APPENDIX B.10 UPPER OHIO SERVICE AREA
ELEMENT 1. SERVICE AREA DESCRIPTION

The Upper Ohio Service Area (SA) is located in southern Indiana on the Indiana/Kentucky and Indiana/Ohio borders and is composed of the following three 8-digit HUC watersheds:

- 05140104 - Blue-Sinking
- 05140101 - Silver-Little Kentucky
- 05090203 - Middle Ohio-Laughery

The Upper Ohio SA includes all or portions of fifteen Indiana counties listed below and is located within the Southern Hills and Lowlands physiographic region.

<table>
<thead>
<tr>
<th>Perry</th>
<th>Jefferson</th>
<th>Ohio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crawford</td>
<td>Ripley</td>
<td>Switzerland</td>
</tr>
<tr>
<td>Orange</td>
<td>Decatur</td>
<td>Clark</td>
</tr>
<tr>
<td>Washington</td>
<td>Franklin</td>
<td>Floyd</td>
</tr>
<tr>
<td>Scott</td>
<td>Dearborn</td>
<td>Harrison</td>
</tr>
</tbody>
</table>

The Upper Ohio SA drains approximately 2,374 square miles of southern Indiana and is located in both the Interior Plateau and Interior River Valleys and Hills ecoregions. Resting below the Lower White and Whitewater-East Fork White SAs, the southern border of the Upper Ohio SA is the Ohio River. The western portion of the SA is characterized by its rugged terrain and upland forest types; a majority of the area is thinly populated with minor areas of barren land and sandstone and limestone glades. The middle portion of the SA is part of the Southern Bottomlands natural region consisting of neutral to acidic silt loam soils. Bottomland forests, swamps and ponds make up a majority of the natural communities within this region (Homoya, Abrell, Aldrich, & Post, 1985). The remainder of the Upper Ohio SA is within the Bluegrass natural region, characterized by dissected plateaus underlain by limestone and shale (Hill).

The westernmost portion of the Upper Ohio SA and along its border with the Ohio-Wabash Lowlands SA contains a noticeable fraction of Indiana state and federally-owned lands. The Blue-Sinking
Watershed, the westernmost watershed in the SA, also has the greatest karst region in the state and is denoted by its many sinkholes and caves (Hasenmueller, Powell, Buehler, & Sowder, 2011).

The Blue River is a popular river to the region originating in Washington County and traveling south to the Ohio River; it is part of the Indiana Natural, Scenic, and Recreational River System and is managed by the Blue River Commission (Blue River Commission, 2016). The river travels through one of the most scenic and diverse areas in the entire state of Indiana; features along the river include Indian sites, caves, and vast forests, to name a few. The Blue River provides many ecological benefits to its aquatic community, including biodiversity and pristine habitat.

Based on the 2011 NLCD, the land cover type with the most area in the Upper Ohio SA is forest and scrub/shrub (52.9%), followed by agricultural land use (36.2%), developed and impervious land use (7.33%), and wetlands and open water (0.9%) (Homer, et al., 2015). Woody wetlands are the prominent wetland type and range from approximately 0.19% per the 2011 NLCD to 0.75% per the NWI. Emergent herbaceous wetlands range from 0.06% per the 2011 NLCD to 0.12% per the NWI.

**ELEMENT 2. THREATS TO AQUATIC RESOURCES**

Aquatic resource threats specific to the Upper Ohio SA have been identified using the same approach as the statewide portion of the CPF. The threats are presented in the order of the current predominance within the SA.

**2.1 Section 404 Permitted Impacts**

The Corps Section 404 permit data for impacts that required mitigation in the Upper Ohio SA from 2009 – 2015 was collected and analyzed (Table 100). According to the data, 17.7 acres of impacted wetlands and 24,162.5 linear feet of impacted streams required mitigation in the seven year time period. Locations of the permitted stream and wetland impacts are provided in Figure 116.

The growth and development work type accounted for the most stream impacts (40.8%), followed closely by transportation and service corridors (40.5%), then dam and/or levee related activities (15.5%), and energy production and mining (3.3%). There were no documented stream impacts requiring mitigation for agricultural activities for this time period in the SA.

Development accounted for the most wetland impacts (74.4%), followed by transportation and service corridors (12.2%), energy production and mining (10.4%), and dam and/or levee related activities (3.02%). There were no documented wetland impacts requiring mitigation for agricultural activities for this time period. Locations of the permitted stream and wetland impacts are provided in Figure 116.
Table 100. Authorized 404 stream and wetland impacts requiring mitigation by work type category, 2009 – 2015
Source: USACE Louisville District

<table>
<thead>
<tr>
<th>Work Type Category</th>
<th>Authorized Stream Impacts – Linear Feet</th>
<th>Percent of Stream Impact per Category</th>
<th>Authorized Wetland Impacts - Acres</th>
<th>Percent of Wetland Impact per Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0.00%</td>
</tr>
<tr>
<td>Dam</td>
<td>3,742</td>
<td>15.49%</td>
<td>0.534</td>
<td>3.02%</td>
</tr>
<tr>
<td>Development</td>
<td>9,854</td>
<td>40.78%</td>
<td>13.159</td>
<td>74.44%</td>
</tr>
<tr>
<td>Energy Production</td>
<td>790</td>
<td>3.27%</td>
<td>1.834</td>
<td>10.38%</td>
</tr>
<tr>
<td>Transportation</td>
<td>9,776.5</td>
<td>40.46%</td>
<td>2.15</td>
<td>12.16%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>24,162.5</td>
<td>100.00%</td>
<td>17.677</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

Upper Ohio Service Area
404 Permitted Aquatic Resource Impacts Requiring Mitigation

Figure 116. 404 permitted stream and wetland impacts requiring mitigation 2009-2015

Indiana Stream and Wetland Mitigation Program Instrument
2.2 Land Cover and Land Use
In addition to 404 permitted work type categories, IDNR utilized the 2011 NLCD (Homer, et al., 2015) to identify land cover and land uses that currently contribute to aquatic resource and habitat impacts. Overall land cover within the Upper Ohio SA is presented in Figure 117 and displays the geographical relationship of converted cover types relative to naturally occurring cover types.

![Upper Ohio Service Area 2011 Land Cover](image)

Figure 117. Land cover within the Upper Ohio Service Area from the 2011 NLCD (Homer, et al., 2015)
The land uses exhibited within the 2011 NLCD include multiple classes of cover, and some have additional values within specific classes based on variants or intensities within the classification (Table 101).

<table>
<thead>
<tr>
<th>Land Cover</th>
<th>Value</th>
<th>Sum of Acres</th>
<th>Percent of Total Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open Water</td>
<td>*</td>
<td>11,332</td>
<td>0.65%</td>
</tr>
<tr>
<td>Developed</td>
<td>Open Space</td>
<td>88,863</td>
<td>5.08%</td>
</tr>
<tr>
<td>Developed</td>
<td>Low Intensity</td>
<td>23,027</td>
<td>1.32%</td>
</tr>
<tr>
<td>Developed</td>
<td>Medium Intensity</td>
<td>11,091</td>
<td>0.63%</td>
</tr>
<tr>
<td>Developed</td>
<td>High Intensity</td>
<td>5,162</td>
<td>0.30%</td>
</tr>
<tr>
<td>Barren Land (Rock/Sand Clay)</td>
<td>*</td>
<td>3,240</td>
<td>0.19%</td>
</tr>
<tr>
<td>Forest</td>
<td>Deciduous</td>
<td>874,661</td>
<td>50.00%</td>
</tr>
<tr>
<td>Forest</td>
<td>Evergreen</td>
<td>42,112</td>
<td>2.41%</td>
</tr>
<tr>
<td>Forest</td>
<td>Mixed</td>
<td>3,053</td>
<td>0.17%</td>
</tr>
<tr>
<td>Shrub/Scrub</td>
<td>*</td>
<td>5,346</td>
<td>0.31%</td>
</tr>
<tr>
<td>Grassland/Herbaceous</td>
<td>*</td>
<td>43,588</td>
<td>2.49%</td>
</tr>
<tr>
<td>Pasture/Hay (Agriculture)</td>
<td>*</td>
<td>363,365</td>
<td>20.77%</td>
</tr>
<tr>
<td>Cultivated Crops (Agriculture)</td>
<td>*</td>
<td>269,930</td>
<td>15.43%</td>
</tr>
<tr>
<td>Wetlands</td>
<td>Woody</td>
<td>3,349</td>
<td>0.19%</td>
</tr>
<tr>
<td>Wetlands</td>
<td>Emergent Herbaceous</td>
<td>1,084</td>
<td>0.06%</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td>1,749,206</td>
<td>100.00%</td>
</tr>
</tbody>
</table>

* Class does not have additional values. (Homer, et al., 2015)

Table 101. Upper Ohio SA land cover classification/value percentages from 2011 National Land Cover Database

IDNR combined the values within the same land cover classification in Figure 117 below to demonstrate the current overall land cover distribution of the SA.
Upper Ohio Service Area
Combined Land Use
(Acres)

2.3 Agricultural Land Use
Agricultural land use is the largest anthropogenic land use in the Upper Ohio SA. Total agricultural land use covers approximately 36% of the SAs total land area of 633,294 acres (Homer, et al., 2015). Agricultural land uses occur throughout the SA, with the exception of the distribution of forested lands and a few developed areas, such as Jeffersonville and Clarksville.

Within the identified land use areas, cultivated crops cover over 269,930 acres (15.43%) and pasture/hay lands cover 363,364 acres (20.77%) of the SA (Homer, et al., 2015). Although corn production is predominant across the SA, soybean production is the primary cultivated crop based on USDA 2015 harvested crop production survey data from counties that comprise the majority of the Upper Ohio SA (USDA-NASS, 2017).

Pasture/hay lands support livestock production for small to major livestock farming operations throughout the SA. The Lower Ohio SA is the sixth largest SA with approximately 1,749,206 acres, and contains chicken and pork confined feeding operations (CFOs) which have a minimum of 5,000 animal units (Thompson, 2008). When combining these major agricultural land use activities, the Upper Ohio SA ranks ninth in percentage of total statewide land use (2.74%), and it’s a significant land use throughout the SA.

2.4 Growth and Development
Developed impervious land use is the second largest land use covering 128,143 acres (7.3%) of the 1,749,206 total SA acres, the second least developed density of all SAs. The Upper Ohio SA is the second most rural of all SAs with agricultural land use and forest combining for approximately 89% of
total cover. Communities with densely developed footprints are primarily located along the Ohio River and include Lawrenceburg, Aurora, Madison, Jeffersonville, Clarksville and New Albany, amongst many other smaller communities scattered across the SA.

The SA contains portions of the Cincinnati and Louisville-Jefferson County MSA’s, both of which experienced solid growth in the previous decade (Manns, 2013). Approximately 76% (840,664 acres) of the Louisville-Jefferson County MSA within Indiana is located in the SA accounting for 48% of total SA acres. Approximately 61% (219,605 acres) of the Cincinnati MSA within Indiana is located in the SA accounting for 13% of total SA acres. Analysis of the INDOT cities and towns GIS data shows the Upper Ohio SA contains entirely or in part 193 cities and/or towns, 46 of which are incorporated (INDOT, 2016).

Three Indiana regional councils that overlap with the SA include the River Hills Economic Development District and Regional Planning Commission (EDD & RPC) (48%), the Southeastern Indiana Regional Planning Commission (SIRPC) (38%), and the Indiana 15 Regional Planning Commission (14%) (IARC, 2017).

According to the River Hills EDD & RPC 2015 CEDS, existing and emerging industry sectors in the region include agribusiness, biomedical/biotechnical, advanced materials, chemicals and chemical based products, IT and telecommunications, machinery manufacturing, mining, computer and electronic product manufacturing, forest and wood projects, and primary metal manufacturing. Additional strong industries in the SA, with some decline, are food processing and technology, as well as transportation and logistics. Industrial parks are most heavily concentrated in Clark County, though sites are available in each county of the region. These parks range from fully developed and operating to shovel-ready (River Hills EDD & RPC, 2015).

The River Hills EDD & RPC has access to a comprehensive and robust network of roads, highways, railways, airports, and river ports. These assets are invaluable to a number of industries and employers across the area and provide a distinct competitive advantage over other regions (River Hills EDD & RPC, 2015). The Port of Jeffersonville along the Ohio River is one of three ports in the Ports of Indiana system. It has been one of the fastest growing U.S. ports adding more than 20 companies since 1993 with record annual volumes increasing each year. Major cargo includes corn, fertilizer, paper, salt, wire rod, soybeans, steel, liquid asphalt, pig iron, and project cargo (Indiana15RPC, 2016).

Additionally, analysis of INDOT’s local roads GIS data shows there are approximately 5,800 miles of municipal and county roads contributing to the developed impervious land cover within the SA (INDOT Road Inventory Section, 2016). The Upper Ohio SA ranks last among SAs in local road miles to square mile ratio at approximately 2.12 miles of local roads per square mile.
2.5 Transportation and Service Corridors

2.5.1 Roads

The Upper Ohio SA contains approximately 863 miles of U.S. Interstates and highways, 1,967 miles of state highways, and 5,800 miles of local roads with in its boundary (INDOT Road Inventory Section, 2016). Although this is the sixth largest SA, the concentration of the various road types per square mile of land has varying distribution throughout its boundary.

U.S. Interstates and highways have a concentration of approximately 0.32 mile per square mile, which ranks eighth among the eleven SAs. Although the concentration of U.S. Interstates and highways ranks in the lower tier, the concentration of state roads ranks third with 0.72 mile per square mile and is the highest ranking road type within the Upper Ohio SA. Similar to the U.S. roadways, the concentration of local roads ranks near the bottom. The concentration of local roads is approximately 2.12 mile per square mile ranking it eleventh and making this the lowest ranking road type within the SA. Although the combined ranking of the concentration for all roadways isn’t last, it has a concentration of 3.16 mile per square mile, which places ninth overall.

Although the concentration of state highways ranks within the top three, closer analysis reveals the concentration of the other road types rank near the bottom when compared to all other SAs. The construction and maintenance of roads and bridges throughout the Upper Ohio SA supports the predominant mode of transportation and play an integral role in sustaining business and commerce for the region.

2.5.2 Railroads

As an alternative mode of transportation, the Upper Ohio SA has approximately 331 miles of railroad within the SA (Federal Railroad Administration, 2002). These active railroads provide an important means of transportation for freight and passengers throughout the SA and state. The Upper Ohio SA contains the smallest concentration of railroads in the state with a density of 0.12 mile per square mile. Although the concentration of railroads ranks last in the state, they contribute to aquatic resource threats including habitat fragmentation, disruption to fluvial processes, resource degradation, conversion and loss of aquatic resources.

2.5.3 Service Corridors

Similar to threats associated with roads and railroads, the Upper Ohio SA contains service corridors that contribute to aquatic resource impacts and habitat loss associated with linear infrastructure. The SA contains over 1,128 miles of service corridors.

The Upper Ohio SA contains an extensive network of large kilovolt (kV) electric transmission lines within its boundary. The large kV transmission lines identified within the SA include approximately sixty-six (34.5 kV) lines, seventy-seven (69 kV) lines, ninety-one (138 kV) lines, fourteen (230 kV) lines, forty-eight (345 kV) lines, and five (765 kV) lines (Indiana Geological Survey, 2001). These lines extend
over 793 miles throughout the SA, which is the eleventh highest concentration of electric transmission lines relative to the SA size with 0.29 mile of transmission line per square mile.

In addition to electric transmission lines, the Upper Ohio SA contains over 335 miles of pipelines in total that contains over 290 miles of pipelines that transport natural gas and 45 miles of pipelines that deliver refined petroleum products (Indiana Geological Survey, 2002). Unlike all the other SAs, the Upper Ohio doesn’t contain crude oil pipelines which ranks it eleventh. The SA ranks tenth for concentration of natural gas pipelines and last for concentration of refined petroleum product pipelines.

### 2.6 Dams and Non-Levee Embankments
There are currently 15 known low head dams (IDNR DOW, 2016) within the SA, ranking sixth among all SAs for number of low head dams, and the fifth highest in concentration at one low head dam per 182 square miles. There are currently 72 state regulated high head dams (IDNR DOW, 2016) documented within the SA at a density of one dam per 38 square miles, tied for the fourth highest concentration of all SA’s, containing 8% of documented high head dams statewide.

Per the NLE GIS analysis (IDNR, 2016), there are approximately 132,000 linear feet (25 miles) of NLE’s mapped within the SA, averaging one mile of NLE per 109 square miles; the lowest concentration among all SA’s. Approximately 18 miles of the NLE’s are located within predominantly developed areas with the remaining seven miles mapped in rural agricultural settings.

### 2.7 Energy Production and Mining Threats
#### 2.7.1 Natural Gas and Oil Production
The Upper Ohio SA contains a multitude of active oil and gas fields, along with associated wells that support, or have supported, the petroleum industry. The Indiana Geological Survey (IGS) identifies 20 petroleum gas fields with 239 associated gas wells; three oil fields with three oil wells; and one oil & gas field ranking the Upper Ohio SA tenth statewide for active natural gas and oil fields (Indiana Geological Survey, 2015).

The Upper Ohio SA also contains a series of wells that are supplemental to, or associated with, the petroleum industry as identified within the IGS statewide well dataset. The IGS petroleum well data identifies 233 abandoned gas wells, five abandoned oil wells, eight abandoned gas storage wells, two abandoned observation wells, 508 dry wells, 58 gas storage wells, 12 observation wells, 29 stratigraphic wells, two abandoned saltwater disposal wells, 29 temporarily abandoned wells, 11 saltwater disposal wells and one water injection well within the SA (Indiana Geological Survey, 2015).
2.7.2 Mineral Mining and Aggregates
The Upper Ohio SA contains active mineral mining operations that extract and produce aggregate commodities. Based on the Indiana Geological Survey (IGS) 2016 active Indiana industrial mineral production data, the SA contains four sand & gravel mining operations, one clay and shale mining operation, 17 crushed stone operations, and one dimensional sandstone quarry operation (Indiana Geological Survey, 2016). In addition to the extraction of raw material aggregates, the SA includes one cement operation, an industry byproduct commodity that is used as an aggregate (Indiana Geological Survey, 2016). In addition to the Upper Ohio SA ranking sixth based on its size, mineral mining within its boundary ranks sixth in the state with 24 active operations.

2.7.3 Coal
The Upper Ohio SA does not have recoverable coal reserves and contains no active surface or underground coal mines.

2.8 Indiana State Wildlife Action Plan (SWAP) Identified Threats Anticipated Threats
The Upper Ohio SA contains the Indiana SWAP Interior Plateau (50.1%) and Valleys and Hills (49.9%) Planning Regions. The SWAP identifies the most significant threats to habitats and SGCN overlapping these planning regions as:

- Habitat conversion, fragmentation and loss
- Natural systems modification
- Invasive species
- Dams
- Fish passage
- Point and non-point source pollution
- Water management and use
- Housing and urban areas
- Commercial and industrial areas
- Agriculture, aquaculture, livestock
- Roads and service corridors
- Changing frequency, duration, and intensity of drought and floods

These SWAP planning regions have experienced loss in the majority of habitat types over the last decade mostly to urban development (SWAP, 2015).

2.9 Anticipated Threats
The existing land uses within the agricultural and developed impervious footprints make up approximately 43.5% of the land use within the SA and are expected to remain as the top contributors to aquatic resource impairments.

IDNR expects development along with transportation and service corridor projects to remain the foremost permitted activities in the SA requiring mitigation for aquatic resource impacts if the 404 permitting trends of the past 7 years continue.
According to the River Hills EDD & RPC 2015 CEDS, continued development of industrial/commerce parks throughout the district, but particularly at River Ridge in Clark County, will continue to be an economic priority for the region. These sites represent a great opportunity for industrial growth and attraction of quality employment opportunities (River Hills EDD & RPC, 2015). According to the Indiana 15 Regional Planning Commission, infrastructure improvements are a priority in this region that include adequate access to affordable water, efficient wastewater treatment, and effective storm water drainage and telecommunication infrastructure. There are a number of issues related to water services in the district requiring infrastructure and capacity improvements due to expanding development and failures in old systems. Infrastructure and public utilities are expected to remain a threat to the karst topography in the region due to sink holes, drainage, and erosion events especially following significant precipitation (Indiana15RPC, 2016).

Major near term priorities to stimulate economic growth and development for this region include, but are not limited to, roadway and other infrastructure improvements to facilitate industrial and business site expansion, relief of congested areas with road expansion projects, residential development opportunities, sewer capacity expansions and line extensions, wastewater treatment expansion, and storm drainage improvements. Transportation goals for this region include strategic development near Interstates I-64 and I-69 as well as state road linkages. Additionally, an expansion of the Ohio River transportation system is a priority (Indiana15RPC, 2016).

The region is well forested with a variety of hardwood species well suited for timber production which is expected to continue to contribute to a number of industries. In addition to forested land, the district also has significant agricultural lands. Counties in the district produce a substantial amount of crops annually such as corn, soybeans, and wheat. Livestock production is also a large contributor to the district’s agricultural output. Hogs, sheep, and especially cattle are all raised in the district. In addition, natural gas production has had a resurgence since the mid-1990s with the development of new extraction technology and is expected to remain a foreseeable threat to aquatic resources (Indiana15RPC, 2016).

2.10 Offsets to Threats
IDNR will apply the same restoration, enhancement and/or preservation approaches to offsetting the predominant threats in the Upper Ohio SA that were stated in the statewide portion of the CPF. The SA goals and objectives further define the general types and locations of the aquatic resources IDNR will provide as compensatory mitigation based upon identified threats, historic loss and current conditions. See Appendix C for a summary of offsets per major anthropogenic category and a general matrix of offset measures for each of the predominant threats to aquatic resources throughout the SA and the state.
ELEMENT 3. HISTORIC AQUATIC RESOURCE LOSS

The Upper Ohio SA’s historic natural communities were predominantly composed of southern forests on hilly to very rugged topography of the relatively unglaciated region. In addition, significant areas of karst topography persist in much of this SA. The unique landscape found along the Ohio River historically consisted of high quality aquatic resources. These aquatic and natural communities were permanently altered by early European settlement throughout the SA.

The SA’s natural resources have experienced conversions to agriculture since early European settlement began in the region. The establishment of agriculture within the southwestern portion of the SA resulted in land use changes that led to aquatic resource losses. Settlement of Harrison and Floyd Counties during the early 1800s resulted in the area’s forests being cleared for agriculture and farmland, including areas prone to highly erosive conditions (Harrison County Board of Commissioners, 2008). The land-use changes during this period resulted in the clearing of large tracts of land for agriculture, this included the draining of wetlands and the channelization of streams which resulted in early water quality problems (Whitaker Jr., Amlaner Jr., Jackson, Parker, & Scott, 2012). The removal of forests within the watersheds resulted in increased sediment loads to the region’s largest rivers, including the Ohio River (Whitaker Jr., Amlaner Jr., Jackson, Parker, & Scott, 2012).

Transportation has played a key role in establishing settlements by facilitating access for early settlers. With the Upper Ohio SA’s southern boundary being the Ohio River, this part of the state became important to early settlers because it provided a means for travel and the transport of goods. The predominant means of travel for settlers and their products and crops, during the late 1700s and early 1800s in Indiana was by boat on the Ohio River (The History Museum, 2017).

The ability to ship commodities from the region supported permanent settlements in southwestern Indiana. The northeastern half of the SA began to be settled by European settlers in the late 1790’s following the Revolutionary War (Tanners Creek Watershed Steering Committee, 2003). As settlers established in the area and created transportation routes, this region began to see the formation of towns during the 1800s. For example, Dover was known as the “Crossroads” in the 1820s because it was located at the intersection of the trail from Lawrenceburg to Brookville and the trail from Harrison to Napoleon, resulting in a multitude of laborers constructing their headquarters there (Tanners Creek Watershed Steering Committee, 2003).

Near the central region of the SA, similar settlements and towns were established along the Ohio River due to accessibility. Vevay was established in 1813 by early French and Swiss settlers with the attempt to establish viticulture in the region. However, in the mid-1800s, wine making in the region was abandoned due to commercially oriented farming and commerce which established an important trading center and river port for grains, soybeans, tobacco and livestock (Indian Creek Watershed Steering Committee, 2007).
In addition to using waterways for transportation, the SA contained overland transportation routes that led to an increase in settlements in the area. The Buffalo Trace provided an overland route through southern Indiana for early settlers and started near the Falls of the Ohio, connecting current day New Albany to Vincennes, crossing multiple streams and rivers and providing a connection to the Wabash River (Indiana’s Historic Pathways, 2010). This route facilitated commerce within southwestern Indiana by providing early American settlers an avenue to move livestock and ultimately settle the Northwest Territory (Snell, Jackson, & Krieger, 2013).

In order to provide overland travel from the Ohio River to Lake Michigan and increase interior travel access, business and commerce, the construction of Michigan Road began in 1832 connecting the southern Indiana town of Madison to the states northern border resulting in the clearing of forests (Carman, 2013). In addition to Michigan Road, the region was affected by the railroads. In 1836, the establishment of the Madison, Indianapolis, and Lafayette Railroad in Madison created the state’s first railroad (U.S. Department of Interior, 2017). This transformed Madison which experienced growth and wealth because it contained the only port for river and rail in the state of Indiana (U.S. Department of Interior, 2017).

The present Clark and Floyd County area located on the Ohio River played an important role in the SA because it became a major settlement area for early Europeans due to its proximity to the Falls of the Ohio and the accessibility of the river. The first American settlement in the Northwest Territory was Clarksville in 1784, which led to the formation of Clark County in 1801 and Floyd County in 1873 (The Clark County Soil and Water Conservation District, 2007).

As the region experienced increased population growth, the region’s aquatic resources were negatively impacted. Increases in habitat conversion associated with agriculture, urban and industrial development resulted in water quality issues from point source and non-point source pollution, increased siltation and sedimentation, and increased stream temperatures due to the loss of riparian forests (Whitaker Jr., Amlaner Jr., Jackson, Parker, & Scott, 2012).

In response to settlers’ needs to process lumber and agricultural commodities, many of the region’s streams and rivers were dammed in order to provide water power for mills. In the mid-1800s, Silver Creek was impacted by the installation of several dams for this purpose. One of best known dams constructed within Silver Creek was The Blackison Mill Dam. It was built in 1853 to provide water power for a saw mill that operated a saw saw that cut limber, operated a grist mill that used burros to grind grain, and a cement mill with a lime kiln (The Clark County Soil and Water Conservation District, 2007). As this region experienced further industrial growth, streams and wetlands were lost and degraded. The wetland located at the confluence of Silver Creek and the Ohio River, known as Loop Island, received leather tanning processing waste from a leather company beginning in the early 1860s (The Clark County Soil and Water Conservation District, 2007).
Due to extensive aquatic resource loss within the Upper Ohio SA, the understanding of the regions aquatic resources and the natural communities in which they existed is best reconstructed by evaluating the identified Natural Regions and Sections, and their related natural aquatic communities, associated within each respective Region and Section. Figure 118 depicts each Natural Region and Section, located within the Upper Ohio SA, and identified within the Natural Regions of Indiana journal. In addition to the natural communities, the utilization of studies on Indiana’s historic vegetative cover and mapped hydric and partially hydric soils provide further insight into the general location and makeup of the historic aquatic resources that existed before early European settlement initiated their prolonged loss (Table 102). The table details the SA’s estimated land cover percentages for each region and section, identified natural communities, estimated hydric and partially hydric soils, and estimated forest cover.
Upper Ohio Service Area
Natural Regions and Sections

BLUEGRASS NATURAL REGION, MUSCATATUCK FLATS AND CANYONS SECTION
BLUEGRASS NATURAL REGION, SCOTTSBURG LOWLAND SECTION
BLUEGRASS NATURAL REGION, SWITZERLAND HILLS SECTION
HIGHLAND RIM NATURAL REGION, KNOBSTONE ESCARPMENT SECTION
HIGHLAND RIM NATURAL REGION, MITCHELL KARST PLAIN SECTION
SHAWNEE HILLS NATURAL REGION, CRAWFORD UPLAND SECTION
SHAWNEE HILLS NATURAL REGION, ESCARPMENT SECTION

Figure 118. Natural regions and sections within the Upper Ohio Service Area (Homoya, Abrell, Aldrich, & Post, 1985)
Table 102. The historic natural community composition for the Upper Ohio Service Area based upon the natural region and section

**ELEMENT 4. CURRENT AQUATIC RESOURCE CONDITIONS**

**4.1 Streams and Rivers**

GIS analysis of 303(d) category 4A and 5 impaired streams (IDEM-IR, 2016) indicates there are currently zero (0) miles of category 4A impaired streams and 1,269 miles of category 5 impaired streams documented in the SA. IDEM reported E. coli (617 miles), impaired biotic communities (261 miles), PCBs in fish tissue (193 miles), dissolved oxygen (139 miles), nutrients (29 miles), total mercury in fish tissue (22 miles), and dioxin (water) (9 miles) are current stream impairments in the SA (IDEM-IR, 2016). There are stream reaches in which multiple impairments may occur; therefore there is some overlap with the impaired stream miles.

As of 2014, IDEM conducted 249 QHEI assessment reaches within the SA (Table 103 and Figure 119) (IDEM OWQ, 2014). Of the stream and river habitat reaches assessed, 45.38% are capable of supporting a balanced warm water community.
<table>
<thead>
<tr>
<th>QHEI Score Ranges</th>
<th>Narrative Rating</th>
<th>Count</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;51</td>
<td>Poor Habitat</td>
<td>50</td>
<td>20.08</td>
</tr>
<tr>
<td>51-64</td>
<td>Habitat is partially supportive of a stream's aquatic life design</td>
<td>86</td>
<td>34.54</td>
</tr>
<tr>
<td>&gt;64</td>
<td>Habitat is capable of supporting a balanced warm water community</td>
<td>113</td>
<td>45.38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>249</strong></td>
<td></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Table 103. IDEM Overall QHEI scores for Upper Ohio SA, 1991 – 2014 (IDEM OWQ, 2014)

As discussed in the statewide portion of the CPF, the functions and services provided by forests are important to the ecological health of aquatic resources in all portions of the SA that were historically forested. Analysis of the 2011 NLCD indicates that the Upper Ohio SA ranks first overall in forested cover density of all SAs at 53% of total area with approximately 919,827 acres, and is the SA with the second most total forest cover of any SA with approximately 17.64% of the of 5,215,169 acres of forest cover statewide.

GIS analysis identified approximately 3,559,241 linear feet (674 miles) of stream located within 100 feet of agricultural fields. Under these criteria, the Upper Ohio SA has the fourth lowest ratio of restorable stream miles to square miles of SA at approximately 0.25 mile of potential restoration per one square mile, or one mile of potential restoration for every 4.06 square miles of SA.
Upper Ohio Service Area
Qualitative Habitat Evaluation Index (QHEI) Scores

Figure 119. IDEM overall QHEI scores within the Upper Ohio service area; 1991-2014 (IDEM OWQ, 2014)
4.2 Wetlands
Analysis of the NWI in the Upper Ohio SA identifies approximately 2,090 acres of freshwater emergent wetland (PEM) and approximately 13,056 acres of combined freshwater forested (PFO) and scrub-shrub (PSS) wetlands, accounting for approximately 0.9% of the total SA acreage. All of the aquatic resource types from the NWI combined account for approximately 9.7% of the total SA (Table 104 and Figure 120).

<table>
<thead>
<tr>
<th>Aquatic Resource Type</th>
<th>Sum of NWI Aquatic Resource ACRES in SA</th>
<th>Percent of Total NWI Aquatic Resource Acres in SA</th>
<th>Percent of SA Total Acres</th>
<th>Percent of Total State Area – Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freshwater Emergent Wetland</td>
<td>2,090</td>
<td>1.24%</td>
<td>0.12%</td>
<td>0.01%</td>
</tr>
<tr>
<td>Freshwater Forested/Shrub Wetland</td>
<td>13,056</td>
<td>7.73%</td>
<td>0.75%</td>
<td>0.06%</td>
</tr>
<tr>
<td>Freshwater Pond</td>
<td>12,644</td>
<td>7.49%</td>
<td>0.72%</td>
<td>0.05%</td>
</tr>
<tr>
<td>Lake</td>
<td>124,777</td>
<td>73.89%</td>
<td>7.13%</td>
<td>0.54%</td>
</tr>
<tr>
<td>Riverine</td>
<td>16,302</td>
<td>9.65%</td>
<td>0.92%</td>
<td>0.07%</td>
</tr>
<tr>
<td>Grand Total</td>
<td>168,869</td>
<td>100.00%</td>
<td>9.65%</td>
<td>0.73%</td>
</tr>
</tbody>
</table>

Table 104. Acres and percentage of acres of aquatic resource types from NWI analysis (USFWS NWI, 2015)

Hydric and partially hydric soils account for 52,009 acres (Figure 121), or 2.97% land cover within the SA, out of which approximately 43,794 acres have the potential to be restored, accounting for 2.5% of the total SA. This was determined by mapping current hydric and partially hydric soils data (NRCS-USDA, 2016) with potentially restorable land cover types (e.g., cropland, pasture), excluding PFO, PSS and PEM wetlands from the NWI within agricultural land use. The Upper Ohio SA has the lowest percentage of recoverable wetland acres to total SA size of all SAs and the second least amount of potentially restorable wetland acres of any SA.
Upper Ohio Service Area
National Wetlands Inventory

Figure 120. NWI for the Upper Ohio Service Area (USFWS NWI, 2015)
Upper Ohio Service Area
Hydric Soils

Figure 121. Hydric and partially hydric soils within the Upper Ohio Service Area (NRCS-USDA, 2016)
4.3 Concentrations of Potentially Restorable Wetlands and Streams

GIS hotspot analysis was conducted to document concentrations of the identified potentially restorable wetlands and streams. Hotspots account for 25,328 acres of potentially restorable wetlands within the SA. The watershed with the most hotspots of potentially restorable wetlands is Rogers Run-Fourteen Mile Creek (HUC 051401010403 [Table 105]).

Hotspots account for 1,098,240 linear feet of potentially restorable streams within the SA. The watershed with the most hotspots of potentially restorable streams is Highland Creek-West Fork Blue River (HUC 051401040703 [Table 106]). The watersheds with the highest concentrations of potentially restorable streams and wetlands (Tables 4 & 5) serve as the basis of identification of areas that have experienced the most recoverable aquatic resource loss within the SA and are shown in Figure 122.

Versailles State Park is the IDNR-managed land with the most adjacent hotspots of potentially restorable wetlands within the Upper Ohio SA (551 acres). Approximately 1,304 linear feet of hotspots of potentially restorable streams are on IDNR-managed lands. Approximately 4,047 linear feet of hotspots of potentially restorable streams are adjacent to IDNR-managed lands. Harrison-Crawford State Forest is the IDNR-managed land with the most adjacent hotspots of potentially restorable streams (2,266 linear feet).

<table>
<thead>
<tr>
<th>HUC 12 Code</th>
<th>HUC 12 Name</th>
<th>Hotspots of Potentially Restorable Wetlands (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>051401010403</td>
<td>Rogers Run-Fourteen Mile Creek</td>
<td>4,513</td>
</tr>
<tr>
<td>050902030501</td>
<td>Tub Creek-Laughery Creek</td>
<td>4,193</td>
</tr>
<tr>
<td>050902030507</td>
<td>Henderson Bend-Laughery Creek</td>
<td>3,079</td>
</tr>
<tr>
<td>050902030506</td>
<td>Jericho Creek-Laughery Creek</td>
<td>2,573</td>
</tr>
<tr>
<td>051401010402</td>
<td>West Fork Fourteen Mile Creek</td>
<td>2,398</td>
</tr>
</tbody>
</table>

Table 105. Watersheds in the Upper Ohio Service Area with the most hotspots of potentially restorable wetlands

<table>
<thead>
<tr>
<th>HUC 12 Code</th>
<th>HUC 12 Name</th>
<th>Hotspots of Potentially Restorable Streams (linear feet)</th>
</tr>
</thead>
<tbody>
<tr>
<td>051401040703</td>
<td>Highland Creek-West Fork Blue River</td>
<td>62,832</td>
</tr>
<tr>
<td>051401040603</td>
<td>City of Pekin-South Fork Blue River</td>
<td>44,352</td>
</tr>
<tr>
<td>050902030501</td>
<td>Tub Creek-Laughery Creek</td>
<td>43,824</td>
</tr>
<tr>
<td>051401040604</td>
<td>Dutch Creek-South Fork Blue River</td>
<td>35,904</td>
</tr>
<tr>
<td>051401040901</td>
<td>Slick Run-Blue River</td>
<td>35,376</td>
</tr>
</tbody>
</table>

Table 106 Watersheds in the Upper Ohio Service Area with the most hotspots of potentially restorable stream
Upper Ohio Service Area
Concentrations of Potentially Restorable Streams and Wetlands

Figure 122. Concentrations of Potentially Restorable Streams and Wetlands in the Upper Ohio Service Area

Indiana Stream and Wetland Mitigation Program Instrument
**4.4 Lakes, Reservoirs and Ponds**

GIS analysis of 303(d) lake impairments (IDEM-IR, 2016) in the Upper Ohio SA identified one lake currently documented having the category 5 impairment of algae, which measured using the National Hydrography Dataset (NHD) accounts for approximately 73 acres.

The 2011 NLCD identifies approximately 11,332 acres of open water which accounts for 0.65% of the SA. This varies slightly from the NWI, which identifies approximately 12,644 acres of freshwater pond comprising of 0.9% of the SA, and 2,106 acres of lake comprising of 0.12% of total SA acres. There are no PFL's (IC 14-26-2-1.5) located within the Upper Ohio SA. IDNR will remain up to date with reservoir (lake) condition data from sources such as IDEM, the Indiana Clean Lakes Program, watershed management plans, lake associations and the like as the landscape watershed approach is utilized to identify aquatic resource needs within the SA.

**4.5 Ground Water and Surface Water Interaction**

The data presented in this section will help identify potential areas in need of increased ground water recharge and/or identifying sensitive aquifers in need of increased buffering and protection from potential contamination threats.

Analysis of the near surface aquifer recharge rate data from IGS (Letsinger S. L., 2015) for the Upper Ohio SA shows that approximately 96% of the shallow unconsolidated aquifers receive 6 or less inches of ground water recharge annually (Table 107).

<table>
<thead>
<tr>
<th>Recharge Rate</th>
<th>Inches/Year</th>
<th>Square Miles</th>
<th>Percent of Calumet-Dunes SA</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>14</td>
<td>6</td>
<td>0.22%</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>19</td>
<td>0.68%</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>20</td>
<td>0.74%</td>
</tr>
<tr>
<td></td>
<td>11</td>
<td>25</td>
<td>0.93%</td>
</tr>
<tr>
<td></td>
<td>10</td>
<td>13</td>
<td>0.48%</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>5</td>
<td>0.19%</td>
</tr>
<tr>
<td></td>
<td>8</td>
<td>6</td>
<td>0.22%</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>19</td>
<td>0.70%</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>270</td>
<td>9.91%</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>679</td>
<td>24.91%</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>627</td>
<td>22.98%</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>599</td>
<td>21.97%</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>305</td>
<td>11.20%</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>133</td>
<td>4.89%</td>
</tr>
</tbody>
</table>

*Table 107. Approximate ground water recharge rates in the Upper Ohio Service Area (Letsinger S. L., 2015)*
Analysis of the IGS near surface aquifer sensitivity mapping (Letsinger et al., 2015) indicates that approximately 96% of the Upper Ohio SA near surface aquifers are in the high to low range for sensitivity to contamination with 87% in the moderate to low range (Table 108). The aquifer sensitivity reflects the middle to lower range of aquifer recharge rates.

<table>
<thead>
<tr>
<th>Sensitivity</th>
<th>Square Miles</th>
<th>Percent of Total Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very High</td>
<td>85</td>
<td>3%</td>
</tr>
<tr>
<td>High</td>
<td>235</td>
<td>9%</td>
</tr>
<tr>
<td>Moderate</td>
<td>1,176</td>
<td>43%</td>
</tr>
<tr>
<td>Low</td>
<td>1,198</td>
<td>44%</td>
</tr>
<tr>
<td>Very Low</td>
<td>33</td>
<td>1.2%</td>
</tr>
</tbody>
</table>

Table 108. Ground water sensitivity distribution in the Upper Ohio Service Area (Letsinger et al., 2015)

Analysis of the IDNR Division of Water’s Water Rights Section 2015 significant water withdrawal facilities data shows the Upper Ohio SA as the second most registered capacity of surface water withdrawal among SA’s with a 2015 withdrawal capacity of 543,944 MGD (Figure 123) (IDNR DOW, 2016). Energy production and mining accounts for approximately 99% of registered surface water withdrawal capacity.

![Upper Ohio Service Area 2015 Surface Water Use](image)

Figure 123. 2015 surface water usage in the Upper Ohio Service Area (IDNR DOW, 2016)

Significant ground water withdrawal in the Upper Ohio SA is the seventh among SA’s with a 13,654 MGD registered withdrawal capacity (Figure 124). Public water supply accounts for approximately 58% of registered ground water withdrawal capacity in the SA, followed by industrial uses with 34%, energy production and mining with 8%, and agricultural irrigation accounting for the remainder.
4.6 High Quality Aquatic Resources and Natural Communities

In addition to previous eco and natural region descriptions of this SA, other high quality natural communities currently documented in the Natural Heritage Database within the Upper Ohio SA include, but are not limited to, aquatic cave, sinkhole swamp, wet floodplain forest, and flatwoods, in addition to many other transitional, mixed and upland communities.

There are currently a minimum of seven amphibian species, 44 bird species, eight fish species, 17 mammal species, nine mollusk species, and 11 reptile species listed as SGCN within the SWAP Planning Regions within the Upper Ohio SA (SWAP, 2015).

ELEMENT 5. AQUATIC RESOURCE GOALS AND OBJECTIVES

Aquatic resource goals and objectives identified in the statewide CPF also apply to the Upper Ohio SA. The following aquatic resource goals and objectives apply specifically to the Upper Ohio SA based on 404 permitted impact trends, predominant threats, historic loss, currently impaired and high quality aquatic resource conditions, habitats and SGCN, and current and future priority conservation areas. The general amounts of aquatic resources IDNR will seek to provide will depend on ILF credit demand.

1. Restoration, enhancement and preservation of aquatic resources that will offset current and anticipated threats within the SA.
2. Re-establishment of historic aquatic resources that have experienced high concentrations of loss, fragmentation and/or impairment, such as the identified concentrations of potentially restorable streams and wetlands to include any stream channel restoration needs.
3. Implement projects within and adjacent to current and future areas identified as conservation priorities by federal, state and local government entities, and non-governmental organizations (stakeholder involvement/conservation partnerships).
4. Preservation of rare and high quality aquatic resources; critical habitat for rare and endangered species; priority habitat for species of greatest conservation concern; and/or other areas meeting the requirements of 33 CFR §332.3(h).
5. Implement natural stream channel restorations in order to help offset chemical, physical and biological impairments and degradation resulting from anthropogenic activities to include considerations such as in-stream habitat, physical integrity, riparian cover, and/or potential removal or modification of dams.
6. Support critical habitat restoration for federal and state listed SGCN within and adjacent to aquatic resources while applying the SWAP identified conservation needs and actions in the Eastern Corn Belt and Interior Plateau Planning Regions where feasible.
7. Stream and wetland restoration projects to buffer and protect karst features and systems unique to areas in southern Indiana.
8. Implement stream and wetland restoration projects that will improve the water quality and habitat within the Blue River watershed.

**ELEMENT 6. PRIORITIZATION STRATEGY**

The four steps below present the prioritization criteria for mitigation site identification and selection. This prioritization strategy will be used for project selection within each SA. When prioritizing sites for mitigation projects, the following core criteria shall be utilized.

1. Mitigation site proposals must contain the ability to result in a successful and sustainable net gain and/or preservation of aquatic resource functions and services and/or result in no net loss of Indiana’s aquatic resources.
2. Prioritization will be given to compensatory mitigation projects that provide the greatest benefit to the Upper Ohio SA, by providing the greatest lift in aquatic resource functions and services based upon the specific needs identified within the SA and/or watershed utilizing the watershed approach for site selection.
3. Project proposals will consider how to offset the anthropogenic threats to aquatic resources, historic loss, and existing and future impairments while achieving IN SWMP goals and objectives, within the SA.
4. Other prioritization evaluation criteria may include, but are not limited to; cost, feasibility, size, proximity to other conservation lands or protected areas, connectivity or location with respect to corridors, human use value, and efficient long term maintenance.

In addition to the Core Criteria, information from conservation partners, landowners and additional stakeholders may also be utilized during the site selection process as they may have additional data or a pre-existing list of priority restoration projects. Ground investigations will be required to confirm or dismiss these datasets and determine the best locations for compensatory mitigation project sites.
Currently, the following watershed plans exist within the SA: Hogan Creek WMP, Indian Creek WMP, Silver Creek WMP, South Laughery Creek WMP, and Tanners Creek WMP. However, IDNR will utilize the most current watershed planning information that is available as these plans are updated and/or new watershed plans are developed within this SA over the life of the program.

**ELEMENT 7. PRESERVATION OBJECTIVES**

When applicable under 33 CFR §332.3(h) of the Federal Mitigation Rule, preservation objectives within the SA will include rare and high quality natural aquatic and riparian communities, waters having a significant contribution to ecological sustainability, and important habitat for SGCN while addressing the physical, chemical, or biological functions provided to the watershed that address critical conservation needs throughout the service area. Additionally, there will likely be aquatic resource and habitat preservation and/or enhancement opportunities in conjunction with the primary objective of restoration to be determined on a per project basis and approved by the DE.

**ELEMENT 8. PUBLIC AND PRIVATE STAKEHOLDER INVOLVEMENT**

Currently, the following land trusts exist within the SA: Oak Heritage Conservancy, Indiana Karst Conservancy, George Rogers Clark Land Trust, Oxbow, Inc., and Sycamore Land Trust. There is the potential for land trusts to dissolve, adjust their geographical boundaries, and for new land trust organizations to be created within the SA. IDNR will work with the land trusts that exist in the SA over the life of the program.

Additional stakeholders’ interest and potential conservation partnerships specific to the Upper Ohio SA, and in which IDNR is an interested party include, but are not limited to the following organizations and/or initiatives:

- USGS Indiana Water Science Center
- USGS Kentucky Water Science Center
- USGS Ohio Water Science Center
- U.S. Forest Service Hoosier National Forest
- Ohio River Valley Water Sanitation Commission (ORSANCO)
- Appalachian Landscape Conservation Cooperative
- Municipal Separate Storm Sewer Systems (MS4) Communities
- Municipal and County governmental entities
- Active Watershed Groups and appropriate Watershed Management Plans
- River Hills Economic Development District & Regional Planning Commission
- Indiana 15 Regional Planning Commission
- Southeastern Indiana Regional Planning Commission
- Indiana Karst Conservancy
- Oak Heritage Conservancy
- The Regional Council of Governments (OKI)

Currently known public, private and non-profit conservation priority areas as identified by the 2015 IWPP (IWPP, 2015) are shown in Figure 125 below.
Upper Ohio Service Area
High Priority Aquatic Resource Conservation Sites

Figure 125. Priority aquatic resource conservation groups and sites within the Upper Ohio Service Area (IWPP, 2015)
ELEMENT 9. LONG TERM PROTECTION AND MANAGEMENT
Long term protection and management strategies will be conducted in the same manner per SA as outlined in the statewide CPF.

ELEMENT 10. PERIODIC EVALUATION AND REPORTING
Periodic evaluation and reporting on the progress of IN SWMP will be conducted in the same manner per SA as outlined in the statewide CPF.