Appendix A
Species Viability Analysis

TABLE OF CONTENTS

APPENDIX A–SPECIES VIABILITY ANALYSIS **1**

HABITAT INDICATOR 6 - SPECIES WITH VIABILITY CONCERNS 1

Viability Outcomes Based On ANF Lands 1

Direct and Indirect Effects *2*

Vascular Plant Species 2

All Species 2

Cumulative Effects *10*

Viability outcomes based on all lands within the ANF proclamation boundary 10

REFERENCES 20

LIST OF TABLES

TABLE 1. SPECIES WITH VIABILITY CONCERNS – OUTCOMES BY PRIMARY BROAD HABITAT BY ALTERNATIVE FOR DIRECT AND INDIRECT EFFECTS. 8

TABLE 2. SPECIES WITH VIABILITY CONCERNS – OUTCOMES BY PRIMARY BROAD HABITAT BY ALTERNATIVE FOR CUMULATIVE EFFECTS. 11

TABLE 3. SPECIES PRESENT CONDITION, SHORT- AND LONG-TERM OUTCOMES BY ALTERNATIVE 14

APPENDIX A–SPECIES VIABILITY ANALYSIS

Habitat Indicator 6 - Species with Viability Concerns

A species viability outcome was determined for each of the 78 species identified during the species viability process completed for the FEIS (USDA-FS 2007a p. 3-253–3-255). In Table 1, outcomes for species with viability concerns are summarized by primary broad habitat by alternative for direct and indirect effects. In Table 2, outcomes for species with viability concerns are summarized by primary broad habitat by alternative for cumulative effects.

A detailed description of the life history, distribution, habitat requirements, threats, direct, indirect and cumulative effects are contained in the Species Viability Evaluation section of the 2007 Forest Plan record. The 2007 Forest Plan BE also provides detailed information on RFSS. Changes to the 2007 Forest Plan BE are addressed in the BE for the SEIS.

Viability Outcomes Based On ANF Lands

These outcome descriptions were used for determining present condition and direct and indirect effects in the short term (2020) and long term (2060) by alternative for ANF lands within the proclamation boundary.

Outcome A: Suitable ecological conditions are broadly distributed and of high abundance across the historical range of the species within the planning area. The combination of distribution and abundance of ecological conditions provides opportunity for continuous or nearly continuous intraspecific interactions for the species.

Outcome B: Suitable ecological conditions are either broadly distributed or of high abundance across the historical range of the species within the planning area, but there are gaps where suitable ecological conditions are absent or only present in low abundance. However, the disjunct areas of suitable ecological conditions are typically large enough and close enough to permit dispersal among subpopulations and potentially to allow the species to interact as a metapopulation across its historical range within the planning area.

Outcome C: Suitable ecological conditions are distributed frequently as patches and/or exist at low abundance. Gaps where suitable ecological conditions are either absent, or present in low abundance, are large enough that some subpopulations are isolated, limiting opportunity for species interactions. There is opportunity for subpopulations in most of the species range to interact as a metapopulation, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition, reduction in overall species range from historical within the planning area may have resulted from this isolation.

Outcome D: Suitable ecological conditions are frequently isolated and/or exist at very low abundance. While some of the subpopulations associated with these ecological conditions may be self-sustaining, there is limited opportunity for population interactions among many of the suitable environmental patches. For species for which this is not the historical condition within the planning area, reduction in overall species range from historical condition within the planning area may have resulted from this isolation.

Outcome E: Suitable ecological conditions are highly isolated and exist at very low abundance, with little or no possibility of population interactions among suitable environmental patches, resulting in strong potential for extirpations within many of the patches, and little likelihood of re-colonization of such patches. There has likely been a reduction in overall species range from historical within the planning area, except for some rare, local endemics that may have persisted in this condition since the historical period.

Direct and Indirect Effects

Vascular Plant Species

The 2007 Biological Evaluation (USDA-FS 2007c) discusses the potential effects to vascular plants. In this analysis, pvt. OGD effects are considered direct and indirect and S&Gs differ among the four alternatives. The following guidelines are for plant species with viability concerns under Alternatives 2 and 3 and are deemed appropriate to conserve plant species with viability concerns and/or suitable habitat where implemented. As described in the 2007 Biological Evaluation, site specific conservation measures are determined in part by site conditions such as slope, aspect, soil drainage, topography, amount of sunlight available and amount preferred by species, etc.

Alternatives 1 and 4
Standards and/or Guidelines for plant species with viability concerns are generally lacking that would adequately protect plant species and/or suitable habitat from disturbance and/or habitat conversion. Species that are tracked through PNDI are afforded more protection under Alternative 4, however, not all plant species with viability concerns for the ANF are tracked species.

Alternative 2
Prior to ground disturbing activities or vegetation management activities, sites should be evaluated or surveyed for habitat for plants with viability concerns to determine habitat suitability and/or occupancy. Management actions should avoid plant species with viability concerns and their associated habitat unless management is necessary to maintain, enhance, or restore that habitat. Conservation and/or management activities should be determined on a site specific basis.

Alternative 3
Prior to ground disturbing activities, sites should be evaluated or surveyed for habitat for plants with viability concerns to determine habitat suitability and/or occupancy. Oil and gas activities should avoid plant species with viability concerns and appropriate conservation measures should be determined on a site specific basis.

All Species

Alternative 1

Short Term Outcomes

2020 Mid-Late Structural Forest 1
Two species change from Outcome B to C (American ginseng and Northern goshawk). One species changed from C to D (Hooker's orchid). Five species change from D to E (Canada yew, Checkered rattlesnake plantain, Kidney-leaved twayblade, Mountain starwort, and Mountain wood fern).

For the Northern goshawk, under all alternatives, the short term outcome changes from B to C due to a 25 to 30 percent increase in unsuitable habitat due to pvt. OGD (USDA-FS 2007b p. E-29).

Standards and guidelines for plant species with viability concerns are generally lacking that would adequately protect plants and suitable habitat from disturbance and/or habitat conversion.

2020 Aquatic (rivers, streams and impoundments) 3

Outcomes would not change for any of the fish, mussels, and aquatic invertebrates based on the following rationale. To minimize impacts from dirt and gravel roads, there are guidelines stating roads should be constructed outside the riparian area, be built where there is an effective filter strip between the road and stream, and surfacing roads with a type of stone to minimize sediment. To further minimize sediment input to streams, perennial and intermittent stream crossings would be surfaced with a high quality surfacing material. The construction of new roads would limit the grade of the road except for short pitches, thus minimizing potential runoff concerns that can occur from roads built with steeper grades. The ANF can suspend the use or construction of roads if unacceptable damage is or would occur, which would prevent rutting and runoff. ATV and OHV use is not permitted to travel cross-country, thus avoiding potential runoff to streams and impacting suitable habitats. During road construction/reconstruction at perennial and intermittent stream crossings, and areas that could affect water quality and aquatic species/habitat, interim and final erosion control measures would be implemented. This guideline doesn't specify the number of days in which to complete these measures as does Alternatives 2 and 3, although the interim measures as stated in the guideline should be done concurrently with the activity.

2020 Riparian/Wetlands 4

Two species change from Outcome C to D (Bristly black currant and Wiegand's sedge). Nine species change from D to E (Bartram shadbush, Butternut, Creeping snowberry, Red currant, Rough cotton-grass, Stalked bulrush, Sweet-scented Indian plantain, Thread rush, and White trout lily).

Standards and guidelines for plant species with viability concerns are generally lacking that would adequately protect plants and suitable habitat from disturbance and/or habitat conversion.

2020 Grassland/Seedling/Sapling 5

One species changes from D to E (Queen-of-the-prairie). Standards and guidelines for plant species with viability concerns are generally lacking that would adequately protect plants and suitable habitat from disturbance and/or habitat conversion.

Long term outcomes

2060 Mid-Late Structural Forest 1

Three species change from B to C (N. goshawk, eastern box turtle and American ginseng). Two species change from C to D (N. flying squirrel and Hooker's orchid). Five species change from D to E (Canada yew, Checkered rattlesnake plantain, Kidney-leaved twayblade, Mountain starwort, and Mountain wood fern).

In the long term, the outcome for the northern goshawk would change from B to C under Alternatives 1 through 3 due to the loss of suitable habitat.

Under all alternatives the long term outcome for the eastern box turtle would change from B to C as pvt. OGD increases and potential for mortality due to roads increases (USDA-FS 2007b E-32). Suitable ecological conditions would likely become isolated and exist at low abundance. While some of the subpopulations associated with these ecological conditions may be self sustaining, there would be limited opportunity for population interactions among many of the suitable habitat patches.

Under all alternatives, for the northern flying squirrel the long term outcome changed from C to D due to loss of suitable conifer habitat from oil and gas development by the year 2060. There will likely be limited opportunity for population interactions among many of the suitable environmental patches.

2060 Aquatic (rivers, streams and impoundments) 3
Same as the short-term for Aquatics described above.

2060 Riparian/Wetlands 4
One species changes from B to C (Wood turtle). Three species change from C to D (Jefferson salamander, Bristly black currant, and Wiegand's sedge). Ten species change from D to E (Four-toed salamander, Bartram shadbush, Butternut, Creeping snowberry, Red currant, Rough cotton-grass, Stalked bulrush, Sweet-scented Indian plantain, Thread rush, and White trout lily).

Under all alternatives the long term outcome for the wood turtle would change from B to C. Because the wood turtle has such a small home range and populations and nesting success are not fully known, if one population is lost, interaction between subpopulations could be restricted (USDA-FS 2007b E-34).

Under Alternative 1 vernal pools would not have any protective measures so the long term outcome for the Jefferson Salamander would drop to D and the Four-toed salamander would drop to E.

2060 Grassland/Seedling/Sapling 5
One species changes from D to E (Queen-of-the-prairie).

Alternative 2

Short Term Outcomes

2020 Mid-Late Structural Forest 1
One species changes from Outcome B to C (Northern goshawk).

2020 Aquatic (rivers, streams and impoundments) 3
Outcomes would not change based on the following rationale: standards and guidelines for operating restrictions on slopes greater than 40 percent, keeping the grade of new roads to less than 10 percent except for short pitches up to 15%, using a high quality surfacing on roads within 300 feet of a stream, protecting all springs (and not just those shown on a USGS quadrangle as in Alternative 4), limiting the use of ATV's and OHV's including no cross country travel, requiring stabilization of disturbed sites within a specific timeframe, and preventing the use of dirt and gravel roads during spring thaw or excessively wet weather will all result in minimizing the potential for sediment delivery to streams and protect habitat for aquatic species.

Varying buffer widths for the various types and classifications of the streams found on the ANF (USDA-FS 2007a, Table 24, page 75) are provided. Within these areas, road construction and the surface occupancy of pvt. and fed. OGD should be avoided. These buffer widths should ensure high water quality and support good habitat for native aquatic organisms, as summarized by Wenger (1999).

Within the 13% Area (that area of the ANF that drains directly to the Allegheny River between Kinzua and Tionesta Dams), dirt and gravel roads within 300' of a stream are to be surfaced with a high quality material to minimize sediment runoff to the Allegheny River where endangered mussels occur (USDI-FWS 2007), and which will also benefit other aquatic species.

Long Term Outcomes

2060 Mid-Late Structural Forest 1
One species changes from C to D (N. flying squirrel). Two species change from B to C (Northern goshawk and Eastern box turtle).

2060 Aquatic (rivers, streams and impoundments) 3
See short-term outcomes above.

2060 Riparian/Wetlands 4
One species changes from B to C (Wood turtle).

Alternative 3

Short Term Outcomes

2020 Mid-Late Structural Forest 1
One species changes from Outcome B to C (Northern goshawk).

2020 Aquatic (rivers, streams and impoundments) 3
Same as Alternative 2 outcomes, including rationale.

Long Term Outcomes

2060 Mid-Late Structural Forest 1
One species changes from C to D (N. flying squirrel). Two species change from B to C (Eastern box turtle and Northern goshawk).

2060 Aquatic (rivers, streams and impoundments) 3
Same as Alternative 2 outcomes, including rationale.

2060 Riparian/Wetlands 4
One species changes from B to C (Wood turtle).

Alternative 4

Short term outcomes

2020 Mid-Late Structural Forest 1
Two species change from Outcome B to C (American ginseng and Northern goshawk). One species changes from C to D (Hooker's orchid). Five species change from D to E (Canada yew, Checkered rattlesnake plantain, Kidney-leaved twayblade, Mountain starwort, and Mountain wood fern).

Standards and guidelines for plant species with viability concerns are generally lacking that would adequately protect plants and suitable habitat from disturbance and/or habitat conversion.

2020 Aquatic (rivers, streams and impoundments) 3

Eight species change from B to C (Bluebreast darter, Round pigtoe, Harpoon clubtail, Maine snaketail, Mustached clubtail, Ocellated darner, Rapids clubtail, and Zebra clubtail). Seven species change from C to D (Channel darter, Gilt darter, Longhead darter, Longsolid, Midland clubtail, Ski-tailed emerald, and Uhler’s sundragon). One species changes from D to E (Creek heelsplitter). The outcomes are based on the following rationale on two scales, the 13% Area and the rest of the ANF outside of the 13% Area and are primarily for those species whose habitats include the streams in the interior of the ANF, that is, the area outside of the 13% Area where less restrictive S&Gs apply. For species that primarily inhabit the Allegheny River and the 13% Area, no decrease in outcomes would likely occur. This is because the 13% Area of the ANF that drains directly into the Allegheny River is a relatively small land base (less than 5%) contributing to the watershed upstream of Tionesta, it is primarily forested with a large portion in the National Recreation Area, and S&Gs for the protection of threatened and endangered mussels will be implemented. But, as discussed in the 2007 FEIS (USDA-FS 2007b, Appendix E), the main

reason for effects to occur and outcomes to drop for species that inhabit or have suitable habitat in the Allegheny River is the likely impacts from zebra mussels. That threat still exists, and the outcomes for cumulative effects in the 2007 FEIS are carried into Table 3.

13% Area

S&Gs applicable to protecting the mussels in the Allegheny River remain in place and will provide protection to aquatic species in tributary streams as well as the river itself. This includes the standard that roads within 300' of a stream be surfaced with a high quality material to minimize sedimentation; implementation of riparian corridor buffers the same as Alternatives 2 and 3, which includes avoidance of construction of pvt. and fed. OGD; where natural revegetation is unlikely, or sedimentation and erosion are concerns, native or desired non-native species will immediately be planted after road construction or reconstruction; stream crossings will be sized to handle a 50-year stream flow; temporary stream crossings should be constructed to accommodate a minimum of bank full flow; and pvt. OGD will implement and maintain their submitted Soil Erosion and Sedimentation Control Plan and Spill Prevention Plan.

ANF outside the 13% Area

This alternative is the least restrictive of the four. There is no standard or guideline prohibiting the use of heavy equipment on slopes greater than 40 percent, nor is there a standard or guideline restricting the use of ATVs or OHVs. There is a guideline for the use of durable surfacing on constructed pvt. OGD roads, which may or may not be of a high-quality.

Alternative 4 provides a guideline that roads should be built with grades less than 10 percent, but short pitches of 15 to 20 percent could occur. These percentages are steeper than the guideline for Alternatives 1, 2, and 3. Small increases in the grade of the road greatly increase the runoff potential and the formation of rutting and washing of the road. It becomes difficult to retain adequate gravel surfacing at these grades. When rutting begins, water runs down the road carrying sediment with it. If a stream is located adjacent to or at the bottom of these steeper grades, sediment is more likely to reach the watercourse. Based on personal observations, most pvt. OGD roads are not maintained and when steeper roads are built, runoff becomes more prevalent.

Riparian areas are not specifically addressed in a standard or guideline, but Alternative 4 provides a standard and guideline that no well site may be prepared or drilled within 100 feet from any stream shown on the most recent USGS quadrangles, but a waiver can be granted from the State with specific requirements. This leaves out a considerable number of streams that aren't shown on quadrangle maps. Within this buffer however, the buffer is narrowed for the construction of roads and surface occupancy of oil and gas developments. Additionally, only springs identified from a USGS quadrangle would be protected. Springs are prevalent across the ANF and generally supply streams with clear cold water throughout the year. Not only do they provide habitat for aquatic invertebrates, they are a conduit to streams where habitat for other aquatic species occurs in greater abundance. Preventing impacts to springs will also prevent or minimize impacts to receiving streams.

There is no standard or guideline that prevents a pvt. OGD from continuing to use dirt and gravel roads during excessively wet periods or during spring thaw. This can result in rutting and contribute to excessive sedimentation to any nearby stream as documented on numerous occasions during field surveys.

Alternative 4 requires an operator to conduct weekly inspections of their implemented BMPs and after each measurable rainfall to include the repair of any BMPs to ensure their continued effectiveness.

Specific timeframes are given for stabilizing disturbed areas from a pvt. OGD similar to Alternatives 2 and 3, but does not require it in watersheds with streams classified as CWF by the State and also allows the stabilization to occur in the next growing season which can leave exposed soil to runoff during rain events. While the majority of streams on the ANF do not fall into the CWF category, they are still prevalent, tend to be larger, and provide a substantial amount of suitable habitat for many aquatic species, making up approximately 25 percent of the stream miles within the proclamation boundary. Without timely stabilization, the potential for greater amounts of sediment to move offsite are increased.

2020 Riparian/Wetlands 4
Five species change from D to E (Butternut, Creeping snowberry, Sweet-scented Indian plantain, Thread rush, and White trout lily).

Standards and guidelines for plant species with viability concerns are generally lacking that would adequately protect plants and suitable habitat from disturbance and/or habitat conversion.

2020 Grassland/Seedling/Sapling 5
One species changes from D to E (Queen-of-the-prairie).

Standards and guidelines for plant species with viability concerns are generally lacking that would adequately protect plants and suitable habitat from disturbance and/or habitat conversion.

Long Term Outcomes

2060 Mid-Late Structural Forest 1
The red-shouldered hawk, eastern box turtle, and American ginseng change from a B to C, and the northern flying squirrel, timber rattlesnake, and Hookers orchid from C to D. The northern goshawk changes from B to D. Five species change from D to E (Canada yew, Checkered rattlesnake plantain, Kidney-leaved twayblade, Mountain starwort, and Mountain wood fern).

The red-shouldered hawk is not included on the current Pennsylvania Natural Diversity Inventory (PNDI) tracked species list so therefore would not receive protection under Alternative 4. With no guidelines to buffer active nests from disturbance, the long term outcome would drop from B to C.

Under Alternative 4 the long term outcome for the timber rattlesnake would change from C to D. Although some subpopulations may remain self sustaining, there would likely be limited opportunity for population interaction among many of the suitable habitat patches.

Under Alternative 4 the long term outcome for the Northern goshawk would drop to D because guidelines for nest protection are uncertain and compliance with the guideline is not required. Suitable ecological conditions would likely be isolated and exist at very low abundance.

2060 Aquatic (rivers, streams and impoundments) 3
Ten species change from B to C (Bluebreast darter, Round pigtoe, Green-faced clubtail, Harpoon clubtail, Maine snaketail, Mustached clubtail, Ocellated darner, Rapids clubtail, Resolute damsel, and Zebra clubtail). Twenty species change from C to D (Channel darter, Gilt darter, Longhead darter, Mt. brook lamprey, Longsolid, Midland clubtail, Ski-tailed emerald, and Uhler's sundragon). One species changes from D to E (Creek heelsplitter). See Alternative 4, Aquatics short-term outcomes for the rationale which is the same.

2060 Riparian/Wetlands 4
The wood turtle changes from B to C. One species changes from C to D (Jefferson salamander). Six species change from D to E (Four-toed salamander, Butternut, Creeping snowberry, Sweet-scented Indian plantain, Thread rush, and White trout lily).

Neither the Jefferson salamander nor the Four-toed salamander is included on the PNDI tracked species list. Under Alternative 4, guidelines would not be implemented to protect suitable habitat. The result would be a drop in the long term outcome for both species.

2060 Grassland/Seedling/Sapling 5
One species changes from D to E (Queen-of-the-prairie).

Table 1. Species with viability concerns – outcomes by primary broad habitat by alternative for direct and indirect effects.

	Existing Condition (number of species	Direct and Indirect Effects – 2020 (number of species by alternative)				Direct and Indirect Effects – 2060 (number of species by alternative)			
		1	2	3	4	1	2	3	4
Mid-Late Structural Forest 1									
Outcome A	0	0	0	0	0	0	0	0	0
Outcome B	9	7	8	8	7	6	7	7	5
Outcome C	3	4	4	4	4	3	3	3	3
Outcome D	6	2	6	6	2	4	8	8	5
Outcome E	0	5	0	0	5	5	0	0	5
Mid-Late Structural Oak Forest 2									
Outcome A	0	0	0	0	0	0	0	0	0
Outcome B	1	1	1	1	1	1	1	1	1
Outcome C	1	1	1	1	1	1	1	1	1
Outcome D	1	1	1	1	1	1	1	1	1
Outcome E	0	0	0	0	0	0	0	0	0
Aquatic (rivers, streams and impoundments) 3									
Outcome A	0	0	0	0	0	0	0	0	0
Outcome B	13	13	13	13	5	13	13	13	3
Outcome C	23	23	23	23	24	23	23	23	25
Outcome D	1	1	1	1	7	1	1	1	8
Outcome E	0	0	0	0	1	0	0	0	1
Riparian/Wetlands 4									
Outcome A	0	0	0	0	0	0	0	0	0
Outcome B	1	1	1	1	1	0	0	0	0
Outcome C	3	1	3	3	3	1	4	4	3
Outcome D	10	4	11	11	6	4	11	11	6
Outcome E	2	10	1	1	6	11	1	1	7
Grassland/Seedling/Sapling 5									
Outcome A	0	0	0	0	0	0	0	0	0
Outcome B	0	0	0	0	0	0	0	0	0
Outcome C	0	0	0	0	0	0	0	0	0

	Existing Condition (number of species	Direct and Indirect Effects – 2020 (number of species by alternative)				Direct and Indirect Effects – 2060 (number of species by alternative)			
		1	2	3	4	1	2	3	4
Outcome D	3	2	3	3	2	2	3	3	2
Outcome E	1	2	1	1	2	2	1	1	2

Cumulative Effects

Viability outcomes based on all lands within the ANF proclamation boundary

These outcome descriptions were used for determining present condition and cumulative effects in the short term (2020) and long term (2060) by alternative for all lands (both NFS and non-NFS lands) within the proclamation boundary (Table 2). Historical conditions are those that persisted prior to European settlement. The rationale for the species with a change in outcome is provided in the Plants and Animals section of Chapter 3 of the SEIS.

Outcome A: The combination of environmental and population conditions provides opportunity for the species to be broadly distributed and of high abundance across its historical range within the cumulative effects analysis area. There is potential for continuous or nearly continuous intraspecific interactions at high population size.

Outcome B: The combination of environmental and population conditions provide opportunity for the species to be broadly distributed and/or of high abundance across its historical range within the cumulative effects analysis area, but there are gaps where populations are potentially absent or present only in low density as a result of environmental or population conditions. However, the disjunct areas of higher potential population density are typically large enough and close enough to other subpopulations to permit dispersal among subpopulations and potentially to allow the species to interact as a metapopulation across its historical range within the cumulative effects analysis area.

Outcome C: The combination of environmental and population conditions restrict the potential distribution of the species, which is characterized by patchiness and/or areas of low abundance. Gaps where the likelihood of population occurrence is low or zero is large enough that some subpopulations are isolated, limiting opportunity for species interactions. There is opportunity for subpopulations in most of the species range to interact as a metapopulation, but some subpopulations are so disjunct or of such low density that they are essentially isolated from other populations. For species for which this is not the historical condition within the planning area, reduction in overall species range from historical condition may have resulted from this isolation.

Outcome D: The combination of environmental and population conditions restrict the potential distribution of the species, which is characterized by areas with high potential for population isolation and/or very low potential abundance. While some of these subpopulations may be self-sustaining, gaps where the likelihood of population occurrence is low or zero are large enough that there is limited opportunity for interactions among them. For species for which this is not the historical condition within the planning area, reduction in overall species range from historical has likely resulted from this isolation.

Outcome E: The combination of environmental and population conditions restricts the potential distribution of the species, which is characterized by high levels of isolation and very low potential abundance. Gaps where the likelihood of population occurrence is low or zero are large enough there is little or no possibility of interactions, strong potential for extirpations, and little likelihood of recolonization. There has likely been a reduction in overall species range from historical within the planning area, except for some rare, local endemics that may have persisted in this condition since the historical period.

Table 2. Species with viability concerns – outcomes by primary broad habitat by alternative for cumulative effects.

	Existing Condition (number of species)	Cumulative Effects – 2020 (number of species by alternative)				Cumulative Effects – 2060 (number of species by alternative)			
		1	2	3	4	1	2	3	4
Mid-Late Structural Forest 1									
Outcome A	0	0	0	0	0	0	0	0	0
Outcome B	9	6	7	7	6	5	6	6	4
Outcome C	3	3	3	3	3	3	3	3	4
Outcome D	6	4	8	8	4	5	9	9	4
Outcome E	0	5	0	0	5	5	0	0	6
Mid-Late Structural Oak Forest 2									
Outcome A	0	0	0	0	0	0	0	0	0
Outcome B	1	1	1	1	1	1	1	1	1
Outcome C	1	1	1	1	1	1	1	1	1
Outcome D	1	1	1	1	1	1	1	1	1
Outcome E	0	0	0	0	0	0	0	0	0
Aquatic (rivers, streams and impoundments) 3									
Outcome A	0	0	0	0	0	0	0	0	0
Outcome B	13	8	8	8	2	0	0	0	0
Outcome C	23	15	15	15	15	13	13	13	12
Outcome D	1	14	14	14	19	24	24	24	24
Outcome E	0	0	0	0	1	0	0	0	1
Riparian/Wetlands 4									
Outcome A	0	0	0	0	0	0	0	0	0
Outcome B	1	0	0	0	0	0	0	0	0
Outcome C	3	2	4	4	4	1	4	4	3
Outcome D	10	4	11	11	6	4	10	10	6
Outcome E	2	10	1	1	6	11	2	2	7
Grassland/Seedling/Sapling 5									
Outcome A	0	0	0	0	0	0	0	0	0
Outcome B	0	0	0	0	0	0	0	0	0
Outcome C	0	0	0	0	0	0	0	0	0
Outcome D	3	2	3	3	2	2	3	3	2
Outcome E	1	2	1	1	2	2	1	1	2

Alternative 1

Short Term Outcomes

2020 Mid-Late Structural Forest 1
One species changes from Outcome B to C (American ginseng). Two species change from C to D (Northern goshawk and Hooker's orchid). Five species change from D to E (Canada yew, Checkered rattlesnake plantain, Kidney-leaved twayblade, Mountain starwort, and Mountain wood fern).

2020 Riparian/Wetlands 4
Two species change from C to D (Bristly black currant and Wiegand's sedge). Nine species change from D to E (Bartram shadbush, Butternut, Creeping snowberry, Red currant, Rough cotton-grass, Stalked bulrush, Sweet-scented Indian plantain, Thread rush, and White trout lily).

2020 Grassland/Seedling/Sapling 5
One species changes from D to E (Queen-of-the-prairie).

Long term outcomes

2060 Mid-Late Structural Forest 1
One species changes from Outcome B to C (American ginseng). One species changes from B to E (Northern goshawk). One species changes from C to D (Hooker's orchid). Five species changes from D to E (Canada yew, Checkered rattlesnake plantain, Kidney-leaved twayblade, Mountain starwort, and Mountain wood fern).

2060 Riparian/Wetlands 4
Two species change from C to D (Bristly black currant and Wiegand's sedge). Eight species change from D to E (Bartram shadbush, Creeping snowberry, Red currant, Rough cotton-grass, Stalked bulrush, Sweet-scented Indian plantain, Thread rush, and White trout lily).

2060 Grassland/Seedling/Sapling 5
One species changes from D to E (Queen-of-the-prairie).

Alternative 2

Short term outcomes

2020 Mid-Late Structural Forest 1
One species changes from B to D (Northern goshawk).

Long term outcomes

2060 Mid-Late Structural Forest 1
One species changes from B to E (Northern goshawk).

Alternative 3

Short term outcomes

2020 Mid-Late Structural Forest 1
One species changes from C to D (Northern goshawk).

Long term outcomes

2060 Mid-Late Structural Forest 1
One species changes from C to E (Northern goshawk).

Alternative 4

Short Term Outcomes

2020 Mid-Late Structural Forest 1
Two species change from Outcome B to C (Northern goshawk and American ginseng). One species changes from C to D (Hooker's orchid). Five species change from D to E (Canada yew, Checkered rattlesnake plantain, Kidney-leaved twayblade, Mountain starwort, and Mountain wood fern).

2020 Aquatic (rivers, streams and impoundments) 3
Six species change from B to C (Harpoon clubtail, Maine snaketail, Mustached clubtail, Ocellated darner, Rapids clubtail, and Zebra clubtail). Six species change from C to D (Channel darter, Gilt darter, Longsolid, Midland clubtail, Ski-tailed emerald, and Uhler's sundragon). One species changes from D to E (Creek heelsplitter).

2020 Riparian/Wetlands 4
Five species change from D to E (Butternut, Creeping snowberry, Sweet-scented Indian plantain, Thread rush, and White trout lily).

2020 Grassland/Seedling/Sapling 5
One species changes from D to E (Queen-of-the-prairie).

Long Term Outcomes

2060 Mid-Late Structural Forest 1
Three species change from B to C (Red-shouldered hawk, Eastern box turtle, and American ginseng). One species changed from B to D (Northern goshawk). Three species change from C to D (Timber rattlesnake, Hooker's orchid and N. flying squirrel). Five species change from D to E (Canada yew, Checkered rattlesnake plantain, Kidney-leaved twayblade, Mountain starwort, and Mountain wood fern).

2060 Aquatic (rivers, streams and impoundments) 3
One species changed from C to D (Mt. brook lamprey). One species changed from D to E (Creek heelspitter).

2060 Riparian/Wetlands 4
One species changes from B to C (Wood turtle). One species changes from C to D (Jefferson salamander). Five species change from D to E (Four-toed salamander, Creeping snowberry, Sweet-scented Indian plantain, Thread rush, and White trout lily).

2060 Grassland/Seedling/Sapling 5
One species changes from D to E (Queen-of-the-prairie).

Table 3. Species Present Condition, Short- and Long-term Outcomes by Alternative

Species	Primary Habitat	Present Condition (NFS lands)	Outcomes															
			Alt 1				Alt 2				Alt 3				Alt 4			
			2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	C 20
Mammals																		
Indiana bat	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
N. flying squirrel	1	C	C	D	D	D	C	D	D	D	C	D	D	D	C	D	D	
Birds																		
Bald eagle	3	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
Black-throated blue warbler	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Cerulean warbler	2	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Common raven	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Golden-winged warbler	5	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
Great blue heron	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	
Henslow's sparrow	5	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
Northern goshawk	1	B	C	C	D	D	C	C	D	D	C	C	D	D	C	D	D	
Osprey	3	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	

Species	Primary Habitat	Outcomes																
		Present Condition	Alt 1				Alt 2				Alt 3				Alt 4			
		(NFS lands)	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	C 20
Red-shouldered hawk	1	B	B	B	B	B	B	B	B	B	B	B	B	B	B	C	B	
Swainson's thrush	1	B	B	B	B	C	B	B	B	C	B	B	B	C	B	B	B	
Yellow-bellied flycatcher	1	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
Reptiles and Amphibians																		
Coal skink	2	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
Eastern box turtle	1	B	B	C	C	C	B	C	C	C	B	C	C	C	B	C	C	
Timber rattlesnake	1	C	C	D	C	D	C	D	C	D	C	D	C	D	C	D	C	
Wood turtle	4	B	B	C	C	C	B	C	C	C	B	C	C	C	B	C	C	
Four-toed salamander	4	D	D	E	D	E	D	D	D	D	D	D	D	D	D	E	D	
Jefferson salamander	4	C	C	D	C	D	C	C	C	C	C	C	C	C	C	D	C	
Fish																		
Bluebreast darter	3	B	B	B	C	C	B	B	C	C	B	B	C	C	C	C	C	
Burbot	3	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	
Channel darter	3	C	C	C	C	D	C	C	C	D	C	C	C	D	D	D	D	
Gilt darter	3	C	C	C	C	D	C	C	C	D	C	C	C	D	D	D	D	

Species	Primary Habitat	Outcomes																
		Present Condition	Alt 1				Alt 2				Alt 3				Alt 4			
		(NFS lands)	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	C 20
Gravel chub	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	
Longhead darter	3	C	C	C	D	D	C	C	D	D	C	C	D	D	D	D	D	
Mt. brook lamprey	3	C	C	C	C	C	C	C	C	C	C	C	C	C	C	D	C	
Mt. madtom	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	
N. madtom	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	
Spotted darter	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	
Tippecanoe darter	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	
Mussels																		
Clubshell	3	B	B	B	C	D	B	B	C	D	B	B	C	D	B	B	C	
Creek heelspitter	3	D	D	D	D	D	D	D	D	D	D	D	D	D	E	E	E	
Longsolid	3	C	C	C	C	D	C	C	C	D	C	C	C	D	D	D	D	
N. riffleshell	3	B	B	B	C	D	B	B	C	D	B	B	C	D	B	B	C	
Rabbitsfoot	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	
Rainbow	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	
Rayed-bean	3	B	B	B	C	D	B	B	C	D	B	B	C	D	B	B	C	
Round pigtoe	3	B	B	B	C	D	B	B	C	D	B	B	C	D	C	C	C	
Sheepnose	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	

Species	Primary Habitat	Outcomes																
		Present Condition	Alt 1				Alt 2				Alt 3				Alt 4			
		(NFS lands)	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	C 20
Snuffbox	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	
Threeridge	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	
Wabash pigtoe	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	
White heelspitter	3	C	C	C	D	D	C	C	D	D	C	C	D	D	C	C	D	
Aquatic Invertebrates																		
Green-faced clubtail	3	B	B	B	B	C	B	B	B	C	B	B	B	C	B	C	B	
Harpoon clubtail	3	B	B	B	B	C	B	B	B	C	B	B	B	C	C	C	C	
Maine snaketail	3	B	B	B	B	C	B	B	B	C	B	B	B	C	C	C	C	
Midland clubtail	3	C	C	C	C	D	C	C	C	D	C	C	C	D	D	D	D	
Mustached clubtail	3	B	B	B	B	C	B	B	B	C	B	B	B	C	C	C	C	
Ocellated darner	3	B	B	B	B	C	B	B	B	C	B	B	B	C	C	C	C	
Rapids clubtail	3	B	B	B	B	C	B	B	B	C	B	B	B	C	C	C	C	
Resolute damsel	3	B	B	B	B	C	B	B	B	C	B	B	B	C	B	C	B	
Ski-tailed emerald	3	C	C	C	C	D	C	C	C	D	C	C	C	D	D	D	D	
Uhler's sundragon	3	C	C	C	C	D	C	C	C	D	C	C	C	D	D	D	D	

Species	Primary Habitat	Outcomes																
		Present Condition	Alt 1				Alt 2				Alt 3				Alt 4			
		(NFS lands)	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	C 20
Zebra clubtail	3	B	B	B	B	C	B	B	B	C	B	B	B	C	C	C	C	
Plants																		
American fever-few	5	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	
American ginseng	1	B	C	C	C	C	B	B	B	B	B	B	B	B	C	C	C	
Bartram shadbush	4	E	E	E	E	E	D	D	D	D	D	D	D	D	D	D	D	
Boreal bog sedge	4	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	E	
Bristly black currant	4	C	D	D	D	D	C	C	C	C	C	C	C	C	C	C	C	
Butternut	4	D	E	E	E	E	D	D	D	E	D	D	D	E	E	E	E	
Canada yew	1	D	E	E	E	E	D	D	D	D	D	D	D	D	E	E	E	
Checkered rattlesnake plantain	1	D	E	E	E	E	D	D	D	D	D	D	D	D	E	E	E	
Creeping snowberry	4	D	E	E	E	E	D	D	D	D	D	D	D	D	E	E	E	
Hooker's orchid	1	C	D	D	D	D	C	C	C	C	C	C	C	C	D	D	D	
Kidney-leaved twayblade	1	D	E	E	E	E	D	D	D	D	D	D	D	D	E	E	E	
Mountain	1	D	E	E	E	E	D	D	D	D	D	D	D	D	E	E	E	

Species	Primary Habitat	Outcomes																
		Present Condition	Alt 1				Alt 2				Alt 3				Alt 4			
		(NFS lands)	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	Cum 2060	2020	2060	Cum 2020	C 20
starwort																		
Mountain wood fern	1	D	E	E	E	E	D	D	D	D	D	D	D	D	E	E	E	
Northeast bulrush	4	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
Queen-of-the-prairie	5	D	E	E	E	E	D	D	D	D	D	D	D	D	E	E	E	
Red currant	4	D	E	E	E	E	D	D	D	D	D	D	D	D	D	D	D	
Rough cotton-grass	4	D	E	E	E	E	D	D	D	D	D	D	D	D	D	D	D	
Small whorled pogonia	2	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	D	
Stalked bulrush	4	D	E	E	E	E	D	D	D	D	D	D	D	D	D	D	D	
Sweet-scented Indian plantain	4	D	E	E	E	E	D	D	D	D	D	D	D	D	E	E	E	
Thread rush	4	D	E	E	E	E	D	D	D	D	D	D	D	D	E	E	E	
White trout lily	4	D	E	E	E	E	D	D	D	D	D	D	D	D	E	E	E	
Wiegand's sedge	4	C	D	D	D	D	C	C	C	C	C	C	C	C	C	C	C	

References

Buckley, D. S., T. R. Crow, E. A. Nauertz, and K. E. Schulz. 2003. Influence of skid trails and haul roads on understory plant richness and composition in managed forest landscapes in Upper Michigan, USA. Forest Ecology and Management, Vol. 175 (2003) 509-520.

Calhoun, A.J.K. and P. deMaynadier.2004. Forestry habitat management guidelines for vernal pool wildlife. MCA Technical Paper No. 6, Metropolitan Conservation Alliance, Wildlife Conservation Society, Bronx, N.Y. 32 p.

Calhoun, A.J. K., N. A. Miller, M. W. Klemens. 2005. conserving pool-breeding amphibians in human-dominated landscapes through local implementation of Best Development Practices. Wetlands Ecology and Mgmt. Vol. 13 pp. 291-304.

Carr, L. W. and L. Fahrig. 2001. Effect of Road Traffic on Two Amphibian Species of Differing Vagility. Conservation Biology Vol 15 (4) pp. 1071-1078.

deMaynadier, P. G. and M. L. Hunter Jr. 1995. The relationship between forest management and amphibian ecology: a review of the North American literature. Environ. Rev. 3: 230-261.

Forman, R. T. T. and L.E. Alexander. 1998. Roads and Their Major Ecological Effects. Annu. Rev. Ecol. Syst. 1998.29.207-231.

Gucinski H, M.J. Furnisss, F.F. Ziemer, M.H. Brookes. 2000. Forest Roads: A Synthesis of Scientific Information. USDA Forest Service.

Moen, A. N. 1978. Seasonal Changes in Heart Rates, Activity, Metabolism, and Forage Intake of White-tailed Deer. Jour Wildlife Mgmt. Vol 42 (4) pp. 715-738.

Reid, L. M., R.R. Ziemer, and M.J. Furniss. 2002. What do we know about Roads? Humbolt Interagency Watershed Analysis Center, McKinleyville, CA 19 pp.

Roberson, A.M., D.E. Anderson, and P.L. Kennedy. 2003. The Northern goshawk (Accipiter gentiles atricapillus) in the Western Great lakes Region: a technical conservation assessment. Rpt. For the Minnesota Fish and Wildlife Research Unit. 91pp. unpublished report.

Semlitsch, R. D. and J.R. Bodie. 2003. Biological Criteria for Buffer Zones around Wetlands and Riparian Habitats for Amphibians and Reptiles. Conservation Biology Vol 17 (5) pp. 1219-1228.

Trombulak S. C. and C. A. Frissell. 2000. Review of Ecological Effects of Roads on Terrestrial and Aquatic Communities. Conservation Biology Vol. 14(1) p. 18-30.

Wenger, S. 1999. A Review of the Scientific Literature on Riparian Buffer Width, Extent, and Vegetation. Office of Public Service and Outreach, Institute of Ecology, Univ. of Georgia, Athens pp. 59.