

FINAL ENVIRONMENTAL ASSESSMENT

FOR THE MISSOURI DEPARTMENT OF CONSERVATION BAT HABITAT CONSERVATION PLAN

U.S. Fish and Wildlife Service
Missouri Field Office
101 Park DeVille Drive, Suite A
Columbia, MO 65203

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List of Acronyms

°C	Celsius
°F	Fahrenheit
APE	area of potential effects
BCRs	Bird Conservation Regions
BEA	Bureau of Economic Analysis
BMP	best management practice
CFR	Code of Federal Regulations
CH ₄	methane
CO	carbon monoxide
CO ₂	carbon dioxide
CSR	Code of State Regulations
CWA	Clean Water Act
EA	environmental assessment
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GHG	greenhouse gas
GIS	geographic information system
HAPs	hazardous air pollutants
HCP	habitat conservation plan
HUC	Hydrologic Unit Code
IPaC	Information for Planning and Consultation
ITP	incidental take permit
ITS	incidental take statement
Ldn	day-night level
MDC or Applicant	Missouri Department of Conservation
MDNR	Missouri Department of Natural Resources
MLRA	major land resource areas
N ₂ O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act

NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act
NLCD	National Land Cover Database
NO ₂	nitrogen dioxide
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NWI	National Wetlands Inventory
O ₃	ozone
OSHA	Occupational Safety and Health Administration
Pb	lead
PBMZ	Priority Bat Management Zones
PM ₁₀ and PM _{2.5}	particulate matter smaller than 10 and 2.5 microns
Service	United States Fish and Wildlife Service
SGCN	species of greatest conservation need
SHPO	State Historic Preservation Office
SNP	Sodalis Nature Preserve
SO ₂	sulfur dioxide
SWAP	State Wildlife Action Plan
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
VOCs	volatile organic compounds
WNS	white-nose syndrome
WQS	Water Quality Standards

1.1 Introduction

Under section 10 of the Endangered Species Act of 1973, as amended (ESA; 16 United States Code [U.S.C.] §§ 1531–1544), state or local governments, private landowners, corporations, or other non-federal entities may be authorized, through issuance of a section 10(a)(1)(B) incidental take permit (ITP), to conduct activities that may result in take of a threatened or endangered species as long as the take is incidental to, and not the purpose of, otherwise lawful activities. Applicants must include in their application a Habitat Conservation Plan (HCP) that outlines measures to avoid, minimize, and mitigate impacts on covered species. As defined in ESA section 3(19), “take” of listed endangered or threatened species means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

The United States Fish and Wildlife Service (the Service or USFWS) received an application for an ITP from the Missouri Department of Conservation (MDC or Applicant) related to the *Missouri Department of Conservation Bat Habitat Conservation Plan* (the HCP, ICF 2022). The Applicant prepared an HCP to address anticipated incidental take of five listed or otherwise at-risk bat species resulting from habitat management on lands owned or managed by MDC and operation and maintenance of MDC facilities and properties. Incidental take of the five bat species also is anticipated from habitat management on private lands MDC supports with technical assistance or funding. The following bat species are the *Covered Species* in the HCP: Indiana bat (*Myotis sodalis*), gray bat (*Myotis grisescens*), northern long-eared bat (*Myotis septentrionalis*), little brown bat (*Myotis lucifugus*), and tricolored bat (*Perimyotis subflavus*). The Indiana bat, gray bat, and northern long-eared bat are federally protected. The little brown bat and tricolored bat currently have no federal protection, but might be listed in the future.

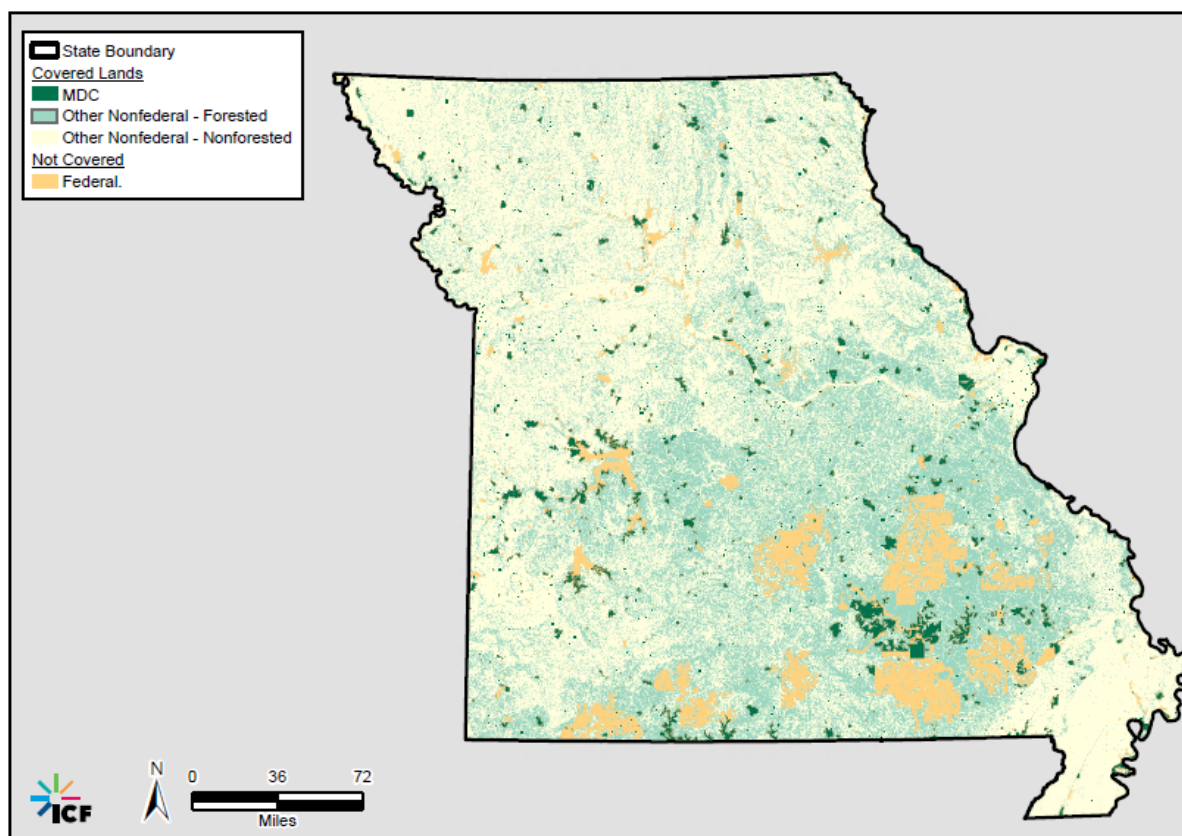
The *Plan Area* for the HCP is defined as the entire state of Missouri and includes areas where conservation activities occur with which MDC is directly involved. The *Covered Lands* are those areas within the Plan Area where take of Covered Species from MDC activities is anticipated to occur. The Covered Lands consist of approximately 42 million acres in two categories: lands owned or managed by MDC (MDC lands) and other non-federal, non-MDC lands where MDC financially supports or provides technical assistance to private landowners to manage fish, forest, and wildlife resources (Figure 1-1). The 42 million acres of Covered Lands consist of 15.7 million acres of forested land that provide potential habitat for the Covered Species. This total includes approximately 178,000 acres of land leased to and managed by MDC on behalf of the United States Army Corps of Engineers (USACE).

Covered Activities are those activities that may result in take and for which take authorization via an ITP is being sought. Covered Activities under the HCP include habitat management, public access and asset management, and HCP implementation. The Applicant manages land for the purpose of promoting fish and wildlife habitat, enhancing and maintaining forest health, and providing recreational opportunities. These Covered Activities may result in impacts that lead to take of the five bat species listed above, as defined under the ESA.

The Applicant proposed an ITP term of 50 years because it provides a foreseeable planning horizon of the effects of forest management activities on species listing, Covered Activities, and for the full

implementation and evaluation of the conservation strategy, including monitoring and adaptive management. Furthermore, the Applicant considered 50 years to allow for a sufficient assessment of many of the effects of the proposed forest management activities on Covered Species, for tracking the implementation of conservation actions, and for tracking the responses of resources to climate change and the uncertainties associated with the spread of white-nose syndrome (WNS) and WNS's effects on bats. Upon expiration of the permit, or to incorporate major revisions during the permit term, MDC may apply to renew or amend the permit and the HCP. MDC may also relinquish the permit prior to its expiration in the event of the extirpation, extinction, or delisting of a Covered Species.

Figure 1-1. Map of Covered Lands



Source: ICF 2022.

The Service prepared this Environmental Assessment (EA) according to the requirements of the National Environmental Policy Act (42 U.S.C. §§ 4321–4370, *et seq.*; NEPA); Council on Environmental Quality NEPA implementing regulations (40 Code of Federal Regulations [CFR] 1500–1508); the United States Department of the Interior's NEPA Procedures (43 CFR 46); and the Service's guidance for compliance with those regulations, including the 2016 *Habitat Conservation and Planning and Incidental Take Permit Processing Handbook* (USFWS and NOAA 2016).

1.2 Proposed Federal Action

The proposed federal action being evaluated in this EA is issuance of an ITP under section 10(a)(1)(B) of the ESA. The ITP would authorize incidental take of the Covered Species from Covered Activities in the Plan Area over the 50-year ITP.

As a condition of an ITP, an applicant must prepare and submit to the Service an HCP containing the following mandatory elements set forth under section 10(a)(2)(A) of the ESA:

- The impact that will likely result from the taking
- The steps the applicant will take to minimize and mitigate such impacts, and the funding that will be available to implement such steps
- The alternative actions to such taking the applicant considered, and the reasons why such alternatives are not being utilized
- Such other measures that the Service (under authority delegated by the Secretary of the Interior) may require as being necessary or appropriate for the purposes of the HCP

Under provisions of the ESA, the Service (under authority delegated by the Secretary of the Interior) will issue an ITP if the application meets the following issuance criteria identified in section 10(a)(2)(B) of the ESA and implementing regulations:

- The taking of the listed species will be incidental.
- The Applicant will, to the maximum extent practicable, minimize and mitigate the impacts of such taking on the species.
- The Applicant will ensure that adequate funding for implementation of the HCP, including procedures to deal with changed and unforeseen circumstances, will be provided.
- The taking will not appreciably reduce the likelihood of survival and recovery of the species wild.
- Other measures required by the Service as being necessary or appropriate for purposes of the HCP will be implemented.

The Service will document its assessment of the ITP and HCP in an ESA Section 10 findings document. If the Service makes the requisite findings, they will issue the ITP; the Service will decide whether to issue the ITP conditioned on implementation of the proposed HCP as submitted or as amended to include other measures the Service determines are necessary or appropriate. If the Service finds that the requisite criteria are not satisfied, they will deny the permit request.

1.3 Purpose and Need

The purpose of the federal action is to fulfill the Service's authority under the ESA, section 10(a)(1)(B), to address the application for an ITP to authorize take of federally listed species for the Applicant's Covered Activities in the Plan Area.

The need for the federal action is for the Service to fulfill these legal obligations in response to an applicant's HCP and request for an ITP. The Service's issuance of the ITP would provide the Applicant with a mechanism to comply with the ESA and provide for the conservation of the Covered Species and their habitat while allowing current and future Covered Activities in the Plan Area where effects that rise to the level of take cannot be avoided. Section 10 of the ESA specifically directs the Service to issue ITPs to non-federal entities for take of endangered and threatened species when the applicant satisfies the criteria in section 10(a)(2)(B). Once the Service receives an application for an ITP, the application is reviewed to determine if it meets the issuance criteria. As part of the application, the HCP must provide the information necessary to obtain an ITP under the ESA, and the EA provides the information necessary under NEPA.

The purpose and need establish the basis for determining whether other viable alternatives to issuing an ITP may meet the intended purpose and reduce potential effects from the ITP. The Service's decision on whether to issue an ITP to the Applicant will be based on the statutory and regulatory criteria of the ESA. In applying these criteria, the Service will analyze the effects of Covered Activities on the Covered Species, as well as the effectiveness of the proposed conservation strategy in avoiding, minimizing, and mitigating impacts on the Covered Species. The Service will make a determination after the public has had an opportunity to comment on the EA and HCP. The Service will document the determination in an ESA Section 10 findings document and ESA Section 7 Biological Opinion developed at the conclusion of the NEPA and ESA compliance processes. Under the ESA, the Service may implement one of the following options in evaluating an application for an ITP under Section 10(a)(1)(B).

- Issue an ITP conditioned on implementation of the HCP.
- Issue an ITP conditioned on implementation of the HCP and other specified measures.
- Deny the ITP application.

The Service will document their NEPA determination at the conclusion of the EA process, by either issuing a Finding of No Significant Impact or a Notice of Intent to prepare an environmental impact statement.

1.4 Public Involvement

The Service published a notice of availability of permit application and request for public comments on the HCP and the Draft EA in the *Federal Register* on September 15, 2021. The HCP and Draft EA were made available to the public, and comments were accepted through October 15, 2021. Two non-substantive comments and two substantive comments were received from the public through Regulations.gov. The Service made only minor editorial revisions to this Final EA. A copy of the notice of availability and comments received on the Draft EIS are included in Appendix D of this Final EA. Copies of the Final HCP and Final EA are available on the Service's "Habitat Conservation Plans in the Midwest Region" website (www.fws.gov/Midwest/endangered/permits/hcp/r3hcps.html), as well as the EA project website (www.mobatnepa.com).

NEPA requires that federal agencies consider a reasonable range of alternatives when evaluating the environmental effects of an action. This chapter describes the alternatives considered in this EA, including the No Action Alternative (Section 2.1), Proposed Action (Section 2.2), and alternatives considered, but eliminated from further consideration (Section 2.3).

2.1 No Action Alternative

NEPA requires that an alternatives analysis include consideration of a no action alternative, which serves as a baseline with which to compare the impacts of the proposed action and any other action alternatives. Under the No Action Alternative, the Service would not issue an ITP for the Covered Activities (i.e., MDC's habitat management, public access and asset management, and HCP implementation). The MDC's mandate to manage land for the purpose of promoting fish and wildlife habitat, enhancing and maintaining forest health, and providing recreational opportunities would remain in place and continue to be subject to the ESA. For the northern long-eared bat, MDC could continue to operate under the existing ESA 4(d) rule, which includes take allowances for certain activities. MDC would continue to avoid affecting Indiana bat and, where this would not be possible, minimize the potential impacts. MDC would continue to have the option to pursue project-by-project incidental take authorization under ESA section 7 (if a federal agency is funding, authorizing, or carrying out the activity) or section 10 for Indiana bat, gray bat, and/or northern long-eared bat (in instances where northern long-eared bat take is not covered by the existing 4(d) rule).

Under this alternative, MDC's habitat management and public access and asset management on the Covered Lands are anticipated to occur at historical levels, with annual Indiana bat take similar to historical averages.¹ Although take authorization for Indiana bat over the last 5 years has varied widely (Table 2-1) and in several years was greater than the estimated annual take under the HCP. MDC has stated that the amount of take that actually occurred under previous authorizations was significantly less than the amount of take the Service authorized. In order to develop an annual take average, part of MDC's take estimate for Covered Species under the HCP is based on a review of MDC's actual Indiana bat take over last 10 to 20 years; MDC added an additional 10 percent to this historical annual average for flexibility. Therefore, Indiana bat take under the No Action Alternative is anticipated to be similar to the Proposed Action, but may be slightly less in some years due to the HCP's 10 percent increase on the historical annual take average. MDC has not previously requested take authorization for the northern long-eared bat or gray bat as they have been able to avoid take of these species to date. However, MDC is no longer able avoid take of these species, and MDC will need take authorization under the No Action Alternative over the next 50 years. Therefore, the Service anticipates that northern long-eared bat and gray bat take under the No Action Alternative would be similar to the Proposed Action.

¹ Note that MDC has not previously needed nor requested take authorization from the Service for northern long-eared bat or gray bat.

Table 2-1. Authorized MDC Indiana Bat Take 2016–2020

Year	Indiana Bat Take (acres)^a
2016	16,179
2017	34,458
2018	47,560
2019	34,099
2020	9,801
Total	142,097

Source: USFWS Weber personal communication.

^a Acres of suitable maternity and non-maternity habitat removed or modified.

In the absence of the conservation activities included in the HCP (see HCP Chapter 5, *Conservation Strategy*), the project-by-project approach to compliance with ESA under the No Action Alternative would result in variable application, or non-application, of the avoidance and minimization measures included in the HCP and eliminate the application of compensatory mitigation. Similarly, the adaptive management approach included in the HCP would be applied variably or not at all.

2.2 Proposed Action

Under the Proposed Action, the Service would approve the HCP and issue a 50-year ITP to the Applicant for incidental take of the Covered Species from the Covered Activities in the Plan Area. The Plan Area, Covered Lands, Covered Activities, and Covered Species are summarized here. A full description of these items is provided in the HCP, which is posted on the “Habitat Conservation Plans in the Midwest Region” website (<https://www.fws.gov/Midwest/endangered/permits/hcp/r3hcps.html>), as well as the EA project website (www.mobatnepa.com). The HCP is incorporated by reference into this EA.

2.2.1 Plan Area and Covered Lands

The *Plan Area* is defined as the State of Missouri and includes all lands necessary for the HCP to be fully implemented, including all areas where impacts, conservation actions, and monitoring would occur. The Covered Lands is subsumed by the Plan Area and includes those areas where the incidental take authorization applies (see Figure 1-1). The Covered Lands consist of approximately 42 million acres in two categories: MDC Lands (those owned and/or managed by MDC) and Other Non-federal Lands (lands not owned by the federal government or MDC where MDC financially supports or provides technical assistance to manage fish, forest, and wildlife resources) (Table 2-2).

Table 2-2. HCP Covered Lands

Ownership Type	Acres^a	% of All Covered Lands
MDC-Owned and Managed Lands ^b	1,024,792	2.4
Other Non-federal Lands	41,419,778	97.6
Other Non-federal Lands—Forested	14,715,955	34.7
Other Non-federal Lands—Non-forested	26,703,823	62.9
Total Covered Lands	42,444,570	–

Source: ICF 2022.

^a Numbers may not sum exactly due to rounding.

^b Includes United States Army Corps of Engineers lands that are managed by MDC.

MDC lands account for approximately 1.02 million acres (2.4 percent) of the Covered Lands. MDC activities may also occur on federal lands owned by USACE and leased to MDC. Through these leases, MDC has authority to manage the lands, including obtaining any necessary state and federal permits to conduct the management. Activities on these MDC-managed lands are covered as MDC activities and are grouped with MDC lands for the purposes of the HCP. Although MDC lands represent a relatively small proportion of the Covered Lands, *the majority of the Covered Activities would occur on MDC lands.*

Other non-federal lands represent most of the Covered Lands (approximately 41.4 million acres or 97.6 percent) and consist of all land not owned by the federal government or MDC. Other non-federal lands are typically owned by corporations, private individuals, nonprofit conservation groups, local government, and private clubs. MDC does not anticipate conducting activities on all, or even most, of the 41.4 million acres of non-federal land in Missouri, but seeks to cover all non-federal lands in the HCP to facilitate current and future opportunities to provide landowner assistance, including cost-sharing and technical assistance, to any interested landowner anywhere in Missouri for the duration of the ITP. All non-federal landowners receiving coverage under MDC's ITP for conducting Covered Activities on non-federal lands would be subject to all requirements of the HCP and the ITP terms and conditions. Of the 41.4 million acres of non-federal lands, 14.7 million acres are forestlands, which is where Covered Activities would be most likely to occur. Although take is more likely to occur in forested land than in open land, some amount of take in open land is likely to occur for the following reasons:

1. MDC removes trees from open lands in order to keep them open. Woody encroachment is a common challenge for MDC when managing open land. Trees removed are primarily small trees, but some of the Covered Species (e.g., northern long-eared bat, tricolored bat) are more generalist and may use smaller trees as roosts.
2. Bats (including Indiana bat) are known to roost in small clusters of trees within an open/agricultural matrix, particularly in northern Missouri, where wooded landscapes are very fragmented. Based on the scale at which habitat is mapped in the HCP, these small woodlots or wooded strips are most likely mapped as open lands.
3. Prescribed fire is an important management tool in grassland habitats, and smoke from prescribed fire may affect adjacent woodland and savanna habitat used by Covered Species.

To address potential take from these types of situations, open lands were included in the HCP, but the amount of take estimated in open lands was calculated separately. HCP Chapter 2, *Covered Lands and Activities*, and HCP Chapter 3, *Environmental Setting*, provide more information about Covered Lands.

2.2.2 Covered Activities

The Proposed Action includes issuance of an ITP for Covered Activities, which are MDC's activities that would result in take of the Covered Species on Covered Lands. The Covered Activities, as documented in the HCP and summarized in this section, include the following three main categories: habitat management, public access and asset management, and HCP conservation strategy. Refer to HCP Chapter 2, *Covered Lands and Activities*, for a detailed description of Covered Activities.

2.2.2.1 Habitat Management

The term *habitat* refers to the various types of foods, cover, and other factors needed by a species to survive and reproduce. Approximately 191 native species of vertebrates (80 breeding birds, 42 mammals, and 69 reptiles) use Missouri's forests, woodlands, and savannas as key habitat for part or all of their lifecycle. Several of MDC's divisions (i.e., Forestry, Wildlife, Fisheries, and Private Land Services) manage forest and other natural land cover types to fulfill habitat management objectives and maintain natural landscapes in the Plan Area.

The HCP groups habitat management into two major categories: prescribed fire and tree removal for habitat restoration and management. *Prescribed fire* is used as a habitat and wildlife management tool. Prescribed fire can be applied to regenerate and improve habitats, increase biological diversity, control invasive or pest species and diseases, improve watershed quality, and improve recreational and hunting opportunities. *Tree removal* includes a range of activities from the targeted removal of single trees to the broad practice of selective timber harvest (silviculture), where new age classes are created by opening the canopy to allow tree growth. With the exception of trees removed to facilitate public access and asset management, tree removal on MDC lands has a designated goal of managing or restoring habitat.

Table 2-3 shows the estimated acres of prescribed fire on MDC lands. Table 2-4 summarizes the estimated amount of tree removal that is expected to occur each year and every 5 years on MDC lands. These estimates of tree removal will function as caps for the ITP. A 5-year rolling cap is proposed to address the reality that the amount of timber harvest completed in a year is influenced by many factors outside MDC's control, including the market for timber. MDC's focus on habitat management results in forestry practices typically being spread evenly (on a per-acre basis) across MDC lands. Over the 50-year ITP term, approximately 3.9 million acres of MDC lands would be affected by prescribed fire and timber harvest.

Table 2-3. Estimated Acres of Prescribed Fire on MDC Lands

Land Cover	Acres Burned Annual Average ^a	Acres Burned 5-Year Average ^a
Forest and Woodland	19,448	97,240
Glades	1,155	5,775
Open Lands	28,009	140,045
Total	48,612	243,060

Source: ICF 2022.

^a Annual acreage based on recorded past activities provided by MDC. Average estimates of acreage used when multiple years of data were provided.

Table 2-4. Estimated Acres of Trees Removed on MDC Lands

Habitat Type	Activity Purpose	Extent of Removal ^a	Annual Average (Acres) ^b	5-Year Average ^b (Acres)
Forests and Woodlands	Allow New Trees to Grow	–	–	–
Forests and Woodlands	Regeneration	Extensive	1,800	9,000
Forests and Woodlands	Shelterwood	Limited	2,000	10,000
Forests and Woodlands	Uneven-age	Limited	4,000	20,000
Forests and Woodlands	Manage Existing Habitat	–	–	–
Forests and Woodlands	Stand Improvement	Limited	13,998	69,990

Habitat Type	Activity Purpose	Extent of Removal ^a	Annual Average (Acres) ^b	5-Year Average ^b (Acres)
Glades	Remove Woody Ingression	Limited	79	395
Open Lands	Remove Woody Ingression	Limited	8,143	40,715
Total	-	-	30,020	150,100

Source: ICF 2022

^a Extensive tree removal removes more than 75% of canopy trees from a forested or wooded landscape while leaving a small residual. Limited tree removal removes less than 75% from a forest or woodland or removes trees from other habitat types.

^b Acreage estimates based on recorded past activities provided by MDC.

The 5-year average was estimated by comparing current harvest levels (based on years 2005–2017) to projected future needs to obtain a future estimate of activity, and then multiplying annual average by 5. Tables 2-5 and 2-6 summarize activities expected to occur on other non-federal lands. Table 2-5 summarizes prescribed fire and tree removal completed under the Missouri Cost Share Program. Table 2-6 summarizes tree removal completed under the Missouri forestry programs.

Table 2-5. Estimated Acres of Wildlife Habitat Restored and Managed on Other Non-federal Lands under Missouri Cost Share Program

Type of Activity	Land Cover	Annual Average (Acres) ^a	5-Year Average (Acres) ^a
Prescribed Fire ^b	Forest/Woodland and Glades	3,437	17,185
Prescribed Fire ^b	Open Lands	4,672	23,362
Prescribed Fire ^b	Subtotal	8,109	40,547
Tree Removal (Limited) ^c	Forest/Woodland and Glades	9,579	47,895
Tree Removal (Limited) ^c	Open Lands	553	2,765
Tree Removal (Limited) ^c	Subtotal	10,132	50,660
Total	-	18,241	91,207

Source: ICF 2022.

^a Acreage estimates based on a number of acres restored/managed in a year by MDC.

^b Prescribed fire total acreage provided and acres in each habitat type estimated based on proportion of activities conducted on MDC lands.

^c Tree removal total and land-cover-specific data are based on recorded past activities.

Table 2-6. Estimated Acres and Type of Timber Harvest on Other Non-federal Lands under State Forestry Programs ^a

Type of Harvest	Extent of Removal	Annual Average (Acres)	5-Year Average (Acres)
Regeneration	Extensive	200	1,000
Shelterwood	Limited	800	4,000
Uneven Age	Limited	3,200	16,000
Stand Improvement	Limited	3,200	16,000
Total	-	7,400	37,000

Source: ICF 2022.

^a Harvest data are provided by MDC and are based on recorded past activities and adjusted based on changes to expected number of future activities.

2.2.2.2 Public Access and Asset Management

Activities associated with public access and asset management are necessary to maintain the infrastructure (e.g., buildings, roads) needed to administer MDC lands and allow for public access. These activities include other tree removal, vehicle operation, and structure demolition.

Other Tree Removal

In addition to removing trees for habitat management, MDC removes trees for construction, maintenance, and repair of facilities. Relatively little of this activity consists of converting potential bat habitat into developed lands. Trees may be permanently removed to allow construction of buildings (e.g., offices, interpretive centers); development of restrooms, boat ramps, roads, and trails; and bank management associated with streams, engineered wetlands, and lakes. Trees might also be removed to allow access for repairs such as roof or heating, ventilation, and air conditioning replacement, levee and dam maintenance, or culvert replacement; however, maintenance activities typically remove young, tight-barked trees (i.e., non-roost trees) from areas where trees have grown since construction. Hazard trees are potentially roost trees, but are only removed when there is a threat to people or property. Table 2-7 below summarizes the estimated amount of tree removal for public access and asset management expected to occur each year and every 5 years. Similar to the estimates provided above in Table 2-4, these estimates of tree removal will function as caps for the ITP. A 5-year rolling cap is proposed to address the reality that the amount of other tree removal in 1 year is not static, but influenced by many factors outside MDC's control.

Table 2-7. Estimated Acres of Other Tree Removal (>9 inches dbh) for Public Access and Asset Management

Impact Type	Annual Average (Acres) ^a	5-Year Average (Acres) ^a
Habitat Converted ^b	10.5	52.5
Habitat Affected (No Conversion)	140.5	702.5
Total	151.0	755.0

Source: ICF 2022.

^a Harvest data are provided by MDC and are based on recorded past activities and adjusted based on changes to expected number of future activities.

^b Habitat conversion occurs when natural landcovers (e.g., trees) are replaced with anthropogenic landcovers (e.g., buildings)

dbh = diameter at breast height

Vehicle Operation

MDC manages 872 miles of roads and 804 miles of trails, which MDC and the general public use to access parts of the conservation lands. Road use includes paved and graveled road area access, access for people with disabilities, and access to levees. Trail access includes use by pedestrians, bicycles, and horseback riding. Additionally, users with mobility-related disabilities are allowed access to MDC trails and field roads using motorized vehicles, which may include all-terrain vehicles, with a special use permit. MDC maintains a 45 mile-per-hour speed limit on all its lands. During vehicle operation, Covered Species may be harmed or killed if they are struck by vehicles. Although this is extremely unlikely, it may occur over the course of the permit term.

Demolition of Structures

Based on MDC data, an average of six structures per year are demolished. This is commonly the result of MDC acquiring a new parcel of land with existing structures. Demolition eliminates

maintenance and liability concerns while returning a developed area back to a natural area. During demolition of structure, there is the potential for take of Covered Species if bats are roosting in or near the structure. Demolition of structures would occur only on MDC lands.

2.2.2.3 HCP Conservation Strategy

The conservation strategy described in the HCP incorporates measures intended to avoid, minimize, and mitigate impacts on Covered Species from Covered Activities such that take is fully offset, an adaptive management approach, and monitoring and reporting requirements. The goal of the conservation strategy is to promote and protect the Covered Species. However, some activities implemented for the HCP have the potential for incidental take of Covered Species. The HCP avoidance, minimization, and mitigation measures are listed in Table 2-8. The full details on the conservation strategy's adaptive management, monitoring, and reporting requirements can be found in HCP Chapter 5, *Conservation Strategy*.

Table 2-8. HCP Conservation Measures

HCP Conservation Measure
1. Maintain and acquire forested lands as part of the MDC system, continue sustainable forestry and habitat management on MDC lands, and protect MDC lands as managed forests that results in the removal of these lands from the development stream.
2. Maintain and acquire open habitats as part of the MDC system, continue habitat management on MDC lands, and protect MDC natural lands that results in the removal of these lands from the development stream.
3. Implement 10,000 acres of prescribed fire on MDC lands in areas that would benefit bats.
4. Continue updating and promoting the Missouri Forest Management Guidelines; develop and implement a communication plan (by year 5) and associated public outreach efforts related to bats, forestry, and WNS; implement the technical assistance and cost-share programs; and incorporate the bat conservation measures described in HCP Chapter 5 into these programs.
5. Snag retention, maternity roost retention, patch retention, den-tree retention, super-canopy tree retention, snag creation, and additional measures as described in HCP Table 5.2 for even- and uneven-aged stand management.
6. Update known roost data per natural heritage database, delineate buffer areas, and implement forestry restrictions within the buffer between April 1 and August 31.
7. Establish 31 PBMZs (28,613 acres). These PBMZs will be focused on maternity colonies and will be distributed as feasible throughout the state. Each species will have a minimum of 7,000 acres of PBMZs, each of which is a minimum of 100 acres. The PBMZs will be managed to benefit the target species by implementing forest management actions to achieve the species-specific habitat conditions described in HCP Appendix F. Within the PBMZs, removal of trees equal to or greater than 9 inches in diameter at breast height will be avoided between April 1 to August 31, and prescribed fires will be avoided between May 1 and July 31.
8. Determine the status of entrances around occupied caves and mines, trim vegetation around entrances, and remove other obstructions as needed, and maintain entrances over time.
9. Implement a 20-acre buffer around the 275 identified caves on MDC lands, within which habitat will be managed to provide old-growth forest conditions; activities associated with this management will be restricted between March 15 and April 30, and September 15 and October 31. In addition, activities within a quarter mile of all hibernacula will be limited to reduce the potential for noise or other disturbance during the winter season. At Level-1 and -2 priority hibernacula for Covered Species, harvest activities will be restricted in the spring and fall within 5 miles. Around the SNP, within 10 miles, harvest activities will be limited to the winter.

HCP Conservation Measure

10. Document sites with existing physical barriers, prioritize sites in need of physical barriers (including those on private lands where opportunity and feasibility allow), install physical barriers at sites without barriers where they are determined to be beneficial, and maintain existing and future physical barriers.
 11. Develop and implement burn plans on modeled habitat during the spring/fall in areas where bats may be present.
 12. Implement seasonal guidelines on tree removal associated with road and trail construction, maintain speed limits, investigate additional speed restrictions near hibernacula, and implement bat-friendly demolition practices.
 13. Require bat-specific training as part of the on-boarding process for new staff.
 14. Develop bat-friendly best management practices and integrate them into the Professional Timber Harvester training.
 15. Develop an updated WNS action plan for MDC.
 16. A provision of technical assistance, permitting, and other collaborative efforts that could help treat WNS.
-

Source: ICF 2022

HCP = Habitat Conservation Plan; MDC = Missouri Department of Conservation; PBMZ = Priority Bat Management Zone; SNP = Sodalis Nature Preserve; WNS = white-nose syndrome

2.2.3 Covered Species

Incidental take coverage would be provided for the Indiana bat, gray bat, northern long-eared bat, little brown bat, and tricolored bat for the Covered Activities. Complete descriptions of the Covered Species are provided in HCP Section 3.5, *Covered Species*, and HCP Appendix A, *Species Accounts*. A brief description of these species is provided in Section 3.8.1.3, *Covered Species*, of this EA.

2.3 Alternatives Considered but Eliminated from Further Consideration

The alternatives considered but eliminated from further consideration would not meet the purpose and need for the federal action.

2.3.1 Shorter Permit Term

The Service considered, but eliminated from detailed analysis, an alternative to approve the proposed HCP and issue an ITP covering a 30-year permit term, rather than approving the Applicant's proposed 50-year permit term. A 30-year permit term would provide long-term take coverage for the Covered Activities, with the exception of some forestry treatments that occur over longer time horizons. Thirty years is likely long enough to realize the benefits of the conservation strategy and monitoring and adaptive management program in providing habitat benefits that could contribute to listed species recovery and help prevent further declines of the non-listed bats. This timeframe also addresses the uncertainty associated with the spread of WNS and the unexpected effects of climate change. However, 30 years may not allow for a sufficient assessment of the impacts of the proposed forest management activities on Covered Species because the full duration of some of the harvest treatments (e.g., stand rotations) can take 50 years or more. As a result, the habitat benefits resulting from long-duration harvest treatments may not be fully evident during a 30-year permit term. Therefore, this alternative was dismissed from detailed analysis in the EA.

2.3.2 Additional Covered Species

The Service considered, but eliminated from detailed analysis, an alternative to cover additional species in the HCP. Several other federally listed species occur or potentially occur in the Plan Area. The Applicant has not proposed these species as Covered Species in the HCP because incidental take of these species from the Covered Activities is not anticipated because these species are either not widespread in the Plan Area, considered extirpated, considered to have accidental or migratory occurrence in Missouri, or will be avoided or permitted separately (see HCP Appendix B, *Species Evaluation*).

The Service decided not to further evaluate this alternative because the Covered Activities are not anticipated to result in take of any federally listed species other than those included as Covered Species in the HCP. If it is determined later that the Covered Activities are reasonably certain to result in take of any federally listed species other than the Covered Species and take could not be avoided, a permit amendment or a separate ITP would be required.

2.3.3 Retain Current Indiana Bat and Northern Long-Eared Bat Buffer Zones

The Service considered, but eliminated from detailed analysis, an alternative to retain current Indiana bat and northern long-eared bat buffer zones. Currently, MDC avoids take of these bats by precluding or minimizing forest management activities around known roost locations during the active season. Avoidance areas are established by creating buffer zones around known roost trees. The maternity roost buffers for the Indiana bat and the northern long-eared bat are 300 acres and 150 feet, respectively. Within these buffers, timber harvesting is prohibited between April 1 and August 31, and prescribed burns are not allowed, as much as possible, between May 1 and July 31, and are completely prohibited during June and July in woodland and forest communities.

Avoiding all timber harvest in the buffer zones between April 1 and August 31 prevents MDC from carrying out its mission with respect to forest health, wildlife management, and habitat restoration, particularly in the northeastern section of Missouri, where roost concentrations are highest. In this part of the state, the unique climate, together with soil type, creates conditions unsuitable for forestry activities in the fall and winter. Soils are highly erodible in this region, and freeze-thaw cycles that occur during the fall and winter months create unstable conditions for safe and effective forestry activities. Soil and weather conditions and seasonal restrictions greatly limit the number of days for timber harvest in the northeast and does not allow MDC to meet its forestry management mandate in the region. The reduction in forest management activities also has negative effects for the Covered Species because the forest management benefits to the Covered Species would not be realized, resulting in a decline in habitat quality and quantity. Because roost densities are greatest in the northeast, this management limitation could have a disproportionate effect on the long-term habitat quality of remaining populations, especially for northern long-eared bat.

Avoiding forest management activities within buffer areas minimizes flexibility and creates uncertainty (regarding the timing and feasibility of certain actions) for MDC forest managers. Increased certainty in forest management is one of the reasons MDC is pursuing an HCP. Further, the buffer zones do not provide protection for little brown and tricolored bats, both of which are Covered Species under the HCP. The conservation strategy, as proposed, provides landscape-level protections for all Covered Species through the development of priority bat management zones in areas of high conservation value throughout the state. For these reasons, this alternative was dismissed from detailed analysis in the EA.

2.3.4 Reduced Prescribed Burns

The Service considered, but eliminated from detailed analysis, an alternative to reduce take by discontinuing prescribed burns. Relative to tree cutting, prescribed burns comprise a smaller proportion of estimated annual take. Also, fewer restrictions and considerations are placed on tree cutting than prescribed burns. Prescribed burns require specific weather conditions, additional agency coordination, and specialized staff, all of which constrain timing and feasibility. To provide the greatest flexibility to forest managers, MDC must maximize their ability to cut trees.

Prescribed fire impacts are relatively low compared to tree cutting, both in terms of the frequency of burns and the number of acres burned. Fire likely results in lower levels of take, as bats can shelter from fire under tree bark. Also, prescribed fires primarily take place in March and April before the pupping season. The timing of fire activities minimizes the potential for take and allows foresters to conduct management before conditions are ready for cutting. Fire also kills smaller trees while leaving the larger, more mature trees that provide habitat for bats. Finally, prescribed fire may kill trees, but those dead trees remain on the landscape as snags and continue to provide habitat for bats for years to come. In fact, fire is documented to create roost trees for bats and improve habitat in many instances (Ford et al. 2016).

MDC currently uses a combination of timber harvest and prescribed burns to fulfill their habitat management mandate. Removing fire as a covered activity would reduce impacts by 46 percent and 17 percent on MDC forested lands and other non-federal lands, respectively, for each bat species and would force MDC to rely only on tree cutting to manage forest ecosystems. Prescribed burns, however, have a disproportionate ecosystem benefit, especially for bats. Covering the full suite of MDC habitat management activities at the preferred extent and frequency would allow managers to better enhance forest conditions for bats. The flexibility in timing of prescribed burning proposed in the HCP would allow MDC to take advantage of favorable environmental conditions and opportunistic burns. Management flexibility increases the potential for achieving conservation goals at the landscape level. For these reasons, this alternative was dismissed from detailed analysis in the EA.

2.3.5 Indiana Bat Only

The Service considered an alternative managing only the Indiana bat under the proposed HCP. Under this alternative, the northern long-eared bat would be managed in accordance with the existing ESA 4(d) rule, which does not prohibit incidental take in certain circumstances. The Plan Area and Covered Lands, Covered Activities, conservation strategies, and monitoring protocol would apply to the Indiana bat as set forth in HCP, and an ITP would be issued only for Indiana bat.

This alternative was eliminated from detailed review for several reasons. Managing take for the northern long-eared bat from the Covered Activities under the 4(d) rule would reduce certainty for MDC should the listing status of the northern long-eared bat change from threatened to endangered. Such a change in listing status would remove the 4(d) rule take exceptions, because 4(d) rules only apply to species listed as threatened. In this case, MDC would either avoid take of northern long-eared bats or engage in project-by-project ESA section 10 or 7 consultations for the species. Managing the northern long-eared bat under the 4(d) rule would preclude implementation of the proposed HCP conservation strategy for this species. For these reasons, this alternative was dismissed from detailed analysis in the EA.

2.3.6 No Take Alternative

Under the no take alternative, MDC would not engage in forest management activities that result in the take of Indiana bat, gray bat, and northern long-eared bat, thereby removing the need for an ITP from the Service. However, MDC conducts forest management activities to meet their legal statutes, strategic goals, and mission statement. The MDC mission statement is to sustain and improve fish, forest, and wildlife resources; enhance the relevance of conservation; connect Missourians with fish, forest, and wildlife resources; and strengthen operational excellence to deliver superior customer service. Through its many duties, MDC fulfills the designation and protection of threatened and endangered species statutes, which are outlined in the Missouri Code of State Regulations (CSR) (Title 3, Department of Conservation, Division 10, Conservation Commission, Chapter 4 – Wildlife Code: General Provisions). In most cases, the goals of MDC are entirely aligned with the need to protect and improve habitat for Indiana bat, gray bat, and northern long-eared bat. However, MDC also has management goals for recreation, public access, and asset management, and the implementation of these goals (e.g., tree removal) may compete or conflict with implementation of bat habitat management goals, particularly in the short term. In addition, activities that provide long-term benefit to bat habitat (e.g., prescribed fire) may have direct, short-term impacts on individual bats. Because forest management activities are necessary for MDC to meet its required mandates, take of Indiana bat, gray bat, and northern long-eared bat can be minimized, but not entirely avoided. Therefore, the no take alternative was dismissed from detailed analysis in the EA.

Chapter 3

Affected Environment and Environmental Consequences

3.1 Introduction

This chapter describes the existing conditions and potential impacts on aspects of the human environment that could be affected by the proposed federal action and a reasonable range of alternatives. The scope of the analysis of the EA is focused principally on the direct and indirect impacts of the proposed Covered Activities anticipated to result in incidental take of the Covered Species. Thus, this EA is more detailed in its analyses of species and species habitats than for other aspects of the human environment, given the direct relationship between issuing an ITP and effects on wildlife species and their habitat. After comparing the range of alternatives, the Service determined that seven components of the environment had the potential to be significantly affected and required additional analyses. These components include air quality, climate change, soils, water resources, biological resources, cultural resources, and socioeconomics and are further described in this chapter.

Each section of this chapter includes a summary of the sources of information used to describe the affected environment and a description of resources within the study area. Unless otherwise noted in each section, the study areas for the EA analyses correspond to the Plan Area (i.e., the State of Missouri). This study area encompasses all lands that could potentially be used for HCP implementation. The description of the affected environments and impact analyses are generally focused on MDC lands and other non-federal, non-MDC lands where MDC financially supports or provides technical assistance to private landowners because this is where the ITP would apply and where Covered Activities would occur.

A basic tenet of the Proposed Action—issuance of the ITP and subsequent implementation of the HCP—is that the Service does not directly authorize the Applicant’s activities that may cause take of Covered Species, only the take resulting from those activities. An ITP from the Service provides an applicant with incidental take authorization under the ESA and requires the applicant to obtain permits from other entities, as necessary. Accordingly, the scope of the analysis of this EA is focused principally on the direct and indirect impacts of the proposed Covered Activities anticipated to result in incidental take of the Covered Species. The potential impacts are discussed at a broad scale to reflect the indirect nature of the impacts, the unspecified locations of the Covered Activities that would occur over the 50-year ITP term, and the geographic breadth of the Plan Area.

This EA does not analyze potential environmental impacts on the following resource areas in detail, for the reasons explained below:

- **Noise and Vibration.** The Proposed Action’s noise sources and levels are not different from the No Action Alternative’s noise sources. Based on the 55 day-night level (Ldn) noise contour associated with United States Environmental Protection Agency (EPA) noise level standards for residences, noise levels from machinery and equipment associated with Covered Activities are

predicted to result in a noise exposure of 55 Ldn² to a maximum distance of 900 feet during daytime hours, or up to 1,600 feet during nighttime hours. This may result in a perceptible increase in ambient noise where receptors exist in these areas. The majority of the Covered Activities are anticipated to occur on MDC lands, which would be unlikely to have residences; some residences could occur near an MDC land boundary where receptors could be within the 55 Ldn contour of a Covered Activity. However, noise from Covered Activities in a given location would be isolated, short-term, intermittent, and cease once work is complete and would likely be surrounded by other forest areas that can act like a buffer to reduce noise. Furthermore, given the nature of the Covered Activities and local noise ordinances, it is likely that the majority of activities would occur during daytime hours. Therefore, Covered Activities are not likely to contribute to ambient noise.

Equipment vibration from Covered Activities would generally be at low levels and only be perceptible within about 50 feet of heavy equipment. This would not cause an adverse effect at sensitive receptor locations. Noise from Covered Activities could affect workers onsite; however, occupational exposure to noise levels in excess of 85 A-weighted decibels requires monitoring and mitigation (e.g., hearing protection) to protect workers. Given that onsite workers would be protected under these Occupational Safety and Health Administration (OSHA) requirements, no adverse noise impacts on workers would be expected to occur.

- **Geology.** Based on the nature of the Covered Activities, ground excavation would be minimal and unlikely to reach depths of geologic formations or would avoid geologic formations if the Covered Activity would create a potential hazard (e.g., landslides, creation of sinkholes/karst formations). Covered Activities are unlikely to occur at rock outcrops and geologically important landforms that have limited potential for timber harvesting and are likely unsuitable for road construction. Therefore, effects on geology would be minimal or avoided.
- **Public Health and Safety.** The primary potential impact on public health and safety related to Covered Activities would include workplace-related accidents during tree removal or demolitions of structures and smoke inhalation and exposure from prescribed fires. Forestry is considered a dangerous industry because of the types of the equipment used and the safety risks involved in their operation. However, employers and workers are legally required to adhere to OSHA regulations and standards regarding worker training and safety procedures and use personal protective equipment (e.g., gloves, leg protection, hearing protection, hard hats, eye protection, respiratory protection, first aid kits onsite). The regulation of open burning in Missouri is found in the CSR, Rules of the Department of Natural Resources, Division 10, Chapter 6, 10 CSR 10-6.045, Open Burning Requirements. Although sub-paragraph (I) on page 48 of the regulations does not specifically mention prescribed burning, is applicable to prescribed burns (Missouri Prescribed Fire Council 2020). The open burning of material associated with agriculture or forestry operations is allowed statewide. If the prescribed burn is within an ozone (O₃) non-attainment area between April 15 and September 15, the Missouri Department of Natural Resources (MDNR) must be notified. Existing MDC Forest Management Guidelines and Best Management Practices (BMPs) (MDC 2014a), such as the consideration of visually sensitive areas, high vehicular traffic areas, residential areas, business areas, and other public use areas prior to prescribed burns would minimize the impacts on public health and safety.

² Ldn is the energy average of A-weighted sound levels occurring over a 24-hour period, with a 10 decibel penalty applied to A-weighted sound levels occurring during nighttime hours between 10 p.m. and 7 a.m.

- **Environmental Justice.** An environmental justice analysis considers the potential of federal actions to cause disproportionately high and adverse effects on low-income or minority populations. The Covered Activities would occur mostly on lands owned and managed by MDC and would not result in high and adverse effects on any population because no environmental justice populations are located on these lands, or where MDC conducts operations to manage fish, forest, and wildlife resources of the state. Therefore, the Proposed Action would not result in disproportionately high and adverse effects on low-income or minority populations.
- **Land Use, Recreation, and Visual Resources.** The MDC has historically performed, is currently performing, and would continue to perform (regardless of the alternative selected) the Covered Activities across the study area. The Proposed Action would not result in any new land use, recreational, or visual conflicts because activities must be consistent with MDC's existing mandates and land management policies. MDC's techniques and approaches used to conduct Covered Activities would not change under the Proposed Action and would only result in insignificant and temporary effects to recreational and visual values.

3.2 Environmental Consequences for No Action Alternative

Covered Activities and associated resource impact types and mechanisms would occur under the No Action Alternative because the Applicant would continue to conduct forest habitat management and public access and assessment management activities on MDC lands and other non-federal lands to fulfill their mandates to promote fish and wildlife habitat, enhance and maintain forest health, and provide recreational opportunities. Because the impacts under the Proposed Action are addressed at a broad scale (except the Covered Species take quantification in the form of habitat impacts), the impact assessment for all components of the human environment under the No Action Alternative becomes a relative statement of impact compared to the Proposed Action. Because the relative comparison does not vary meaningfully for the various components of the human environment and to avoid redundancy in each resource section, the impact assessment for the No Action Alternative is provided here.

Under the No Action Alternative, the Service would not issue the requested ITP for forest habitat management and public access and assessment management activities on MDC lands and other non-federal lands. The Applicant would continue to conduct these activities (i.e., the same activities defined as Covered Activities under the Proposed Action) on MDC lands and other non-federal lands, including avoidance of take of Indiana bat, gray bat, and northern long-eared bat except as provided under the 4(d) rule, or use the inefficient project-by-project ESA consultations to authorize take, through either section 7 (if a federal nexus exists) or through individual project-specific section 10(a)(1)(B) permits. Under the No Action Alternative, the impact mechanisms and types of impacts would be the same as those described for the Proposed Action (i.e., the proposed HCP). However, the timing and extent of impacts (i.e., when the impacts would occur and to what extent) would be different than the Proposed Action because they would occur on a project-by-project basis. The number of projects and amount of activities MDC could accomplish under the No Action Alternative would be similar to the Proposed Action based on MDC's method for estimating take in the HCP, i.e., estimated Indiana bat take is in line with MDC's historical take averages. MDC's inclusion of 10 percent more take added to historical take averages could result in a slight increase in management activities and take under the Proposed Action when compared to the No Action Alternative. Conversely, there may be years under the HCP where Covered Activities and take are less than the

historical management activity and take averages. As such, over the course of 50 years, there may be slightly more or less impacts on all resources under the No Action Alternative compared to the Proposed Action. Therefore, a commensurate reduction or increase in both adverse and beneficial impacts from forest management activities would be expected on components of the human environment when compared to the Proposed Action.

3.3 Reasonably Foreseeable Trends and Planned Actions in the Affected Areas

This section provides a broad scale review of relevant trends or actions that are or could affect the resources potentially affected by the No Action and Proposed Action alternatives. This section examines several broad trends occurring across the Plan Area. The Service focused on regional trends because specific identification or quantification of past, present, and reasonably foreseeable future actions was not feasible given the extensive geographic scope and long timeframe considered for the ITP. A qualitative approach was also preferred because impacts from these trends may occur over different timeframes, cover different footprints, or occur over widely different locations within the Plan Area, making a quantification of impact acreages infeasible. The relevant trends identified include (1) forest management and health, (2) continued wind development, (3) proliferation of WNS, (4) mining, and (5) runoff from agricultural activities. These trends are summarized in Table 3-1.

The Service also considered past and existing ITPs and incidental take statements (ITs) associated with biological opinions for federal actions; proposed non-federal projects for which the Service has received applications for take authorization; and proposed non-federal projects for which applications have not yet been received but that the Service believes are reasonably certain to occur and where the Service can reasonably estimate potential impacts. Current and past ITPs and ITs are listed in Table 3-2. Each of these present or reasonably foreseeable future projects resulted in impacts on the listed species proposed for coverage under the considered alternatives, and mitigation for those impacts was required, intended to ensure survival of the listed species.

The impact types and mechanisms for all resources from the identified trends would be similar to those occurring from the Covered Activities, as described in the environmental consequences sections below. In addition, the Covered Activities' impact types and mechanisms will not differ between alternatives because the Applicant would continue to conduct Covered Activities on Covered Lands as part of their mandates to manage these lands.

Table 3-1. Summary of Reasonably Foreseeable Trends

Trends	Potential Effects
<p>Forest Management and Health (Forest Composition, Structure, and Health). As of 2017, forests cover approximately 15.3 million acres (34 percent) of the total land area in Missouri. The majority of forest land in Missouri (82 percent) is privately owned, while 12 percent is federally owned. State and local government ownership account for the remaining 6 percent of forests in the state (Goff 2018).</p> <p>Forest land has increased steadily since 1972 in Missouri. Land uses in Missouri have changed little in the recent past, with losses in forest lands of less than 1 percent and the area of forested land in Missouri remains stable (Goff 2018). Missouri’s timberland continues to mature exemplified by the area of timberland in the large diameter stand-size class increased by 3 percent between 2012 and 2017 (Goff 2018). Larger and more mature trees are more suitable for use by bats.</p> <p>Across both publicly and privately held forests, a variety of ecological and climatic factors have and will continue to adversely affect forest cover and forest species composition. Extreme weather events and climate change can greatly diminish the habitat suitability for various species including white oak, a dominant species in Missouri, and could cause large scale die-offs and forest species composition changes in Missouri (MDC 2010a). In 2009, for example, one extreme windstorm leveled 113,000 acres of forest in the Ozarks (MDC 2010a). Invasive species, such as emerald ash borer, gypsy moth, and Asian longhorn beetle, are continuing to alter species abundance and forest composition in the state (MDC 2010a). Climatic changes, pest/disease die-off of once-dominant species, and certain cultural practices are causing the replacement of historically dominant tree types, such as red oak.</p> <p>Continued Wind Development. More than a decade ago, wind speeds throughout most of Missouri were not suitable for commercial wind-energy developments with contemporary technology (Missouri Division of Energy 2005). Thus, most wind-energy development in the state is currently restricted to four counties (Atchison, Nodaway, Gentry, and Dekalb) in the state’s northwest corner. However, as available technology changes to facilitate energy generation at lower wind speeds, additional areas of the state are becoming more available to commercial wind energy development. Alternatively, smaller wind turbines (such as those used by farmers or homeowners) can be located throughout much of the state. The operation of commercial wind energy facilities results in the accidental mortality of both birds and bats, including all species HCP covers.</p> <p>White-Nose Syndrome and Take of Listed Bat Species. Since WNS was first discovered in Missouri in 2012, survey efforts indicate species-specific responses; however, once-common species including little brown, northern long-eared, and tricolored bats all have suffered substantial population declines (Colatskie 2017). Also, bats migrate to and from lands from surrounding states, including Arkansas, Illinois, Iowa, Kansas, Kentucky, Nebraska, Oklahoma, and Tennessee, all of which are known to be infected with WNS (whitenosesyndrome.org 2018). The disease has extensive bat mortality in the state, and there is no currently known cure.</p> <p>A variety of completed or reasonably foreseeable requests for incidental take permits for the listed bat species overlap the populations the HCP covers. Granting multiple overlapping ITPs for these species could increase the potential for take levels that adversely affect the species.</p>	<ul style="list-style-type: none"> • Potential increases in forest fragmentation due to private-land timber harvest and development. • Changes in forest cover and forest health due to pests, climate, diseases, and other factors. • Accidental mortalities of individual bats from strikes with turbine blades. • Extensive and ongoing loss of bats due to white-nose syndrome. • Additional granted or ongoing ITP requests for listed bat species increasing overall take.

Trends	Potential Effects
<p>Mining Development Activities Statewide. Although coal mining played a significant role in Missouri’s past leaving approximately 40,000 acres of abandoned mining shafts that Missouri is currently mapping and working to reclaim, the main resources currently being mined in Missouri are metallic minerals (MDNR 2017). Missouri currently is a global leading producer of lead. Missouri also has large deposits of barium and zinc ores that are currently being mined. Three main mining districts are in Missouri: the Southeast Missouri Lead District covering 550 square miles; the Tri-State District covering 2,000 square miles in Missouri, Kansas, and Oklahoma; and the Central District covering 600 square miles (MDNR 2020a). Mining of these resources is expected to continue.</p> <p>Runoff from Agricultural Activities. Runoff from agricultural areas may lead to an increase in sedimentation and other pollutants that may alter the biogeochemical cycling of nutrients in the system and change the wetland ecosystem. In recent years, there has been relatively little change in the amount of farmland and number of farms in Missouri. In 2016, 27.8 million acres of farmland were in Missouri and more than 95,000 farms (MDA 2016).</p> <p>Continuation of Other Permitted Activities on State and Private Lands. Other allowable uses of MDC lands will continue, regardless of implementation of the HCP or granting of an ITP. These activities include:</p> <ul style="list-style-type: none"> • <i>Gas, power line, and other linear right-of-way developments.</i> State agencies grant use of rights-or-way on state lands. • <i>Energy exploration and development.</i> There are three potential areas for oil and gas development and production in Missouri: the Forest City Basin in the northwest, the Lincoln Fold anticline in the northeast, and the Mississippi Embayment in the southeast corner of the state (DOE 2019). Currently, Missouri produces very small amounts of oil and natural gas and, with the exception of a few private natural gas wells, production of natural gas has ceased (DOE 2019). Oil production in 2019 yielded approximately 85,000 barrels (MDNR 2019). • <i>Invasive plant controls.</i> State agencies engage in invasive plant control using herbicides or pesticides to increase regeneration or survival of native species through the control or eradication of invasive plants. • <i>Recreational activities.</i> Various recreational activities occur on state and private lands throughout the year. Specific allowable activities (biking, hiking, hunting, fishing, and use of motorized vehicles) vary by location and agency. 	<ul style="list-style-type: none"> • Potential increase in habitat fragmentation, disturbance, and other environmental impacts from mining infrastructure development on public and private land. • Continuation of current farming trends; increase in sedimentation and pollutants that may affect surface waters and wetland ecosystems. • Potential for forest habitat fragmentation, disturbance, and other environmental impacts from energy and rights-of-way development. • Potential improvement in forest health or forest stand quality from invasive species controls. • Potential wildlife disturbance impacts from recreational activities and energy and rights-of-way development.

HCP = habitat conservation plan; ITP = incidental take permit; MDC = Missouri Department of Conservation

Table 3-2. Current and Past ITPs and Incidental Take Statements for Covered Species in Missouri

Source of Take	Project Name	Species	Duration	Level of Take
HCP	NiSource Multi-Species HCP	Indiana bat, northern long-eared bat	2013–2063	Estimated take is all mitigated.
HCP	High Prairie Wind HCP	Indiana bat, northern long-eared bat	6 years	Estimated take is all mitigated

Source: USFWS 2021a.

HCP = Habitat Conservation Plan

3.4 Air Quality

3.4.1 Affected Environment

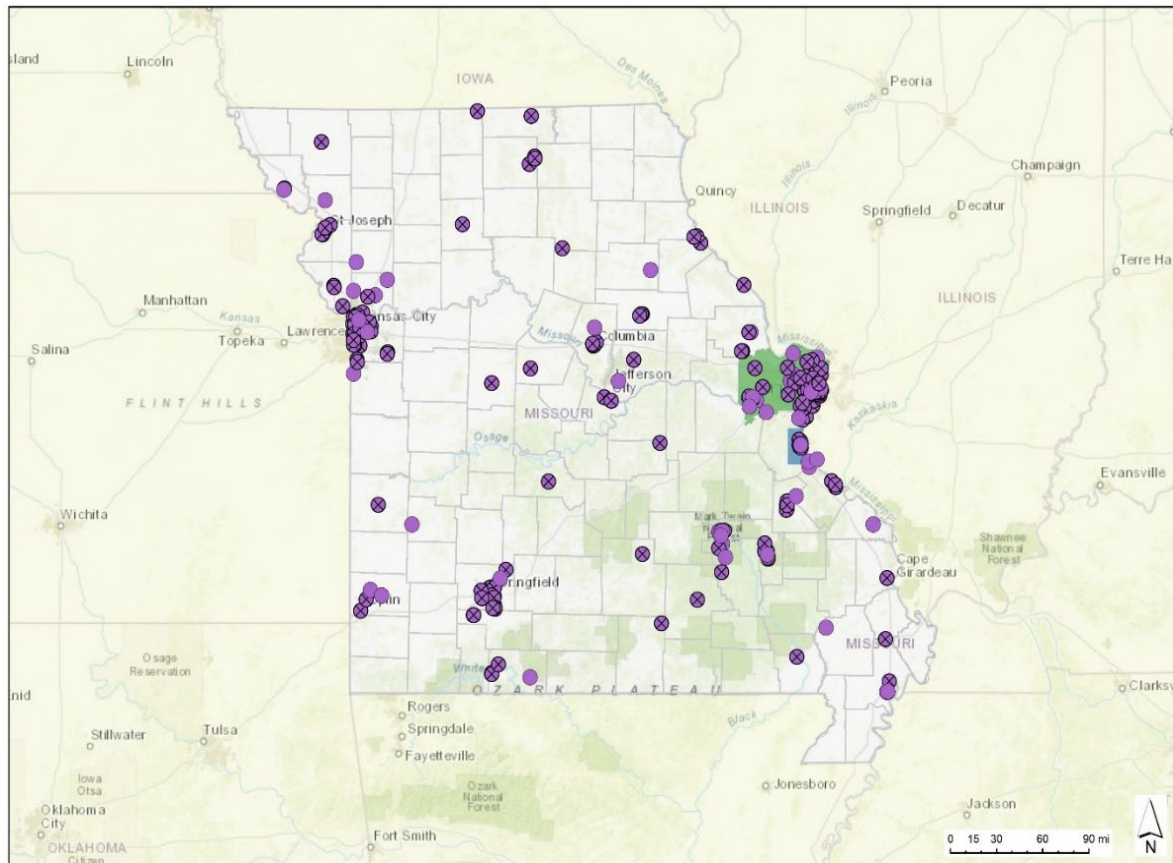
To account for construction and operations-related air emissions that may occur as a result of Covered Activities, the study area for air quality encompasses the Plan Area and includes all nonattainment and maintenance areas that overlap the Covered Lands. EPA has established National Ambient Air Quality Standards (NAAQS) under the Clean Air Act for common pollutants. EPA designates geographic regions as *nonattainment* when measured concentrations of these air pollutants exceed NAAQS for specific pollutants and time periods, and as *attainment* when pollutant levels are less than NAAQS. EPA designates former nonattainment areas that have reduced pollutant levels below NAAQS as *maintenance areas*. Some pollutants, particularly particles emitted by fires, can affect air quality by contributing to regional haze and reduced visibility. The Clean Air Act lists other pollutants known as Hazardous Air Pollutants (HAPs). However, EPA has not set NAAQS for visibility or for HAPs. Existing air quality is characterized in this section by describing NAAQS and indicating the portions of the study area where air quality is of concern, as indicated by those locations designated nonattainment or maintenance.

Air quality conditions are characterized by measuring ground-level ambient (outdoor) pollutant concentrations. Measured concentrations are compared to NAAQS. The most important measured pollutants are the “criteria” pollutants which are those pollutants for which EPA has set NAAQS. Criteria pollutants are air contaminants that have been shown to affect human health and are commonly emitted from a variety of sources and include carbon monoxide (CO), lead (Pb), nitrogen dioxide (NO₂), ozone (O₃), particulate matter smaller than 10 and 2.5 microns (PM₁₀ and PM_{2.5}, respectively), and sulfur dioxide (SO₂). Primary standards are set at levels to protect public health, including the health of sensitive populations (e.g., asthmatics, children, the elderly), with a margin of safety. Secondary standards are set to protect public welfare, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings. MDNR’s Air Conservation Commission has set state standards that are similar to NAAQS and also has set state standards for hydrogen sulfide and sulfuric acid.

The MDNR maintains a number of monitoring stations that measure ambient air pollutant levels throughout the state. Figure 3-1 depicts the locations of air quality monitors for criteria pollutants in the study area. Monitors typically are located in largest numbers where air quality is of greatest concern, primarily major urban areas.

Figure 3-2 indicates that air quality in large portions of the study area is within NAAQS. Most NAAQS exceedances in the study area are for O3 and PM2.5, and are concentrated in the St. Louis metropolitan area. The vast majority of Covered Lands are in attainment and are outside of NAAQS exceedance (nonattainment) areas.

Figure 3-1. Locations of Air Quality Monitors

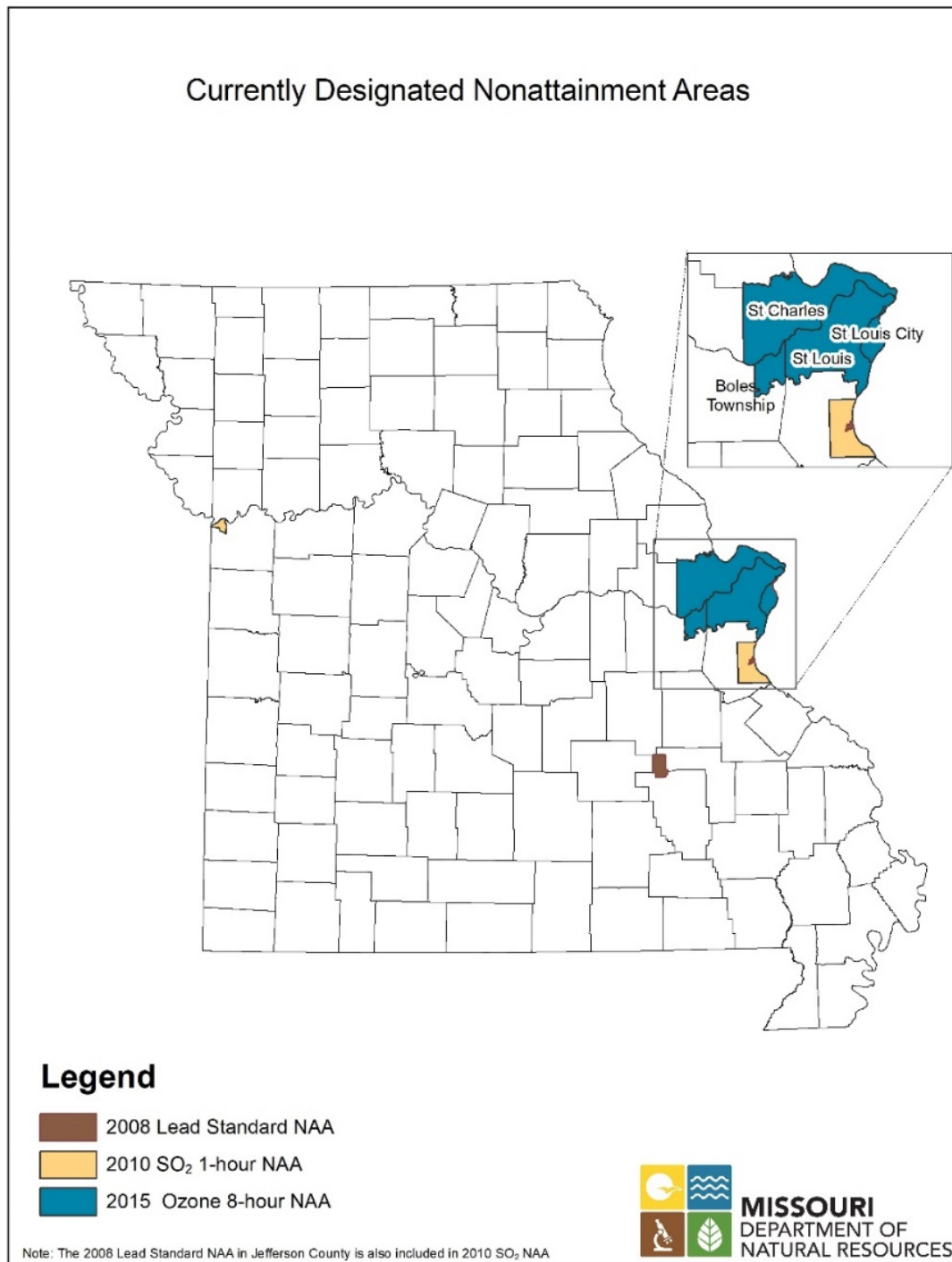


Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri 8/29/2020 4:10:59 PM 3:11:13 PM CDT



Disclaimer: Although this map has been compiled by the Missouri Department of Natural Resources, no warranty, expressed or implied, is made by the department as to the accuracy of the data and related materials. The act of distribution shall not constitute any such warranty, and no responsibility is assumed by the department in the use of these data or related materials.

Figure 3-2. Missouri Nonattainment Areas



Source: MDNR Undated.

3.4.2 Environmental Consequences – Proposed Action

Many human activities cause gases and particles to be emitted into the atmosphere. Air quality impacts are assessed qualitatively, at a broad scale, in terms of typical or anticipated direct, indirect, and cumulative emissions associated with Covered Activities. The analysis describes any anticipated instances where these emissions could lead to a violation of a NAAQS. The analysis describes typical air quality BMPs implemented to reduce the adverse effects of emissions.

3.4.2.1 Emissions Impacts on Air Quality

Covered Activities typically involve the use of various vehicles, heavy equipment, and small equipment (e.g., chainsaws) that emit air pollutants. The quantity of equipment and vehicle usage is expected to be substantially similar to those under conditions in the absence of the HCP. Emissions associated with vehicles and equipment would consist of criteria pollutants, volatile organic compounds (VOCs), and HAPs from engine exhaust, and fugitive particulate matter (e.g., dust) from unpaved roads and disturbed earth surfaces. Effects of these emissions would tend to be localized and specific to the conditions and equipment in use at each site. Because timber harvesting, operations, and road and trail construction maintenance and use would be expected to occur at numerous sites across the extent of the Covered Lands, vehicle and equipment use typically would be short-term at any one location. Emissions would occur intermittently, depending on the work schedule and the specific equipment in use on any particular day. Activities currently occurring on Covered Lands and additional emissions from the Covered Activities under the Proposed Action are not likely to be sufficiently large enough to cause a violation of ambient air quality standards or have substantial impacts on long-term air quality in the region.

Prescribed fires would involve the use of trucks and firefighting vehicles; tractors with plows, mowers, or other attachments; and potentially helicopters. Emissions would consist of the same pollutants as discussed above for the other Covered Activities, but at levels reflecting the amount of equipment and vehicle usage. The largest source of emissions from prescribed fire activities, however, is the combustion of biomass from the prescribed burn. Biomass combustion can emit criteria pollutants, VOCs, and HAPs. Large wildfires (i.e., unplanned ignitions) consume the overstory of a forest and can be relatively large contributors to the total emissions in a region, affect regional haze and visibility, and increase ambient pollutant concentrations in the area near the burn, especially for CO, HAPs, and particulate matter. However, prescribed fires are intentionally kept small and controlled, do not affect the overstory, and do not have many regional effects. As noted in Chapter 2, *Alternatives*, prescribed burns are regularly conducted on Covered Lands and are carried out only under specific conditions designed to minimize impacts on air quality and other resources. Prescribed fires should also follow a Prescribed Fire Plan in accordance with best practices (MDC 2011a; USDA 2008). Therefore, the application of prescribed fire under the Proposed Action is not anticipated to significantly affect air quality.

3.4.2.2 Effects from Conservation Strategy

Implementation of the HCP Conservation Strategy is not anticipated to significantly change emissions in the study area.

3.5 Climate Change

3.5.1 Affected Environment

The study area for climate and climate change encompasses the Plan Area, but is described in the context of the influence of regional and global meteorology and climatic trends. Climate is characterized in this section by describing climate trends and projections globally and for the midwestern United States over a 50-year planning horizon.

3.5.1.1 Greenhouse Gases and Global Climate

Earth absorbs heat energy from the sun and returns most of this heat to space as terrestrial infrared radiation. Greenhouse gases (GHGs) trap heat in the lower atmosphere (i.e., the atmosphere extending from Earth's surface to approximately 4 to 12 miles above the surface) by absorbing heat energy emitted by Earth's surface and lower atmosphere and reradiating much of it back to Earth's surface, thereby causing warming. This process, known as the *greenhouse effect*, is responsible for maintaining surface temperatures that are warm enough to sustain life. Most GHGs, including carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), water vapor, and O₃, occur naturally. Human activities, particularly fossil-fuel combustion, as well as the use of several industrial gases that are GHGs, lead to the presence of increased concentrations of GHGs in the atmosphere, thereby intensifying the warming associated with the Earth's greenhouse effect.

The Intergovernmental Panel on Climate Change (2014) has predicted that the increase of global mean surface temperature by the end of 2100 relative to 1986–2005 is likely to range from 0.3 degrees Celsius (°C) to 4.8°C, which could have substantial adverse impacts on the natural and human environments. This buildup of GHGs in the atmosphere is changing the Earth's energy balance and causing the planet to warm, which in turn affects sea levels, precipitation patterns, cloud cover, ocean temperatures and currents, ocean acidification, polar snow and ice accumulation, and other climatic conditions. Scientists refer to this phenomenon as *global climate change*.

3.5.1.2 Midwest and Missouri Regional Climate

The study area is located in the Midwest Climate Region as defined by the National Climatic Data Center, which includes Illinois, Indiana, Iowa, Kentucky, Michigan, Minnesota, Missouri, Ohio, and Wisconsin. The Midwest is located far from the moderating effect of the oceans and lacks mountains to the north or south, allowing cold air masses from the Arctic and warm, humid air masses from the Gulf of Mexico to overspread the region. As a result, the region experiences wide extremes of temperature and precipitation, and damaging storms can occur at any time of year (NOAA 2013).

Missouri has a continental type of climate with large seasonal variation. Most climatic characteristics in Missouri vary from northwest to southeast. Summer temperatures rise to 90 degrees Fahrenheit (°F) or higher on an average of 40 to 60 days in the west and north and 55 to 60 days in the southeast. Temperatures below zero are infrequent, but on the average occur 2 to 5 days per year in northern counties and 1 to 2 days per year in the southern counties (MCC 2020).

Mean annual precipitation varies from 34 inches in the northwest to 50 inches in the southeast. Precipitation as rain can occur at any time of the year. Thunderstorms are frequent from April through July. Most snow falls in December, January, and February. Average annual snowfall varies from 24 inches in the north to 8 inches in the south (MCC 2020).

All of Missouri experiences "extreme" climate events including, high-intensity rains³, extended drought, heat waves and cold waves, ice storms, windstorms, and tornadoes. These climatic events, in turn, may lead to other environmental disturbances such as floods, fires, landslides, and abrupt changes in plant and animal populations and distributions. (MCC 2020).

3.5.2 Environmental Consequences – Proposed Action

Climate change impacts are assessed qualitatively, at a broad scale, in terms of typical or anticipated direct, indirect, and cumulative GHG emissions associated with the Covered Activities. Where possible, indicators such as changes in acreage affected or types of equipment employed are used to assess potential climate effects. Regulatory agencies have not established specific thresholds for assessment of impacts of GHG emissions under NEPA.

Covered Activities typically involve the use of vehicles and construction and logging equipment that emit GHGs in their engine exhaust. Prescribed burns produce GHG emissions from combustion of biomass, as well as GHGs emitted in the exhaust of vehicles and equipment used to manage the prescribed burn. In addition, forest management practices carried out as part of Covered Activities can influence the amount of carbon that the forest sequesters (absorbs and removes from the atmosphere) and stores in biomass and soil.

3.5.2.1 Release of Greenhouse Gas Emissions

The sources of, and likely changes in, GHG emissions from Covered Activities would be consistent with those discussed for criteria pollutants in Section 3.4.2.1, *Emissions Impacts on Air Quality*. As with criteria pollutant emissions, the levels of GHG emissions from these sources would vary with changes in the amount of equipment usage and the size of prescribed burns. Equipment GHG emissions would be similar to emissions in the absence of implementation of the HCP, would be localized and short term at any one location, and not likely to be sufficiently large to have a noticeable impact on long-term climate change in the region. Additional GHG emissions may occur with the increase in prescribed burns compared to current conditions. However, prescribed fires are intentionally kept small and controlled, do not affect the overstory, and do not have much regional effects. Prescribed burns are regularly conducted on Covered Lands and are carried out only under specific conditions designed to minimize impacts on air quality and other resources. Therefore, the Proposed Action is not anticipated to significantly affect GHG emissions and is not likely to have a noticeable impact on long-term climate change in the region.

3.5.2.2 Carbon Sequestration

The direction and size of changes in carbon sequestration due to Covered Activities would vary depending on the amounts and species of vegetation removed and the amounts and species that regrow, are planted, or are otherwise managed. Potential climate change effects would be expected, depending on the direction and size of the changes in carbon sequestration levels. Trees grow relatively quickly in the early stages of growth and store carbon rapidly. As tree growth slows, so does the rate of carbon sequestration. Trees naturally release carbon throughout their lifecycle as they shed leaves and other materials, which then decay, releasing carbon as CO₂ (EPA 2016). When trees are burned, the combustion process releases CO₂. Logging and fires also lead to increased CO₂

³ For example, the town of Holt in northwestern Missouri holds the world record for a high-intensity rain, having received 12 inches within a 42-minute period on June 22, 1947 (MCC 2020).

emissions due to increased respiration from the exposed soil and decreased plant productivity in the cleared areas (Gelman et al. 2013). When trees are cleared and processed, the impact on carbon storage and CO₂ emissions depends on the end uses of the wood. Covered Activities could increase or decrease the net amount of carbon storage, as well as the capacity of the forest to adapt to future climate change, depending on the specific activity and the characteristics of the forests. However, overall changes in the amount of carbon sequestration are expected to be substantially similar to those under conditions in the absence of the HCP. Therefore, the Proposed Action is not anticipated to significantly affect carbon sequestration on Covered Lands.

3.5.2.3 Effects from Conservation Strategy

Implementation of the HCP Conservation Strategy is not anticipated to significantly change emissions in the study area.

3.6 Soils

3.6.1 Affected Environment

The study area comprises three United States Department of Agriculture (USDA) soil orders: Alfisol, Entisols, and Mollisols. *Alfisols* are the dominate Missouri soil and occur throughout the state. *Entisols* are found in the northwestern portion of the state, adjacent to the Missouri River, and also emanating east from the Missouri River in a contiguous area south of the Iowa border. A small patch of entisols also occurs adjacent to the Mississippi River in the Missouri Bootheel region (far southeast portion of the state). *Mollisols* are found in the far western-central portion of Missouri where tallgrass prairie exists and adjacent to the Missouri River in the northwestern portion of the state. Rich glacial and loessal soils cover Northern Missouri. The bottomlands along the rivers and streams are covered by silts, sands, clays, gravels, and organic matter typical of alluvial soils (USDA-NRCS 2020). The dominant parent material of soils over the study area is composed of residuum from primarily weathered sedimentary bedrock and, to a lesser degree, igneous bedrock.

The soils in the Bootheel region and the northern half of Missouri are very poorly to somewhat poorly drained, and the south has moderate to well-drained soil (USDA ISEE 2015–2020). Clay and sand are the primary soil textures in Missouri (USDA-NRCS 2020). Susceptibility to erosion is an important soil property to consider when assessing potential impacts on soil and adjacent waterways from forest management activities. The NRCS State Soil Geographic Database provides information on soil erosion potential (both water and wind erosion). Approximately 88 percent of Covered Lands have soils classified as low wind erosion potential (NRCS 2020). Approximately 50 percent of Covered Lands have soils classified as moderate and slight water erosion potential and 50 percent as severe and very severe, although very severe is only about 7 percent (NRCS 2020).

The Missouri General Soil Map (USDA-NRCS 2005) shows the broad patterns (associations) of soils in Missouri. Each association is represented by several major and multiple minor soil series in the eleven major land resource areas (MLRA)⁴ of Missouri. Table 3-3 shows the general description of the major soil associations that represent approximately 90 percent of the State of Missouri.

⁴ A *major land resource area* is a geographic area, usually several thousand acres in extent, that is characterized by a particular pattern of soils, climate, water resources, land uses, and type of farming.

Table 3-3. Major Soil Associations of Missouri

Soil Association Soil Order Slope Ranges	Soil Properties and Typical Vegetation	Major Land Resource Area (Representative Soil Survey County)
Bardley–Goss– Gasconade Alfisols and Mollisols 1–100% slopes	Shallow to deep, gently sloping to very steep, well-drained and somewhat excessively drained soils; on uplands. Vegetation: native grass and sparse oak and cedar trees.	Ozark Highland (Benton)
Ocie–Mano– Gateway Alfisols 1–60% slopes	Moderately deep to deep, moderately well-drained soils formed in gravelly slope alluvium and residuum; on narrow ridgetops, shoulders, and back slopes. Vegetation: mixed hardwood, deciduous hardwood.	Ozark Highland (Laclede)
Viraton–Wilderness Alfisols 1–35% slopes	Gently Sloping and moderately sloping, moderately well-drained soil; on uplands. Vegetation: mixed hardwoods	Ozark Highland (Wright)
Gara–Armstrong Alfisols 2–40% slopes	Very deep, moderately sloping to moderately steep, well-drained and moderately well-drained soils that formed in glacial till; on uplands. Vegetation: mixed deciduous trees and tall prairie grasses	Iowa and Missouri Heavy Till Plain (Schuyler)
Carlow–Dockery– Tice Mollisols & Entisols 0–5% slopes	Deep, level, and nearly level, poorly drained soils formed in alluvium; on flood plains. Vegetation: mixed woodlands, mixed hardwoods, deciduous trees, and grasses	Iowa and Missouri Heavy Till Plain (Livingston)
Lamoni–Shelby– Grundy Mollisols 0–40% slopes	Deep, gently sloping to moderately steep, moderate, and somewhat poorly drained soils formed in loess and glacial till; on uplands. Vegetation: tall prairie grasses	Iowa and Missouri Heavy Till Plain (Grundy)
Zook–Nodaway– ColoWabash Mollisols and Entisols 0–5% slopes	Nearly level, moderately well-drained, and poorly drained soils formed in alluvium; on intermediate flood plains. Vegetation: scattered deciduous trees and tall prairie grasses	Iowa and Missouri Heavy Till Plain (Andrew)
Zaar–Liberal–Barden Alfisols and Mollisols 0–20% slopes	Deep, gently sloping, and moderately sloping, moderately well-drained, and somewhat poorly drained soils that have a surface layer of silt loam or silty clay and a subsoil of silty clay or silty clay loam; on uplands. Vegetation: tall prairie grasses	Cherokee Prairies (Vernon)
Parson–Barden Alfisols 0–5% slopes	Deep, somewhat poorly drained and moderately well-drained, nearly level and gently sloping soils of the uplands; formed under grass and shale residuum. Vegetation: tall prairie grasses	Cherokee Prairies (Barton)

Sources: USDA-NRCS 2005, 2020; National Cooperative Soil Survey 2000, 2003, 2004a, 2004b, 2004c, 2006a, 2006b, 2008, 2009a, 2009b, 2011, 2015a, 2015b, 2015c, 2015d, 2016a, 2016b, 2017a, 2017b, 2018a, 2018b, 2019, 2020a, 2020b.

3.6.2 Environmental Consequences – Proposed Action

This analysis describes the primary mechanisms by which Covered Activities could affect soils. The description of potential impact mechanisms is supported by references to pertinent scientific literature, agency reports, and guidance documents. Due to the geographic breadth of the study area and the lack of information on the precise location and timing of future forest management activities, impacts on soils are described qualitatively. Covered Activities could affect soils primarily by altering erosion rates.

3.6.2.1 Erosion

The use of equipment during Covered Activities, particularly tree removal, can disturb and compact soil, leading to increased runoff and soil erosion. Increased erosion can adversely affect soil productivity through loss of soil, organic matter, and nutrients. MDC uses equipment to reduce the potential for these impacts. Soil erosion susceptibility is influenced by many factors, which include the degree of slope, soil type, vegetation, the amount and intensity of rain, and wind velocity, and the degree of erosion is dependent on the interactions between these factors. In general, the clay and sand well-drained Missouri soils are moderately resistant to erosion, but there are soils on Covered Lands more susceptible to water erosion. However, under most conditions, natural and human-caused soil disturbances rebound quickly, and erosion rates decline rapidly. Therefore, use of equipment during Covered Activities is anticipated to have short-term adverse effects on soil but no long-term impact.

Prescribed fires are typically low intensity and low-frequency fires, and the fire effects are limited to the forest floor. Although the use of prescribed fire could increase soil erosion potential in the short term, it could decrease the potential for large wildfires that could result in more severe and long-term increases in soil erosion. Prescribed fire would have long-term improvement on soil organic matter/nutrient pool and limited short-term adverse effects on soil flora and fauna due to loss of organic matter and erosion from exposure of the soil surface to weather and soil compaction depending on the terrain (Forest Encyclopedia Network 2006; Kennard et al. 2008). Short-term erosional impacts from prescribed fires would diminish rapidly with forest regeneration, and soil stability may improve through management activities that promote regeneration of desirable vegetation species.

Public access and asset management Covered Activities would result in limited tree removal to maintain and/or construct roads and trails, which is anticipated to have minimal short-term soil impacts. New impervious surfaces would reduce infiltration and result in long-term adverse effects on soil properties and productivity. However, impervious surface impacts are not anticipated to be significant because of the limited areas that would be affected. The use of heavy vehicles during site clearing, grading, and excavation for new construction would disturb and compact soil. Under most conditions, natural and human-caused soil disturbances rebound quickly, and erosion rates decline rapidly. Management of roads and trails and special-use permitted off-road/trail vehicle use would result in soil compaction and soil loss due to increased erosion; however, these impacts are anticipated to be limited in area and short-term. Limited off-road vehicle use would result in short-term adverse impacts on soil. MDC demolition and removal of structures would have a beneficial impact to soils by returning to the site to a natural state.

Overall, Covered Activities already occur on MDC lands and other non-federal lands, and potential forest management activities under the Proposed Action are not anticipated to significantly change erosion rates or loss of productivity relative to baseline conditions at the scale of the study area.

Covered Activities result in relatively small contributions to soil erosion when compared to other sources and, in the case of prescribed fire and structure removal, are expected to have beneficial impacts on factors that promote soil stability over the long term.

3.6.2.2 Effects from Conservation Strategy

Although most Covered Activities would have short-term adverse, but long-term beneficial impacts on soil, the HCP conservation strategy would prohibit Covered Activities in some areas, resulting in avoiding and minimizing short-term adverse soil impacts. Conservation Measure #7 (in Table 2-8) includes establishing Priority Bat Management Zones (PBMZ) and associated 100-foot protective riparian buffers. Conservation Measures #5 and #9 would ultimately result in no or less ground disturbance in some areas. In the areas where these conservation measures are implemented, soil would not be exposed to the same level of potential impact that could have otherwise occurred under the No Action Alternative.

3.7 Water Resources

3.7.1 Affected Environment

3.7.1.1 Surface Waters

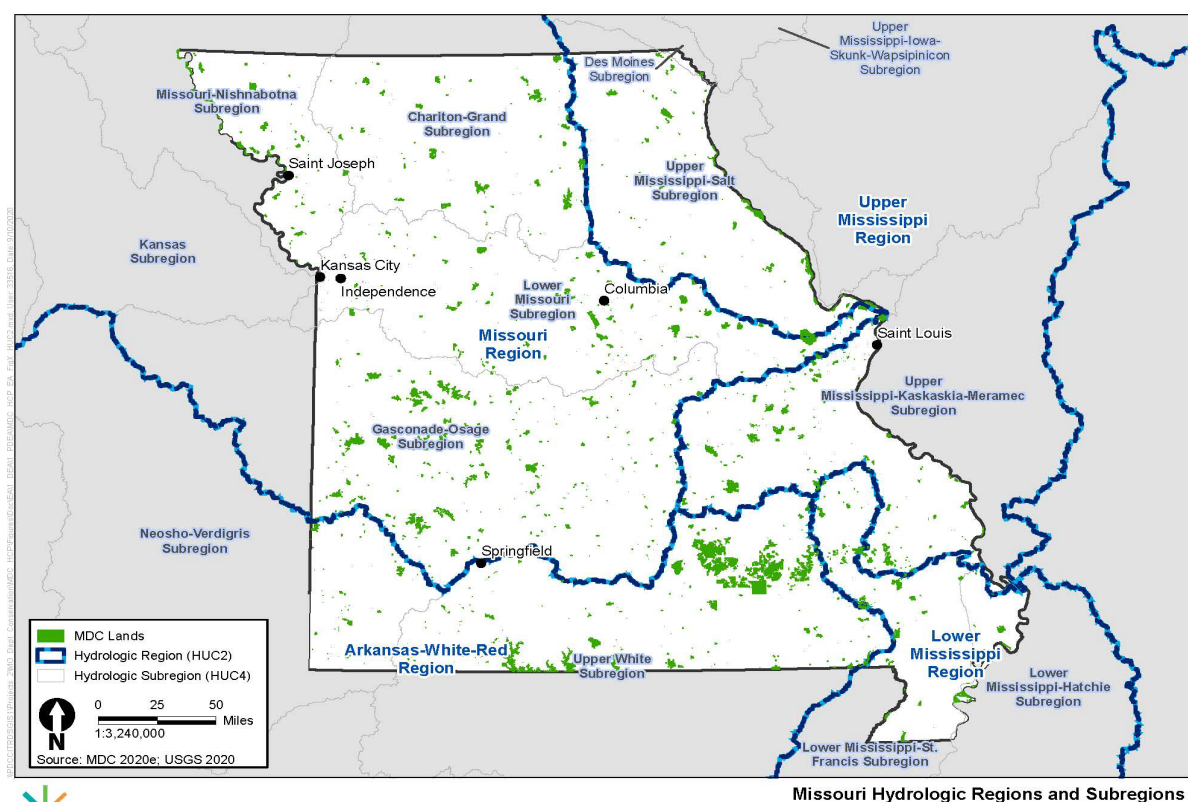
The area of watershed resource regions was determined using geographic information system (GIS) by overlaying the National Hydrography Dataset and Watershed Boundary Dataset (USGS 2020) with the study area. Watershed resource regions and subregions are also known as Hydrologic Unit Codes (HUCs), which are part of a hierarchical system that divides the drainage basins of the United States based on surface hydrologic features. The National Hydrography Dataset is a relational dataset defining the spatial location of the drainage network of surface waters in the United States. From this dataset, the lengths of streams and rivers and the acres of waterbodies (e.g., lakes, ponds, reservoirs) in the study area were summarized.

Existing surface water quality conditions in the study area described using the Missouri Integrated Water Quality Report and section 303(d) List (MDNR 2020b). section 303(d) of the Clean Water Act (CWA) requires states to identify surface waters where pollution control measures are not stringent enough to maintain water quality standards for the designated uses. Surface waters where water quality standards are not met and where designated uses are not supported are listed as *impaired* on the 303(d) list for the state. In order to describe the water quality of surface waters within the study area, the linear miles of streams and rivers and acres of waterbodies included in the Missouri Integrated Water Quality Report and 303(d) list were summarized.

The four major regional watersheds (HUC 2 watersheds) in Missouri are the Upper Mississippi Region, Lower Mississippi Region, Arkansas–White–Red Region, and the Missouri Region. Within these major regional watersheds are 13 subregional watersheds (HUC 4 watersheds), as shown on Figure 3-3. Total acreages of the Covered Lands in the HUC 2 and HUC 4 watersheds are provided in Appendix A, Table A-1. Missouri contains an estimated total of 251,937 miles of rivers and streams and 704,165 acres of lakes and reservoirs (MDNR 2020b). Classified streams and lakes include those waters listed in Tables G and H of Missouri's Water Quality Standards (WQS) at 10 CSR 20-7.031 (MDNR 2020b). Classified waters are given priority under MDNR current water monitoring program. Missouri's classified streams account for approximately 115,701 of the state's total stream miles, and classified lakes account for an estimated area of 321,736 acres of all lakes in the state

(MDNR 2020b). Unclassified streams contribute another 136,236 miles to Missouri's stream network, while unclassified lakes provide an additional 382,429 acres of surface area. Unclassified streams and lakes refer to waters not listed in Tables G and H of Missouri's WQS, but that are still considered waters of the state. Total waters of the state that occur on the Covered Lands (MDC lands and other non-federal lands) consist of 157,373 stream miles and 433,452 acres of lakes (Appendix A, Tables A-1 and A-2).

Figure 3-3. Missouri Hydrologic Regions and Subregions



Missouri Hydrologic Regions and Subregions

MDNR protects surface water for the following designated uses: drinking water supply; human health protection–fish consumption; whole body contact recreation (e.g., swimming); secondary contact recreation (e.g., fishing, wading); aquatic life protection for general warm water and limited warm water fisheries; aquatic life protection for cold water and cool water fisheries; aquatic life protection for ephemeral and modified aquatic habitats; irrigation; livestock and wildlife watering; and, industrial water supply (MDNR 2020b). All of Missouri's surface waters have designated uses for aquatic life, human health protection (i.e., fish consumption), secondary contact recreation, livestock and wildlife watering, and irrigation (MDNR 2020b). Impaired streams, rivers, and waterbodies occur throughout the study area, primarily affecting aquatic life (2,440 miles of streams/ivers and 67,047 acres of lakes), whole body contact recreation uses (1,732 miles of streams/ivers and 0 acres of lakes), and to a lesser extent human health protection–fish consumption uses (945 miles of streams/ivers and 27,072 acres of lakes) (MDNR 2020b). In total, approximately 5,215 stream miles and 180,402 acres of lakes are categorized as impaired by a specific pollutant in the study area. Pollutants most commonly identified include bacteria (165 listings), heavy metals in water or sediment (86 listings), dissolved oxygen (73 listings), and mercury in fish tissue (64 listings). Pollutants most commonly identified include bacteria (142

listings), heavy metals in water or sediment (878 listings), dissolved oxygen (71 listings), and mercury in fish tissue (63 listings). Most common pollutant sources include nonpoint source runoff (urban, rural, or unspecified nonpoint sources), mining-related impacts, atmospheric deposition, municipal wastewater treatment plants and other point sources (MDNR 2020b). Appendix A, Tables A-3 and A-4 provide details on water quality in the study area.

3.7.1.2 Floodplains

Floodplains in the study area were identified using two GIS data sources: the National Flood Hazard Layer database, which contains Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) data (FEMA 2020), and the USDA Natural Resources Conservation Service (NRCS) soil data (NRCS 2019). FEMA special flood hazard areas are mapped by FIRMs for regulatory purposes under the National Flood Insurance Program (NFIP). FEMA special flood hazard areas are also known as *100-year floodplains* and represent areas with a 1 percent annual chance of flooding.

The FEMA FIRM mapping data are not comprehensive of all floodplains because not all communities (e.g., cities/counties) participate in the NFIP, and not all floodplains in participating communities contain insurable structures. Thus, there is no reason for FEMA to map floodplains for NFIP purposes in these areas. NRCS soil data were used to identify flood-prone soils in the study area where FIRM data were not available. The NRCS data are described in terms of the *flood frequency* classification of the soil, which is the number of times flooding occurs over a period of time. The classes described are rare, occasional, frequent, and very frequent (NRCS 2018). FEMA and NRCS GIS data were overlain with the Covered Lands to quantify and describe floodplains on Covered Lands.

FEMA has mapped approximately 5,232,085 acres of 100-year floodplains on Covered Lands (FEMA 2020). The majority of FEMA-mapped areas on Covered Lands are mapped as Zone X, which are outside the 100-year floodplain, but considered to be low to moderate flood risk areas (31,411,213 acres); 56,615 acres on Covered Lands have an undetermined risk (FEMA 2020). Approximately 5 percent of the 100-year floodplains are mapped on MDC lands; 1 percent and less than 1 percent of moderate to low risk and undetermined areas are mapped on MDC lands, respectively. Approximately 37,863,855 acres of flood-prone soils are located on Covered Lands (NRCS 2019). Approximately 3 percent (993,239 acres) of these flood-prone soils are mapped on MDC lands.

3.7.1.3 Wetlands

GIS data from the National Wetlands Inventory (NWI) (USFWS 2020a) were used to identify wetlands and estimate their acreages in the study area. The Service first created the NWI in 1974 to “conduct a nationwide inventory of United States wetlands to provide its biologists and others with information on the distribution of wetlands to aid in wetland conservation efforts.” The description of NWI wetlands is based on a classification system developed by Cowardin et al. (1979), which is used as the federal standard for wetland classification. Cowardin et al. (1979) classifies wetlands using *system* and *class* descriptors. The palustrine wetland system is the main system that occurs in the study area, and the three main wetland classes that occur on Covered Lands include emergent, scrub–shrub, and forested.

NWI maps 265,059 acres of palustrine emergent wetlands and 735,360 acres of palustrine forested/shrub wetlands on Covered Lands (USFWS 2020a). Covered Species could inhabit forested wetlands because of their forested habitat requirements. Approximately 83,261 acres and 652,099 acres of palustrine forested–shrub wetlands are mapped on MDC lands and other non-federal lands,

respectively. Common wetland vegetation includes cattails, bulrushes, bur-reed, arrowheads, sedges, cottonwoods, maples, ash, elm, sycamore, hackberry, and willows (MDC 2010b).

Wetlands are unique landscape features that provide many important ecosystem functions. Some of these functions include surface and subsurface water storage; nutrient cycling; sediment and shoreline stabilization; removal, retention, and transformation of nutrients; and fish and wildlife habitat. As a result of these functions, wetlands can provide measurable benefits to human society referred to as *wetland values*. Values can include protection of property from floodwater, aesthetic or visual quality, recreational opportunities, educational or scientific opportunities, and food production. Functions and values vary among wetlands depending on size, landscape position, and wetland type (USACE 1999).

3.7.2 Environmental Consequences – Proposed Action

3.7.2.1 Surface Waters

Surface water impacts are evaluated at a broad scale because the specific location and timing of Covered Activities are not known. These impacts are qualitatively described by identifying the possible mechanisms associated with the Covered Activities that may affect surface waters. The surface water impact discussion focuses on the Covered Activity impact mechanisms that would occur outside of the surface waters because Covered Activities by definition occur in forested or open areas identified as Covered Species habitat (i.e., where take would occur and the area to which the ITP applies). Potential surface water impacts relate to sedimentation, accidental chemical spills, vegetation removal, and alteration of runoff. Surface water impacts would likely be avoided or significantly minimized through implementation of BMPs contained in MDC's Forest Management Guidelines (MDC 2014a), MDNR Water Protection Program requirements for stormwater, erosion and sedimentation control, spill prevention plans, and other federal, state, and local surface water protection regulations.

Sedimentation and Erosion

The Covered Activities, including tree removal, vehicle operation, demolition of structures, and prescribed fire may result in an increase in sedimentation and erosion into surface waters in the study area. Any ground disturbance associated with the Covered Activities may expose and loosen bare soils and potentially increase sedimentation and erosion into nearby surface waters. The amount of sedimentation into nearby surface waters depends on several factors, including soil type, ground slope, precipitation, and the management practices in place. As discussed in Section 3.6.2.1, *Erosion*, soil erosion susceptibility is influenced by many factors that include the degree of slope, soil type, vegetation, the amount and intensity of rain, and wind velocity. Sedimentation into nearby streams and waterbodies can alter aquatic habitat, increase turbidity, decrease light penetration, and increase nutrient and pollution levels, all of which can degrade water quality and aquatic habitats. Soil erosion is not usually a major impact associated with forest management in most parts of Missouri, except when associated with roads and skid trails (MDC 2014a). Minimizing the number of haul roads and primary skid trails would reduce the chance for erosion and sedimentation to occur. However, these impacts would likely be avoided or significantly minimized by the previously mentioned state and federal requirements for protecting surface waters and water quality.

Potential surface water impacts from prescribed fires include deposition of ash; reduced infiltration; and increased runoff, sedimentation, overland flows, nutrient (i.e., nitrogen, phosphorus, cations, anions) concentrations, and nutrient fluxes (Kolka 2012). It is difficult to generalize the potential

impacts on surface waters in the study area following prescribed fires because previous studies have reported both increases and decreases in the mechanisms previously discussed (Elliott and Vose 2006; Kolka 2012). The potential impacts are highly variable and depend on the location, intensity of the fire, and time of year. Although the potential for adverse impacts exists in the study area, these possible mechanisms have a minor impact following low-intensity prescribed fires (Elliott and Vose 2006; Kolka 2012). Impacts on perennial streams would be avoided or significantly minimized through implementation of MDC guidelines requiring aquatic buffers of appropriate vegetation cover for 100 feet on each side of perennial streams (third order). Additional implementation of MDC's Forest Management Guidelines (MDC 2014a) and associated BMPs to protect soil productivity and water quality when conducting Covered Activities would likely result in minimal impacts on surface waters, and any impacts that do result would be short term.

In summary, forest management activities currently occur on MDC lands and other non-federal lands, and any increase in these activities under the Proposed Action relative to baseline conditions are not anticipated to significantly affect sedimentation and erosion. Potential surface water impacts from Covered Activities would likely be avoided or significantly minimized by the previously mentioned state and federal requirements for protecting surface waters and water quality.

Accidental Chemical Spills

Consistent with current MDC forest management practices on MDC lands and other non-federal lands, construction and maintenance equipment would be used during Covered Activities and could result in spills or leaks of gasoline or hydraulic fluid into the land adjacent to surface waters. Accidental spills that reach surface waters may degrade water quality, kill aquatic organisms or vegetation, or limit the use of waters for drinking or recreation. However, the use of MDC Forest Management Guidelines BMPs (e.g., chemical spill BMPs) (MDC 2014a) would avoid or significantly minimize these impacts. Any potential increase in forest management activities projected under the Proposed Action relative to baseline conditions are not anticipated to significantly affect water quality through accidental chemical spills. Potential impacts from the Covered Activities would likely be avoided or significantly minimized by the previously mentioned state and federal requirements for protecting surface waters and water quality.

Vegetation Removal and Alteration of Runoff and Natural Drainage

Removal of vegetation during Covered Activities has the potential to affect surface waters in the study area. Stream channels are a product of the energy of flowing water (from the slope of the channel), sediment (from the watershed), and water quantity (from climate-watershed interactions). Altering these factors through upland, floodplain, streamside corridor, or channel activities can cause a stream to adjust to form a new balance between energy, sediment, and water quantity (MDC 2014a). For example, tree removal and road construction or maintenance activities conducted without the use of BMPs can result in roads and skid trails that funnel water moving at a high rate of speed, which has energy to erode sediment from the landscape and deposit it directly into the stream. This can result in water quality problems, as well as negative environmental and biological impacts (MDC 2014a). As vegetation is regenerated, stream flows would return to baseline conditions.

Covered Activities also have the potential to affect surface runoff and overland flow patterns. As discussed above, increased sedimentation into surface waters following tree removal and prescribed fires may affect water quality or cause an increase in peak flows. Firebreaks or the construction of roads or trails may compact the soil, resulting in reduced water infiltration and

increased runoff into adjacent surface waters; increases in peak water flows are typically related to the extent of soil compaction.

In summary, Covered Activities already occur on MDC lands and other non-federal lands, and any potential increase in forest management activities under the Proposed Action relative to baseline conditions is not anticipated to significantly affect surface waters. Potential impacts from Covered Activities would likely be avoided or significantly minimized by the previously mentioned MDC guidelines and associated BMPs (MDC 2014a) and state and federal requirements for protecting surface waters and water quality.

Effects from Conservation Strategy

HCP conservation measures that would directly protect surface waters or avoid and minimize ground disturbance and vegetation removal would provide protection to surface waters. Conservation Measure #7 (in Table 2-8) includes establishing PBMZs and associated 100foot protective riparian buffers on streams, lakes, and ponds, which would provide direct protection of surface waters. Conservation Measures #5 and #9 would ultimately result in no or less vegetation removal in some areas, which would decrease the potential for erosion and sedimentation, and altered runoff. Any surface waters in the areas where these conservation measures are implemented would not be exposed to the same level of potential impact that could have otherwise occurred under the No Action Alternative.

3.7.2.2 Floodplains

Floodplain impacts are evaluated at a broad scale because the specific location and timing of Covered Activities are not known. The impacts are described by identifying the mechanisms associated with the Covered Activities that may affect floodplains. Covered Activities may result in floodplain loss, changes to floodplain functions, and decreased floodwater storage capacity.

It is anticipated that floodplains would be largely avoided because Covered Activities must comply with state agency and other regulations regarding avoidance and minimization of impacts on surface waters, i.e., buffer requirements and erosion and sediment control (these requirements are discussed in more detail in Section 3.7.2.1, *Surface Waters*). In addition, any activity that would fill a FEMA-mapped floodplain would need to comply with FEMA NFIP requirements.

Floodplain Degradation and Decreased Floodwater Storage, Conveyance, and Retention

Any Covered Activity that disturbs land could affect floodplain function, including tree removal and timber harvest (e.g., vegetation removal); road construction or maintenance; and prescribed fires. These activities could result in permanent loss or alteration of floodplain area or function, such as changing floodwater storage and conveyance capacity, erosion and sedimentation potential, and available aquatic habitat.

Construction of roads, trails, or other structures could interfere with the storage and passage of floodwater as well as the infiltration of water into the soil. A decrease in floodwater storage capacity may result in direct, short- and long-term increases in floodwater levels downstream. Road, trail, or other structure construction may also result in redirection of floodwaters, potentially causing erosion in adjacent areas. Any impervious surface would impede infiltration, but gravel roads and trails would still have some water infiltration capacity.

Removal of vegetation (i.e., timber harvest or tree removal) would affect the ability of a floodplain to retain and absorb floodwaters. Dense vegetation has a higher capacity to retain floodwaters; thus, vegetation removal could potentially lead to increased floodwaters downstream, runoff, or erosion. Removal of floodplain vegetation would also reduce the floodplain's capacity to filter sediment, pollutants, and nutrients in water, which could affect water quality (FIFMTF 1996).

In summary, Covered Activities already occur on MDC lands and other non-federal lands, and any potential increase in forest management activities under the Proposed Action relative to baseline conditions is not anticipated to significantly affect floodplains. Potential impacts from the Covered Activities would likely be avoided or significantly minimized by the previously mentioned MDC guidelines and associated BMPs (MDC 2014a) and state and federal requirements for surface waters that would concurrently protect many floodplains (refer to Section 3.7.2.1, *Surface Waters*).

Effects from Conservation Strategy

The HCP conservation strategy would avoid, minimize, and mitigate impacts from Covered Activities on floodplains for similar reasons described above in section 3.7.2.1, *Surface Waters*.

3.7.2.3 Wetlands

Wetland impacts are evaluated at a broad scale because the specific location and timing of Covered Activities are not known. Because the locations of future forest management activities are unknown, general assumptions are made concerning potential effects on wetlands. Any forested wetland that is identified as potential Covered Species habitat would be most affected by the Covered Activities because that is where take would primarily occur, and the ITP applies. Other non-forested wetlands could be indirectly affected (similar to surface waters) where Covered Activities affect Covered Species' forest habitat near non-forested wetlands. Although it is possible for the Covered Activities to affect wetlands, it is likely that the MDC would avoid most wetlands to comply with federal and state regulations, such as CWA section 404. If a particular Covered Activity required filling jurisdictional wetlands in excess of the allowance under a CWA section 404 Nationwide Permit, the MDC must obtain an Individual Permit from USACE, which requires NEPA compliance.⁵ Under section 404 of the CWA, compensatory mitigation would be mandatory to offset the loss of wetland functions and values.

Alteration or Loss of Wetlands and Wetland Functions

Covered Activities could alter or result in loss of wetland habitat, water quality, and hydrology functions. Permanent fill placement in wetlands would permanently remove these wetland functions, causing a loss of wildlife habitat and loss of capacity to filter pollutants and retain stormwater and floodwater flows in the watershed. If a wetland is partially filled (e.g., road construction or reconstruction) or if vegetation is cleared, there could be an interruption and alteration in a wetland's natural hydrological regime and habitat structure, resulting in draining or impounding water, which can affect vegetation (e.g., wetter conditions changing species composition), fragmenting of habitat, change in pollutant filtering, and runoff retention. For example, if a wetland is impounded due to a road embankment, water circulation would decrease and result in stagnation and altered water quality (e.g., increased water temperature). If a wetland's

⁵ By definition, Nationwide Permits only authorize activities that have minimal individual and cumulative adverse effects on the aquatic environment (77 FR 10184–10290). Nationwide Permits have already gone through the NEPA process.

vegetation is cleared, there would be an expected shift in wetland type (e.g., forest to scrub–shrub or emergent) and changes in wetland functions (e.g., changes in wildlife habitat or reducing vegetative coarseness, which may decrease a wetland’s ability to slow down and retain stormwater).

Sedimentation and chemical spills can also adversely affect wetland water quality in similar ways and by similar mechanisms as described above in Section 3.7.2.1, *Surface Waters*.

Heavy equipment used for Covered Activities could result in rutting and compaction as wetland soils generally have low weightbearing capacity, making them more susceptible to rutting and compaction compared to upland soils (MDC 2014a). In addition, it is common for water to move through the soil near the surface. Changes like rutting can interfere with water movement and result in vegetation changes and reduced wetland function, which can affect the health of the wetland ecosystem and the functions it performs. MDC’s Forest Management Guidelines wetland BMPs (MDC 2014a) are designed to prevent erosion, minimize changes to the surface and below-surface water movement, and strengthen or increase the weight-bearing capacity of the soil. In addition to federal regulations, measures to avoid and minimize wetland impacts would include implementing wetland protection standards, guidelines, and BMPs found in MDC’s Forest Management Guidelines (MDC 2014a). As a result, the Covered Activities would avoid or significantly minimize the identified potential impacts on wetlands, and are not anticipated to significantly affect wetlands.

In summary, Covered Activities already occur on MDC lands and other non-federal lands, and any potential increase in forest management activities under the Proposed Action relative to baseline conditions is not anticipated to affect wetlands significantly. Potential impacts from Covered Activities would likely be avoided or significantly minimized by the previously mentioned MDC guidelines and associated BMPs (MDC 2014a) and state and federal requirements for protecting wetlands.

Effects from Conservation Strategy

The HCP conservation strategy would avoid, minimize, and mitigate impacts from Covered Activities on wetlands for similar reasons described above in Section 3.7.2.1, *Surface Waters*. In addition, Objective 1.2 of the HCP conservation strategy and associated Conservation Measure #2 (Table 2-8) commits MDC to managing open areas, such as prairies, old fields, and emergent wetlands that compliment forested habitat to bats, which would have beneficial impacts on these wetlands that may have otherwise not occurred under the No Action Alternative.

3.8 Biological Resources

3.8.1 Affected Environment

3.8.1.1 Vegetation

Existing Conditions

Ecological classifications categorize biophysical features based on vegetation type, geology, hydrology, and physiographic features. The Missouri Ecological Classification System was used to identify, map, and describe the study area into areas with similar physical and biological characteristics (Nigh and Schroeder 2002). Vegetation communities within the study area are characterized and mapped using the 2011 National Land Cover Database (NLCD (Homer et al. 2015)).

The Covered Lands were superimposed over the NLCD to identify and quantify land cover types. Forested cover types are further characterized at the state level using United States Forest Service Forest Inventory and Analysis Program data (Goff 2018). Invasive plant information for the study area was obtained from the Missouri Department of Agriculture (MDA 2020) and MDC (MDC 2020a). Protected plant species are considered special-status species and are discussed in Section 3.8.1.4, *Special Status Species*. Wetland vegetation is described in Section 3.7.1.3, *Wetlands*.

Ecological Classifications

Ecological classification divides large landscapes into units based on physical or biotic factors, such as soils, climate, hydrology, geology, plant communities, and wildlife habitat. There are four general Ecological Classification sections in the study area (Nigh and Schroeder 2002):

- **Mississippi Alluvial Basin Section.** Formerly a forested swamp filled with bald cypress, sweet gum, and associated wetland plants. Major natural habitats are swamp, bottomland forest, upland sand prairie, and woodland. Located in the southeastern portion of the state.
- **Osage Plains Section.** Unglaciaded prairie historically a tallgrass prairie. Major natural habitats are grassland, broken prairie/woodland landscape, and floodplain forest/wetland. Located in western-central Missouri.
- **Ozark Highlands Section.** Western extension of a large deciduous forest. Major natural habitats include forest, woodland, caves and karst, rivers, and streams. Located in central and southern Missouri.
- **Central Till Plains Section.** Moderately dissected glaciaded plains that slope toward the Missouri River and Mississippi River. This area is covered with Pleistocene loess over glacial till. Major natural habitats are primarily grassland and woodland, but also contain floodplain wetland and forest and prairie streams. Located generally in the northern portion of the state.

Vegetation Cover

The NLCD is a large-scale, public domain collection of satellite imagery and derived supplementary datasets used for environmental, land management, and modeling applications. The 15 land cover types in the NLCD were aggregated into high-level groupings: forest and woodland, barren/glades, open lands, open water, and developed (Table 3-4).

The *Forest and Woodland* cover type varies in composition throughout the study area (Table 3-4). The Ozark Highlands in the central and southern portion of the state contain large, forested areas. Riparian forest corridors are present in the Osage Plains, Northern Plains, and Mississippi Alluvial Basin; however, they are not as extensive as those found in the Ozark Highlands.

The *Barren/Glades* cover type is found generally in the Ozark Highlands in the southern portion of Missouri in small, patchy areas where the surficial limestone and/or igneous rocks outcrops are highly weathered. This cover type is generally comprised of exposed bedrock with shallow soils that support drought-adapted forbs and grasses.

The *Open Lands* cover type is the aggregate of cultivated crop areas and grasslands/herbaceous cover types that are generally found in the Osage and Dissected Till Plains in northern and western-central Missouri and in the Mississippi Alluvial Basin in southeastern Missouri (Table 3-4). This cover type additionally includes savannas, which are grasslands with scattered trees.

The *Open Water* cover type include streams, rivers, and lakes with less than 25 percent of vegetation cover (Table 3-4). This covered type is distributed throughout the study area.

The *Developed* cover type has some degree of human presence or disturbance, and ranges from high-intensity development to open space (Table 3-4). Generally, these areas contain impervious surfaces that cover 20 to 100 percent of the total land area. Vegetation in these cover types is characterized by lawns, parks, or other plantings.

Table 3-4. Aggregated NLCD classes and Acreage on Covered Lands

NLCD Aggregated Categories	NLCD Land Cover	Acres on MDC Lands	Acres on Private Lands	Description
Forest and Woodland	Deciduous Forest	599,131	13,040,781	Forest with greater than 75% cover of deciduous trees
Forest and Woodland	Evergreen Forest	25,005	451,617	Forest with greater than 75% cover of evergreen trees
Forest and Woodland	Mixed Forest	27,620	432,185	Forest with neither deciduous nor evergreen species accounting for greater than 75% of total tree cover
Forest and Woodland	Woody Wetlands	84,495	644,202	Forest or shrubland with greater than 20% cover of vegetative cover with semipermanent or permanent floodwaters.
Forest and Woodland	Shrub/Scrub	6,862	189,658	Dominated by shrubs with shrub canopy greater than 20% of total vegetation. Includes true shrubs and young or stunted trees
Barrens/ Glades	Barren Land (Rock/Sand/Clay)	2,443	59,863	Barren areas of bedrock, scarps, strip mines, talus, slides, glacial debris, volcanic material, gravel pits, and other accumulation of earthen material. Vegetation accounts for less than 15% of land cover.
Open Lands	Cultivated Crops	97,428	9,301,198	Predominantly cropland including row, close-grown, forage, and perennial woody crops. Crop vegetation accounts for greater than 20% of total vegetation.
Open Lands	Grasslands/ Herbaceous	23,094	628,647	Predominantly graminoid or herbaceous vegetation, generally greater than 80% of total vegetation
Open Lands	Pasture/Hay	58,785	13,140,272	Grasses, legumes, or grass-legume mixtures planted for livestock grazing or production of seed/hay crops. Pasture vegetation accounts for greater than 20% of total vegetation.

NLCD Aggregated Categories	NLCD Land Cover	Acres on MDC Lands	Acres on Private Lands	Description
Open Lands	Emergent Herbaceous Wetland	31,883	88,082	Perennial herbaceous vegetation accounts for greater than 80% of vegetative cover with semi-permanent or permanent floodwaters.
Open Water	Open Water	42,704	437,976	All areas of open water, generally with less than 25% cover of vegetation or soil
Developed	Developed, High Intensity	46	101,492	Non-vegetated, impervious surfaces dominated by streets, parking lots, buildings. Impervious surfaces account for 80–100% of total cover.
Developed	Developed, Medium Intensity	276	255,267	Mixture of vegetated urban environments and constructed materials. Impervious surfaces account for 50–79% of total cover.
Developed	Developed, Low Intensity	2,529	822,788	Mixture of vegetated urban environments and constructed materials. Impervious surfaces account for 20–49% of total cover.
Developed	Developed, Open Space	22,369	1,822,871	Predominantly vegetated urban environments with some constructed materials. Impervious surfaces account for less than 20% of total cover.

Source: Homer et al. 2015.

MDC = Missouri Department of Conservation; NLCD = National Land Cover Database

Forest Types

Forest cover in Missouri currently remains at approximately one-third of the overall land area with the most heavily forested areas located in the southeastern and south-central parts of the state (Goff 2018). Prior to European settlement, forests comprised approximately 70 percent, or 31 million acres, of Missouri. In the late nineteenth and early twentieth centuries, Missouri was one of the leading timber-producing states in the United States. By the time of the first forest inventory in 1947, forestland area had declined by about 50 percent, and since then, forest cover in the state has varied greatly. In spite of periodic fluctuations over the past 70 years, essentially one-third of Missouri has remained forested.

Table 3-5 includes overall acreages of general forest-type groups in Missouri. These forest types are further detailed in Chapter 3, *Environmental Setting*, of the HCP. The oak/hickory forest type comprises approximately 80 percent of the total forested area of Missouri. The next most common forest type in the state is elm/ash/cottonwood, comprising 7 percent of the total forested area of the state. The most common tree species in the state is eastern red cedar (Goff 2018; Piva and Treiman 2017). The number of red cedar trees increased by 4 percent from 2012 to 2017. The number of white oak (*Quercus alba*) trees has decreased by 3 percent since 2012; however, it continues to be the most dominant species based on volume (increased by 1 percent since 2012). According to Goff (2018), more than half of Missouri's 21.4 billion cubic feet of live tree volume on forestland

constituted white oak and four other species: black oak (*Q. velutina*), post oak (*Q. stellata*), shortleaf pine (*Pinus echinata*), and northern red oak (*Q. rubra*). Net volume increased on both forestland (2.8 percent) and timberland⁶ (2.7 percent) from 2012 to 2017. Annual net growth of growing stock exceeded removals on timberland for all the major species groups in Missouri for this same period, whereas mortality for several dominant oak species was particularly high. As a consequence of higher mortality rates, average annual removals decreased for white oak (17 percent) and black oak (43 percent) during this time (Goff 2018).

Table 3-5. Forest-Type Groups and Forest Types in Missouri

Forest-Type Group	Thousands of Acres
White/Red/Jack Pine	3.9
Loblolly/Shortleaf Pine	269.8
Other Eastern Softwoods	365.8
Exotic Softwoods	0.7
Oak/Pine	907.6
Oak/Hickory	12,307.6
Oak/Gum/Cypress	153.9
Elm/Ash/Cottonwood	1,134.0
Maple/Beech/Birch	97.2
Other Hardwoods	42.1
Exotic Hardwoods	3.0
Nonstocked	60.8
Total	15,346.3

Source: United States Forest Service 2017.

Invasive Plant Species

The state of Missouri identifies noxious weeds as those that cause economic harm to the state's agriculture industry and are difficult to eradicate or control. There are 12 noxious weed species on the Missouri Noxious Weed List (MDA 2020). The MDC also maintains a list of nuisance or problem plant species. This list includes native plants that can become nuisances and nonnative invasive species that may harm agriculture or wildlife habitat. Table 3-6 includes invasive and noxious plant species identified by the state of Missouri.

Table 3-6. Invasive and Noxious Plant Species in Missouri

Common Name	Scientific Name
Autumn olive	<i>Eleaagnus umbellata</i>
Beefsteak plant	<i>Perilla frutescens</i>
Black locust	<i>Robinia pseudoacacia</i>
Bush honeysuckles	<i>Lonicera maackii</i> and <i>Lonicera x bella</i>
Callery pear	<i>Pyrus calleryana</i>
Canada thistle*	<i>Cirsium arvense</i>

⁶ Timberland is defined as forestland that is producing or is capable of producing crops of industrial wood and not withdrawn from timber utilization by statute or administrative regulation.

Common Name	Scientific Name
Cattail	<i>Typha</i> spp
Caucasian bluestem	<i>Bothriochloa bladhii</i>
Chinese yam	<i>Dioscorea oppositifolia</i>
Common buckthorn	<i>Rhamnus cathartica</i>
Common reed	<i>Phragmites australis</i>
Common teasel*	<i>Dipascus fullonum</i>
Coontail	<i>Ceratophyllum demersum</i>
Crown vetch	<i>Securigera varia</i>
Cutleaf teasel*	<i>Dipascus laciniatus</i>
Didymo	<i>Didymosphenia geminata</i>
Duckweed	<i>Lemnoideae</i> sp
Elodea	<i>Elodea</i> sp
Field bindweed*	<i>Convolvulus arvensis</i>
Garlic mustard	<i>Alliaria petiolata</i>
Golden rain tree	<i>Koelreuteria paniculata</i>
Gray dogwood	<i>Cornus racemosa</i>
Heavenly bamboo	<i>Nandina domestica</i>
Hydrilla	<i>Hydrilla verticillata</i>
Indian strawberry	<i>Duchesnea indica</i>
Japanese honeysuckle	<i>Lonicera japonica</i>
Japanese knotweed	<i>Fallopia japonica</i>
Japanese stiltgrass	<i>Microstegium vimeneum</i>
Johnsongrass*	<i>Sorghum halepense</i>
Kudzu*	<i>Pueraria montana</i>
Leafy spurge	<i>Euphorbia esula</i>
Marijuana*	<i>Cannabis sativa</i>
Mimosa	<i>Albizia julibrissin</i>
Multiflora rose*	<i>Rosa multiflora</i>
Musk thistle*	<i>Carduus nutans</i>
Osage orange	<i>Maclura pomifera</i>
Poison ivy	<i>Toxicodendron radicans</i>
Purple loosestrife*	<i>Lythrum salicaria</i>
Reed canarygrass	<i>Phalaris arundinacea</i>
Russian olive	<i>Elaeagnus angustifolia</i>
Scotch thistle*	<i>Onopordum acanthium</i>
Sericea lespedeza	<i>Lespedeza cuneata</i>
Sesbania	<i>Sesbania herbacea</i>
Smooth sumac	<i>Rhus glabra</i>
Spotted knapweed*	<i>Centaurea stoebe</i>
Tall fescue	<i>Festuca arundinacea</i>
Tree-of-heaven	<i>Ailanthus altissima</i>
Waterlily	<i>Nymphaeaceae</i> sp

Common Name	Scientific Name
Water primrose	<i>Ludwigia peploides</i>
Watermeal	<i>Wolffia</i>
Watershield	<i>Brasenia schreberi</i>
White and yellow sweet clover	<i>Melilotus albus</i> and <i>M. officinale</i>
Wintercreeper	<i>Euonymus fortunei</i>
Yellow bluestem	<i>Bothriochloa ischaemum</i>
Yellow lotus	<i>Nelumbo lutea</i>

Sources: MDA 2020; MDC 2020a.

*Missouri Noxious Weed Species List

3.8.1.2 General Fish and Wildlife

Wildlife Habitat

Habitat descriptions are based on the habitat systems presented in the Missouri State Wildlife Action Plan (SWAP) (MDC 2015a). The SWAP identifies six general habitat types in Missouri:

1. **Grasslands/Prairie/Savanna.** Grasslands in Missouri consist of prairie or savanna. Prairies support a diverse assemblage of perennial grasses and forbs and generally contain few to no trees or shrubs. Prairie types include deep-soil loess hill prairies, glaciated prairies, sand prairies, and wet prairies. Savannas are generally transitional habitat types between prairies and woodlands.
2. **Forest/Woodlands.** Forest habitat types are dominated by trees forming a closed canopy. Woodlands are habitat types with 30 to 100 percent canopy cover with sparse woody understory or midstory that allows for more sunlight to penetrate the canopy than forests. Woodlands generally have more ground cover composed of forbs, grasses, and sedges. Fire maintains and restores woodland habitat structure and composition. There are seven forest/woodland habitat types in Missouri: Glaciated forest, Ozark oak-pine forest, Ozark hardwood forest, Bottomland forest, Glaciated woodland, Ozark oak-pine and pine woodlands, and Ozark hardwood woodland.
3. **Glades.** Glades are open rocky, barren areas usually located within woodlands. This habitat type is typically located on steep slopes overlaying resistant bedrock and characterized by shallow soils that support drought-adapted forbs and warm-season grasses. Glades are generally characterized by the associated bedrock type.
4. **Cave/Karst.** Karst is characterized by areas with soluble limestone or dolomite that dissolves into caverns over time below the surface. There are five karst regions in Missouri: Hannibal Karst, St. Louis Karst, Perryville Karst, Salem Plateau, and Springfield Plateau. Biodiversity varies between karst regions. Cave habitat generally occurs in the Ozark Highland within karst topography and often overlaps surface or groundwater community types.
5. **Wetland.** Wetland habitat types are characterized by surface or groundwater saturation, hydric soils, and hydrophytic vegetation. Wetlands are generally differentiated by timing, duration, and extent of flooding or soil saturation and dominant vegetation communities. There are five general wetland habitat types in Missouri, as described in the SWAP: ephemeral wetlands, emergent marsh, forested swamp, shrub swamp, and fens. These wetland habitat types occur within the Cowardin et al. (1979) wetland classifications described in Section 3.7.1.3, *Wetlands*

(i.e., palustrine forested wetlands, palustrine emergent wetlands, and palustrine scrub-shrub wetlands).

6. **Rivers and Streams.** Streams are characterized by region: grassland/prairie, Ozark, Mississippi lowland, and big river. Grassland/prairie streams are located in the northern and western portion of the state and are generally very sinuous, low-gradient streams with fine substrate. Ozark streams are located in the middle and southern portion of the state and generally have steep gradients and coarse, rocky substrate. Mississippi lowland streams are in the southeastern corner of the state, along the Mississippi River, and are generally very low gradient with sandy alluvial substrate. The big rivers region refers to the Missouri and Mississippi rivers and their confluence.

Species of Greatest Conservation Need

According to the SWAP, 603 species of greatest conservation need (SGCN) are known to occur in Missouri. SGCN are those species with low and declining populations or those that are characteristic species, or indicative of the diversity and health of Missouri's wildlife populations (MDC 2015a). Table 3-7 reports SGCN species in the study area by habitat system type. In some cases, an SGCN may be found in different habitat systems.

Table 3-7. Species of Greatest Conservation Need by Habitat System Type in the Study Area

Habitat System Type	Taxa	Characteristic Species ^a	SGCN Species	Total Species
Grassland/Prairie/Savanna	Plants	19	30	49
Grassland/Prairie/Savanna	Insects	3	17	20
Grassland/Prairie/Savanna	Fishes	3	4	7
Grassland/Prairie/Savanna	Amphibians	4	2	6
Grassland/Prairie/Savanna	Reptiles	10	4	14
Grassland/Prairie/Savanna	Birds	16	3	19
Grassland/Prairie/Savanna	Mammals	4	3	7
Grassland/Prairie/Savanna	Subtotal	59	63	122
Forest/Woodlands	Plants	12	65	77
Forest/Woodlands	Mollusks	0	1	1
Forest/Woodlands	Insects	0	6	6
Forest/Woodlands	Fishes	0	3	3
Forest/Woodlands	Amphibians	10	0	10
Forest/Woodlands	Reptiles	5	0	5
Forest/Woodlands	Birds	16	3	19
Forest/Woodlands	Mammals	4	3	7
Forest/Woodlands	Subtotal	47	81	128
Glades	Plants	13	10	23
Glades	Arachnids	2	0	2
Glades	Insects	2	2	4
Glades	Reptiles	7	0	7
Glades	Birds	4	0	4
Glades	Subtotal	28	12	40

Habitat System Type	Taxa	Characteristic Species ^a	SGCN Species	Total Species
Cave and Karst	Plants	2	12	14
Cave and Karst	Flatworms	0	4	4
Cave and Karst	Mollusks	0	4	4
Cave and Karst	Arachnids	0	5	5
Cave and Karst	Crustaceans	0	19	19
Cave and Karst	Millipedes	0	3	3
Cave and Karst	Insects	0	11	11
Cave and Karst	Fishes	0	4	4
Cave and Karst	Amphibians	2	0	2
Cave and Karst	Mammals	2	1	3
Cave and Karst	Subtotal	6	63	69
Wetland	Plants	13	47	60
Wetland	Crustaceans	0	4	4
Wetland	Insects	4	11	15
Wetland	Fishes	1	1	2
Wetland	Amphibians	6	1	7
Wetland	Reptiles	5	1	6
Wetland	Birds	7	10	17
Wetland	Mammals	3	0	3
Wetland	Subtotal	39	75	114
Rivers and Streams	Plants	0	1	1
Rivers and Streams	Mollusks	0	28	28
Rivers and Streams	Crustaceans	0	8	8
Rivers and Streams	Insects	1	9	10
Rivers and Streams	Fishes	45	34	79
Rivers and Streams	Amphibians	4	0	4
Rivers and Streams	Reptiles	2	0	2
Rivers and Streams	Birds	1	0	1
Rivers and Streams	Subtotal	53	80	133
Total	-	232	374	606

Source: MDC 2015a.

^a Characteristic Species are those that are indicative of diversity and health of the wildlife characteristic of a specific habitat type and ideal for monitoring management effectiveness and overall community health. For these reasons, Missouri's SGCN list includes both rare and declining species, and Characteristic Species (some species may fit both categories).

3.8.1.3 Covered Species

The HCP covers five bat species: Indiana bat, gray bat, northern long-eared bat, little brown bat, and tricolored bat. The Service lists Indiana bat and gray bat as endangered. The northern long-eared bat was listed in 2015 as a threatened species. Little brown bat and tricolored bat are not currently listed by the Service; however, the Service plans to conduct a formal review of the species to determine whether listing is warranted. Recent studies have shown declines in little brown bat

populations. The tricolored bat was petitioned for listing under the ESA in 2016 and is pending a formal status review. These two species may become listed during the HCP permit term.

Details on Covered Species' status and distribution, habitat characteristics and use, and population status and threats can be found in HCP Section 3.5, *Covered Species*, and HCP Appendix A, *Species Accounts*. Covered Species' occurrence in the study area is summarized below.

Indiana Bat

There are regulated hibernacula in 24 counties in Missouri, although several other counties contain minor or historic sites. Missouri contains the largest overwintering population of Indiana bats (USFWS 2017a). The majority of hibernacula occur in karst topography of the Ozark Plateau in southeastern Missouri. This region has numerous natural cave formations, as well as abandoned mines. Hibernacula are generally absent from the Till Plains that dominate portions of the state located north of the Missouri River. However, it is notable that the most populous hibernaculum is located in the northeast portion of the state on the Sodalite Nature Preserve (SNP) in Hannibal, Marion County (USFWS 2017a). The hibernaculum is in an area where the Missouri River exposed a limestone seam that was subsequently quarried and abandoned.

Indiana bat hibernacula are assigned priority numbers (1 through 4) based on the number of individuals contained within, with Priority 1 the most important to recovery and conservation and Priority 4 least important (USFWS 2007). Missouri is home to seven Priority 1 (3 Priority 1A and 4 Priority 1B), nine Priority 2, 29 Priority 3, 42 Priority 4, and one Ecological Trap hibernacula (USFWS 2007). The Priority 1 hibernacula are in Crawford, Franklin, Iron, Marion, Pulaski, and Washington counties. The Priority 2 hibernacula are in Franklin, Pulaski, Shannon, and Washington counties. Within the MDC lands, 19 hibernacula are located in 10 different counties: Boone, Crawford, Franklin, Hickory, Laclede, Pulaski, Ripley, Shannon, Washington, and Wright. Ownership of the seven Priority 1 hibernacula is variable, with one each occurring on property owned by the City of Hannibal, the Service, Missouri Department of Natural Resources – State Parks, and the United States Army, whereas three Priority 1 and the Ecological Trap hibernacula are on MDC-owned land (USFWS 2007). Three Priority 2 hibernacula are located on MDC-owned or managed lands.

During the active months (April–October) occasional Indiana bats may be found throughout the state (USFWS 2017b). In summer, Indiana bats are relatively common in northeastern Missouri. Much of the MDC lands are within the Indiana bat's summer distribution, with over 502,029 acres occurring within the active season range. Shannon and Reynolds Counties contain a large portion of MDC lands within the Indiana bat active season range.

Gray Bat

Gray bats are known from 66 counties in Missouri. Lands owned and managed by MDC are present in all 66 of these counties. MDC has actively managed the gray bat since before the species was federally listed. This has included the purchase and management of many of the most important gray bat sites in the state. MDC owns and manages 27 areas in 18 counties, including approximately 64 caves used by gray bats. These include several well-established hibernacula, most notably Coffin Cave (approximately 500,000 bats—the largest concentration in the state) and Bat Cave (11,000–61,000 bats). Important maternity and transient season caves on MDC lands include Saloon, Blackwell, and Shop Hollow caves, each of which contain several thousand gray bats each year. Gray bats have been recorded in 55 counties during the active months (April–October).

Northern Long-eared Bat

Northern long-eared bats are known to hibernate in 52 counties in Missouri, with most of these sites located in the caves and mines of southern Missouri. The species is easily overlooked because of its tendency to hibernate in cracks and crevices inside caves and mines. Recent evidence indicates they hibernate in rock faces in neighboring Nebraska (Lemen et al. 2016). Therefore, northern long-eared bats may have a much wider winter range than previously suspected. Several Missouri hibernacula historically contained large numbers of northern long-eared bats and have received special attention from MDC. MDC lands in 16 counties contain hibernacula of the northern long-eared bat. Records of northern long-eared bats are known from 61 counties in Missouri during the active months (April–October). These counties comprise 643,674 acres of MDC lands.

Little Brown Bat

Little brown bats are known to hibernate in 61 counties in Missouri, largely in the caves and mines of southern Missouri. Important exceptions to this pattern include the hibernaculum at SNP in Hannibal, Marion County, in northeastern Missouri, where little brown bats were once common. Other exceptions include some quarries in the northern portion of state and several smaller caves and quarries located along the Missouri River north of Kansas City. MDC lands in 15 counties contain hibernacula little brown bat uses. Prior to WNS, little brown bats were regularly found throughout most of Missouri in the summer. Little brown bats have been recorded in 56 counties during the active months (April–October). These counties include 585,061 acres of MDC lands.

Tricolored Bat

Tricolored bats are known to hibernate in 46 counties in Missouri, largely in the caves and mines of southern Missouri. Important exceptions to this pattern include the hibernaculum at SNP in Hannibal, Marion County in northeastern Missouri, as well as other quarries in the northern portion of state and several smaller caves and quarries located along the Missouri River north of Kansas City where tricolored bats were once commonly encountered. Prior to arrival of WNS, tricolored bats were found in many hibernacula but rarely in large numbers. MDC lands in 22 counties contain hibernacula tricolored bat uses. Records of tricolored bats are known from 77 counties in Missouri during the active months (April–October). These counties contain 848,054 acres of MDC lands.

3.8.1.4 Special Status Species

Special-status species include ESA-listed species not covered under the HCP and plant and wildlife species listed as endangered by the MDC. Migratory birds subject to the Migratory Bird Treaty Act (16 U.S.C. § 703 *et seq.*) and bald and golden eagles protected by the Bald and Golden Eagle Protection Act (16 U.S.C. § 668 *et seq.*) are also included in this section. A list of federally threatened, endangered, and candidate species was generated using the Service's Information for Planning and Consultation (IPaC, USFWS 2022) system. A list of Birds of Conservation Concern was generated using the Service's IPaC system (USFWS 2022). The list of state endangered species was generated from Wildlife Code of Missouri – 3 CSR 10-4.111: Endangered Species.

Federally Listed Species

Thirty-four federally listed and proposed listed species occur or potentially occur in the study area, including 8 plants, 12 mollusks, 3 crustacean, 1 insect, 6 fish, 2 amphibians, 1 bird, and 1 mammal (USFWS 2022; USFWS Weber personal communication). Two of these species are currently

considered extirpated from Missouri. The full list of federally listed species, a brief summary of their habitat and regional distribution in the study area is included in Table 3-8.

Designated Critical Habitat for five federally listed species occurs within Missouri: Hines emerald dragonfly, Neosho mucket, Niangua darter, rabbitsfoot, and Tumbling Creek cavesnail (USFWS 2022). Designated Critical Habitat for Hines emerald dragon fly occurs in 11 locations in the Ozark Mountains in southeastern Missouri. Designated Critical Habitat for the Indiana bat occurs generally southwest of St. Louis, Missouri, in the Ozark Highlands ecoregion. Critical habitat for Neosho mucket is located in the southwestern corner of the state, within the Elk River, Spring River, and Shoal Creek. Niangua darter Critical Habitat is located in the Niangua River, the Little Niangua River, Brush Creek, Tavern Creek, and the Pomme de Terre River. Critical habitat for rabbitsfoot occurs in the St. Francis River upstream of Lake Wappapello. Critical habitat for Tumbling Creek cavesnail occurs in the vicinity of Tumbling Creek in Taney County. Critical habitat has also been proposed for the Big Creek crayfish and St. Francis River crayfish, and includes streams in the Upper St. Francis River watershed (USFWS 2022). The proposed critical habitat for both species are separate but overlap in some areas.

Table 3-8. Federally Listed Species in the Study Area

Species Common Name (Scientific Name)	Federal Status^a	Habitat Association^b	Distribution by County^c
<i>Plants</i>	–	–	–
Mead's milkweed (<i>Asclepias meadii</i>) ^d	T	Dry-mesic to mesic tallgrass prairies in areas with vegetation adapted to drought and fire in chert glades or sandstone rock- ledges.	Adair, Barton, Benton, Cass, Cedar, Dade, Harrison, Henry, Iron, Johnson, Pettis, Polk, Reynolds, Scotland, St. Clair, St. Louis, Sullivan, Vernon
Decurrent false aster (<i>Boltonia decurrens</i>) ^d	T	Periodically disturbed riverine moist sandy soil habitats with little cover.	Cape Girardeau, Dunklin, Franklin, Howell, Lincoln, Mississippi, Pike, St. Charles, St. Louis
Geocarpon (<i>Geocarpon minimum</i>) ^d	T	Small streams in sandstone glades. Grows in shallow depressions and in saline prairies.	Cedar, Dade, Greene, Henry, Jasper, Lawrence, Polk, St. Clair
Virginia sneezeweed (<i>Helenium virginicum</i>) ^d	T	A wetland plant found in shallow, seasonally inundated ponds located in or near sinkholes and wet meadows in the Ozark Highlands.	Christian, Dent, Howell, Oregon, Shannon, Texas, Webster, Wright
Pondberry (<i>Lindera melissifolia</i>) ^d	E	Seasonally flooded wetlands such as floodplain/bottomland hardwood forests, forested swales, seasonal ponds in old dune fields, pond margins in pinelands, and edges of sinkholes in coastal karst areas.	Butler, Ripley
Missouri bladderpod (<i>Physaria filiformis</i>) ^d	T	Open limestone glades, barrens, and outcrops in unglaciated prairie areas. Often associated with grazed pastures.	Christian, Dade, Greene, Lawrence

Species Common Name (Scientific Name)	Federal Status ^a	Habitat Association ^b	Distribution by County ^c
Eastern prairie fringed orchid (<i>Platanthera leucophaea</i>) ^d	T	Variety of habitats, from mesic prairie to wetlands in areas with full sun and little woody encroachment.	Adair, Audrain, Boone, Butler, Callaway, Carter, Chariton, Clark, Cole, Crawford, Daviess, Dent, Douglas, Franklin, Gasconade, Grundy, Harrison, Howard, Howell, Iron, Jefferson, Knox, Lewis, Lincoln, Linn, Livingston, Macon, Madison, Maries, Marion, Mercer, Miller, Monroe, Montgomery, Oregon, Osage, Ozark, Phelps, Pike, Pulaski, Putnam, Ralls, Randolph, Reynolds, Ripley, Schuyler, Scotland, Shannon, Shelby, St. Charles, Ste. Genevieve, St. Francois, St. Louis, Sullivan, Texas, Warren, Washington, Wayne
Western prairie fringed orchid (<i>Platanthera praeclara</i>) ^d	T	Unplowed calcareous tallgrass prairies in areas of full sun and moist or wet soils.	Atchison, Carter, Greene, Harrison, Holt, Jackson, Jasper, Johnson, Lawrence, Ralls, Vernon
<i>Mollusks</i>	–	–	–
Tumbling Creek cavesnail (<i>Antrobia culveri</i>) ^d	E	Known only from silt-free sections of the underground stream in Tumbling Creek in Taney County, Missouri.	Taney
Curtis pearlymussel (<i>Epioblasma florentina curtisii</i>) ^d	E	Headwater and lowland stream reaches with slow currents and stable sand, gravel, cobble, or boulder substrates.	Bollinger, Butler, Carter, Madison, Perry, Ripley, Ste. Genevieve, St. Francois, Wayne
Snuffbox mussel (<i>Epioblasma triquetra</i>) ^d	E	Riffles of small and medium creeks, large rivers, shoals, and wave-washed shores of lakes. Spends most of its life buried in sand, gravel, or cobble.	Bollinger, Butler, Carter, Crawford, Franklin, Gasconade, Jefferson, Maries, Oregon, Phelps, Ripley, St. Charles, Ste. Genevieve, St. Francois, St. Louis, Stoddard, Warren, Washington, Wayne
Pink mucket (<i>Lampsilis abrupta</i>) ^d	E	Large rivers in fast-flowing water over rocky or boulder substrates. Occasionally found in deeper water with slower current and sand/gravel substrates.	Butler, Camden, Carter, Cedar, Cole, Crawford, Franklin, Gasconade, Hickory, Iron, Jefferson, Maries, Miller, Morgan, Osage, Phelps, Polk, Pulaski, Reynolds, Ripley, St. Clair, St. Louis, Wayne
Higgins eye (<i>Lampsilis higginsii</i>) ^d	E	Fast flowing waters with substrates of mud mixed with gravel and stones.	Clark, Lewis, Marion, Pike, Ralls

Species Common Name (Scientific Name)	Federal Status ^a	Habitat Association ^b	Distribution by County ^c
Neosho mucket (<i>Lampsilis rafinesqueana</i>) ^d	E	Variety of riverine habitats. Most often found in shallow riffles and runs over gravel substrate.	Barry, Barton, Jasper, Lawrence, McDonald, Newton
Scaleshell (<i>Leptodea leptodon</i>) ^d	E	Variety of riverine habitats in riffles over substrates of mud, sand, or assemblages of gravel, cobble, and boulders.	Callaway, Camden, Cole, Crawford, Dallas, Dent, Douglas, Franklin, Gasconade, Iron, Jefferson, Laclede, Maries, Miller, Montgomery, Osage, Phelps, Pulaski, St. Charles, Ste. Genevieve, St. Francois, St. Louis, Texas, Warren, Washington, Webster, Wright
Spectaclecase (<i>Margaritafera monodonta</i>) ^d	E	Large rivers in microhabitats sheltered from the main current over substrates of mud, sand, gravel, cobble, or boulders. Often found in firm mud between large rocks in slow-moving waters adjacent to swift currents.	Cedar, Cole, Crawford, Franklin, Gasconade, Jefferson, Laclede, Lincoln, Maries, Marion, Miller, Osage, Phelps, Pike, Pulaski, Ralls, St. Clair, St. Louis, Texas, Washington
Sheepnose (<i>Plethobasus cyphus</i>) ^d	E	Deep water with varied currents and mud, sand, or gravel substrates in medium to large rivers.	Crawford, Franklin, Jefferson, Laclede, Lewis, Marion, Pike, Ralls, St. Louis
Fat pocketbook (<i>Potomilus copax</i>) ^d	E	Mud, sand, or fine gravel substrates in rivers.	Clark, Dunklin, Marion, Mississippi, Pike, Ralls
Winged mapleleaf (<i>Quadrula fragosal</i>) ^d	E	Medium to large-order rivers with a mud bottom or in riffles with sand or gravel substrates in clear water with high water quality.	Crawford, Franklin, Gasconade, Jefferson, St. Charles, St. Louis, Warren, Washington
Rabbitsfoot (<i>Quadrula cylindrica cylindrica</i>) ^d	T	Small to medium rivers in moderate to swift currents over sand and gravel substrate. In smaller rivers, it occurs in gravel or cobble in fast currents.	Barton, Butler, Dunklin, Iron, Jasper, Lawrence, Madison, Mississippi, Newton, Stoddard, Wayne
<i>Crustaceans</i>	–	–	–
Cave crayfish (<i>Cambarus aculabrum</i>)	E	Found in cave streams less than 50 centimeters deep. The type locality is Logan Cave on the Springfield Plateau.	McDonald, Newton
Big Creek crayfish (<i>Faxonious peruncus</i>)	PT	Streams with widths less than 33 feet under small rocks or in shallow burrows in headwater streams and small rocky creeks in shallow depths.	Reynolds, Wayne, Iron, Madison, St. Francois, Ste. Genevieve
St. Francis River crayfish (<i>Faxonious quadruncus</i>)	PT	Swiftly moving streams under rocks and boulders in small headwater streams and up to moderately larger rivers.	Reynolds, Wayne, Iron, Madison, St. Francois, Ste. Genevieve

Species Common Name (Scientific Name)	Federal Status ^a	Habitat Association ^b	Distribution by County ^c
<i>Insects</i>	–	–	–
Hine's emerald dragonfly (<i>Somatochlora hineana</i>) ^d	E	Occurs in calcareous, shallow wetlands dominated by grass or grass-like plants near forests.	Crawford, Dent, Iron, Morgan, Phelps, Reynolds, Ripley, Shannon, St. Francois, Washington, Wayne
<i>Fishes</i>	–	–	–
Ozark cavefish (<i>Amblyopsis rosae</i>) ^d	T	Occurs in clear cave streams with chert or rubble bottoms in caves and caverns with little to no sunlight.	Barry, Christian, Dade, Greene, Jasper, Lawrence, McDonald, Newton, Polk, Stone, Webster, Wright
Grotto sculpin (<i>Cottus specus</i>) ^d	E	Found in cave systems in karst areas in pools and riffles with moderate flow over silt, gravel, cobble, or cobble substrates.	Perry
Niangua darter (<i>Etheostoma nianguae</i>) ^d	T	Found in rocky pools and runs of clear creeks and small to medium rivers over gravel or rock substrates. Inhabit rivers typically have intact banks and riparian corridors and less agricultural development.	Benton, Camden, Cedar, Dallas, Greene, Hickory, Maries, Miller, Osage, Polk, St. Clair, Webster
Topeka shiner (<i>Notropis topeka</i>) ^d	E	Occurs in quiet, open, permanent pools of small, clear, high-quality headwaters and creeks in upland prairie areas.	Howard, Boone, Callaway, Pettis, Cooper, Moniteau, Benton, Morgan, Camden, Miller, Pulaski, Phelps, Maries, Osage, Gasconde (MDC 2020c)
Neosho madtom (<i>Noturus placidus</i>) ^d	T	Occurs in permanent flows of medium sized to large streams in moderate to strong currents over loosely packed gravel or small rocky substrate.	Jasper
Pallid sturgeon (<i>Scaphirhynchus albus</i>) ^d	E	Found in large, turbid, free-flowing rivers in strong currents over firm gravel or sandy substrates. Sometimes occurs in Reservoirs.	Andrew, Atchison, Boone, Buchanan, Callaway, Cape Girardeau, Carroll, Charlton, Clark, Clay, Cooper, Franklin, Gasconade, Holt, Howard, Jackson, Jefferson, Lafayette, Lewis, Lincoln, Marion, Miller, Mississippi, Moniteau, Montgomery, New Madrid, Osage, Pemiscot, Perry, Pike, Platte, Ralls, Ray, Saline, Scott, St. Charles, Ste. Genevieve, St. Louis, Warren

Species Common Name (Scientific Name)	Federal Status ^a	Habitat Association ^b	Distribution by County ^c
<i>Amphibians</i>	–	–	–
Ozark hellbender (<i>Cryptobranchus alleganiensis bishopi</i>) ^d	E	Found in rocky, clear creeks and rivers with abundant large shelter rocks.	Butler, Carter, Dent, Douglas, Howell, Oregon, Ozark, Reynolds, Ripley, Shannon, Texas, Webster, Wright
Eastern hellbender, MO Distinct Population Segment (<i>Cryptobranchus alleganiensis</i>) ^d	E	Found in rocky, clear creeks and rivers with abundant large shelter rocks.	Osage, Dallas, Camden, Laclede, Pulaski, Texas, Dent, Phelps, Crawford, Franklin, Jefferson, St. Louis, St. Charles (MDC 2020d)
<i>Birds</i>	–	–	–
Red Knot (<i>Calidris canutus rufa</i>)	T	Found along shorelines of large rivers and lakes. Uses shoreline habitats in MO as stopovers during migration.	Andrew, Atchison, Boone, Buchanan, Callaway, Cape Girardeau, Carroll, Charlton, Clark, Clay, Cooper, Franklin, Gasconade, Holt, Howard, Jackson, Jefferson, Lafayette, Lewis, Lincoln, Marion, Miller, Mississippi, Moniteau, Montgomery, New Madrid, Osage, Pemiscot, Perry, Pike, Platte, Ralls, Ray, Saline, Scott, St. Charles, Ste. Genevieve, St. Louis, Warren
<i>Mammals</i>	–	–	–
Ozark big-eared bat (<i>Corynorhinus townsendii ingens</i>) ^d	E	Considered extirpated in Missouri.	None

Sources: MDC 2020b; USFWS 2022; USFWS Weber personal communication; USFWS 2020b; NatureServe 2020.

^a Federally listed species under the Endangered Species Act of 1973, as amended.

^b Source: USFWS 2020b unless otherwise noted.

^c Source: NatureServe 2020

^d Also listed as endangered by the State of Missouri

E = Endangered; MDC = Missouri Department of Conservation; MO = Missouri; PE = Proposed Endangered; PT = Proposed Threatened; T = Threatened; USFWS = United States Fish and Wildlife Service

State of Missouri Endangered Species

There are 73 state endangered species in Missouri, 33 of which are also listed by the Service as threatened or endangered species that occur or potentially occur in Missouri. Of the state endangered species that are not also federally listed, there are 8 bird, 3 crustacean, 14 fish, 2 plant, 2 mammal, 4 mollusk, 1 insect, and 6 reptile species. The full list of state-endangered species and a brief summary of their habitat and regional distribution in the study area is included in Table 3-9.

Table 3-9. State of Missouri Endangered Species

Common Name Scientific Name	Habitat Association
<i>Mollusks</i>	–
Slippershell mussel <i>Alasmidonta viridis</i>	Small headwater streams in substrates of sand and fine gravel or in mud or sand near aquatic vegetation in areas with continuous current.
Elephant ear <i>Elliptio crassidens</i>	Muddy sand, sandy, or rocky substrates in streams or rivers with moderate currents.
Ebonyshell <i>Reginaia ebenus</i>	Large rivers with swift currents over stable, coarse sandy or gravel shoals. May also be found in silt or mud.
Salamander mussel <i>Simpsonaias ambigua</i>	Larger rivers or lakes in strong current under large flat stones in sand or silt.
<i>Insects</i>	–
American burying beetle <i>Nicrophorus americanus</i>	Variety of habitats, but requires soil conditions to bury carrion—typically not in areas that are very dry, saturated, or loose.
<i>Crustaceans</i>	–
Coldwater crayfish <i>Faxonius eupunctus</i>	Rivers in coarse gravel or rocky substrates in swift, shallow water.
Caney Mountain cave crayfish <i>Orconectes stygocaneyi</i>	Caves or underground streams. Known from one cave in southern Missouri.
Spring River crayfish <i>Faxonius roberti</i>	Mainstem rivers or streams with substrates of cobble or gravel in areas with moderate to fast flow.
<i>Plants</i>	–
Small whorled pogonia <i>Isotria medeoloides</i>	Acidic soils in dry to mesic second-growth deciduous or deciduous-conifer forests with an open herb layer. Frequently found on flats or slope bases near breaks in the canopy.
Running buffalo clover <i>Trifolium stoloniferum</i>	Commonly occurs in regions underlain with limestone in a variety of mesic woodland types in partial to filtered sunlight with moderate disturbance (e.g., grazing, mowing).
<i>Fishes</i>	–
Crystal darter <i>Crystallaria asprella</i>	Clear to slightly turbid waters of small to medium rivers in swift currents. Substrates include clean sand and gravel.
Swamp darter <i>Etheostoma fusiforme</i>	Slow or still waters in swamps, ponds, lakes, and streams over substrates of mud and detritus or in aquatic vegetation.
Harlequin darter <i>Etheostoma histrio</i>	Small to medium rivers in sand or gravel runs. Commonly found in riffles with coarse gravel substrate. In lowland streams, found in sandy substrates near detritus in mid-stream currents.
Goldstripe darter <i>Etheostoma parvipinne</i>	Pools of vegetated, spring-fed headwaters and creeks over substrates of clay or sand.
Redfin darter <i>Etheostoma whipplei</i>	Rocky pools and sometimes runs and riffles of headwaters, creeks, and small rivers. In medium-sized rivers may occur in current-swept vegetation over gravel and sand or sand and mud.
Spring cavefish <i>Forbesichthys agazzisii</i>	Springs and cave streams in surface waters. Spawns in underground waters.
Cypress minnow <i>Hybognathus hayi</i>	Sluggish pools and backwaters of low-gradient streams, oxbows, and cypress lakes. Preferred substrate consists of soft silt, detritus, or mud.

Common Name Scientific Name	Habitat Association
Lake sturgeon <i>Acipenser fluvescens</i>	Big rivers with firm, silt-free bottoms of sand, gravel, and rock. Rarely found in lakes.
Taillight shiner <i>Notropis maculatus</i>	Sluggish pools and backwaters of large rivers, swamps, ponds, and lakes. Prefers mud substrates with some aquatic vegetation.
Sabine shiner <i>Notropis Sabinae</i>	Runs or pools in creeks or small to medium-sized rivers over substrates of fine, silt-free sand.
Mountain madtom <i>Noturus eleutherus</i>	Small to large rivers in clear, fast-flowing sections over sand, gravel, or rubble. Requires cover such as rocks or crevices.
Longnose darter <i>Percina nasuta</i>	Clear riffles over gravel or rubble in small- to medium-sized rivers in the spring. In the fall, found in slower water over sand or silt.
Flathead chub <i>Platygobia gracilis</i>	Small to large rivers in turbid currents over mud, sand, or rocks.
Central mudminnow <i>Umbra limi</i>	Still waters in streams, sloughs, or swamps with ooze or detritus bottoms. Tolerant of low oxygen and high-water temperatures.
Reptiles	–
Western chicken turtle <i>Deirochelys reticularia miaria</i>	In or near lakes, ponds, streams, and swamps in slow-moving shallow water. Migrates between aquatic habitat and upland habitats, where it will burrow into moist soils to hibernate.
Blanding's turtle <i>Emydoidea blandingii</i>	Marshes, ponds, swamps, lakes, backwaters, slow-moving rivers, oxbows, or pools with soft, muddy bottoms and aquatic vegetation. Nests in uplands adjacent to aquatic habitat.
Illinois mud turtle <i>Kinosternon flavescens spooneri</i>	Natural marshes, oxbow lakes, muddy sloughs, and ponds. They may also be found in flooded fields associated with sandy soils.
Yellow mud turtle <i>Kinosternon flavescens</i>	Quiet or slow-moving bodies of water with soft mud or sand bottoms in areas of sand prairies or scrub-oak savannas. Often nests or seeks shelter in uplands immediately adjacent to preferred aquatic habitats.
Mississippi green watersnake <i>Nerodia cyclopion</i>	Quiet waters of wooded areas, such as marshes, forested swamps, ditches, shallow lakes or ponds, and oxbows. Basks on banks or shores in vegetation.
Eastern massassauga <i>Sistrurus catenatus</i>	Variety of habitats from bogs, fens, swamps, and marshes to dry woodlands. Prefers seasonal wetlands with open grass-sedge areas and a low-growing closed canopy.
Birds	–
American bittern <i>Botaurus lentiginosus</i>	Wetlands, lakes, or ponds with a combination of open water and vegetated shorelines. Prefers dense herbaceous cover consisting of cattails, sedges, and bulrushes.
Northern harrier <i>Circus hudsonius</i>	Indicative of wet prairies. In general, this species occurs in open wetlands, grasslands, pastures, and prairies.
Snowy egret <i>Egretta thula</i>	Wetlands, lakes, ponds, and shallow coastal habitats. Nests in trees or shrubs adjacent to water.
Interior least tern <i>Sternula antillarum</i>	Breeds on sandbars or salt flats with little to no vegetation associated with large rivers or reservoirs.
Swainson's warbler <i>Limnothlypis swainsonii</i>	Breeds in damp deciduous floodplain or swamp forests with high canopy closure and understory cover. Forages on the ground.

Common Name	Habitat Association
Scientific Name Bachman's sparrow <i>Peucaea aestivalis</i>	Old growth southern pine woodlands with frequent fires. Requires grass and herbaceous cover with little shrubby understory or midstory. May colonize other habitats in early seral stages following disturbances.
King rail <i>Rallus elegans</i>	Freshwater marshes, rice fields, shrub swamps or salt marshes along upland edges. Nests on an elevated platform in shallow water or immediately adjacent.
Greater prairie-chicken <i>Tympanuchus cupido</i>	Tall prairie grasslands and occasionally in pastures and hayfields. Nests in a shallow scrape.
Mammals	–
Black-tailed jackrabbit <i>Lepus californicus</i>	Open grasslands or fields with scattered shrubs or thickets.
Plains spotted skunk <i>Spilogale putorius interrupta</i>	Forested areas, open brushy areas, rocky canyons, or outcrops in woodlands and prairies. Dens in protected sites such as brush piles, hollow logs, rock crevices, or under buildings.

Source: Wildlife Code of Missouri – 3 CSR 10-4.111: Endangered Species (last updated on 1/29/22)

Bald and Golden Eagles

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act. Bald eagles are also an SGCN. Golden eagles are observed infrequently in the state during the non-breeding season (eBird 2020; Kochert et al. 2020). Bald eagles nest in Missouri in forested areas in proximity to large waterbodies (Buehler 2020). This species is also known to over winter on the Missouri and Mississippi rivers in the state (Buehler 2020). In the winter, bald eagles roost in large, prominent trees typically adjacent to rivers or lakes.

Migratory Birds

A variety of migratory birds occur within the study area. The state is located in the Mississippi Flyway, a major migratory route for bird species during the spring and fall that generally follows the Missouri and Mississippi Rivers. There are three Bird Conservation Regions (BCRs) identified by the Service located within the study area: Eastern Tallgrass Prairie BCR, Central Hardwoods BCR, and Mississippi Alluvial Valley BCR (USFWS 2008). There are 19 Birds of Conservation Concern that occur within these BCRs in the study area (Table 3-10). Birds of Conservation Concern are those that, without additional conservation actions, are likely to become candidates for listing under ESA (USFWS 2008).

Table 3-10. Birds of Conservation Concern in the Study Area

Common Name	Scientific Name
American golden-plover	<i>Pluvialis dominica</i>
King rail	<i>Rallus elegans</i>
Lesser yellowlegs	<i>Tringa flavipes</i>
Prairie warbler	<i>Dendroica discolor</i>
Ruddy turnstone	<i>Arenaria interpres morinella</i>
Yellow rail	<i>Coturnicops noveboracensis</i>
Hudsonian godwit	<i>Limosa haemastica</i>

Common Name	Scientific Name
Bobolink	<i>Dolichonyx oryzivorus</i>
Short-billed dowitcher	<i>Limnodromus griseus</i>
Black-billed cuckoo	<i>Coccyzus erythrophthalmus</i>
Eastern whip-poor-will	<i>Antrostomus vociferus</i>
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>
Wood thrush	<i>Hylocichla mustelina</i>
Cerulean warbler	<i>Setophaga cerulea</i>
Prothonotary warbler	<i>Protonotaria citrea</i>
Kentucky warbler	<i>Geothlypis formosa</i>
Henslow's sparrow	<i>Ammodramus henslowii</i>
LeConte's sparrow	<i>Ammodramus leconteii</i>
Rusty blackbird	<i>Euphagus carlinus</i>

Source: USFWS 2022.

3.8.2 Environmental Consequences – Proposed Action

3.8.2.1 Vegetation

Vegetation impacts are described qualitatively by identifying changes in vegetation habitat types and potential effects from invasive plants from Covered Activities and the HCP conservation strategy.

Changes in Vegetation Composition and Structure

Forest management activities on MDC lands are ongoing, including prescribed fire and tree removal, which result in changes to vegetation composition and structure. The goal of these activities includes conservation of forest and woodland biodiversity, reintroduction or restoration of specific forest types, and maintenance of a spectrum of wildlife habitats in the state. Therefore, any potential increase in forest management activities under the Proposed Action relative to baseline conditions is not anticipated to significantly affect changes in vegetation composition and structure.

Prescribed Fire

At the landscape scale, prescribed fire is not likely to change vegetation cover types. Prescribed fire recreates conditions that historic wildfires would have on the landscape. There would be impacts on vegetation composition and structure in forests/woodlands, glades, and open lands at the scale of the prescribed burn and immediate vicinity. Immediately following prescribed burning, herbaceous understory vegetation would be removed for several months, after which vegetation would regenerate. Prescribed fire may kill individual trees and remove some patches of forests, creating openings in the canopy. However, prescribed fire is not likely to substantially change canopy forest composition or structure at the level of the study area. Canopy openings created by prescribed burns may alter species composition in the understory, likely increasing diversity of species in the understory (Hutchinson and Sutherland 2000).

Tree Removal

Impacts from tree removal would vary depending on the type of activity. Targeted removal of individual trees to protect MDC assets or facilitate public access would not change overall forest

composition or structure or result in a conversion to open lands. Selective timber harvest activities may result in the loss of canopy cover in harvest areas. Opening the forest canopy is expected to create new age classes within the forest by allowing tree growth and regeneration following disturbance. In general, forest succession during the first several years following disturbance would convert to grasslands/herbaceous or scrub/shrub cover. Following this, the harvest area would likely change to scrub/shrub. After two to three decades, the harvested area would likely return to its previous forest cover type, unless the area is managed to become a different cover type (MDC 2010a; Thompson and Dessecker 1997). Over the course of forest succession, in the first several years following harvest, there would likely be an increase in herbaceous species diversity in the understory.

Removal of trees would have beneficial impacts on barrens and glades and open lands because it would remove woody ingression and restore native vegetation composition in structure in those cover types.

Overall, tree removal and prescribed burning would alter vegetation composition and structure at the scale of treatments; however, these effects would not be significant at the scale of the study area. These activities are expected to have beneficial impacts on native vegetation composition and structure over the long-term.

Spread of Non-Native Invasive Plants

Covered Activities that disturb the surface or expose bare soil have the potential to create conditions for invasive or nuisance plants to establish or expand existing coverage. Construction equipment brought to areas to conduct Covered Activities can bring plant material or seeds from invasive plant species from other regions. Covered Activities involving vegetation removal, trampling, compaction, or blading/scraping may increase bare soil areas, which would allow for establishment or colonization of invasive plants. Materials such as mulch, seed, or wattle used during revegetation activities may be contaminated with nonnative invasive seeds or plant material. Nonnative invasive vegetation can alter or disrupt native vegetation cover types. The extent of the impact from nonnative invasive plant species depends on the presence of invasive species seed sources in the area, the time of year, and implementation of control or avoidance procedures to reduce or prevent the spread of invasive species or treat areas of infestation. The MDC would follow strategies and BMPs outlined in the *Forest Resource Assessment and Strategy* (MDC 2010a) and MDC's Forest Management Guidelines (MDC 2014a) for control of spread and establishment of invasive species. With the implementation of these strategies and BMPs, spread of nonnative invasive plant species would be controlled to the greatest extent practicable and would not result in significant effects to vegetation. Covered Activities already occur on MDC lands and other non-federal lands, and any potential increase in forest management activities under the Proposed Action relative to baseline conditions is not anticipated to significantly affect the establishment and spread of nonnative invasive plants.

Effects from Conservation Strategy

Although most Covered Activities would have short-term adverse, but long-term beneficial, impacts on vegetation composition and structure, the HCP conservation strategy would prohibit Covered Activities in some areas, resulting in avoiding and minimizing short-term adverse vegetation impacts. Conservation Measure #7 (in Table 2-8) includes establishing PBMZs and associated 100-foot protective riparian buffers. Conservation Measures #5 and #9 would ultimately result in no or less vegetation disturbance in some areas. In the areas where these conservation measures are

implemented, vegetation would not be exposed to the same level of potential impact that could have otherwise occurred under the No Action Alternative.

3.8.2.2 General Fish and Wildlife

The Covered Activities and conservation strategy can potentially affect fish and wildlife species where habitat is altered in association with forest management activities. Effects can be adverse or beneficial depending on the species and timing of activities. Impacts on fish and wildlife are described qualitatively for prescribed fire, tree removal, activities associated with public access and asset management, and implementation of the conservation strategy. The impact discussion focuses more on terrestrial species because Covered Species do not occur in aquatic habitats, and, by definition, Covered Activities only occur where take of Covered Species occurs (and where the ITP applies). Covered Activities that occur adjacent to aquatic habitats could result in some limited indirect impacts (see Section 3.7.2, *Environmental Consequences – Proposed Action*).

Habitat Loss, Degradation, Alteration, or Improvement

Public access and assessment management would require tree removal to construct new buildings, roads, and parking lots, which would result in permanent loss of habitat; this impact is not anticipated to be significant due to the limited areas that would be affected. Prescribed fires and tree removal would mimic the effects of historic natural disturbances in habitats within the study area. Immediately following tree removal or prescribed fires, a change in habitat structure and composition would occur. Once the activities are completed, vegetation would regenerate in the understory and canopy. Composition of the forest stand generally would remain the same in the long-term, although more shade intolerant species may dominate in the early stages of forest succession (Thompson and Dessecker 1997). Immediately following Covered Activities, more sunlight would reach the forest floor and increase the abundance and diversity of grasses, forbs, and tree seedlings. Increases in insects and plants that provide food sources for wildlife species such as turkeys, bears, and some species of migratory birds would accompany these changes. Species common to late-seral forests may be adversely affected in the short term immediately following prescribed fires and tree removal; however, creating a mosaic of successional stages in the forest would lead to future suitable habitat for species that occur in mature, closed-canopy forests.

Changes to vegetative cover in the vicinity of aquatic ecosystems may alter water quantity and quality through increased runoff events and sedimentation due to increased erosion in upland areas and within waterbodies (see Section 3.7.2, *Environmental Consequences – Proposed Action*). Impacts on aquatic wildlife may include reduced survival of juveniles of aquatic species in areas with increased water yields and turbidity. Implementation of MDC's Forest Management Guidelines and associated BMPs (MDC 2014a) and state and federal requirements for protecting water quality would reduce or eliminate the risk to aquatic wildlife.

The Missouri SWAP indicates that healthy forests and woodland systems generally have a wide variety of seral stages that creates a mosaic of habitats at the landscape level for generalist and specialist wildlife species (MDC 2015a). Over the long-term, habitat management activities would have overall beneficial impacts on wildlife species within the study area.

In summary, forest management activities are ongoing on MDC lands and other non-federal lands and would continue to cause changes in wildlife habitats. Permanent habitat removal would not be significant due to the limited area affected. Prescribed burning and tree removal effects on habitats would result in adverse conditions in the short-term, but would be beneficial in the long term; some

individual animal loss could occur, but in mimicking natural processes, these activities restore conditions on the landscape that benefit natural communities. Any potential increase in forest management activities under the Proposed Action relative to baseline conditions is not anticipated to affect habitat significantly.

Effects on Fish and Wildlife

The presence of humans and mechanized equipment and subsequent increase in noise disturbance during Covered Activities may cause wildlife to avoid the immediate area. The majority of wildlife species are expected to disperse into nearby habitats in response to disturbance from the increase in human activity. Some individuals may return to the newly disturbed area following completion of activities. Noise impacts from increased human activity would be short term and temporary and limited to the duration of activities in the treatment areas. Implementing prescribed fire and timber harvest activities may result in the injury or mortality of individuals. Species that are less mobile, such as small mammals, reptiles, amphibians, and nesting birds, may not be able to disperse in response to disturbance. As a result, individual small mammals, reptiles, amphibians, and birds may be injured or killed during Covered Activities.

A spill of hazardous materials during Covered Activities could directly affect wildlife through ingestion or contact or, if a spill were to reach a surface water, affect aquatic habitat and water quality. Implementation of standard operating procedures during Covered Activities would reduce or eliminate the potential for spills such that the risk of exposure to habitats and wildlife would be minimal, with no anticipated population-level effects.

In summary, the effects of Covered Activities on fish and wildlife from presence of humans and operation of mechanized equipment would not be significant due to the short-term and temporary nature of these potential impacts. Covered Activities already occur on MDC lands and other non-federal lands, and any potential increase in forest management activities under the Proposed Action relative to baseline conditions is not anticipated to affect fish and wildlife significantly.

Effects from Conservation Strategy

Although most Covered Activities would have short-term adverse, but long-term beneficial, impacts on habitat and wildlife, the HCP conservation strategy would prohibit Covered Activities in some areas, resulting in avoiding and minimizing short-term adverse habitat and wildlife impacts. Conservation Measure #7 (in Table 2-8) includes establishing PBMZs and associated 100-foot protective riparian buffers. Conservation Measures #5 and #9 would ultimately result in no or less habitat disturbance in some areas and the creation of snags, which could benefit wildlife that use snags for roosting, nesting, or food resources. In the areas where these conservation measures are implemented, habitats and wildlife would generally not be exposed to the same level of potential impact that could have otherwise occurred under the No Action Alternative.

Conducting bat surveys may result in the capture of non-covered bat or bird species and potentially result in injury or death. However, biologists conducting these surveys would be trained in handling wildlife and permitted by the Service to handle Covered Species. These effects would not be expected to result in population-level impacts for bat or bird species in the study area.

3.8.2.3 Covered Species

Impacts from the Covered Activities on Covered Species are discussed in detail in HCP Chapter 4, *Effects Analysis*, and are summarized in this section. The HCP relies on acres of habitat removal as a

surrogate measure to estimate incidental take expected to result from Covered Activities; these amounts are limits (or caps) on the total allowable amount of habitat impacts and, therefore, incidental take expected over the 50-year ITP term. In the HCP, NLCD aggregated land cover types are grouped based on habitat preference for bats. Forests and Woodlands and Glades are considered “Preferred by Bats,” whereas Open Lands, Open Water, and Developed are considered “Other Land Covers.” The MDC has implemented avoidance and minimization measures to reduce take of Covered Species to the greatest extent practicable, including habitat buffers around known hibernaculum during the winter. Table 3-11 summarizes impacts on occupied fall/spring habitat for each Covered Species on MDC lands and other non-federal lands for preferred land covers and open lands. Impacts on occupied summer bat habitat are summarized by habitat type in Table 3-12. It should be noted that take of gray bats is not quantified in the HCP because the species does not typically inhabit trees. Gray bats may occasionally be taken by vehicles on MDC lands, although this limited potential for take is greatly reduced by the conservation measures outlined in HCP (see HCP Section 4.3, *Results*, and Chapter 5, *Conservation Strategy*, for details on gray bat take and conservation measures).

Table 3-11. Summary of Direct Effects on Covered Species from Covered Activities in the Study Area – Occupied Fall/Spring Habitat

Activities and Preferred Land Covers	Available Fall/Spring Habitat (Total Acres)^a	Occupied Fall/Spring Habitat Affected (Acres/Year) Management	Occupied Fall/Spring Habitat Affected (Acres/Year) Public Access and Management	Occupied Fall/Spring Habitat Affected (Acres/Year) Total	Percent Occupied Habitat Affected	Total Acres – 50 Year Permit Term
<i>MDC Activities on MDC Lands</i>						
Forest, Woodlands, Glades	-	-	-	-	-	-
Indiana Bat	114,198	2,160	11	2,171	1.90%	108,550
Little Brown Bat	154,392	2,920	16	2,935	1.90%	146,750
Northern Long-eared Bat	160,637	3,038	16	3,054	1.90%	152,700
Tricolored Bat	178,174	3,369	18	3,387	1.90%	169,350
<i>Open Lands^b</i>						
Indiana Bat	32,348	2,157	0	2,157	6.67%	107,850
Little Brown Bat	43,734	2,916	0	2,916	6.67%	145,800
Northern Long-eared Bat	45,503	3,033	0	3,033	6.67%	151,650
Tricolored Bat	50,470	3,365	0	3,365	6.67%	168,250
<i>MDC Activities on Other Non-federal Lands</i>						
Forest, Woodlands, Glades	-	-	-	-	-	-
Indiana Bat	874,208	309	< 1	309	0.04%	15,450
Little Brown Bat	1,759,340	621	< 1	621	0.04%	31,050
Northern Long-eared Bat	1,563,762	552	< 1	552	0.04%	27,600
Tricolored Bat	1,669,340	589	< 1	589	0.04%	29,450
<i>Open Lands^b</i>						
Indiana Bat	1,366,221	79	0	79	0.01%	3,950
Little Brown Bat	2,749,515	159	0	159	0.01%	7,950
Northern Long-eared Bat	2,443,864	141	0	141	0.01%	7,050

Activities and Preferred Land Covers	Available Fall/Spring Habitat (Total Acres) ^a	Occupied Fall/Spring Habitat Affected (Acres/Year) Management	Occupied Fall/Spring Habitat Affected (Acres/Year) Public Access and Management	Occupied Fall/Spring Habitat Affected (Acres/Year) Total	Percent Occupied Habitat Affected	Total Acres - 50 Year Permit Term
Tricolored Bat	2,608,861	151	0	151	0.01%	7,550
<i>All Activities Statewide</i>	-	-	-	-	-	-
Forest, Woodlands, Glades	-	-	-	-	-	-
Indiana Bat	988,406	2,468	11	2,480	0.25%	124,000
Little Brown Bat	1,913,732	3,541	16	3,556	0.19%	177,800
Northern Long-eared Bat	1,724,399	3,590	16	3,606	0.21%	180,300
Tricolored Bat	1,847,514	3,959	18	3,977	0.22%	198,850

Source: ICF 2022.

^a Modeled high-suitability fall and spring habitat occurs within 5 miles of most known hibernacula (with the exception of the 10-mile buffer at SNP) and, unlike modeled summer habitat, is not broken into high, medium, and low occupancy (see HCP Tables 4-3 through 4-6 for occupancy breakdown).

^b Most effects occur on preferred land covers (forest, woodlands, and glades). Other potential effects on open lands are displayed for completeness. Effects on open lands include prescribed fire and occasional tree removal. Urban and open water land covers are not affected by MDC covered activities.

Table 3-12. Summary of Direct Effects on Covered Species from Covered Activities – Occupied Summer Habitat

Activities and Preferred Land Covers	Available Summer Habitat When Occupied (Total Acres) ^a	Potential Summer Habitat Affected When Occupied (Acres/Year) Management	Potential Summer Habitat Affected When Occupied (Acres/Year) Public Access and Management	Potential Summer Habitat Affected When Occupied (Acres/Year) Total	Percent Occupied Habitat Affected	Total Acres - 50 Year Permit Term
<i>MDC Activities on MDC Lands</i>	-	-	-	-	-	-
Forest, Woodlands, Glades	-	-	-	-	-	-
Indiana Bat	651,294	6,038	43	6,081	0.93%	304,050
Little Brown Bat	745,556	6,911	50	6,961	0.93%	348,050

Activities and Preferred Land Covers	Available Summer Habitat When Occupied (Total Acres) ^a	Potential Summer Habitat Affected When Occupied (Acres/Year) Habitat Management	Potential Summer Habitat Affected When Occupied (Acres/Year) Public Access and Management	Potential Summer Habitat Affected When Occupied (Acres/Year) Total	Percent Occupied Habitat Affected	Total Acres - 50 Year Permit Term
Northern Long-eared Bat	745,556	6,911	50	6,961	0.93%	348,050
Tricolored Bat	745,556	6,911	50	6,961	0.93%	348,050
Open Lands ^b	-	-	-	-	-	-
Indiana Bat	184,489	6,029	0	6,029	3.27%	301,450
Little Brown Bat	211,190	6,902	0	6,902	3.27%	345,100
Northern Long-eared Bat	211,190	6,902	0	6,902	3.27%	345,100
Tricolored Bat	211,190	6,902	0	6,902	3.27%	345,100
<i>MDC Activities on Other Non-federal Lands</i>	-	-	-	-	-	-
Forest, Woodlands, Glades	-	-	-	-	-	-
Indiana Bat	13,256,888	7,021	< 1	7,021	0.05%	351,050
Little Brown Bat	14,818,306	7,848	< 1	7,848	0.05%	392,400
Northern Long-eared Bat	14,818,306	7,848	< 1	7,848	0.05%	392,400
Tricolored Bat	14,818,306	7,848	< 1	7,848	0.05%	392,400
Open Lands ^b	-	-	-	-	-	-
Indiana Bat	20,717,999	1,797	0	1,797	0.01%	89,850
Little Brown Bat	23,158,199	2,009	0	2,009	0.01%	100,450
Northern Long-eared Bat	23,158,199	2,009	0	2,009	0.01%	100,450
Tricolored Bat	23,158,199	2,009	0	2,009	0.01%	100,450
<i>Statewide Preferred Habitats</i>	-	-	-	-	-	-
Forest, Woodlands, Glades	-	-	-	-	-	-
Indiana Bat	13,908,182	13,059	43	13,102	0.09%	655,100
Little Brown Bat	15,563,862	14,759	50	14,809	0.10%	740,450
Northern Long-eared Bat	15,563,862	14,759	50	14,809	0.10%	740,450

Activities and Preferred Land Covers	Available Summer Habitat When Occupied (Total Acres) ^a	Potential Summer Habitat Affected When Occupied (Acres/Year) Habitat Management	Potential Summer Habitat Affected When Occupied (Acres/Year) Public Access and Management	Potential Summer Habitat Affected When Occupied (Acres/Year) Total	Percent Occupied Habitat Affected	Total Acres - 50 Year Permit Term
Tricolored Bat	15,563,862	14,759	50	14,809	0.10%	740,450

Source: ICF 2022.

^a Summer habitat is presumed to occur in all preferred habitats.

^b Most effects occur on preferred land covers (forest, woodlands, and glades). Other potential effects on open lands are displayed for completeness. Effects on open lands include prescribed fire and occasional tree removal. Urban and open water land covers are not affected by MDC covered activities.

Impacts on occupied fall/spring bat habitat resulting from tree removal for public access or asset management during the fall and spring would be less than 18 acres per year on MDC lands and less than 1 acre on non-federal lands. Impacts on occupied summer bat habitat resulting from tree removal for public access or asset management is expected to be less than 50 acres per year on MDC lands and less than 1 acre on non-federal lands.

Vehicle operations could result in take of Covered Species, but take that occurs is anticipated to be low. Vehicle use during Covered Activities could result in collisions with Covered Species that may result in mortality or injury to individual bats. Although bats are unlikely to use roads or trails for foraging, and vehicle traffic would occur during daylight hours, when bats are not active, it is still possible for limited take to occur. As stated in the HCP, take for vehicle operations cannot be quantified. However, the HCP's conservative take estimate for timber harvest (i.e., liberally includes more take than is likely to occur) would cover the minor take anticipated from vehicle operations.

Demolition of structures could result in take of Covered Species, but take that occurs is anticipated to be low. If bats are present, demolition of structures could crush individuals or expose individuals to predation when escaping a disturbed area. The level of impact could vary from eliminating a maternity colony to the loss of individuals that are not part of a maternity colonies (i.e., male and nonreproductive females). Although a limited number of structures (up to six) are anticipated to be demolished per year, and buildings would be checked ahead of time and demolition scheduled for a time when bats are absent, it is still possible for limited take to occur. As stated in the HCP, take for structure demolition cannot be quantified. However, the HCP's conservative take estimate for timber harvest (i.e., liberally includes more take that is likely to occur) would cover the minor take anticipated from structure demolition.

Implementation of the HCP conservation strategy would result in beneficial impacts on Covered Species, as detailed in HCP Section 5.3, *Beneficial and Net Effects*, and summarized here. Beneficial effects to Covered Species result from a combination of implementing several measures and activities, including protecting, managing, and enhancing existing habitats (e.g., prescribed fires); creating PBMZs; establishing protective buffers; practicing seasonal avoidance; and conducting public outreach. These measures and activities are detailed in HCP Table 5-4, *Summary of Species Take During Spring and Fall after Sodalis Nature Preserve (SNP) and other Avoidance/Minimization and Offsetting Conservation Measures*. The SNP, which contains the largest known Indiana bat hibernaculum, would be protected with a 10-mile buffer. Over the 50-year permit term, habitat management activities, such as prescribed fire and tree removal, are expected to promote a diversity of forest types and ages; and therefore, a diversity of suitable Covered Species foraging and roosting habitat throughout the state. Table 3-13 highlights the HCP's beneficial effects on Covered Species that contribute to offsetting take. Table 3-14 shows the total net benefits compared to take.

Table 3-13. Beneficial Effects on Covered Species that Contribute to the Net Effect Analysis

Covered Species	Beneficial Effects that Offset Take
Indiana Bat	<ul style="list-style-type: none"> • Management and enhancement activities on approximately 6,800 acres of preferred fall/spring habitat and 38,750 acres of occupied preferred summer habitat each year on lands owned/managed by MDC. • Management and enhancement activities on approximately 1,200 acres of preferred fall/spring habitat and 18,270 acres of occupied preferred summer habitat each year on lands owned/managed by other non-federal cooperators. • Creation of 7,000-acre PBMZs around known Indiana bat maternity colonies in which MDC will apply seasonal avoidance to limit potential take and apply positive management to generate improved habitat in areas of known occupancy.
Northern Long-eared Bat	<ul style="list-style-type: none"> • Management and enhancement activities on approximately 9,560 acres of preferred fall/spring habitat and 44,360 acres of preferred summer habitat each year on lands owned/managed by MDC. • Management and enhancement activities on approximately 2,150 acres of preferred fall/spring habitat and 20,400 acres of preferred summer habitat (total habitat) each year on lands owned/managed by other non-federal cooperators. • Creation of 7,000-acre PBMZs around known northern long-eared bat maternity colonies in which MDC will apply seasonal avoidance to limit potential take and apply positive management to generate improved habitat in areas of known occupancy.
Little Brown Bat	<ul style="list-style-type: none"> • Management and enhancement activities on approximately 9,200 acres of preferred fall/spring habitat and 44,000 acres of preferred summer habitat each year on lands owned/managed by MDC. • Management and enhancement activities on approximately 2,400 acres of preferred fall/spring habitat and 20,000 acres of preferred summer habitat each year on lands owned/managed by other non-federal cooperators. • Creation of 7,000-acre PBMZs around known maternity colonies in which MDC will apply seasonal avoidance to limit potential take and apply positive management to generate improved habitat in areas of known occupancy.
Tricolored Bat	<ul style="list-style-type: none"> • Management and enhancement activities on approximately 10,600 acres of preferred fall/spring habitat and 44,000 acres of preferred summer habitat each year on lands owned/managed by MDC. • Management and enhancement activities on approximately 2,300 acres of preferred fall/spring habitat and 20,000 acres of summer habitat each year on lands owned/managed by other non-federal cooperators. • Creation of 7,000-acre PBMZs around known or suspected tricolored bat maternity colonies in which MDC will apply seasonal avoidance to limit potential take and apply positive management to generate improved habitat in areas of known occupancy.

Source: ICF 2022.

Table 3-14. Total Net Benefit on Covered Species

Covered Species	Take (Acres) ^a	Take Offset – Management and Enhancement (Acres) ^b	Take Offset – Creation of PBMZs (Acres) ^c	Total Net Benefit (Acres) ^d
Indiana Bat	25,644	65,020	7,000	+46,376
Northern Long-eared bat	30,500	76,470	7,000	+52,970
Little Brown Bat	30,351	75,600	7,000	+52,249
Tricolored bat	31,212	76,900	7,000	+52,688

Source: ICF 2022.

^a Includes combined total of all spring/fall habitat and summer habitat take on MDC lands and other non-federal lands.

^b Includes combined total of all management and enhancement activities on spring/fall habitat and summer habitat.

^c PBMZs are seasonal avoidance areas to limit potential take and where MDC would apply positive management to generate improved habitat in areas of known occupancy.

^d Quantifying a one-to-one offset is difficult because the exact locations of bats is often unknown (making it difficult to quantify avoidance), and efforts to understand fecundity and recruitment of bats are in their infancy. However, the acres of net positive benefit compared to the acres of take (which is a conservative estimate) is anticipated to more than offset take of the Covered Species.

Monitoring activities would evaluate the outcome of the Conservation Strategy of the HCP, advance scientific understanding of Covered Species and their management, and allow for modification of conservation measures in order to better achieve goals in the Conservation Strategy. Monitoring program details are included in HCP Section 5.5, *Monitoring*. Additionally, the HCP identifies five major adaptive management themes that would be monitored during HCP implementation. Due to the 50-year permit term, the HCP addresses scientific uncertainty and the potential for ecological and regulatory changes that may affect implementation of the conservation strategy. The five themes addressed in the adaptive management plan are: (1) changes to populations due to WNS; (2) shifts in population distribution as a result of climate change; (3) addition or subtraction of subterranean habitat or maternity colonies; (4) changes to prescribed burning regulations; and (5) addition or subtraction of priority bat zones. More details these themes are included in HCP Section 5.4, *Adaptive Management*.

3.8.2.4 Special-status Species

This section discusses impacts from Covered Activities on special-status species other than Covered Species. The impact mechanisms for special-status species are the same as those described in Section 3.8.2.2, *General Fish and Wildlife*, and the reader should refer to this section for an overview of how Covered Activities may affect wildlife in general.

Covered Activities are not anticipated to result in take of other federally listed species or adverse modification of Critical Habitat. As described in HCP Section 1.2.5, *Covered Species*, and HCP Appendix B – *Species Evaluation*, the Covered Activities are anticipated to avoid impacts on other federally listed species that would reach the level of take. Federally listed plants are not widespread in study area, and MDC would screen for those species and address any potential impacts with the Service on a case-by-case base. Impacts on federally listed aquatic species would largely be avoided because Covered Activities, by definition, would not occur in surface waters (i.e., outside of ITP coverage). Any indirect impacts on federally listed aquatic species from Covered Activities conducted in the vicinity of surface water would largely be avoided through BMPs and other requirements to protect surface waters (see Section 3.7.2, *Environmental Consequences – Proposed Action*) and, therefore, have low potential to indirectly affect species or result in take. Similarly, the Hines’s emerald dragonfly is associated with herbaceous wetlands, which are habitats also outside

of the area where Covered Activities would occur. In addition, the one federally listed bird and one federally listed mammal species in the study area are considered extirpated in the Missouri. In all cases, Covered Activities would either avoid take of other federally listed species, or these species would be addressed separately under ESA section 7 or section 10. Although take of other federally listed species would be avoided, the Service cannot rule out some potential that Covered Activities may affect other federally listed species. The Covered Activities would not result in adverse modification of the designated or proposed critical habitats in the study area because all of these habitats are aquatic and would largely be avoided for the same reasons described above for the aquatic species.

Covered Activity impacts on state endangered species, bald and golden eagles, and Birds of Conservation Concern would need to comply with Wildlife Code of Missouri – 3 CSR 10-4.111: *Endangered Species*, Bald and Golden Eagle Protection Act, and the Migratory Bird Treaty Act. The Applicant's compliance with this Missouri regulation and two federal statutes would avoid or minimize impacts on these species.

3.9 Cultural Resources

3.9.1 Affected Environment

Cultural resources (archaeological, architectural, and historical) encompass past and present expressions of human culture and history in the physical environment, such as prehistoric and historic archaeological sites, structures, objects, and districts that are considered important to a cultural or community. They also include aspects of the physical environment, namely natural features and biota, which are a part of traditional ways of life and practices and are associated with community values and institutions.

The study area for cultural resources is also known as the area of potential effects (APE). APEs associated with a potential undertaking (such as this proposed ITP) are defined as “the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist” (36 CFR § 800.16[d]). The APE encompasses MDC lands and other non-federal lands where Covered Activities and implementation of the conservation strategy activities in the HCP would result in ground disturbance or other impacts. This document does not cover USACE's responsibility to comply with the National Historic Preservation Act (NHPA) for Covered Activities on their land. This section describes the cultural resources setting, the types of cultural resources that may occur, and where they are likely to occur.

NHPA section 106 (54 U.S.C. § 300101 *et seq.*) is the primary federal law governing the preservation of cultural and historic resources in the United States and requires the National Register of Historic Places (NRHP) be considered when planning and implementing federal projects. The NRHP lists properties (e.g., districts, sites, buildings, structures, objects) of historic significance. The list of historic properties in the study area was developed using the NRHP.

3.9.1.1 Cultural Resources Setting

Missouri cultural resources have their genesis in antiquity. Missouri archaeological record provides evidence that the state's earliest human inhabitants arrived at the end of the last ice age. Prehistoric cultural overviews developed by archaeologists (Chapman 1975, 1980; Hamilton et al. 1989; Weston and Weichman 1987) have identified a series of general prehistoric periods based on

distinctions in material cultural, site distribution patterns and concomitant changes in the cultural spheres in technology, belief structures, social organization and the economy that is associated with several Native American Tribes from the time of their earliest arrival (Pre-12,000 BCE) to historic times (A.D. 1700–Present). These general periods are summarized below.

Early European explorers entering Missouri seem to have left more in the written record than the archaeological one. Hernando De Soto reached and crossed the Mississippi River in 1541, exploring the Arkansas Ozarks and claiming the Mississippi Valley for Spain, but he and his band of conquistadors did not quite reach what is now Missouri. It was not until Marquette and Joliet traveled down the Mississippi in 1673 that the first written accounts of Missouri's topography and peoples were recorded.

Marquette and Joliet's expedition opened the way for a series of French explorers, traders and missionaries who claimed the Mississippi River and its tributaries for France. The French missionaries and traders that explored Missouri also built its first European settlements, which include several historically significant communities in Missouri, notably along the Missouri and Mississippi Rivers.

Little remains from the earliest settlement period communities, but in Ste. Genevieve, a Mississippi River town, there is some evidence of French colonial life, buildings, and landscape. The town retains one of the largest collections in the country of French Creole buildings from the eighteenth and early nineteenth centuries and has retained several early buildings from the growing American population in the first two decades of the 1800s. The town's oldest buildings are recognized as National Historic Landmarks.

The return of the Louisiana Territory to France by Spain in the 1800 and the subsequent purchase of the entire territory by the United States (1803–1804) effectively gave control of Lower Louisiana and upper portion of the territory (including Missouri) to the United States. The Lewis and Clark voyage of discovery provided opportunity for the exploration of the interior parts of Missouri and marked the state as a starting point for western exploration and settlement and as a major player in fur trade throughout its early settlement and statehood period. Forts such as Fort Osage (1808), in what is now Jackson County, sought to provide political stability in the new territory through trade and alliances with American Indians in the area.

Missouri became a state in 1821. Despite its growing population and organization of a state government, most of the state was still a frontier. Settlers came from the states of Kentucky, Virginia, North Carolina, and Tennessee for the area's natural resources and agricultural potential, but also because Missouri allowed slavery. In addition to its agricultural potential, Missouri's early statehood period also saw slow growth of industry. Some of the earliest manufacturers supported the western outfitting and agricultural needs, such as wagon and saddle making and metal works.

Improved transportation systems spurred economic and population growth in the state. The Missouri and Mississippi rivers were the original highways, with flatboats or keelboats plying the waters in the early period. Beginning in 1817, steamboats plied the waters of the Mississippi, Missouri, and other large rivers in the state, boosting trade and growth of river towns such as Cape Girardeau, Jefferson City and St. Joseph.

By the 1850s, river transportation was being supplemented and replaced to an extent by the railroad. The first trans-state railroad, the Hannibal and St. Joseph, was completed by 1859. The Civil war slowed construction of the Pacific Railroad until 1856, when the line connected St. Louis and Kansas City. After the Civil War, rail construction burgeoned, creating new towns, opportunities for

business growth and development, and pushing agriculture from largely subsistence to a profit-making enterprise.

Population growth and an expanding economic base encouraged the development of religious, educational, and social institutions across the state. The last three decades of the nineteenth century were times of booms and busts in the state. Missouri's recent past record indicate a state that is highly motivated in the preservation of its historic past. According to the MDNR, Division of State Parks, State Historic Preservation Office (SHPO) it is important to recognize that preservation in the state of Missouri is not the responsibility of any one entity or organization. The network of individuals, governmental, and private-sector partners cooperatively working together is what makes for effective preservation of Missouri's irreplaceable heritage (MDNR 2018a).

3.9.1.2 National Register of Historic Places

There are NRHP properties listed in all of Missouri's 114 counties and one independent in the City of St. Louis. In total, there are approximately 2,250 listings in the study area, including schools, churches, historic districts, multiple property submission listings, and sites (NPS 2020).

3.9.1.3 Native American Tribes

Missouri at one time was home to several Native American tribes, but today none remain. The Illini, Missouri, Osage, and Quapaw were the primary tribes, with the Chickasaw occupying the far southeastern corner, the Ioway in the northern border, and the Otoe in the far northeastern corner of the state. All of these tribes were removed to Oklahoma. A few Missouri Native Americans were reported to have escaped during the removal. Others may have married into Euro-American families earlier and avoided removal in that fashion (Estes 2012).

Other tribes crossed Missouri on their forced march, known as the Trail of Tears, in the 1830s, while being removed to Oklahoma. In particular, the Cherokee were housed in the eastern side of the Mississippi River during the winter of 1838, many freezing and starving, and crossed into Missouri in the spring of 1839. Later records show that many fell ill and left along the way. It does appear that although the tribes native to Missouri were removed and their land confiscated in the 1830s, some 80–90 years later, Native Americans were still present in Missouri—not as an organized tribe, but as remnant peoples (Estes 2012).

3.9.2 Environmental Consequences – Proposed Action

Potential effects on historic properties are reviewed under the criteria of adverse effect at 36 CFR § 800.5 (a)(1). An *adverse effect on cultural resources* is defined as an undertaking that may alter, either directly or indirectly, the integrity of any historic properties that qualify for inclusion on the NRHP. Adverse impacts may include those visual effects that diminish a property's integrity, historical significance, or eligibility for listing on the NRHP; however, the temporary nature of the ground-disturbing Covered Activities would not result in any long-term visual impacts on the historic setting. The cultural resources in this EA are examined at a broad scale because the exact location and timing of Covered Activities in the study area are unknown.

3.9.2.1 Effects from Covered Activities

Certain Covered Activities would involve ground-disturbing activities that may adversely affect historic properties. Potential ground-disturbing Covered Activities include tree removal (which

includes fire breaks), road and trail construction, building construction, some forms of road maintenance activities, building removal, and rehabilitation or demolition of structures. Surface disturbance or even shallow ground disturbance from Covered Activities may disturb or expose previously buried cultural resources.

Indirect adverse effects to known and unknown historic properties may occur through site vandalism and illegal site excavation of newly identified sites. Where Covered Activities result in additional erosion or alternations in the hydraulic cycle, indirect impacts on known or unknown cultural resources may also occur.

In accordance with provisions set forth in criteria of adverse effect at 36 CFR § 800.5 (a)(1), potential adverse effects on historic properties from Covered Activities include:

- Physical damage to part or all of the historic property
- Change to the integrity of the property including the property setting
- Removal of historic property from its present location
- Any alteration to the historic property not consistent with the Interior Standards for Treatment of Historic Properties (36 CFR Part 68) and applicable guidelines

It is important to note that under NHPA, only properties identified as eligible or potentially eligible for inclusion on the NRHP are required to be reviewed through the Section 106 process. This means that those deemed not eligible for inclusion on the NRHP do not require avoidance or mitigation under NHPA. In cases where an undertaking may not have adverse effect on historic properties (see 36 CFR § 800.3 (a) (1)), no avoidance or mitigation measures are required. Value engineering measures could efficiently be used at the planning stages of a project to modify proposed activities to avoid adverse effects on historic properties.

In all applicable cases where adverse effects on historic properties are anticipated, compliance with the NHPA is required by law for all federal undertakings. An undertaking is defined in 36 CFR § 800.16(y) of the NHPA's implementing regulations as "a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a federal agency, including those carried out by or on behalf of a federal agency; those carried out with federal financial assistance; and those requiring a federal permit, license or approval." The Service recognizes the magnitude and nature of the undertaking and degree of federal involvement and intends by this process to maintain maximum flexibility in achieving NHPA goals while meeting statutory and regulatory obligations.

The issuance of an ITP for activities covered in an HCP constitutes an undertaking subject to review and compliance under Section 106 of the NHPA. Although an ITP issued under section 10(a)(1)(B) of the ESA authorizes take of species "incidental to, and not the purpose of, the carrying out of an otherwise lawful activity," those same otherwise-lawful activities are subject to approval under other applicable federal, state, or local regulations, including the NHPA. The covered activities and conservation measures described in an HCP that have the potential to cause an adverse effect to historic properties are therefore subject to further review under applicable statutes, including the NHPA. Section 106 and its implementing regulations at 36 CFR Part 800 provide the steps and requirements for complying with NHPA.

Note that only properties identified as eligible or potentially eligible for inclusion on the NRHP are required to be reviewed through the Section 106 process. In practical terms, this means that not every artifact or building will meet the definition of a historic property under section 106, so those that fail to meet the criteria of eligibility do not require avoidance or mitigation under NHPA. In

some cases, an undertaking may have no potential to affect historic properties (36 CFR § 800.3 (a)(1)). It may also be possible to modify proposed activities to avoid adverse effects. This is most efficiently accomplished at the early planning stages of the project.

Because the covered activities and conservation measures proposed for coverage under the ITP are under the sole and direct control of the applicant and may occur within the 42-million-acre Covered Lands over the course of 50 years, and the entire permit area has not been surveyed to the requirements found in regulations at 36 CFR § 800.4(b)(1), Service must rely on information provided by applicants, their consultants, or designees to satisfy the requirements of the NHPA process. Therefore, the applicant will consult with the SHPO. The Service remains responsible for all required findings and determinations associated with the NHPA review, coordination with the applicant and SHPO, and documented completion of the compliance process. However, the Service will require the permittees to satisfy Section 106 requirements prior to initiating any ground-disturbing activities that could affect historic properties and provide documentation to the Service.

The intent of Section 106 is not to stop or delay projects, but to ensure that issues concerning historic and cultural resources receive reasonable and fair consideration. These review processes are performed in the project planning stage, when adverse impacts on the environment can best be avoided or mitigated.

Completion of the required NHPA consultation process can be satisfied through several alternative pathways. For example, the applicant could choose to consult with SHPO on a project-by-project basis, coordinate NHPA consultation on each resource/comprehensive management plan, develop an agreement with the SHPO that could spell out requirements for future consultations on a programmatic basis, or identify another alternative. The applicant is encouraged to choose the scope and scale of coordination that best suits their needs, so long as documentation confirming that the required consultation has been concluded and provided to the Service.

The Section 106 process also requires consultation with federally recognized Tribal Nations whose interests could be affected by covered undertakings (or covered activities). In accordance with 36 CFR Part 800, the Service shall delegate initiation of Tribal consultation to the permittee. As part of their Section 106 compliance, the applicant will notify consulting Tribes about proposed undertakings early in the planning process, and take Tribal comments on historic properties into consideration prior to initiating any ground-breaking activities that could affect historic properties. The applicant will provide documentation of Tribal consultation to the Service.

3.9.2.2 Effects from the Conservation Strategy

HCP conservation measures that would avoid and minimize ground disturbance would minimize adverse effects on cultural resources. Conservation Measure #7 (in Table 2-8) includes establishing PBMZs and associated 100-foot protective riparian buffers on streams, lakes, and ponds, which would significantly minimize ground-disturbing activities in these areas. Conservation Measures #5 and #9 would ultimately result in no or less ground-disturbing activities in some areas, which would decrease the potential for impacts on cultural resources. Any cultural resources in the areas where these conservation measures are implemented would not be exposed to the same level of potential impact that could have otherwise occurred under the No Action Alternative.

3.10 Socioeconomics

3.10.1 Affected Environment

This section provides an overview of socioeconomic conditions that might be affected by Covered Activities. The Council on Environmental Quality NEPA implementing regulations state that the human environment “shall be interpreted comprehensively to include the natural and physical environment and the relationship of people with that environment” (40 CFR § 1508.14). This means that economic or social effects are not intended by themselves to require preparation of an environmental analysis. When economic, social, and natural or physical environment effects are interrelated, then the environmental analysis will discuss these effects on the human environment (40 CFR § 1508.14).

3.10.1.1 Labor Force

In June 2020, the total labor force of Missouri consisted of approximately 3,059,038 people with an unemployment rate of 3.8 percent. As shown in Table 3-15, from June 2010 to June 2020, the unemployment rate decreased by 1.7 percent. The average unemployment rate in Missouri over the last 10 years is 5.8 percent (BLS 2020).

Table 3-15. Missouri Labor Force and Unemployment Rate, 2010 and 2020

Year	Labor Force	Employed	Unemployed	Unemployment Rate (%)
June 2010	3,059,038.00	2,768,613.00	290,425.00	9.5
June 2020	3,027,726.00	2,791,523.00	236,203.00	7.8
Change	-31,312.00	+22,910.00	-54,222.00	-1.7
Percentage Change (%)	-1.02	+0.82	-18.70	-17.9

Source: BLS 2020.

Table 3-16 summarizes employment by select industry sectors between 2008 and 2018. During this period, growth in employment occurred in the non-farm sector, and support activities for agriculture and forestry subsectors. A decline in employment occurred in the farm sector and in the forestry and logging industry and fishing, hunting, and trapping subsectors. Overall, the total number of jobs increased in the State of Missouri from 3,625,612 in 2008 to 3,779,836 in 2018.

Table 3-16. Missouri Employment for Farm, Nonfarm, and Forestry, Fishing, and Related Activities in 2008 and 2018

Employment by Sector	2008	Percentage of Total (%)	2018	Percentage of Total (%)
Farm Employment	104,343	3	93,918	2
Nonfarm Employment	3,521,269	97	3,685,918	98
Forestry, Fishing, and Related Activities ^a	-	-	-	-
Forestry and Logging	2,129	0	1,935	0
Fishing, Hunting, and Trapping	882	0	813	0
Support Activities for Agriculture and Forestry	8,834	0	11,670	0
Subtotal	11,845	0	14,418	0

Employment by Sector	2008	Percentage of Total (%)	2018	Percentage of Total (%)
Total Employment (Number of Jobs)	3,625,612	-	3,779,836	-

Source: Bureau of Economic Analysis (BEA) 2020.

^a This sector comprises less than 1 percent of all employment for 2008 and 2018.

3.10.1.2 Economics

Economic Impacts of Ecosystem Services from Bats

Bats in Missouri play essential ecological and economic roles in the agriculture and ecosystem of the state, primarily because they are the main predators on night-flying insects. Bats consume millions of insects each summer, many of which are crop pests, such as corn ear worms and cucumber beetles, or pests to humans, such as mosquitos. In and around forests, bats eat tremendous numbers of moths (Clawson et al. 2006). Two studies have estimated that female little brown bats consume over 100 percent of their body weight in insects each night during lactation and 50 percent of their body weight during the rest of the active season. Indiana and northern long-eared bats are related to little brown bats, and likely consume a similar quantity of insects (Womack 2018).

The article “Economic Importance of Bats in Agriculture” asserts that bats are likely one of the most economically important nondomesticated animals in North America (Boyles et al. 2011). The article presents a study in Texas that concluded the value of pest suppression services provided by bats ranges from about \$12 to \$173 per acre (with a most likely scenario of \$74 per acre) in a cotton-dominated agricultural landscape in southern-central Texas. These estimates were then extrapolated to the entire United States as a first assessment of how the agricultural industry would be affected without the ecosystem services provided by bats. Assuming values obtained from the cotton-dominated agroecosystem in Texas and the number of acres of harvested cropland across the continental United States in 2007, the study estimates the value of bats to the agricultural industry is roughly \$22.9 billion per year. If values at the extremes of the probable range are used, the value of bats in the ecosystem are as low as \$3.7 billion per year and as high as \$53 billion per year (Boyles et al. 2011).

Economic Impacts from Forestry and Logging

Forest land in Missouri makes up about 35 percent of total land area in the state (USDA 2014). About 82 percent of the total forest land in Missouri is privately held, whereas the other 18 percent is publicly held. Forest land in Missouri has seen a slight decrease (1.3 percent) in recent years, from about 15.5 million acres in 2014 to about 15.3 million acres in 2019 (USDA 2021).

Direct employment in the forestry and logging industry experienced a decline of 9 percent between 2008 and 2018 (2,129 jobs in 2008 to 1,935 jobs in 2018; Table 3-16). Support activities for forestry and logging experienced a growth of 32 percent between 2008 and 2018 (8,834 jobs in 2008 to 11,670 jobs in 2018; Table 3-16). Overall, the forestry, logging, and support activities sector account for less than 0.5 percent of total employment in Missouri (Table 3-16); however, the forestry sector is a substantial economic contributor to the economy of the State of Missouri. In 2018, forest products, wood, lumber, paper, and related industries contributed \$9.7 billion to the Missouri economy (MDC 2018a). These industries support more than 41,000 jobs, with a payroll of over \$2.6 billion. In addition, the forestry sector was responsible for \$800 million in taxes and \$103 million in state sales tax. These numbers include logging and sawmill operations, secondary wood products, furniture and cabinet makers, log cabins, and paperboard manufacturing. The total economic impact

for field and logging operations plus primary mills is estimated at \$1.9 billion, supporting more than 11,500 jobs at a total payroll of about \$760 million. These numbers fluctuate from year to year, as forest products and related industries are affected by the overall economy (MDC 2018a).

In 2018, the State of Missouri harvested a total of 746,245 thousand board feet of industrial roundwood (MDC 2018a). MDC's Ozark Region was the leading supplier of industrial roundwood, with 252,000 thousand board feet in 2018 (MDC 2018a). Data from the *Missouri Timber Market Price Trend: 2018 1st Quarter Report* (MDC 2018b) was used to estimate the economic value of timber harvest in Missouri. The quarterly Timber Market Price Trend data are reported for two regions (North and South). These two regions reflect unique forest product markets in Missouri. The timber harvest amount in each region was calculated and applied to the average timber price for that region. The prices for all tree species for each region were then averaged and applied to the timber harvest amount per region in order to estimate the economic value of timber harvest in Missouri in 2018 as shown in Table 3-17. Overall, the economic value of timber harvest for the State of Missouri was approximately \$263 million in 2018.

Table 3-17. Economic Value of Harvest Volume for Missouri, 2018

Region	Land Percentage	MBF	Average Timber Price/Region	Timber Price
North	38	280,688	\$665	\$186,657,520
South	62	465,557	\$165	\$76,816,905
Total	100	746,245	-	\$263,474,425

Sources: MDC 2018a; MDC 2018b.

MBF = thousand board feet

Timber harvests also occur on MDC lands. Table 3-18 shows timber harvest acreages and timber sales on MDC lands from 2010–2015. MDC Annual Reports from 2016 to 2020 were not available for this analysis. From 2010 to 2015, the total timber harvest on MDC lands was approximately 35,590 acres, with timber sales at \$15.5 million (Table 3-18). MDC harvested an average of 7,118 acres of trees from 2010 to 2015. Timber sales on MDC lands has seen a decrease (47 percent), from \$3.6 million in 2010 to \$1.9 million in 2015. In conjunction with the timber sales, harvest acreage on MDC lands has also seen a 41 percent decrease. It should be noted that harvest acreage did slightly increase (7 percent) between 2011 and 2012. For additional information on timber harvest trends, refer to HCP Chapter 2, *Covered Lands and Activities*.

Table 3-18. Harvest Acreage and Timber Sales on MDC Lands from 2010 to 2015

Fiscal Year	Harvest Acreage	Timber Sales	Average Price Per Acre
2010–2011	8,010	\$3,625,946	\$453
2011–2012	8,578	\$2,642,195	\$308
2012–2013	7,922	\$1,894,080	\$239
2013–2014	6,311	\$2,959,932	\$469
2014–2015	4,769	\$1,993,142	\$418
Total	35,590	\$15,498,551	-
Average	7,118	\$3,099,710	\$361

Sources: MDC 2010a; MDC 2011b; MDC 2012; MDC 2013; MDC 2014b; MDC 2015b.

Note: MDC Annual Reports from 2016 to 2020 were not available for review.

Recreation and Tourism

Recreation and tourism activities are common uses for public lands that generate economic activity for state and local economies. A 2018 report by the Outdoor Industry Association (OIA 2018) noted that outdoor recreation is among the largest economic sectors in the United States, generating \$887 billion annually in consumer spending, directly supporting 7.6 million jobs and generating \$125 million in tax revenue. Missouri outdoor recreation generates \$14.9 billion annually in consumer spending, supports 133,000 jobs, creates \$4.6 billion in salaries and wages, and produces \$889 million in tax revenue (OIA 2018). In 2011, total expenditures on wildlife-related recreational activities in Missouri equaled \$2,681,426, and total expenditures on fishing and hunting equaled \$1,740,608 (DOI et al. 2011). In 2018, Missouri State Parks were visited by 21 million people (Missouri State Parks 2019). Missouri's regional and local parks and recreation agencies produced nearly \$2 billion in economic activity in 2015, which in turn supported over 16,000 jobs and \$719 million in labor income (MDNR 2018b). In fiscal year 2014, a total of 1,9994,021 hunting and fishing permits were issued, and revenues were over \$33 million (MDC 2015c).

3.10.2 Environmental Consequences – Proposed Action

Potential socioeconomic impacts are assessed at a broad scale because the location and timing of the Covered Activities are not known. The Covered Activity with the greatest potential to affect socioeconomic conditions is timber harvest. Any increased timber harvests compared to baseline conditions may result in additional jobs and revenue. Any increase in the use of prescribed burns compared to baseline conditions could result in a localized short-term reduction in recreational access and corresponding localized losses of recreational revenue. The construction of roads, trails, and structures may result in increased access to recreational opportunities and additional recreational resources (e.g., additional hiking trails), which could lead to additional revenue from recreational activities.

3.10.2.1 Labor Force

Timber harvest and tree removal associated with the Covered Activities under the Proposed Action is projected to average approximately 104,424 acres per year, totaling 5,221,200 acres over the 50-year permit term. The increase in timber harvest and tree removal activities over the 50-year ITP term could result in limited increased forestry and logging jobs (i.e., direct employment), as well as indirect employment in the forestry processing sector and other support jobs. Forestry and logging jobs made up less than 0.5 percent of all employment in Missouri in 2018 (see Section 3.10.1.1, *Labor Force*), and any forestry and logging jobs created from increased or decreased timber harvest tree removal associated with the Covered Activities are likely to have a negligible effect on overall employment in the state.

3.10.2.2 Economics

Economic Value of Ecosystem Services Provided by Bats

As noted in the *Economic Value of Ecosystem Services Provided by Bats* section in Section 3.10.1.2, *Economics*, bats provide an ecosystem service to the agriculture industry in the form of pest control. Covered Activities would result in take of Covered Species, which could have an adverse effect on ecosystem services by removing individual bats from the population. However, the estimated number of Covered Species individuals that would be lost annually due to take would be extremely small compared to the Covered Species' populations. As shown in HCP Table ES-3, *Conservative*

Estimate of Bats Taken by Covered Activities, the number of individual bats removed from the population annually from Covered Activities is approximately 0.01 percent or less of the population for each of the Covered Species. In addition, the HCP conservation strategy is expected to benefit bat populations in the long term in Missouri. Overall, the Proposed Action could result in short-term negligible adverse effects on ecosystem services, but is anticipated to result in a long-term economic benefit to the agriculture industry by controlling pest populations and thereby helping prevent crop losses and minimizing the use of pesticides. Therefore, the Covered Activities would not result in any significant adverse impacts on the economic value of ecosystem services provided by bats.

Economic Impacts from Forestry and Logging

Any additional timber harvest and tree removal associated with the Covered Activities under the Proposed Action relative to baseline conditions would likely increase the board feet of timber that could be harvested, and related economic benefits of those forest products compared to current levels (refer to Table 3-17 and Table 3-18). This additional harvest capacity would result in beneficial economic impacts.

3.10.2.3 Effects from the Conservation Strategy

Implementation of the HCP Conservation Strategy is not anticipated to significantly affect socioeconomics in the study area.

Appendix A

Water Resources

Table A-1. Acres of Subregional Watersheds and Covered Lands within each Subregional Watershed

Regional Watershed (HUC 2)	Subregional Watershed (HUC 4)	Study Area in Subregional Watershed			Percentage of Covered Lands by Regional Watershed
		MDC Lands ^a	Other Non-Federal Lands	Total	
Arkansas-White-Red	Neosho-Verdigris	21,240	1,839,629	1,860,869	17.80%
	Upper White	336,541	5,449,979	5,786,520	
	Total	357,781	7,289,608	7,647,389	
Lower Mississippi	Lower Mississippi-Hatchie	20,878	526,351	547,229	6.94%
	Lower Mississippi-St. Francis	46,680	2,386,446	2,433,126	
	Total	67,557	2,912,797	2,980,355	
Missouri	Chariton-Grand	80,266	5,223,561	5,303,828	53.77%
	Gasconade-Osage	194,485	8,764,262	8,958,747	
	Kansas	0	4,558	4,558	
	Lower Missouri	107,457	6,381,685	6,489,142	
	Missouri-Nishnabotna	49,052	2,300,053	2,349,105	
Total	431,261	22,674,120	23,105,380		
Upper Mississippi	Des Moines	1,253	38,236	39,488	21.50%
	Upper Mississippi-Iowa-Skunk-Wapsipinicon	0	1	1	
	Upper Mississippi-Kaskaskia-Meramec	100,056	4,136,690	4,236,746	
	Upper Mississippi-Salt	66,889	4,895,912	4,962,801	
Total	168,198	9,070,838	9,239,036		

Source: USGS 2020.

^a MDC lands (those owned and/or managed by MDC) and other non-federal lands. MDC activities may also occur on federal lands owned by the U.S. Army Corps of Engineers or other federal entities, which are leased to MDC.

HUC = Hydrologic Unit Code; MDC = Missouri Department of Conservation

Table A-2. Linear Streams/River Miles and Waterbody Areas (Acres) on Covered Lands

Surface Water Type	MDC Lands ^a	Other Non-Federal Lands	Total
Perennial Stream/River ^b	535	21,143	21,678
Intermittent Stream/River ^c	2,937	132,758	135,695
Stream Total (miles)	3,472	153,901	157,373
Lake/Pond Perennial ^d	32,249	391,648	423,897
Lake/Pond Intermittent ^e	1,636	2,920	4,555
Reservoir ^f	22	4,964	4,986
Waterbody Total (acres)	33,907	399,532	433,438

Source: USGS 2020.

^a MDC lands (those owned and/or managed by MDC) and other non-federal lands. MDC activities may also occur on federal lands owned by the U.S. Army Corps of Engineers or other federal entities, which are leased to MDC.^b A perennial stream has continuous flow all year during a year with normal rainfall.^c An intermittent stream only contains water during portions of the year.^d A perennial waterbody contains water throughout the year during years with normal rainfall.^e An intermittent waterbody contains water during portions of the year.^f A reservoir is a natural or artificial waterbody used to store water.

MDC = Missouri Department of Conservation

Table A-3. Causes of Designated Use Impairments Assigned to Missouri's Classified Streams

Total Impaired Streams/Rivers (miles)		8,148
Impairment Cause	Impaired Stream Miles	Percent of Total Miles
Bacteria (Fecal Coliform and <i>E. coli</i>)	3,455	42.4
Low Dissolved Oxygen	1,328	16.3
Mercury in Fish Tissue	849	10.4
Lead	539	6.6
Fish Bioassessments	369	4.5
Macroinvertebrate Bioassessments	278	3.4
Cadmium	265	3.3
Zinc	263	2.1
Sediment/Siltation	167	1.4
Water Temperature	116	1.3
Chloride	105	1.1
Habitat Assessment	92	0.7
Unknown Cause(s)	53	0.6
pH	50	0.5
Ammonia, Total	44	0.5
Sulfates	37	0.4
Physical Substrate Habitat Alterations	32	0.4
Total Dissolved Solids	28	0.2
Solids, Suspended Bedload	18	0.2
Ammonia, Un-ionized	13	0.1
Copper	9	0.1
Dissolved Oxygen Saturation	9	<0.1
Nickel	8	<0.1

Total Impaired Streams/Rivers (miles)		8,148
Impairment Cause	Impaired Stream Miles	Percent of Total Miles
Total Suspended Solids	5	<0.1
Chlordane in Fish Tissue	4	<0.1
Polycyclic Aromatic Hydrocarbons	4	<0.1
Biological Indicators of Eutrophication	4	<0.1
Total Nitrogen	4	<0.1
Total	8,148	100.0

Source: MDNR 2020b.

Table A-4. Causes of Designated Use Impairments Assigned to Missouri's Classified Lakes

Total Impaired Lakes (acres)		308,341
Impairment Cause	Impaired Lake Acres	Percent of Total Acres
Chlorophyll (Total and Chlorophyll-a)	108,682	35.0
Total Nitrogen	84,503	27.0
Biological Indicators of Eutrophication	83,642	27.0
Mercury in Fish Tissue	27,169	8.8
Total Phosphorus	2,182	0.7
Dissolved Oxygen Saturation	2,119	0.7
Pesticides (Atrazine)	44	0.01
Total	308,341	100.0

Source: MDNR 2020b.

Water Resources Buffer Details

The HCP conservation measures, specifically the stream and aquatic habitat buffer guidelines, would minimize or avoid adverse impacts on surface water resulting from the Covered Activities involving the removal of vegetation. Current MDC guidelines and the HCP conservation measures include maintaining a buffer of 100 feet from each side of perennial streams (third order streams). The PBMZ approach uses roost locations and water sources (such as second-order streams, lakes, and ponds) to create PBMZs that protect high-quality maternity zones. This PBMZ approach consolidates activity areas for bats and factors in aquatic features in a way that allows for long-term planning and is consistent with Service guidance on creating protected zones.

Appendix B

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List of Preparers

U.S. Fish and Wildlife Service

- John Weber, Deputy Field Supervisor, Missouri Field Office

Contractors

ICF

- David Johnson, Project Manager
- Madeline Terry, Project Director
- Alex Bartlett, Water Resources Lead
- David Ernst, Air Quality and Climate Change
- Kylan Frye, Biological Resources
- Lissa Johnson, GIS
- Tamar Love Grande, Editor
- Jenelle Mountain-Castro, Publications Specialist

Seagull Environmental Technologies, Inc.

- Ryan Lunt, Socioeconomics
- Hieu Vu, Socioeconomics

Mustardseed Cultural and Environmental Services, LLC

- Ike Francis, Cultural Resources and Soils
- Timberlyn Smith, Cultural Resources and Soils

Appendix D

Responses to Public Comments

1. Public Comment #FWS-R3-ES-2021-0062-0005; Commenter: Jean Publieee, Flemington, New Jersey

i totally oppose this plan. i do not want any of the bats killed and used for research. we are in big trouble right now because fake fauci did a bat research plan with china and it is a plague. i do not believe gods put bats on this eart for this morbid disgusting evil venomous reason. leave the bats alone and protect them from the evil dr strangelove dr faucis. they lie they waste our tax dolalrs. they make people sick with crap punched into americans bodies. this entire bat thing is sick.

Response: The comment does not raise any specific concern regarding the conclusions or adequacy of the draft EA or HCP, and no revisions are necessary. The U.S. Fish and Wildlife Service (USFWS or Service) will consider all comments received on the draft Environmental Assessment (EA) and Habitat Conservation Plan (HCP) and the entire environmental record when preparing its final decision regarding the issuance of the Incidental Take Statement (ITP).

2. Public Comment #FWS-R3-ES-2021-0062-0006; Commenter(s): Grand Valley Students, Allendale, Michigan

I understand that the Missouri Department of Conservation would like a permit to do a forest habitat restoration project. As a part of completing this project, there is a risk to the surrounding bat population. This project could potentially take around 21 bats, but in return would restore 28 thousand acres of land, making it much more suitable for the remaining bats as well as other species. Have you taken a hard look at whether this is in the best interest of the bats? Will your restoration have a positive impact on bat population in the future? After all, it is a controversial topic of who will qualify for these permits in the future. Will you be more likely to allow incidental take of bats in the future even if there will be less positive impacts? According to a special on the mid-Missouri local radio station: KBIA I see that the population of bats in this area have been negatively affected by White-Nose Syndrome.

Regarding the Habitat Conservation plan; I would propose that incidental take permits only be available for conservation and restoration projects that will help more bats than they harm (which the MDC likely qualifies for). I would like NEPA to research the potential impacts of each project before a permit is issued to get a more accurate estimation of the quantity of incidental takes that could occur. While I see that this project has a net positive effect on the overall bat population in the long run due to the benefit of the restoration, I still believe there is more background work that could be included in this proposal. This leads to my comment on the length of the permit.

I propose that instead of a 50 year permit, the permit would be reduced to 10 years. Although I understand that management projects do not happen overnight, 50 years is a very long time to go unchecked. If a project lasts longer than 10 years, I propose that they must reapply for another permit. This would allow time for investigation and further research to verify the actual number of incidental takes is not higher than the allotted amount. If the applicant has taken more bats than is in the best interest of the population, they will be denied the permit and must stop the project. If they prove that they are not having a significant negative impact on the bat population they shall be issued another permit to continue for another 10 years.

Issue #1: *RE: Have you taken a hard look at whether this is in the best interest of the bats?* Commentor questions the benefit of the HCP to bats.

Response: The commenter refers to the taking of 21 bats, which is specific to Indiana bat. However, mitigation (and impacts) are assessed for all five covered species. Per the *Habitat Conservation Planning and Incidental Take Permit Processing Handbook* (HCP Handbook)⁷, the proposed mitigation must fully offset the impact of the taking or—at a minimum—minimize and mitigate to the maximum extent practicable. This has been done by analyzing the potential impacts on bats (see HCP Chapter 4, *Effects Analysis*) and describing the proposed avoidance, minimization, and mitigation (see HCP Chapter 5, *Conservation Strategy*). The Net Effects of impacts and conservation are described in HCP Section 5.3, *Beneficial and Net Effects*. See also the response to Issue #2, below.

Issue #2: *RE: Will your restoration have a positive impact on bat population in the future?* Commentor questions the effects of restoration on bat populations.

Response: The core activity permitted by the HCP—habitat management (e.g., prescribed fire and tree removal for habitat restoration and management)—has been assessed with respect to the future sustainability of bat populations (refer to HCP Section 5.3, *Beneficial and Net Effects*, and Section 4.3.4, *Impacts of the Taking*). Habitat management maintains and improves habitat on the landscape over the long term. The few bats killed will be offset by increased fertility and survivorship accomplished through habitat management. Management techniques that the Missouri Department of Conservation (MDC) implemented promote heterogeneity in forests across Missouri, providing appropriate species composition and forest structure necessary to maintain long-term viability of bat populations. Forests with greater diversity are more capable of coping with fluctuations in environmental conditions. Such resilience can help buffer against climate change and its potential effects on Missouri's forests.

For future positive sustainability of bat populations, the MDC will be developing priority bat management zones in areas with documented summer use by target bat species, creating protective buffers that will provide avoidance and minimization acreages around areas known to contain bat roosts, implementing seasonal avoidance around known bat hibernacula, protecting and managing old-growth forests in appropriate habitat around all caves and other subterranean sites on MDC lands, maintaining physical barriers (i.e., gates) at subterranean sites, where appropriate, providing outreach programs to citizens regarding the presence of bat populations on private lands, and updating research on white-nose syndrome. Over the course of the 50-year permit term, these areas will be protected and enhanced and will be re-delineated to adjust for changes through time, particularly with respect to white-nose syndrome.

Issue #3: *RE: Will you be more likely to allow incidental take of bats in the future even if there will be less positive impacts?* Commentor questions whether future incidental takes of bats will continue to occur if the permitted projects result in less positive impacts on the bat population, notably in light of continued negative impact by white-nose syndrome.

Response: For the duration of the 50-year permit term, an annual report will be submitted to the Service detailing compliance, impacts, conservation actions, and monitoring through data tracking. Analysis of each year's activities will include an assessment of the impacts of white-nose syndrome

⁷ U.S. Department of the Interior Fish and Wildlife Service; U.S. Department of Commerce National Oceanic and Atmospheric Administration National Marine Fisheries Service. 2016. *Habitat Conservation Planning and Incidental Take Permit Processing Handbook*. December 21.

on the five covered bat species. As the Service issues the incidental take permit and oversees implementation and enforcement of the permit, review and approval by the Service may be required if progress toward conservation goals negatively changes through the 50-year permit term.

The HCP documents all of the potential take permitted over the next 50 years, as well as the required conservation measures that will be implemented. Incidental take beyond what is described and quantified in the HCP is not covered and would require a separate permit or a permit amendment. As long as the MDC is implementing the terms of the HCP properly, the permit will be valid over the permit term, except in extreme cases where the species is in jeopardy of extinction. To date, of the several hundred HCPs permitted by the Service, ITP revocation due to jeopardy has not occurred.

Issue #4: RE: Regarding the Habitat Conservation Plan; I would propose that incidental take permits only be available for conservation and restoration projects that will help more bats than they harm (which the MDC likely qualifies for). Commenter proposes that the MDC only issue permits on projects that will result in a positive impact on bats.

Response: This HCP is designed to be programmatic in nature. Across the landscape and over the permit term, the actions that benefit bats are expected to offset fully any impacts. As discussed above in responses to Issue #1 and Issue #2, the rationale for this conclusion is addressed in HCP Section 5.3, *Beneficial and Net Effects*. The Service also notes that under Endangered Species Act (ESA) section 10, the Service cannot issue an ITP unless specific criteria are met (see EA Section 1.2, *Proposed Federal Action*), including that “the taking will not appreciably reduce the likelihood of survival and recovery of the species in the wild.”

Issue #5: RE: I would like NEPA to research the potential impacts of each project before a permit is issued to get a more accurate estimation of the quantity of incidental takes that could occur. The commenter proposes that NEPA analyses be performed for each project before an ITP is issued.

Response: Researching the potential impacts of each project before an ITP is issued is outside the scope of the EA and would not meet the needs of the MDC. An HCP is a voluntary method to which a non-Federal entity may comply with the ESA. Under ESA section 10, an HCP enables the Service to issue an ITP to allow non-Federal entities to carry out otherwise legal activities that may “take” threatened or endangered species. An HCP can be programmatic (i.e., cover multiple activities over a wide geographic area and long period of time) or can be specific to a single project. Because the MDC determined that a programmatic HCP best suited their needs for conducting their mandated forestry activities, the Service must respond to MDC’s request for an ITP based on the HCP. As such, the Service’s National Environmental Policy Act (NEPA) document (EA) must address the Proposed Action of issuing an ITP based on the information presented in the HCP submitted by MDC and consider a reasonable range of alternatives in the EA. The MDC currently complies with ESA on a project-by-project basis; however, MDC has determined that this approach no longer suits their needs and that a programmatic HCP approach would be more efficient. Regardless of the HCP approach an applicant may take (programmatic HCP or project specific HCP), the Service can still only issue an ITP if all ITP issuance criteria are met (see EA Section 1.2, *Proposed Federal Action*, for issuance criteria). The Service does note in EA Section 2.1, *No Action Alternative*, that, in the absence of the conservation activities included in the HCP, the project-by-project approach to comply with ESA under the No Action Alternative would result in variable application, or nonapplication, of the avoidance and minimization measures included in the HCP and eliminate the application of compensatory mitigation. Similarly, the adaptive management approach included in the HCP would be applied variably or not at all.

Issue #6: RE: While I see that this project has a net positive effect on the overall bat population in the long run due to the benefit of the restoration, I still believe there is more background work that could be included in this proposal. The commentor believes more background work is needed for the HCP.

Response: This HCP was designed to meet the issuance criteria for an incidental take permit and follows regulatory guidance provided by the Service, including the HCP Handbook (see the 2016 HCP Handbook Glossary, which refers to “Section 10 (a)(2)(B) of the Endangered Species Act, which describes issuance criteria for incidental take permits...” and the HCP Handbook Section 12.5, *Effects Analysis and Permit Issuance Criteria*). The background work in the HCP document is consistent with the level of detail provided in other permitted HCPs. Without additional details about specific background work requested, the authors cannot provide a more specific response.

Issue #7: RE: I propose that instead of a 50 year permit, the permit would be reduced to 10 years. Although I understand that management projects do not happen overnight, 50 years is a very long time to go unchecked. The commentor proposes that the 50-year permit term for management projects be reduced to 10 years because 50 years is a long time to go unchecked, with reissuance after the project is reevaluated relative to the impact on the bat population.

Response: Based on guidance provided in the 2016 USFWS Handbook, in determining the duration of a permit, the decisionmakers consider the following:

- The duration of the planned covered activities;
- Whether available information is sufficient to develop a conservation program and determine effects on covered species over the proposed permit duration;
- How much certainty there is that the conservation plan will enhance the habitat and increase the long-term survivability of covered species [see 50 Code of Federal Regulations 17.22 and 17.32(b)(4) for USFWS];
- How well the monitoring and adaptive management program addresses risk and uncertainty; and
- Whether the funding strategy for the conservation program is sufficient for the proposed duration of the permit.

Forest management activities are long in duration because tree stand rotations for forestry often range from about 20 to 75 years. Considering the length of the covered activities that encompass forest management activities, a longer permit term is essential. The HCP will benefit the five covered bat species by providing 50 years of guaranteed protection and management for a minimum of 900,000 acres of natural habitat under MDC jurisdictions. The HCP represents a commitment by the state of Missouri to maintain and manage these lands for the 50-year permit term. This permit term will allow for a sufficient assessment of many of the effects of the proposed forest management activities on covered bat species, for tracking the implementation of conservation actions and the responses of resources to climate change and the uncertainties associated with the spread of white-nose syndrome.

To ensure that each project meets the incidental take permit requirements, the MDC will implement an internal and external organizational structure that includes biologists, foresters, administrators, and other natural resource specialists, who will carry out planning and design, monitoring, adaptive management, and periodic coordination with and reporting to the Service. Over the course of the 50-year permit term, these MDC-managed areas with known roosting/hibernacula/foraging activities

will be protected and enhanced and will be re-delineated to adjust for changes through time, particularly with respect to white-nose syndrome.

3. Public Comment #FWS-R3-ES-2021-0062-0007; Commenter: Anonymous

Please don't approve this plan for the sake of these five bat species. Please protect the northern long-eared, tricolor, little brown, Indiana, and gray bats from destruction. 50 years is a very long time and white-nose syndrome is still a very real threat to these bat species that has killed so many bats already. Please help the bats. God bless.

Response: The comment does not raise any specific concern regarding the conclusions or adequacy of the draft EA or HCP, and no revisions are necessary. The Service will consider all comments received on the draft EA and HCP and the entire environmental record when preparing its final decision regarding the issuance of the ITP. See response to Public Comment #FWS-R3-ES-2021-0062-0006 (Comment 2), for additional information.

4. Public Comment #FWS-R3-ES-2021-0062-0008; Commenter: Daniel Drees, Van Buren, Missouri

Good job on the MO [Missouri] Bat HCP. I am a retired MDC wildlife management biologist with considerable experience managing caves and cave bats. Since there is always room for improvement, I offer this suggestion. On page 5-6 the plan says, "Conservation measures associated with this objective include the implementation of a 20-acre buffer around the 275 identified caves on MDC lands within which habitat will be managed to provide old-growth forest conditions, and activities associated with this management will be restricted between March 15 and April 30 and September 15 and October 31." There are MDC caves that do not shelter bats for various reasons. Some caves routinely flood entirely to the ceiling. Some caves are low and short where racoons would get any bat. Restricting prescribed burns starting on March 15 for a cave with no bats is contrary to the science that says prescribed burning improves bat habitat. It would be wise to exempt caves that have no known history of bat use from the March 15 restriction since the last half of March is often the best for conducting prescribed burns.

Response: This measure was developed to address the fact that not all caves on MDC land have been surveyed for bat use or suitability. Additionally, tricolored bats use a wide variety of caves for hibernation, even very small, shallow caves, and may move between hibernacula during the winter. Because the population of tri-colored bats has declined significantly because of white-nose syndrome, defining what caves provide suitable hibernation habitat for this species in retrospect is not feasible. Therefore, in addition to the larger buffers applied to known hibernacula, the HCP provides a 20-acre buffer around all caves. This buffer is not entirely new; the practice of limiting active management within the 20-acre buffer around known cave entrances on MDC land with a goal of establishing and maintaining appropriate old-growth forest habitat in this buffer area has been a part of MDC habitat management guidance for many years. The primary change proposed is restricting management activities during defined time periods. The specific restrictions during these time periods are not defined in the HCP, and MDC recognizes the importance of prescribed fire in improving bat habitat. In practice, MDC will strive to prioritize completing prescribed burns in units that contain caves earlier in the season, to minimize the application of prescribed fire within the buffers during the restricted dates. However, if it is necessary to conduct prescribed burns in units that contain 20-acre buffers during the restricted dates, in order to meet management objectives (e.g., due to weather conditions), staff will use a burn plan that manages smoke dispersal. These measures are intended to facilitate manager ability to meet management objectives, while minimizing potential impacts on target bat species.