

Appendix G – Bridge Habitat

The 4FRI project would not achieve desired conditions on all treatment acres immediately post-treatment; as it would take time for the largely even-aged forests to develop uneven-aged structure, for trees to mature into larger diameter classes, and for tree canopies within tree groups to reach the desired interlocking crown condition. Because of this, there is a concern that post-treatment conditions within the 4FRI project area would not provide sufficient habitat for canopy-dependent wildlife in the short term.

The wildlife species of concern identified by our publics include the northern goshawk, the MSO, Abert’s squirrel, turkey, mule deer, black bear, and some songbird species. The information provided in this appendix clarifies how post-treatment conditions within the 4FRI project area would provide habitat for canopy-dependent wildlife in the short term. We are referring to those areas as “bridge habitat,” suggesting that these more densely forested areas would be available to wildlife to bridge the time between treatment and the attainment of desired conditions across the broader landscape.

Bridge Habitat at the Landscape Scale

For purposes of this discussion, the landscape is considered to be the 988,764-acre 4FRI Coconino and Kaibab NFs’ project area. To clarify where and how much bridge habitat would be available to canopy-dependent wildlife at the landscape scale, some review of the acreage categories may be helpful. Table 157 displays an accounting of project area acres in terms of what was considered for management actions and what was excluded from consideration under this EIS. All treatment area acreages are calculated based on alternative C because it is the preferred alternative and has the most comprehensive set of potential treatments that could impact canopy-dependent wildlife.

Table 157. Acres of treatment and nontreatment areas within the 4FRI project area

Description		Acres
Project Area	Total area within 4FRI project boundary	988,764
Exclusions	Total excluded area within 4FRI project boundary	395,553
	Other projects	204,957
	Special management areas (wilderness, research natural areas, inventoried roadless areas, Camp Navajo, and experimental forests)	29,821
	Non-FS lands	145,156
	Miscellaneous (other cover types, no treatment protected activity center (PAC) core areas, inaccessible areas, etc.)	15,618
Treatment Area	Area within the proposed treatment boundary (includes mechanical treatment and prescribed burning)	593,211
	Ponderosa pine treatment area	512,178
	Other cover types treatment area	81,033

At the landscape scale, there is a highly diverse mosaic of patches that would vary in terms of overall density and openness post-treatment. Two bridge habitat categories (“other projects” and “wilderness, slopes, PACs”) were analyzed at the scale of the total project area to demonstrate the

patch-mosaic of deferrals versus treated areas across the larger landscape. The remainder of the bridge habitat categories that were analyzed are at the ponderosa pine treatment area (512,178 acres) scale. This scale was used to demonstrate how bridge habitat would persist where mechanical treatments and prescribed fire are proposed. The percentages provided for each category are not necessarily additive. Some categories are merely subsets of other categories but they provide several different ways of looking at how we account for closed-canopy species through project design.

Project Area Scale

Other projects: Excluded fuels reduction and forest restoration projects account for 204,957 acres (21 percent) of the total project area (988,764 acres). We can assume that some proportion of these projects would/do retain closed-canopy conditions after treatment or remain untreated. The average proportion of projects that would be untreated on the Coconino and Kaibab NFs is roughly 37 percent, due to site-scale factors such as archaeological and historical sites, wildlife deferrals, funding issues, and areas with insufficient road access (Hampton et al. 2008, page 17). Using this estimate of 37 percent remaining untreated, we extrapolated that 8 percent (75,834 acres) of the total project area would likely remain in deferral simply due to site-scale logistics and protection measures on these excluded projects. Though data were not available to arrive at an accurate percentage of those excluded projects that remain in deferral or closed-canopy condition, we assume that some proportion of this area would contribute to available habitat for canopy-dependent species.

Wilderness Areas, Slopes >40 percent, and MSO PACs not identified for mechanical treatment: These areas have not been identified for mechanical treatment (including 81 of 99 MSO PACs) and are generally characterized by dense forest conditions used by canopy-dependent wildlife. These areas account for 8 percent (79,382 acres) of the total project area.

Ponderosa Pine Treatment Area Scale

Treated areas remaining in closed (10 to 25 percent open) to moderately closed (25 to 40 percent open) condition post-treatment: This category includes mechanically treated and prescribed fire only areas where post-treatment conditions maintain 60 to 90 percent forested cover. Included in the analysis were areas outside and within northern goshawk PFAs where post-treatment openness would be 10 to 25 percent and 25 to 40 percent, northern goshawk nest areas, MSO restricted and target/threshold habitats, and 18 MSO PACs proposed for mechanical treatment. Total acreage for this category is 213,084 or 42 percent of the ponderosa pine treatment area. If we only look at areas that would remain in closed condition (75 to 90 percent forested) post-treatment, the total acreage is 84,632 or 17 percent of the ponderosa pine treatment area. This percentage includes all those areas listed above, but excludes areas in the 25 to 40 percent open category. Table 158 provides acreages by post-treatment openness within the ponderosa pine treatment area. Also, see figure 79.

Table 159 provides a detailed summary of acreages and percentages for each treatment category within the ponderosa pine treatment area in terms of post-treatment density and contributions to bridge habitat. Table 159 demonstrates the patch-mosaic of denser forests (post-treatment) relative to areas that would be more open after treatment. The narrative following table 159 and figure 79 discusses habitat specific post-treatment density.

Table 158. Acres of proposed treatment in terms of post-treatment openness

Post-treatment Openness Category	Acres	Percent of Ponderosa Pine Treatment Area
Very Open	56,692	11
Open	154,524	30
Mixed (LOPFA prescribed fire only)	87,879	17
Moderately Closed	128,452	25
Closed	84,632	17
Total	512,178	100

Table 159. Post-treatment contributions to bridge habitat provided by each treatment designation

Treatment	Post-treatment Density	Landscape Scale Bridge Habitat	Mid-scale Bridge Habitat	Total Acres	Percent of Ponderosa Pine Treatment Area
Mechanical Treatment					
Low Density	Savanna/Grassland Restoration	X	X	56,692	11
	LOPFA 40–55% Interspace	X	Some	141,628	28
	PFA 40–55% Interspace	X	Some	12,895	3
Low Density Total			211,252	41	
Moderate Density	LOPFA 25–40% Interspace	X	X	53,058	10
	MSO Restricted	X	X	63,191	12
	PFA 25–40% Interspace	X	X	4,800	1
Moderate Density Total			121,050	24	
High Density	LOPFA 10–25% Interspace	X	X	29,776	6
	PFA 10–25% Interspace	X	X	2,850	1
High Density Total			32,626	6	
Very High	MSO Target/Threshold	X	X	8,410	2

Treatment	Post-treatment Density	Landscape Scale Bridge Habitat	Mid-scale Bridge Habitat	Total Acres	Percent of Ponderosa Pine Treatment Area
Density	MSO PAC Mechanical	X	X	10,741	2
Very High Density Total				19,151	4
Prescribed Fire Only Areas					
Low/Moderate Density	LOPFA Prescribed Fire Only	Some	Some	87,879	17
Low/Moderate Density Total				87,879	17
Moderate/High Density	PFA Prescribed Fire Only	X	X	3,216	1
	Restricted Prescribed Fire Only	X	X	4,187	1
Moderate/High Density Total				7,403	1
Very High Density	PFA Nest Area Prescribed Fire Only	X	X	6,839	1
	Target/Threshold Prescribed Fire Only	X	X	303	0
	Protected Prescribed Fire Only	X	X	25,714	5
Very High Density Total				32,626	6
Grand Total				512,178	100

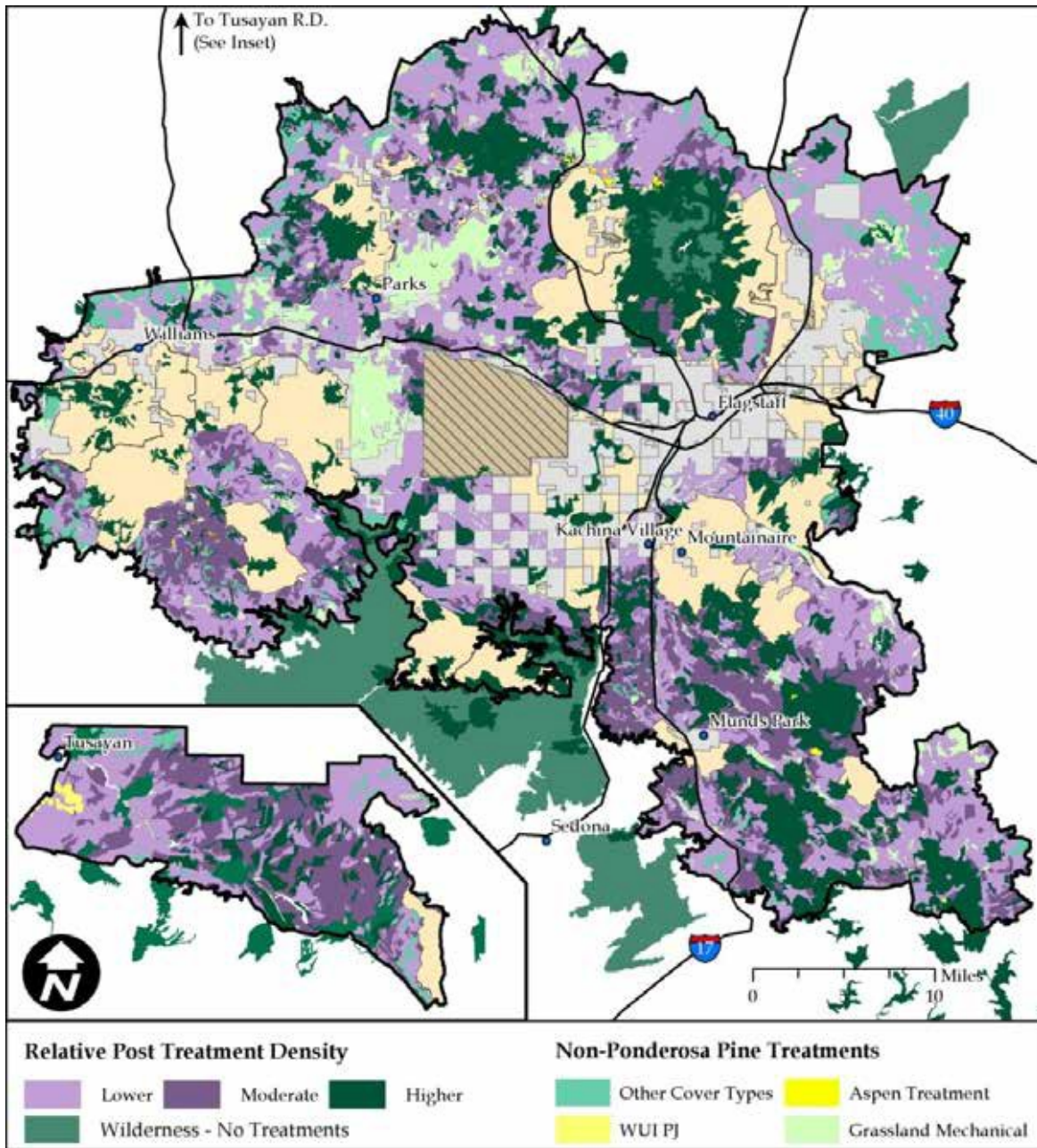


Figure 79. Relative, post-treatment forest density across the 4FRI project area, alternative C

MSO protected, target/threshold, and restricted habitats: These three habitat designations have specific guidelines per the MSO recovery plan to meet the denser forest conditions selected for by the owl. Within the 4FRI project, these designations could be ranked in terms of their forest density and, therefore, their provision of bridge habitat for other closed-canopy species. Protected habitat is generally densely forested, target/threshold habitat is similar to protected habitat, and restricted habitat is slightly less dense than protected but still more densely forested relative to the surrounding treated areas outside MSO designations.

- Protected owl habitat accounts for roughly 36,455 acres, which is 7 percent of the ponderosa pine treatment area (table 159, see the “MSO PAC Mechanical” and “Protected Prescribed Fire Only” row in the “Post-treatment Density” column). This designation includes 72 PACs (18 of which are proposed for some mechanical thinning) and slopes >40 percent. Protected owl habitat is designed to provide a multilayered, more closed canopy condition relative to the other habitats in the ponderosa pine treatment area, with an emphasis on managing for large trees (18-inch d.b.h. or greater). The average basal area for protected habitat, based on modeled projections for the year 2020, is 154 square feet per acre.
- Target/threshold habitats include those areas that meet or are approaching protected habitat conditions, specifically within the pine-oak vegetation type. These areas account for 2 percent (8,410 acres,) of the ponderosa pine treatment area (see MSO target/threshold row in table 159). Per the MSO recovery plan, the guideline within target/threshold habitats is to manage for ≥ 15 percent of total SDI in each of the three targeted ponderosa pine tree size classes (12- to 18-inch d.b.h., 18- to 24-inch, and >24-inch), and a stand average of 110 to 150 square feet per acre basal area at the stand level with a preponderance of large trees (≥ 18 -inch d.b.h.).
- Restricted habitat accounts for 67,191 acres (table 159), which is 12 percent of the ponderosa pine treatment area. Like target/threshold, this is also specific to pine-oak in the 4FRI project. The guidelines for restricted habitat are less specific and operate in conjunction with ecosystem management and existing management guidelines. 4FRI objectives include managing for an abundance of ponderosa pine trees larger than 18-inch d.b.h., maintain tree form oak, and manage for a stand average of 70 to 90 square feet per acre basal area at the stand level.

Northern goshawk habitat: Closed canopy conditions would also be realized within areas managed according to the northern goshawk guidelines. Higher tree density, canopy cover, and larger group sizes would be retained in the PFAs and LOPFAs where the post-treatment density remains high (10 to 25 percent interspace, 32,626 acres) (table 159). Denser forest structure would also be retained in northern goshawk nest areas, all of which have been identified as burn only (6,839 acres) (see the “PFA Nest Areas Prescribed Fire Only” row in table 159). Together, these categories account for 8 percent of the ponderosa pine treatment area. In addition, PFA and LOPFA proposed for moderately dense condition (25 to 40 percent interspace) account for 11 percent of the ponderosa pine treatment area (see the “Moderate Density” category in “Mechanical Treatment Areas” in table 159. About 41 percent of the ponderosa pine treatment area is LOPFA and PFA goshawk habitat proposed for low density condition (savanna/grassland restoration and 40 to 55 percent interspace) (table 159).

Wildlife movement corridors: Efforts were taken to ensure habitat connectivity for canopy-dependent wildlife at the landscape scale using data from known wildlife movement corridors for black bear, turkey, mule deer, and tassel-eared squirrels (AGFD 2011, figure 51). In areas where canopy-dependent wildlife corridors overlapped with proposed mechanical treatments, treatment intensities were strategically designed to leave areas with closed or moderately closed conditions post-treatment. In addition to areas that were already proposed to remain in at least moderately closed condition, roughly 4,276 acres were actively changed from a more open treatment. Adjusted treatment areas were located within five different wildlife movement corridors within the project area. This action was taken to ensure adequate retention of thermal and hiding cover

for the wildlife that depends on closed-canopy conditions for their movement across the landscape. (The inverse was done for open-canopy dependent wildlife corridors, where treatment intensities were designed to create open or very open conditions post-treatment. Open-canopy corridors were identified for pronghorn, Gunnison's prairie dog, and American badger).

In summary, there are four key considerations with regard to bridge habitat for closed-canopy species at the landscape scale:

1. At the project area scale, a patch-mosaic of bridge habitat would remain available for canopy-dependent wildlife. At a minimum, 8 percent of the project area would be in deferral due to wilderness, slope, and MSO untreated PACs. Potentially another 8 percent of the project area would be in deferral as part of other excluded projects.
2. Roughly 1 in 5 acres (22 percent of the ponderosa pine treatment area) would be managed as MSO habitat, creating conditions that also provide bridge habitat for other canopy-dependent wildlife.
3. Bridge habitat would be maintained across 42 percent of the ponderosa pine treatment area, despite the use of mechanical and burning treatments.
4. Project area connectivity for closed-canopy species was specifically built into treatment designs separately from MSO and northern goshawk guidelines.

Bridge Habitat at the RU Scale

At the RU scale (figure 80), there are additional ways of accounting for bridge habitat. Factors contributing to bridge habitat at the RU scale include the area remaining in closed and moderately closed condition post-treatment and areas allocated for old growth.

Treated areas remaining in a closed (<25 percent interspace) to moderately closed (25 to 40 percent interspace) condition post-treatment: Table 160 summarizes the range of post-treatment openness by RU under alternative C. (Also, see table 64 in the silviculture specialist's report). Overall ranges indicate a fairly diverse condition within RUs, with openness leaning toward the moderately closed to closed side of the range. RU 1 has the highest percentage of post-treatment habitat in a closed condition, due in large part to ecological conditions such as soil, climate, and site quality that result in a denser reference condition relative to the other restoration units. RU 1 also contains the highest proportion of MSO habitat relative to the other RUs. Note that RU 3, 4, and 6 include savanna, grassland, and pine-sage habitats (e.g., Garland Prairie in RU 3, Government Prairie in RU 4, and pine-sage in RU 6). Savanna and grassland restoration is based on soil characteristics and would total 56,692 acres of very open treatment. RU 5 shows a different distribution of habitat and this is largely based on the amount of prescribed fire only acres. Although some of these acres may be more open, few mechanical treatments have occurred in the recent past and none are proposed in this project.

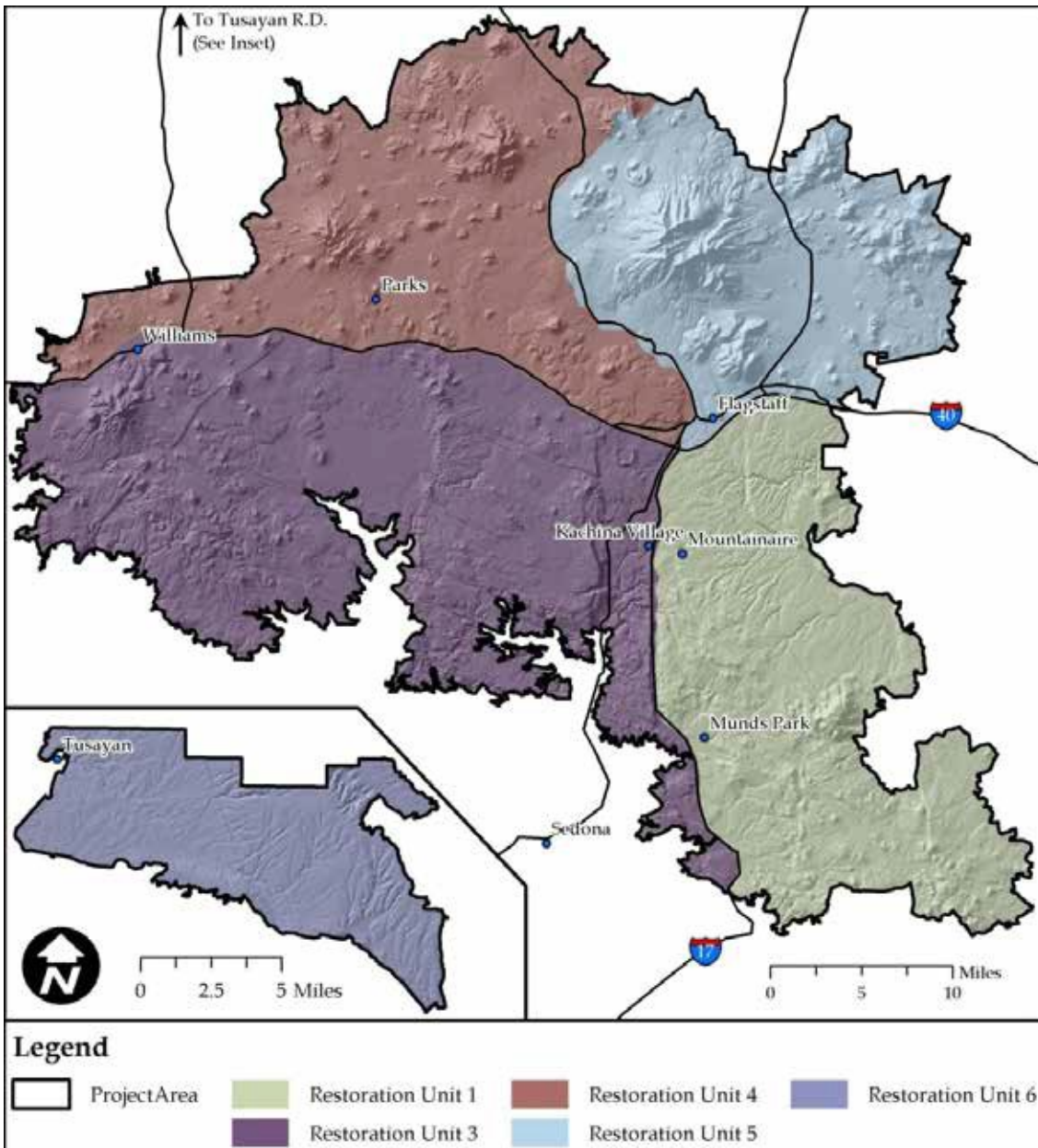


Figure 80. RU boundaries within the 4FRI project area

Table 160. Proposed post-treatment openness condition (Percent) by RU

RU	Very Open	Open	Moderately Closed	Closed
1	10%	32%	20%	21%
3	12%	34%	41%	12%
4	18%	39%	30%	13%
5	2%	5%	87%	6%
6	0%	21%	65%	14%

Areas allocated for old growth: Desired conditions for old growth in ponderosa pine are provided by forest plan direction.

- 20 trees per acre at 18-inch d.b.h. and at least 180 years old,
- one snag per acre at least 14-inch d.b.h. and 25 feet tall,
- two down dead tree pieces 12 inches in diameter and 15 feet long,
- basal area at least 90 square feet, and
- canopy cover of at least 50 percent.

Old growth habitats play a crucial role for many wildlife species in ponderosa pine forests. The microhabitat diversity provided by the old trees, multistoried canopies, and decadent trees/downed logs within old growth areas are rare across the landscape. The forest plans' direction is to allocate and maintain at least 20 percent old growth forest within each ecosystem management unit (EMU). For the purposes of the 4FRI project, the EMU most closely resembles the RU and old growth areas were allocated by RU (see table 38 in the silviculture specialist report).

Since MSOs, and to some extent northern goshawks, are associated with old growth forests, old growth is a subset of those habitats in the 4FRI project (see chapter 1, existing and desired conditions for more details). Forty percent of the ponderosa pine treatment area on the Coconino NF (128,994 acres) and 38 percent (65,810 acres) of the Kaibab NF are allocated for old growth. Current conditions in these areas most closely resemble old growth, but do not currently meet all the forest plan parameters of old growth. It is the intent of the 4FRI project to manage these areas according to old growth standards, moving them toward mature, diverse forest over time. Similar provisions were made for pinyon-juniper habitats.

Bridge Habitat at the Mid-Scale

Bridge habitat for canopy-dependent wildlife would also occur at the mid-scale in the 4FRI project. It is expected that some densely forested areas would be deferred simply due to the vagaries of implementation. The 4FRI project also intentionally plans for bridge habitat at the mid-scale through its desired conditions, design features/best management practices/mitigation, the old and large tree implementation plans, and the silvicultural design and implementation guide. Those elements are described below.

Desired conditions for bridge habitat: During the implementation phase of the 4FRI project, treatment area specific prescriptions for mechanical thinning would be designed based on the desired conditions proposed in this analysis. The following subset of desired conditions helps ensure bridge habitat is maintained in the proposed project area (see chapter 1 purpose and need for the full set of desired conditions):

- The desired condition is to restore tree density and pattern to the natural range of variability, while meeting forest plan requirements for MSO protected and target/threshold habitat and goshawk nest areas.
- At the fine scale, the desired condition is a ponderosa pine ecosystem consisting of groups of trees that typically range in size from 0.1 acre to 1 acre in size. Tree group size

exceeds 1 acre in size as needed to respond to site-specific conditions such as the presence of pre-settlement trees or mature, young trees that are developing old tree characteristics.

- Tree groups in the mid-age and older VSS classes have canopies that provide moderate to closed conditions and connectivity for wildlife that are dependent on this type of habitat. These conditions are widely distributed on the landscape. At the landscape scale (extent of ponderosa pine vegetation), all canopy density conditions exist and provide for heterogeneity.
- Moderate to closed-canopy conditions (and the connectivity between groups supporting these conditions) are met in a variety of ways: habitat for goshawk and MSO, steep slopes, buffers for several resources including bald eagle roosts, other raptor nests, caves, and special designations that would not be treated (including wilderness and most research natural areas).
- There is a need to use management strategies that: (1) promote tree regeneration and understory vegetation, (2) move tree canopy density, tree group pattern and interspaces toward the historic range of variability, and (3) provide a mix of open, moderately closed, and closed-canopy conditions at the fine (group) to landscape (ponderosa pine vegetation) scale.
- There is a need to implement uneven-aged management strategies and manage for high density, relatively uneven-aged stands in MSO restricted habitat, including target/threshold habitats to meet forest plan and MSO recovery plan requirements.

Wildlife design features/best management practices/mitigation measures: These components of the project design provide safeguards for wildlife and other resources during the implementation phase. Those listed in table 161 are those that best illustrate how treatment area design features would result in a well-distributed network of bridge habitat for wildlife across the larger landscape. For a more complete list of design features, BMPs, and mitigation, see appendix C, as well as the silvicultural design and implementation guide found in appendix D. See also table 36 of the wildlife specialists report. Silvicultural design features that contribute to bridge habitat are described in greater detail below.

Old and large tree implementation plans: In response to public input from several stakeholders requesting a design feature of the proposed action include no cutting of pre-settlement old growth trees, the 4FRI project implements an old tree implementation plan. Old trees (approximately ≥ 150 years old) would be retained regardless of their diameter within the 4FRI project area. Exceptions would be made for threats to human health and safety and those rare circumstances where the removal of an old tree is necessary in order to prevent additional habitat degradation. Retention of old trees as individuals and groups will contribute significantly to bridge habitat, providing old growth structure for wildlife in the short term.

In response to input from some stakeholders, alternative C includes a large tree implementation plan. The strategy identifies areas where large, post-settlement trees (≥ 16 inches d.b.h.) would be retained and those exceptions where removal of large, young trees would be necessary to move toward ecological desired conditions. Exception categories include the WUI and the following ecological sites where young tree encroachment is inhibiting ecological function: seeps and springs, riparian areas, wet meadows, grasslands, aspen forest and woodland, pine-oak forest,

within-stand openings, and heavily stocked stands (with a high basal area) generated by a preponderance of large, young trees. Elsewhere, those trees would be retained, adding to the mid-scale provision of bridge habitat for canopy-dependent wildlife.

Silvicultural design and implementation guide: Vertical and horizontal heterogeneity are important components of wildlife habitat in ponderosa pine forests. Restoring variability and diversity to forest structure and pattern is a central desired condition of the 4FRI project. The silvicultural design and implementation guide (hereafter “implementation guide”; appendix D) is intended to translate desired conditions, management direction, and design features into guidance for the district silviculturists responsible for writing site-specific prescriptions in the implementation phase. The intent is to balance the need for flexibility to adapt to on-the-ground realities, while ensuring adequate sideboards to minimize or avoid impacts to important resources. Below are some examples of how we would address maintenance of bridge habitat through the implementation guide.

Implementation guide—MSO guidance: Several features of the implementation guide treatment design for the MSO would serve as a proxy for other canopy-dependent wildlife. Design features for the owl are too numerous to list here, but those listed below serve to illustrate specifically how bridge habitat would be maintained at the mid-scale:

- Each PAC has a 100-acre, no treatment area around the known nest or roost sites.
- Each PAC to be thinned would have an upper diameter limit of trees that may be cut.
- Manage for 110 to 150 square feet of basal area in protected and target/threshold habitats, and 70 to 90 square feet basal area in restricted other habitat.
- Individual trees and tree groups would occupy approximately 60 to 75 percent of the area within restricted other habitat.
- Treatments are designed to manage for old age trees to sustain as much old forest structure as possible across the landscape. Treatments would follow the old tree implementation plan.
- No trees larger than 24-inch d.b.h. would be cut.
- In restricted other habitat, tree groups on average would range in size from 0.1 to 1 acre with northerly aspects and highly productive microsites having larger average group sizes.
- In restricted other habitat, manage for tree groups with different age classes by retaining individual and clumps of vigorous ponderosa pine seedlings, saplings and poles within the larger mid-aged, mature, or old tree groups.
- In restricted other habitat, interspace width between tree groups would average from 25 to 60 feet with a maximum width of 200 feet.
- Manage for large oaks and pine snags.

Table 161. Design features, BMPs, and mitigation measures contributing to bridge habitat

Species/Resource	Description
Bald Eagle Nests	No mechanical treatments would occur within a 300-foot radius of bald eagle nest trees.
Bald Eagle Roosts	No mechanical treatments will occur around confirmed bald eagle roost sites (300' radius around roosts on the Coconino NF and a 10-chain radius on the Kaibab NF).
VSS 4, 5, and 6	<p>Within group density – Manage mid-aged tree groups for a range of density and structural characteristics by thinning approximately 50 percent of the mid-aged groups to the lower range of desired stocking conditions, approximately 20 percent each to the middle and upper range of desired stocking conditions, and approximately 10 percent remain unthinned.</p> <p>Within group structure – Enhance and maintain mid-aged, mature, or old group structure by retaining individual and clumps of vigorous ponderosa pine seedlings, saplings, and poles within the larger group.</p>
Caves and Sinkholes	A 300-foot, no mechanical treatment buffer unless mitigated by logical topographical breaks would be designated around cave entrances and sink hole rims to protect cave ecosystems and reduce disturbance to bats.
Dependable Waters	Hiding cover would be maintained near dependable waters by not targeting drainages for interspaces and openings and through implementation of watershed BMPs.
Great Blue Herons	No dominant or codominant trees would be cut in rookeries. Nest trees will be prepped prior to prescribed burning.
MSO	Trees greater than 24-inch d.b.h. would not be harvested.
Mixed Conifer	4FRI activities would not include mechanical or fire treatments in the mixed conifer inclusions within the ponderosa pine forest (e.g., nest and roost buffers in Bear Seep and Red Raspberry PACs). Similarly, islands of ponderosa pine within mixed conifer forest would not be treated as part of this project.
Northern Leopard Frogs	A no-treatment buffer (no thinning, no direct ignition) ¼-mile distant from tanks in the vicinity of known northern leopard frog sites, or a buffer designated along logical topographic breaks.
Northern Leopard Frogs	A 200-ft protection zone (100 feet either side of stream course) would be established around designated stream courses for northern leopard frogs. There would be no thinning and no direct ignition of prescribed burning within the protection zones. Designated skid trail crossings through the buffer zones are allowed.
Raptor Nests	No mechanical treatment buffers would be designated around raptor nests. Sharp-shinned hawk nests = 10 acres, Cooper's hawk nests = 15 acres, osprey nests = 20 acres, other raptors = 50 acres.
Snags	Emphasize retention of snags \geq 18-inch d.b.h.
Snags	Retain trees \geq 18-inch d.b.h. with dead tops, cavities, and lightning strikes wherever possible to provide cavity nesting/foraging habitat (i.e., the living dead).
Streamside Management Zones	On areas to be prescribed burned, establish filter strips (also known as streamside management zones). Applies to riparian and nonriparian stream courses. Deferral widths range from 35 to 120 feet on each side of the stream course.
Turkeys	Retain medium to high canopy cover in pine stringers in the pinyon-juniper transition zone and target low-severity burns to retain yellow pine and roosting cover.

Species/Resource	Description
Wildlife Cover	<p>Gambel oak, juniper, and pinyon species may only be cut as necessary to facilitate logging operations (skid trails and landings) and by design as follows:</p> <p>Within UEA, IT, SI, and WUI treatments, pinyon/juniper seedling/sapling and young/mid-aged trees may be cut within a 40-foot radius of individual or groups of old ponderosa pine (as defined in the old tree implementation strategy).</p> <p>Within savanna and WUI PJ mechanical treatment areas, pinyon/juniper seedling/sapling and young/mid-aged trees may be cut.</p>

Implementation guide—northern goshawk habitat guidance: Several features of the treatment design for the northern goshawk would serve as a proxy for other canopy-dependent wildlife. Design features are too numerous to list here, but a key few are highlighted to illustrate how bridge habitat would be maintained. Relevant design features from table 161 are not repeated below.

- Treatments are designed to manage for old age trees, following the old tree implementation plan.
- Treatments would strive to attain an overall stand average density ranging from 40 to 90 square feet of basal area and 15 to 40 percent of maximum SDI. Density would vary within this range depending on treatment type, intensity, and existing stand structure.
- Tree group density would be managed to meet the canopy cover requirement of 40 plus percent within mid-aged forest (VSS 4), mature forest (VSS 5), and old forest (VSS 6) tree groups and to assure that immature tree groups (VSS 2 and 3) are managed to maintain tree stocking necessary to provide for desired canopy cover as the groups mature.
- To achieve overall stand average density targets, basal area and SDI within tree groups would often need to exceed the average target. Table 162 illustrates how this could work for basal area (see the implementation guide for greater detail). For example, a unit with a treatment intensity of 10 to 25, with an objective of 20 percent interspace and 80 percent treed, with 70 percent of treed area as groups and individuals and 10 percent as regeneration, and an overall target basal area of 60 would require the tree groups to average 86 basal area.
- Within group structure specific to mid-aged to old classes (VSS 4 to 6) includes open understories, interlocking tree crowns, abundant large limbs, and shade.
- Tree groups, on average, would range in size from 0.1 to 1 acre. Overall average group size would vary within this range depending on existing stand structure and pre-settlement tree evidence.
- Maximum interspace width of 200 feet.
- Maximum regeneration opening size of 4 acres or 200 feet wide.
- One group of reserve trees, three to five trees per group, would be left in created regeneration openings larger than 1 acre in size.
- Manage for large oaks.
- Within the proposed ADGF research areas, tree group size is dependent on experimental design and would range in size from 1 to 15 acres.

Table 162. Excerpt from section D of the 4FRI implementation guidelines

Treatment Intensity	Percent of Area		Percent of Area with Tree Cover		Average Group Basal Area to Achieve Overall Basal Area					
	Inter-space	Tree	Groups & Individuals	Regeneration	40	50	60	70	80	90
10–25	10	90	90	0		56	67	78	89	100
			85	5		59	71	82	94	
			80	10		63	75	88	100	
			75	15		67	80	93	107	
			70	20		71	86	100	114	
	15	85	85	0		59	71	82	94	106
			80	5		63	75	88	100	
			75	10		67	80	93	107	
			70	15		71	86	100	114	
			65	20		77	92	108	123	
	20	80	80	0		63	75	88	100	113
			75	5		67	80	93	107	
			70	10		71	86	100	114	
			65	15		77	92	108	123	
			60	20		83	100	117	133	

In summary, bridge habitat would be managed for at the mid-scale in four key ways:

1. Desired conditions that strive to attain the full range of natural variability which would include areas for canopy-dependent wildlife,
2. Design features/BMPs/mitigation measures that result in a well-distributed mosaic of small-scale deferrals in an otherwise mechanically treated landscape,
3. Implementation guidance for MSO habitat that retains higher forest density and canopy cover relative to the surrounding landscape, and
4. Implementation guidance for the northern goshawks that allows for higher density within tree groups given the contribution of interspaces and openings to overall stand averages.

Conclusions About Bridge Habitat in the 4FRI Project

Closed-canopy, high-density forest conditions are currently common in the 4FRI project area. To achieve ecological objectives and modify landscape-scale fire behavior, prevalence of those dense forests must be significantly reduced. Given the evolutionary history of canopy-dependent wildlife on this landscape, we can assume that closed-canopy conditions were present within the natural range of variability. The question of how much of the pre-settlement landscape was in this condition remains unanswered, but the literature suggests that this was not the predominant

condition. Nevertheless, it is the intent of the 4FRI project to provide bridge habitat for canopy-dependent wildlife to span the time between restoration treatments and achievement of desired conditions.

Potentially 13 percent of the landscape within the 4FRI project boundary would be deferred from treatment. Nearly 42 percent of the ponderosa pine treatment area would remain in a moderately closed to closed condition after treatment. Seventeen percent would remain in closed condition after treatment. Restoration units near the Mogollon Rim would provide the greatest percentage of bridge habitat after treatment. Old growth allocations account for 38 percent of the ponderosa pine treatment area and are well distributed across the landscape. A patch-mosaic of small deferrals would be created all across the 4FRI project area to provide safeguards for wildlife features such as nests and hiding cover. Implementation guidance in MSO and northern goshawk habitats includes provisions for higher density and canopy cover relative to the surrounding landscape. It is our assumption that all of these measures would provide adequate bridge habitat for canopy-dependent wildlife. Monitoring would be an important test of this assumption, and adaptive management would be employed if outcomes prove otherwise.

