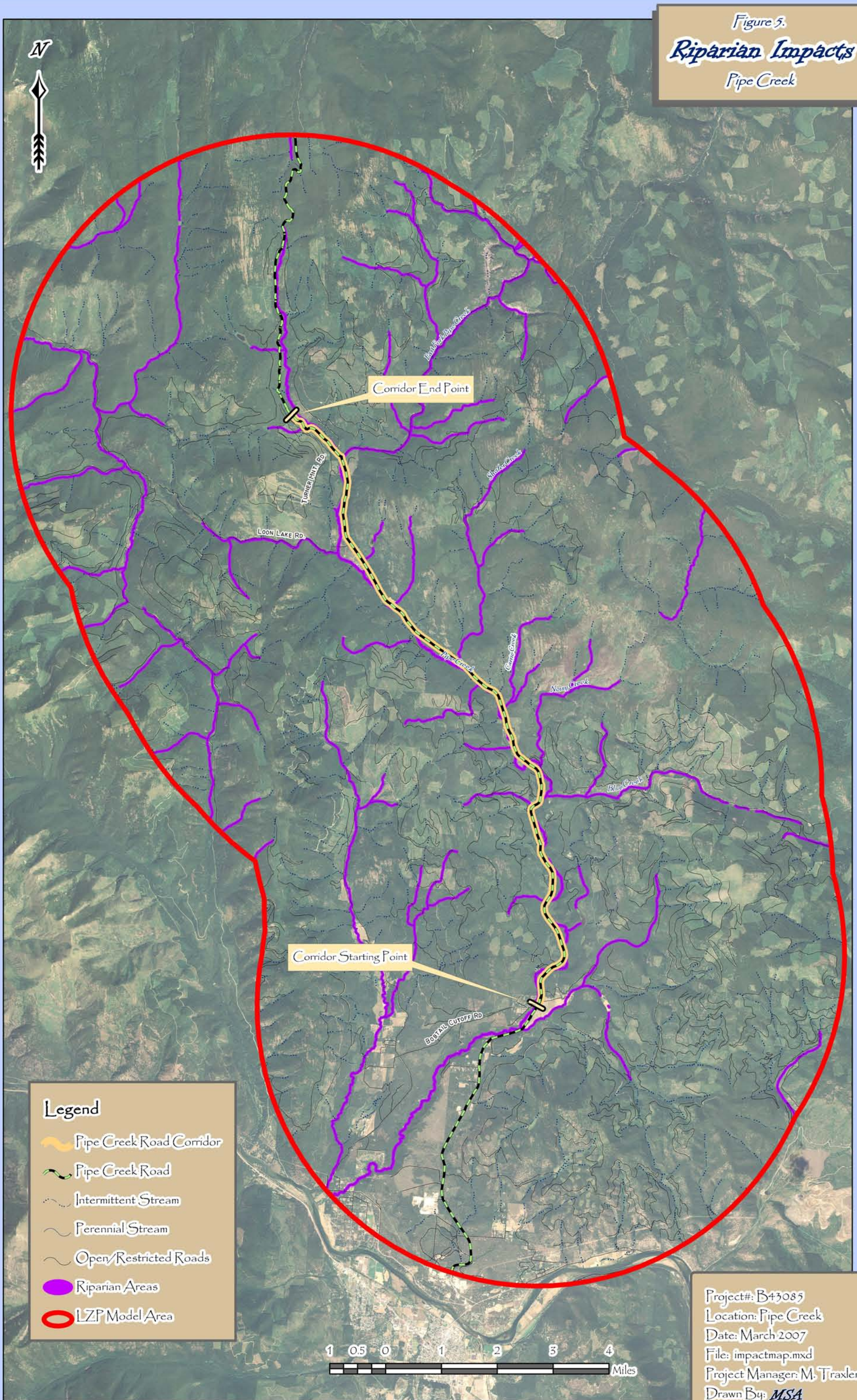
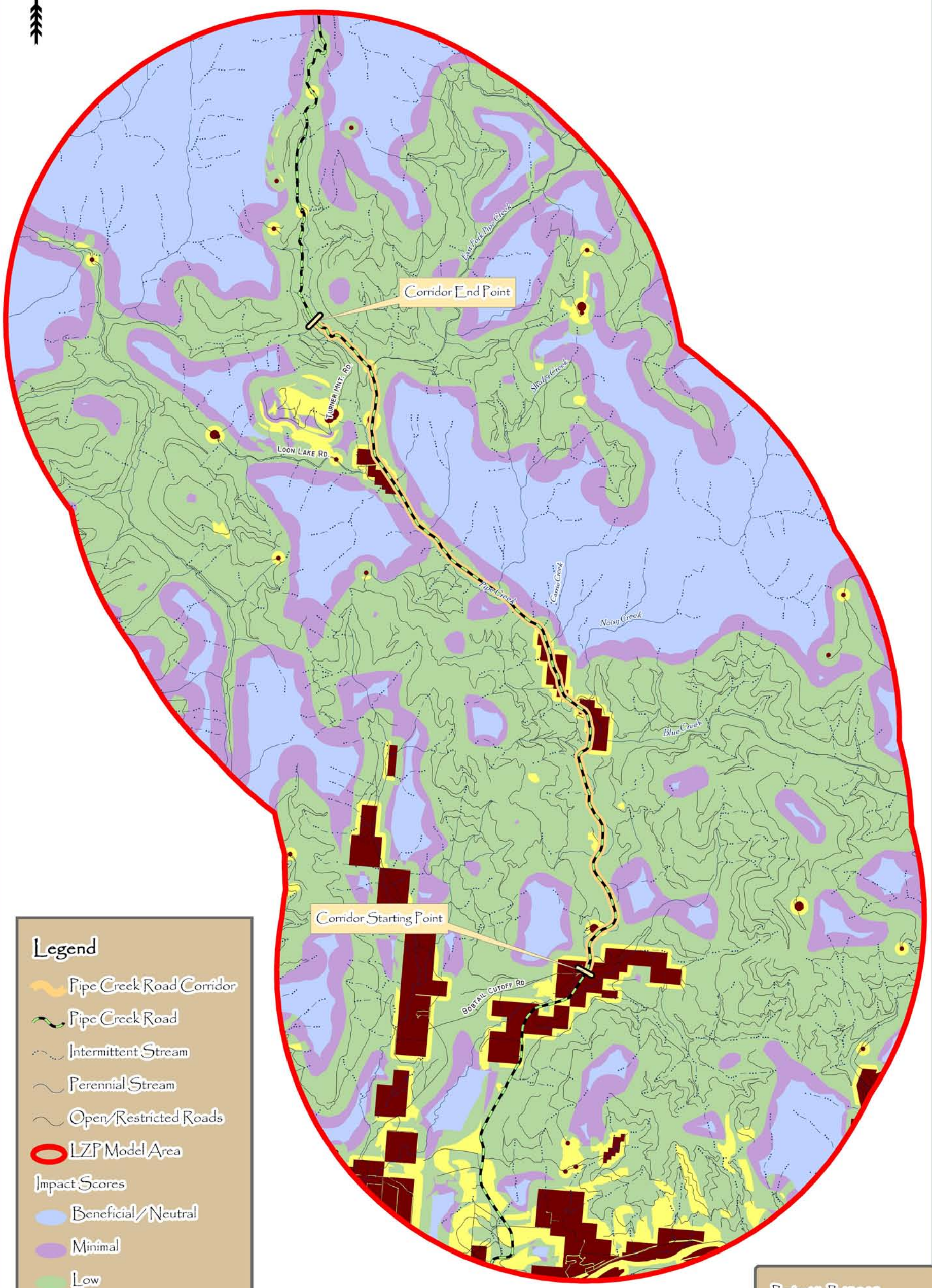


Figure 5.
Riparian Impacts
Pipe Creek
N
Corridor End Point
Corridor Starting Point
Turner Mnt. Rd.
Loon Lake Rd.
Bobtail Cutoff Rd.
Pipe Creek
Shafer Creek
Carrie Creek
Noisy Creek
Blue Creek
Legend
Pipe Creek Road Corridor
Pipe Creek Road
Intermittent Stream
Perennial Stream
Open/Restricted Roads
Riparian Areas
LZP Model Area
1 0.5 0 1 2 3 4
Miles
Project#: B43085
Location: Pipe Creek
Date: March 2007
File: impactmap.mxd
Project Manager: M. Traxler
Drawn By: MSA

Figure 6.

Impact Map

Pipe Creek



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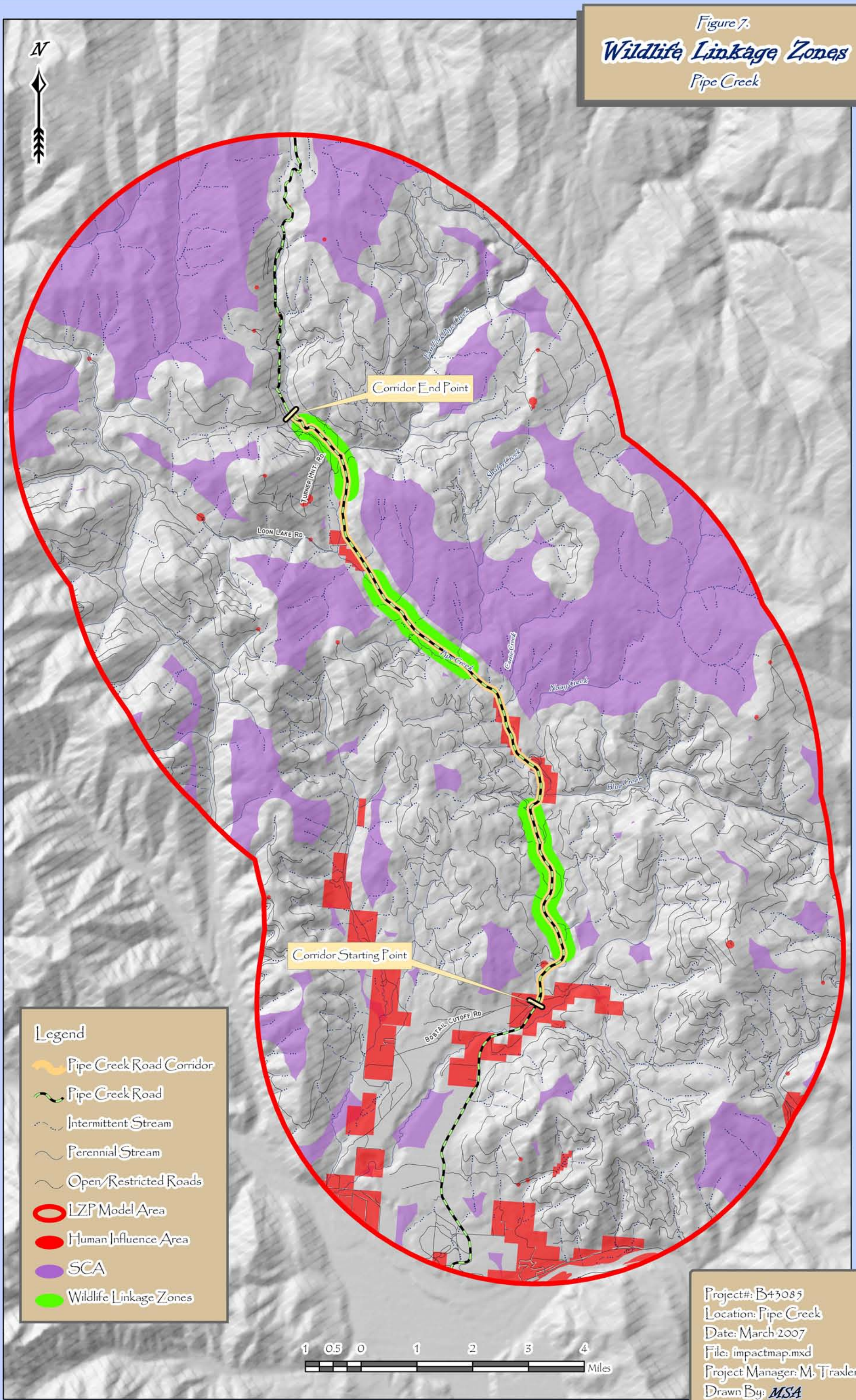
Figure 7.
Wildlife Linkage Zones
Pipe Creek
N
Corridor End Point
Corridor Starting Point
Turner Mnt. Rd.
Loon Lake Rd.
Bobtail Cutoff Rd.
Pipe Creek
Shafer Creek
Cassie Creek
Noisy Creek
Blue Creek
Legend
Pipe Creek Road Corridor
Pipe Creek Road
Intermittent Stream
Perennial Stream
Open/Restricted Roads
LZP Model Area
Human Influence Area
SCA
Wildlife Linkage Zones
1 0.5 0 1 2 3 4
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LIBBY NORTH CORRIDOR STUDY: PRELIMINARY WILDLIFE HABITAT LINKAGE ANALYSIS

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March 7, 2007

LIBBY NORTH CORRIDOR STUDY
PRELIMINARY WILDLIFE HABITAT LINKAGE ANALYSIS
MONTANA DEPARTMENT OF TRANSPORTATION PROJECT

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March 7, 2007

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Appendix A *Figures 2 through 7*

1.0 INTRODUCTION

Post, Buckley, Schuh & Jernigan (PBSJ) was contracted by PB Americas, Inc. (PB) to conduct a wildlife habitat linkage analysis for the Montana Department of Transportation (MDT) Libby North Corridor Study. The study area is located in Lincoln County on Secondary 567 (Pipe Creek Road) (see **Figure 1** for project location). The study area begins at RP 6.1 at the Bobtail Junction Road intersection and extends approximately 14.0 miles north to the intersection with Turner Mountain Road at RP 20.1.

Pipe Creek Road is a paved, rural secondary highway that traverses heavily forested terrain in a sparsely populated area of extreme northwest Montana. MDT is in the process of studying all aspects of the existing roadway corridor in an attempt to identify roadway deficiencies including but not limited to safety and design concerns. Also as part of the corridor study, MDT is examining all natural resource concerns in the study area that would need to be addressed during future planning efforts. Considering the largely undeveloped nature of the study corridor and high potential for wildlife movement across the roadway, wildlife linkage was identified as a key issue to be addressed in the corridor study.

PBS&J was requested to develop a GIS-based model for predicting wildlife habitat linkage potential and apply the model to the Libby North Corridor study area. The methods used in developing the model are presented in this report along with its application within the study area. Results of the linkage analysis can be used in future planning efforts in the corridor to preserve and enhance wildlife movement across the highway corridor.

2.0 WILDLIFE LINKAGE ZONES

As defined by Servheen and others (Servheen et al. 2001), wildlife habitat linkage zones are defined as:

> *"The area between larger blocks of habitat where animals can live at certain seasons and where they can find the security they need to successfully move between these larger habitat blocks. Linkage zones are broad areas of seasonal habitat where animals can find food, shelter, and security."*

Maintaining linkage zones is critical in mitigating the detrimental effects of habitat fragmentation often associated with highway corridors. In northwest Montana and much of the Rocky Mountain West, private development is often situated in a linear fashion along the valley floors adjacent to major highways (Servheen et al. 2001). When development reaches moderate to high concentrations, cross-highway habitats become fragmented to a point where certain species such as grizzly bears (*Ursus arctos horribilis*) and other more secretive carnivores may no longer cross the valley floor.

Insert Figure 1 here

These areas have been termed "habitat fracture zones" (Servheen et al. 2001, Servheen and Sandstrom 1993).

Analysis of wildlife linkage zones in the Northern Rocky Mountains to date has largely focused on grizzly bears and other rare carnivore species with relatively large home ranges. To date, analysis of linkage zones for grizzly bears has been conducted on a broad scale as biologists and land managers throughout the Rockies and Cascade Mountains attempt to identify key wildlife linkages between the six identified grizzly bear recovery areas. More recently, including the Libby North Corridor study, efforts are being made at a local scale to address wildlife linkage for all species including grizzly bears and other carnivores, ungulates, and small mammals. Stakeholders at all levels of government along with private landowners and special interest groups are all becoming more aware of the growing challenges of trying to maintain wildlife linkages for the benefit of all wildlife.

3.0 STUDY APPROACH

Initial method development efforts for this analysis focused on reviewing available literature and determining how previously generated GIS-based models might apply to the Libby North Corridor study area. The Linkage Zone Prediction (LZP) model cited in Servheen et al. (2001) on the Interstate 90 corridor from Superior to Lookout Pass and the work more recently completed by Geodata Services Inc. (Wall 2006) provided a solid foundation upon which to develop this model.

For purposes of this analysis, it was decided to use grizzly bears as an indicator species in applying the model. The Libby North Corridor Study area lies outside the designated Cabinet – Yaak Grizzly Bear Recovery Zone, but does occur within designated occupied habitat. According to the USFWS, grizzly bears occur within the study corridor on occasion; however, little research has been conducted in this area to adequately ascertain populations or overall use in this area (Kasworm pers. comm.). As recently as 2005, a nuisance grizzly bear was relocated from the Pipe Creek drainage due to conflicts with local residents along Pipe Creek Road in the 17-mile area (Kasworm pers. comm.). Suitable grizzly bear habitat does exist within the study corridor, especially towards the northern end.

While selecting the grizzly bear as a key indicator species is important to this study in helping define and prioritize GIS thematic layers used in the model, it should be noted that the results and identification of key linkage areas are directly applicable to a number of important wildlife species in the corridor including but not limited to wolverine (*Gulo gulo*), lynx (*Lynx Canadensis*), fisher *(Martes pennanti)*, pine marten (*Martes americana*), elk (*Cervus elaphus*) and deer (*Odocoileus virginianus*).

4.0 STUDY AREA

Secondary Highway 567 (Pipe Creek Road) begins at its junction with State Highway 37 on the outskirts of the Libby community and extends approximately 35 miles north to its

junction with State Secondary Highway 508 in the small rural community of Yaak. Corridor limits for this study begin at approximately RP 6.1 (Bobtail Junction) and extend to the Turner Mountain Ski Area road near RP 20.1. The southern tip of the project is characterized by private land holdings, with many rural home sites and the Red Dog Saloon. Utility services such as telephone and electricity only extend a short distance north of the south corridor terminus. The remainder of the study corridor has no utility services at this time.

Pipe Creek Road is generally maintained by the U.S. Forest Service (USFS) through the corridor, although Lincoln County plows snow through the winter. Traffic counts are low, with a 2006 average daily traffic (ADT) of 220 vehicles and a projected 2030 ADT of 350 vehicles. The existing roadway is narrow with a number of tight curves and few or no pavement markings. Little-to-no data on animal/vehicle collisions are available for the study area; however, collision rates are expected to be low, with low ADT's and slow rate of travel on this narrow, winding roadway. Deer populations are high in the area and collisions likely occur on occasion, but may not be reported with any regularity.

The existing roadway closely parallels Pipe Creek in the valley bottom to approximately RP 18.5, where it begins a steep ascent towards Pipe Creek Summit beyond the northern limits of the study corridor. A vast majority of the land in the Pipe Creek watershed, including that which is bisected by the existing highway, is heavily forested and is owned and managed by the U.S. Forest Service. Approximately 83% of the land within a 5-mile radius of the study corridor is under USFS ownership. Plum Creek Timber Company has significant holdings in the watershed (approximately 12%), while other smaller private tracts occur in small clusters immediately adjacent to the roadway. **Figure 1** shows ownership patterns in the study corridor.

Land management within this rural corridor has been largely geared towards timber production in recent decades, although timber harvest has declined significantly in the last five to ten years. Extensive forest road systems have long been established in most tributary drainages and are actively managed by the USFS, with many seasonal or yearlong road closures in place for wildlife security purposes.

A 10,000+ acre roadless area, *Gold Hill West*, occurs within the study corridor and is generally located towards the northern portion of the corridor on the east side of the roadway. This roadless area includes portions of the Shafer, Carrie, and Noisy Creek drainages.

Small private holdings adjacent to the roadway are becoming more and more developed over time, with minor levels of subdivision still occurring on the few remaining parcels that have not yet been developed. Private land holdings are generally clustered and occur near the southern terminus of the corridor, towards the middle of the corridor (approx. RP 10 to 13) and in the vicinity of Loon Lake Road (RP 17).

Forest Service lands within the corridor are managed for a number of multiple uses including but not limited to timber harvest, recreation (hunting, hiking, fishing, camping), wildlife, and aesthetics. Timberlane Campground is located towards the southern end of the corridor and numerous hiking trails occur in the drainage, with several trailheads

located along the highway. Turner Mountain Ski Area is located just west of the highway towards the northern end of the study corridor and is a popular winter recreation site. Hunting in the fall and snowmobiling during the winter are also popular recreational activities in the corridor.

5.0 METHODS

PBS&J used readily available spatial data layers and combined the data into one composite model to assess habitat conditions within a five mile radius of the corridor study area and identify potential wildlife habitat linkage zones along Pipe Creek Road. The model intent is to define favorable habitat and areas of potential wildlife avoidance, using grizzly bears as the indicator species, to determine potential cross-highway linkage areas in the corridor. The modeled linkage zones were based on the Linkage Zone Prediction (LZP) model cited in Servheen et.al (2001) on the Interstate 90 corridor from Superior to Lookout Pass. The LZP model combines four different thematic layers: roads and road density; vegetative cover conditions, developed human areas, and riparian habitat. Characteristics of each of the themed layers were ranked for their impact to grizzly bear habitat as the indicator species from neutral or beneficial impacts to high impacts.

Field reconnaissance of the study corridor was completed by PBS&J during August 2006. At this time, the entire corridor was walked or driven, while noting vegetation communities, wildlife observations, basic stream and riparian attributes, and human development patterns. 2005 color aerial photographs of the corridor were downloaded from the internet and utilized in the field and during subsequent air photo interpretation of the study area. U.S. Fish & Wildlife Service (USFWS) and USFS Biologists familiar with the study area were also contacted as part of the wildlife linkage analysis (Kasworm, Brundin pers. comms.).

5.1 Roads

PBS&J obtained road coverage from the Kootenai National Forest (KNF) to identify roaded and roadless areas and assess the road density throughout the modeled area. Roads can cause fragmentation of habitat for many different species and also increase the risk of mortality. The road analysis considered two factors: 1) secure core areas (SCA) or roadless areas; and 2) road density in roaded areas. Roads that were open or had restricted access were considered in the analysis and permanently closed roads were excluded. The Interagency Grizzly Bear Committee (IGBC) road definition in the KNF road database was used to define which road segments were open, seasonally closed or restricted, or permanently closed (1998 Selkirk / Cabinet – Yaak Grizzly Bear Recovery Areas / Interim – Access Management Rule Set approved 12/1/98 by Selkirk / Cabinet – Yaak Subcommittee). **Figure 2** in **Appendix A** shows all forest road systems considered in the road analysis.

The road layer was first used to define SCAs. SCAs are defined as areas greater than 1640 feet (1/3 mile) from open roads, seasonally restricted roads, or trails receiving high use (more than 12 parties/week). SCAs can include impassible and permanently closed

roads. SCAs define areas where grizzly bears or other wildlife are less impacted by humans and less displaced by human activity. SCAs are defined by roads and therefore typically exclude human occupation zones, but may include features such as primitive lookouts without motorized vehicle access. Trails were not used to define SCAs, because KNF categorizes the trails in the modeled area as receiving low to moderate use (Brundin pers. comm.).

Road density was calculated using a moving circle analysis. The moving circle analysis measures length of open and seasonally restricted roads within a ½ mile radius of every 100 ft pixel across the modeled area. Road density was grouped into four categories of impact: beneficial, minimal, low, and moderate (see **Table 1**).

5.2 Developed Areas

Human activity has a strong influence on the habitat-use patterns of grizzly bears (Servheen 2001). Grizzly bears may be both attracted to human occupations by the presence of garbage and food and will also avoid these areas because of the human activity. Either way, developed areas, or human influence areas, have a negative, or high, impact on grizzly bear habitat. Developed areas considered human influence zones included residential and commercial structures, campgrounds, trailheads, and the base area of Turner Mountain (**Figure 3**). The model considered all of them to have a high impact. Plum Creek land was not considered as human influence zone unless it had been subdivided for residential development.

Sources of data for identifying human influence zones included Montana Department of Administration/Information Services Division cadastral data and various shapefiles identifying trailheads, campgrounds, and lookouts provided by KNF. The Montana Cadastral data relates property boundaries in a GIS coverage to various land ownership fields. PBS&J queried the land ownership to identify private parcels that could represent a developed human influence area. Based on observations in the field, it was assumed that all private parcels in the study corridor, except for Plum Creek ownership, represented a human influence zone and had the potential to affect grizzly bear habitat currently or in the future when developed. The entire parcel was designated a high impact level with decreasing impact levels farther from the property (see **Table 1**).

Other human influence areas were identified from the Geographic Names Information System (GNIS). Montana GNIS is an inventory of place names contained on all U.S. Geologic Survey (USGS) maps of Montana and all federal and local maps inventoried by the USGS. It includes populated places, mountain peaks, rivers and streams, schools, farms, glaciers, railroad sidings, etc. GNIS identifies each of these as points and areas of high impact were assigned to the various types of points as shown in **Table 1**. The areas around the human influence area were assigned decreasing impacts proportional to distance as shown in **Table 1**.

Table 1. ***Estimated levels of impact based on various human activities and vegetative cover.***

Category	Beneficial	Neutral	Minimal	Low	Moderate	High
Road Density Outside Secure Core Areas	NA	0 mi/mi^2	0.01 - 1.00 mi/mi^2	1.01 - 2.00 mi/mi^2	>2.00 mi/mi^2	NA
Riparian Areas	Inside	Outside	NA	NA	NA	NA
Cover	NA	Area provides hiding cover or open area within SCA	100 ft edge buffer around open area outside SCA	NA	Open area, outside SCA	NA
Residential and Commercial Properties	NA	> 800 ft buffer around property	NA	400 – 800 ft buffer around property	<400 ft buffer around property	Within property boundary
Trailheads, Lookouts, Misc Structures	NA	> 1000 ft buffer from around point	NA	600 – 1000 ft buffer around point	200 - 600 ft buffer around point	<200 ft buffer Around Point Location
Campgrounds	NA	> 1200 ft buffer from around point	NA	800 – 1200 ft buffer around point	400 - 800 ft buffer around point	<400 ft buffer around point location

5.3 Cover

Cover can have a significant impact on grizzly bear movement as bears seldom move from hiding cover into open areas during daylight hours if near areas of frequent human activity (Servheen 2001). The Flathead National Forest defines hiding cover as vegetation that screens 90% of an adult bear at 200 feet. PBS&J used Montana GAP Analysis land cover data to identify land types classified as open areas; generally agricultural lands, grasslands, meadows, ponderosa pine, and mixed barren/rock land types. These areas were then compared to aerial photography to identify areas of naturally occurring open area or areas opened through human activity. The areas did not include logged areas as regeneration within a few years will likely provide hiding cover to meet the Flathead National Forest definition (**Figure 4**).

The cover layer was divided into three classifications: open, edge (100 ft [30 m] buffer around open), and hiding cover. All areas that were identified as hiding cover were considered to have a neutral impact level. Open areas and edge areas within SCAs were also considered neutral. Open areas outside SCAs were considered to have a moderate impact level and the edge areas outside SCAs were considered to have a minimal impact level (see **Table 1**).

5.4 Riparian Areas

Riparian areas have been shown to be important grizzly bear habitat, providing more security and forage than other cover areas (Servheen 2001). While riparian zones provide habitat for wildlife species such as grizzly bears, riparian areas often coincide with roadways and human influence areas. In mountainous terrain, riparian areas are often the first to be developed. In such cases, the beneficial effects of riparian areas are offset by the high impacts from traffic and human presence. These riparian areas are likely used by wildlife, but in the high impact areas their movements are likely restricted to nocturnal travel (Waller 2005).

The study corridor lacked detailed mapping of riparian habitat and the extent of riparian areas was subjectively designated based on a sample of field observations (**Figure 5**). The riparian areas are fairly limited in width because of the steep topography of the modeled area and its drainages. PBS&J identified the full length of Pipe Creek to have an average riparian zone width of 60 feet. East Fork Pipe Creek was assigned a riparian zone width of 40 feet and all other perennial streams were assigned a riparian width of 20 feet. However, based on the scale of the model, the riparian zones had little significance on identifying micro areas conducive to grizzly bear and wildlife use. Further, the model does not allow for beneficial habitat to overcome other impacts, therefore riparian areas in the study corridor had minor overall effect on identifying potential linkage zones.

6.0 RESULTS

All four coverages were combined into a LZP model that visually displays potential areas of beneficial habitat and areas of avoidance for wildlife (**Figure 6**). Each of the coverages were represented by polygons defining the level of impact. The LZP model combined all layers and assigned a composite impact score based on the combinations of category impacts described in **Table 2.** The LZP model assumes that the roadless areas and secure core areas are key determinants for identifying beneficial habitat and that areas developed with permanent structures represent areas that grizzly bears and other wildlife will typically avoid.

Table 2. ***Combined linkage zone prediction model categories.***

Beneficial/Neutral	Minimal	Low	Moderate	High
All 4 categories were identified as neutral or beneficial	One Category having a minimal/low rating, all others having beneficial or neutral	Any area having 2 categories with minimal or low rating, and the other 2 neutral/beneficial rating	Any area with more than 2 categories with moderate rating, but none with high	Any one category with a high rating
		OR		
		1 category with moderate rating and 1 category with low/minimal rating and neutral/beneficial rating for the other 2		

Figure 6 shows large secure core areas in the Gold Hill Roadless area on the east side of Pipe Creek Road and in the Flatiron and Roderick Mountain areas north and northwest of the study corridor. Other significant secure core areas occur near Turner Mountain and Mount Tom at the northern end of the corridor. Other significant areas include the Blue Creek drainage, which is heavily roaded but provides large areas of undeveloped land with abundant hiding cover. Human influence zones occur along Pipe Creek in the Seventeen Mile area, the Blue Creek/Noisy Creek residential development, and the Bobtail Cutoff Road area at the south end of the corridor. Isolated human influence zones are located at trailheads and lookouts.

Figure 7 identifies the potential wildlife habitat linkage zones along Pipe Creek Road. Wildlife linkage zones are identified in the following locations: 1) south of Blue Creek and north of the Bobtail Cutoff Road area; a section north of Shafer Creek and south of the Seventeen Mile area, and a section of Pipe Creek Road north of the Seventeen Mile development to the end of the study corridor. It should be noted that Pipe Creek Road north of the study corridor would likely be included as a potential wildlife linkage zone because of the large secure areas on either side of Pipe Creek Road.

7.0 DISCUSSION

As previously mentioned, the Pipe Creek Road corridor is situated within a rural, relatively undeveloped, and largely publicly owned watershed of extreme Northwest Montana. To date, habitat fragmentation and fracture zones, as previously defined have been kept to a minimum in the corridor, thus affording ample opportunity for grizzly bears and other wildlife to safely cross the valley floor. While the Pipe Creek Road corridor may not provide a critical link between grizzly bear recovery areas, it is important locally for the imperiled Cabinet/Yaak grizzly bear population. Especially important as shown through the LZP model is the linking of large "Secure Core Areas" in the Gold Hill West roadless area east of the roadway and habitat in the Mount Tom and Flat Iron and Roderick Mountain areas to the west and northwest. Biologists familiar with the study area confirmed wildlife movement across the valley floor in these general locations, thus providing a certain level of validation for the results obtained from applying the LZP model (Brundin, Kasworm pers comms.).

With a majority of the private land holdings in the corridor (except Plum Creek) having been developed or in the process of being developed, few additional human influence zones are anticipated. What could influence the level of human disturbance in the study area is the introduction of utilities, subdivision of Plum Creek land holdings, construction of additional forest logging road systems, and/or land exchanges that might transfer public lands to private ownership or visa versa. Highway planning within the study corridor should be coordinated with all levels of county, state, and federal government and private stakeholders to ensure linkage zones and their potential benefits to local wildlife are taken into consideration.

While the applied LZP model provides a strong basis for identifying potential wildlife linkage between SCA's in a particular area, significantly more field data collection and study would be needed to address specific grizzly bear or other wildlife crossing locations within a particular linkage zone. Wildlife crossing structures such as underpasses and overpasses are becoming more common in Montana and throughout much of the United States. Crossing structures are typically incorporated in locations where cross-highway movements by local wildlife populations are thought to be occurring, but may be slowed or even precluded, by future highway development.

The interagency lynx biology team (ILBT 2000) cites highway/carnivore research in Canada that suggests highway traffic volumes of 2,000-3,000 vehicles per day are problematic with respect to wildlife habitat fragmentation and mortality. Traffic volumes exceeding 4,000 vehicles per day may result in serious habitat fragmentation and mortality impacts. Projected traffic volumes of 350 vehicles per day by the year 2030 in the study corridor, fall well below the anticipated level at which traffic volumes become an impediment to wildlife movement. Therefore, mitigation measures such as placement of wildlife underpasses may not be warranted at this time nor in the foreseeable future; however, any highway improvements that would significantly widen the existing roadway could add to habitat fragmentation in the project area by: further reducing the amount of physical cover adjacent to the highway, incrementally increasing separation

between cross-highway habitats, and increasing traffic speeds, increasing the chance for wildlife/vehicle collisions.

Results of the previously described LZP model as applied to the Libby North Corridor Study area will likely serve as a helpful planning tool for MDT as intended, as well as for other stakeholders in the corridor including Plum Creek and the Forest Service. Cooperative land use and highway planning in the corridor would lend itself well to maintaining and perhaps enhancing wildlife habitat linkage zones in the corridor.

Application of this model within other highway corridors under consideration for improvements by MDT in western Montana is highly recommended. Application of the model in non-forested areas of eastern Montana would require significant modifications, as the primary species of concern would change, as would various habitat variables to be included in the model.

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APPENDIX A

FIGURE 2: ROAD IMPACTS
FIGURE 3: HUMAN IMPACTS
FIGURE 4: COVER IMPACTS
FIGURE 5: RIPARIAN IMPACTS
FIGURE 6: IMPACT MAP
FIGURE 7: WILDLIFE LINKAGE ZONES

Libby North Corridor Study – Wildlife Linkage Analysis
Libby, Montana