Chapter 1. The Ohio Landscape

1.0 Ohio’s Climate and Land
1.0.1 Climate
The climate of Ohio is classified as a humid continental, warm summer type according to a climate classification system widely used in the United States. However, the state tends to encompass more than one type of climate because of variations in longterm average climatic factors within its borders, and its location at the transitional boundary between climate types. Ohio is situated in a region where prevailing winds are from the west, southwest, and northwest. The interior location that the state occupies on the continent is subject to the influence of both polar air and tropical maritime air masses. Alternation of low- and high-pressure air masses accompanying passage of cyclones and anticyclones produces irregularly spaced changes in the weather (Noble and Korsok 1975).

Ohio lies along the track of cyclonic systems that move across mid-continent from west to east. The vast majority of moisture producing precipitation in Ohio derives from cyclones that form in the lee of the Rocky Mountains. These cyclones track northeastward toward the Great Lakes Region and Ohio River Valley bringing tropical maritime air from the Gulf of Mexico. The cyclonic systems usually track farther north in summer than in winter. In summer, tropical maritime and continental tropical maritime air masses dominate producing high temperatures and frequently high humidity. In winter, polar continental air masses that produce cold dry weather dominate with intermittent, brief interjections of tropical maritime air bringing wet warmer weather (Noble and Korsok 1975).

Ohio’s diverse climate is influenced on a large scale by its location on the continent, and locally by its own geography and topography. Locally, the climate in the northern (especially northeastern) part of the state is affected by Lake Erie, and the unglaciated southern and eastern parts of the state see topographical influences to their climate. The glaciated central, western, and northwestern parts of the state experience a continental climate without the modifying effects of large bodies of water or hills.

Temperature
Ohio’s continental climate is typified by a wide range of seasonal variability that includes cold dry winters and warm humid summers. Falls tend to be dry and mild, and springs are generally a roller coaster of temperature fluctuations accompanied by significant precipitation. During the winter, arctic air masses that follow the jetstream down bring the coldest temperatures to Ohio. These “Alberta Clippers” can bring sub-zero temperatures to the state. At the opposite extreme, mid-latitude storms from the Gulf of Mexico can reach Ohio during the winter. These storms can produce significant precipitation in the form of snow, freezing rain, or rain depending upon the storm’s interaction with other air masses (Pfingsten et al. 2013). Mean monthly high temperatures range from a low of 33 degrees F in January in northern Ohio to 41 degrees in extreme southern Ohio. Similarly, mean monthly highs in July range from 82 in the north to 87 in the south (U.S. Climate Data).

Mean annual temperatures vary by season, and as mentioned above, can vary across the state. Northwest Ohio is often the coldest part of the state – given the prevailing weather direction, northwestern Ohio’s weather is largely unaffected by Lake Erie. The weather in northeastern Ohio is very much affected by Lake Erie. Falls tend to be protracted and mild due to the warm lake waters, but the spring warm-up can be delayed because of the influence of cold lake waters. Lake effect snows in winter can be significant in northeastern Ohio. Temperatures in the glaciated portion of Ohio tend to vary less than those in the unglaciated eastern and southeastern part of the state. The growing season differs by about 12% from the southern part of the state to the northern part as measured by “freeze-free” days (Pfingsten et al. 2013). Seasonal changes in temperature and other climatic factors force a cycle of vegetative growth and dormancy characteristic of the north temperate climatic zone (Schiefer 2002).
**Precipitation**
Due to its geographic location, Ohio experiences fairly consistent and significant precipitation throughout the year. The spring and summer months are typically the wettest while the fall and winter months are the driest. June and July are the wettest months with the state averaging nearly 4 inches of precipitation each month. October and February are the driest months with the state averaging about 2 1/4 inches of precipitation each month (ODNR 2011). Precipitation varies across the state with southern and northeast Ohio getting the most due to the influences of moist Gulf air and lake effect precipitation, respectively. Average annual precipitation is lowest in the northwestern part of the state Ohio can experience droughts during the spring and summer, but these occurrences are fairly rare. Flooding on the other hand is more common, occurring primarily in late winter and spring as snow melts and precipitation levels increase (Pfingsten et al. 2013).

Based on the 50-year period 1931-80, Ohio averages 37.57 inches of precipitation annually. Average annual precipitation ranges from a high of nearly 44 inches to less than 30 inches. Snowfall ranges from greater than 100 inches in the northeast (Ohio’s snowbelt), to less than 20 inches in the south along the Ohio River. Snowfall contributes significantly to the average annual precipitation total in the snowbelt areas (ODNR 2011).

Frontal lifting of air masses associated with passage of cyclones is the primary mechanism triggering precipitation in Ohio. Normal passage of cyclonic depressions is supplemented with convectional precipitation in summer. The convectional precipitation is typically produced by thunderstorms moving as squall lines ahead of cold fronts. More stable air masses in fall make it the driest season in most parts of the state (Schiefer 2002).

**Humidity**
The statewide relative humidity averages about 75% throughout the year. Because the amount of moisture that can be held by cold air is less than that of warm air, at 75% relative humidity, the air is much drier in the winter than in the summer. Fog tends to vary seasonally in Ohio due to the conditions required for its creation. Fall and winter are the times when those conditions are most prevalent. Cloud cover peaks during the winter months in Ohio. On average, about 70% of the days during each month are cloudy during the winter (Pfingsten et al. 2013).

**Wind & Severe Weather**
The primary wind direction is southwest in Ohio, although high/low pressure systems and storms can create winds from any direction on any given day. Winds in general tend to be higher in the northern part of the state, and seasonal variation is seen statewide with higher winds in winter than summer.

Convective weather during the spring and summer can and does generate thunderstorm-induced severe weather. Hail, tornadoes, high winds, and localized flooding are often the result. Although Ohio is not located in the heart of tornado country, it does lie at the eastern end of “tornado alley”, and some of the most famous tornado events have occurred here (Pfingsten et al. 2013).

**1.0.2 Lands**
At the time of European settlement, Ohio’s landscape consisted primarily of a vast expanse of forest, with a few large grassland and wetland areas. Scattered throughout the state, in smaller amounts, there were other significant habitats, including the Lake Erie islands, oak savannas, boreal (snowbelt) communities, and caves. These habitats were delineated from the native vegetative communities described and mapped by the Ohio Biological Survey in “The Natural Vegetation of Ohio In Pioneer Days”. Figure 1 is adapted from Gordon (1966).
According to the 2010 National Resources Inventory (USDA 2013) the total surface area of Ohio is 26,444,800 acres, including water areas. Over 80% of the state (21,491,500 acres) is characterized as nonfederal rural lands (nonfederal = all lands in private, municipal, state, or tribal ownership). Of this rural lands total, croplands account for about 52%, forestlands 33%, pastureland 10%, CRP lands 0.8%, and other rural land 4%. “Inland” water areas (not including Lake Erie) account for about 1.6% of Ohio’s surface area.

The following information regarding Ohio’s physiography, geology, soils, vegetation, land use, and water development is adapted from Schiefer (2002) except where otherwise indicated.
Figure 2. The Physiographic Regions of Ohio (Brockman 1998).
Physiography

Physiographic classifications provide a key to the general topography and character of the land surface in Ohio. Detailed physiographic classifications for Ohio are mapped and described by Brockman (1998). The physiographic regions in Ohio are shown in Figure 2.

Ohio overlaps parts of three physiographic provinces in the United States. Most of the western half of the state is in the Central Lowland Province while nearly all the eastern half is in the Appalachian Plateaus Province. The Bluegrass Section of the Interior Low Plateau Province extends across the Ohio River marginally into southwestern Ohio.

The Central Lowland Province in Ohio is separated from the Appalachian Plateaus Province by a transitional boundary that coincides with the Allegheny Escarpment of erosion resistant sandstones. Sandstones and shales are at or near the surface near the boundary while limestones, dolomites and shales underlie more distant land in the Central Lowland. The rocks in the Central Lowland part of the state are overlain with glacial tills and lacustrine deposits that form a relatively youthful plain only slightly scarred by streams. Two physiographic sections of the Central Lowland Province are represented in Ohio, the Till Plains and the Huron-Erie Lake Plain (Figure 2).

Till Plains

About one-third of Ohio is in the Till Plains Section of the Central Lowland Province.

This land is gently rolling for the most part, and covered with glacial deposits of moderate (100-200 feet) to moderately low (25-60 feet) relief. Moderately high relief (250 feet) exists in the Bellefontaine Upland of the Till Plains. Areas where morainal belts cross the Till Plains are undulating while intervening areas of ground moraine tend to be level. Transitional land bordering the Appalachian Plateaus is more rolling.

The Till Plains include land that drains to Lake Erie and to the Ohio River. Streams draining to Lake Erie are generally smaller and less numerous than those draining to the Ohio River. Streams draining to the Ohio River are more deeply entrenched (Cross and Hedges 1959).

The Till Plains in Ohio are divided into six physiographic regions (numbers below refer to regions of the map in Figure 2):

1) Steuben Till Plain – hummocky terrain with rolling hills interspersed with flats and closed depressions, few streams, deranged drainage, abundant wetlands

2) Central Ohio Clayey Till Plain – well-defined moraines with intervening flat-lying ground moraine and intermorainal lake basins, few large streams, limited sand and gravel outwash, surface of clayey till

3) Southern Ohio Loamy Till Plain – moraines commonly associated with boulder belts between relatively flat-lying ground moraine, cut by steep-valleyed large streams, stream valleys filled with outwash alternate between broad floodplains and narrows, surface of loamy till

4) Illinoian Till Plain – rolling ground moraine of older till lacking ice constructional features, loess cap till deposits, many buried valleys, modern valleys alternate between broad floodplains and bedrock gorges

5) Dissected Illinoian Till Plain – hilly former till plain with relatively high stream density, loess caps till deposits

6) Galion Glaciated Low Plateau – rolling upland mantled with thin to thick drift, transitional to Appalachian Plateaus

Huron-Erie Lake Plains

The Huron-Erie Lake Plain Section of the Central Lowland Province covers a large area of Ice-Age lake-bottom land in northwestern Ohio and a narrow band between Lake Erie and the Portage Escarpment across extreme northeastern Ohio. The boundary of the Lake Plain inland from modern Lake Erie coincides with the margin of the highest Pleistocene lake (Lake Maumee). The Lake Plains are flat with
low (10 feet) to extremely low (5 feet) relief. Although glaciated, much of the present land surface is
covered with lacustrine deposits in the form of clay flats, sand plains, dunes, deltas, and beach ridges.

The larger western part of the Lake Plain is separated from the eastern part by a karst plain thinly
mantled with till. Channels modified for agricultural drainage are pervasive in the western part of the Lake
Plain where drainage density is about 2 miles of stream per square mile of drainage area, representing
the lowest in the state (Brockman 1998).

The Huron-Erie Lake Plain in Ohio is divided into two physiographic regions (numbers below refer to
regions of the map in Figure 2):

7) Maumee Lake Plains – flat lying lake basin with beach ridges, bars, dunes, deltas, and clay flats,
slightly dissected by modern streams, contained the former Black Swamp

8) Erie Lake Plain – edge of very low relief Ice-Age lake basin separated from modern Lake Erie by
shoreline cliffs, major streams in deep gorges

Bluegrass Section
The Bluegrass Section of the Interior Low Plateau Province covers land in extreme southwestern Ohio
south of the Till Plains and east of the Appalachian Plateaus. This land in proximity to the Ohio River
constitutes the Outer Bluegrass Region.

9) Outer Bluegrass Region – has an unglaciated eastern segment and a glaciated western segment. Both
segments are dissected plateau of carbonate rocks with moderately high relief (300 feet). High gradient
limestone and shale bedrock streams are common. The eastern segment is bounded by the maximum
glacial margin and eastern high ridges are capped by non-carbonate rocks. Caves and other karst
features are present in the eastern segment. The eastern segment is connected to the western segment
by Ohio River bluffs. The western segment is bounded by nondissected till plain. Thin pre-Wisconsinan till
covers narrow ridges in the western segment (Brockman 1998).

The western boundary of the Appalachian Plateaus Province is close to Lake Erie at the Ohio-
Pennsylvania state line. From there it parallels the lake to Cleveland, then turns southwest across central
parts of Ohio and crosses into Kentucky a little west of the Scioto River. The Appalachian Plateaus in
Ohio are underlain with sandstones and shales including the coal measures. Two physiographic sections
of the Appalachian Plateaus Province are represented in Ohio. These are the Allegheny Plateaus Section
and the Glaciated Allegheny Plateaus Section.

Glaciated Allegheny Plateaus
The Glaciated Allegheny Plateaus Section of the Appalachian Plateaus Province covers most of
northeastern Ohio and extends southward across central and southern parts of the state in a narrow
irregular pattern along the Wisconsinan and Illinoian glacial margins. The glaciated plateaus in the
northeastern part of the state are smoother and more rolling than the unglaciated plateaus to the south.
Valleys are less deep due to glacial erosion of hills and glacial deposition that has filled bottomlands.
Drainage density is lower than in the unglaciated plateaus as streams are more widely spaced; drainage
patterns transition from dendritic to parallel and trellis forms. Land along the southward extension of the
glaciated plateaus is rugged hills like the unglaciated plateaus (Brockman 1998).

The Glaciated Allegheny Plateaus in Ohio are divided into four physiographic regions (numbers below
refer to regions of the map in Figure 2):

10) Killbuck Glaciated Pittsburgh Plateau – ridges and flat uplands covered with thin drift, dissected by
steep valleys, valley segments alternate between broad drift filled and narrow rock walled reaches

11) Akron-Canton Interlobate Plateau – area dominated by kames, kame terraces, eskers, kettles, kettle
lakes, and wetlands, deranged drainage and many natural lakes
12) Illinoian Glaciated Allegheny Plateau - rugged hills with loess and older drift on ridge tops, dissection similar to unglaciated plateau

13) Grand River Low Plateaus – gently rolling ground with thin to thick drift, poorly drained areas and wetlands common

Allegheny Plateaus
The Allegheny Plateaus Section of the Appalachian Plateaus Province covers about one-third of Ohio including all of the southeastern part of the state. It includes all of the unglaciated land except for that in the Bluegrass Section of the Interior Low Plateau Province. Land in the Allegheny Plateaus part of Ohio is mature hill country with moderate (300-600 feet) to high (400-800 feet) relief. The land is deeply incised by well developed stream systems leaving narrow ridges and hillocks separated by steep-walled valleys up to 300 feet deep. All of the streams in the area drain to the Ohio River. The largest streams flow in flat-bottom valleys at relatively low gradient. Tributaries to the larger streams are relatively high gradient. Headwater channels with intermittent flows actively engaged in down cutting are common. Drainage patterns are dendritic with drainage density about 5 miles of stream per square mile of drainage area, representing the highest in the state (Brockman 1998).

The Allegheny Plateaus in Ohio are divided into four physiographic regions (numbers below refer to regions of the map in Figure 2):

14) Muskingum-Pittsburgh Plateau – moderate to high relief, dissected with medium grained bedrock sequences, broad major valleys containing outwash terraces, and tributaries with lacustrine terraces

15) Shawnee-Mississippian Plateau – high relief, highly dissected with coarse and fine grained bedrock sequences, remnants of ancient clay-filled Teays drainage system extensive in lowlands

16) Ironton Plateau – moderately high relief, dissected with coarse grained coal bearing rock sequences more common than in other regions, lacustrine clayfilled Teays valley remnants common

17) Marietta Plateau – high relief, highly dissected with fine grained rocks, red shales and red soils common, remnants of ancient clay-filled Teays drainage system common

Geology
The landforms of Ohio are the culmination of geological and climatological conditions existent throughout geologic time. The various conditions of the past are evidenced by the bedrock sequences and surficial glacial deposits found in the state. The character of the rocks and surficial glacial deposits is a primary factor determining the amount of ground water storage in basins in Ohio.

Ohio is underlain with thousands of feet of sedimentary rocks formed during the Paleozoic Era. The sedimentary rock sequences provide evidence that Early Paleozoic environments were characterized by tropical and subtropical climates, shallow to moderately deep seas with an abundance of mud bars, sand bars, and reefs. Limestone and calcareous shales were the dominant sedimentary deposits. Later Paleozoic environments were characterized by tropical climates, terrestrial streams, deltas, coal swamps, and near shore seas. Sandstones, siltstones, and shales were the dominant sedimentary deposits. Tropical climates prevailed because the continental plate was located in equatorial regions during the Paleozoic 245 to 570 million years ago (Feldmann 1996).

The sedimentary rocks in Ohio and neighboring states have been subject to uplifting and subsidence caused by tectonic forces. The sedimentary rocks and permeable surficial deposits largely determine the amount of ground-water storage in drainage basins. Shallow ground-water systems affecting base flow of streams are generally confined to water bearing strata of the surface rocks and permeable surficial deposits, the latter having the greater influence (Stout et al. 1943). Regional flows of ground water from rock strata contribute significantly to base flows of streams in certain areas of the state.
During the period of erosion that preceded the first glaciation of the Pleistocene Epoch, the surface rocks in Ohio were deeply incised by Teays-Stage drainage systems. The Teays drainage gathered its headwaters in the Piedmont of Virginia and North Carolina. The main stem crossed the Highlands and flowed down the Teays valley to Ohio where it entered the state at Wheelersburg. From there, it flowed north to the vicinity of present day Chillicothe and then turned northwest crossing into Indiana through Mercer County to join the ancient Mississippi system. The Teays was a mature drainage system whose main stem cut a rock valley through Ohio averaging 1.5 miles wide with local relief of 300 to 600 feet. All but the northern and eastern parts of the state were drained by it. The northern and eastern parts were drained by streams contemporary with the Teays but flowing northeast to the Atlantic Ocean rather than to the Gulf of Mexico (Stout et al. 1943).

The Teays was blocked by the Kansan and pre-Kansan glaciation during the Early Pleistocene creating a glacial lake hundreds of feet deep. During the blockage, silt deposits averaging 20 to 40 feet deep accumulated in the lake bottom. Remnants of these deposits, termed Minford silts, appear as terraces along many present day streams in unglaciated parts of the state and in the bottoms of buried valleys in glaciated areas. The impounded water eventually overflowed to the southwest creating a new outlet known as the Cincinnati River. This post-Kansan drainage is referred to as the Deep Stage drainage because the general level of incising exceeded that of the Teays. Narrow rock valleys of the Deep Stage indicate that it was a more youthful system than the Teays (Stout et al. 1943).

The Deep Stage drainage was blocked by the Illinoian glaciation that extended south of the Cincinnati River and present day Ohio River. Impounded water overflowed to the northeast. The post-Illinoian drainage was at generally higher levels than either the Teays or Deep Stage and followed in part the course of northeastward flowing streams contemporary with the Teays. Many streams in unglaciated parts of the state reversed flow direction and cut new channels through low divides. The Illinoian glaciation deposited greater quantities of material than the Kansan glaciation leaving varied assortments of sand, gravel, silt and clay along its margin (Stout et al. 1943).

The post-Illinoian drainage was blocked by the Wisconsinan glaciation in the Late Pleistocene forcing impounded water to overflow again to the southwest along the course of the present day Ohio River. The Wisconsinan glaciation involved several major advances and retreats that left two-thirds of the state covered with varying depths of glacial tills including extensive ground moraine and end moraines in the form of morainal belts across the state.

Enormous quantities of sand and gravel were deposited in interlobate areas at the glacial margin. Glacial melt waters extended the impact of glaciation well beyond the margin through transport, sorting, and deposition of sand and gravel in the form of valley trains, terraces, and outwash plains. Loess deposits capped considerable areas in southwestern Ohio as the Late Wisconsinan glaciation retreated. Drainage in unglaciated areas underwent another cycle of realignment and stream flow reversals. Streams flowed through valleys representing a composite of valley reaches created during different post-glacial drainage cycles (Stout et al. 1943).

Ancestral lakes to present day Lake Erie formed during the retreat of Wisconsinan glaciation leaving widespread lacustrine deposits throughout the Lake Plains. Final retreat of the Late Wisconsinan glaciation allowed for re-establishment of drainage to the northeast and for head cutting into the Till Plains by streams draining to the Ohio River. Ice front streams, wholly or partly aligned with morainal belts, drained to Lake Erie. Glacial lakes in areas of ground moraine became lacustrine lakebeds and in some places, peat bogs.

Soils and Natural Vegetation
Soils in the portion of Ohio that was covered by glacial ice during one or more glaciations (Figure 3) formed in glacial deposits. Most of the soils in the glaciated part of Ohio are very deep to bedrock. Soils in the unglaciated portion of Ohio formed from materials weathered from sedimentary rocks. Because soil forms more slowly from bedrock than from glacial material, soils in unglaciated east and southeast Ohio tend to be more shallow to bedrock (ODNR Soil Regions of Ohio).
Land in Ohio near the glacial margin during the Late Pleistocene supported spruce-dominated communities. As the Late Wisconsinan ice sheet retreated, spruce-dominated communities spread northward reforesting the glacial plains.

The cool, wet climate that prevailed during the Late Pleistocene changed rapidly to a warmer, drier climate about 10,000 years ago. This period of rapid climate change marked the end of the Pleistocene and the beginning of the Holocene. During the Early Holocene, oak-dominated communities replaced the spruce communities in Ohio. Composition of the forests became more mixed as a result of fluctuations in Holocene climate. Warm, humid periods favored development of mixed deciduous forests dominated by beech, maple, elm, ash, and walnut, while warm, dry periods favored oak and hickory (Feldmann 1996).

Most soils in Ohio developed under deciduous forest cover in a humid temperate climate. Ohio has a great variety of soils due mainly to differences in parent material. Differences in slope and drainage contribute to variety by allowing formation of different soils from the same parent material. Weathering and erosion of carbonate parent rock produced high-lime parent material in the western half of the state while weathering and erosion of sandstone and shales produced low-lime parent material in the eastern half of the state. Soils developed from high-lime parent material generally have lower acidity than those developed from low-lime parent material (Dotson 1954).

The most common soils with greatest areal coverage in Ohio can be categorized as glacially transported soils, lacustrine soils, or residual soils. Soils occupying relatively small but widely scattered areas in the state include alluvial soils and organic soils. Although relatively small in areal coverage, these latter soils tend to be highly fertile and of economic importance (Noble and Korsok 1975). Variation in infiltration rates and permeability of soils in basins is an important factor affecting ground-water recharge rates and low-flow regimens of streams.

**Land Use**

The U. S. Department of Agriculture has identified 24 distinct Land Resource Regions in the United States based on land use, elevation and topography, climate, water, soils, and potential natural vegetation. The regions have been subdivided into subregions termed Major Land Resource Areas. Boundaries of the Major Land Resource Areas in Ohio coincide with the soil region boundaries. Eight
Major Land Resource Areas (MLRA) are represented in Ohio. The location of the following MLRAs is shown in Figure 4:
Erie-Huron Lake Plain (MLRA 99)
Erie Fruit and Truck Area (MLRA 100)
Indiana and Ohio Till Plain (MLRA 111)
Southern Illinois and Indiana Thin Loess and Till Plain (MLRA 114)
Kentucky Bluegrass (MLRA 121)
Western Allegheny Plateau (MLRA 124)
Central Allegheny Plateau (MLRA 126)
Eastern Ohio Till Plain (MLRA139)
Figure 4. Major Land Resource Areas in Ohio (modified from ODNR Soil Regions of Ohio)

The Erie-Huron Lake Plain Resource Area (#99 in Figure 4) is characterized by nearly level crop fields with agricultural drainage ditches and subsurface drains. Stream habitat and water quality have been impacted by channelization, ditching, and agricultural activities. Soybean and corn production dominate, but a wide variety of agricultural activity exists in the area. Farmland accounts for nearly all land use outside of urban areas. Cropland typically accounts for 80 to 90 percent of farmland use, and pasture generally 10 percent or less. Forestland mostly in the form of woodlots accounts for about 3 to 8 percent of land use. The major area of continuous woodland is in the Oak Openings, a 5-10 mile wide belt along the Sand Plains in western Lucas and eastern Fulton Counties. Maumee State Forest and Oak Openings...
Metro Park are located in the Oak Openings. This area contains some of the last remaining oak savanna habitat.

Agricultural activity in the Erie Fruit and Truck Resource Area (#100 in Figure 4) emphasizes production of fruit and vegetable crops as soil and climate advantage exists for these purposes. The area has the most intensive nursery and greenhouse operations in the state. Woodland covers about 15 to 20 percent of the land in this resource area. Urban, industrial, commercial, and other built up land accounts for a third or more of land use.

The Indiana and Ohio Till Plains Resource Area (#111 in Figure 4) is dominated by corn and soybean production, and livestock to a lesser degree. Outside of the major metropolitan areas, farmland generally accounts for nearly all land use. Farmland across the area receives similar use despite different emphasis in agricultural activity. About 90 percent of the farmland is used as cropland with pasture and woodlots accounting for the remainder.

The Southern Illinois and Indiana Thin Loess and Till Plain Resource Area (#114 in Figure 4) consists of about 50 percent cropland, 20 percent pasture, 25 percent forestland, and 5 to 10 percent urban and other land uses. Agricultural enterprises generally involve grain crops and livestock, but timber sales are an additional source of farm income in the eastern parts of this resource area.

The Kentucky Bluegrass Resource Area (#121 in Figure 4) is 20-30 percent forestland. Over half of the land in the western part of the area in the vicinity of Cincinnati is urban land. Nursery and greenhouse operations are common near this population center. In the eastern half of the resource area, crop and pastureland account for 50 to 60 percent of land use, and forestland most of the remainder.

The Western Allegheny Plateau Resource Area (#124 in Figure 4) includes the most heavily forested area in the state. The southern portion of the resource area is 60 to 70 percent forested. Logging operations are common, and national and state forests cover some of the land. Most of the hills remain in forest, with agriculture and residential developments are concentrated in the valleys. Pasture and cropland account for about 30 percent of land use. The northern portion of the resource area is about 40 to 50 percent forestland. Pasture and cropland account for about 30 to 40 percent of land use. Surface mining for coal affects land to varying degree in most parts of this resource area.

The Central Allegheny Plateau Resource Area (#126 in Figure 4) is about 50 to 60 percent forested. Forests dominate steeper hillsides. National and state forests cover some of the land. Pasture and cropland cover about 30 percent of the land, the majority being pasture. Cropland is largely limited to bottomlands. In northern parts of the area, 10 to 20 percent of the land is affected by strip mining, the most extensive in the state. The larger towns in the area border the Ohio River.

The Eastern Ohio Till Plain Resource Area (#139 in Figure 4) includes several counties that are highly urbanized with most land used for commercial, industrial, or residential purposes. Land being held for development purposes is typically former crop and pasture land. Extensive park systems along major streams including the Cuyahoga Valley National Recreation Area constitute most of the forestland in urban counties. Land use outside metropolitan areas in this resource area is generally about 25 percent crop and pasture, 25 percent forestland, and about half residential.

Water Development
In the early 1800s, thousands of small dams were built on the streams in Ohio to power grist and saw mills. Most of these mill dams no longer exist, and there is very little hydro-power developed because of the low available head. The major water developments have been for flood control and water supply.

Five large earthen dams were constructed on the major streams above Dayton in the 1920s by the Miami Conservancy District to control floods. These structures are automatic retarding basins with no movable gates and no permanent pools.
The Corps of Engineers and Muskingum Watershed Conservancy District built fourteen flood-control dams in the late 1930s in the Muskingum River Basin. All but three of these dams have permanent pools. Since the 1930s, the Corps of Engineers has constructed 14 additional multiple purpose reservoirs in Ohio including: 2 in the Muskingum River Basin, 3 in the Mahoning River Basin, 4 in the Scioto River Basin, 2 in the Little Miami River Basin, and one each in the Hocking River Basin, Mill Creek Basin, and Miami River Basin. All of these large dams significantly affect the flow regimen of streams.

Many water supply reservoirs exist in the state, some of large size such as those at Columbus, Akron, and Youngstown. Stream flow regimes are affected by the larger reservoirs. Many smaller impoundments with limited storage and nearly complete return of diverted flows through wastewater discharge have limited, local effect on streams.

Although surface water provides the majority of water supply used in Ohio, ground-water systems are far more numerous, some are of substantial size such as the ones at Dayton and Canton. Ground-water pumpage from buried valley deposits, where these large systems are located, significantly affects the low-flow regimen of streams.

*Descriptions of Basins and Characteristics of Flow*

Ohio lies along the topographic divide between the Lake Erie drainage and the Ohio River drainage. The relatively low divide is about 750 feet above mean sea level at Fort Wayne and rises irregularly across Ohio toward the northeast approaching Lake Erie closely in the northeast corner of the state. Because of its low profile, the divide has little effect on climatic factors in Ohio except in the snowbelt southeast and east of Cleveland.

The divide between the Lake Erie drainage and the Ohio River drainage in Ohio crosses the Till Plains and Glaciated Allegheny Plateaus roughly along the path of the Wabash End Moraine. All of the land in the Lake Erie Basin is glaciated while only part of the land in the Ohio River Basin is glaciated. Streams in the Lake Erie Basin are more youthful than those in the Ohio River Basin and tend to be smaller and shorter. Streams draining to the Ohio River are more deeply entrenched. Mean annual flows of streams draining to Lake Erie are generally lower than those draining to the Ohio River due to latitudinal variation in mean annual precipitation (with the exception of streams located in the snowbelt).

*Lake Erie basin*

About 30 percent of the land in Ohio is in the Lake Erie Basin. Land draining to Lake Erie includes all of the Huron-Erie Lake Plain in Ohio and portions of the Till Plains and Glaciated Allegheny Plateaus.

Streams east of Cleveland gather headwaters in the Glaciated Allegheny Plateaus and flow across a narrow band of Lake Plain to Lake Erie. The larger streams have cut deep gorges through the Portage Escarpment. These are relatively steep gradient streams except for the Grand River that has moderate gradient.

Tributaries to Lake Erie between Cleveland and Sandusky flow at more moderate gradients than those east of Cleveland, but at greater gradients than those west of Sandusky. Most of these streams gather headwaters in the Galion Glaciated Plateau and flow across the Berea Headlands before crossing the narrow Lake Plain to Lake Erie. The larger streams west of Sandusky gather headwaters in end moraines of the Till Plains and flow at relatively low gradient to the Lake Plain where they continue at very low gradient to Lake Erie.

*Ohio River basin*

About 70 percent of the land in Ohio is in the Ohio River Basin. Land draining to the Ohio River in the eastern half of the state is in the Allegheny Plateaus and Glaciated Allegheny Plateaus. Land draining to the Ohio River in the western half of the state is mainly in the Till Plains. All of the land in the state beyond the glacial margin drains to the Ohio River.

The larger streams in the Allegheny Plateaus flow at relatively low gradient in flat bottom valleys confined by steep hillsides. Lower reaches of these streams are affected by high stages of the Ohio River.
Tributaries originating in the Allegheny Plateaus rise at relatively steep gradient in narrow valleys. These tributaries are prone to flash floods that descend rapidly from the hills filling the flat-bottom valleys of the larger streams.

The largest tributary streams to the Ohio River in the state originate in either the Glaciated Allegheny Plateaus or the Till Plains. All the streams originating in the Glaciated Allegheny Plateaus flow through the unglaciated Allegheny Plateaus to join the Ohio River. Some of the streams originating in the Till Plains flow through the Allegheny Plateaus while others flow directly to the Ohio River. Some streams originating in the Till Plains have unusual profiles where the flatterest gradients are in upper channel reaches while the steepest gradients are along middle channel reaches. This reverse profile is due to glaciation – headwaters are in flat lying glacial moraine deposits and downstream reaches are in areas of greater of relief.

1.1 Ohio's People and Economy
Ohio is the 34th largest (by area), the 7th most populous, and the 10th most densely populated of the 50 United States. From just over 45,000 residents in 1800, Ohio's population grew at rates of over 10% per decade until the 1970 census, which recorded just over 10.65 million Ohioans (U.S. Census Bureau 1970). Growth then slowed for the next four decades. The United States Census Bureau estimates that the population of Ohio was 11,594,163 on July 1, 2014, a 0.5% increase since the 2010 census (U.S. Census Bureau 2014).

Wildlife-related recreation is big business in Ohio. Outdoor enthusiasts spend money on equipment, licenses, stamps, tags, permits, fuel, lodging, food, bait, ice, transportation, books/magazines/DVDs, clothes, guides, and equipment rental. These expenditures create jobs and tax revenues, and have a significant economic impact on the state. The 2011 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation (FHWAR) found that state residents and nonresidents spent $3.5 billion on wildlife recreation in Ohio. Survey data showed that 4.3 million Ohio residents and nonresidents 16 years old and older fished, hunted, or wildlife watched in Ohio. Of the total number of participants, 1.3 million fished, 553 thousand hunted, and 3.2 million participated in wildlife-watching activities, which includes observing, feeding, and photographing wildlife.

Ohio data from the 2011 FHWAR survey showed $1,903,619,503 in fishing retail sales that generated an economic impact of $2,925,344,790, in addition to $789,311,723 in salaries & wages, 26,354 jobs, federal tax revenues of $208,530,370, and state/local tax revenues of $203,191,366 (Southwick Associates 2012a). Similarly, Ohio data from the 2011 survey indicated $853,801,721 in hunting retail sales that generated an economic impact of $1,404,942,870, in addition to $490,289,685 in salaries & wages, 20,471 jobs, federal tax revenues of $111,472,383, and state/local tax revenues of $97,437,823 (Southwick Associates 2012b).

Lake Erie is known as the walleye capital of the world, and is the driver for Ohio’s sportfishing industry. Ohio’s Lake Erie, shoreline, and tributary sport fisheries generally harvest about 60% of the roughly 10 million pounds of the total Ohio catch each year. These Lake Erie sport fisheries combined contribute over $800 million to the Ohio economy (American Sportfishing Association 2008). While the exact number of anglers participating in these fisheries is unknown, data from Ohio fishing license sales locations and the USFWS National Fishing and Hunting Surveys suggest that it exceeds 300,000 annually. The Ohio charter boat industry includes approximately 800 licensed guides, and is the largest on the Great Lakes.

Ohio is also a top deer hunting destination in the U.S., boasting 3 of the top ten non-typical whitetails of all time. Deer hunting is the most popular kind of hunting in Ohio, and the quality of Ohio’s deer herd draws hunters from across the country. Data from 2011 indicates that deer hunting generates an economic impact of $421,133,504 in Ohio (Southwick Associates 2012b).

Tourism is Ohio’s 3rd largest industry. In 2013, 195 million people travelled in Ohio, spending of $29.9 billion. Of all tourism visits to Ohio, 83% were leisure related and 17% were business related (Ohio Tourism Division 2014). Ecotourism has increased in popularity in recent years. People travel to Ohio to
visit animal/nature preserves, zoos, resorts, parks, state/national forests, botanical gardens, historic sites, paddle its lakes and rivers, hike, bicycle, go zip-lining, ride horses, and participate in numerous other low-impact outdoor activities.

Ohio’s state and local economies also benefit from money and jobs created by industries based on natural resources. Ohio has more than 450,000 recreational boats, and ranks ninth in the country for registered boats. In 2013, more than $5.5 million was paid in boat registration and titling fees, and boaters paid about $15 million in state marine fuel taxes (ODNR Watercraft 2013 Annual Report). The value of Ohio’s forest products industry is in excess of $15.1 billion annually, and employs about 119,000 Ohioans. Ohio ranks in the top five nationally in maple syrup production, and has led the nation in “Tree City USAs” for the past 27 years (ODNR 2009).

Ohio's geographic location has proven to be an asset for economic growth and expansion. Because Ohio links the Northeast to the Midwest, much cargo and business traffic passes through its borders along its well-developed highways. Ohio has the nation’s 10th largest highway network, and is within a one-day drive of 50% of North America’s population and 70% of North America’s manufacturing capacity (ODOT 2003). Lake Erie’s 312 miles of Ohio coastline is home to numerous cargo ports. To the south, 461 miles of the Ohio River support the movement of coal, aggregates, grain, and other raw materials.

Ohio’s manufacturing and financial sectors are the largest industries by percentage of gross domestic product (GDP). Ohio has the largest bioscience sector in the Midwest, and is a national leader in the "green" economy. Ohio is the largest producer in the country of plastics, rubber, fabricated metals, electrical equipment, and appliances. Ohio’s manufacturing sector is the third-largest of all fifty United States states in terms of GDP (Wikipedia). Ohio ranks fourth among the states in lime production and high in sand and gravel and crushed stone production. It is also among the national leaders in the production of clays, salt, ceramics, and glass.

Although most of the state’s income is derived from commerce and manufacturing, Ohio also has an extensive agriculture industry. USDA data from 2012 indicated that Ohio had 75,462 farms occupying over 26 million acres. The top 5 agricultural commodities are soybeans, corn, dairy products, hogs, and cattle. Ohio is also a significant producer of oats, greenhouse and nursery products, wheat, hay, and fruit including apples, peaches, strawberries, and grapes.

1.2 Ohio’s Wildlife and Ecosystems
1.2.1 Wildlife
Ohio is home to about 56 species of mammals, 200 species of breeding birds, 84 species and subspecies of amphibians and reptiles, 173 species of fish, 100 species of mollusks, 21 species of crustaceans, 100 species of trees, over 200 species of native plants, and thousands of native insects.

The story of Ohio’s wildlife since species records were first kept is one of rich flora and fauna, increasing human population, overharvest and habitat destruction resulting in extirpation of species, a realization that protection was needed, and a slow road to recovery through management, regulations, and species/habitat restoration. A brief timeline of the Ohio country highlighting wildlife species (adapted from ODNR/OEPA Ohio Wildlife History Timeline) is presented below:

1748 - The Ohio Company builds a trading post near Piqua to trade items made in England for furs; beaver pelts are in high demand
1770 - Wolves, cougars, bear, bison, and elk are found across the state
1803 - Ohio becomes a state. The last bison reported in the state is killed
1818 - The “War of Extermination” in Ohio is declared against bear and wolves
1829 - The first wild animal protection law is passed making it illegal to kill muskrats from May to mid-October, and marking the first time Ohioans recognize that wildlife should be conserved as a valuable resource
1840 - Elk, once found across the state, are now gone from Ohio
1850 - Ohio leads the nation in all kinds of farming, and Ohio's population reaches 2 million, the third highest in the country
1855 - Bobcats, wolves, and mountain lions have been extirpated from the state
1857 - First law is enacted for the protection of fish, and the first non-game protection law is passed protecting songbirds
1875 - The Great Black Swamp is drained after a decade of ditch work and draining, marking the end of what was likely the last wilderness in the state
1881 - The last known black bear reported in Ohio is killed
1883 - Ohio's original forest land that covered more than 24 million acres is now reduced to only 4 million acres
1886 - The Commission of Fish and Game is established, and the first game wardens are appointed
1890 - Wild turkeys and white-tailed deer are now extirpated from Ohio
1893 - The last year that ospreys are reported nesting successfully in the state
1894 - The last passenger pigeon in the world dies at the Cincinnati Zoo
1899 - The first coyote is seen in Ohio; these animals have been spreading from the western states into new areas as forests were cleared and wolves were eliminated
1900 - Lacey Act is passed, curbing trafficking in plumage and other wildlife products
1902 - The first Ohio wildlife area is purchased with license dollars
1943 - Ohio's first "modern-day" deer season; only 3 of 88 counties are open for hunting
1947 - A survey of beaver populations finds only 100 animals scattered across 11 counties in Ohio
1956 - Wild turkeys are reintroduced into southeast Ohio where forests are recovering; Ohio's first statewide deer season is held
1966 - The first wild turkey season is opened in limited counties
1970 - The blue pike is declared extinct in Great Lakes
1973 - Ohio's Endangered Species law is passed
1975 - Only 4 pairs of bald eagles remain along Lake Erie
1978 - Blizzards decimate Ohio's bobwhite quail population; Ohio's beaver population tops 10,000 for the first time in decades.
1986 - River otters are reintroduced into 4 Ohio watersheds
1987 - Sandhill cranes return to Ohio - the first nesting pair observed since 1926
1988 - A pair of peregrine falcons nests on an old hotel building in Toledo; Ohio joins other states in establishing pairs in other Ohio cities as part of a regional effort to restore peregrine populations in the eastern U.S.
1995 - Ospreys return to Ohio nesting on an electrical tower along the Ohio River, and osprey restoration efforts begin the next year; Ohio's deer herd now estimated at 550,000
1996 - Trumpeter swan restoration efforts begin with birds released at Magee Marsh
1999 - Snowshoe hares are reintroduced into Ashtabula and Geauga Counties
2002 - River otters are removed from Ohio's Endangered Species list
2008 - A modern day record of 184 bald eagle nests in 48 of Ohio's 88 counties
2009 - The Ohio Wildlife Legacy Stamp is introduced to bring attention to wildlife diversity issues and generate funding for wildlife diversity programs

Today, Ohio's wildlife is a mixture of permanent resident north temperate species, and seasonal migrants. Winters play a large role in determining the composition, abundance, and distribution of Ohio's wildlife species. Species that are unable to tolerate winter temperatures either migrate south or perish. Seasonal migrants that live and breed in Ohio during the warm weather months include many species of birds, as well as several species of butterflies and skippers. A total of 421 species of birds have been reported from Ohio, of which about 300 occur annually, and about 180 of these are known to breed here. About 1/3 of Ohio's breeding species of birds spend winters in the Central and South America. Butterflies such as the monarch migrate to Mexico where they overwinter before returning to Ohio to breed during the summer. Other common butterfly migrants include the cloudless sulphur, little sulphur, sleepy orange, variegated fritillary, painted lady, buckeye, checkered skipper, fiery skipper, and sasameh. Over 160 species of dragonflies/damselflies have been recorded from Ohio, and a number of these, such as the striped saddlebags appear far from their normal range. Whether these species wander here on their own, or ride large weather systems, they are not considered residents and they do not reproduce here.
Ohio’s aquatic wildlife species for the most part are the typical cool and warmwater assemblage found throughout most of the Midwest, with a few exceptions. Central and eastern Lake Erie support trout and salmon, and these fish can be found in Lake Erie tributaries in northeastern Ohio from October to May. Ohio also has a few inland streams that receive enough groundwater to support stocked brown and rainbow trout, as well as native naturally reproducing brook trout. American eels occasionally make their way from the Sargasso Sea to rivers and streams in Ohio. Burbot, the only freshwater member of the cod family, are occasionally found in the Ohio waters of Lake Erie. Twenty-seven percent of all mussels known to be from North America have been found in Ohio (Watters et al. 2009). Ohio is home to some of the few remaining populations of purple and white catspaw mussels. The Norwood River crayfish to this point has only been found in Ohio.

The first list of Ohio’s endangered wildlife was adopted in 1974 and included 71 species. An extensive examination of the list is conducted every five years. The Division seeks input from our staff along with other noted professional and amateur wildlife experts across Ohio. The Division uses six categories: endangered, threatened, species of concern, special interest, extirpated, and extinct, to define the status of applicable wildlife species. These categories and the species contained within them are revised as our knowledge of the status of Ohio’s wildlife evolves.

State listing categories are defined as follows:

*Endangered* - a native species or subspecies threatened with extirpation from the state. The danger may result from one or more causes, such as habitat loss, pollution, predation, interspecific competition, or disease.

*Threatened* - a species or subspecies whose survival in Ohio is not in immediate jeopardy, but to which a threat exists. Continued or increased stress will result in its becoming endangered.

*Species of Concern* - a species or subspecies which might become threatened in Ohio under continued or increased stress. Also, a species or subspecies for which there is some concern, but for which information is insufficient to permit an adequate status evaluation. This category may contain species designated as a furbearer or game species, but whose statewide population is dependent on the quality and/or quantity of habitat and is not adversely impacted by regulated harvest.

*Special Interest* - a species that occurs periodically and is capable of breeding in Ohio. It is at the edge of a larger, contiguous range with viable population(s) within the core of its range. These species have no federal endangered or threatened status, are at low breeding densities in the state, and have not been recently released to enhance Ohio’s wildlife diversity. With the exception of efforts to conserve occupied areas, minimal management efforts will be directed for these species because it is unlikely to result in significant increases in their populations within the state.

*Extirpated* - a species or subspecies that occurred in Ohio at the time of European settlement and that has since disappeared from the state.

*Extinct* - a species or subspecies that occurred in Ohio at the time of European settlement and that has since disappeared from its entire range.

Presently (2015) there are 276 state-listed species in Ohio. Of these, 119 are endangered, 54 threatened, and 102 species of concern (Table 1). Ohio’s list includes 14 Federally-listed endangered species, and 3 Federally-listed threatened species. Aquatic species (fish and mussels in particular) make up the majority of Ohio’s state-listed endangered species.
Table 1. Number of species in major taxa groups classified as Endangered, Threatened, Species of Concern, Special Interest, Extirpated, or Extinct in Ohio.

<table>
<thead>
<tr>
<th>Taxon</th>
<th>Endangered</th>
<th>Threatened</th>
<th>Concern</th>
<th>Special Interest</th>
<th>Extirpated</th>
<th>Extinct</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mammals</td>
<td>3</td>
<td>2</td>
<td>19</td>
<td>1</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td>Birds</td>
<td>13</td>
<td>5</td>
<td>13</td>
<td>33</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>Reptiles</td>
<td>5</td>
<td>4</td>
<td>11</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Amphibians</td>
<td>5</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>0</td>
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</tr>
<tr>
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<td>13</td>
<td>9</td>
<td>0</td>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>Mollusks</td>
<td>24</td>
<td>4</td>
<td>8</td>
<td>0</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Crayfishes</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Isopods</td>
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<td>0</td>
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<td>0</td>
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<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Dragonflies</td>
<td>13</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Damselldives</td>
<td>3</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>Caddisflies</td>
<td>3</td>
<td>6</td>
<td>3</td>
<td>0</td>
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<td>0</td>
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<td>Mayflies</td>
<td>2</td>
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<td>1</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Midges</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Crickets</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Butterflies</td>
<td>8</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Moths</td>
<td>14</td>
<td>4</td>
<td>22</td>
<td>11</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Beetles</td>
<td>2</td>
<td>2</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>119</strong></td>
<td><strong>54</strong></td>
<td><strong>102</strong></td>
<td><strong>46</strong></td>
<td><strong>36</strong></td>
<td><strong>11</strong></td>
</tr>
</tbody>
</table>

1.2.2 Action Plan Habitats and Imperiled Ecosystems

Ohio’s State Wildlife Action Plan uses a habitat-based approach that divides the state into 15 habitat categories. Significant changes to the Ohio landscape since settlement have negatively impacted a number of these habitats. While the exact numbers vary, it is generally agreed that Ohio has lost about 90% of its original wetlands, over 95% of its original prairies, and about 68% of its original forestlands.

NatureServe’s assessment of the status of ecological communities and systems indicates a number of Ohio ecosystems that fall into the critically imperiled or imperiled categories (NatureServe 2015). The habitat categories in the NatureServe assessment are at a finer scale than the categories used in this Action Plan. Within this Action Plan’s habitat categories, NatureServe identifies 4 Forestland ecosystems, 12 Grassland ecosystems, 8 Wetland ecosystems, 2 Oak Savanna ecosystems, 1 Lake Erie Islands ecosystem, and 1 Boreal Community ecosystem that are either critically imperiled or imperiled. Within each of the habitat categories used in this Action Plan, the table below (Table 2) lists the NatureServe classification, Ohio Natural Heritage Database classification, and degree of imperilment for each ecosystem in the NatureServe assessment.
Table 2. NatureServe ecological communities and systems degree of imperilment by Ohio SWAP habitat category for ecosystems occurring in Ohio (CI = critically imperiled, I = imperiled).

<table>
<thead>
<tr>
<th>NatureServe classification</th>
<th>Ohio Natural Heritage Database classification</th>
<th>degree of imperilment</th>
</tr>
</thead>
<tbody>
<tr>
<td>FORESTLAND HABITAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Appalachian Cliff White-cedar Woodland</td>
<td>Arbor Vitae-Mixedwood Forest</td>
<td>I</td>
</tr>
<tr>
<td>Beech-Maple Glaciated Forest</td>
<td>Beech-Oak-Red Maple Forest &amp; Beech-Sugar Maple Forest</td>
<td>I</td>
</tr>
<tr>
<td>Beech-Hardwoods Till Plain Flatwoods</td>
<td>Beech-Oak-Red Maple Forest</td>
<td>I</td>
</tr>
<tr>
<td>Maple-Hickory Mesic Floodplain Forest</td>
<td>Mixed Floodplain Forest</td>
<td>I</td>
</tr>
<tr>
<td>GRASSLAND HABITAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Mesic Tallgrass Prairie</td>
<td>Big Bluestem Prairie</td>
<td>CI</td>
</tr>
<tr>
<td>Post Oak Chert Barrens</td>
<td>Post Oak Opening</td>
<td>I</td>
</tr>
<tr>
<td>Central Shale Glade</td>
<td>Post Oak Opening</td>
<td>I</td>
</tr>
<tr>
<td>Cottonwood Dune Open Woodland</td>
<td>Beach-dune Community</td>
<td>CI</td>
</tr>
<tr>
<td>Central Limestone Glade</td>
<td>Little Bluestem Prairie</td>
<td>I</td>
</tr>
<tr>
<td>Mesic Sand Tallgrass Prairie</td>
<td>Big Bluestem Prairie</td>
<td>I</td>
</tr>
<tr>
<td>Midwest Dry-Mesic Prairie</td>
<td>Little Bluestem Prairie</td>
<td>I</td>
</tr>
<tr>
<td>North-Central Dry-Mesic Limestone-Dolomite Prairie</td>
<td>Little Bluestem Prairie</td>
<td>I</td>
</tr>
<tr>
<td>Lakeplain Wet-Mesic Prairie</td>
<td>Big Bluestem Prairie</td>
<td>I</td>
</tr>
<tr>
<td>Lakeplain Wet Prairie</td>
<td>Slough Grass-Bluejoint Prairie</td>
<td>I</td>
</tr>
<tr>
<td>Twig-rush Wet Prairie</td>
<td>Twigrush-Wiregrass Wet Prairie</td>
<td>I</td>
</tr>
<tr>
<td>Midwest Sand Barrens</td>
<td>Sand Barren</td>
<td>I</td>
</tr>
<tr>
<td>WETLAND HABITAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highland Rim Parnassia Seepage Fen</td>
<td>Seep</td>
<td>CI</td>
</tr>
<tr>
<td>Midwest Acidic Seep</td>
<td>Seep</td>
<td>I</td>
</tr>
<tr>
<td>Southern Tamarack-Red Maple Rich Swamp</td>
<td>Tamarack-Hardwood Bog</td>
<td>I</td>
</tr>
<tr>
<td>Northern (Great Lakes) Flatwoods</td>
<td>Oak-Maple Swamp</td>
<td>I</td>
</tr>
<tr>
<td>Pin Oak-Swamp White Oak Sand Flatwoods</td>
<td>Oak-Maple Swamp</td>
<td>I</td>
</tr>
<tr>
<td>Bur Oak-Swamp White Oak Mixed Bottomland Forest</td>
<td>Maple-Ash-Oak Swamp</td>
<td>I</td>
</tr>
<tr>
<td>Highbush Blueberry Poor Fen</td>
<td>Tall Shrub Bog</td>
<td>I</td>
</tr>
<tr>
<td>Dogwood-Willow-Poison Sumac Shrub Fen</td>
<td>Cinquefoil-Sedge Fen</td>
<td>I</td>
</tr>
<tr>
<td>LAKE ERIE ISLANDS HABITAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alvar Nonvascular Pavement</td>
<td>Shoreline Alvar</td>
<td>I</td>
</tr>
<tr>
<td>OAK SAVANNA HABITAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Bur Oak Openings</td>
<td>Bur Oak Savanna</td>
<td>CI</td>
</tr>
<tr>
<td>Oak Savanna</td>
<td>Bur Oak Savanna</td>
<td>I</td>
</tr>
<tr>
<td>BOREAL COMMUNITY HABITAT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western Allegheny Tall Shrub Rich Fen</td>
<td>Cinquefoil-Sedge Fen</td>
<td>I</td>
</tr>
</tbody>
</table>

All of Ohio’s habitats are deserving of conservation efforts, and the ecological communities described in the table above merit additional attention based upon their status relative to degree of imperilment. However, in making decisions about allocation of resources for conservation efforts, consideration must be given to leverage. Managing tiny parcels of extremely rare habitat that function more as “museums” rather than contributing to larger scale conservation may not always be the best choice – even when it seems to be the obvious choice. Each of the ecosystems listed above must be carefully considered in
Terms of “bang for the buck” conservation efforts. In the end, additional attention to these systems may be warranted – but this decision should not be solely based on the “rarity” or “uniqueness” of a given ecosystem. That said, the fine-scale NatureServe ecosystems referenced in the table above will be addressed within the context of the larger habitat categories in Ohio’s Action Plan. Conservation efforts directed at these ecosystems will flow through tactical and operational plans that can be tailored to the specific conditions that need to be addressed.

1.3 Statewide Threats

Threats to Ohio’s species and habitats are many and varied. Some act independently while others work synergistically. Some have immediate and noticeable impacts (shopping centers, chemical spills), while others have less obvious but long-term effects (pharmaceuticals in aquatic environments). Impacts of these threats are generally felt across habitats and species. In nearly every case, these threats are either a result of human activities on the landscape, or introduced species and diseases, or both. Looking forward, climate change acting in concert with existing threats could have a “multiplier effect”. Ecosystems already stressed by human activities and/or invasive species are at higher risk from and increased susceptibility to the effects of climate change.

Below is a brief overview of the primary threats to Ohio’s species and habitats. Threats are categorized and discussed based upon the description above.

1.3.1 Habitat Loss and Alteration from Development

Ohio’s population of about 11.6 million people equates to 282 residents per square mile, making Ohio the 10th most densely populated state in the United States. The infrastructure and resources necessary to sustain Ohio’s human population are substantial – and take their toll on the environment. Direct habitat loss results from development in the form of cities, towns, neighborhoods, commercial and industrial areas, roads, bridges, utility and service corridors, parking lots, and airports. Habitat alteration is caused by agriculture, parks, recreation areas, golf courses, and dams. In addition, the activities of 11.6 million humans have a profound effect on habitats and wildlife species.

The amount of development necessary to sustain Ohio’s human population often results in the fragmentation of remaining unaltered wildlife habitat. Fragmentation affects habitat function as well as the species that live there. The two primary fragmentation issues are population isolation for some species, and loss of ecological connectivity (with like or other habitats) which affects movement of individuals, populations, and genetic material. Loss of habitat function (e.g., altered hydrology) impacts resident species as well as the quality of the habitat itself.

1.3.2 Negative Impacts of Resource Use

Surface mining (after completion and reclamation) results in a tremendous loss of habitat and species diversity – typically leaving behind poor, thin soils and very limited plant/animal communities. Large scale timber harvest radically alters habitat, impacts resident species, and affects local hydrology. Groundwater withdrawal can affect local hydrology and impact baseflow for streams. Impacts to baseflow can alter stream temperature regimes if the reduction in baseflow is significant. Surface water withdrawal or diversion impacts aquatic habitats and wetlands, and these impacts are manifested in the plant and animal communities that occur there. Impacts are a result of changes to temperature, dissolved oxygen, flow, pH, and concentration of allochthonous substances that are caused by or exacerbated by reductions in water volume.

1.3.3 Negative Impacts of Effluents

Ohio’s human population generates a significant amount of “effluent” as a result of their activities on the landscape. Primary sources include household sewage and urban wastewater, industrial effluents, agricultural effluents, garbage and solid waste, and air-borne pollutants. A myriad of chemicals are released into terrestrial and aquatic ecosystems from anthropogenic sources. Impacts from these occur at many levels. Habitats and water quality are degraded, and mortality to resident species may be direct and rapid. Species can be impacted indirectly through compromised immune systems, reduced or eliminated reproductive ability, genetic defects, and alteration of food webs. Additionally, the speed with which water
moves across the landscape (due to the amount of impervious surfaces) impacts local hydrology and affects the physical and chemical characteristics of aquatic ecosystems.

### 1.3.4 Introduced Species and Diseases

The Great Lakes basin is the aquatic gateway to the heartland of America, but it is also a major highway for aquatic invasive species (AIS) introductions. Since 1960, a new invasive species has been discovered every 28 weeks. Lake Erie is especially vulnerable due to the variety of habitat available to these non-native species (NOAA 2015). In addition to introductions into Lake Erie via the Welland Canal and ballast water, the aquarium trade is also a pathway for the introduction of AIS. Fortunately many popular aquarium species are tropical and will not survive an Ohio winter, but this is not always the case. Once established, AIS can expand their range through the bait industry and as aquatic hitchhikers on watercraft and related equipment. Invasive species negatively impact aquatic ecosystems through competition, predation, and the spread of disease. Ohio’s primary AIS include sea lamprey, common carp, white perch, zebra mussel, quagga mussel, round goby, tubenose goby, ruffe, rusty crayfish, curleaf pondweed, flowering rush, purple loosestrife, phragmites – and the threat of Asian carp looms.

Approximately one-fourth of the plant species known to occur in Ohio are not native to the state. Most of these non-native plant species are not problematic, and have been part of the landscape for many years. Other species such as Japanese honeysuckle, Japanese knotweed, autumn olive, buckthorn, garlic mustard, multiflora rose, and bush honeysuckle can change community structure and composition. These species can displace or reduce native species, impact the wildlife that depend upon native plants, and reduce biological diversity. Non-native plants have been introduced through a number of pathways, but landscapers purchasing plants from nurseries and garden stores account for a high percentage of recent introductions.

While invasive aquatic species and insects tend to occupy the headlines, Ohio is also battling invasive feral swine, sometimes called wild boar or hogs. These destructive animals can damage important habitat that other wildlife species depend on. Other terrestrial invasive species include the European starling, mute swan, and Norway rat. The pet trade is a primary pathway for introductions in other parts of the country, but Ohio winters tend to check that pathway to a large degree.

Invasive insects and diseases have probably caused the most visible environmental damage in Ohio. Both can cause significant damage to native species and habitats, as well as being human health threats and causing substantial economic damage. In Ohio, Dutch elm disease and chestnut blight nearly wiped out both of these tree species. More recently, insects such as the Asian longhorned beetle, emerald ash borer, gypsy moth, hemlock wooly adelgid, and walnut twig beetle are using up the time and resources of state and federal agencies in control efforts.

### 1.3.5 Climate Change

Any long-term change (wetter, dryer, hotter, colder) in Ohio’s climate will affect habitats and species. Lesser tolerant flora and fauna will be impacted first regardless of their condition. Also at risk will be ecosystems already stressed by previously mentioned threats. It is unlikely that much can be done for species on the edge of their range in terms of buffering them from the effects of climate change. However, healthy and connected habitats are likely the best chance that the remaining species have in terms of mitigating the effects of climate change.

### 1.3.6 The Relationship Between the Land and the Water – Aquatic Habitat Health

The following information comes from the Ohio EPA 2014 Integrated Report and provides a synopsis of the relationship between the land and the water, indicating why Ohio’s aquatic systems are a product of their surrounding watersheds.

An examination of the aquatic life use (see the Determining the Condition of Ohio’s Aquatic Habitats section in Ohio’s Approach to Conservation for an explanation of aquatic life use) attainment status of individual sampling sites relative to the amount of land area drained by the stream at that point, reveals that unhealthy fish and aquatic insect populations are more common on smaller streams. In other words, the larger the drainage area (and usually the larger the stream), the more likely the stream is to be
healthy. This phenomenon correlates well with the most widespread causes associated with aquatic life use impairment in watersheds. The top five aquatic life use impairment causes for the period 2003 through 2012 are:

- siltation/sedimentation
- nutrient enrichment
- organic enrichment
- habitat modification
- hydromodification/flow alteration

For watersheds, most impairment is related to modification of the landscape. These types of impairments have the most impact on smaller streams. Most of the impaired watershed units with current data had at least one of these causes contributing to impairment and many had two or more of the top five causes listed.

Of note is the prevalence of watersheds and large rivers that are impaired by the organic enrichment cause category. About 40 percent of impaired watersheds show “sewage” related impairments such as high biochemical oxygen demand, elevated ammonia concentrations, and/or in-stream sewage solids deposition. Over half of 19 impaired large rivers also have sewage-related causes. This suggests that adequate treatment and disposal of human and animal wastes via wastewater treatment plants, home sewage treatment systems, and land applications of septage and animal manure continue to be critical water quality issues in many Ohio watersheds.

The major causes and sources of water quality problems are described below:

**Siltation/sedimentation** describes the deposition of fine soil particles on the bottom of stream and river channels. Deposition typically follows high-flow events that erode and pick up soil particles from the land. Soil particles also transport other pollutants. As the flow decreases, the soil particles fall to the stream bottom and cover stream habitat available to aquatic organisms.

**Nutrient enrichment** describes the excess contribution of materials such as nitrogen and phosphorus used for plant growth. Excess nutrients are not toxic to aquatic life, but can have an indirect effect because algae flourish where excess nutrients exist. The algae die and their decay uses up the dissolved oxygen that other organisms need to live. The same nutrients that cause impairment of the aquatic life beneficial use also are a major contributing factor to the recent extensive harmful algal blooms (HABs) that have been observed in Lake Erie, the Ohio River, and many inland Ohio water bodies. Grand Lake St. Marys in western Ohio, and Lake Erie have been particularly affected. HABs, a visually identified concentration of cyanobacteria, can occur almost anywhere there is water: lakes, ponds, storm water retention basins, rivers, streams, or reservoirs. Many HAB-forming organisms are native to Ohio but only cause problems when environmental conditions favor them.

**Organic enrichment** is the addition of carbon-based materials from living organisms beyond natural rates and amounts. Natural decomposition of these materials can deplete oxygen supplies in surface waters. Dissolved oxygen is vital to fish and other aquatic life.

**Habitat modification** is the straightening, widening, or deepening of a stream’s natural channel. Habitat modification can also include the degrading or complete removal of vegetation from stream banks; such vegetation is essential to a healthy stream. These activities can effectively transform a stream from a functioning ecosystem to a simple drainage conveyance. Some aquatic life will not be protected from predators and stressful flows and temperatures. The stream also often loses its ability to naturally process water pollutants.

**Hydromodification, or flow alteration,** describes any disruption to the natural hydrology of a stream system. Flow alteration includes stream impoundment, increased peak flows associated with the urbanization of watersheds, and water-table regulation through sub-surface drainage. Such changes can cause extended periods without stream flow, more extreme or frequent floods, and loss of fast current habitat in dam pool areas.
1.4 Key Conservation Challenges

Successful implementation of Ohio’s State Wildlife Action Plan will require an immense amount of cooperation and coordination – scientifically, politically, and culturally. Though often disjoint, the pieces exist to carry out an efficient and effective conservation program in Ohio. It will take buy-in from the highest political office to regulatory agencies to the suburban homeowner to the hobby farmer – and everyone in between. Equally important is it will take a change in mindset – a recognition of the importance of nature to the quality of life of all Ohioans. Everyone needs to take ownership. In the end, conservation of Ohio’s wildlife species and their habitats will depend upon the commitment of Ohioans to their protection. This section highlights some of the challenges to creating and harnessing that commitment.

1.4.1 Public Participation – Elevating the Priority of Conservation for Ohioans

Among the public in Ohio, there is a gradient of interest in the out-of-doors. This gradient begins with a vague awareness that there is a world outside of the house/office where weather happens, and animals live, and trees grow, and somebody(?) certainly takes care of it all. At the other end of this gradient are people whose feet hit the floor every morning in the name of the great outdoors. Life is worth living because of nature, and enjoying it and protecting it drive people at this end of the interest gradient. Conservation for these people is a meta-value, and therefore a lifestyle. The issue here however, is that not enough of the general population fall into this category. The $64,000 question is how do we (conservation meta-value folks) elevate the priority of conservation in the lives of people at lower levels of the outdoor interest gradient? How do we increase the importance of nature, and the conservation of it, in the value system of the average Ohioan? Can we?

We are quite adept these days at increasing “awareness”. We have a myriad of electronic pathways with which to get the conservation message out. We have outdoor education programs for schools. We have camps and clinics. We have programs for citizens of all ages. The problem is that awareness does not necessarily equate to caring, and caring is what is necessary to take the next step, which is action. Action is what gets things done, action moves the proverbial needle, action is what the previously mentioned “conservation meta-value” folks are into! Having a public that is aware, but does not care enough to alter their behavior, or contribute financially – does not make conservation happen. Our public participation challenge may be the most daunting of any conservation challenge we face.

1.4.2 Ecological Data Collectors – Communication, Cooperation, Coordination

With limitations on time, money, and personnel, it makes no sense that ecological data collectors operate independently – regardless of mission or statutory authority. Time spent planning and coordinating the collection of data would more than pay for itself in increased efficiency. Additional time spent standardizing methods would tremendously increase the utility of data collected. Having access to a central data repository would be the payoff for all of the communication and coordination. The challenge here is to bring all the collectors together, and get them to agree on the sharing of data and the standardization of its collection to the fullest extent possible. The end result would often be the ability to avoid sending crews into the field to collect data that could be accessed from a computer in someone’s office. Our ability to make regulatory and management decisions would be enhanced, and operating costs would be reduced.

1.4.3 Identifying and Filling Data Gaps

Data gaps for species and habitats limit our ability to prioritize and manage. For popular species (usually sport species or high-profile endangered species) lots of information on distribution, life history, population status and trends, genetics and management needs exists. For other species, simple distribution information is not even available. Lack of basic information on many species not only hampers management efforts, but makes it difficult to determine if, and how much, protection may be needed. There is no question that if we knew as much about invertebrates, insects, mussels, and other species groups as we do about largemouth bass and whitetail deer, our state and federal T&E species lists might look different than they do today.
Identifying data gaps for species and habitats, and launching at minimum survey and inventory efforts should be a priority. Habitat mapping in particular should be taking advantage of improvements in geospatial technology, habitat type characterization, imagery resolution, and other advanced technologies to produce accurate habitat information necessary to monitor the status of Ohio’s habitats. To develop more effective and holistic conservation strategies, data gaps need to be identified and filled.

The issues affecting Ohio’s wildlife and habitats today are incredibly complex. They cut across political, social, and economic boundaries – and property boundaries as well. No single jurisdiction, agency, or group in Ohio owns enough land or has enough authority to cover all the conservation bases. It will take the resources of all government agencies (state, county, municipal), academia, and conservation groups to be more successful in the future than we have been in the past. The passion and expertise of all of these groups working in a coordinated fashion, with a shared vision and common goal, will be needed to create the synergy necessary to fully implement Ohio’s Action Plan.

Improving the level of cooperation and coordination among the previously mentioned groups will be the challenge if history has taught us anything. Historically we have underachieved in the area of working together for conservation. Regulatory agencies have different missions and statutory authorities, and do not always work well together. Turf wars are common, and cooperation and coordination are often inhibited. Additionally, there is enough redundancy between different levels of government that it confuses the public, and creates a management conundrum because of often differing missions (e.g., state parks vs county parks vs metro parks). Academia often views applied research as a necessary evil, but the answers applied research provides are what natural resources managers need. National conservation organizations with state chapters, and in-state conservation groups do some excellent work, but generally have a fairly narrow focus.

The hope here is that Ohio’s SWAP will serve as the vehicle to bring all levels of government, academia, and non-government conservation groups together in a coordinated fashion in the name of conservation. Each group playing their part, based upon their mission, authority, expertise, and available resources to achieve a common goal. Leadership will be the key – to overcome issues between groups, determine what needs done and get buy-in from all involved, and determin how best to use all of the “players” to accomplish the goal. The degree to which this Action Plan is implemented will play a large part in determining the future of Ohio’s wildlife resources.

1.5 Ohio’s Approach to Conservation

The health and well being of Ohio’s wildlife resources are important, which means their sustainability is important. Ohio’s citizens and visitors to the state enjoy Ohio’s wildlife resources in many ways, making them important economically. Clean lakes and rivers, lush woodlands, and abundant and diverse flora and fauna enhance the quality of life for all Ohioans. Healthy wildlife and healthy habitats help make healthy Ohioans. The importance of Ohio’s natural resources necessitates that every tool and technique be used to preserve and enhance them for today and for future generations. The following is an overview of Ohio’s approach to conservation – it is our hope that everyone who enjoys the great outdoors will join us on this journey to conserve and improve Ohio’s wildlife and their habitats for sustainable use and appreciation by all.

Effective conservation comes down to the ability to achieve a functional coexistence between wildlife, habitat, and people. The three are inextricably linked, and effective management actions recognize this fact. With more than 11 million people in Ohio and more than 95% of Ohio’s land in private ownership, balancing the needs of all three represents a significant challenge.

The success of efforts to minimize and/or mitigate the effects of people and development on wildlife and habitats depends upon the ability of conservationists to elevate the value of nature to the general public. When the public values nature enough to make changes in the way they live for the benefit of wildlife and habitats, the effectiveness of conservation efforts will increase. Consequently, one could argue that Ohio’s approach to conservation should focus primarily on the people component, and that improvements
to species and habitats will naturally follow. Changing the environmental consciousness of society unfortunately cannot be achieved (if it can be achieved) in the amount of time that it would take to prevent the loss of species and habitats. Therefore, Ohio’s approach to conservation will consist of a balanced strategy aimed at using the best science to manage species and habitats, with the best communication strategies to raise public awareness and appreciation for conservation.

Ohio’s approach to conservation is founded upon the following five principles:

STEWARDSHIP - to foster healthy ecosystems that support diverse and abundant fish and wildlife populations
OPPORTUNITIES - to improve outdoor recreational opportunities for all Ohioans
CONNECTIONS - to create, expand, and improve public awareness, understanding, and appreciation of Ohio’s fish and wildlife resources
TRADITIONS - to preserve and promote Ohio’s tradition of conservation
PARTNERSHIPS - to create a conservation coalition aimed at improving communication, coordination, and cooperation among all with an interest in Ohio’s outdoors

We recognize that a clean separation of conservation strategies, goals, and objectives for the management of the complex relationship between people/wildlife/habitat cannot be made. However, in the interest of maximizing the utility of this Action Plan among all levels of conservationists in Ohio, we have separated strategies based upon these three groups. Taken together, this approach addresses the full spectrum of challenges, issues, and opportunities related to conservation in Ohio.

1.5.1 Wildlife
Evaluate the status of fish and wildlife populations using the best science available
Identify species information gaps regarding distribution, abundance, and population trends, and focus efforts on closing those gaps
Maintain a current and comprehensive database that stores data related to the distribution of state-listed and other rare plant and animal species as a tool for environmental review, research, conservation planning and species listing decisions
Identify ecosystem- or population-level threats through research, surveillance, monitoring, and inventory
Based upon the issues determined to be impacting fish and wildlife species, use existing or develop new methods to stabilize and enhance populations (e.g., reintroduction programs, regulations and enforcement, education programs, partnerships)
Develop and implement a comprehensive plan to address current known and emerging diseases in wildlife that includes prevention, detection, diagnosis and identification, monitoring outbreaks, and management of affected wildlife populations
Conduct inventory and monitoring efforts to determine the distribution and abundance of invasive species
Work to prevent the introduction of and control spread of invasive species through legislation, regulation, policy, management practices, education, and partnerships
Continue to pursue legislation to check the introduction and spread of species like feral hogs and captive deer that pose a threat to native free-ranging wildlife
Address climate change issues related to wildlife populations through the development of monitoring projects and coordination of adaptive management strategies among key conservation partners
Evaluate proposed energy development projects and existing energy producing facilities using established protocols to minimize impacts on wildlife
1.5.2 Habitat
Protect land and water resources through strategic acquisitions, easements, agreements, and partnerships

Manage an effective land/waters acquisition program by annually reviewing and prioritizing parcels containing key habitats for potential protection

Maintain a current and comprehensive database that stores data related to the distribution of habitats, significant geologic features, and lands managed for conservation as a tool for environmental review, research, and conservation planning

Manage and evaluate fish and wildlife habitats using the best available science

Restore and/or enhance habitats where appropriate

Protect habitats by preventing and/or mitigating incompatible ecosystem uses

Communicate and coordinate with landowners to manage wildlife habitat on private property

Form broad coalitions with other agencies, industry, and non-government organizations (NGO) to minimize impacts to aquatic ecosystems and effectively implement conservation and restoration programs at a watershed level.

Work to prevent the introduction of and control spread of invasive species that impact habitats (e.g., gypsy moth, emerald ash borer, garlic mustard, purple loosestrife) through legislation, regulation, policy, management practices, education, and partnerships

Address climate change issues related to wildlife habitats through the development of monitoring projects and coordination of adaptive management strategies among key conservation partners

Evaluate proposed energy development projects and existing energy producing facilities using established protocols to minimize impacts to wildlife habitat

1.5.3 People
Develop and maintain partnerships to better deliver the conservation message to Ohioans and promote opportunities to experience Ohio’s fish and wildlife resources

Maintain a corps of conservation partners and volunteers to assist, lead, and promote outdoor programs

Develop and promote educational materials that address fish and wildlife management principles, conservation concepts, and outdoor skills

Develop programs and materials designed to stimulate interest in the outdoors that can be incorporated into school curricula

Partner with outdoor-oriented clubs and organizations to develop conservation recruitment programs

Recruit and retain a broad range of fish and wildlife enthusiasts to increase support for conservation

Use partnerships to leverage fish and wildlife conservation funding

Conduct research to better understand how and why people value wildlife

Enlist citizen-science groups to gather data and help promote the conservation message to the public
Identify and address the public’s evolving information needs related to outdoor recreation and conservation

Utilize a variety of fish and wildlife exhibits, programs, educational materials, and hands-on experiences to increase knowledge and appreciation of Ohio’s fish and wildlife resources

Utilize youth- and family-oriented events to promote participation in fish and wildlife recreation

Provide timely and accurate information about fish and wildlife recreational opportunities using state-of-the-art communication technologies

Work to bring outdoor recreational opportunities closer to home by providing opportunities in urban/suburban areas

Increase public access to land and water through purchases, easements, agreements, and partnerships

Provide information and guidance to reduce human/wildlife conflicts and improve interactions with fish and wildlife

1.5.4 Land Stewardship in Ohio

The following information and map regarding the status of conservation lands in Ohio was adapted from the 2007 USGS Ohio Aquatic Gap Analysis (Covert et al. 2007).

A patchwork of conservation lands in Ohio is owned and managed by a diverse group of Federal, state, regional, and local agencies and private organizations. Although state and Federal lands make up more than 80 percent of the conservation area in the state, a map of protected lands would be incomplete without considering other sources. A list of conservation land stewards in the state was generated and OH-GAP requested GIS data from these stewards. With one exception, where DLG lines were used to delineate Muskingum Watershed Conservancy District lands, no new GIS datasets were created for the map. Unfortunately, some counties and regions may be underrepresented in their mapped conservation lands from lack of available or usable GIS data. Nonetheless, conservation lands in 87 out of 88 counties in the state are represented, encompassing Federal, state, regional, local, and private land tracts.

The four GAP management (stewardship) status categories in Figure 5 can generally be defined as follows:

Status 1: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a natural state within which disturbance events (of natural type, frequency, and intensity) are allowed to proceed without interference or are mimicked through management.

Status 2: An area having permanent protection from conversion of natural land cover and a mandated management plan in operation to maintain a primarily natural state, but which may receive use or management practices that degrade the quality of existing natural communities.

Status 3: An area having permanent protection from conversion of natural land cover for the majority of the area, but one that is subject to extractive uses of either a broad, low intensity type or localized intense type. It also confers protection to federally listed endangered and threatened species throughout the area.

Status 4: Lack of irrevocable easement or mandate to prevent conversion of natural habitat types to anthropogenic habitat types. This status allows for intensive use throughout the tract. Also includes those tracts for which the existence of such restrictions or sufficient information to establish a higher status is unknown.
Statewide Assessment
Ohio has very little conservation land in public ownership (Figure 5). In a state dominated by agriculture and increasing urban land cover, only about 3.7 percent of the state’s land is protected for conservation, either publicly or privately. Of this total, state agencies control about 52 percent and Federal agencies control about 29 percent. The ODNR and The Nature Conservancy manage the bulk (43.4 percent and 30.3 percent, respectively) of the status 1 lands. Status 1 lands, the most highly protected lands, account for 6 percent of the conservation lands and 0.2 percent of the total land area in Ohio (conservation and non-conservation lands).
Conservation lands are distributed throughout Ohio in 87 of 88 counties. This is largely due to ODNR, the largest land steward by area in Ohio, which protects lands in 86 counties (all but Van Wert and Union). These 86 counties include 32 counties, mostly in the northwest, that would otherwise not be represented on the map. A cursory look at the stewardship map shows that the size of the tracts of conservation lands are much smaller and more fragmented in the northwestern quarter of Ohio compared to other parts of the state. Many of these tracts are ODNR Division of Wildlife Habitat Restoration Program areas.

Although Federal and state stewards are responsible for more than 80 percent of the conservation lands in Ohio, regional and local governments also have an important role in Ohio’s conservation. The metroparks around sprawling cities such as Columbus and Cincinnati protect and restore lands that otherwise may be converted to suburbs. Regional governments, like metroparks, are the stewards of 10.8 percent of all status 1 lands and 14.3 percent of status 2 lands.

1.5.5 Conserving Ohio’s Aquatic Habitats and Species - a Watershed Approach
Ohio’s water resources consist of approximately 61,532 miles of streams, 2.24 million acres of Lake Erie, over 188,000 acres of inland lakes and ponds, and 451 miles of the Ohio River, creating a variety of aquatic habitats.

Aquatic systems and their associated riparian habitats are the most biologically diverse systems in Ohio. The structural variability of these systems creates highly diverse habitats that are inhabited by many aquatic species including 168 fishes, 67 mussels, 21 crayfish, 14 amphibians, and thousands of aquatic invertebrates. Almost half of Ohio’s state listed species are found in these aquatic systems, including 42 species of fish, 36 species of mussels, 23 species of odonates, and 5 species of crayfish.

For effective conservation of aquatic systems, a watershed approach that takes into account the link between terrestrial and aquatic systems is clearly the best strategy. Land uses within the watershed are extremely important in structuring aquatic communities in Ohio. The majority of conservation threats and actions related to aquatic systems are terrestrially linked (see Statewide Threats section in this chapter). This watershed approach is intended to focus on permanent aquatic systems, from small headwater streams to larger tributaries, and include man-made and natural lakes. Wetlands (ephemeral, natural, and controlled) are covered under terrestrial habitats.

To effectively implement a basin management approaches requires collaboration with other agencies and NGO’s that share common goals regarding the status and function of watersheds within basins. Basins cut across county lines, consequently their management involves multiple government, administrative, and management jurisdictions. Broad coalitions must be formed to ensure effective planning, maximize resources, and efficiently implement conservation and restoration programs to achieve short and long-term management goals.

Studies conducted by various environmental regulatory agencies (OEPA, ODNR, USEPA, USGS) clearly demonstrate the connection between the land and aquatic ecosystems. Aquatic ecosystems are a product of the land and land use that surrounds them. In general, the quality of water, habitat, and life in aquatic systems varies inversely with the influence of humans in the surrounding watershed. Human impacts in the watershed (land uses) directly affect physical habitat and water quality in aquatic systems – which drives biotic communities. Aquatic systems have proven over time to be amazingly durable and adaptable. Their ability to withstand human induced perturbations, as well as recover from stressors once they are removed, is a testament to the resiliency of nature. However, using “uninfluenced” aquatic ecosystems as a benchmark, it is easy to see the impacts of human activities on Ohio’s aquatic ecosystems. Compromised habitat and water quality push biotic communities in the direction of reduced diversity and “disturbance” tolerant species. Abatement of stressors on the system can result in a shift back to original habitat and water quality conditions – with a slow return of the biotic community that occupied the pre-disturbance system. Effects of individual stressors, multiple stressors, and synergistic effects of stressors acting on aquatic systems are often difficult to define due to the mitigating affects of the physical environment. Excess nutrient inputs may have a profound effect on one system, yet seemingly no effect on another due to size, volume, channel morphology, current, or substrate.
differences between the systems. Consequently, remediation and/or restoration strategies must be considered on a system-by-system basis.

Understanding how various land uses impact water quality is the key to effective prevention and restoration. Primary causes and sources of aquatic ecosystem impairment (from the 2014 Ohio EPA Integrated Report) include:

*Row crop cultivation* is a common land use in Ohio. Frequently, cultivated cropland involves tile drainage, and a challenge is to carry out actions that improve water quality while maintaining adequate drainage for profitable agriculture. The land application of manure, especially during winter months, is often a large source of both bacteria and nutrients entering streams and subsurface drainage tiles. Many cropland practices involve the channelization of streams, which creates deeply incised and straight ditches or streams. This disconnects waterways from floodplains, which has damaging impacts on the quality of the system. The regularity of the stream channel and lack of in-stream cover reduces biological diversity.

*Land development* is the conversion of natural areas or agriculture to residential, industrial, or commercial uses. Numerous scientific studies show that increasing impervious cover—hard surfaces such as roads, parking lots, rooftops, and lawns—harms water quality. More water runs off the hard surfaces and more quickly. The rate of erosion increases and streams become unstable. The resulting channel is less able to assimilate nutrients and other pollution. Higher runoff volume increases the amount of pollutants (e.g., nutrients, metals, sediment, salts, pesticides). Another problem is that stream temperatures can be raised when water runs over hot pavement and rooftops or sits in detention basins. When this heated water enters a stream, the higher temperatures reduce dissolved oxygen concentrations that aquatic life need to survive. With proper planning of development, many of these problems can be mitigated or avoided entirely.

*Agricultural livestock operations* can vary widely in how they are managed. Pasture land and animal feeding operations can be sources of nutrients and pathogens. Frequently livestock are permitted direct access to streams. Direct access not only allows direct input of nutrients and pathogens, but also erodes the stream bank, causing excess sediments to enter the stream and habitat degradation. The most critical aspect of minimizing water quality impacts from any size animal feeding operation is the proper management of manure in terms of application and storage.

*Industrial and municipal point sources* include wastewater treatment plants and factories. Wastewater treatment plants can contribute to bacteria, nutrient enrichment, siltation, and flow alteration problems. Industrial point sources, such as factories, sometimes discharge water that is excessively warm or cold, changing the temperature of the stream. Point sources may contain other pollutants such as chemicals, metals and solids.

*Acid mine drainage* impacts streams with high levels of acidity (low pH), high metal concentrations, elevated sulfate levels, and/or excessive dissolved and suspended solids and/or siltation. Acid mine drainage often has toxic effects on stream organisms and degrades habitat quality when deposited metals form a crust on the stream bed and susceptible soils erode from areas disturbed from mining. Ultimately it reduces biological diversity, eliminates sensitive aquatic life, and lowers ecosystem productivity.

1.5.5.1 Determining the Condition of Ohio’s Aquatic Habitats
The condition of Ohio’s aquatic habitats is determined primarily from Ohio EPA surveys and data. In monitoring water quality, habitat, and biological community health, OEPA uses a “life-use attainment” system where various indices are measured and compared to ecoregion standards. Depending upon how measured indices compare to standards, a particular water body may fully meet, partially meet, or not meet a designated aquatic life use. Given the length of time this system has been in place, the number of water bodies surveyed, and the amount of data collected – this system represents the best way to monitor aquatic habitat health both spatially and temporally.
The Ohio EPA 2014 Integrated Report provides a detailed description of how the health of Ohio’s aquatic habitats are assessed and monitored:

Ohio’s water quality standards (WQS) have seven subcategories of aquatic life uses for streams and rivers (see Ohio Administrative Code 3745-1-07, http://www.epa.ohio.gov/portals/35/rules/01-07.pdf). The WQS rule contains a narrative for each aquatic life use and the three most commonly assigned aquatic life uses have quantitative, numeric biological criteria that express the minimum acceptable level of biological performance based on three separate biological indices. These indices are the Index of Biotic Integrity (IBI) and Modified Index of Well-Being (MlwB) for fish and the Invertebrate Community Index (ICI) for aquatic macroinvertebrates. A detailed description of Ohio EPA’s biological assessment and biocriteria program including specifics on each index and how each was derived is available (see Biological Criteria for the Protection of Aquatic Life, http://www.epa.ohio.gov/dsw/bioassess/BioCriteriaProtAqLife.aspx).

Procedures established in a specially designed 1983-1984 U.S. EPA study known as the Stream Regionalization Project (Whittier et al. 1987) were used to select reference (or least impacted) sites, in each of Ohio’s five Level III ecoregions (Omernik 1987). Biological data from a subset of these sites in addition to supplemental data from other least impacted Ohio reference sites were used to establish the ecoregion-specific biocriteria for each aquatic life use. Note that some criteria vary according to stream size and some indices do not apply in certain circumstances. Ohio’s WQS rule stipulates that “biological criteria provide a direct measure of attainment of the warmwater habitat, exceptional warmwater habitat and modified warmwater habitat aquatic life uses” (OAC 3745-1-07(A)(6)). The numeric biological criteria based on IBI, MlwB, and ICI thresholds applicable to exceptional warmwater habitat (EWH), warmwater habitat (WWH), and modified warmwater habitat (MWH) waters are found in Table 7-15 of the WQS rule. Neither coldwater habitat (CWH) nor limited resource water (LRW) streams have numeric biological criteria at this time, so attainment status must be determined on a case-by-case basis. For sites and segments designated with these aquatic life uses, attainment status was determined by using biological data attributes (e.g., presence and abundance of coldwater species in CWH streams) and/or interim assessment index targets (e.g., those for LRW streams, Lake Erie lacustrines, Lake Erie nearshore) to assess consistency with the narrative aquatic life use definitions in the WQS.

Briefly defined, aquatic life use classifications are:

- **Coldwater Habitat CWH** - native cold water or cool water species; put-and-take trout stocking
- **Seasonal Salmonid Habitat SSH** - supports lake-run steelhead trout fisheries
- **Exceptional Warmwater Habitat EWH** - unique and diverse assemblage of fish and invertebrates
- **Warmwater Habitat WWH** - typical assemblages of fish and invertebrates
- **Modified Warmwater Habitat MWH** - tolerant assemblages of fish and macro-invertebrates
- **Limited Resource Waters LRW** - fish and macroinvertebrates severely limited by physical habitat or other irretrievable condition

A biological community at a EWH, WWH, or MWH sampling site must achieve the relevant criteria for all three indices, or those available and/or applicable, in order to be in full attainment of the designated aquatic life use criteria. Partial attainment is determined if one criterion is not achieved while non-attainment results when all biological scores are less than the criteria or if poor or very poor index scores are measured in either fish or macroinvertebrate communities.

Most of Ohio’s water quality problems will not be solved by issuing a permit or building a new wastewater treatment system to treat point sources of pollution. Improving Ohio’s surface water quality will require effectively managing land use changes to ensure that polluted runoff is either captured and treated or allowed to infiltrate through the soil before running off into a stream. Restoring and protecting natural stream functions so that pollutants may be more effectively assimilated by streams is also critical. These actions will require various programs and people working collaboratively on local water quality issues and concerns. Local educational efforts and enhanced water quality monitoring will also play important roles if we are to see significant water quality improvements throughout Ohio.

Many areas of the state are benefitting by the participation of individuals and organizations in local watershed organizations. Some of these organizations have been active for quite some time and are
successfully influencing local land use decision making and implementing projects designed to improve water quality in their watershed. Since 2000, Ohio EPA has worked in conjunction with the Ohio Department of Natural Resources to provide section 319(h) grant funding assistance to hire local watershed coordinators to help facilitate the development of watershed action plans. In recent years, the emphasis has shifted from developing plans to implementing water quality improvement projects such as stream restoration, dam removals, agricultural best management practices and others. Ohio EPA is measuring improvements resulting from these projects; however, there remain challenges associated with changing land use decisions and consumer and producer attitudes.

### 1.6 Action Plan Evaluation and Updates

The “owners manual” describing how the Division of Wildlife operates is its Comprehensive Management System (CMS). A CMS is a method of developing and documenting a series of processes and procedures that organize an agency’s “way of doing business.” The four components of a CMS include Inventory and Scanning, Strategic and Tactical Planning, Operational Planning, and Control and Evaluation. While the comprehensive management system does not address all of the fish and wildlife resource needs, issues, and problems in Ohio, it provides the management framework of assessment and adaptation necessary to carry out effective conservation programs. The following is a brief description of how the Division uses the CMS, broken down by each of its four components.

#### 1.6.1 Inventory and Scanning

The inventory and scanning process answers the questions, “Where are we, and what do we have to work with?” By definition, inventories are concerned with current conditions, whether they describe animal abundance, habitat quality, or number of recreational users. Oftentimes, however, inventory information is most useful when put into context with historical information or informed predictions. Inventories are performed at various steps in Ohio’s CMS; hence, the types of inventories, their purposes, and their frequency vary widely. In reality, different types of inventories are conducted for different reasons at various steps in the CMS cycle on varying time intervals – and they form the critical first step in the CMS process.

**Operational Inventories**

Operational inventories are conducted either on a continuous basis or frequently (at least every biennium), and address both administrative and traditional resource survey needs. Resource inventories provide routine information on fish and wildlife abundance, habitat quality or quantity, and human use of and/or attitudes towards fish and wildlife resources. Examples of these routine inventories include annual waterfowl surveys, fish population surveys, harvest summaries, breeding bird surveys, and angler creel surveys. A variety of methods are used to collect information on attitudes towards wildlife and to estimate participation in wildlife-related recreation. Methods used to collect information include annual wildlife district open houses, website surveys, mail questionnaires, angler surveys, conservation club meetings, as well as contacts at county fairs, the state fair, and a host of outdoor shows.

Regardless of whether routine inventories are used to sample human dimensions or wildlife populations, ongoing survey projects are evaluated during operational planning to determine if the data are still needed, if the projects sufficiently meet management objectives, if the projects provide reliable data, and if the survey methodologies are efficient and up-to-date.

**Tactical Inventories**

Tactical inventories are usually conducted less frequently, at intervals that can range up to several years. Information from these inventories can be used during both the tactical plan development phase and the evaluation phase. Some tactical inventories are simply a compilation and synthesis of trend data taken from routine operational inventories, and in some cases, tactical inventory information is provided by external sources or partner agencies.

Tactical inventories obtained from external sources provide crucial information about long-term trends. Examples of resource inventories include the North American Breeding Bird Survey (USGS) and the Ohio Wetland Inventory (USFWS). Examples of demographic and human dimension inventories include the decennial census (US Census Bureau), the National Survey of Fishing, Hunting, and Wildlife Associated
Recreation (USFWS), and various industry trade organization reports (e.g. Recreational Boating and Fishing Foundation).

Tactical inventories can address both administrative and resource issues. Habitat and population inventories are used for developing tactical approaches to maintaining or improving habitat, and managing fish and wildlife populations. Human dimension and public attitude inventories are crucial for developing tactical approaches for facility and access development, recreational opportunities management/enhancement, and public communication.

**Strategic Inventories**

Strategic inventories are performed during the strategic plan development phase, and therefore are conducted less frequently than almost all other inventories. Inventories related to strategic planning involve an amalgam of inventory types including recent operational and tactical inventories. However, the long interval between strategic planning cycles demands that strategic inventories include not only a complete description of, “where are we”, but also a thorough examination of predicted changes that could dramatically influence strategic and tactical direction.

A situation analysis is used to provide a “future look” component to the strategic inventory. Sources of trend data related to people, wildlife, and habitat are assembled. Important types of information (and their sources) include: human demographics (US Census Bureau, Ohio Dept. of Development); outdoor recreation participation trends (USFWS, industry trade groups, social science research); habitat quantity and quality (Ohio Dept. of Agriculture, ODNR, USDA, USFWS, USGS, Ohio EPA). All of this inventory information is synthesized to produce statements regarding the current status of, and possible future trends of major factors that will impact conservation in Ohio.

### 1.6.2 Strategic Planning

The information collected at the inventory stage aids in strategic planning. The strategic plan creates a shared, common, vision of the future of conservation in Ohio. It is forward-looking and encourages action, anticipates needs of wildlife, habitat, and people – and identifies problems/opportunities related to those needs. Strategic planning defines direction, while specific actions are planned and implemented through tactical planning and operational planning processes.

The strategic plan is designed to make effective and efficient use of available resources. The plan identifies fundamental principles that will guide the future of conservation in Ohio, and involves the entire division staff, constituents and stakeholder groups, and other government agencies as part of the planning process. The strategic planning component answers the question, “Where do we want to go?”

The concept of the current strategic plan (2011-2030) is to “build on the past to prepare for the future.” The current plan is a landscape-view of Ohio, considering species and habitat types, their relationship and arrangement within the natural world, and the impact and interactions that people have with fish and wildlife.

**Evaluation of the Strategic Plan**

Evaluation of the strategic plan is a critical process and tool for administrators and managers within the division. Evaluation of the strategic plan measures the progress towards the preferred direction for each action stated in the plan. Evaluation of the strategic plan is formally completed every two years, and a final evaluation of the plan will occur at the beginning of the planning process for the Strategic Plan for 2031 and beyond.

The review considers each component of the plan, and each component is rated for applicability, effectiveness and inclusiveness. The existing strategic plan is then either affirmed, recommended for revision, or recommended for replacement by a new strategic plan.

The final evaluation of the strategic plan is an evaluation of the success of conservation efforts during the life of the plan. Did we successfully achieve the objectives? If not, why not? And what adjustments need
to be made to better achieve them during the next strategic plan, assuming they are still appropriate. The final evaluation provides the foundation for the next Strategic Plan.

1.6.3 Tactical Planning
A tactical plan is a guidance document that provides multi-year operational direction for projects, and also provides specific outcomes and objectives for the implementation of strategic action areas identified in the strategic plan. Additionally, it includes a description of opportunities, problems, needs, or issues that will influence the accomplishment of outcomes and objectives.

The purposes of a tactical plan are to (1) provide linkage between the strategic plan and operational projects, (2) set tactical outcomes and objectives that correspond to strategic actions, (3) lay out the sequence of projects which are needed to address strategic actions, (4) provide a basis for the evaluation of operational projects, and (5) organize the multi-year operations of projects.

The scope of a tactical plan may be function specific, habitat/ecosystem specific, or species specific, or it may be based on strategic actions of the Strategic Plan. It may encompass elements of more than one strategic action, and/or be supported by one or more operational projects.

Evaluation of Tactical Plans
A biennial review, evaluation, and update of tactical plans helps to insure that each plan is helping address strategic actions of the strategic plan. Evaluation of tactical plans measure progress towards the preferred outcomes stated in that plan. The basis of evaluation should be the metrics associated with objective statements, including all quantities, qualities, and deadlines associated with the accomplishment of a particular objective.

Tactical plans are evaluated every two years. The review considers each component of the plan, and each component is rated for continued validity, effectiveness, and quality. A biennial review, evaluation, and update of tactical plans insures that each plan is helping address strategic actions of the strategic plan.

The final evaluation of tactical plans is an evaluation of the success of conservation efforts during the life of the plan. Were the desired outcomes achieved? If not, why not? And what adjustments need to be made so those goals can be achieved during the next tactical planning cycle, assuming those goals are still appropriate. The final evaluation provides the foundation for the next set of tactical plans.

1.6.4 Operational Planning
The operational planning process is an annual process which results in activities that put ideas into action. It is where specific outcomes, objectives, and strategies identified in tactical plans are turned into projects, in which tasks are organized and resources allocated. Each operational project identifies the need/justification for the project, the related objective(s), the approach and activities involved, the expected results or benefits, and costs. The operational planning component answers the question, “For this year, how are we going to get where we want to go?”

Operational Project Linkage to Strategic and Tactical Plans
In order to help accomplish the conservation mission, operational projects need to help achieve tactical plan outcomes, and where appropriate support objectives and strategies in tactical plans. This approach links operational projects to tactical plans in a fashion similar to how tactical plans link to the strategic plan. Strategic actions from the Strategic Plan provide broad direction and associated objectives. Tactical plans link to these objectives. Detailed information about what actions need to be taken for “on the ground” progress are found in tactical plans which provide a shorter term, specific view of how the desired future can be achieved. Tactical plans then link to detailed operational projects that put financial and human resources into action.

Project Monitoring
Project monitoring assures that every effort is made to accomplish operational project objectives. The project leader and associated advisory team monitor schedules, completion dates and fiscal information
for project activities. Monitoring allows managers to identify potential problems and resolve them before they have an irreversible impact.

Project Evaluation and Performance Reports
Operational project evaluation measures the success of projects and helps identify improvements/modifications that may be needed in future years. Project performance reports close the loop for operational planning by providing project leaders an objective view of project performance and evaluation. All operational projects are evaluated every year. These reports focus on accomplishments, costs, and recommendations concerning the future of the project. Final reports mirror annual performance reports, but provide details for each project year and synthesize overall results.

1.6.5 Control and Evaluation
The control and evaluation component allows us to the answer the question, "Did we get there?" Regular feedback to determine how well strategies are working and if objectives have been met is an essential part of our comprehensive management system. This is a key component in improving conservation of Ohio's fish and wildlife resources.

Every operational project is evaluated at the end of each fiscal year - evaluation of project objectives allows us to determine if projects have been accomplished as planned. Strategic and tactical plans are evaluated by periodic formal and informal reviews. Surveys of fish and wildlife populations and input from constituents concerning use of these resources allows for the evaluation of direction and progress at several levels. Formal evaluation and modification of strategic and tactical plans occurs every two years. The information gathered from these evaluations is then used as part of the inventory component of subsequent strategic and tactical plans.

1.6.6 Evaluation and Adaptive Management
The condition of species and habitats is determined based upon the best data available at the time. Problems, opportunities, issues, and needs are determined, and priority is assigned regarding which ones to address first. Goals and actions are developed, and projects are implemented to produce some desired outcome related to an issue affecting species and/or habitats. To some degree during, but primarily at the end of some implementation timeframe, an assessment is made regarding progress toward the desired outcome. As is often the case, early efforts aimed at issues result more in increasing our understanding of the issue than they do resolving it. At this point, adaptation occurs and efforts continue. The process of effort, assessment, adaptation, and revised effort continues until the issue is resolved, or priorities change.

Ohio’s State Wildlife Action Plan will be implemented, reviewed, reported on, modified, updated, and rewritten (if necessary) according to CMS protocols. It is however important to keep in mind that the Action Plan is intended to be a flexible, adaptable, living document, and therein lies its strength. As our knowledge of species and habitats grows, and as new threats and conservation actions are identified – the Plan will be revised and updated. Some of the revision and updates will take place per the CMS described above. Others, when necessary, will be done less formally at various intervals. Formal and informal updates to the Action Plan will incorporate USFWS notification and opportunity for comment.