoint source pollution in watersheds that protects water quality downstream. Some benefits of these streamside forests include:

- Effective removal of excess nutrients and sediment from surface runoff and shallow groundwater
- Shade the stream to helps control temperatures for aquatic plants and animals
- Provide dissolved and particulate organic matter that forms the basis of aquatic and associated terrestrial food websthat sustain high biological productivity and biotic diversity
- They remove or ameliorate the effects of pollutants from runoff in the surrounding watershed

Riparian forests function as **filters**, **transformers**, **sinks** and **sources,** and sometimes all at the same time. They function as a **filter** to remove sediment and other suspended solids from surface runoff. Sediment in the stream, whether suspended or deposited on the stream bottom, has adverse impacts on aquatic plants and interferes with the feeding and reproduction of bottom-dwelling fish and aquatic insects. A healthy, functioning riparian forest also **transforms** nitrates to nitrogen gas as part of its natural cycle. Add to this that these areas function as a **sink** when the plants take up nutrients and sequester them in plant tissue – perhaps not leaving the site unless trees are harvested. In wetter zones the nutrients that are stored in leaves and leaf litter may be stored as peat. Riparian trees are an important **source** of energy for aquatic life. Inputs of carbon compounds, organic detritus, and fruits, limbs, leaves, and insects from the forest canopy) provide energy to stream ecosytems. In summary, the aquatic food chain that begins at the headwaters of any stream system and the OSUM property is no exception.

Stream surveys were performed by SENR Capstone course students in May 2015 to assess the health of the two largest streams that flow through the campus property. Large sections of these stream segments flow through the mature forest areas of the campus, so it is no surprise that the diameter of the trees in floodplains of these area these areas averages 15.5 inches. The dominant tree species (among those that account for < 10% of basal area per acre) in these areas are black walnut, sugar maple, slippery elm and ash. Since both emerald ash borer (EAB) and Dutch elm disease (DED) will continue to impact these trees, abundance of the latter two species will continue to decline as they become infested. These survey areas also indicate



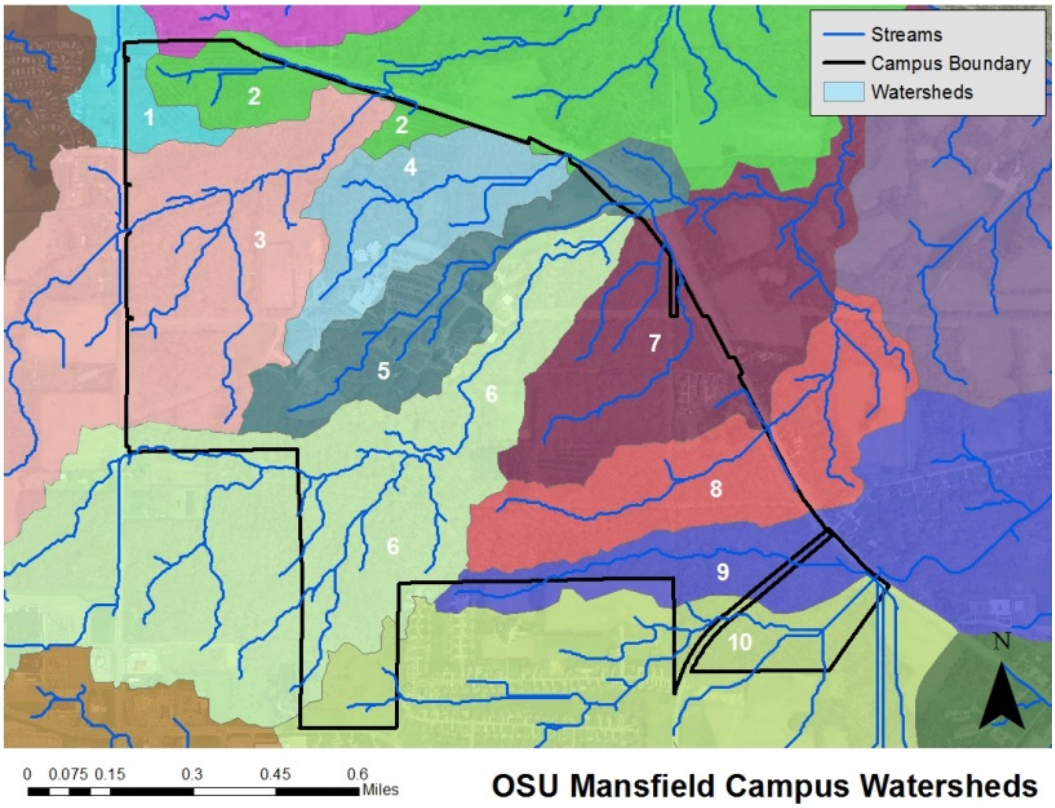


Figure 7: Stream survey points of ENR 4900.02 students and the watersheds for the campus

the presence of multiflora rose and garlic mustard. These non-native invasive plant species have the potential to negatively impact the forest's effort to regenerate itself by reducing the successful regeneration of seedlings in the understory. In many of these areas the amount of ash seedlings in the understory is particularly high, however due to emerald ash borer these seedlings will probably not reach a functional size within these streamside forest areas. So, while the overstory appears to be well stocked, the future is not as optimistic. The non-native invasive plant species on the forest floor could limit the regeneration to the point where little to no shade cover for these areas is available in the future. Moderate browsing by deer observed in floodplain forest areas may further limit regeneration.

As the area west of campus continues to develop, the impacts will show in the amount of streambank erosion that is occurring. While some streambank erosion is normal, increased erosion due to the hardening of the surface area west of campus forces water into these channels at rates that they (the stream channel and riparian zone) were not developed to handle. Storm event flows are occurring with higher water amounts and at faster speeds – which results in more erosion – as the stream channel tries to adjust to increases in the frequency and magnitude of episodic high flows. Entrenchment and incision of the stream channels negatively impacted habitat quality ratings of stream segments sampled by SENR capstone students in 2015.

Resources should be focused on sustaining woodland riparian corridors along the two largest streams. Manage invasive species, remove stream debris and provide supplemental woodlands regeneration 100' either side of the stream corridors. Monitor stream erosion annually and identify areas that may require stabilization. Assess all six watersheds every 5 years for stream ecosystem health.

Storm Water Management

The Campus should continue to use decentralized storm water management and design strategies to sustain or restore site hydrology to pre-development conditions. Environmental Protection Agency (EPA) storm water management best practices should be used to the extent practical. These best management practices include, but are not limited to: bio-retention cells, limited curb & gutter, grassed swales, green parking design, infiltration trenches, inlet protection devices, permeable pavement & pavers, rain barrels & cisterns, riparian buffers, sand & organic filters, soil amendments, storm water planters and vegetated filter strips.

Particular attention should be given to the developed Campus Core and planning for future improvements that might occur throughout the Campus woodlands. Promote green storm water management and sustainable practices with development likely to occur along the campuses western border with Lexington-Springmill Road. Coordinate with City of Mansfield, City of Ontario and Richland County Soil & Water Conservation District that have storm water regulatory jurisdiction immediately adjacent to the Campus.

Forests

The forested acreage on the campus has been delineated into several stands based on their characteristics. Those stands are **mature**, **young** and **plantations** with the mature segment also including a small parcel delineated as the **legacy forest**. The SENR student crews over the last several years have worked to create a listing of the species found within the campus woodlands and that list is shown in Table 2. Those non-native plants considered to be invasive are noted as 'invasive' in the table.

Table 2: Plant species found in and around the woodlands of the OSU Mansfield campus

Tree Species	
Common Name	Scientific Name
American beech	*Fagus grandifolia*
American chestnut	*Castanea dentata*
American elm	*Ulmus americana*
American hornbeam	*Carpinus caroliniana*
Baldcypress	*Taxodium distichum*
Black ash	*Fraxinus nigra*
Black cherry	*Prunus serotina*
Blackgum	*Nyssa sylvatica*
Bitternut hickory	*Carya cordiformis*
Black locust	*Robina pseudoacacia*
Black walnut	*Juglans nigra*
Callery pear (invasive)	*Pyrus calleryana*
Chinkapin oak	*Quercus muehlenbergii*
Choke cherry	*Prunus virginiana*
Cucumbertree	*Magnolia acuminata*
Eastern cottonwood	*Populus deltoides*
Eastern hemlock	*Tsuga canadensis*
Eastern hophornbeam	*Ostrya virginiana*
Eastern redbud	*Ceris canadensis*
Green ash	*Fraxinus pennsylvanica*
Honeylocust	*Gleditsia tricanthos*
Northern catalpa	*Catalpa speciosa*
Northern red oak	*Quercus rubra*
Norway spruce	*Picea abies*
Ohio buckeye	*Aesculus glabra*
Pignut hickory	*Carya glabra*
Pin oak	*Quercus palustris*
Quaking apsen	*Populus tremuloides*
Red elm (slippery elm)	*Ulmus rubra*
Red maple	*Acer rubrum*
Red pine	*Pinus resinosa*
Sassafras	*Sassafras albidum*
Scotch pine	*Pinus sylvestris*
Shagbark hickory	*Carya ovata*
Shellbark hickory	*Carya laciniosa*

Silver maple	*Acer saccharinum*
Sugar maple	*Acer saccharum*
Swamp white oak	*Quercus bicolor*
White oak	*Quercus alba*
White ash	*Fraxinus Americana*
Yellow buckeye	*Aesculus octandra*
Yellow poplar	*Liriodendron tulipifera*
Shrub species	
Arrowwood viburnum	*Viburnum dentatum*
Autumn olive (invasive)	*Elaeagnus umbellata*
Japanese barberry (invasive)	*Berberis thunbergii*
Blackhaw viburnum	*Viburnum prunifolium*
Buckthorn (invasive)	*Rhamnus cathartica*
Bush honeysuckle (invasive)	*Lonicera spp.*
Buttonbush	*Cephalanthus occidentalis*
Mapleleaf viburnum	*Viburnum acerifolium*
Mutiflora rose (invasive)	*Rosa multiflora*
Chinese privet (invasive)	*Ligustrum sinense*
Silky dogwood	*Cornus amomum*
Spicebush	*Lindera benzoin*
Winged Euonymus (invasive)	*Euonymus alta*
Witch hazel	*Hamamelis virginiana*
Vine species	
Grapevine	*Vitis spp.*
Oriental bittersweet (invasive)	*Celastrus orbiculatus*
Poison ivy	*Toxicodendron radicans*
Virginia creeper	*Parthenocissus quinquefolia*

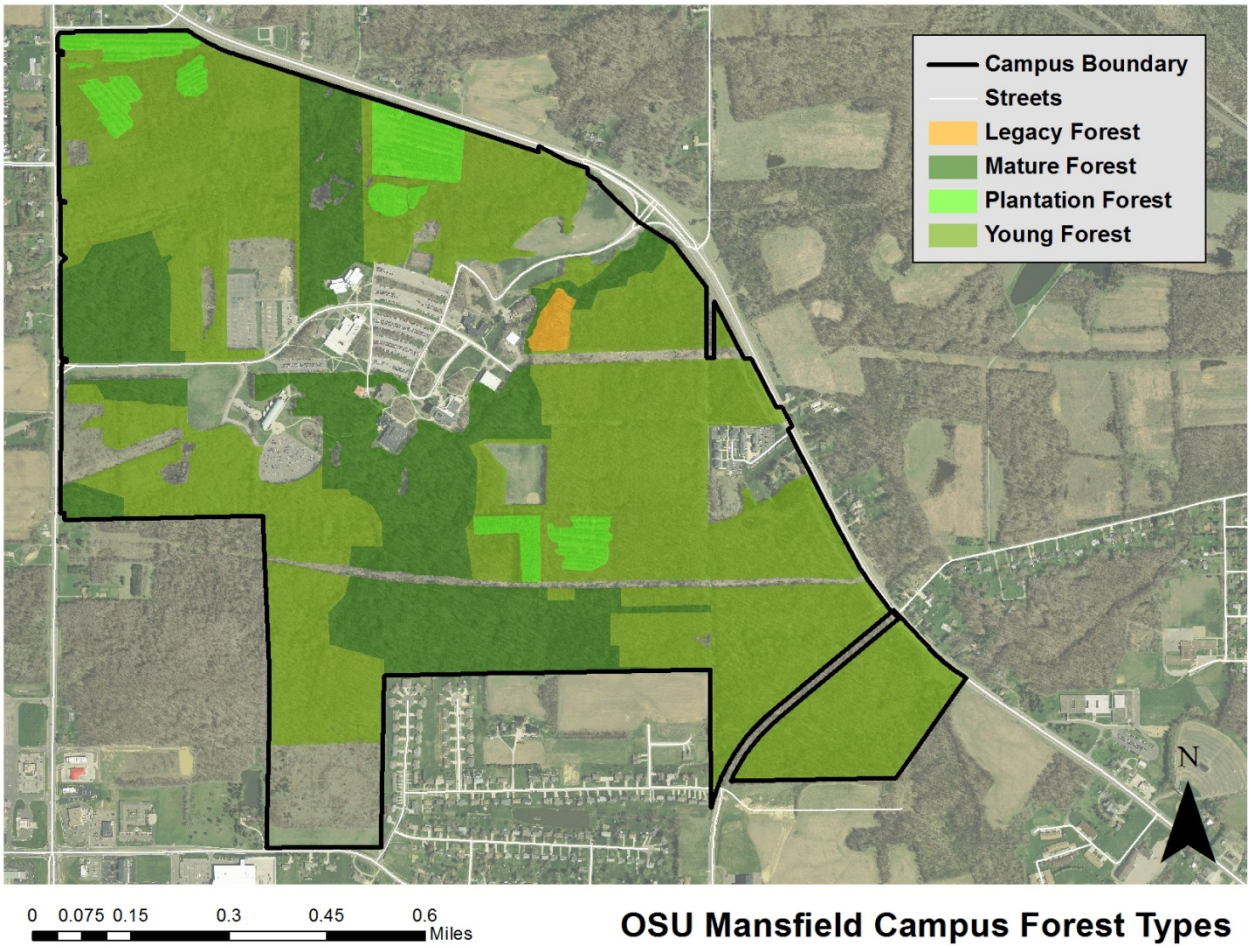


Figure 8: OSU Mansfield Forest Types 2013

Mature Forest - 126 acres

This acreage was in forest cover when the property was purchased by Ohio State in 1964. While some of the original forested acreage was eventually converted into the current campus core – the remainder of the acreage has been allowed to grow and creates today's designation of the more mature section of the campus woodlands.

These mature forest areas may be less densely populated with numbers of trees in comparison to the young forest areas; however these trees are much larger in size. The average diameter breast height (dbh) for these trees is 16.3 inches. The trees in these areas are producing higher benefits including timber value and wildlife value.

While these trees are growing well, the down side of these stands being so completely occupied is that the amount of regeneration for the future forest is limited. In time, canopy gaps will open up to provide the sunlight needed to create the future regeneration. Some of that is currently taking place with the death of ash trees due to emerald ash borer.

Legacy Forest - 2.8 acres

This small acreage parcel is located just across the stream from the Schuttera Service center as well as the Child Development center. The area contains 30 trees/acre that are 20" in diameter or larger. Most of these trees are northern red oak with a few cucumber magnolia, sugar maple, white ash, and American beech. There is an old fence on the south edge of the area just north of the electric right-of-way. There is also an old fence row on the east side of the area. To the west and north the stream creates a natural barrier that may have contributed to its isolation and lack of historical use by the previous landowners. In trying to investigate the history of this section increment cores were taken and an approximate age for the trees was 140 years old.

The stand itself is fairly open and has few tree saplings in the understory – mostly maple. There are a few non-native invasive plants entering the area (privet and barberry) and are in the early stages of infesting the understory.

Plantations - 31 acres

There are several plantations established on the campus covering a total of 31.8 acres at the time of establishment. Species composition includes yellow poplar, red pine, Norway spruce and white pine. The plantations are dominated by white pine with a red pine and yellow poplar mix. The plantations are scattered throughout the property with the two that are in the best condition being located south of the current athletic fields. These plantations have had little to no management once they were established but are nearing a stage in their growth that merits a close look as to their future existence.

Tree plantations that are implemented to reforest an area are typically planted using bare-root seedlings. Since not all of those seedlings are expected to survive and thrive, spacing of these seedlings is usually very close (10'x10' or even as close as 8'x8'). The intent is that some will survive, and others won't. If a site has high survival then eventually, in order to create a healthy thriving stand of trees some type of thinning will need to be performed to allow the dominant trees the room they need to grow. In the case of these plantations no follow-up management was ever implemented. All of this leads to now having stands that are way too thick with trees – meaning that there are more trees living on the site than the site can realistically support. At some point decisions need to be made about their future purpose since pine plantations have limited life spans and will not regenerate on their own. If a pine plantation fits the long term goals and objectives of this project then steps need to be taken to establish new plantations.

Young Forest - 326 acres

If you look at the aerial images from 1950 and 1964 you will see that much of the campus was either in row crops or being utilized as pasture for livestock. Once the property was purchased most of these fields were gradually allowed to go through natural succession to become today's young stands of trees. These areas contain a lot of red maple, along with some sassafras, black gum and a few other species. The trees are small in size and the understory is mostly bare except for where non-native invasives such as multiflora rose and barberry are establishing. There is almost no young tree regeneration and shrubs are non-existent.

When looking at forests one of the measurements that is performed is to look at how heavily stocked the stand is with trees. Stocking levels tell us how many trees should be growing on a site compared to what is being seen when measurements are taken. In the case of these young forest areas the stands are so over stocked with trees that they are competing heavily with each other for the limited resources the site can provide. Ideally these areas should be thinned out in a manner that allows the dominant, healthy trees to better utilize the site's available resources.

Vernal Pools/Wetlands/Wet Meadow 6.1 acres

A vernal pool is a type of seasonal or temporary wetland. Vernal pools are often shallow and separated from streams and rivers, as is the case on the OSU Mansfield campus. Generally these pools fill annually from snow melt, precipitation, runoff, or rising groundwater. In most years, the pools will hold water through spring and into summer. By late summer, evaporation and transpiration typically leave the pools dry. Drying may occur sooner in drought years and conversely heavy rains may fill pools any time of year.

It is the ephemeral nature of these pools that makes them valuable. The wet to dry cycle prevents the establishment of fish allowing potential prey (i.e. aquatic invertebrates, tadpoles and salamander larvae) to thrive and reproduce. Besides providing habitat for many species of animals and plants, vernal pools are important in a healthy ecosystem in additional ways by slowing floodwaters, filtering sediment and pollutants, and replenishing ground water. Finally, these pools contribute to the overall biodiversity of the Mansfield woodland and can provide an excellent site for research and education for all ages.

Nine vernal pools or wetlands were identified on the OSU Mansfield campus. The boundaries of these vernal pools and wetlands were digitized May 2014 (Figure 9).

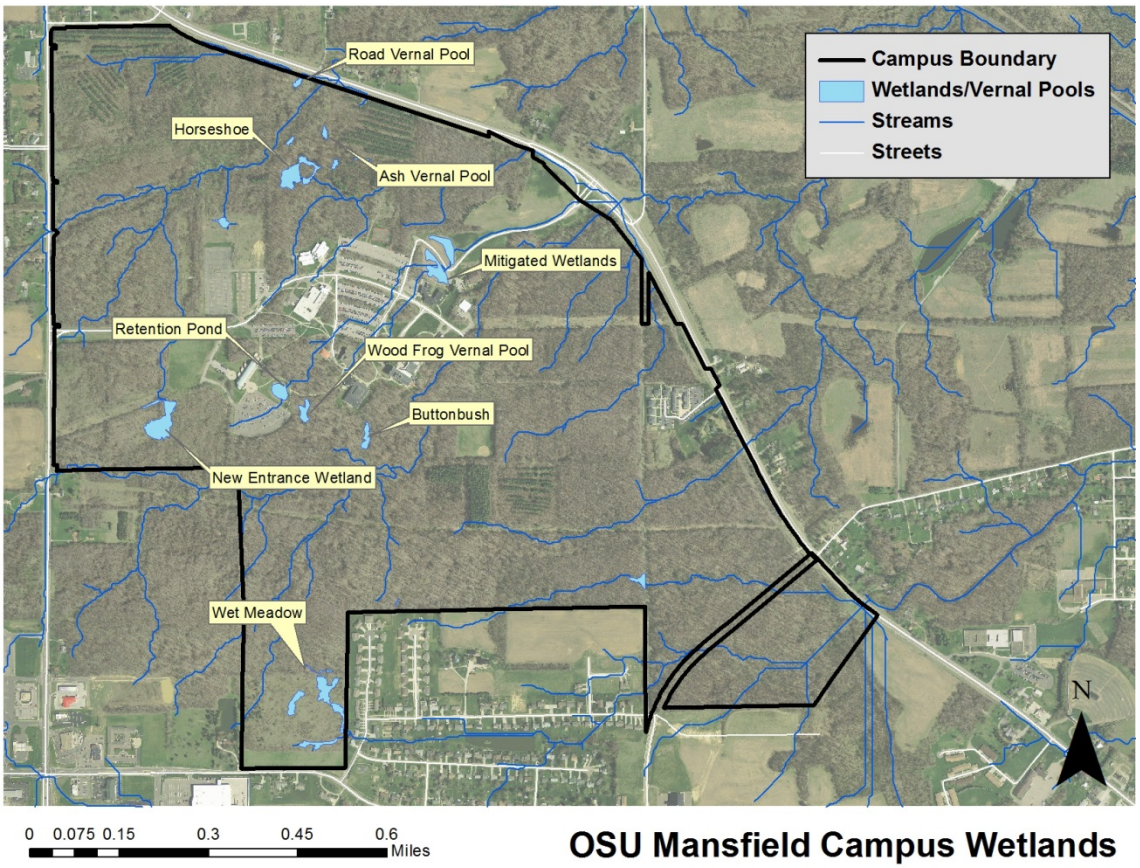


Figure 9: Locations and names of various wetlands and vernal pools identified on the OSU Mansfield's campus area during surveys conducted in May, 2014.

Soils and Geology for the Wetland Areas

The wetland resource areas on the property occurred on Frenchtown, Canfield, Rittman, Wadsworth, Tiro, and Udorthents soil series. The horseshoe vernal pool, and part of the wet meadow occur on Frenchtown silt loam soils. Frenchtown soils occur in depressions on till plains from a glacial till parent material. These soils have a depth of 13 to 24 inches to a restrictive feature in the form of a fragipan, a depth of 0 to 6 inches to the water table, and are poorly drained. Part of the wet meadow also occurs on Wadsworth silt loam soils. Wadsworth soils also occur in depressions on till plains from a glacial till parent material. These soils have a depth of 16 to 28 inches to a restrictive feature in the form of a fragipan, a depth of about 6 to 18 inches to the water table, and are classified as somewhat poorly drained. The new entrance wetland occurs partially on Wadsworth and Canfield soils. The ash vernal pool and road vernal pool also occur on Canfield soils. The buttonbush wetland occurs on Rittman soils. The parking lot drainage wetland occurred on Tiro silt loam soils. Tiro soils occur on till plains and are from a parent material of lacustrine deposits over water modified loamy till. These soils have a depth of over 80 inches to a restrictive feature, a depth of about 6 to 18 inches to the water table, and are classified as somewhat poorly drained. Lastly, the mitigated wetlands occur on Frenchtown and Udorthent soils. Udorthents are soils that have been unnaturally modified, and occur in disturbed areas. These soils have a depth of over 80 inches to a restrictive feature and to the water table, and are classified as well drained.

Vegetation and Land Cover

Total percent vegetation cover of vernal pools and wetlands varied widely. The overall percent cover was not correlated with whether buttonbush (*Cephalanthus occidentalis*) was present. Buttonbush is known to grow in dense thickets, but in larger pools may not cover all of the area of the pool, leading to overall percent cover values that were relatively low. This was especially evident in the horseshoe vernal pool. We found that the buttonbush grew only in a small section of the whole pool. In smaller pools, such as the buttonbush vernal pool, the buttonbush had expanded to cover the entirety of the pool, and a much higher percent cover. Buttonbush is not the only plant to cause high percent cover however, as we found that in the wet meadow the high presence of grasses and sedges provided an almost continuous cover. We found non-native invasive species (NNIS) at every wetland we sampled. Multiflora rose (*Rosa multiflora*) was the most common NNIS and was present at every wetland except the ash vernal pool and the retention pond wetland. We found narrow leaf cattail (*Typha angustifolia*), garlic mustard (*Alliaria petiolata*), and autumn olive (*Elaeagnus spp.)* in great abundance as well. Reed canary grass (*Phalaris arundinacea*), honeysuckle (*Lonicera spp.*), and callery pear (*Pyrus calleryana*) were also present in smaller quantities.

Wildlife

There have currently been three years of the ENR 4900.02 classes recording all sorts of data. To this end there has been a list of wildlife species documented on the campus. Table 3 is a listing of those species that the students over the course of three years (along with their faculty counterparts) have identified on campus.

Table 3: Listing of wildlife species (vertebrates) found on the Mansfield campus through SENR student surveys and other observations.

Bird species	
Acadian Flycatcher	*Empidonax virescens*
American Crow	*Corvus brachyrhynchos*
American Goldfinch	*Spinus tristis*
American Redstart	*Setophaga ruticilla*
American Robin	*Turdus migratorius*
Baltimore Oriole	*Icterus galbula*
Barn Swallow	*Hirundo rustica*
Belted Kingfisher	*Megaceryle alcyon*
Black-and-White Warbler	*Mniotilta varia*
Black-capped Chickadee	*Poecile atricapillus*
Black-throated green warbler	*Setophaga virens*
Blue-gray Gnatcatcher	*Polioptila caerulea*
Blue Jay	*Cyanocitta cristata*
Blue-winged Warbler	*Vermivora cyanoptera*
Broad-winged hawk	*Buteo platypterus*
Brown-headed Cowbird	*(Molothrus ater*
Brown Creeper	*Certhia americana*
Brown Thrasher	*Toxostoma rufum*
Canada Goose	*(Branta canadensis*
Carolina Wren	*Thryothorus ludovicianus*
Cerulean Warbler	*Dendroica cerulean*
Chimney swift	*Chaetura pelagica*
Chipping Sparrow	*Spizella passerine*
Common Grackle	*Quiscalus quiscula*
Common Yellowthroat	*Geothlypis trichas*

Downy Woodpecker	*Picoides pubescens*
Eastern Bluebird	*Sialia sialis*
Eastern Phoebe	*Sayornis phoebe*
Eastern Towhee	*Pipilo erythrophthalmus*
Eastern Wood Pewee	*Contopus virens*
European Starling	*Sturnus vulgaris*
Field Sparrow	*Spizella pusilla*
Gray Catbird	*Dumetella carolinensis*
Great Blue Heron	*Ardea Herodias*
Great Crested Flycatcher	*Myiarchus crinitus*
Green Heron	*Butorides virescens*
Hairy Woodpecker	*Picoides villosus*
Hermit Thrush	*Catharus guttatus*
Hooded Warbler	*Wilsonia citrina*
House Sparrow	*Passer domesticus*
House Wren	*Troglodytes aedon*
Indigo Bunting	*Passerina cyanea*
Louisiana Waterthrush	*Parkesia motacilla*
Mallard	*Anas platyrhynchos*
Magnolia Warbler	*Setophaga magnolia*
Northern Cardinal	*Cardinalis cardinalis*
Northern Flicker	Colaptes auratus
Northern Mockingbird	*Mimus polyglottos*
Northern Parula	*Setophaga americana*
Orchard Oriole	*Icterus spuruis*
Ovenbird	*Seiurus aurocapilla*
Pileated Woodpecker	Dryocopus pileatus
Purple Martin	*Progne subis*
Red-bellied Woodpecker	*Melanerpes carolinus*
Red-eyed Vireo	*Vireo olivaceus*
Red-shouldered Hawk	*Buteo lineatus*
Red-tailed Hawk	*Buteo jamaicensis*

Red-winged Blackbird	*Agelaius phoeniceus*
Rose-breasted Grosbeak	*Pheucticus ludovicianus*
Ruby-throated Hummingbird	*Archilochus colubris*
Savannah Sparrow	*Passerculus sandwichensis*
Scarlet Tanager	*Piranga olivacea*
Song Sparrow	*Melospiza melodia*
Swainson's Thrush	*Catharus ustulatus*
Tufted Titmouse	Baeolophus bicolor
Turkey Vulture	*Cathartes aura*
Tree Swallow	*Tachycineta bicolor*
Veery	*Catharus fuscescens*
Warbling Vireo	*Vireo gilvus*
White-breasted Nuthatch	*Sitta carolinensis*
White-crowned sparrow	*Zonotrichia leucophrys*
White-eyed Vireo	*Vireo griseus*
Wild Turkey	*Meleagris gallopavo*
Willow Flycatcher	*Empidonax traillii*
Wood Duck	*Aix sponsa*
Wood Thrush	*Hylocichla mustelina*
Yellow-breasted chat	*Icteria virens*
Yellow-bellied Sapsucker	*Sphyrapicus varius*
Yellow-throated Vireo	*Vireo flavifrons*
Yellow-throated Warbler	*Setophaga dominica*
Yellow Warbler	*Setophaga petechia*
Mammal Species	
Coyote	*Canis latrans*
Eastern Chipmunk	*Tamias striatus*
Eastern Cottontail Rabbit	*Sylvilagus floridanus*
Eastern Gray Squirrel	*Sciurus carolinensis*
Fox Squirrel	*Sciurus niger*
Groundhog	*Marmota monax*

Meadow Vole	*Microtus pennsylvanicus*
Mink	*Mustela vison*
Muskrat	*Ondatra zibethicus*
Raccoon	*Procyon lotor*
Red fox	*Vulpes fulva*
Red Squirrel	*Sciurus vulgaris*
Southern Flying Squirrel	*Glaucomys volans*
Striped Skunk	*Mephitis mephitis*
Virginia Opossum	*Didelphis virginiana*
White-tailed Deer	*Odocoileus virginianus*
Amphibians	
American Bullfrog	*Lithobates catesbeianus*
American Toad	*Anaxyrus americanus*
Green Frog	*Lithobates melanoma*
Leopard Frog	*Lithobates pipiens*
Northern Dusky Salamander	*Desmognathus fuscus*
Northern Two-lined Salamander	*Eurycea bislineata*
Ravine Salamander	*Plethodon richmondi*
Redback Salamander	*Plethodon cinereus*
Western Chorus Frog	*Pseudacris triseriata*
Wood Frog	*Lithobates sylvatica*
Reptiles	
Eastern Garter Snake	*Thamnophis sirtalis sirtalis*

Many wildlife species use woodlands to obtain their major habitat requirements - food, cover, water, and space. The amount and type of habitat available in a woodland is influenced by forest succession. Forest succession is the natural progression of growth, development, and replacement of plant species over time. For example, a harvested stand or grassy field will eventually become a mature forest. Young woodlands, or early successional woodlands, consist of woody shrubs, seedlings, and saplings. They typically offer more fruit, seeds, and woody

browse but less nuts, acorns, and cavity trees (trees that provide denning sites for wildlife). As succession continues, trees mature to sizes large enough to produce acorns and cavities. Mature woodlands offer more nuts, acorns, and cavity trees but less fruit, seeds, and woody browse than young woodlands. Early successional woodlands also provide cover, both for escape from predators and thermal protection during cold and wet weather.

The OSU Mansfield campus has both young and mature woodlands, offering a diversity of wildlife habitat resources. Species such as white-tailed deer, eastern cottontail rabbit, and songbirds (gray catbird, eastern towhees, and blue-winged warbler) are associated with young woodlands, while wild turkey, spotted salamanders, and pileated woodpeckers are often associated with mature woodlands. All of the aforementioned species have been documented on the campus. It is important to realize that manipulation of the woodland resources will influence available wildlife habitat and those associated wildlife species.

White-tailed deer are abundant throughout the OSU Mansfield campus in both young and mature woodlands. The 2015 ENR 4900.02 class conducted an evaluation of the campus' deer abundance and estimated 15-22 deer per square mile. This estimate was slightly below the Ohio Division of Wildlife's estimate of 24 deer per square mile in Richland County.

The May 2015 estimate for the OSUM property should be considered a conservative estimate of deer density over the entire property. Deer may be more locally abundant or concentrated in certain areas where they find food and cover. Deer were more frequently encountered by the deer herbivory student study in young forest (45% of observations) and old-field habitats (40%) compared to mature forest (15%) during May 2015. The student deer herbivory study group found that deer dropping and browsing intensity were highest in young forest than in older forest types, pine plantations, and old-field areas. The deer population appears to be below carrying capacity, a finding supported by absence of pronounced browse lines along forest edges. Nevertheless, the population may still impact growth and regeneration of forb and tree species that are sensitive to deer browsing. Deer browsing may also inhibit growth of trees that are planted to promote regeneration or to restore riparian communities.

The optimum deer population level for the campus is unknown, as the impact deer browsing on forb growth and tree regeneration is yet to be determined. Nearly 30% of browsed plant stems observed by the deer herbivory student study team were on seedlings of trees that the current forest canopy comprises (e.g. .white ash, American beech, American elm, and sugar maple) and 33% were invasive species such as privet, autumn olive, and multiflora rose. Jewel weed was also heavily browsed (22% of stems).

A deer exclosure was erected during the winter of 2013-2014 in the woodlands behind Key Hall. This ¼ - acre fenced plot will exclude deer, allowing vegetation within the exclosure to grow without the pressure of deer browsing. This will help to determine the level of impact deer are having on the campus woodlands. Additional exclosures have been proposed in different forest types of the campus woodlands. Seasonal and annual measurements of plant communities

and browsing intensity within the exclosures and on nearby unfenced will provide additional data to assess impacts of deer browsing.

Endangered Species

There are several federally endangered (E) and threatened (T) species that have been listed within Richland County. Those species are as follows: Indiana bat (E), northern long-eared bat (T), eastern massasauga (Candidate), eastern hellbender (Special Concern), bald eagle (Special Concern). In addition, there are several state listed species for Richland County, see [http://wildlife.ohiodnr.gov/species-and-habitats/state-listed-species/state-listed-species-by-county].

While the OSU Mansfield woodlands have not been surveyed for E&T species, there is potential habitat available for some of the listed species (specifically the Indiana and northern long-eared bat). Manipulation of the woodland resources and other land use changes may require surveys as delineated by the Endangered Species Act.

Invasive Species

Throughout the campus area there are a variety of non-native invasive species to be found. The list includes such plants as garlic mustard, autumn olive, glossy and common buckthorn, narrow leaved cattail, crownvetch, bush honeysuckle, bittersweet and privet (see known list in Table 4). While garlic mustard seems to be the most dominant one in the woods, many of the others are lurking on the edges of the woodland areas waiting for the right canopy gap or disturbance that will give them access to the understory. This canopy gap is happening in those areas where ash trees existed in the dominant canopy structure and have now been killed by emerald ash borer (EAB).

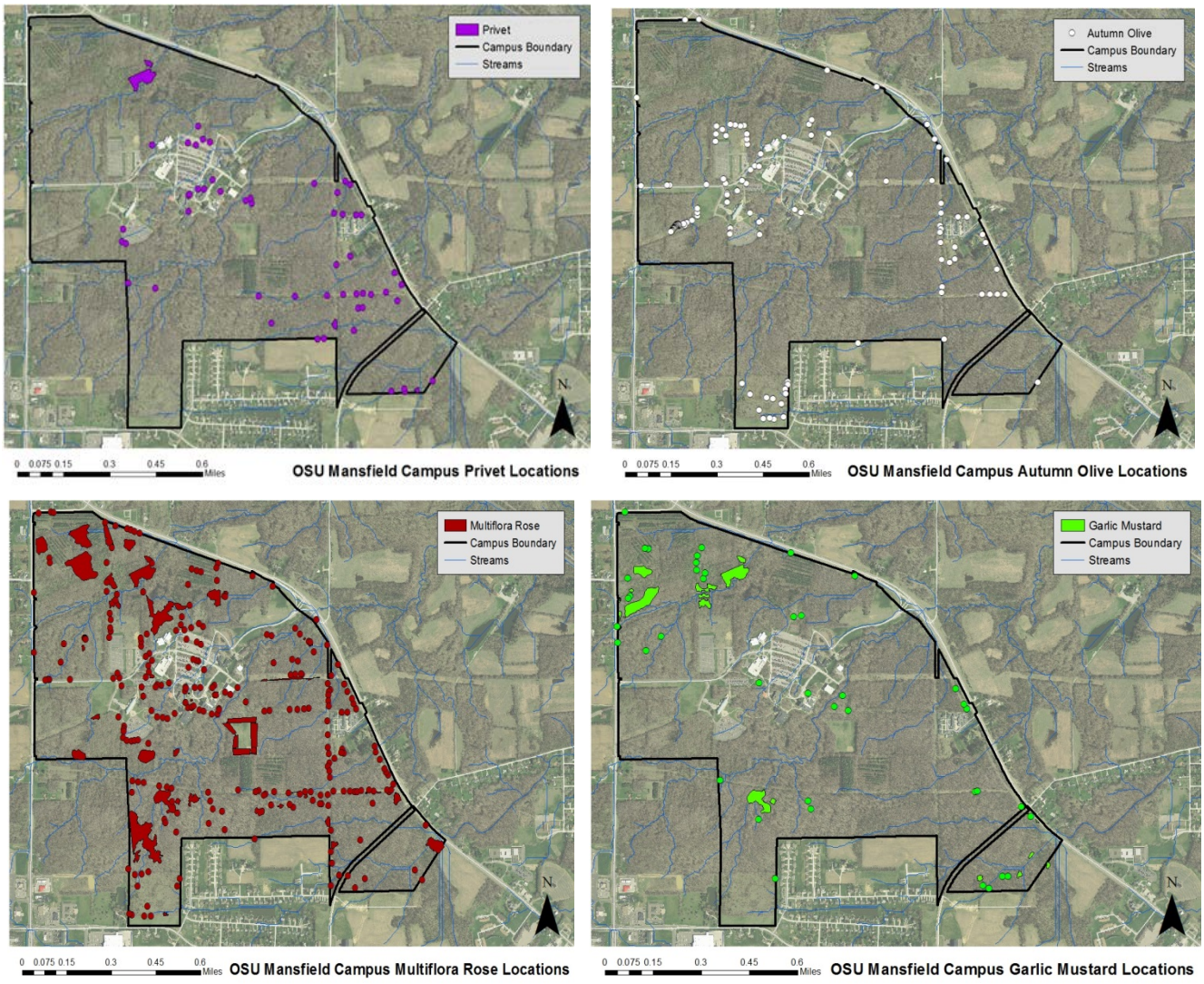


Figure 10: Maps of multiflora rose, garlic mustard, autumn olive and privet non-native invasive plants on the Ohio State University Mansfield campus. 2015

In addition to those non-native invasive plants, there is the potential for several non-native invasive insects and diseases to greatly impact the acreage. Pests such as emerald ash borer

(EAB), and viburnum leaf beetle (VLB) are already present on campus. Others such as Asian longhorned beetle (ALB), hemlock woolly adelgid (HWA), spotted lantern fly (*Lycorma delicatula*) (SLF) and thousand cankers disease of black walnut (TCD) all have the potential to impact the campus landscape.

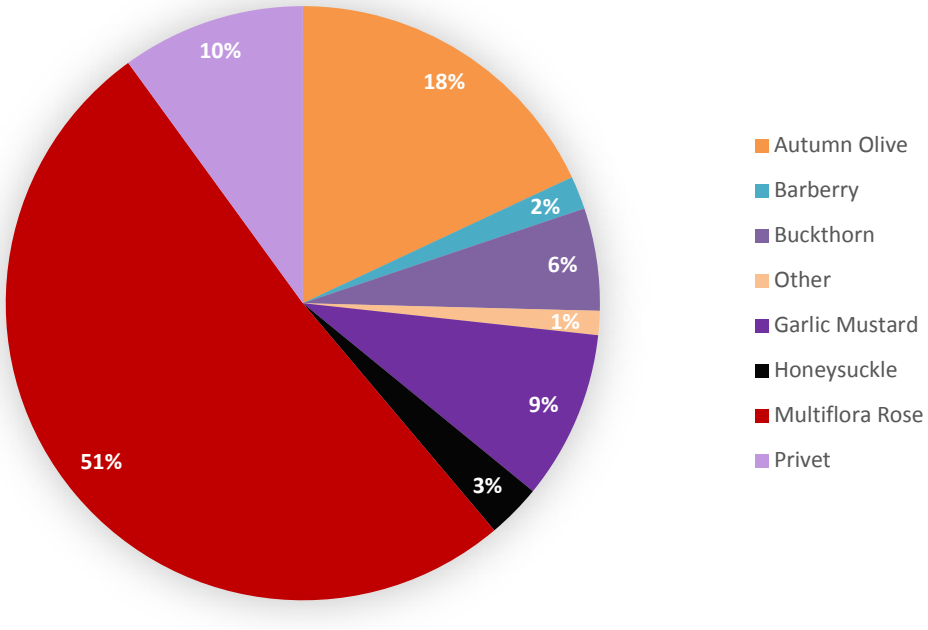


Figure 11: Chart shows percentages of non-native invasive plant species on the Ohio State University Mansfield campus 2015 as tallied by the ENR 4900.02 class.

Table 4: Listing of known non-native invasive species found on the Mansfield campus.

Non-native Invasive Plant Species	
Autumn Olive	*Elaeagnus umbellata*
Callery pear	*Pyrus calleryana*
Chinese Privet	*Ligustrum sinense*
Common Buckthorn	*Rhamnus cathartica*
Crown Vetch	*Securigera varia*
Garlic mustard	*Alliaria petiolata*
Honeysuckle	*Lonicera spp.*
Japanese Barberry	*Berberis thunbergii*
Multiflora rose	*Rosa multiflora*
Oriental Bittersweet	*Celastrus orbiculatus*
Winged Euonymus	*Euonymus alta*

Resource Management Plan Goals and Objectives
OSU Mansfield Campus

Overall Goal (EcoLab Mission Statement):

Situated on 640 acres of mature and new growth forest and farmland, dotted with vernal pools and stream heads, The Mansfield campus of The Ohio State University offers a unique setting for education, research and community engagement in environmental studies and stewardship. We strive for a paradigm that understands the earth and the environment including humans as an integrated whole. Our mission is to educate and train citizens and leaders, and to develop new knowledge and techniques that will restore and sustain the health of our planet. Our objectives are:

- Creating opportunities for student research, training, and internships;
- Supporting environmental and scientific programs of study at The Ohio State University;
- Supporting research on forests, vernal pools, wetlands, water resources, and environmental stewardship and sustainability;
- Supporting unique educational opportunities for K-12 students, teachers, and future teachers;
- Providing educational opportunities for children and youth;
- Fostering informed decision-making through education, outreach, training programs and collaborations.

Detailed below are the defined resource areas (invasive species, trails, forests, wildlife habitat, water resources, campus core, open land, restricted property/easement areas and historical) with their corresponding short term (2-5 years) and long term (10-20 years) objectives.

1. **Invasive Species**

   Non- native invasive species are one of the biggest threats to the long term health of our forests. This includes but isn't limited to plants, animals and insects and diseases. The current level of infestation at the Mansfield campus is still at a manageable level.

   Short Term Objective #1 – Develop a strategy to eradicate invasive species (plants and insects where appropriate) around and within the campus acreage utilizing accepted methods and labeled chemicals where and when necessary. (reference OSU Extension fact sheets on the various species and their control methods).

   Long Term Objective #1 – Continue to monitor and eradicate invasive species (both insects and plants) as the need arises.

2. **Trails**

   In order to provide access to many of the unique natural resource areas of the campus (mature and young forested areas, vernal pools and wetlands, streams etc.) a master plan for a series of trails should be created. These trails will then be used for environmental and natural resource education and recreation. Side trails for research and demonstration areas should also be looked at. Trails should be designed for low impact recreational activities and service access.

Short Term Objective #1 – Develop “tree identification” trail to legacy forest and successional forest south of the Child Development Center.

Short Term Objective #2 – Develop “vernal pool” trail and board walk to vernal pool behind Conard Hall & Health Science at the rear of Parking Lot #10. (Identified as wood frog vernal pool on map – (see Figure 9)

Short Term Objective #3 – Develop “horseshoe vernal pool” research restricted access trail to significant vernal pool behind and north of Kee Hall.

Short Term Objective #4 - Develop “wetlands & prairie” trail from Milliron Wetlands along Campus environmental entrance from Route 39.

Short Term Objective #5 – Develop “stream ravine overlook” trail along wooded riparian corridor behind Ovalwood Hall.

Short Term Objective #6 – Provide for bike and pedestrian access along the new Lexington-Springmill campus gateway entrance. Provide connectivity to existing Buckeye Village and Campus District Town Center development.

Short Term Objective #7 – Complete bike and walking connection between Molyet Village and Buckeye Village and student housing areas.

Long Term Objective #1 – Develop plan for connecting Campus bike and walking trails with the Richland County Regional Bike Plan.

3. Forests

There is a wide variety of ages and species mixed in the 600 plus acres of the campus forest. For management purposes this acreage is being broken into plantations, mature forests, and young forests. (Figure 8) Any and all forest management activities will need to follow the *Best Management Guide for Logging Operations in Ohio – OSU Extension Bulletin 916* – these BMP’s keep forest operations within the legal guidelines of the Agriculture Pollution Abatement Law.

Short Term Objective #1 – Establish permanent monitoring plots throughout the forested acreage for the purpose of monitoring forest health and adding to the forest inventory that the SENR students have started. These permanent monitoring plots will follow the protocol set up by the U.S. Forest Service in their Forest Inventory and Analysis (FIA) program. *See Wildlife Habitat Short Term Objective #5.*

Short Term Objective #2 – Collect additional data and create a long term plan for management demonstration areas along the gas line easement and/or along the Molyett Village bike path.

Long Term Objective #1 – Work towards keeping the Mansfield forested acreage healthy and functioning in the best capacity to meet the overall goals and objectives for the campus.

3a. Plantations

These areas were planted to a variety of conifer species (and some hardwoods) over the course of a few years. They have never had any management applied to them and are starting to show this neglect.

Short Term Objective #1 – There are several of the conifer plantations that are in need of management. Several are starting to decline and therefore now would be the time to harvest these plantations and create some early successional habitat – one component that is missing in the campus habitat structure. (*See Wildlife Habitat Short Term Objective #3.)*

Long Term Objective #1 – The remaining plantation will need to be monitored and perhaps thinned in order to keep the plantation healthy and growing. Eventually it will need to be evaluated as to letting it die and revert naturally to a young hardwood stand or be re-planted into another stand of conifers.

3b. Mature Forests

These forested areas were existing when the original farm was purchased by Ohio State University to create the Mansfield campus. They include an area of trees that the SENR students dubbed the 'legacy forest' – an area of extremely large trees that are in the age range of 140 years old.

Short Term Objective #1 - In order to work towards some demonstration areas that can be used to educate private woodland owners in sound woodland management practices, an area(s) should be designated for appropriate harvesting techniques (those recommended for upland central hardwoods). These cuts should be performed along trails that create access to these areas. (see OSU Extension fact sheet *Harvesting and Reproduction Methods for Ohio Forests, F-47-01*)

Short Term Objective #2 – Create passive interpretive signage to go along with these demonstration cuts so interested clientele can visit and explore the site on their own. This would include, but not be limited to signs, brochures and electronic media where appropriate.

Short Term Objective #3 – Document the details of the trees that exist in the 'legacy forest' and create an informational piece that could be used along the trail that would pass through the right-of-way into the area.

Short Term Objective #4 – Explore the potential of setting up an area to be managed as a sugar bush for producing maple syrup. (see OSU Extension publication *North American Maple Syrup Producers Manual*). (See Figure 8 – mature forest area on north side of the west entrance)

Long Term Objective #1 – Where harvests occur, have pictorial documentation to go along with data collected on the changes that occur in the stand to use in landowner education programs.

3c. Young Forests

These areas became forests after either 1) livestock were removed from the pasture area or 2) row crop production ceased. Through natural succession these areas exist as young forest stands today.

Short Term Objective #1 – Identify which stands can be used as management demonstration areas (examples include but are not limited to different levels of thinning and crop tree management protocols – intermediate harvesting techniques) and set up a protocol for data collection and pictorial documentation of the progression as the plots age.

Short Term Objective #2 – Create outreach materials for landowners and other interested parties. This includes but should not be limited to fact sheets and signage on site.

Long Term Objective #1 – Continue with the appropriate intermediate harvest protocols until the trees in the stand either reach harvestable size or objectives for the site change (20+ years).

4. Wildlife Habitat

There are many species of birds, mammals, amphibians, reptiles, and insects using the campus woodlands, open lands, and water resources as habitat. Additional inventory and assessment of key habitat (woody and herbaceous understory, early successional habitat, and riparian areas) and long-term monitoring of wildlife populations and subsequent responses to management is recommended.

Short Term Objective #1 – Expand and repeat deer population density estimates and herbivory impact assessment (browse transect) to determine if population control is needed.

Short Term Objective #2 – Establish at least three additional deer exclosures, one in mature forest and two in young forest.

Short Term Objective #3 – Conduct a thorough biological inventory (emphasis on woody understory and herbaceous plants, herptiles, and bats) and physical habitat

assessment (soils, hydrology, bank-side erosion, etc.) of riparian zones associated with streams, vernal pools, and wetlands.

Long Term Objective #1 – Develop and implement a long-term wildlife monitoring program and protocols to assess population responses to forest management and restoration, and ecological change (i.e. succession, human development, climate, etc.). (*See Forest short-term objective #1*.)

5. Water Resources

5a. Streams

Short Term Objective #1 – Manage invasive species and remove stream debris (tree limbs and logs that can clog the drainage culverts) annually.

Short Term Objective #2 – Assess all six watersheds every 5 years for minor stream (approx. 8.5 km) ecosystem health.

Long Term Objective #1 – Sustain healthy woodland riparian corridors along the two largest streams. Provide supplemental woodland regeneration 100' either side of stream corridors.

Long Term Objective #2 – Manage 300' of stream and 200' of enhanced wooded-riparian corridor adjacent to Riedl Hall and Child Development Center in accordance with the Environmental Covenant.

5b. Wetland & Vernal Pools (ephemerals)

Short Term Objective #1 – Delineate hydrological protection and ecological sensitivity zones around vernal pools and wetlands and develop best management practices for conservation of these areas.

5c. Storm Water

Short Term Objective #1- Monitor and report annually Milliron Wetlands water quality and the health for 46 acres of source uplands drainage.

Long Term Objective #1 – Continue to use decentralized storm water management and design strategies to sustain or restore site hydrology to pre-development conditions. Apply EPA storm water management best practices to extent practical.

Long Term Objective #2 – Promote “green” storm water management and sustainability practices for increased development likely to occur along the western border of Campus. Coordinate with City of Mansfield, City of Ontario and Richland County Soil & Water Conservation that have regulatory jurisdiction immediately adjacent to Campus.

5d. Water Quality

Long Term Objective #1 – Develop and implement a long-term continuous monitoring program and protocols to track changes in hydrology and water quality associated with forest management and restoration, campus development, and ecological change (i.e. succession, climate, etc.).

6. Campus Core

Short Term Objective #1 – Improve way-finding signage.

Short Term Objective #2 – Develop campus core landscape philosophy and plan. Identify and implement specific ground maintenance practices, techniques and care activities.

Short Term Objective #3 - Work with the ODNR Division of Forestry Urban Forester to create a comprehensive long-term plan for the trees within the campus core.

Short Term Objective #4 – Map and protect campus core areas used for academic, research and demonstration.

Short Term Objective #5 – Work towards Tree Campus USA certification – an Arbor Day Foundation certification similar to the Tree City USA certification. Ohio currently has 13 Tree Campus USA certifications – including the Columbus and Wooster campus of Ohio State.

Long Term Objective #1 – Provide a sustainable natural landscape, balanced with operations and growth of the broader academic and student services mission and needs in the Campus Core. Coordinate with growth and improvements identified in the 2013 Mansfield Campus Framework Plan.

Long Term Objective #2 – Plan for connecting a walkable Campus with the walkable Campus District Town Center.

Long Term Objective #3 – Construct a Natural Resource Center facility to promote learning, research and partnerships. Reference OSU Mansfield Capital Needs Inventory Project #12000420 – Mansfield Wetlands and Woodlands Laboratory.

7. Open Land

Short Term Objective #1 – Identify areas of opportunity for enhancement or development of native prairie and early successional and forest-openland edge habitats. See Plantation short-term objective #3.

8. Restricted Property/Easement Areas/Underutilized Property

Short Term Objective #1 – Inspect property and easement lines annually.

Short Term Objective #2 – Return "as is" approximately 60 acres (CNI #130440) along the Home Road right-of-way extension and 30 acres (CNI #130434) adjacent to Walker Lake Road development corridor to the community for economic development through fee simple sale. Proceeds to be used for gateway entrance roadway and bike/walking path development (see Campus Core Long Term Objective #1 and #2 and Trails Short Term Objective #6)

Long Term Objective #1 – Map all easements and property restrictions.

Long Term Objective #2 – Maintain a 200' natural buffer along all Campus property limits. Encourage adjacent property owners and development to maintain 100' of "green space" with the campus.

Long Term Objective #3 – Promote and partner with First Energy Corporation and Ohio Gas the use of their respective transmission right-of-ways for research and demonstration purposes. Coordinate with their maintenance & service plans.

9. Historical

Short-term Objective #1 – Remove Ohio Standard Baseline foundations along planned Campus Entranceway/Gateway from Lexington-Springmill Roadway. Complete a Historical American Engineering Record (HAER). Apply for an Ohio Historical Marker. Reference: OSU Planning & Real Estate Ohio Standard Baseline Study of June 15, 2015.

Long-term Objective #1 – Apply NEPA and National Historic Preservation Act Section 106 consultation process on all planning & projects that effect cultural resources.

10. Management

Short Term Objective #1 – Active day-to-day management of resource plan using existing campus organization. Provide training and additional resources.

Short Term Objective #2 – Establish Community Natural Resource Collaboration Committee to advise and promote natural resource management techniques and practices.

Long Term Objective #1 – Obtain dedicated natural resource manager for regular operations and management of campus resources and coordination with programs.

Appendix: Geodetic Site Historical Images