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1. PURPOSE AND NEED

1.1 Purpose

The Michigan Department of Natural Resources (DNR) has developed the Michigan Karner Blue Butterfly Habitat Conservation Plan (hereafter, Comprehensive HCP; Michigan DNR 2007) to facilitate the conservation of the Oak Sava

conditions, and HCP management partners would coordinate management activities and benefit from predictable regulatory approaches. The Comprehensive HCP would therefore facilitate efforts to evaluate and minimize the cumulative adverse impacts of individual projects to particular KBB populations.

Activities that would be conducted under the Comprehensive HCP would not be expected to either increase or decrease the amount of occupied KBB habitat in Michigan; rather, they would be conducted to help prevent the loss of occupied KBB habitat on non-Federal land. Maintenance of existing populations is a critical component of the KBB conservation program in Michigan. It is also consistent with objectives of the Federal Recovery Plan, which outlines a strategy for "maintaining extant populations" and "improving and stabilizing populations where the butterfly is imperiled" (USFWS 2003a:52). In this way, the Comprehensive HCP is a

Bu Fish and Wildlife Se a) divides existing KBB range w overy Units. Addition ith potential to contribute to the lo cies have also been id gure 2).

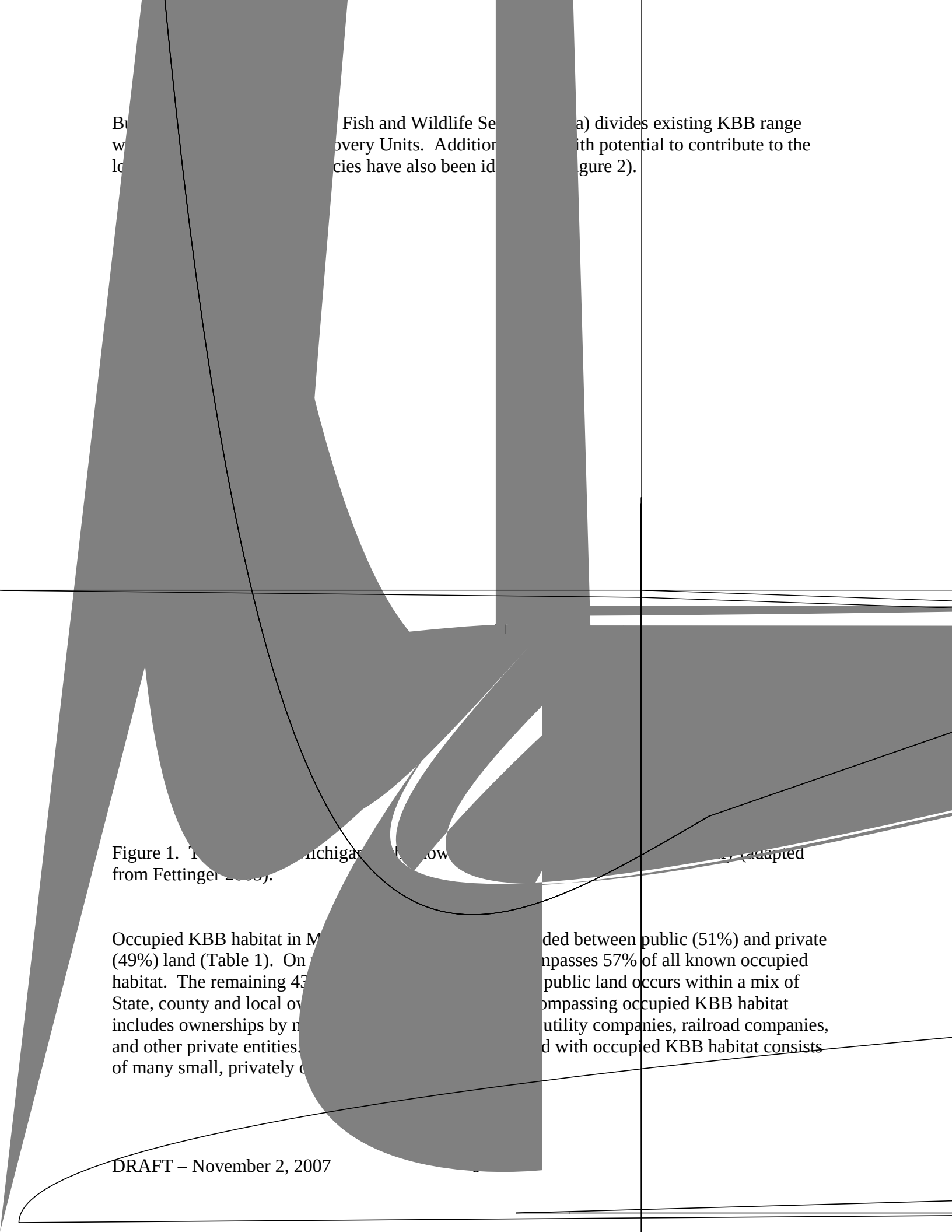

Figure 1. T ichiga low (adapted from Fettinger

Occupied KBB habitat in M ded between public (51%) and private (49%) land (Table 1). On mpasses 57% of all known occupied habitat. The remaining 43 public land occurs within a mix of State, county and local ow ompassing occupied KBB habitat includes ownerships by n utility companies, railroad companies, and other private entities. d with occupied KBB habitat consists of many small, privately

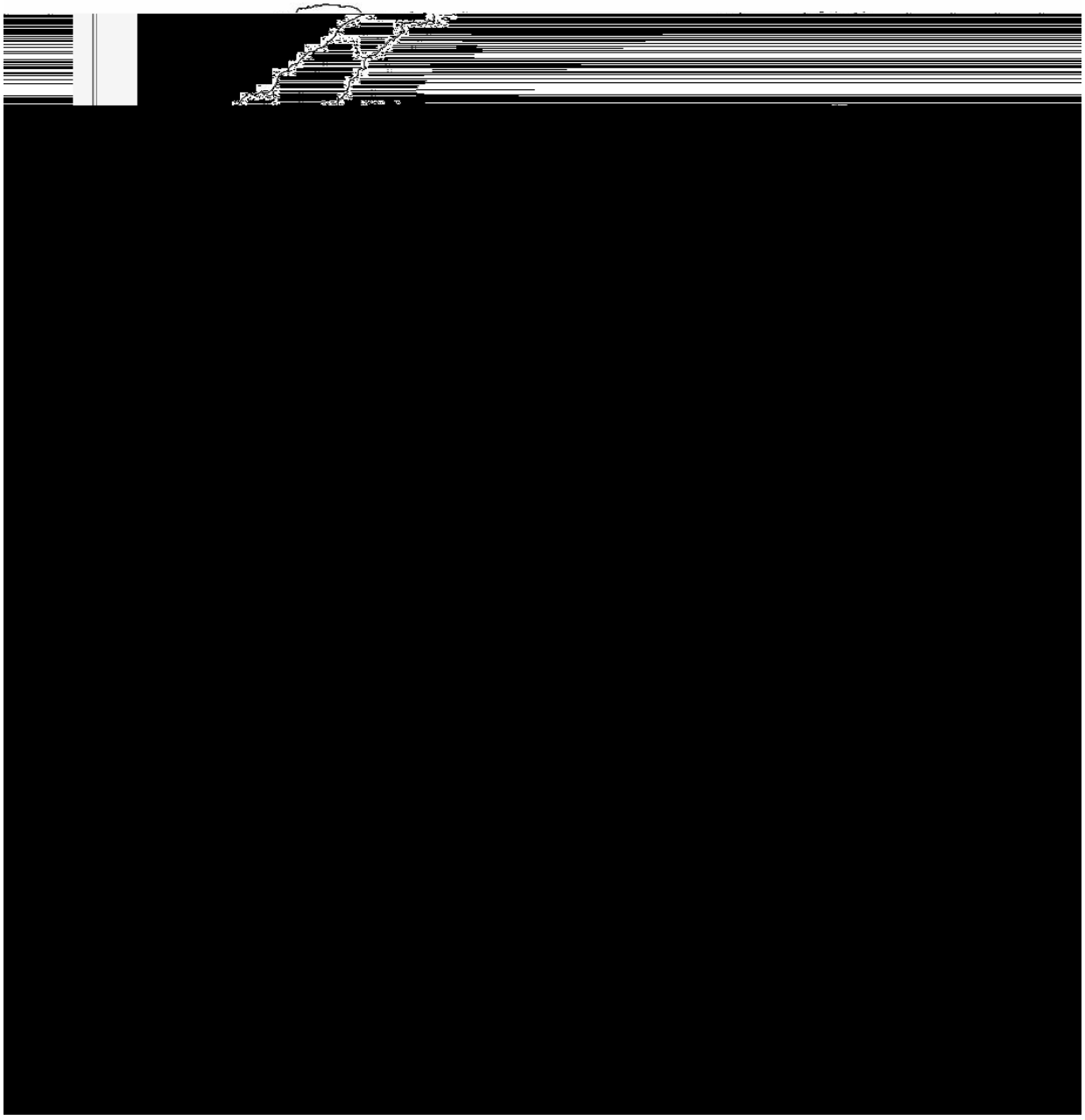

Table 1. Acres of occupied Karner blue butterfly habitat currently known to occur on public and non-public land within each Recovery Unit.

		Recovery Unit				
Ownership	**Owner**	**Allegan**	**Ionia**	**Muskegon**	**Newaygo**	**Total**

subset of those incidental take activities that would be conducted under the Comprehensive HCP alternative. The Comprehensive HCP alternative could apply to all occupied KBB habitat on non-Federal land in Michigan and would facilitate coordination among a wide diversity of management partners. The Reduced-scope HCP could apply only to a subset of occupied KBB habitat on non-Federal land and would facilitate coordination among a smaller number of partners. The No Action alternative would include activities in occupied KBB habitat that have already been authorized through other processes.

2.2.1 Alternative A: Comprehensive HCP (Proposed Action)

The Comprehensive HCP area could include all occupied KBB habitat on non-Federal land in Michigan (approximately 2,700 acres). Any additional occupied KBB habitat created or discovered in the future also could be included in the HCP area and would be covered by the ITP.

Authorized by a 20-year ITP, a coalition of management partners would cooperate to implement the Comprehensive HCP. Management partners could include State, county and local government agencies, non-governmental organizations, utility and transportation right-of-way managers, private land developers, and other private landowners. Landowners and land managers would not be required to participate in implementation of the HCP. Rather, participation would be offered as a reasonable and practical option for those agencies, organizations and individuals that seek authority for incidental take of KBB. Activities under the Comprehensive HCP would not be conducted on any particular parcel of land without the participation and explicit permission of the landowner.

Activities that would be conducted under the Comprehensive HCP fall into three general categories: 1) habitat management; 2) utility and transportation right-of-way maintenance; and 3) development.

2.2.1.1 Habitat Management

Habitat management would involve simulation of natural processes to maintain the conditions required by KBB and other species associated with the Oak Savanna Ecosystem. Natural processes historically included fire, windthrow, wild herbivore grazing, and insect and disease outbreaks (Nuzzo 1986, Grundel et al. 1998, Ritchie et al. 1998, Fuhlendorf and Engle 2001). Management techniques that would be used to mimic these processes include:

- prescribed burning,
- mowing/hydroaxing,
- manual vegetation removal,
- chemical vegetation removal,
- soil scarification,
- seeding and planting, and
- livestock grazing.

throughout the treatment area would be assumed. Pre-treatment habitat assessments would also be used to identify the most degraded habitat portions on which to focus treatment.

To the extent possible, foot and vehicle traffic would avoid occupied KBB habitat and other lupine patches outside treatment areas.

All employees and contractors working in occupied habitat would be trained on KBB life history and habitat requirements, and instructed on the measures required to minimize or avoid take of the species.

Prescribed burning

Prescribed burning would be used to suppress undesirable plant species, enhance the diversity and abundance of desirable plant species, reduce soil nitrogen and organic matter, raise soil pH, expose mineral soils, and reduce woody plant cover and thus increase incident sunlight at ground level (Wright and Bailey 1982, Tester 1989, Haney and Apfelbaum 1990, Lane 1994, Payne and Bryant 1994, Neary et al. 2005). Soil-disturbance measures required as a part of this activity would conform to specifications described under the subsequent heading for soil scarification.

Prescribed burning may be conducted throughout the Michigan range of KBB, but it would not be used when it could pose a threat to human safety, property, or the safe and reliable use of utility infrastructure. Public-safety, property and infrastructure concerns would be addressed through existing requirements to secure permits from the appropriate State or local agencies prior to burning. Additionally, prescribed burning would conform to National Wildfire Coordinating Group (NWCG) Standards, and burns would be conducted by Certified Burn Managers pursuant to Michigan law (Public Act 451 of 1994, Part 515). This law deals comprehensively with codified prerequisites, certifications and processes for prescribed burning, and is compatible NWCG Standards.

As required by Michigan law, prescribed burning would be conducted under a system of redundant containment and control measures, wherein appropriate firebreaks, ignition strategies, and suppression equipment (e.g., fire plows, pump trucks, bulldozers) would be used by trained personnel to safely and effectively conduct burns. In addition, modeling of expected fire intensity would be used to assist in optimizing application of containment measures. Finally, local fire departments would be informed of all prescribed fire plans and burn dates in case there is need to mobilize them. These measures would help ensure prescribed fires remain under control, and would thus ensure a high degree of safety and prevent the burning of more occupied KBB habitat than intended.

Mowing/Hydroaxing

Mowing and hydroaxing would be used to mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). It would suppress herbaceous and woody plants and increase incident sunlight at ground level. Tools used in this activity would include rotary

mowers (e.g., mowers, brushogs, hydroaxes) powered and propelled by rubber-tired or tracked vehicles (e.g., tractors, skidders, dozers, all-terrain vehicles).

Take of KBB due to mowing or hydroaxing can be entirely avoided when at least 4 inches of snow cover the ground or when cutting equipment would directly avoid lupine; thus, entire patches or patch portions may be treated without take. These activities would be scheduled to occur under these conditions whenever possible. When mowing over snow is not possible, mowing and hydroaxing would be restricted to periods when adult KBB are not present. To avoid or minimize impacts to lupine and KBB eggs and larvae, equipment would be operated to achieve a cutting height of at least 6 inches above the ground.

Where aggressive vegetation (e.g., bracken fern: *Pteridium aquilinum*) threatens to shade out lupine throughout the lupine growing season, mowing may be conducted during periods when adult KBB are present, on as much as one-third of the area each year, provided Michigan DNR and USFWS approval has been received.

Manual vegetation removal

Manual vegetation removal would be used to mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). This activity would remove or suppress individual herbaceous or woody plants and increase incident sunlight at ground level.

Compared to mowing and hydroaxing, this activity is more selective with regard to the plants that are removed: lupine and KBB nectar plants would not be removed with this technique. It would be conducted through plant cutting, plant pulling, or application of heat to individual plants (e.g., propane-torch removal). Tools used in this activity would include various forms of hand-operated and power-assisted hand-directed implements (e.g., axes, saws, weed whips, spades, loppers) and various forms of hand-held torches and gas-fueled torches mounted on all-terrain vehicles (ATVs). The torches would be used to direct heat to individual plants when the immediately surrounding environment is too wet to burn. On-site fire-suppression capabilities (e.g., hand pumps, ATV-mounted sprayers, extinguishers) would provide for contingency response in case of fire persistence and would help prevent the unintentional ignition of lupine and KBB nectar plants.

Chemical vegetation removal

ChemisCp.72miival would be used to m]TJ19.6080 TD-0.0024 Tw[(m)8.3(i)-1.7(c)8.3(i)-1.7(c certain effects of

areas occupied by lupine. Because lupine impacts and KBB take would be avoided with this technique, spot spraying may be conducted throughout an occupied site when it would be most effective for achieving KBB habitat-management objectives.

Tools used in this activity would include various forms of hand-held, ATV-mounted, and machine-driven applicator tools. Herbicides would be applied by certified applicators in compliance with label directions.

Soil scarification

Soil scarification would mimic certain effects of fire by exposing mineral soils, reducing organic material, and providing sunlit seed beds to promote germination and growth of lupine and nectar plants (Tester 1989, Payne and Bryant 1994, Neary et al. 2005). Tools used in this activity would include hand-operated and power-driven implements (e.g., blades, rakes, thatchers, discs, harrows). This activity would be used when lupine or nectar plant densities are insufficient to meet KKB habitat-management objectives. This technique would often be followed by seeding or planting.

Livestock grazing

Livestock grazing could be used to mimic effects of wild herbivore grazing and browsing (Sinclair et al. 1987, Payne and Bryant 1994, Ritc

A second category of right-of-way maintenance activity would include activities that would result in habitat disturbance not expected to provide long-term benefits to KBB. This type of habitat disturbance is associated with infrastructure replacement and repair, and includes:

- heavy-equipment operation/traffic and
- soil excavation.

To avoid or minimize incidental take of KBB, these techniques would be conducted according to the following conditions.

General

With rare exception, activities in occupied KBB habitat that could result in take would not occur when adult KBB are present, typically between May 15 and August 15.

Surveys would be used to determine the presence and distribution of lupine and KBB within rights-of-way prior to disturbance. Whenever pre-treatment surveys are not conducted, presence of KBB throughout the right-of-way would be assumed.

Prior to any ground-disturbing activities, areas that contain lupine immediately adjacent to treatment areas would be flagged or otherwise marked; workers would not stockpile materials, park vehicles, or otherwise cause adverse impacts in those areas.

All employees and contractors working in project sites would be trained on KBB life history and habitat requirements, and instructed on the measures required to avoid or minimize take of the species.

Maintenance activities may deviate from the preceding conditions in emergency situations demanding immediate repair of malfunctioning or dangerous infrastructure. In such situations, measures would be taken to minimize take of KBB, and long-term adverse impacts would be subsequently mitigated according to requirements of 2.2.1.4 (Mitigation).

Heavy-equipment operation/traffic

This activity would involve the operation of vehicles and use of heavy machinery in occupied KBB habitat for the purpose of repairing or replacing physical structures such as pipelines, towers, transmission lines, electrical conductors, signs, fencing, railroad rails and ties, roadways and culverts. To the extent possible, truck and heavy-equipment traffic would be limited to existing disturbed areas, such as access roads that run within a right-of-way. When traffic must leave existing routes to conduct maintenance activities, steps would be taken to avoid lupine areas and to minimize the extent of new disturbance. During replacement and repair of infrastructure, existing structures would be dismantled in place or otherwise repaired in ways to avoid impacts to lupine to the extent possible.

Posts driven into the ground (e.g., sign posts) without excavation represent minimal habitat disturbance and would not be expected to result in take of KBB. Therefore, posts could be

driven in occupied KBB habitat during any time of the year if the associated equipment operation and human trampling would not be expected to adversely affect lupine or KBB.

If disturbance of lupine areas in occupied KBB habitat could not be avoided by heavy-equipment traffic or operation, mitigation would be conducted according to the requirements outlined in 2.2.1.4 (Mitigation).

Soil excavation

Soil excavation would involve the removal or disruption of the soil profile. It could be conducted for the purposes of repairing or replacing structures such as pipelines, towers, signs, railroad rails and ties, roadways and culverts. When soil excavation would occur in lupine areas, efforts would be made to minimize the footprint of the area disturbed. To the extent possible, displaced soils would be deposited away from lupine areas and within the smallest possible side-cast areas needed for temporary storage. Following repair or replacement of structures, excavated areas would be backfilled using the original soil that was deposited in temporary storage areas. Additional mitigation would also be required according to the requirements outlined in 2.2.1.4 (Mitigation).

2.2.1.3 Development

Development activities could include:

- commercial, residential and public-facility construction;
-

soil profile; partial or complete covering of occupied KBB habitat with structures and hardened surfaces (e.g., poles and towers, rails and ties, pavement); and changes in connectivity among habitat patches.

The primary objectives of these three types of development generally do not include maintenance of KBB habitat. Under the Comprehensive HCP, these activities could have long-term impacts that convert at least portions of occupied KBB habitat patches into conditions

of the occupied patch, the project would not qualify under the HCP. This circumstance could occur when a project would result in the complete loss of a large core KBB population within a metapopulation or when created habitat would not adequately replace the function of lost patches.

2.2.1.5 Monitoring and Reporting

Monitoring would be conducted to help evaluate KBB distribution and to assess effects of HCP activities on KBB populations and habitat. Monitoring associated with specific projects would be funded by the management partners that conducted the treatments/disturbances. It would be conducted by qualified personnel, either on management-partner staff or contracted through other organizations. Monitoring would be conducted at a subset (approximately one-third) of treated sites following habitat management and right-of-way vegetation manipulation; each of the treatment types used would be adequately represented within the subset of sites monitored.

A report of activities and monitoring results would be submitted to the USFWS by January 31 each year the ITP is in effect. At a minimum, the report would include:

- a summary of annual activities resulting in take of KBB, including acres treated/disturbed.
- a summary of habitat monitoring conducted at treated/disturbed sites.
- a summary of presence/absence and relative abundance surveys conducted at treated/disturbed sites.
- an analysis of the effect of management techniques on habitat quality at a subset of treated sites. The analysis would include comparison of pre- and post-treatment/disturbance conditions.
- an analysis of the effect of management techniques on KBB populations at a subset of treated sites. The analysis would include comparison of pre- and post-treatment/disturbance population estimates.
- a description of known and assumed take. Known take is take of KBB individuals that is directly observed; assumed take would be reported indirectly as area of occupied habitat treated/disturbed.

2.2.1.6 Federal Endangered Species Act Section 7 Compliance

The USFWS would conduct an internal section 7 consultation prior to issuance of the ITP. This consultation would address impacts to KBB and other federally listed and candidate species that may occur due to HCP implementation. Federally listed species that could occur in or near occupied KBB habitat addressed by this alternative currently include KBB, Kirtland's warbler (*Dendroica kirtlandii*), Indiana bat (*Myotis sodalis*) and Pitcher's thistle (*Cirsium pitcheri*). The only candidate species that could occur in or near occupied KBB habitat is the eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*).

Projects conducted under authority of the ITP would not take or otherwise adversely affect federally listed species other than KBB. Prior to implementation of any project, the potential presence of these species would be evaluated based on review of the Biotics data base (Michigan Natural Features Inventory 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. Occupied KBB habitat does not typically overlap with occupied Kirtland's warbler, Indiana bat or Pitcher's thistle habitat in Michigan; thus, the potential for impacts to these species would be small. In the rare event any of these species occurred or would be likely to occur in or near a project area while they were listed, the project could proceed only if it would not adversely affect the species. Adverse effects might be avoided by reconfiguring activity areas, adjusting timing of activities, or modifying the nature of the activity. Projects that could not avoid adverse effects would not be authorized.

A small subset of occupied KBB habitats addressed by this alternative could be occupied by eastern massasauga rattlesnake, and certain activities conducted under authority of the ITP could result in injury or mortality to a small number of massasaugas. However, the conditions required to avoid or minimize take of KBB would also generally minimize adverse impacts to massasaugas. Consequently, activities conducted under the ITP would not jeopardize the

continued existence of the species. Indeed, activities that maintained KBB habitat would usually improve conditions for massasaugas as well.

2.2.1.7 Protection of Cultural and Paleontological Resources

Cultural and paleontological resources protection is a function of the Michigan Department of State, Bureau of History. The State Historic Preservation Office (SHPO) maintains files of known cultural and paleontological site occurrences. Similar files are maintained with the Tribal Historic Preservation Office (THPO). The SHPO is integrated with the National Historic Preservation Office to extend protection to known sites of Federal concern. Archaeologists are available to review land-management plans to note potential threats to occupied sites.

Before implementing any soil-disturbance activities covered under the ITP, management partners would consult with the SHPO and the THPO, as appropriate, to ascertai

directed habitat management on occupied sites on State-owned or State-managed lands throughout the Flat River, Allegan and Muskegon State Game Areas.

Activities authorized by the permit would continue to be conducted according to the following conditions (adapted from USFWS 2004a).

- Survey and monitoring activities would be conducted in a manner to minimize disturbance to KBB and wild lupine. Netting and handling of adults and larvae for survey purposes would be kept to a minimum. Current appropriate scientific monitoring protocols would be used and would include a variety of transect methodologies, including, but not limited to Pollard–Yates transects, Thomas transects, straight-line transects and mark-release-recapture techniques.

- All individuals conducting permitted management activities would carry a copy of the permit and be knowledgeable about KBB, its habitat requirements, and conservation measures pertinent to habitat management.

- Land-management activities would be conducted on the specified State-owned properties in accordance with Michigan DNR management prescriptions, the Federal Karner Blue Butterfly Recovery Plan (USFWS 2003a), and other current and appropriate scientific protocols with the understanding that management could be further adapted to benefit KBB as new information becomes available.
    - Land-management activities in occupied lupine areas would occur during the dormant season to the maximum extent possible. Lupine growing-season management would occur when necessary to achieve management objectives. The permit defines the lupine growing season as April 16 through August 14.
    - Management techniques would include, but would not be limited to, prescribed burning, mowing, mechanized or hand brush removal, timber harvest, soil scarification and herbicide application.
    - Regardless of management technique, no more than one-third of any occupied habitat patch larger than 0.25 hectare would be treated during a calendar year.

- If the size of an adult KBB population in habitat managed under authority of the permit declined, the Michigan DNR would work with the USFWS to determine the cause of the decline and to implement measures beneficial to KBB and lupine habitat.

- A report of activities would be submitted to the USFWS

with the methods described in Part IV-A of the permit application and with The Nature Conservancy's January 13, 2000 Fire Management and Alien Weed Plan for Clawson Tract **(**McGowan-Stinski 2000). Supplemental knapweed control by hand-pulling or spot-burning during the growing season could occur at the permittee's discretion per Part IV-B of the permit application.
    - Prior to burning or herbicide treatment, The Nature Conservancy would consult with the appropriate staff of the USFWS East Lansing Field Office and obtain written approval of the Field Supervisor.

- In reference to plant reintroductions/establishment in proposed or occupied KBB habitat:
    - Seed would be collected from areas not occupied by KBB whenever possible.
    - If seed would be collected from areas occupied by KBB, trampling of lupine would be minimized, and seed-collection data (species, quantity, location) and results of seeding efforts would be included in monitoring and annual reports.

- The results of management conducted under the permit would be monitored according to the methods described in Part IV-C of the permit application. Monitoring results would be included in the annual report.

- In reference to the disposition of dead specimens of KBB:
    - All specimens obtained under the authority of the permit would remain the property of the United States Government and would be clearly identified as such.
    - KBB that died from natural or accidental causes would be preserved according to standard museum practices and submitted to the University of Michigan Museum of Zoology.

- If the size of the adult KBB population in habitat managed under authority of the permit declined, The Nature Conservancy would work with the USFWS to determine the cause of the decline and to implement measures beneficial to KBB and lupine habitat.

- An annual report of activities conducted under authority of the permit would be submitted to the USFWS by January 31 following each year the permit is in effect. The report would include:
    - a complete discussion of habitat-management activities undertaken and their results, including data collected during monitoring as required above.
    - a complete description of injuries and/or mortalities to listed species observed by the permittee, the dates of occurrence, and any circumstances surrounding the incidents, and a description of any steps taken to reduce the likelihood that such injuries and/or mortalities would occur in the future.
    - a description of the disposition of dead specimens of KBB.
    - legible photocopies of all field-data and monitoring sheets.
    - a complete list of any sightings of any other species listed under the ESA or any potential violations of Federal environmental laws.

Landowner Incentive Program habitat management

The Michigan Landowner Incentive Program would continue to conduct or provide funding for habitat management designed to maintain or restore KBB habitat. Funding for this program is provided by the Federal Land and Water Conservation Fund and is administered by the USFWS. Federal authorization to conduct habitat management that may result in take of KBB was obtained through a Section 7 consultation completed in May 2005 (USFWS 2005a).

Habitat management under the Landowner Incentive Program could hypothetically be conducted in all occupied KBB habitat on private land throughout the State. However, given available resources, approximately 100 acres of occupied habitat would probably be treated in any given calendar year. Habitat-management activities for the Landowner Incentive Program would continue to be conducted in occupied KBB habitat according to the following conditions (adapted from Michigan DNR 2004).

- Brush/tree/herbaceous vegetation removal
    - Brush/tree/herbaceous vegetation removal would be conducted through physical, mechanical and chemical means.
    - Brush/tree/herbaceous vegetation removal would occur during the KBB dormant season (August 16 through April 14) when consistent with the objective of improving habitat for KBB.
    - Brush/tree/herbaceous vegetation removal may occur during the active season (April 15 through August 15) but would be performed on no more than one-third of the occupied habitat once per calendar year.
    - Where aggressive vegetation (e.g., bracken fern) threatens to shade out lupine throughout the lupine growing season, mowing may be conducted throughout the year, on as much as one-third of the area each year.
    - Equipment used would be chosen for

- No more than one-third of occupied KBB habitat at a site would be burned during a calendar year.
- The same portion of occupied KBB habitat would not be burned in consecutive years.

- Livestock grazing
  - Grazing could be conducted on sites with more than 1 acre of occupied KBB habitat.
  - Up to one-third of occupied KBB habitat could be grazed during a calendar year.
  - Any grazing would be conducted on short rotation; livestock would be removed before habitat is reduced to a height of 6 inches.
  - Any grazing would occur during the KBB dormant season to the maximum extent possible. Grazing may occur during the KBB active season, but not on more than one-third of occupied KBB habitat once per calendar year.

- Planting
  - Tree, grass and forb planting would be conducted by hand using hand tools throughout occupied KBB sites.
  - Tree, grass and forb planting would be conducted using heavy equipment such as tractors and no-till drills.
  - Planting with heavy equipment would be conducted throughout occupied KBB sites during the dormant season (typically between early October and late March).
  - Planting with heavy equipment could occur during the lupine growing season (late March to early October). When conducted during this period, planting

2.2.2.3 Development

Development in occupied KBB habitat would not be specifically authorized under this alternative. However, development would be expected to continue within the KBB range. Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the Comprehensive HCP alternative. Under the No Action alternative, legal, incidental take associated with development in occupied KBB habitat would require authorization on an individual, project-by-project basis under existing Federal, State and local regulations.

2.2.2.4 Mitigation

No mitigation would be conducted for any activities authorized by 10(a)(1)(A) permits or performed by the Landowner Incentive Program. Mitigation for other projects would be conducted according to the requirements of any Federal, State and local permits issued on an individual, project-by-project basis.

2.2.2.5 Monitoring and Reporting

Monitoring following habitat management authorized by 10(a)(1)(A) permits or performed by the Landowner Incentive Program would be conducted according to the protocols outlined under 2.2.2.1 (Habitat Management). Monitoring and reporting for other projects would be conducted according to the requirements of any Federal, State and local permits issued on an individual, project-by-project basis.

2.2.2.6 Federal Endangered Species Act Section 7 Compliance

The process for ESA Section 7 compliance and the types of impacts to federally listed and candidate species would be the same as those outlined within the description of the Comprehensive HCP alternative (2.2.1.6).

2.2.2.7 Protection of Cultural and Paleontological Resources

Cultural and paleontological resources would be protected according to the process outlined within the description of the Comprehensive HCP alternative (2.2.1.7).

2.2.3 Alternative C: Reduced-scope HCP

The Reduced-scope HCP alternative differs from the Comprehensive HCP alternative in the:

- scope of affected lands,
- number and diversity of management partners, and
- types of activities conducted.

Under this alternative, as under the Comprehensive HCP, a coalition of management partners would cooperate to implement a KBB HCP authorized through a 20-year ITP. Whereas the

Comprehensive HCP could focus conservation efforts on all non-Federal land with occupied KBB habitat in Michigan, a Reduced-scope HCP could involve only a subset of those habitats. That subset would be limited to occupied KBB habitat owned and managed by State agencies, local governments and conservation-oriented non-governmental organizations (approximately 900 acres). A Reduced-scope HCP would not address occupied KBB habitat on land owned by private transportation and utility companies, private-land developers, and other private landowners. Accordingly, the coalition of management partners would be smaller than that under the Comprehensive HCP, reflecting the smaller scope of affected land.

Landowners and land managers would not be required to participate in implementation of the Reduced-scope HCP. Rather, participation would be offered as a reasonable and practical option for those agencies and organizations that seek authority for incidental take of KBB. Activities under the Reduced-scope HCP would not be conducted on any particular parcel of land without the participation and explicit permission of the landowner.

2.2.3.2 Public Utility and Transportation Right-of-Way Maintenance

Public right-of-way maintenance would be conducted according to conditions outlined under the Habitat Management (2.2.1.1) and Utility and Transportation Right-of-Way Maintenance (2.2.1.2) headings within the description of the Comprehensive HCP alternative. Public right-of way maintenance would occur only on land managed by State and local governments.

Under this alternative, no private right-of-way maintenance would be authorized under the ITP issued in association with the Reduced-scope HCP. However, maintenance would still be necessary to preserve the primary functions of existing private rights-of-way. Legal, incidental take associated with maintenance of those rights-of-way would therefore require authorization on an individual, project-by-project basis under existing Federal, State and local regulations.

2.2.3.3 Development

Under this alternative, no development would be authorized under the ITP issued in association with the Reduced-scope HCP. However, development would be expected to continue within the KBB range. Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the Comprehensive HCP alternative. Under the Reduced-scope HCP alternative, legal, incidental take associated with development in occupied KBB habitat would require authorization on an individual, project-by-project basis under existing Federal, State and local regulations.

2.2.3.4 Mitigation

Mitigation for activities authorized by the ITP pertinent to a Reduced-scope HCP would be conducted according to conditions outlined under the Mitigation heading (2.2.1.4) within the description of the Comprehensive HCP alternative. Mitigation for other projects not pertinent to the Reduced-scope HCP would be conducted according to the requirements of any Federal, State and local permits issued on an individual, project-by-project basis.
2.2.3.5 Monitoring and Reporting

Within occupied KBB habitats treated or dist

2.2.3.7 Protection of Cultural and Paleontological Resources

Cultural and paleontological resources would be protected according to the process outlined within the description of the Comprehensive HCP alternative (2.2.1.7).

2.3 Summary of Alternative Actions Table

Table 2. Summary of the alternative actions carried forward for detailed analysis.

	Alternative A: Comprehensive HCP	Alternative B: No Action	Alternative C: Reduced-scope HCP
Statewide ITP	Yes	No	Yes
ITP Duration	20 years	Not applicable	20 years
Relevant Habitat	All known occupied KBB habitat on non-Federal land in Michigan	Occupied KBB habitat on 3 State Game Areas Occupied KBB habitat on The Nature Conservancy property Occupied KBB habitat managed under the Landowner Incentive Program	All known occupied KBB habitat on non-Federal public land Occupied KBB habitat on some NGO[a] land Occupied KBB habitat managed under the Landowner Incentive Program
Area[b, c]	2,700 acres	900 acres	1,000 acres
Habitat			

Peninsula receives extensive groundwater inputs and another one-third receives moderate groundwater inputs (Seelbach et al. 1997). Groundwater recharge is, in part, facilitated by the coarse-textured soils that are typical of much of the Lower Peninsula (Seelbach et al. 1997, Zorn et al. 1998), including most of the current Michigan range of KBB. These coarse soils encourage water infiltration rather than surface runoff. River basins within the current Michigan KBB range include the Kalamazoo, Muskegon and Manistee Rivers, which have 'superstable' flows, and the Grand River, which has 'stable' flows (Richards 1990). These stable flow conditions are indicators of the large groundwater contributions these rivers receive (Richards 1990, Wehrly et al. 1998).

Table 3. Physical aspects of the Oak Savanna Ecosystem within each Recovery Unit (adapted from Albert 1995).

	Recovery Unit				
	Allegan	**Ionia**	**Muskegon**	**Newaygo**	**Combined**
Growing Season (days)	150–170	130–150	140–150	120–140	120–170
Average Annual Precipitation (inches)	32–38	30–32	32–34	32	30–38
Average Annual Snowfall (inches)	70–100	50–70	100–140	70–140	50–140
Extreme Minimum Temperature (º F)	-22 to -34	-26 to -30	-32 to -42	-32 to -48	-22 to -48
Dominant Landform	Flat lakeplain	Sloping ground moraine	Sand lakeplain	Outwash plain	Outwash plain/ lakeplain
Dominant Soils	Sands	Sands/ loamy			

poorly developed and often include American hazelnut (*Corylus americana*

KBB habitat patches are generally discrete units clearly separated from each other by unsuitable habitat. Historically, some early-successional openings gradually succeeded into forested conditions as other areas became more open due to fire or other natural disturbance. The result was a landscape where the location of KBB habitat fluctuated over space and time, but the amount of habitat remained relatively stable, with enough openings and sufficient connectivity to provide for healthy, viable KBB populations. In this dynamic landscape, KBB may have maintained a metapopulation structure within a shifting mosaic of early-successional habitat patches (Givnish et al. 1988, USFWS 2003a).

Many oak savannas have been destroyed through conversion for agriculture, residential and municipal development, and other land uses. Moreover, suppression of wildfire has removed the primary mechanism that historically maintained early-successional oak-savanna habitats (Abrams 1992, O'Connor 2006). These practices have resulted in the loss or degradation of the majority of KBB habitat in Michigan (Cohen 2000, Cohen 2001, Rabe 2001, U.S. Fish and Wildlife Service 2003a).

Table 4. Nectar plant species reported to be used by KBB (reproduced from USFWS 2003a). Scientific names follow Ownby and Morley (1991), Gleason and Cronquist (1991) or Swink and Wilhelm (1994).

Scientific name	Common name	Location	Reference
----------First brood adult nectar sources----------			
----------Herbaceous species----------			
Achillea millefolium L.	Common yarrow	WI, IN	2,7,14,15
Anenome cylindrical	Gray Thimbleweed	WI,IN	7,15
Arabis lyrata L.	Sand-cress	IN,MN,ON,WI	2,5,7,8,10,9,14, 15
Arenaria serpyllifolia L.	Thyme-leaved sandwort	ON	10
Baptisia bracteata var. *glabrescens* (Larisey) Isely (*leucophaea*)	Prairie wild indigo	WI	2,14
Berteroa incana (L.) DC.	Hoary alyssum	WI	2,7
Centaurea biebersteinii (*maculosa*) DC.	Spotted knapweed	WI	7
Cerastium sp.	Chickweed	WI	7
Chrysanthemum leucanthemum L.	Ox-eye daisy	WI	7
Commandra umbellata (L.) Nutt.	Bastard toadflax	MI	11,13
Coreopsis lanceolata L.	Lance-leafed coreopsis	IN	8,15
Coreopsis tripteris *L*.	Tall coreopsis	IN	15
Erigeron strigosus Muhl.	Daisy fleabane	WI	2
Euphorbia corollata L.	Flowering spurge	WI,IN	9,15
Euphorbia podperae (*esula*) Croizat	Leafy spurge	WI	7,9
Fragaria virginiana	Duchesne Strawberry	NY,WI,IN	3,7,15
Gaylussacia baccata (Wang.) K. Koch			

Liatris Spp.	Blazing star	IN	15
Lithospermum canescens (Michx.) Lehm.	Hoary puccoon	IN	15
Lithospermum caroliniense (Walt.) MacM.	Hairy puccoon	ON,WI,IN	2,10,15
Lupinus perennis L.	Wild lupine	MI,NH,ON,WI, IN	1,2,7,9,10,11,14,15
Medicago lupulina L.	Black medic	WI	2,7
Melilotus officinalis (L.) Pallas	Yellow sweet clover	IN,WI	2,7,8
Pedicularis canadensis L.	Lousewort	WI	2,14
Phlox pilosa L.	Downy phlox	IN	8,15
Potentilla recta L.	Rough-fruited cinquefoil	WI	2
Potentilla simplex Michx.	Common cinquefoil	WI,MI,IN	2,7,13,14,15
Potentilla sp.	Cinquefoil	MI,NY	3,11
Rosa Carolina L.	Carolina rose	IN	15
Rumex acetosella L.	Sheep sorel	WI	2
Senecio pauperculus Michx.	Ragwort	WI	7
Senecio sp.	Ragwort	WI	2,9
Smilacina racemosa (L.) Desf.	False spikenard	WI	2,7
Smilacina stellata (L.) Desf.	Star-flow. fals. sol. seal	WI	2,14
Solidago sciaphila	Steele Cliff goldenrod	WI	7
Tephrosia virginiana (L.) Pers.	Goat's rue	NY	3
Tradescantia ohiensis Raf.	Spiderwort	IN	15
Trifolium hybridum L.	Alsike clover	WI	2,14
Trifolium pratense L.	Red clover	WI	7
Trifolium repens L.	White clover	WI	2
Viccia villosa Roth.	Hairy vetch	WI	2
Viola pedata L.	Bird foot violet	NY,WI	2,3,13
Zizia aurea (L.) Koch	Golden alexanders	WI	2
----------Woody species----------			
Amelanchier sp.	Juneberry	ON	10
Ceanothus herbaceus (ovatus) Raf.	Red root	WI	7
Ceanothus sp.	New jersey tea	WI	2
Physocarpus opulifolius (L.) Maxim.	Common ninebark	WI	7
Prunus sp.	Wild plum	NY	3
Rubus allegheniensis Porter	Blackberry	WI	7
Rubus flagellaris Willd.	Dewberry	IN,MI,WI	7,6,8,13,15
Rubus sp. or spp. (IN)	Bramble	IN,MI,MN,WI	2,5,8,11,9,14,15
Salix humilis Marsh.	Prairie willow	WI	2, 7
Vaccinium sp.	Blueberry	NY,IN	3,15
Vitis riparia Michx.	River grape	MN	5
----------Second brood adult nectar sources----------			
----------Herbaceous species----------			
Achillea millefolium L.	Common yarrow	IN,MI,MN,WI	2,5,7,8,11,14
Amorpha canescens Pursh	Lead plant	WI	2,7,9,14
Apocynum androsaemifolium L.	Spreading dogbane	NH,NY	1,12
Arabis lyrata L.	Sand-cress	IN,WI	2,7,8,14
Asclepias incarnata L.	Swamp milkweed	IN	15
Asclepias syriaca L.	Common milkweed	NH,NY,WI	2,7,12
Asclepias tuberosa L.	Butterfly-weed	IN,MI,MN,NY, ON,WI	2,3,4,5,6,7,8,10,11, 13,15
Asclepias verticillata L.	Whorled milkweed	MI,WI,IN	2,7,8,11,9,13,15
Aster sp.	Aster	WI	2,13

Aureolaria pedicularia (L.) Raf.	Fern-leave false foxglove	WI	2
Aureolaria sp.	False foxglove	WI	2,13
Berteroa incana (L.) DC.	Hoary alyssum	NY,WI	2,4
Campanula rotundifolia L.	Harebell	MN,WI	1,2,9,14
Centaurea biebersteinii (maculosa) DC.	Spotted knapweed	MI,NY,WI	2,3,4,7,11,13,14
Chrysanthemum leucanthemum L.	Ox-eye daisy	WI	7
Coreopsis lanceolata L.	Lance-leaved coreopsis	MI	11
Coreopsis palmata Nutt.	Stiff tickseed	WI	7,9,14
Coreopsis sp.	Coreopsis	WI	2
Dianthus armeria L.	Deptford pink	MI	11
Erigeron annuus (L.) Pers.	Daisy fleabane	MI,MN	5,11
Erigeron canadensis		WI	9
Erigeron strigosus Muhl.	Daisy fleabane	WI,IN	2,7, 9,15
Erigeron sp.	Fleabane	IN,WI,MI	2,8,13,14
Euphorbia corollata L.	Flowering spurge	IN,MI,MN,WI	1,2,5,6,7,8,11,13, 14, 15
Euphorbia podperae (esula) Croizat	Leafy spurge	WI	2,7
Euthamia graminifolia (*Solidago graminifolia*) (L.) Nutt	Grass-leaved goldenrod	NH,WI	2,12,14
Froelichia floridana (Nutt.) Moq.	Cottonweed	WI	7
Galium sp.	Bedstraw	WI	2,14
Gnaphalium obtusifolium L.	Sweet everlasting	MN,WI	1,2,5,9,14
Hackelia deflexa (Wahlenb.) Opiz	Stickseed	MN	5
Hedyotis (Houstonia) longifolia (Gaetrn.) Hook.	Long g ai4g d .6(m)]TJ/TT1 1 Tf3.446o Frostweed (L.) Michx. 0022 Tc0 Tw[ )6.42cv.004 WIe3.446 1 5 He		

Helianthus divaricatus L.*22 Tc166.6(W)-4.2(oodl)-5.9(and s)-8.1(unf)-10.2(lo)-11.9(w)14.1(

Hieracium sp. Hawkeed MI

Hypericum perforatum L. hn’s ort MI 11

Krigia biflora (Walt.) Blake Michx. Two-fl6(d .o)Rough blazing star 11 TD(d .y) d .nthig

Liatris sPP.

Lilium philade

Ling nad( )(a

Lithospermum

*Medicago lupuli na*L.

Monarda fistulosa L.	Wild bergamot	IN	8,9,14,15
Monarda punctata L.	Horsemint	IN,MI,MN,NY, ON, WI	2,3,4,5,6,7, 8, 9, 10,11,14,15
Oenothera sp.	Evening primrose	WI	2,13
Petalostemon candidum (Willd.) Michx.	White prairie clover	WI	2,7,9
Petalostemon purpureum (Vent.) Rydb.	Purple prairie clover	WI	2,7
Phlox pilosa			

3.2.2.1 Karner Blue Butterfly

KBB is classified as endangered under Federal law and as threatened under Michigan law. It has a historic range from Maine to Minnesota, south to Iowa and Pennsylvania, and north to southern Ontario, Canada (USFWS 2003a). Within Michigan, KBB is currently known to occur on approximately 3,900 acres within 10 counties in the western Lower Peninsula (Fettinger 2005; Figure 1). KBB was also found in Monroe County in southeastern Michigan as recently as 1986,

Dispersal between habitat patches greater than 2.3 km apart is pr

throughout much of the southern Lower Peninsula and in the northwest Lower Peninsula within and around the Manistee National Forest (Kurta and Rice 2002).

Indiana bats roost under exfoliating bark or in crevices of tree snags or live trees (Kurta et al. 1996, Kurta and Rice 2002, Kurta et al. 2002), usually within lowland or riparian forests (Humphrey et al. 1977, Kurta and Rice 2002, Kurta et al. 2002) but also within savannas or upland woodlands near edges or openings (Clark et al. 1987, Gardner et al. 1991, Brack 2006). Most maternity colonies are found in trees with diameters larger than 9 inches (22 cm) (Menzel et al. 2001, Kurta et al. 2002, Kurta 2004). Sunlight seems to be an important component in snag selection in Michigan; snags

3.2.2.6 Michigan State-listed Species

At least 17 wildlife species and 16 plant species classified as threatened or endangered under Michigan law (Public Act 451 of 1994, Part 365) could occur in or near occupied KBB habitat (Tables 5 and 6). The following text provides information on those State-listed species (animals and plants grouped separately; arranged alphabetically by scientific name) that are not also classified as Federal threatened, endangered or candidate species.

Table 5. Wildlife species classified as threatened or endangered under Michigan law that potentially occur in or near occupied KBB habitat.

Common name	Scientific name	Status
Dusted skipper	*Atrytonopsis hianna*	State threatened
Three-staff underwing	*Catocala amestris*	State endangered
Spotted turtle	*Clemmys guttata*	State threatened
Least shrew	*Cryptotis parva*	State threatened
Prairie warbler	*Dendroica discolor*	State endangered
Kirtland's warbler	*Dendroica kirtlandii*	Federal endangered; State endangered
Persius dusky wing	*Erynnis persius persius*	State threatened
Bald eagle	*Haliaeetus leucocephalus*	State threatened
Ottoe skipper	*Hesperia ottoe*	State threatened
Frosted elfin	*Incisalia irus*	State threatened
Migrant loggerhead shrike	*Lanius ludovicianus migrans*	State endangered
Great Plains spittlebug	*Lepyronia gibbosa*	State threatened
Karner blue butterfly	*Lycaeides melissa samuelis*	Federal endangered; State threatened
Prairie vole	*Microtus ochrogaster*	State endangered
Indiana bat	*Myotis sodalis*	Federal endangered; State endangered
Phlox moth	*Schinia indiana*	State endangered
Regal fritillary	*Speyeria idalia*	State endangered

Dusted skipper (Atrytonopsis hianna)

The State-threatened dusted skipper has been known to occur as a locally uncommon species at scattered locations in the northern and west-central Lower Peninsula and in Monroe County. The entire range of the species encompasses much

needed to determine existing occurrences of this species. Additional information can be found in Evers (1994).

Prairie warbler (Dendroica discolor)

The State-endangered prairie warbler has been known to nest at scattered locations throughout the Lower Peninsula, as well as a few locations in the Upper Peninsula. It prefers scrub–shrub

Ottoe skipper (Hesperia ottoe)

The State-threatened Ottoe skipper ranges from southern Manitoba through the continental Midwest to northern Texas. It has been reported in southwestern Michigan, as far north as Newaygo County. This skipper is localized in its occurrence, and is almost always found close to larval food plants including little bluestem and fall witchgrass (*Leptoloma cognatum*). In Michigan, this skipper occurs in dry sand prairies and oak savannas, often in association with wild lupine. The single-brooded adults are active from late June through mid August. Eggs hatch and develop to fourth instar larvae before late summer or fall hibernation in buried shelters. Additional information can be found in Nielsen (1999) and Cuthrell (2001). Ottoe skipper is vulnerable to extinction throughout its range and is considered to be imperiled or critically imperiled in most States within its range (NatureServe 2006).

Frosted elfin (Incisalia irus)

The State-threatened frosted elfin has been reported in southern Michigan, as far north as Mason and Iosco counties. The range of the species encompasses much of eastern North America. The single-brooded adults nectar on blueberry (*Vaccinium* spp.) from late April to early June. This elfin occurs in oak savannas where larvae feed on wild lupine flowers. Larvae develop through all subadult life stages and pupate at the base of lupine plants where they overwinter at or below ground level. Frosted elfin is vulnerable to extinction throughout its range and is considered to be imperiled or critically imperiled in most States within its range (NatureServe 2006). Additional information can be found in Nielsen (1999).

Migrant loggerhead shrike (Lanius ludovicianus migrans)

The State-endangered migrant loggerhead shrike has been documented from numerous locations in the Lower Peninsula, mostly in counties bordering the Great Lakes. It can be found in a variety of habitats, including pastures, old fields, rights-of-way, and other grassy areas with perches from which to search for food. They feed on insects, small mammals, small birds, reptiles and amphibians. They nest in a variety of vegetation, but seem to prefer short trees and shrubs that offer a tangle of protective branches or thorns. Loggerhead shrikes arrive in Michigan in early spring and depart in August or September. Shrike numbers declined through the 1960s and 1970s in Michigan, possibly in response to the use of pesticides. Range-wide, migrant loggerhead shrikes have a spotty distribution, have experienced steep declines, and may be vulnerable to extinction (NatureServe 2006).

Great Plains spittlebug (Lepyronia gibbosa)

The Great Plains spittlebug is a State-threatened species in Michigan. It is known from numerous locations in eight counties in western and southwestern Michigan, where it is often locally abundant (Dunn et al. 2002). The Great Plains spittlebug occurs in mesic portions of sand-prairie and oak-savanna communities (Wilsman 1994, Dunn et al. 2002). It appears to use a variety of host plants as nymphs, but may be limited to big bluestem and little bluestem as adults. This single-brooded insect appears as an adult as early as June and persists throughout the summer, probably laying eggs in the late summer or early fall. It appears to be sensitive to

Table 6. Plant species classified as threatened or endangered under Michigan law that potentially occur in or near occupied KBB habitat.

Common name	Scientific name	Status
Rock-jasmine	*Androsace occidentalis*	State endangered
Beach three-awned grass	*Aristida tuberculosa*	State threatened
Silky aster	*Aster sericeus*	State threatened

through vegetative succession. Prescribed fire and other techniques to maintain openings are needed for the conservation of this species. More information on white gentian can be found in Michigan Natural Features Inventory (2006).

Downy gentian (Gentiana puberulenta)

The State-endangered downy gentian has been known to occur in the southeastern Lower Peninsula and in Kent and Allegan counties in southwestern Michigan. It occurs in oak savannas, often along coastal plain marshes (Michigan Natural Features Inventory 2006). Alteration of natural disturbance regimes leading to habitat loss is the primary threat to this species. Prescribed fire and brush removal are needed to restore habitat for this species. More information on downy gentian can be found in Michigan Natural Features Inventory (2006).

Prairie smoke (Geum triflorum)

The State-threatened prairie smoke has been known to occur in the west-central Lower Peninsula and in Chippewa County in the Upper Peninsula. It occurs in dry sand prairies and oak savannas (Choberka et al. 2000). It flowers in mid May and bears fruit from late May to mid June. Threats to this species include off-road-vehicle traffic, invasive species, habitat loss and vegetative succession. More information on prairie smoke can be found in Choberka et al. (2000).

Wild potato-vine (Ipomoea pandurata)

The State-threatened wild potato-vine is known only from a few scattered locations in the southern Lower Peninsula, including Kent County. It is generally found in oak savannas and rights-of-way (Michigan Natural Features Inventory 2006). This sprawling ground-vine has been known to grow to 6 feet long and blooms in late summer. The status of this species in the State is generally unknown; more surveys are needed to determine current distribution. More information on wild potato-vine can be found in Michigan Natural Features Inventory (2006).

Virginia flax (Linum virginianum)

The State-threatened Virginia flax is known from scattered locations in the southern Lower Peninsula, including Kent County. It can be found in oak savannas and other woodland openings (Michigan Natural Features Inventory 2006). This perennial plant flowers from mid to late summer. Large-scale vegetative succession to a woody canopy is probably the major threat to this species. More information on Virginia flax can be found in Michigan Natural Features Inventory (2006).

Leiberg's panic-grass (Panicum leibergii)

The State-threatened Leiberg's panic-grass is known from scattered locations in the southern Lower Peninsula, including Ionia County. It is found in dry to wet prairie remnants, including dry sand prairies, hillside prairies, oak openings and rights-of-way (Penskar and Crispin 2004). It flowers in June and fruiting usually occurs in

September. Prescribed fire is needed to mimic the natural disturbance regime that historically provided habitat for this species. More information on Leiberg's panic-grass can be found in Penskar and Crispin (2004).

Smooth beard tongue (Penstemon calycosus)

The State-threatened smooth beard tongue is known from three counties in Michigan: Menominee County in the western Upper Peninsula, St. Clair County in southeastern Michigan, and Kent County in southwestern Michigan. Throughout its range, it occurs in prairies, meadows, rocky slopes, and sparsely vegetated woodlands (Penskar 2004). More information is needed on the distribution of this species in the State. This species would likely benefit from prescribed fires in the prairie communities where it is found. More information on smooth beard-tongue can be found in Penskar (2004).

Missouri goldenrod (Solidago missouriensis)

The State-threatened Missouri goldenrod occurs in dry sand prairies (Michigan Natural Features Inventory 2006). This drought-tolerant perennial plant flowers in summer or early fall. More surveys are needed in Michigan to determine its status and distribution in the State. This species would likely benefit from prescribed fires in the prairie communities where it is found. More a2ion on smosouri goldenrod (S be found in PenMiJ20.315 0 TD-0.001 Tc-0.0001 T9(Invcan Natural Features)

conservation due to declining populations or other characteristics that make them vulnerable (Eagle et al. 2005).

Thirty-two insect species associated with savannas in the Lower Peninsula have been identified as SGCN. Many other insect species commonly occur in Michigan savannas. Some of them include many mound-building ant species (e.g.,

	Boreal fan moth	*Brachionych borealis*
	Doll's merlolonche	*Merolonche dolli*
	Three-staff underwing	*Catocala amestris*
	Quiet underwing	*Catocala dulciola*
	Blazing star borer	*Papaipema beeriana*
	Phlox moth	*Schinia Indiana*
Birds	Sharp-tailed grouse	*Tympanuchus phasianellus*
	Northern bobwhite	*Colinus virginianus*
	Cooper's hawk	*Accipiter cooperii*
	Northern goshawk	*Accipiter gentilis*
	Merlin	*Falco columbarius*
	Yellow-billed cuckoo	*Coccyzus americanus*
	Short-eared owl	*Asio flammeus*
	Common nighthawk	*Chordeiles minor*
	Red-headed woodpecker	*Melanerpes erythrocephalus*
	Northern flicker	*Colaptes auratus*
	Least flycatcher	*Empidonax minimus*
	Eastern kingbird	*Tyrannus tyrannus*
	Migrant loggerhead shrike	*Lanius ludovicianus Migrans*
	Northern shrike	*Lanius excubitor*
	Purple martin	*Progne subis*
	Sedge wren	*Cistothorus platensis*
	Northern mockingbird	*Mimus polyglottos*
	Brown thrasher	*Toxostoma rufum*
	Prairie warbler	*Dendroica discolor*
	Eastern towhee	*Pipilo erythrophthalmus*
	Field sparrow	*Spizella pusilla*
	Vesper sparrow	*Pooecetes gramineus*
	Dickcissel	*Spiza americana*
	Bobolink	*Dolichonyx oryzivorus*
	Western meadowlark	

Reptiles	Blue racer	*Coluber constrictor foxii*
	Black rat snake	*Elaphe obsolete obsolete*
	Eastern hognose snake	*Heterodon platirhinos*
	Smooth green snake	*Liochlorophis vernalis*
	Six-lined racerunner	*Apidoscelis sexlineatus*
	Eastern massasauga	*Sistrurus catenatus catenatus*
	Spotted turtle	*Clemmys guttata*
	Blanding's turtle	*Emydoidea blandingii*
	Eastern box turtle	*Terrapene carolina carolina*

Twenty-five bird SGCN are associated with Michigan savannas in the Lower Peninsula. Some of the other birds that commonly occupy Michigan savannas include: Lincoln's sparrow (*Melospiza lincolnii*), indigo bunting (*Passerina cyanea*), eastern bluebird (*Sialia sialis*), chipping sparrow (*Spizella passerina*), field sparrow (*Spizella pusilla*), blue-winged warbler (*Vermivora pinus*), Nashville warbler (*Vermivora ruficapilla*), sharp-shinned hawk (*Accipter striatus*), upland sandpiper (*Bartamia longicauda*), ruffed grouse, red-tailed hawk (*Buteo jamaicensis*), American goldfinch (*Carduelis tristis*), killdeer (*Charadrius vociferus*), lark sparrow (*Chondestes grammacus*), American kestrel (*Falco sparverius*), Baltimore oriole (*Icterus galbula*), wild turkey, eastern screech owl (*Otus asio*) and mourning dove (*Zenaida macroura*) (Cohen 2000, 2001, 2004).

Five mammal species associated with savannas in the Lower Peninsula have been identified as SGCN. Some other mammals frequently associated with this habitat include coyote (*Canis latrans*), meadow vole (*Microtus pennsylvanicus*), white-tailed deer, fox squirrel (*Sciurus niger*), thirteen-lined ground squirrel (*Spermophilus tridecemlineatus*), badger (*Taxidea taxus*), red fox (*Vulpes vulpes*) and jumping meadow mouse (*Zapus hudsonia*) (Cohen 2000, 20001, 2004).

Thirteen amphibian and reptile SGCN are associated with savannas in the Lower Peninsula. Some of the other, more-common species associated with this habitat include American toad (*Bufo americanus*), common garter snake (*Thamnophis sirtalis*) and milk snake (*Lampropeltis triangulum*) (Cohen 2000, 20001, 2004).

3.3 Land Use

3.3.1 Statewide

Approximately 20% of Michigan's 36.4 million acres are managed by Federal, State or local governments. More than seven million acres are in State and Federal ownership.

The Michigan DNR manages 4.5 million acres as State Forests, State Wildlife Areas, and State Parks and Recreation Areas. These areas provide wildlife habitat, opportunities for outdoor recreation such as hunting, wildlife viewing and boating, and resources for timber and mineral extraction. An additional 375,000 acres are managed by the Michigan Department of

these openings were appealing to farmers who were the first to intensively use the land. Vestiges

3.5 Local Socio-economic Conditions

On average, Michigan has approximately 175 people per square mile, but this population is disproportionately distributed: residents of the 14 Upper Peninsula counties represent 3% of the total State population, whereas the three southeastern Detroit-metro counties (Oakland, Macomb and Wayne) account for 40% of the total State population (U.S. Census Bureau 2005). Other significant population centers in southern Michigan include: Kent County (6%), Genesee County (4.4%) and Washtenaw County (3.4%).

The 2000 United States census estimated Michigan's human population to be just under 10 million people. This figure represented an increase of 6.9% since 1990, but was less than the national average of 13.1% (U.S. Census Bureau 2005). The impact of development on the landscape has been disproportionate to population growth. 'Built' (developed) land area in Michigan increased 25% from 1980 to 1995, a rate that is eight times greater than the population)]TJ20.600

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the HCP. Activities that would be conducted under this alternative fall into three general categories: 1) habitat management; 2) utility and transportation right-of-way maintenance; and 3) development.

Habitat management would create the range of microclimate conditions that occurred historically in oaks savannas under a natural disturbance regime. The presence of a range of thermal environments is beneficial to KBB and other insects (Lane and Andow 2003, Grundel and Pavlovic in press), and canopy cover would be managed in a pattern that provided both open and shaded areas. In areas where openings were created, average incident sunlight and temperatures at ground level would incr

water would be lost through evapotranspiration, but the difference would not be expected to be significant. Therefore, groundwater inputs to lotic systems would not be expected to change as a

storage areas. Thus, the composition of soils in occupied KBB habitat patches would not be expected to change as a result of soil excavation.

Hydrology

No measurable impacts to hydrology as a result of infrastructure repair and replacement would be expected. Hydrological impacts due to soil compaction associated with heavy-equipment operation/traffic would be negligible because sandy soils are resistant to compaction and operation/traffic would be of short duration and low intensity. Due to sandy, well-drained soils, minimal slopes, and relatively small areas of impact, erosion would not be expected to increase as a result of soil excavation.

Water quality

Infrastructure repair and replacement would not be expected to have measurable impacts on water quality. Right-of-way managers implement safety protocols to prevent spills or leaks (e.g., of petroleum products) associated with heavy equipment and pipelines, and no such accidents would be expected. However, in the event a spill or a leak did occur, the upland locations, well-drained soils, and minimal slopes of occupied KBB habitats would minimize runoff and help prevent contamination of local water bodies.

Air quality

No measurable impacts to air quality as a result of infrastructure repair and replacement would be expected. Emissions associated with heavy-equipment operation/traffic would be negligible compared to emissions from other local sources. Moreover, most equipment operation would occur from September to May, when air-pollutant (e.g., ozone) levels pose less of a health risk.

4.1.1.3 Development

Development activities could include: commercial, residential and public-facility construction; agriculture, horticulture and intensive forestry; and road and utility development.

The specific acreage of occupied KBB habitat that would be impacted by development would be limited by developer interest, zoning, and opportunity and funding for adequate mitigation. Mitigation would be required to ensure activities conducted under the Comprehensive HCP did not cause a long-term net reduction in KBB population sizes, area of occupied KBB habitat, or connectivity of occupied KBB habitat patches. Given an expected time lag between initiation of mitigation and actual replacement of lost occupied KBB habitat, development that would cause occupied KBB habitat on non-Federal land to be reduced by more than 1% at any given time would not be permitted. Given the currently known KBB distribution and this restriction, the amount of occupied KBB habitat that might be developed under specific authority of the ITP in any given year ranges from 0 acres to 27 acres.

The specific physical impacts of 0–27 additional acres of developed land per year would depend on the types of development that would occur. However, the impacts would be small in

comparison to those already being caused by development elsewhere within the Michigan KBB range.

Without the Comprehensive HCP, development within the Michigan KBB range would be expected to continue, either legally, following other authorization processes, or illegally with regard to the ESA. Even though development conducted under the Comprehensive HCP could have localized impacts to physical features, the type and scale of those impacts would not differ regionally from those that would otherwise occur. Under the Comprehensive HCP, however, adverse impacts to KBB and occupied KBB habitat would be offset by required mitigation measures. Oak savanna that was restored or created as part of mitigation would not be eligible for future development. Thus, adverse impacts of development in one area would be balanced with the habitat protection offered in another (i.e., habitat that could have otherwise been developed legally would be protected).

Climate

Elevated levels of greenhouse gases are contributing to global climate change (Vitousek 1994, Karl and Trenberth 2003), and increased traffic and industrial emissions associated with some types of development (e.g., commercial, residential and public-facility construction) would introduce more of these gases into the atmosphere. Other types of development (e.g., agriculture, horticulture and intensive forestry) would not necessarily increase greenhouse gas emissions, and may even help remove some greenhouse gases from the atmosphere.

The climate impacts of a maximum of 27 additional acres of developed land per year are difficult to predict, in part because the impacts would depend on the type of development. In any case, those impacts would be negligible compared to the climate impacts of ongoing development within the region and across the United States (Vitousek 1994, Karl and Trenberth 2003). Moreover, given that the rate of development within the Michigan KBB range would not be expected to be different in the absence of the Comprehensive HCP, any regional climate impacts under this alternative would not differ from those that would otherwise occur.

Topography and soils

Development could affect topographic and soil features in several ways, including: disruption of the soil profile due to grading, excavation or agriculture; soil compaction due to construction of infrastructure and traffic; alteration of soil chemistry due to hardened-surface runoff, agriculture and horticulture; increased erosion due to increased soil exposure and alteration of flow patterns; and modification of organic-matter levels and nutrient availability. The nature and scope of these impacts would depend on the site-specific details of individual development projects.

Hydrology

With its sandy, well-drained soils and upland locations, oak-savanna habitats are less susceptible than other habitat types to changes in hydrology due to development. The primary sources of impacts associated with development could be: 1) the creation of hardened surfaces that are impervious to precipitation or otherwise alter infiltration rates or flow patterns; and 2) irrigation

for agricultural or horticultural purposes. These sources could affect surface runoff, groundwater flow, and groundwater recharge. The nature and scope of these impacts would depend on the site-specific details of individual development projects.

Water quality

Water quality could be adversely affected by several factors related to development, including

density of woody stems (Pauly 1997). It would increase light availability at ground level and increase nutrient availability, which would help maintain high levels of graminoid and forb diversity (Tester 1989). It would also reduce litter layers and help prevent the establishment and spread of invasive herbaceous and woody species (Chapman et al. 1995).

Oak savannas often burn patchily, especially when burns are conducted in the spring. This patchiness would provide natural refugia for fire-sensitive species (Chapman et al. 1995). Moreover, only one-third of an occupied KBB habitat patch would be burned within a single calendar year. With this approach, ample refugia would be available to allow re-colonization of burned areas by fire-sensitive species.

Mowing and hydroaxing, manual vegetation removal, chemical vegetation removal, livestock grazing, and soil scarification would be used to mimic certain effects of fire, wild herbivore grazing and browsing, and insect and disease outbreaks (Sinclair et al. 1987, Payne and Bryant 1994, Ritchie et al. 1998, Fuhlendorf and Engle 2001). These activities would suppress herbaceous and woody plants and increase incident sunlight at ground level. Some of these activities would expose mineral soils, reduce organic material, provide sunlit seed beds, and thus promote germination and growth of lupine and nectar plants (Tester 1989, Payne and Bryant 1994, Neary et al. 2005). All of these activities would simulate processes that occurred historically under a natural disturbance regime, and would help counter some of the detrimental impacts that have occurred since European settlement.

Individuals of some oak-savanna species could be sensitive to the effects of mowing and hydroaxing, manual vegetation removal, chemical vegetation removal, livestock grazing, and soil scarification. Accordingly, these activities would generally be conducted during times of the year when adverse impacts could be avoided or minimized. When impacts could not be avoided with timing, only a portion (generally one-third) of an occupied KBB habitat patch would be treated within a single calendar year. This approach would provide refugia from treatment effects and would allow re-colonization of treated areas by oak-savanna species.

The local and regional diversity of plant and wildlife species is not expected to change as a result of the proposed habitat management. Rather, existing diversity would be maintained by preventing losses associated with the degradation of oak savannas. By contrast, if management was not conducted, species diversity would be expected to decline locally or regionally because loss and fragmentation of early-successional habitat patches could result in the extirpation of several species (Eagle et al. 2005).

Oak savannas are not particularly productive environments due to their harsh physical features (e.g., low nutrients, droughty soils); however, many wildlife species frequently use these areas for foraging due to the structural complexity and the presence of specific (e.g., host plants) or high-quality (e.g., acorns) food sources. Management would help maintain productivity at levels normal for a functioning savanna. Without the management of oak-savanna habitat outlined in the Comprehensive HCP, food sources for some species could be lost and productivity could subsequently decline.

Habitat management under the Comprehensive HCP could impact approximately 2,700 acres, whereas the No Action and Reduced-scope HCP alternatives could impact approximately 900 acres and 1,000 acres, respectively. Therefore, threats to biological structure, function, diversity and productivity associated with degradation of oak-savanna habitats would be addressed on a larger scale by the Comprehensive HCP. Within areas of treatment, the biological impacts of habitat management would be similar, if not the same for all alternatives.

4.1.2.2 Utility and Transportation Right-of-Way Maintenance

Activities that involve vegetation manipulation would be conducted for the primary purpose of maintaining rights-of-way, but would be implemented in ways that simulate or replace the natural processes that historically maintained the Oak Savanna Ecosystem. Vegetation manipulation would generally be conducted according to the conditions outlined under 2.2.1.1 (Habitat Management). Thus, the biological impacts of vegetation manipulation within rights-of-way would generally be the same as those outlined under 4.1.2.1 (Habitat Management).

Additional activities conducted for right-of-way maintenance would include infrastructure repair and replacement, and could involve heavy equipment traffic/operation and soil excavation. These activities could result in take of individual plants and animals. However, given their localized nature, short duration, and associated requirements to minimize adverse effects (see

not cause a long-term net reduction in KBB population sizes, area of occupied KBB habitat, or connectivity of occupied KBB habitat patches. Given an expected time lag between initiation of mitigation and actual replacement of lost occupied KBB habitat, development that would cause occupied KBB habitat on non-Federal land to be reduced by more than 1% at any given time would not be permitted. Given the currently known KBB distribution and this restriction, the amount of occupied KBB habitat that might be developed under specific authority of the ITP in any given year ranges from 0 acres to 27 acres.

The specific biological impacts of 0–27 additional acres of developed land per year would depend on the types of development that would occur. However, the impacts would be small in comparison to those already being caused by development elsewhere within the Michigan KBB range.

No development would be conducted under specific authority of the No Action and Reduced-scope HCP alternatives. However, under those alternatives, development within the KBB range would be expected to continue, either legally, following other authorization processes, or illegally with regard to the ESA. Even though development conducted under the Comprehensive HCP could have localized impacts to biological features, the type and scale of those impacts would not differ regionally from those that would have otherwise occurred. Under the Comprehensive HCP, however, adverse impacts to KBB and occupied KBB habitat would be offset by required mitigation measures. Oak savanna that was restored or created as part of mitigation would not be eligible for future development. Thus, adverse impacts of development in one area would be balanced with the habitat protection offered in another (i.e., habitat that could have otherwise been developed legally would be protected).

4.1.3 Listed, Proposed and Candidate Species

4.1.3.1 Karner Blue Butterfly

KBB is currently known to occur on approximately 2,700 acres of non-Federal land in Michigan (Fettinger 2005). Activities under this alternative could be

- remove excess organic material;
- expose mineral soils; and
- establish lupine and nectar

Additional treatment conditions outlined under 2.2.1.1 would further minimize take of KBB. Treatments would be generally confined to those periods when adult KBB were not present (typically August 15 to May 15). The training of all employees and contractors on KBB life history, habitat requirements, and conservation measures would help ensure the required steps were taken to avoid or minimize take of the species. Take would be avoided when mowing/hydroaxing was conducted when at least

prescribed conditions may be permitted under the ITP only if mitigation is conducted according to the required conditions (see 2.2.1.4). The required mitigation would help ensure activities conducted under the Comprehensive HCP do not cause a net loss of KBB numbers, occupied habitat area or habitat connectivity.

A second category of right-of-way maintenance activity includes infrastructure replacement and repair. This activity could cause habitat disturbance due to heavy-equipment operation/traffic and soil excavation. In most cases, lupine areas would be avoided and detrimental impacts to KBB would not occur. If KBB or occupied KBB habitat would be adversely impacted by these activities, mitigation would be required (see 2.2.1.4).

Take due to infrastructure replacement and repair would be avoided or minimized by following the conditions outlined under 2.2.1.2. With rare exception, activities in occupied KBB habitat that could result in take would not occur when adult KBB were present, typically between May 15 and August 15. Activities that could cause take could be conducted during this period only in emergency situations demanding immediate repair of malfunctioning or dangerous infrastructure. In such situations, measures would be taken to minimize and mitigate take of KBB. In non-emergency situations, areas that contain lupine immediately adjacent to treatment areas would be flagged or otherwise marked; workers would not stockpile materials, park vehicles, or otherwise cause adverse impacts in those areas. Training of all relevant employees and contractors on KBB life history, habitat requirements, and conservation measures would help ensure the required steps are taken to avoid or minimize take of the species.

Measures to avoid or minimize take would also apply to individual maintenance techniques. To the extent possible, truck and heavy-equipment traffic would be limited to existing disturbed areas, such as access roads that run within a right-of-way. When traffic must leave existing routes to conduct maintenance activities, steps would be taken to avoid lupine areas and to minimize the extent of new disturbance. During replacement and repair of infrastructure, existing structures would be dismantled in place or otherwise repaired in ways to avoid impacts to lupine to the extent possible. When soil excavation occurred in lupine areas, efforts would be made to minimize the footprint of the area disturbed. To the extent possible, displaced soils would be deposited away from lupine areas and within the smallest possible side-cast areas needed for temporary storage. Following repair or replacement of structures, excavated areas would be backfilled using the original soil that was deposited in temporary storage areas.

Heavy-equipment traffic/operation and soil excavation that could not avoid disturbance to lupine areas could result in take of KBB. When they would result in take, these activities would be permitted under the Comprehensive HCP only if mitigation in proportion to the impact was conducted according to the requirements outlined in subsection 2.2.1.4 (Mitigation). The required mitigation would help ensure activities conducted under the Comprehensive HCP do not cause a net loss of KBB numbers, occupied habitat area or habitat connectivity.

Development

When conducted in occupied KBB habitat, development can have long-term impacts that, in addition to destroying individual butterflies, convert at least portions of occupied habitat patches

Candidate species

Certain habitat-management and right-of way maintenance activities conducted under authority of the ITP could result in injury or mortality to a small number of eastern massasauga rattlesnakes. For example, individuals could be killed or injured during prescribed burning, mowing, or by heavy-equipment traffic. However, only a small subset of occupied KBB habitat is likely to be occupied by massasaugas, and the conditions required to avoid or minimize take of KBB would also generally minimize adverse impacts to massasaugas. In fact, management activities conducted from late fall to early spring should avoid impacts entirely because massasaugas would be hibernating in lowland areas during that time. Consequently, habitat management and right-of-way maintenance conducted under the ITP would not jeopardize the continued existence of the species. Indeed, activities that maintained KBB habitat would usually improve conditions for massasaugas as well.

Development has occurred and is currently occurring within the overlapping range of KBB and the eastern massasauga rattlesnake, such that the landscape is becoming increasingly fragmented. Under the Comprehensive HCP, regional rates of development and fragmentation would not be expected to differ from those that would have otherwise occurred. Development in occupied KBB habitat could be specifically authorized by the ITP; however, required mitigation would remove the option of developing in newly restored or created oak savanna in other areas. Probability of massasauga presence would not be expected to be different between areas that would be developed and areas that would be protected by mitigation measures. Thus, the threat posed by development in one area could be offset by the habitat protection offered in another (i.e., massasauga habitat that would have otherwise been developed legally would be protected). This protection could be important for the viability of the eastern massasauga in Michigan, given that neither Federal nor State law protects the species against development impacts. In addition, mitigation requirements would help ensure no net increase in fragmentation of occupied KBB habitat and thus, no reduction in habitat connectivity for the eastern massasauga rattlesnake where it occurs with KBB.

4.1.3.3 Michigan State-listed Species

At least 33 species classified as threatened or endangered under Michigan law could occur in or near occupied KBB habitat (Tables 5 and 6). Prior to implementation of any project under the Comprehensive HCP, the potential presence of these species would be evaluated based on review of the Biotics data base (Michigan Natural Features Inventory 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. If a State-listed species was determined to be present in a project area, proposed activities potentially resulting in take could proceed only if authorized under the provisions of the Michigan Endangered Species Protection Law (Public Act 451 of 1994, Part 365).

Many of the State-listed species that co-occur with KBB are also dependent upon early-successional conditionse

4.1.6 Cumulative Impacts

Cumulative impacts are considered from a historical and contemporary perspective. Historic cumulative impacts occurred prior to implementation of the activities outlined under this alternative, whereas contemporary cumulative impacts include additional impacts that could result from implementation of those activities.

4.1.6.1 Historic Cumulative Impacts

The Oak Savanna Ecosystem likely reached its greatest extent in North America during the warm, dry hypsithermal period, peaking between 4,000 and 6,000 years ago (Cohen 2004). Although little is known from this period, it is reasonable to conclude that oak savanna was both extensive and more contiguous compared with its current occurrence and character. Frequent fires, wind, wild herbivores, and insect and disease outbreaks shaped and maintained the early-successional character of this ecosystem (Nuzzo 1986, Grundel et al. 1998, Ritchie et al. 1998, Fuhlendorf and Engle 2001).

During the centuries that followed the hypsithermal period until the advent of Europeans on the continent around 1500 A.D., the climate gradually became cooler and more humid. Again, little is known from this period, but it is reasonable to conclude that oak savanna progressively declined, possibly by an order of magnitude, and became less contiguous as a result of these climatic changes. With the decline of oak savanna, KBB would have been subjected to habitat that was less extensive and more fragmented.

During this period, Native Americans strongly influenced the frequency of fires in savanna habitats (Cohen 2004, O'Connor 2006). Native Americans set fires deliberately for a variety of purposes, and they sometimes set fires accidentally (Cohen 2004, O'Connor 2006). These activities created early-successional habitats that would have been used by many savanna-associated species.

European settlement of the continent in the 1500s resulted in the introduction of human-borne diseases. These diseases spread quickly across the continent and had a profound effect on Native Americans, reducing their numbers continent-wide to a fraction of what they were prior to European settlement (Denevan 1992a). As a result, the substantial influence of Native Americans (e.g., prescribed fire) on maintenance of early-successional areas such as oak savannas sharply diminished (Denevan 1992b, Dickman and Leefers 2003).

With European settlement of Michigan in the mid 1800s, many savannas were logged and then converted to agriculture (Dickman and Leefers 2003). Some of this acreage was eventually abandoned because it was not able to support continued farming, and subsequently reverted back to degraded savanna. Many of these areas have now succeeded to forest, and in many of the savannas that remain, soil disturbance and introduction of exotic plant species have marginalized habitat suitability for many savanna-associated species.

Oak savannas in Michigan were subjected to another impact beginning in the 1920s as broad-scale control of wildfires began (Abrams 1992). This practice sharply reduced the scope and

frequency of fire on the landscape, further marginalizing a force that historically maintained the early-successional conditions characteristic of oak savannas. Fire suppression resulted in succession of many open oak savannas to closed-canopy forests. In many cases, this transition occurred within the span of a few decades (e.g., Curtis 1959). Oak savannas that have succeeded to closed-canopy forest often have a diminished graminoid component as a result of reduced light availability at ground level and the accumulation of thick litter layers (Abella et al. 2001). The overstory is often simplified due to selective timber harvest (Minc and Albert 1990). Native

Habitat management under the Comprehensive HCP would have no known cumulative impacts because it would generally counter the ongoing impacts described above, have impacts that would be temporary, cause levels of disturbance within the natural range of variability for oak savannas, and follow guidelines developed to mini

exposure would be expected to provide more protection for KBB, more information on KBB distribution, and more opportunities for pro-active management.

4.2 Alternative B: No Action

An ITP would not authorize activities conducted specifically under this alternative. Activities resulting in legal KBB take would include: 1) KBB habitat management authorized by existing

4.2.1.2 Utility and Transportation Right-of-Way Maintenance

Right-of-way maintenance in occupied KBB habitat would not be specifically authorized under this alternative. However, maintenance would still be necessary to preserve the primary functions of existing rights-of-way on approximately 800 acres of occupied KBB habitat. Legal, incidental take associated with maintenance of rights-of-way w

and the accumulation of thick litter layers (Abella et al. 2001). The overstory is often simplified due to selective timber harvest (Minc and Albert 1990). Native floristic diversity is often reduced as a result of fire suppression, sustained livestock grazing, woody encroachment, and the establishment of invasive species such as spotted knapweed (Cohen 2000, 2001, 2004). These changes in structure and vegetation were accompanied by declines of many wildlife species that are associated with oak savanna (Eagle et al. 2005, O'Connor 2006).

Where it occurred under this alternative, habitat management would help prevent or reverse many of these detrimental impacts by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem. Thus, habitat management would be used to restore the natural community structure and ecological function of oak savannas. Although they would occur on a smaller scale, the biological impacts of individual habitat management techniques would be virtually the same as those described under (4.1.2.1).

The diversity of plant and wildlife species would be unlikely to change in areas where habitat management would be conducted under this alternative. Rather, existing diversity would be maintained by preventing losses associated with the degradation of oak savannas. By contrast, where management would not be conducted, species diversity would be expected to decline locally or regionally because loss and fragmentation of early-successional habitat patches could result in the extirpation of several species (Eagle et al. 2005). Many species frequently use oak savanna for parts of their life stages and could undergo population declines in habitats not managed under this alternative.

Oak savannas are not particularly productive environments due to their harsh physical features (e.g., low nutrients, droughty soils); however, many wildlife species frequently use these areas for foraging due to the structural complexity and the presence of specific (e.g., host plants) or high-quality (e.g., acorns) food sources. Habitats that would be managed under this alternative would be expected to maintain productivity at levels normal for a functioning savanna. In areas where management would not be conducted, food sources for some species could be lost and productivity could subsequently decline.

Habitat management under the Comprehensive HCP alternative could involve approximately 2,700 acres, whereas habitat management under the No Action alternative could involve approximately 900 acres. Thus, habitat management under the latter alternative would simulate natural disturbance on a smaller scale, and fewer habitats would experience the types of processes that historically shaped their biological features. That is, the No Action alternative would not address biological threats associated with succession of oak-savanna habitats on approximately 1,800 acres of occupied KBB habitat on non-Federal land.

4.2.2.2 Utility and Transportation Right-of-Way Maintenance

Right-of-way maintenance in occupied KBB habitat would not be specifically authorized under this alternative. However, maintenance would still be necessary to preserve the primary functions of existing rights-of-way on approximately 800 acres of occupied KBB habitat. Legal, incidental take associated with maintenance of rights-of-way would therefore require

authorization on an individual, project-by-project basis under existing Federal, State and local regulations.

Many techniques used to maintain rights-of-way can be implemented in ways that simulate or replace the natural processes that historically influenced community structure, diversity and productivity. Therefore, lack of authorization for right-of-way maintenance on approximately 800 acres of occupied KBB habitat would prevent mechanisms that simulate natural processes that are currently missing from these habitats.

4.2.2.3 Development

Development in occupied KBB habitat would not be specifically authorized under this

- suppress woody and invasive plants;
- enhance the diversity and abundance of desirable plants;
- increase incident sunlight at ground level;
- raise soil pH;
- reduce soil nitrogen;
- remove excess organic material;
- expose mineral soils; and
- establish lupine and nectar plants where necessary.

Together, these activities would increase the coverage of lupine and nectar plants in individual habitat patches. As a result, likelihood of KBB persistence in existing occupied habitat would increase.

Detrimental impacts of habitat management would generally be of short duration and include take of individual butterflies and temporary suppression of desired vegetation. Treated portions

conditions to become unsuitable for wild lupine and KBB, and population extirpations could result.

Utility and Transportation Right-of-Way Maintenance

Right-of-way maintenance in occupied KBB habitat would not be specifically authorized under this alternative. However, maintenance would still be necessary to preserve the primary functions of existing rights-of-way on approximately 800 acres of occupied KBB habitat. Legal, incidental take associated with maintenance of rights-of-way would therefore require authorization on an individual, project-by-project basis under existing Federal, State and local regulations.

Many techniques used to maintain rights-of-way can be implemented in ways that simulate or replace the natural processes that historically provided suitable conditions for wild lupine and KBB. Therefore, lack of authorization for maintenance of rights-of way on approximately 800 acres of occupied KBB habitat would prevent mechanisms that could help maintain KBB populations.

Development

Development in occupied KBB habitat would not be specifically authorized under this alternative. However, development would be expected to continue within the KBB range. Legal, incidental take associated with development in occupied KBB habitat would require authorization on an individual, project-by-project basis under existing Federal, State and local regulations.

Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the other alternatives. The No Action alternative would not authorize development of occupied KBB habitat, but it would not prevent development in unoccupied habitat that would have otherwise been restored, created and subsequently protected according to mitigation requirements under the Comprehensive HCP. Therefore, the amount of occupied KBB habitat would not be expected to differ between the No Action and Comprehensive HCP alternatives.

Where development occurred in occupied KBB habitat, it would typically have long-term impacts that, in addition to destroying individual butterflies, convert at least portions of occupied habitat patches into conditions incompatible with sustaining KBB. The average impacts per acre of development could be more severe under the No Action alternative than under the Comprehensive HCP alternative, because development under the No Action alternative would not necessarily be conducted according to the conditions under 2.2.1.3 and 2.2.1.4 that are designed to avoid or minimize and mitigate impacts to KBB and its habitat.

4.2.3.2 Other Federally Listed and Candidate Species

Listed species

No projects authorized under this alternative would be 'likely to adversely affect' federally listed species other than KBB. Prior to implementation of any project, the potential presence of federally listed species would be evaluated based on review of the Biotics data base (Michigan Natural Features Inventory 2007), consideration of known species distributions, assessment of current habitat characteristics, and site surveys as necessary. Occupied KBB habitat does not typically overlap with that of other federally listed species; thus, the potential for impacts to these species would be small. Indeed, this alternative would involve one-third the habitat that could be involved under the Comprehensive HCP alternative; thus, this alternative would have a smaller chance of impacting habitat occupied by other federally listed species. In the rare event any federally listed species occurred or would be likely to occur in or near a project area while it was listed, the project could proceed only if it would not adversely affect the species. Adverse effects might be avoided by reconfiguring activity areas, adjusting timing of activities, or modifying the nature of activities.

Candidate species

Certain habitat-management activities conducted under authority of this alternative could result in injury or mortality to a small number of eastern massasauga rattlesnakes. For example,

law, neither minority nor low-income populations may receive disproportionately large and adverse impacts as a result of a proposed project.

Neither minority nor low-income populations are known to be disproportionately represented near oak-savanna habitats. No environmental justice issues exist for this alternative. No minority or low-income populations would be displaced or negatively affected in any other way by this alternative.

4.2.6 Cumulative Impacts

Cumulative impacts are considered from a historical and contemporary perspective. Historic cumulative impacts occurred prior to implementation of the activities outlined under this alternative, whereas contemporary cumulative impacts include additional impacts that could result from implementation of those activities.

4.2.6.1 Historic Cumulative Impacts

Historic cumulative impacts are described under 4.1.6.1.

4.2.6.2 Contemporary Cumulative Impacts

Limited habitat management would be conducted primarily to counter localized historic and ongoing cumulative impacts that threaten the persistence of oak-savanna habitats, KBB and other oak-savanna species. These ongoing, cumulative impacts include habitat loss and fragmentation due to land conversion (e.g., agriculture, forestry, industrial, commercial and residential development, right-of-way development), vegetative succession following removal of fire from the landscape, and the proliferation of invasive species. These cumulative impacts have

some occupied KBB habitats, but it would require authorization on an individual, project-by-project basis under existing Federal, State and local regulations. Proposed mitigation associated with individual right-of-way maintenance projects may not be well-coordinated with statewide KBB conservation efforts.

Similarly, development in occupied KBB habitat would not be coordinated with statewide KBB conservation efforts and would require authorization on an individual, project-by-project basis under existing Federal, State and local regulations. Without a process to coordinate development with statewide efforts to conserve KBB, there would be fewer opportunities for public exposure to statewide KBB conservation issues, and therefore fewer opportunities for acquisition of KBB distribution information and pro-active KBB habitat management and protection.

Given the limited geographic scope (approximately 900 acres) of this alternative, the accumulation of adverse impacts due to land-use patterns, interruption of natural process, and introduction of invasive species would generally continue in many occupied KBB habitats. Activities that could counter adverse cumulative impacts could be conducted on only one-third of known, occupied KBB habitat on non-Federal land.

4.3 Alternative C: Reduced-scope HCP

Unlike the Comprehensive HCP alternative, this alternative could involve only a subset of occupied KBB habitats occurring on non-Federal land within Michigan. This subset would be limited to land owned and managed by State agencies, selected county and local governments, and conservation-oriented non-governmental organizations. Whereas the Comprehensive HCP could address conservation needs on approximately 2,700 acres of occupied KBB habitat, the Reduced-scope HCP could involve approximately 900 acres of occupied habitat (An additional 100 acres of occupied KBB habitat would be managed under the Landowner Incentive Program). The Reduced-scope HCP would not address KBB-related issues on lands owned by private transportation and utility companies, private-land developers, and other private landowners.

Activities resulting in KBB take that would be addressed in a Reduced-scope HCP fall into two general categories: habitat management and public right-of-way maintenance. Right-of-way maintenance would occur only on lands managed by State, county and local governments.

4.3.1 Physical Impacts

Potential physical impacts of habitat management and public right-of-way management are described under the following headings. Physical features considered include climate, topography and soils, hydrology, water quality and air quality.

4.3.1.1 Habitat Management

Habitat management would be conducted to maintain habitat for KBB and other species of concern by maintaining and restoring early-successional plant communities. This would be achieved by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem.

Habitat-management techniques and conditions would be similar for all the alternatives (cf.

4.3.1.3 Development

Under this alternative, no development would be authorized under the ITP. However, development would be expected to continue within the KBB range. Legal, incidental take associated with development in occupied KBB habitat would require authorization on an

authorization on an individual, project-by-project basis under existing Federal, State and local regulations.

Lack of authorization for right-of-way maintenance on approximately 700 acres of occupied KBB habitat would preclude mechanisms that simulate natural processes that are currently missing from these habitats.

4.3.2.3 Development

Under this alternative, no development would be authorized under the ITP. However, development would be expected to continue within the KBB range. Legal, incidental take associated with development in occupied KBB habitat would require authorization on an individual, project-by-project basis under existing Federal, State and local regulations.

Regional and local rates of development under this alternative would not be expected to differ from those that would occur under the other alternatives. Like the No Action Alternative, the Reduced-Scope HCP alternative would not authorize development of occupied KBB habitat, but it would not prevent development in unoccupied habitat that would have otherwise been restored, created and subsequently protected according to mitigation requirements under the Comprehensive HCP. Therefore, the amount of available oak-savanna habitat would not be expected to differ among the Reduced-scope HCP, No Action and Comprehensive HCP alternatives.

Where development occurred, its general biological impacts would be the same as those outlined under 4.1.2.3.

4.3.3 Listed, Proposed and Candidate Species

4.3.3.1 Karner Blue Butterfly

KBB is currently known to occur on approximately 2,700 acres of non-Federal land in Michigan (Michigan Natural Features Inventory 2007). The Reduced-scope HCP alternative could maintain KBB on approximately 1,000 of those acres. Whereas the Comprehensive HCP alternative could be implemented to help ensure no net loss of occupied KBB habitat on non-Federal land, the Reduced-scope HCP alternative would be expected to result in a loss of 1,700 acres of occupied KBB habitat on non-Federal land, due to lack of legal authority to adequately manage it.

Habitat management

Where it would be conducted under this alternative, habitat management would maintain habitat for KBB and other species of concern by maintaining and restoring early successional plant communities. This would be achieved by simulating or replacing the natural processes that historically maintained the Oak Savanna Ecosystem. Thus, KBB habitat features would fluctuate within the natural range of variability. Habitat management would:

- suppress woody and invasive plants;
- enhance the diversity and abundance of desirable plants;
- increase incident sunlight at ground level;
- raise soil pH;
- reduce soil nitrogen;
- remove excess organic material;
- expose mineral soils; and
- establish lupine and nectar plants where necessary.

Together, these activities would increase the coverage of lupine and nectar plants in individual habitat patches. As a result, likelihood of KBB persistence in existing occupied habitat would increase.

Detrimental impacts of habitat management would generally be of short duration and include take of individual butterflies and temporary suppression of desired vegetation. Treated portions of occupied patches would generally be expected to provide suitable habitat and be re-colonized by KBB within two growing seasons following treatment. Given the required treatment conditions (see 2.2.1.1), habitat management would not be expected to cause extirpation of KBB within any occupied patch. Nevertheless, some habitat management prescriptions would result in the mortality of individual KBB. For instance, a prescribed burn through an occupied area would destroy KBB juveniles or eggs. However, even within a burn unit, mortality may not be complete, because burn intensity tends to be uneven across a patch, and some juveniles or eggs at or near ground level may survive. Take of immature forms of insects (especially eggs) is difficult to quantify; therefore, take would be indirectly quantified as acres of occupied KBB habitat that could be impacted.

Under this alternative, habitat management could occur in approximately 1,000 acres of occupied KBB habitat. Habitat-management techniques would typically not be applied to more than one-third of any particular occupied KBB habitat patch within a calendar year. Therefore, take of KBB could occur on approximately 330 acres in any single calendar year.

Take would be minimized by following the treatment conditions outlined in 2.2.1.1. Treatment would first be conducted on the most-degraded third of a patch. This approach would reduce the risk of extirpating KBB and other species of concern, and it would facilitate re-colonization of recently treated portions. Treatments would be generally confined to those periods when adult KBB were not present (typically August 15 to May 15). Take would be avoided when mowing/hydroaxing was conducted when at least 4 inches of snow cover the ground. By maintaining a mower cutting height of at least 6 inches above the ground when snow was not present, impacts to lupine and take of eggs and larvae would be minimized. Manual vegetation removal, basal herbicide treatment, and spot herbicide spraying would involve removal of individual targeted plants; thus, potential impacts to lupine and take of KBB would be avoided entirely. Conducting grazing on a short rotation and removing livestock before vegetation was reduced to a height of 6 inches would limit trampling of lupine, eggs and larvae.

On the roughly 1,700 acres of occupied KBB habitat on non-Federal land where management would not be conducted under this alternative, habitat succession would probably cause

conditions to become unsuitable for wild lupine and KBB, and population extirpations could result.

Public Utility and Transportation Right-of-Way Maintenance

Based on known occurrences, public right-of-way maintenance under authority of the ITP could occur in approximately 100 acres of occupied KBB habitat. Right-of-way maintenance techniques would typically be applied to no more than one-third of any particular occupied habitat patch (or metapopulation complex: see general guidelines under 2.2.1.1) within a calendar year. Treatment would first be conducted on the most degraded third of the patch. This approach would reduce the risk of extirpating KBB and other species of concern, and it would facilitate re-colonization of recently treated portions. The entirety of a patch (or metapopulation complex) would not be treated until the initially treated portion benefited from two growing seasons and monitoring confirmed densities of KBB, lupine and flowering nectar plants that exceed pre-treatment levels. Given these restrictions and based on the current amount of known occupied habitat in rights-of-way, take of KBB due to this activity could occur on no more than approximately 33 acres in any single calendar year. If the amount of known occupied KBB habitat in public rights-of-way increased due to recovery efforts not conducted under authority of the ITP, right-of-way maintenance under the ITP could occur on a larger number of acres (i.e., one-third of each additional occupied KBB habitat that is discovered or established in rights-of-way could be treated within

The chance of managing habitat occupied by massasauga would be smaller under this alternative than under the Comprehensive HCP alternative, because a smaller amount of habitat would be involved. Also, the conditions required to avoid or minimize take of KBB would also generally minimize adverse impacts to massasaugas. In fact, management activities conducted from late fall to early spring should avoid adverse impacts entirely because massasaugas would be hibernating in lowland areas during that time. Consequently, habitat management conducted under this alternative would not jeopardize the continued existence of the species. Indeed, activities that maintained KBB habitat would usually improve conditions for massasaugas as well.

Development has occurred and is currently occurring within the overlapping range of KBB and eastern massasauga rattlesnake, such that the landscape is becoming increasingly fragmented. Development in occupied KBB habitat would not be specifically authorized under the ITP, but regional rates of development and fragmentation would not be expected to differ from those that would occur under the other alternatives.

4.3.3.3 Michigan State-listed Species

At least 33 species classified as threatened or endangered under Michigan law could occur in or near occupied KBB habitat (Tables 5 and 6). Prior to implementation of any project under this alternative, the potential presence of these species would be evaluated based on revieh.0006 Tc4f tion015.3(e)ss.

Given treatment restrictions and the geographic scope of this alternative, activities that could result in take of a State-listed species could occur on no more than 330 acres in any single calendar year. Only a small subset of occupied KBB habitat is likely to be occupied by any particular State-listed species.

In areas where management would not occur under this alternative, succession may render habitats unsuitable for certain threatened or endangered savanna-dependent species, which could cause the extirpation of local populations.

4.3.4 Cultural Resources

Similarly, development in occupied KBB habitat would not be coordinated with statewide KBB

4.4 Summary of Environmental Consequences by Alternative

Table 8. Summary of environmental consequences by alternative.

Environmental Component	Activity	Alternative A: Comprehensive HCP	Alternative B:

Environmental Component	Activity	Alternative A: Comprehensive HCP	Alternative B: No Action	Alternative C: Reduced-scope HCP
Biological	**Habitat Management**	Replacement and simulation of natural processes that historically maintained the Oak Savanna Ecosystem Maintenance of oak-savanna habitats in early-successional conditions required by savanna-dependent species Maintenance of biological diversity in oak savannas Maintenance of biological productivity at levels normal for functioning oak savannas	Where management was authorized, impacts the same as under Alternative A, on a smaller scale Where habitat management was not authorized: -Lack of natural processes that historically maintained the Oak Savanna Ecosystem -Loss of early-successional habitats required by savanna-dependent species -Loss of biological diversity in oak savannas -Potential decline in biological productivity	Same as under Alternative B
	Right-of-way Maintenance	Same as above, on a smaller scale Mitigation of long-term detrimental impacts to KBB or occupied KBB habitat	No impacts specifically authorized under this alternative Lack of natural processes that historically maintained the Oak Savanna Ecosystem Loss of early-successional habitats required by savanna-dependent species Loss of biological diversity in oak savannas Potential decline in biological productivity	Where maintenance was authorized, impacts the same as under Alternative A, on a smaller scale Where maintenance is not authorized, impacts the same as under Alternative B
	Development	Anticipated impacts the same as those already occurring within the KBB range: -Conversion of localized habitats into conditions unsuitable for oak-savanna species -Loss of biological diversity in oak savannas -Decline in biological productivity Potential creation of habitat corridors through right-of-way development Mitigation of long-term detrimental impacts to KBB or occupied KBB habitat	No impacts specifically authorized under this alternative	No impacts specifically authorized under this alternative

Environmental Component	Activity	Alternative A: Comprehensive HCP	Alternative B: No Action	Alternative C: Reduced-scope HCP
	Habitat Management	Maintenance of oak-savanna habitats in conditions suitable for KBB Incidental take of KBB (on 900 acres per year) [a]		

Environmental Component	Activity	Alternative A: Comprehensive HCP	Alternative B: No Action	Alternative C: Reduced-scope HCP
	Habitat Management	No anticipated adverse impacts on federally		

the Comprehensive HCP. Stakeholders who have land-management authority on occupied Karner blue butterfly habitat are marked with an asterisk.

- Allegan County
- Binder Park Zoo
- Brooks Township, Newaygo County*
- Consumers Energy*
- Detroit Zoo
- El Paso Pipeline Company*
- Grand Rapids Community College
- Grand Valley State University
- Huron-Manistee National Forest
- Indiana Dunes National Lakeshore
- John Ball Zoo
- Land Conservancy of West Michigan*
- Michigan Electric Transmission Company*
- Michigan Department of Military and Veterans Affairs
- Michigan Department of Natural Resources*
- Michigan Department of Transportation*
- Michigan Natural Features Inventory
- Michigan Nature Association*
- Michigan State University
- Muskegon County
- Southwest Michigan Land Conservancy*
- The Nature Conservancy*
- Toledo Zoo
- U.S. Fish and Wildlife Service
- West Michigan Butterfly Association

6. PUBLIC COMMENT ON DRAFT ENVIRONMENTAL ASSESSMENT AND RESPONSE

(To be completed following public comment period)

7. REFERENCES CITED

Abella, S. R., J. F. Jaeger, D. H. Gehring, R. G. Jacksy, K. S. Menard, and K. A. High. 2001. Restoring historic plant communities in the oak openings region of northwest Ohio. Ecological Restoration 19:155-160.

Abrams, M. D. 1992. Fire and the development of oak forests. BioScience 42:346-353.

Albert, D. A. 1995. Regional landscape ecosystems of Michigan, Minnesota, and Wisconsin: a working map and classification. Gen. Tech. Rep. NC-178. U.S. Department of Agriculture Forest Service, North Central Forest Experiment Station, St. Paul, Minnesota, USA.

Andow, D. A., R. J. Baker, and C.P. Lane (editors.). 1994. Karner blue butterfly: a symbol of a vanishing landscape. Miscellaneous publication 84-1994. University of Minnesota Agricultural Experiment Station, Minnesota, USA.

Baker, R. H. 1983. Michigan Mammals. Michigan State University Press, East Lansing, Michigan, USA.

Bernays, E. A. and R. F. Chapman. 1994. Host-plant selection by phytophagous insects. Chapman and Hall, New York, New York.

Bleser, C. A. 1992. Status survey, management and monitoring activities for the Karner blue butterfly *(Lycaeides melissa samuelis)* in Wisconsin 1990–1992. Report submitted to the U.S. Fish and Wildlife Service, Fort Snelling, Minnesota. Wisconsin Department of Natural Resources, Bureau of Endangered Resources, Madison, Wisconsin, USA.

Bowerman, W. W., T. G. Grubb, A. J. Bath, J. P. Giesy, and D. V. C. Weseloh. 2005. A survey of potential bald eagle nesting habitat along the Great Lakes shoreline. Research Paper RMRS-RP-56WWW. U.S. Department of Agriculture Forest Service, Rocky Mountain Research Station, Fort Collins, Colorado, USA..

Brack, V. 2006. Autumn activity of *Myotis sodalis* (Indiana bat) in Bland County, Virginia.

Cohen, J. G. 2004. Natural community abstract for oak openings. Michigan Natural Features Inventory, Lansing, Michigan, USA.

Comer, P. J., D. A. Albert, H. A. Wells, B. L. Hart, J. B. Raab, D. L. Price, D. M. Kashian, R. A. Comer, and D. W. Schuen. 1995. Michigan's presettlement vegetation, as interpreted from the General Land Office Surveys 1816–1856. Michigan Natural Features Inventory, Lansing, Michigan, USA.

Cooper, J. L. 2000. Special animal abstract for *Dendroica discolor* (Prairie warbler) Michigan Natural Features Inventory, Lansing, Michigan, USA.

Curtis, J. T. 1959. Vegetation of Wisconsin: an ordination of plant communities. University of Wisconsin Press, Madison, Wisconsin, USA.

Cuthrell, D. 2001. Special animal abstract for *Hesperia ottoe* (Ottoe skipper). Michigan Natural Features Inventory, Lansing, Michigan, USA.

Denevan, W. M. 1992a. The native population of the Americas in 1492, second edition. University of Wisconsin Press, Madison, Wisconsin, USA.

Denevan, W. M. 1992b. The pristine myth: the landscape of the Americas in 1492. Annals of the Association of American Geographers 82:369-385.

Dickman, D. and L. Leefers. 2003. The forests of Michigan. The University of Michigan Press, Ann Arbor, Michigan, USA.

Dirig, R. 1976. Karner's famous blue butterfly. Pages 197-210, 250-252 *in* Rittner, D., editor. Pine bush—Albany's last frontier. Pine Bush Historic Preservation Project, Albany, New York, USA.

Dirig, R. 1994. Pages 23-36 *in* Andow, D. A., R. J. Baker, and C. P. Lane, editors. Karner blue butterfly: a symbol of a vanishing landscape. Miscellaneous publication 84-1994. University of Minnesota Agricultural Experiment Station, Minnesota, USA.

Dunn, J. P., C. J. Summerfield, and M. Johnson. 2002. Distribution, seasonal cycle, host-plant records, and habitat evaluation of a Michig

Faber-Langendoen, D. 1991. Community structure at Allison savanna: the impact of settlement and fire management. Final report to the Minnesota Chapter of The Nature Conservancy, Minneapolis, Minnesota, USA.

Fettinger, J. L. 2005. Comprehensive population and habitat surveys for the Karner blue (*Lycaeides melissa samuelis*) in Michigan. Report number 2005-08. Michigan Natural Features Inventory, Lansing, Michigan, USA.

Foster, R. and A. Kurta. 1999. Roosting ecology of the northern bat (*Myotis septentrionalis)* and comparisons with the endangered Indiana bat (*Myotis sodalis*). Journal of Mammalogy 80:659-672.

Fried, C. S. 1997. Dispersal of the Karner blue butterfly (*Lycaeides melissa samuelis* Nabokov) in the Albany pine bush. Report submitted to the Endangered Species Unit of the New York State Department of Environmental Conservation, New York, USA.

Gardne. 200E. 200D. Glue . Ho.635 0 T320.0001 Tc-06w( )TjT[(f)0.6(rthe. CommuniSum)0.6(r bur ecotr)lecew Y Ku

Haney A. and S. Apfelbaum. 1990. Structure and dynamics of Midwest oak savannas. Pages 19-30 *in* J. M. Sweeney, editor. Managing dynamic ecosystems. North Central Section, The Wildlife Society, West Lafayette, Indiana, USA.

Hanna, M. 1970. An annotated list of the spittlebugs of Michigan (Homoptera: Cercopidae). The Michigan Entomologist 3(1):2-16.

Harding, J. H. 1997. Amphibians and reptiles of the Great Lakes Region. University of Michigan Press, Ann Arbor, Michigan, USA.

Harding, J. H. 2000. Amphibians and reptiles of the Great Lakes region. The University of Michigan Press, Ann Arbor, Michigan, USA.

Helmbolt, K. M. and M. Amaral. Status of the Karner blue butterfly in New Hampshire. Pages 123-128 *in* Andow, D. A., R. Baker, and C. Lane, editors. Karner blue butterfly: a symbol of a vanishing landscape. Miscellaneous publication 84-1994. University of Minnesota Agricultural Experiment Station, Minnesota, USA.

Higman, P. J. and M. R. Penskar. 1999. Special plant abstract for *Cirsium pitcheri*. Michigan Natural Features Inventory, Lansing, Michigan, USA.

Humphrey, S. R., A. R. Richter, and J. B. Cope. 1977. Summer habitat and ecology of the endangered Indiana bat, *Myotis sodalis*. Journal of Mammalogy 58:334–346.

Indiana Dunes National Lakeshore. 2000. Strategic plan. Indiana Dunes National Lakeshore, National Park Service, U.S. Department of Interior, Porter, Indiana, USA.

Karl, T. R. and K. E. Trenberth. 2003. Modern global climate change. Science 302:1719-1723.

Kurta, A. 2004. Roosting ecology and behavior of Indiana bats (*Myotis sodalis*) in summer. *In* Vories, K. C. and A. Harrington, editors. The Indiana bat and coal mining. Office of Surface Mining, U. S. Department of the Interior, Alton, Illinois, USA.

Kurta, A.D. and S.W. Murray. 2002. Philopatry and migration of banded Indiana bats (*Myotis sodalis*) and effects of radio transmitters. Journal of Mammalogy 83:585-589.

Kurta, A., and H. Rice. 2002. Ecology and management of the Indiana bat in Michigan. Michigan Academician, 33:361-376.

Kurta, A, D. King, J. A. Teramino, J. M. Stribley, and K. J. Williams. 1993. Summer roosts of the endangered Indiana bat (*Myotis sodalis*) on the northern edge of its range. American Midland Naturalist 129:132-138.

Kurta, A., S. W. Murray, and D. H. Miller. 2002. Roost selection and movements across the summer landscape. Pages 118-129 *in*

Kurta, A., K. J. Williams and R. Mies. 1996. Ecological, behavioural, and thermal observations of a peripheral population of Indiana bats (*Myotis sodalis*). Pages 102-117 *in* R. M. R. Barclay and R. M. Brigham, editors. Bats and forests. Research Branch, Ministry of

McEachern, A. K. 1992. Disturbance dynamics of pitcher's thistle (*Cirsium pitcheri*) populations in Great Lakes sand dune landscapes. PhD dissertation, University of Wisconsin, Madison, Wisconsin.

McGowan-Stinski, J. 2000. Fire management and alien weed plan for Clawson Tract, Brooks Township, Newaygo County, Michigan. The Nature Conservancy, Lansing, Michigan, USA.

Menzel, M. A., J. M. Menzel, T. C. Carter, W. M. Ford, J. W. Edwards. 2001. Review of the forest habitat relationships of the Indiana bat (*Myotis sodalis*). General Technical Report NE-284. U.S. Department of Agriculture Forest Service, Northeastern Research Station. Newtown Square, Pennsylvania, USA.

Michigan Department of Environmental Quality. 2004. Water quality and pollution control in Michigan: 2004 Sections 303(d) and 305(b) integrated report. Report number MI/DEQ/WD-04/029. Michigan Department of Environmental Quality Water Division, Lansing, Michigan, USA.

Michigan Department of Labor and Economic Growth. 2005. Industry employment forecasts 2000–2010. Available: http://www.michlmi.org/LMI/ind_proj/sic_02.htm.

Michigan Department of Natural Resources. 2004. Federal Aid Section 7 Evaluation Form: Phase I. Grant title: Landowner Incentive Program Tier 2. Grant number: I-2-T. Lansing, MI, USA.

Michigan Department of Natural Resources. 2005a. Michigan's Kirtland's warblers set new record-high for census count. Press release. Michigan Department of Natural Resources, Lansing, Michigan, USA.

Michigan Department of Natural Resources. 2005b. Michigan remains last stronghold for eastern massasauga rattlesnake. August 18, 2005. http://www.michigan.gov/dnr/0,1607,7-153-10369-125136--,00.html

Michigan Department of Natural Resources. 2006a. Bald Eagle (*Haliaeetus leucocephalus*). http://www.michigan.gov/dnr/0,1607,7-153-10370_12145_12202-32581--,00.html

Michigan Department of Natural Resources. 2006b. Michigan's Kirtland's warbler population continues to grow. Press release. Michigan Department of Natural Resources, Lansing, Michigan, USA.

Michigan Department of Natural Resources. 2007. Michigan Karner blue butterfly habitat conservation plan. Michigan Department of Natural Resources, Lansing, Michigan, USA.

Michigan Economic Development Corporation. 2005. Economic overview: a widely diversified economy. Available: http://medc.michigan.org.

Olson, J. A. 2002. Special animal abstract for *Dendroica kirtlandii* (Kirtland's warbler). Michigan Natural Features Inventory. Lansing, Michigan, USA.

Ownby, G. B .and T. Morley. 1991. Vascular plants of Minnesota: a checklist and atlas. University of Minnesota Press, Minneapolis, Minnesota, USA.

Packer, L. 1987. The status of two butterflies, Karner blue (*Lycaeides melissa samuelis*) and frosted elfin (*Incisalia irus*), restricted to oak savanna in Ontario. Pages 253-271 *in* Allen, G. M., P. F. J. Eagles, and S. D. Price, editors. Conserving Carolinian Canada. University of Waterloo Press, Waterloo, Ontario, Canada.

Papp, C. 1993. Habitat study of the endangered Karner blue butterfly (*Lycaeides Melissa samuelis* Nabokov) in Michigan oak savanna. Preliminary report submitted to the Department of Natural Resources, Wildlife Division. Lansing, Michigan, USA.

Pauly, W. R. 1997. Conducting burns. Pages 223-243 *in* Packard, S. and C. F. Mutel (editors). The tallgrass restoration handbook. Island Press, Washington, D.C., USA.

Payne, N. F. and F. C Bryant. 1994. Techniques for wildlife management of uplands. McGraw-Hill, Inc. New York, New York, USA.

Penskar, M. R. 2004. Special plant abstract for *Penstemon calycosus* (smooth beard-tongue). Michigan Natural Features Inventory, Lansing, Michigan, USA.

Penskar, M. R. and S. R. Crispon. 2004. Special plant abstract for *Panicum leibergii* (Leiberg's panic-grass). Michigan Natural Features Inventory, Lansing, Michigan, USA.

Ritchie, M. E., D. Tilman, and J. M. H. Knops. 1998. Herbivore effects on plant and nitrogen dynamics in oak savanna. Ecology 7991:165-177.

Saunders, D. A., R. J. Hobbs, and C. R. Margules. 1991. Biological consequences of ecosystem fragmentation: a review. Conservation Biology 5:18-32.

Seelbach, P. W., M. J. Wiley, J. C. Kotanchik, and M. E. Baker. 1997. A landscape-based ecological classification system for river valley segments in lower Michigan. Fisheries Research Report 2036. Michigan Department of Natural Resources, Ann Arbor, Michigan USA.

Sferra, N. J., D. N. Ewert, C. A. Clampitt, H. E. Ballard, Jr., J. M. Aguiar and T. Darnell. 1993. Management of oak savanna and oak barrens habitat in Newaygo and Muskegon Counties, Michigan, for Karner blue butterflies *(Lycaeides melissa samuelis)* and other oak savanna invertebrates. Unpublished report. The Nature Conservancy, Lansing, Michigan, USA.

Sinclair, W. A., H. H. Lyon, W. T. Johnson. 1987. Diseases of trees and shrubs. Comstock Publishing Company, Cornell University Press, Ithaca, New York, USA.

Skole, D. L., S. Batzli, S. Gage, B. Pijanowski, W. Chomentowski, Y. Zhou, W. Rustem, and W. Salas. 2002. Land use issues and policy: forecasting land use change in Michigan. A Forecast Michigan Project, Center for Global Change and Earth Observations, Michigan State University, East Lansing, Michigan USA.

Smyth, P. 1995. Patterns on the land: our choices, our future. Prepared for the Planning and Zoning Center on behalf of the Michigan Society of Planning Officials. Rochester, Michigan, USA.

Swengel, A. and S. Swengel. 1993. Observations of Karner blues and

U.S. Department of Agriculture. 2002. 2002 Census of agriculture—state-level data. http://www.nass.usda.gov/census/census92/volume1/mi-22/92_mi.htm

U.S. Department of Commerce. 2005. Regional economic accounts. Bureau of Economic Analysis Web site. Available: http://www.bea.gov/

U.S. Environmental Protection Agency. 2003a. Peak air quality statistics for the six principal pollutants by County, 2003. http://www.epa.gov/airtrends/pdfs/ctyfactbook-04.pdf

U.S. Environmental Protection Agency. 2003b. Air quality index–a guide to air quality and your health. Washington D.C., USA.

U.S. Environmental Protection Agency. 2005a. Criteria pollutants–nonattainment areas. Web site accessed December 2005. http://www.epa.gov/airtrends/non.html.

U.S. Fish and Wildlife Service. 2005b. Federal Fish and Wildlife Permit TE022454-1. Fort Snelling, Minnesota, USA.

U.S. Fish and Wildlife Service. 2006. County distribution of Michigan federally threatened, endangered, proposed, and candidate species. East Lansing, Michigan, USA.

Viele, D. P. 1994. Emergence activities of the big brown bat, *Eptesicus fuscus*, and the Indiana bat, *Myotis sodalis*. M.S. Thesis. Eastern Michigan University, Ypsilanti, Michigan, USA.

Viele, D., A. Kurta, and J. A. Kath. 2002. Timing of nightly emergence. *In* Kurta, A. and J. Kennedy, editors. The Indiana bat: biology and management of an endangered species. Bat Conservation International, Austin, Texas, USA.

Vitousek, P. M. 1994. Beyond global warming: ecology and global change. Ecology 75:1861-1876.

Wehrly, K. E., M. J. Wiley, and P. W. Seelbach. 1998. Landscape-based models that predict July thermal characteristics in Lower Michigan rivers. Fisheries Research Report 2037. Michigan Department of Natural Resources, Ann Arbor, Michigan, USA.