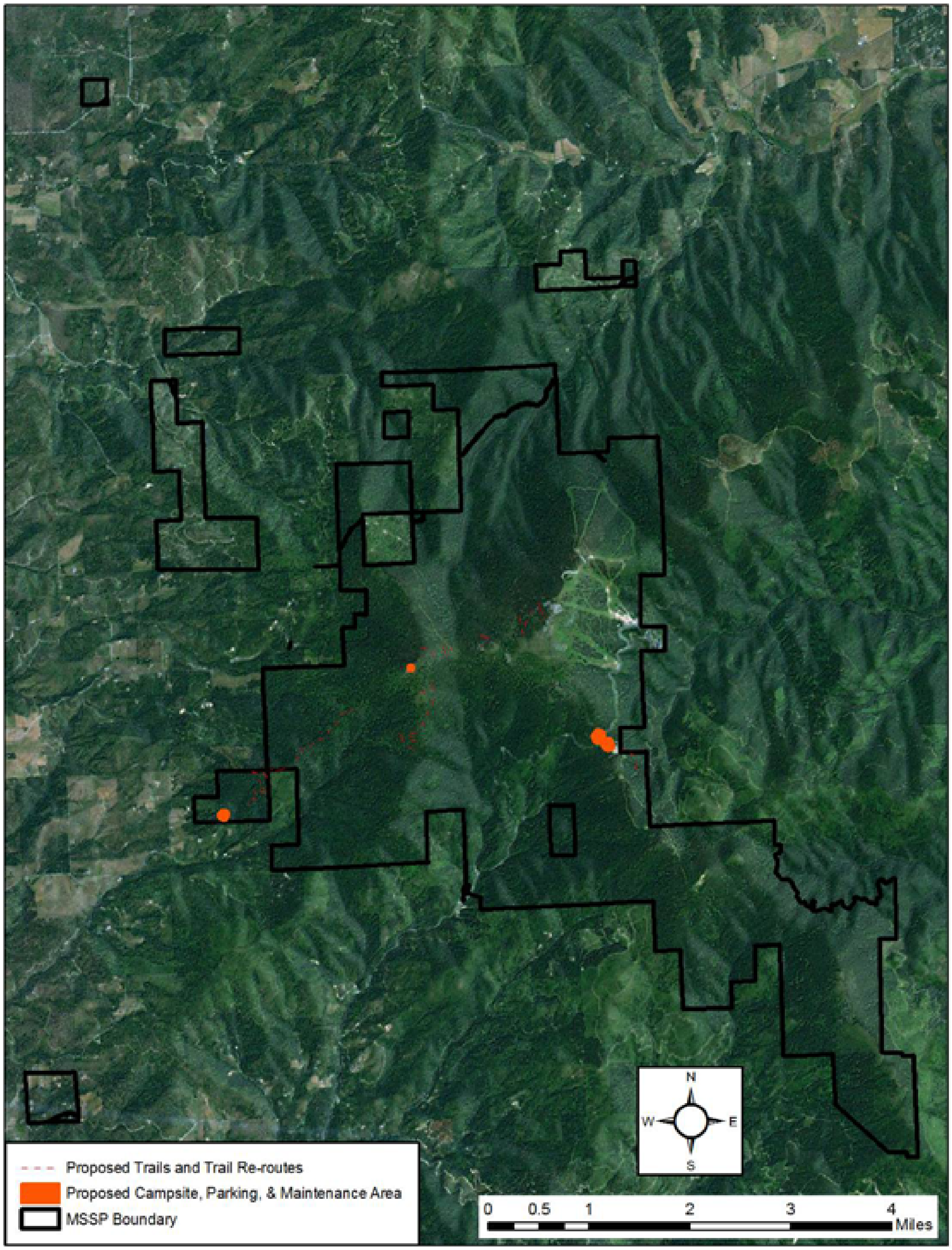
Landscape-Level Analysis of Cumulative Effects
Mt. Spokane State Park Master Facility Plan



Pacific Biodiversity Institute

Landscape-Level Analysis of Cumulative Effects
Mt. Spokane State Park Master Facility Plan

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Recommended Citation

Morrison P.H. and K.R.Romain-Bondi. 2009. Landscape-Level Analysis of Cumulative Effects Mt. Spokane State Park Master Facility Plan. Pacific Biodiversity Institute, Winthrop, Washington. 44 pp.

Project Funding

This project was funded by the Washington State Parks and Recreation Commission through contract AE 709-191.

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Introduction

The cumulative effects of a series of proposed actions over time and / or the cumulative effects of many seemingly unrelated actions that occur in close proximity in a landscape can have dramatic adverse long-term impacts on the environment. This is now widely acknowledged. “Evidence is increasing that the most devastating environmental effects may result not from the direct effects of a particular action, but from the combination of individually minor effects of multiple actions over time.” (CEQ 1997).

The cumulative effects of human activities do not start with the proposed action, but have accumulated over time. The proposed action only adds to the cumulative effects. “Some authorities contend that most environmental effects can be seen as cumulative because almost all systems have already been modified, even degraded, by humans. According to the report of the National Performance Review (1994), the heavily modified condition of the San Francisco Bay estuary is a result of activities regulated by a wide variety of government agencies. The report notes that one mile of the delta of the San Francisco Bay may be affected by the decisions of more than 400 agencies (federal, state, and local). William Odum (1982) succinctly described environmental degradation from cumulative effects as ‘the tyranny of small decisions.’” (CEQ 1997).

Mt. Spokane State Park has a long history of human use, and consequently, there has already been a cumulative effect from this use. The ecology of the park landscape and the status of its wildlife populations reflect the cumulative effect of the past human activities and the on-going uses. The proposed actions considered in this EIS, however minor, will add to the cumulative effect of human use in the park and increase the “human footprint” and its adverse effect on native plants, animals and ecosystems, particularly in light of future proposed development in the park and the surrounding landscape.

In this document, we take a brief look at MSSP and the proposed developments in the context of the surrounding landscape and the human activities and development that have occurred. We subdivide our analysis results into two sections. The first section describes the overall landscape-level cumulative effects analysis from the perspective of landscape ecology and the effect of cumulative human impacts on regional, mid-scale and local levels. This analysis sets the stage for a second section containing an analysis and discussion of cumulative effects on wildlife species, which often bear the brunt of adverse cumulative effects from increasing human activity and development.

Methods

To incorporate cumulative effects analysis into this EIS document, we followed several steps (adapted from methods suggested in “Considering Cumulative Effects Under the National Environmental Policy Act” (CEQ 1997). We undertook the initial scoping process to identify the cumulative effects situations (or management actions) that currently exist in and around MSSP that influence resources, ecosystems, and the human community. Each land manager was also identified and associated to the specific cumulative effect situation. To describe the affected environment, the existing effects were characterized by the resource, ecosystem, and human communities, and their response to change. As well the existing effects were characterized by the stress they induced on resources, ecosystems, or on the human communities. We identified focal wildlife species affected by these stressors. This iterative process was conducted by PBI staff, and reviewed and edited by WDFW Wildlife Biologist, Howard Ferguson. Ideally, this process should be iterative and go beyond our initial scoping to include “creative interactions with all stakeholders” (CEQ 1997). Our cumulative effects analysis was abbreviated due to the low-level of impact predicted for the proposed action and severe limits in our analysis timeframe and budget.

We identified the cumulative effect situations and resulting stresses to wildlife, focusing on all 21 focal wildlife species for MSSP. This process was repeated for the projected effects from the Proposed Actions, and again for some of the potential (future) effects situations (Table 1).

Table 1. Steps in the cumulative effects analysis addressed for MSSP Proposed Action EIS document.

Cumulative Effect Components	Steps
Scoping	1. Identified the cumulative effects situations associated with the current effects of human activities and management in and around MSSP on ecosystems and wildlife. 2. Identified the cumulative effects situations associated with the projected proposed action effects of management in and around MSSP on ecosystems and wildlife. 3. Established a geographic scope for the analysis 4. Established level of analysis to undertake given limited time and resources. 5. Identified other potential actions or potential future situations at MSSP that would affect resources, ecosystems, and human community concerns.
Describe the Affected Environment	6. Characterized the resource, ecosystem, and human communities identified in scoping, and their response to change. 7. Characterized the stressors affecting these resources, ecosystems, and human communities. 8. Identified the ecosystems and focal wildlife species most affected by the stresses associated with the resource, ecosystem, and human communities. 9. Identified the tools that would be most useful for analysis of the cumulative effects on ecosystems and focal wildlife species.
Determining Environmental Consequences	10. Identified the important cause and effect relationships between human activities and the resources, ecosystems, and human communities. 11. Determined the magnitude and significance of cumulative effects from the Proposed Action. 12. Used GIS as a tool to analyze the stresses affecting the resources, ecosystems, and human communities associated with the projected effects from the Proposed Action.

We established a geographic scope for the analysis of the Proposed Actions, based on regional, mid-scale, and local landscape analyses. The regional landscape cumulative effects analysis addressed the larger context of wildlife movements across a broad landscape, from the Columbia Highlands and Selkirk Mountains in northeastern Washington State to the Rocky

Mountains of the United States and Canada. The mid-scale analysis addressed the impacts of human population and road densities in the portions of northeastern Washington and adjacent northern Idaho near to MSSP, again focusing on wildlife movements and habitat availability. An immediate landscape cumulative effects analysis addressed local perturbations on wildlife from recreation and human influences, and how these will affect wildlife and their habitat into the future. This level of analysis in particular takes into account past human activities and the on-going uses at MSSP, as well as the possible future developments and stressors in the park and the surrounding landscape.

We then conducted our cumulative effects analysis using a wide-range of peer-reviewed literature and available GIS tools on the projected cumulative effect situations from the Proposed Action (Table 2). We focused our cumulative effects analysis on federal and state listed species, as well as focal wildlife species that may be more sensitive to recreation and human impacts.

Table 2. Proposed Actions addressed in EIS document, and a description of the name or location.

Proposed Action	Description
Rerouted non-motorized trail developments	Trails 140 Summit Upper, 140 Summit Lower, 160 KC-A, 130/170, and 140 KC-B.
New non-motorized trail development	Trail 180
New snowmobile trail development	Trail 260
New campground development	Mt. Kit Carson summit primitive campsite
Parking area developments	Lidner Ridge parking expansion, Trail 180 trailhead parking
Infrastructure development	KXLY maintenance facility near Selkirk Lodge

Cumulative effects from a landscape ecology perspective

Mt. Spokane State Park in the Context of the Regional Landscape

Mt. Spokane State Park is one of the largest protected areas in northeastern Washington State. The park and its surrounding landscape form an important southern-most lobe of the relatively untrammeled Selkirk Mountain landscape (Figure 1). MSSP and its immediate surroundings have a relatively low "human footprint" (Figure 2, WCS and CIESIN 2005). The park is also connected to large blocks of low human footprint landscapes to the north, extending into wildlands in Canada and the Northern Rockies in the USA (Figure 2). This connectivity is important to many wildlife species; however, it is particularly important to imperiled, large carnivore species which we discuss later in this report.

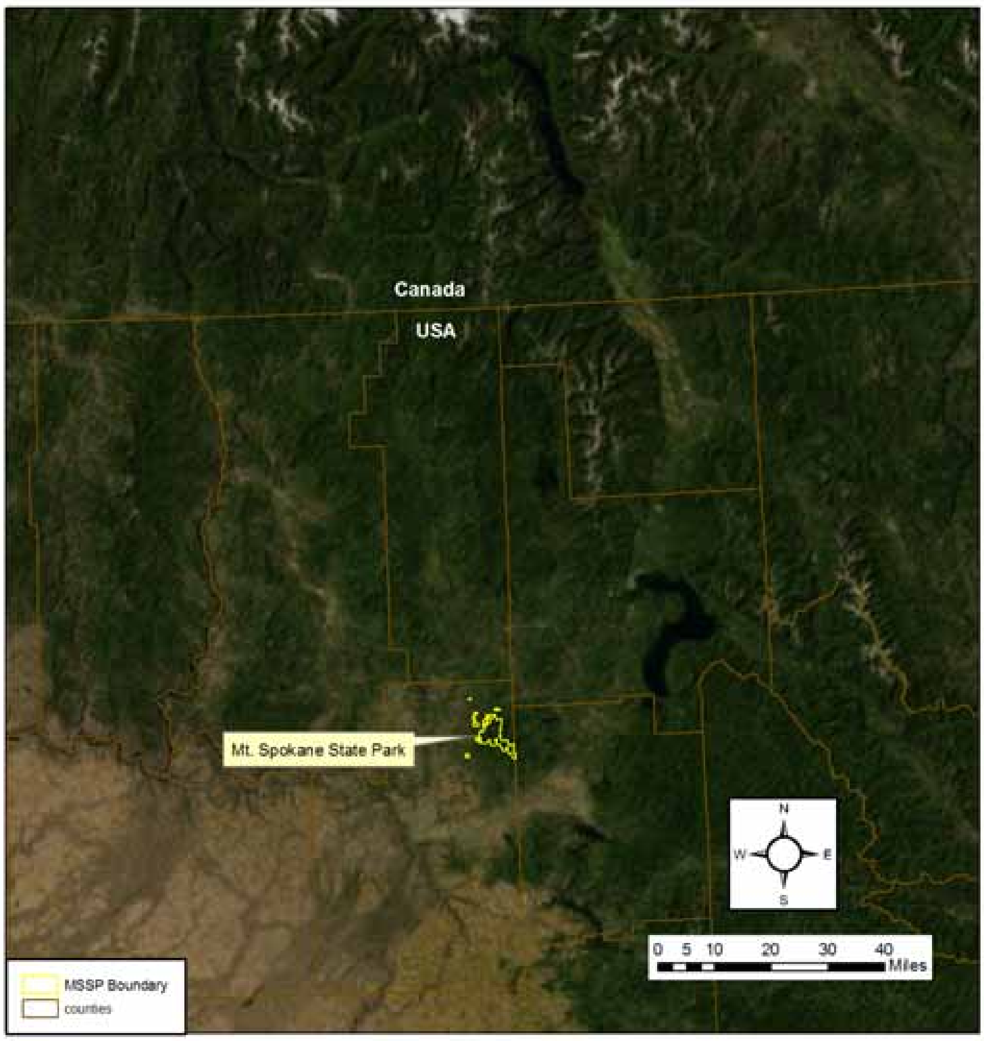

Figure 1. MSSP in the context of the regional landscape – a view from space. Data from ESRI global world imagery.

It is important to note that the human footprint depicted in Figure 2 was calculated on a global scale, from a number of data layers produced at a global that represent the location of various factors presumed to exert an influence on ecosystems: human population distribution, urban areas, roads, navigable rivers, and various agricultural land uses. The combined influence of these factors yields the Human Influence Index (HII), which is then normalized to the North American Biome to calculate the Human Footprint (HF) (WCS and CIESIN 2005). This data and the corresponding map are very general depictions of the current state of cumulative effects of human activities in the landscape that includes MSSP. In this document, we will also explore much finer scale data to examine the "human footprint" and the cumulative effects that have influence MSSP and its more immediate landscape.

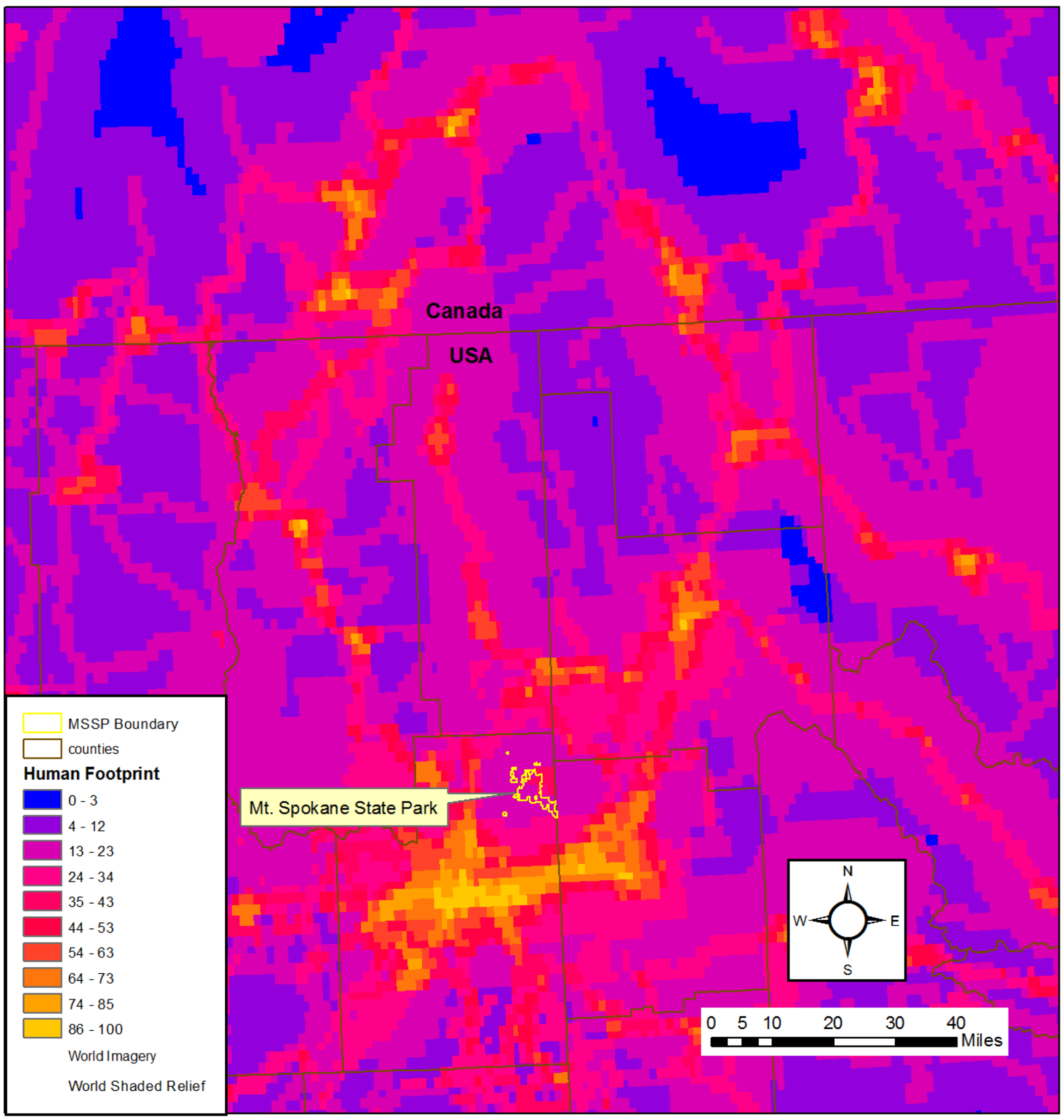

Figure 2. Mt. Spokane State Park in the context of the continental-scale Human Footprint (data from the Human Footprint Project, the Wildlife Conservation Society and the Center for International Earth Science Information Network (CIESIN) at Columbia University).

Mount Spokane is also situated on the edge of several ecoregions: to the southwest is the Columbia Plateau, to the north and northwest is the Okanogan Highlands, and to the northeast and east is the Selkirk Mountain Ecoregion. Therefore, Mount Spokane's is highly influenced by the habitat values and wildlife diversity common to all of these ecoregions.

Mt. Spokane State Park in the context of the mid-scale landscape

"Cumulative effects result from spatial (geographic) and temporal (time) crowding of environmental perturbations" (CEQ 1997). The human footprint depicted in Figure 2 illustrates the current level of crowding of environmental perturbations at a larger regional scale surrounding MSSP. At this scale the additional cumulative effects of the Proposed Action are seemingly unnoticeable and insignificant compared to existing human perturbations and on-going human activities. We now examine MSSP at a mid-scale landscape with finer-scale data on human-induced environmental perturbations. First, we use human population data from the Year 2000 US Census analyzed at a block level as an indicator for the cumulative impact of human activity. MSSP is located in an area of low human population density (Figure 3). A considerable buffer of low human population density also surrounds the park, particularly to the north. There are potential corridor areas of reasonably low human population density (less than 40 people / square mile) that could serve as connecting corridors to areas of very low human population density to the north, west and east for wildlife species that are sensitive to human presence and activity.

A second indicator of the cumulative impact of human activity is the existing road network (Figure 4) and road density (Figure 5) derived from this road network. For the most part, MSSP exists in an area of low road density (Figure 5). The road network and road density illustrated is based on all roads - both open and limited access due to closures (e.g. gates). Many of these roads may not be open for 2-wheel drive vehicles in the winter, but may have snowmobile use. Some of these roads require 4-wheel drive vehicles for easy access. Many of the roads illustrated in these figures may have very low vehicle use, however some roads have relatively high vehicle use.

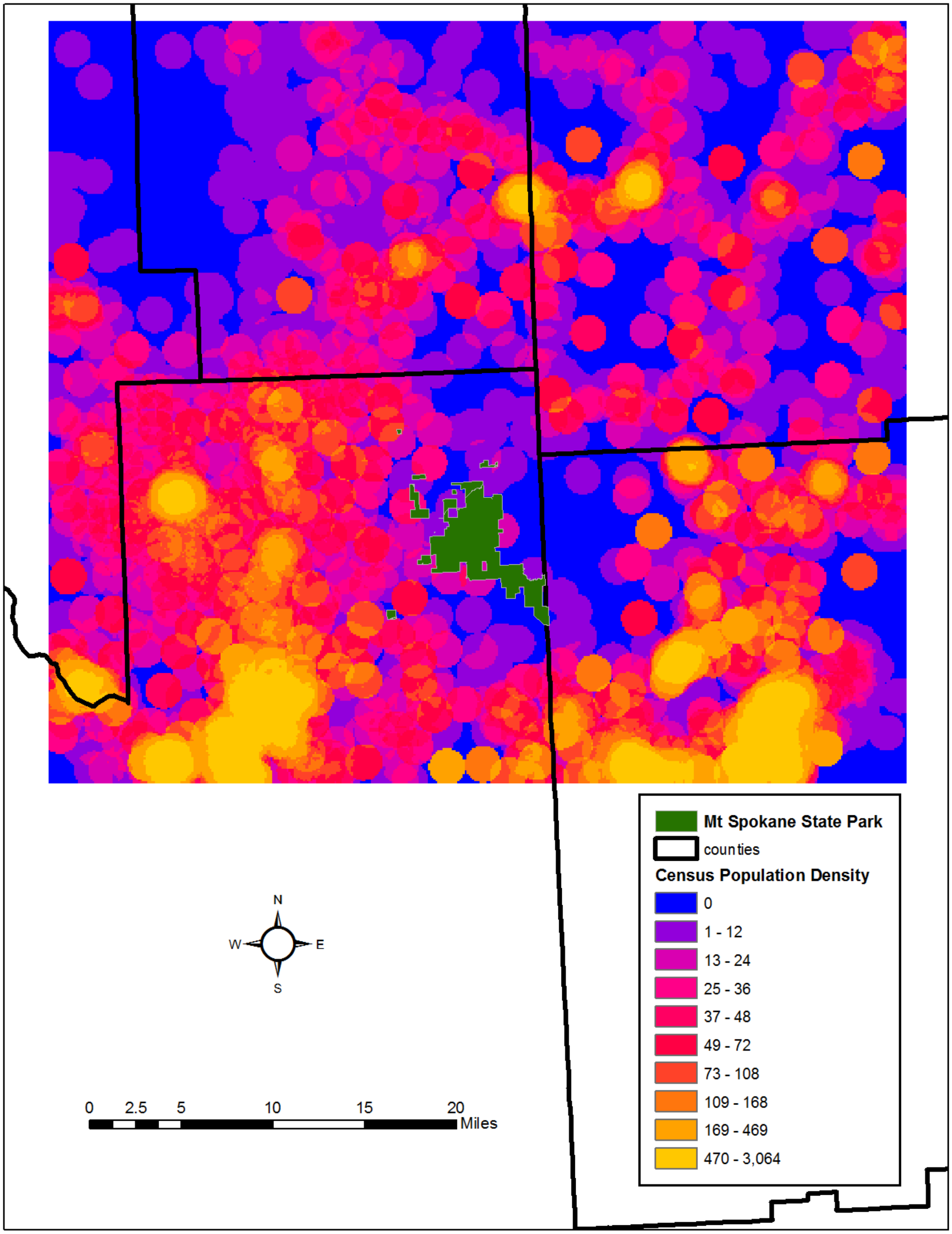

Figure 3. Human population density (people/square mile) in the five county landscape surrounding MSSP (data is derived from US Census 2000). The circles are artifacts of the original data (centers of census blocks) and the GIS processing methods.

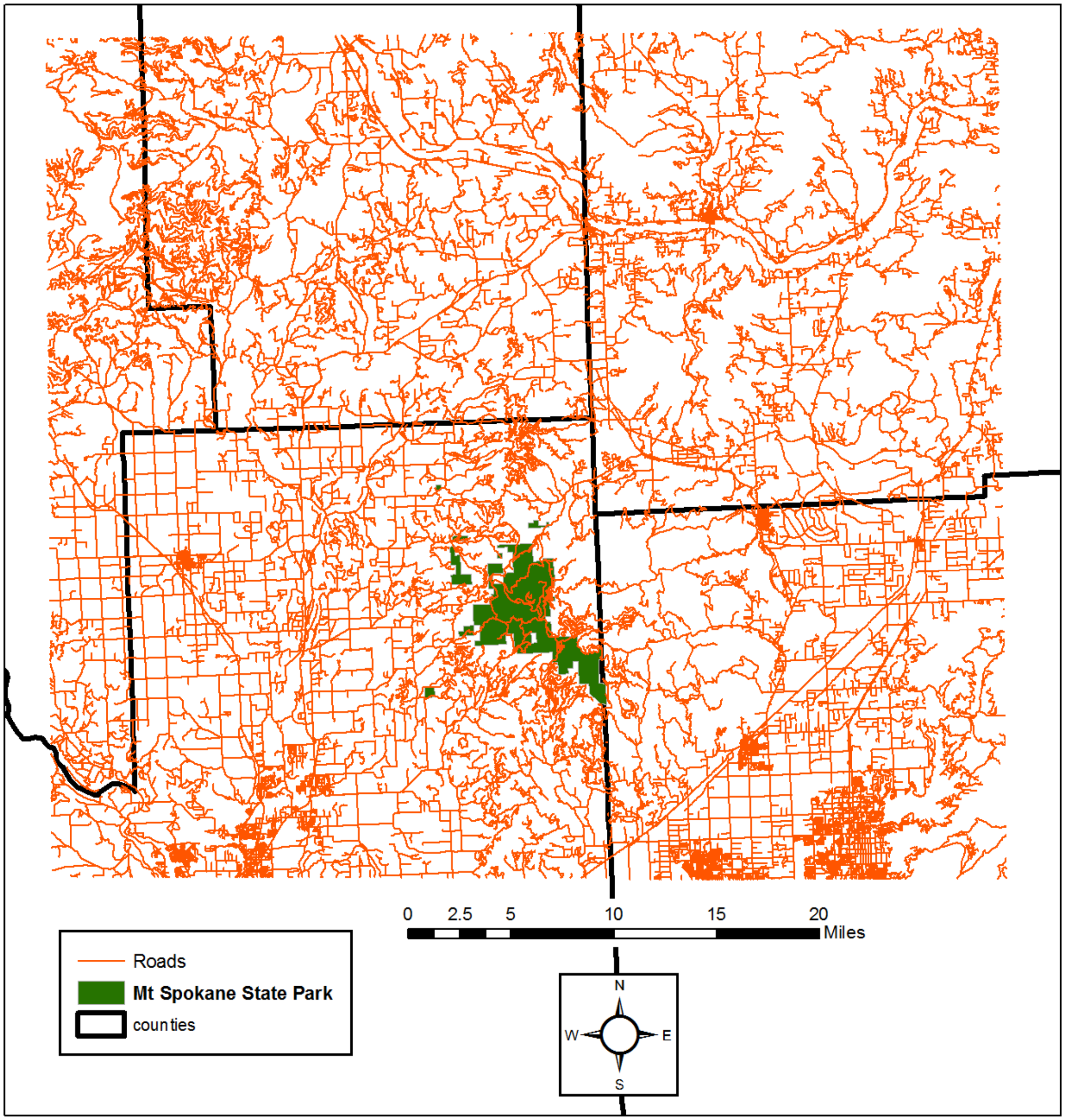

Figure 4. Roads in the larger landscape surrounding MSSP (data derived from WA DNR and US Census 2000).

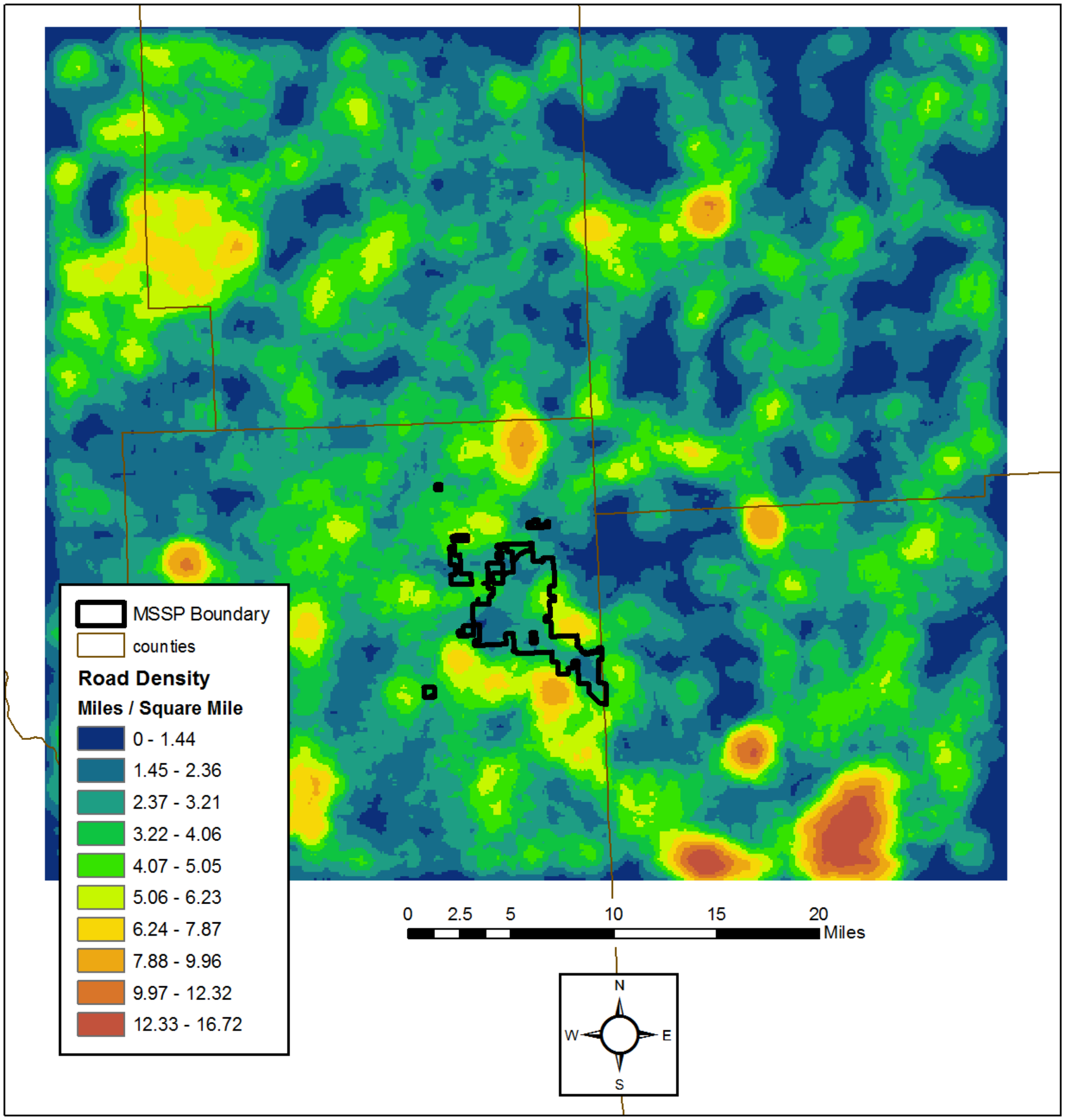

Figure 5. Road density (miles/square mile) in the larger landscape surrounding MSSP. This map illustrates that MSSP is surrounded by areas of high road density, except for a few corridors to the north and west of lower road density (data derived from WA DNR and US Census 2000). Part of the park also has a high road density, which is largely the result of high road density on private timberlands to the east of the park.

Mt. Spokane State Park in the context of the local landscape

Mt. Spokane State Park occupies part of the northeastern corner of Spokane County. The county is developing rapidly and what was once large tracts of private timber land north of the City of Spokane are being converted to residential development. This ongoing subdivision of parcels and conversion of land from forest uses to residential development contributes to the adverse cumulative effect of human activities on wildlife species in the Mt. Spokane vicinity. We briefly analyzed the parcel data from the Spokane County Assessor's office to assess how far the cumulative effect of subdivision and build-out has proceeded in the vicinity of Mt. Spokane (Figures 6-9).

Figure 6 depicts the value of improvements on parcels in Spokane County in the vicinity of MSSP. All parcels that have improvement values in excess of $30,000 likely have some kind of house, mobile home, or other kind of potential human residence. Parcels with improvement values in excess of $50,000 very likely contain residences of some kind. This map is an indicator of the level of human development and activity surrounding MSSP. It is apparent that there has been considerable build-out to the south and west of MSSP. However, there is a still substantial amount of forest land that has not been subdivided and converted to residential use in the immediate vicinity of the park.

Figure 7 depicts the value of new construction occurring in the last year or so in the vicinity of MSSP. All parcels that have new construction values in excess of $50,000 are also likely have some kind of house, mobile home, or other kind of potential human residence. This map is an indicator of the rate of development and increasing human activity surrounding MSSP. It is apparent that there is considerable ongoing residential development in the landscape surrounding MSSP.

Figure 8 is an overlay of probable, approximate home locations derived from the current Spokane County Assessor's parcel data (derived from parcel improvement values plus new construction values > $50,000) on top of the human population density derived from the US Census 2000 block level population data (from Figure 4). This further illustrates the increasing human pressures on MSSP and the current level of human impact on the landscape surrounding the park. This is an important indicator of the potential adverse cumulative effect of human activity on wildlife species that are sensitive to human presence and activities.

Figure 9 depicts the parcel size of each parcel in the landscape around MSSP. This further confirms that large parcels are now rare in the Spokane County landscape, the landscape has been dramatically affected by subdivision, but large parcels still exist in the vicinity of MSSP. However, if the rate of subdivision proceeds as it has in the last 50 years, the cumulative effects of human activities in the MSSP landscape will increase to the level that severe adverse effects will be experienced by wildlife species that are sensitive to human presence and activities.

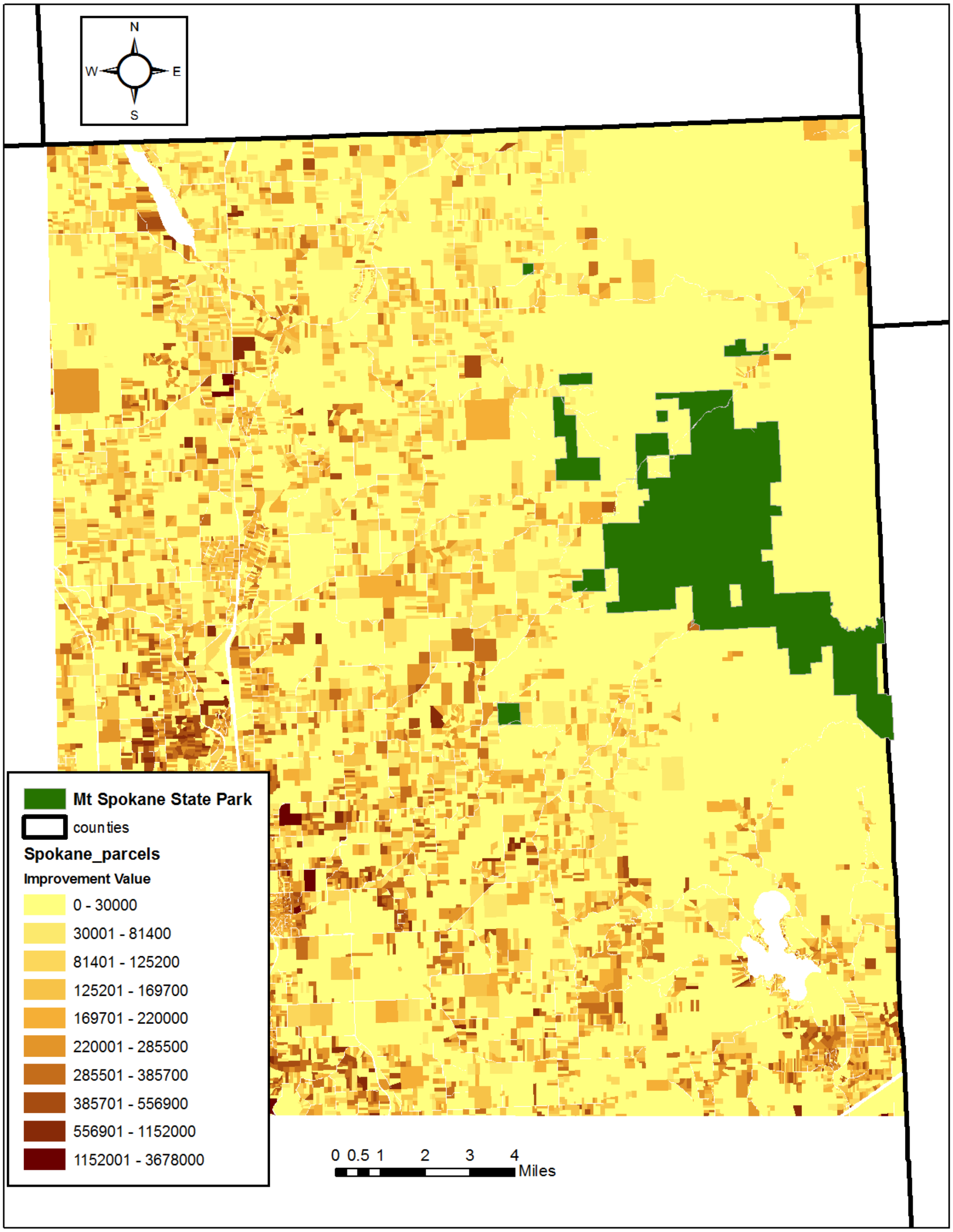

Figure 6. Value of improvements (mostly homes) in Spokane County surrounding MSSP (data derived from Spokane Co. Assessor. This map illustrates that considerable build-out has occurred on private parcels near MSSP, particularly to the west and south.

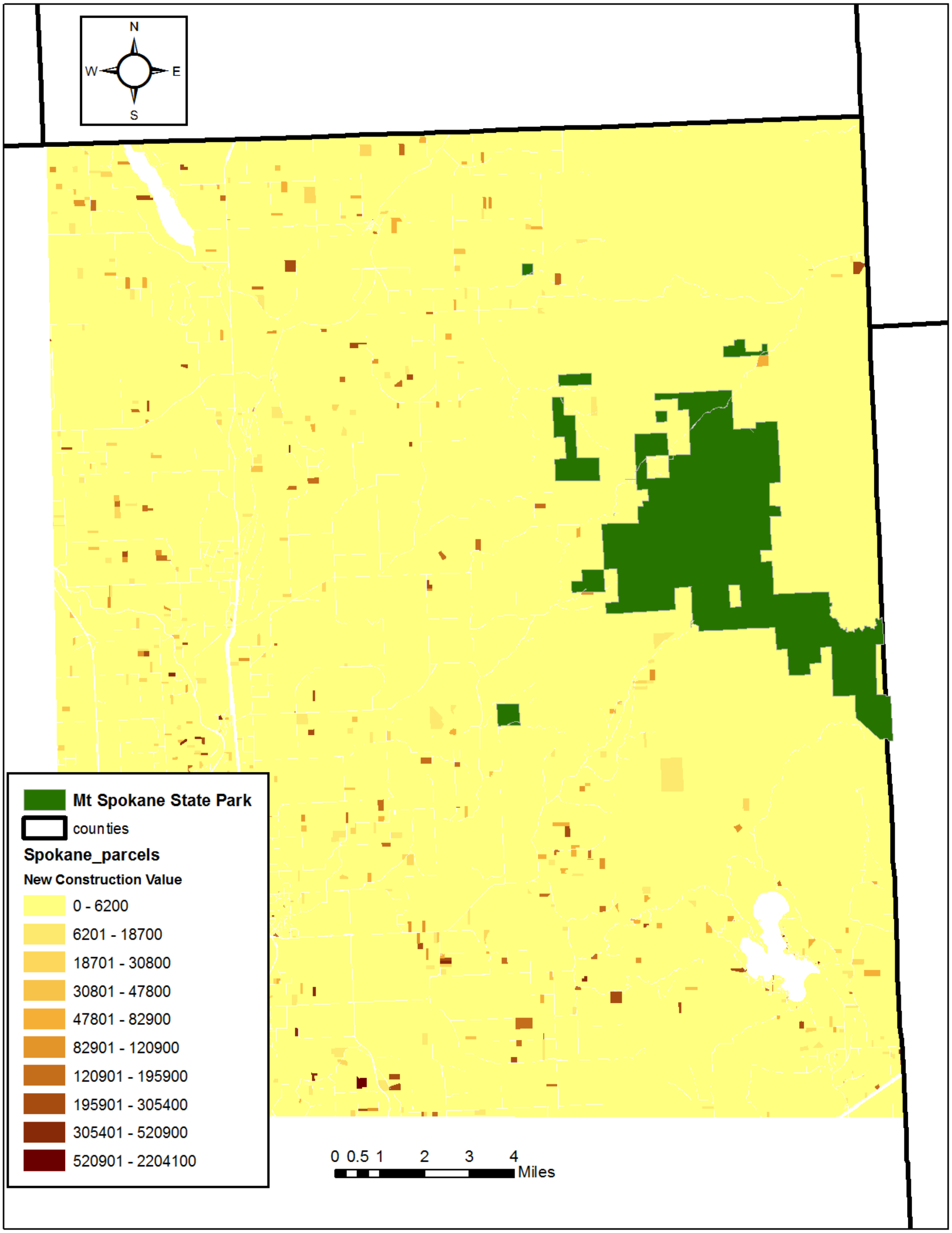

Figure 7. Value of new construction in Spokane County surrounding MSSP (data is derived from Spokane Co. Assessor). This map illustrates that new home construction continues at a fairly rapid pace in the area surrounding MSSP.

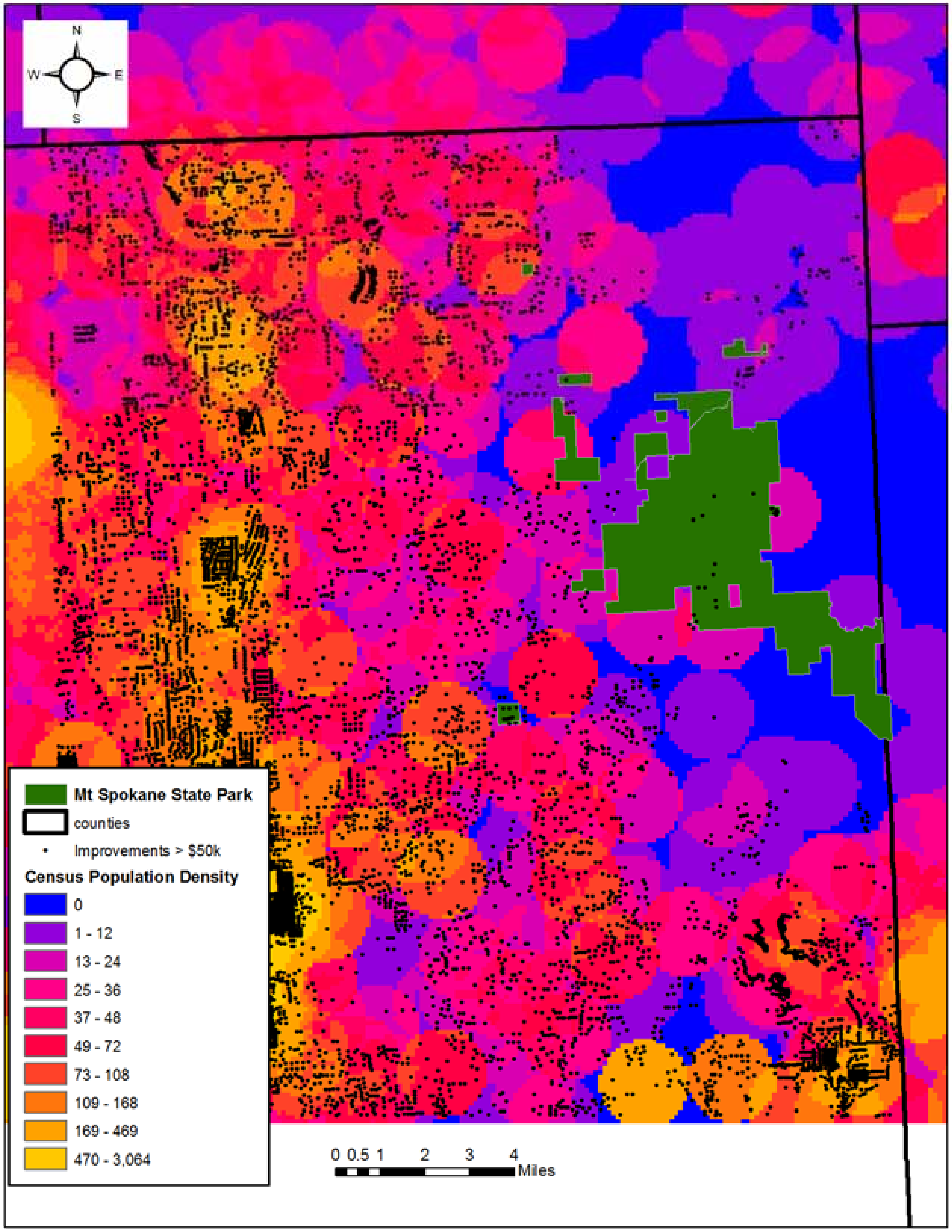

Figure 8. Human population density (people / square mile) and buildings (value > $50,000) in Spokane County surrounding MSSP (data is derived from US Census 2000 and Spokane Co. Assessor).

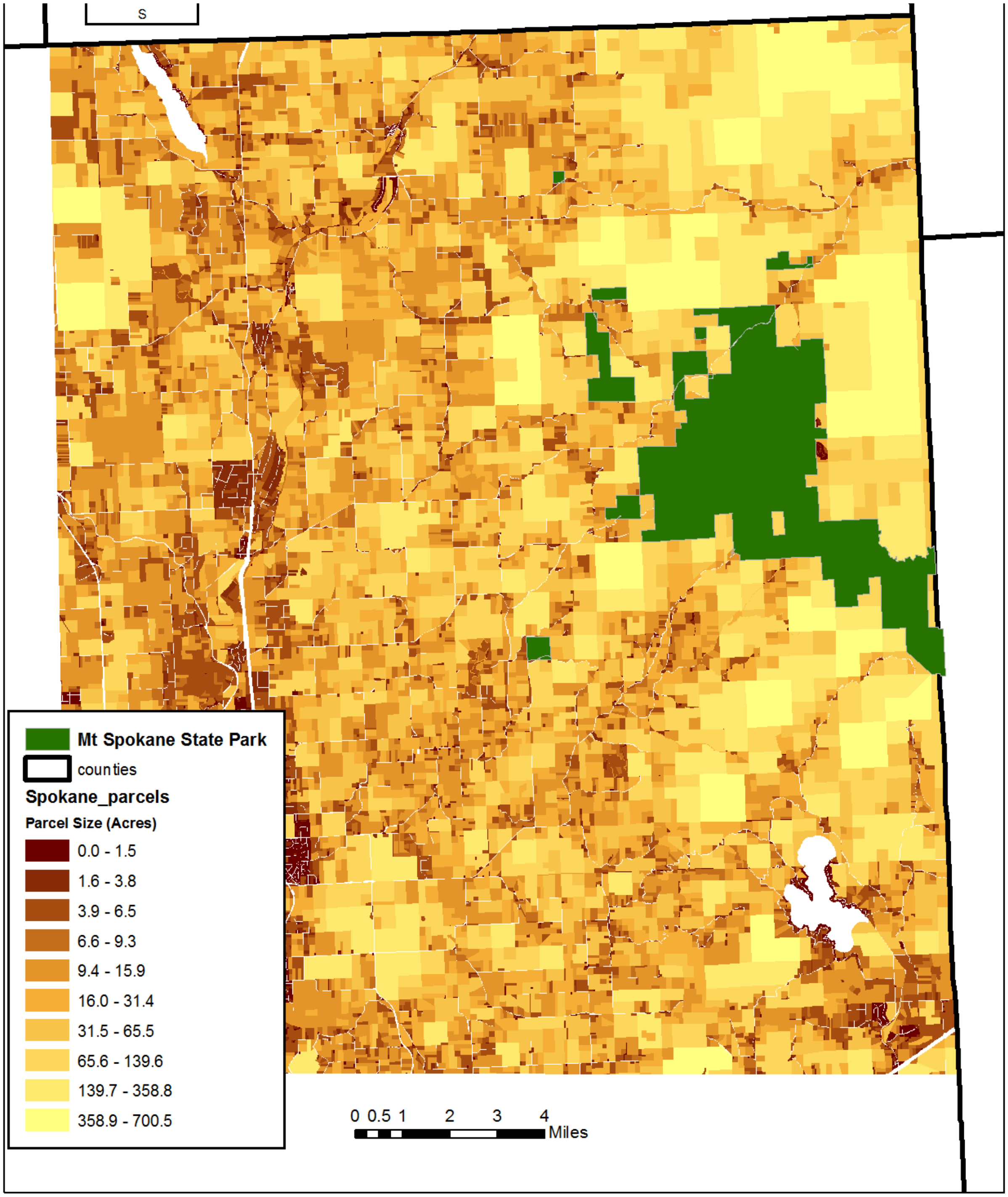

Figure 9. Parcel size of parcels in Spokane County surrounding MSSP (data is derived from Spokane County Assessor). This map represents the potential buildout for future development surrounding MSSP. Many of the large parcels are being subdivided and converted to residential development.

Cumulative impacts at Mt. Spokane State Park in the context of the immediately adjacent landscape

At a much finer scale, we looked at the existing human development footprint at MSSP (Figure 10) and the cumulative additions to this human footprint that would result from the Proposed Actions (Figures 11 and 12). Examination of the maps in these figures reveals that the Proposed actions will result in a barely noticeable increase in the overall human footprint at MSSP (compare Figure 10 to Figure 11). In fact, we created Figure 12, where we have highlighted the Proposed Actions in yellow, to aid the reader of this document in seeing where the proposed actions are located in relationship with the existing human development footprint.

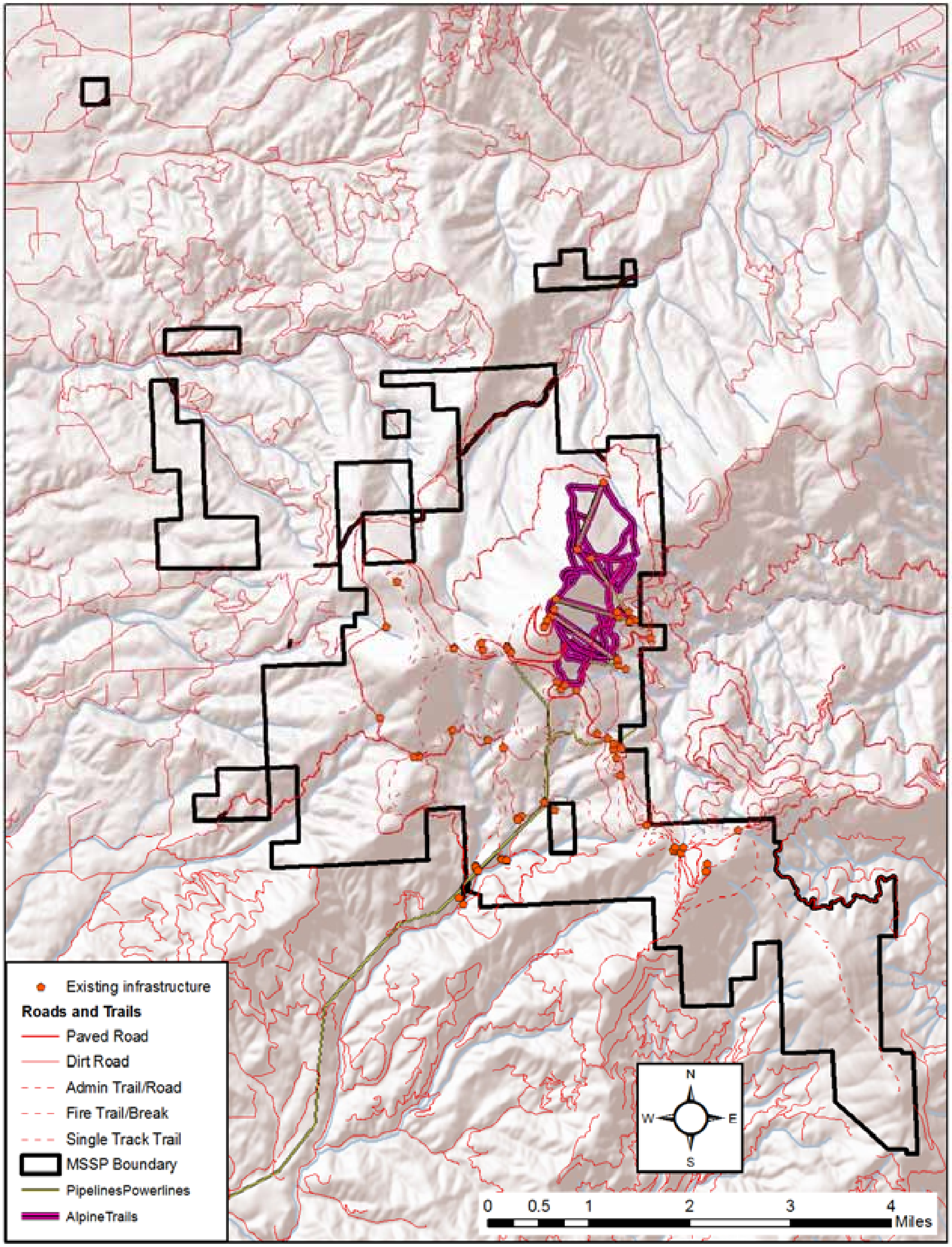

Figure 10. Existing human developments at MSSP and immediate surroundings. This illustrates the current cumulative effect of continued development at the park. Data is derived from WA Parks, WA DNR, US Census 2000, and PBI.

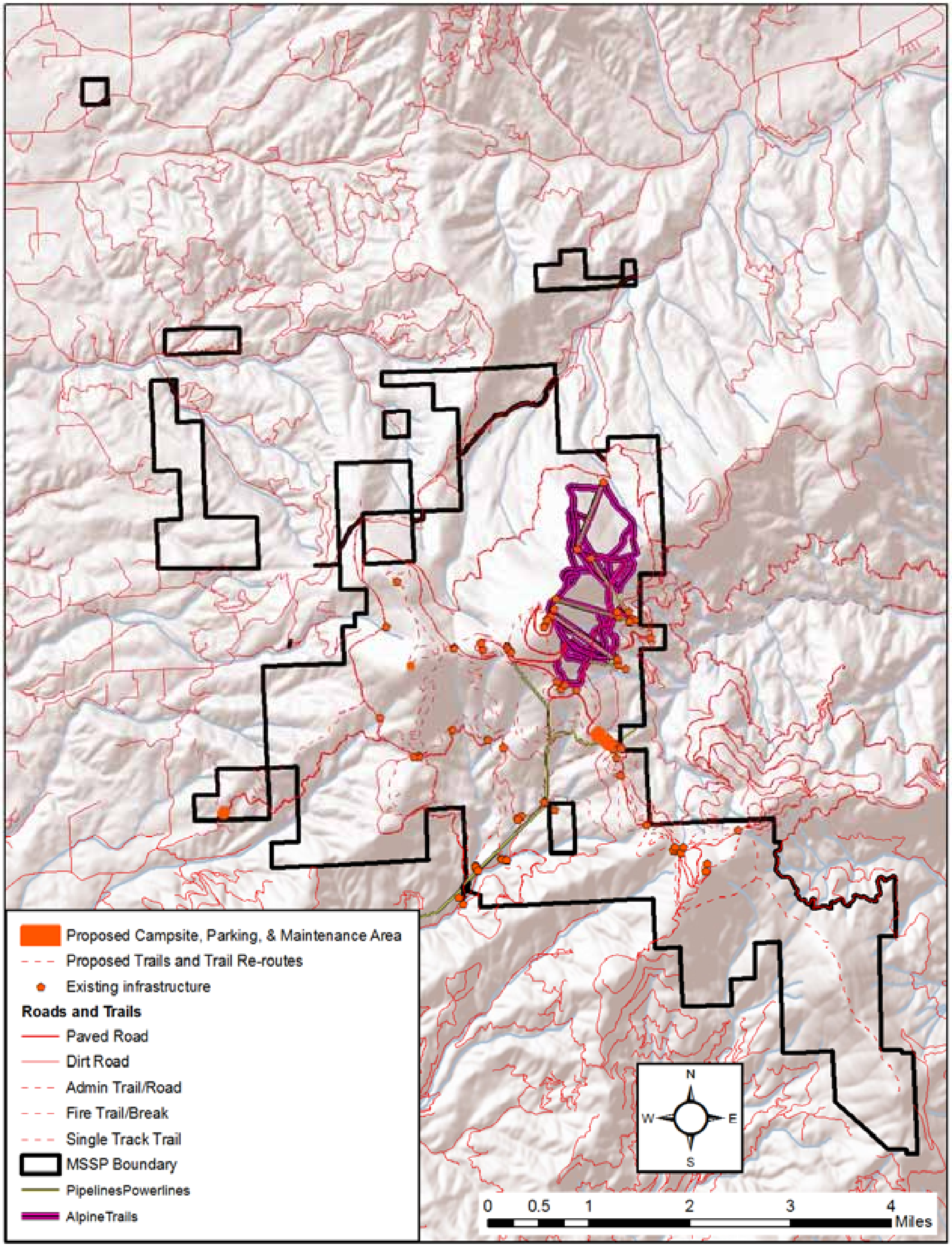

Figure 11. Proposed Action in addition to existing human developments at MSSP and immediate surroundings. This illustrates the proposed cumulative effect of continued development at the park. Data is from the same sources as Figure 9.

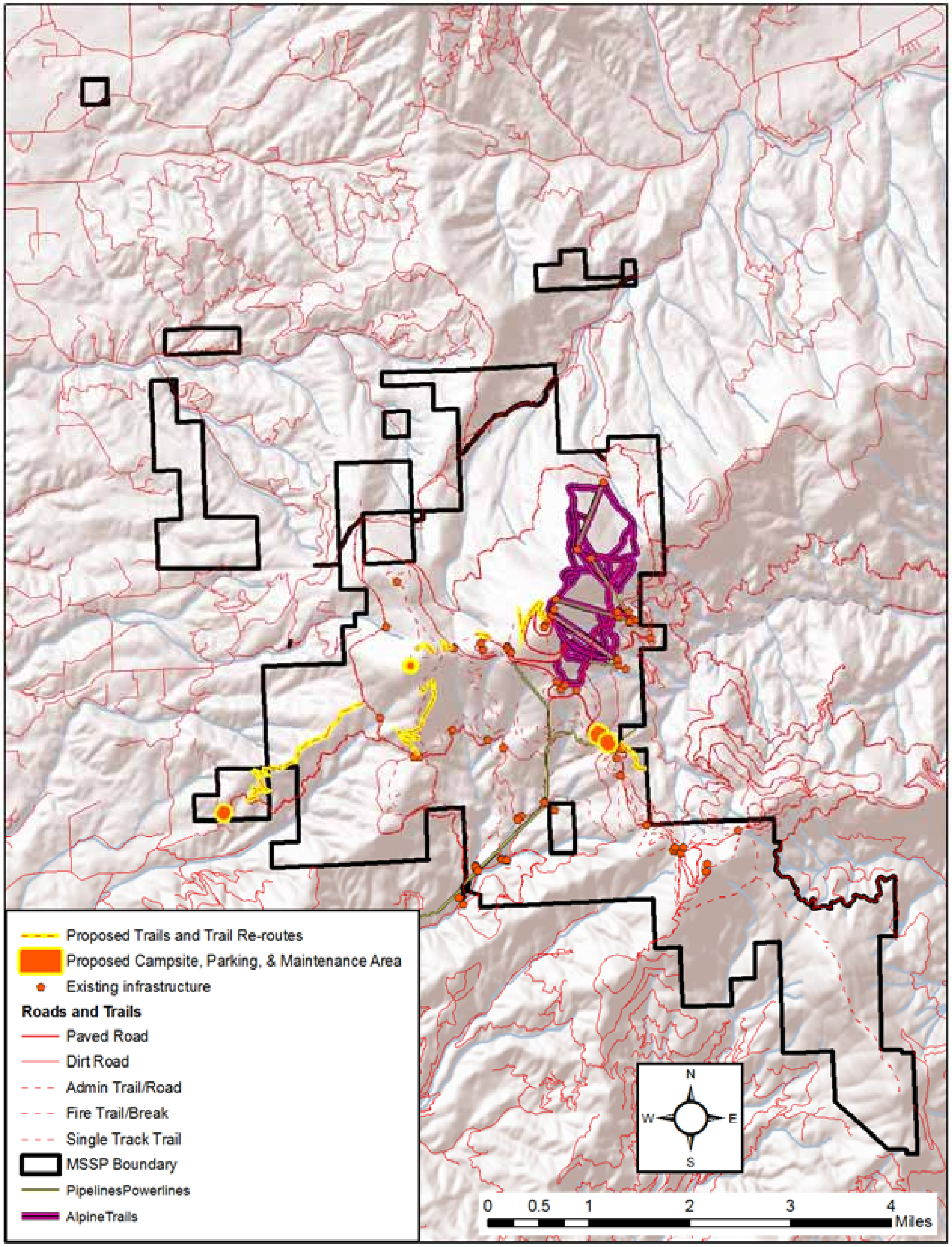

Figure 12. Proposed Action (highlighted in yellow for visibility) in addition to existing human developments at MSSP and immediate surroundings. This illustrates the proposed cumulative effect of continued development at the park. Data is from the same sources as Figure 9.

Cumulative Effects Analysis on Wildlife

The Affected Environment

Several key stresses and cumulative effect situations were identified during the scoping process, from a regional to local landscape level. The key stressors to wildlife from the Proposed Action include: loss of habitat, loss of connectivity, displacement and avoidance behavior, mortality and injury due to vehicle collisions resulting from road traffic, and increased poaching incidents. For an overview of trail and recreation impacts on wildlife species, see Snetsinger and White (2009). These stresses already exist at MSSP from past and on-going human uses, may increase slightly due to the Proposed Actions, and will have increased cumulative effects with future developments in and surrounding MSSP.

The identified stressors and cumulative effect situations from the Proposed Actions, as well as the existing and potential future cumulative effect situations are described in Table 1-3. These situations may not be all-encompassing. A full scoping analysis should be undertaken by stakeholders in the Mount Spokane vicinity to identify additional stresses and cumulative effect situations that may exist on the landscape.

Table 3. Existing cumulative effect situations faced by multiple agencies and private landowners that affect wildlife in and around MSSP.

Landowner	Stressors to Wildlife	Cumulative Effect Situations	Focal Species Most Affected by Actions
Washington State Parks and Recreation Commission	Loss of habitat	Recreation development of trails, roads and infrastructure	• Gray wolf • Lynx • Wolverine • Marten • Pika
Washington State Parks and Recreation Commission	Loss of connectivity and corridors (ie. natural features such as continuous shrub / riparian cover, large blocks of forested habitat, topographic features such as ridgelines, ect)	Recreation development of trails, roads and infrastructure	• Gray wolf • Lynx • Wolverine • Goshawk • Western toad
Washington State Parks and Recreation Commission	Displacement and avoidance behavior	Recreation development of trails, roads and infrastructure	• Gray wolf • Lynx • Wolverine • Marten • Pika
Washington State Parks and Recreation Commission	Population declines for secondary cavity nesting species from loss of snags and wildlife trees	Recreation development of trails, roads and infrastructure	• brown creeper • silver-haired bat
Washington State Parks and Recreation	Population declines for interior forest	Recreation development of trails, roads and	• Brown creeper • Winter wren

Commission	nesting bird species from predation and nest parasitism	infrastructure in climax community forests	
Washington State Parks and Recreation Commission; Mount Spokane 2000	Loss and degradation of habitat	Ski area operations and maintenance	• Gray wolf • Lynx • Wolverine • Marten • Pileated woodpeckers • Winter wren • Pika • Hoary bat • Silver-haired bat • Western toad • CT butterfly
Spokane County	Loss of habitat	Cumulative commercial and residential development and road construction associated with suburban sprawl into the northeastern Spokane county	• All focal species except pika and CT butterfly
Private IEP timber company; Washington State Department of Natural Resources	Degradation and loss of primary / secondary forests	Timber harvest regime and logging operations	• Marten • Moose, deer • Goshawk • Boreal owl • Pileated woodpecker • Brown creeper • Winter wren • Pygmy shrew • Hoary bat • Silver-haired bat • Western toad
All entities and landowners	Direct mortality and injury	Collisions with motorized vehicles	• All focal species
All entities and landowners	Loss of habitat and forage resources	Global warming	• Lynx • Wolverine • Boreal owl • Pika • Pygmy shrew • Western toad • CT butterfly • potentially many other species

Table 4. Projected cumulative effect situations from the Proposed Action faced by multiple agencies and private landowners that affect wildlife in and around MSSP.

Landowner	Stressors to Wildlife	Cumulative Effect Situations [a]	Focal Species Most Affected by Actions
Washington State Parks and Recreation Commission	Displacement and avoidance	New trail developments in areas where human recreation use was limited	• Gray wolf • Wolverine • Marten • Moose • Elk
Washington State Parks and Recreation Commission	Loss of connectivity and corridors	Trail development along important topographic features such as ridgelines, valley bottoms and hilltops	• Gray wolf • Lynx • Wolverine • Elk
Washington State Parks and Recreation Commission	Loss or degradation of habitat	Trail development along important habitat features such as large blocks of forested habitat, streams/seeps and riparian draws	• Marten • Goshawk • Western toad
Washington State Parks and Recreation Commission	Increased poaching/ trapping incidents	Increasing access from adjacent private land. (trail development and parking development/ improvements)	• Gray wolf • Lynx • Wolverine • Marten • Elk • Moose • Deer
All entities and landowners	Direct mortality and injury	Increased vehicle collisions from increased traffic on roads in and around MSSP	• All focal species

[a] Projected effects reference the effects from the Proposed Actions for trail, infrastructure, parking, and campground developments; cumulative effects are in addition to existing effects.

Table 5. Potential future cumulative effect situations beyond the Proposed Action faced by multiple agencies and private landowners that affect wildlife in and around MSSP.

Landowner	Stressors to Wildlife	Cumulative Effect Situations [b]	Focal Species Most Affected by Actions
Washington State Parks and Recreation Commission	Loss of habitat	Recreation development of trails, roads and infrastructure	• Gray wolf • Lynx • Wolverine • Marten • Pika
Washington State Parks and Recreation Commission	Loss of connectivity and corridors (ie. natural features such as continuous shrub / riparian cover, large	Recreation development of trails, roads and infrastructure	• Gray wolf • Lynx • Wolverine • Elk • Goshawk

	blocks of forested habitat, topographic features such as ridgelines, ect)		• Pileated woodpeckers
Washington State Parks and Recreation Commission	Displacement and avoidance behavior	Recreation development of trails, roads and infrastructure	• Gray wolf • Lynx • Wolverine • Marten • Moose, elk, deer • Pika • Goshawk
Washington State Parks and Recreation Commission	Population declines for secondary cavity nesting species from loss of snags and wildlife trees	Recreation development of trails, roads and infrastructure	• brown creeper • silver-haired bat
Washington State Parks and Recreation Commission	Population declines for interior forest nesting bird species from predation and nest parasitism	Recreation development of trails, roads and infrastructure in climax community forests	• Brown creeper • Winter wren
Washington State Parks and Recreation Commission	Declining recreation and wildlife observation experience	Human overcrowding	• Pika • All focal bird species
Washington State Parks and Recreation Commission ; Mount Spokane 2000	Loss and degradation of habitat	Potential ski area expansion	• Gray wolf • Lynx • Wolverine • Marten • Boreal owl • Pileated woodpeckers • Winter wren • Pika • Pygmy shrew • Hoary bats • Silver-haired bats • Western toad • CT butterfly
Private IEP timber company	Loss of habitat, corridors, linkages, and open space	Future and potential development of adjacent timber company sold to residential development (new roads, infrastructure, house pets, fences)	• Gray wolf • Lynx • Wolverine • Marten • Moose, elk, deer • Pileated woodpecker • Dusky grouse
Private IEP timber company; Spokane County	Amplified wildlife hunting and poaching, and egg collection	Increased recreation access from adjacent private lands	• Gray wolf • Lynx • Marten • Moose, elk, deer • Goshawk

			• Dusky grouse
Spokane County and private landowners	Loss of habitat	Cumulative commercial and residential development and road construction associated with suburban sprawl into the northeastern Spokane county	• All focal species except pika and CT butterfly
Dept of Transportation; Washington State Parks and Recreation Commission	Disturbance, avoidance, and habitation	Increased vehicle traffic and noise	• Gray wolf • Moose, elk, deer • Wolverine
All entities and landowners	Direct mortality and injury	Increased vehicle collisions from increased traffic on roads in and around MSSP	• All focal species
Washington State Parks and Recreation Commission	Loss of habitat and danger to homes from increased human-caused catastrophic wildfires	Increased human recreation	• All focal species
All entities and landowners	Loss of habitat and forage resources	Global warming	• Lynx • Wolverine • Boreal owl • Pika • Pygmy shrew • Western toad • CT butterfly

[b] Potential effects reference impacts to wildlife from speculative situations; cumulative effects would be in addition to projected and existing effects.

The Environmental Consequences

The Proposed Actions at MSSP will add to the cumulative effect of human activity in the Park and increase the "human footprint" and its adverse effect on native plants, animals and ecosystems, particularly in light of future proposed development in the park and the surrounding landscape. However these projects will have minor consequences on focal wildlife species due to the limited scope of the projects taking place and their distribution on the landscape relative to existing trails, infrastructure, and roads.

The new non-motorized trail and associated parking development (Trail 180 and trailhead parking) will add to the cumulative effect of human use in the Park, increasing the "human footprint" and its adverse effect on native plants, animals, and ecosystems. These proposed actions pose a larger cumulative effect on wildlife and the landscape, particularly due to increased recreation development (trail), increased access (parking area), and increased human use in an area of MSSP that currently has minimal use at this time.

Below, we address the projected cumulative effect situations from the Proposed Action that affect wildlife from a regional to local or immediate vicinity scale (from Table 4).

Displacement and Avoidance

The behavioral displacement and avoidance effects of non-motorized trails and recreation on wildlife are similar to the effects of roads when disturbance takes place during a critical period such as breeding/ nesting, or on wintering areas (Gaines et al. 2003). Gaines et al. (2003) describes disturbance at a specific site commonly reporting disruption of animal nesting, breeding, or wintering areas, collisions between animals and vehicles affecting a diversity of wildlife species from large mammals to amphibians, and edge effects with the construction of road and trail networks, especially in late-successional forests.

Gray wolves and wolverines are sensitive to road-associated factors but are not particularly affected by summer recreation trails (Banci 1994, Boyd and Pletscher 1999, de Vos 1948, Mech et al.1988, Paquet and Callahan 1996, Thurber et al.1994) (Table 6). Winter recreational activities for example may displace wolverines from important natal dens in subalpine cirques (Copeland 1996, Hornocker and Hash 1981); however, cirques do not exist in MSSP. Negative impacts to wolverines are found when human disturbance actions result in higher people densities and increased interest in high elevation winter recreation (Wisdom et al. 2000, Singleton and Lehmkuhl 1999, Singleton et al. 2002, Rowland et al. 2003). Human impacts associated with roads and people may also displace localized and seasonally abundant food sources where carrion, salmon-spawning streams, and berry patches are commonly located (Ruggiero et al. 1994). Wolves will actually use recreation trails (both summer and winter) as travel corridors during dispersal events and to gain access to prey populations. However, the risk of mortality associated with humans is notably greater along human use corridors (Creel et al. 2002, Claar et al. 1999).

Lynx are generally tolerant of humans, but they exhibit a wide variety of behavioral responses to human presence (Ruediger et al. 2000). Factors associated with recreational non-motorized and motorized trails affect lynx behavior and habitat (Gaines et al. 2003, Table 6). Lynx are, however, potentially sensitive to competition from other carnivores associated with these snow-compacted routes created by humans. To assess the effects of recreational activities on lynx habitat, Gaines et al. (2003) recommends determining the density of groomed or commonly used snowmobile and ski/snowshoe routes to calculate and rate a relative level of human influence on lynx habitat. Low level of human influence on lynx habitat is rated as <25 percent of the lynx analysis units (LAU) with route densities <1 miles/square mile ; high level of human influence on lynx habitat is rated as >25 percent of the LAU with route densities >2 miles/square mile (Gaines et al. 2003). We did not have time to calculate route densities and the changes in route densities based on the proposed trail developments due to time and budget constraints. However, our visual analysis of the proposed actions lead us to the conclusion that the proposed actions are so minor in the context of the existing transportation and recreation trail network that they will cause only very insignificant changes that will not result in changes in the thresholds observed at MSSP described above. A more quantitative analysis would be useful in determining the exact cumulative impacts to lynx habitat in MSSP and the surrounding area, but was not warranted due to the very minor nature of the proposed actions. Any future actions of a more significant nature should undertake a more robust analysis.

Table 6—Road and recreation trail-associated factors for wide-ranging carnivores (from Gaines et al. 2003)

Focal species	Road-associated factors	Motorized trail associated factors	Non-motorized trail associated factors	Snowmobile route associated factors	Ski trail associated factors
Lynx [b]	Down log reduction Trapping Collisions Disturbance at a specific site	Disturbance at a specific site Trapping	Disturbance at a specific site Route for competitors or predators Trapping	Disturbance at a specific site Route for competitors or predators	Disturbance at a specific site
Gray wolf [c]	Trapping Poaching Collisions Negative human interactions Disturbance at a specific site Displacement or avoidance	Trapping Disturbance at a specific site	Trapping Disturbance at a specific site	Trapping Physiological response	
Wolverine [d]	Down log reduction Trapping Disturbance at a specific site Collisions	Trapping Disturbance at a specific site	Trapping Disturbance at a specific site	Trapping Disturbance at a specific site	Trapping Disturbance at a specific site

[b] Sources: Banci 1994, Buskirk 1999, Claar et al. 1999, Koehler and Aubry 1994, McKelvey et al. 2000, Ruediger et al. 2000.

[c] Sources: Boyd and Pletscher 1999; Claar et al. 1999; Creel et al. 2002; De Vos 1948; Harrison and Chapin 1998; Jensen et al. 1986; Mech et al. 1988, 1991; Mladenoff and Sickley 1998; Mladenoff et al. 1995, 1997; Thiel 1985; Thurber et al. 1994.

[d] Sources: Banci 1994, Claar et al. 1999, Copeland 1996, Hornocker and Hash 1981, Koehler and Aubry 1994.

From a regional to local landscape perspective, human activity seems to be an overriding factor in large carnivore resource selection. Hebblewhite and Merrill (2008) suggest wolves respond more to levels of human density and activity than to the density of actual trail and road networks. Similarly, human disturbances described as road and population densities (human activity and presence), were found to correspond negatively with observations of wolverines across the Columbia Basin (Rowland et al. 2003).

Cumulative effects of road and motorized trails on deer and elk summer ranges can have critical affects on healthy ungulate populations (Gaines et al. 2003). People on foot trails however can have a more detrimental effect during critical late winter into early spring seasons when ungulate's energy reserves are at their lowest (Canfield 1999). Elk respond to persons on foot by moving away from trails, however the distance of displacement was quite variable among study areas (Cassier et al.1992, Ferguson and Keith 1982, Schultz and Bailey 1978). Elk moved away from ski trails only when use was >8 persons per day (Ferguson and Keith 1982).

In our regional to mid-scale level human population density analysis, MSSP is located in an area of low human population density and has a considerable buffer of low human population density surrounding the park, particularly to the north (Figure 3 and 8). Wildlife exhibiting behavioral displacement and avoidance affects due to non-motorized trails and recreation should not be greatly affected by human population densities from the larger regional to mid-scale landscape.

From an immediately adjacent landscape perspective, human recreation activity is concentrated in the western and southern portions of MSSP (Figure 10). Separating out recreation by type and seasonality further depicts the lower human use and thus larger blocks of intact wildlife habitat in the Park to the north, west, and southeastern arm (Ragged Ridge area) during the summer and winter recreation seasons (Figure 13 and 14).

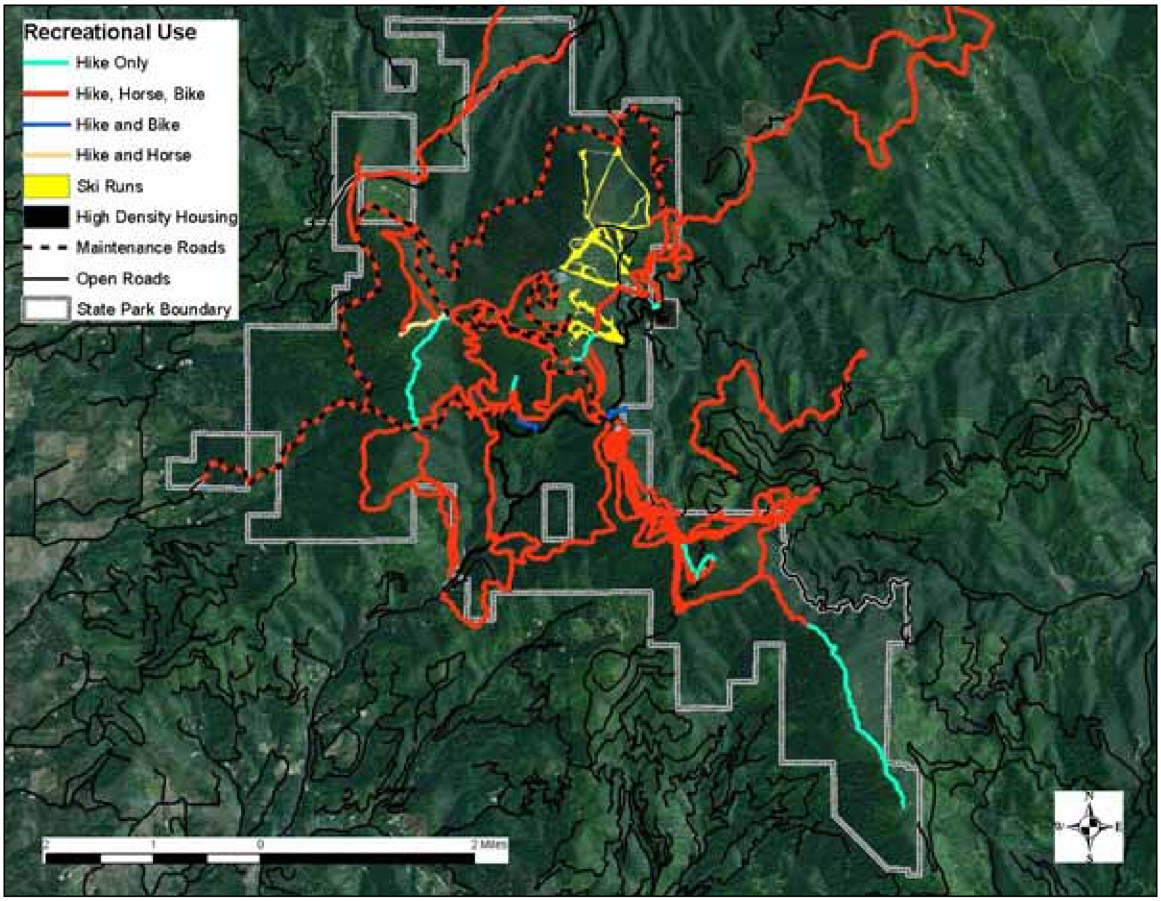

Figure 13. Summer recreational activity at MSSP and immediate surroundings. This illustrates the current cumulative effect of continued development at the park. Data is derived from WA Parks, WA DNR, US Census 2000, and PBI.

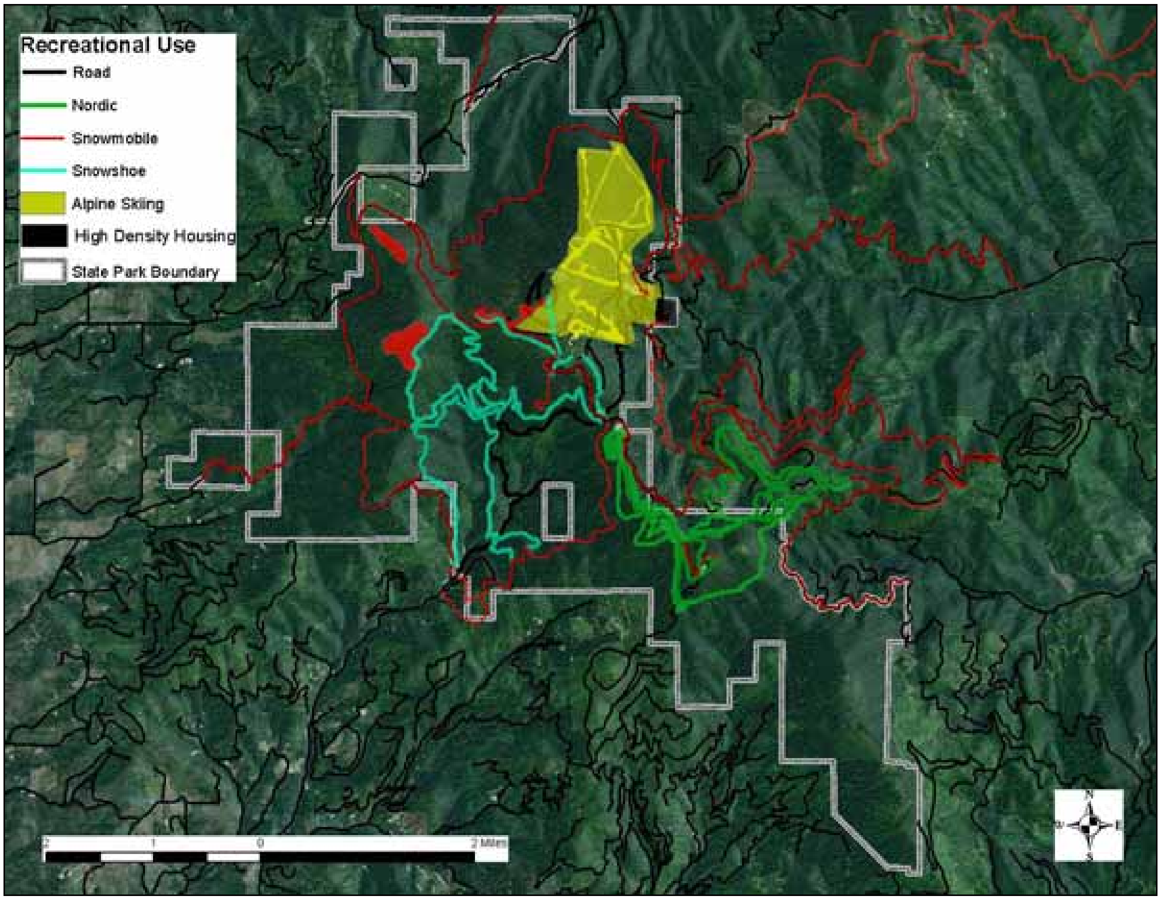

Figure 14. Winter recreational activity at MSSP and immediate surroundings. This illustrates the current cumulative effect of continued development at the park. Data is derived from WA Parks, WA DNR, US Census 2000, and PBI.

Considering these relatively intact blocks of habitat in MSSP with low human use along the west to northeast portion of the Park, Trail 180 and the associated trailhead parking development will likely add the most to the cumulative impacts on wildlife and wildlife habitat (Figure 12). This block of habitat in MSSP is home to concentrations of summer range elk and moose populations. As well, lynx and wolverines have been sighted in this region. To avoid causing displacement and provoking avoidance of the area by large carnivores, Purves et al. (1992 (in Claar et al. 1999)) recommends new recreation opportunities should be concentrated where displacement of large carnivores has already occurred, and discouraged in areas where displacement has not yet occurred. For example, existing backcountry campgrounds should be enlarged as needed, rather than new ones developed, and additional trails should be established in areas that already have a focus on recreational access (Peterson 1977 (in Claar et al. 1999)).

To address management considerations for ungulate conservation in MSSP, Snetsinger and White (2009) recommend “minimizing recreational disturbance on winter range and areas of early spring foraging to reduce negative impacts on elk. This may require closing some trails/routes and re-routing recreational activity as needed”. Bisecting this habitat with an additional year-round recreation trail, increasing human activity in this area, and increasing access to the Park with a new trailhead parking development will add to the cumulative effects already existing on the landscape for all wildlife species mentioned above.

Loss of refugia, connectivity and corridors

Mt. Spokane State Park provides an important refugia for wildlife species in northeastern Washington and northern Idaho. It is the only large protected area in this region that is both closed to hunting and managed to preserve and protect the native ecosystems. This is of particular importance to imperiled carnivores species like the gray wolf and lynx. MSSP can play and important role in the recovery of these two species as a large refugia where habitat is protected and hunting prohibited.

Wildlife movement corridors and connectivity between refugia are important factors to consider in cumulative effects analyses. On a regional scale, wide-ranging carnivores were identified as affected by cumulative effects on movement corridors and connectivity. On a more local scale, animals such as western toads, pileated woodpeckers, marten and elk are likely more sensitive to loss of connectivity between foraging, cover/security and breeding/nesting areas.

At the regional landscape level, animals need to be able to move efficiently within their home ranges to access food, shelter, mates and other basic needs (Stephens and Krebs 1986). Permeable dispersal and travel corridors are necessary to connect large refugia that maintain wildlife populations. Movement corridors are also important for animals colonizing unoccupied habitat and maintaining genetic exchange between groups (Singleton et al 2003). These dispersal corridors likely do not require the same habitat attributes necessary to support self-sustaining carnivore populations, and therefore, atypical or low quality habitats may be important, especially if they connect otherwise isolated wildlife populations and allow for genetic exchange or colonization (Ruggiero et al. 1994). However major highways, rugged topography, human development and changes in land cover types can negatively affect an animal's ability to successfully move through an area (Beier 1995, Brody and Pelton 1989, Gibeau and Heuer 1996).

To aid our regional landscape cumulative effects analysis we looked at a landscape view from space, which helps illustrate the ecological importance of MSSP as a large block have protected habitat within the southern-most lobe of the Selkirk Mountain landscape (Figure 1). A map of the Human Footprint (HF) (Figure 2) illustrates the current state of regional cumulative effects of human activities on the landscape. Together, these maps show potential corridors for carnivore movement from MSSP to the north, northwest, and northeast. At this broad scale, the HF map does not allow us to tease apart low human footprint areas where natural landscape features may result in barriers to wildlife movements and life processes. Conversely, it is possible that there are areas of high human footprint where wildlife movements and life stage needs are currently being met.

In the Canadian Rocky Mountains Ecoregional Assessment (CRMEA 2004), habitat value was measured by the output of resource selection function (RSF) models, which are proportional to the number of animals that can be supported in an area (Carroll et al. 2002). These models show moderate to high RSF values for wolves, lynx and wolverines (Figures 15-17). Similarly, habitat suitability and weighted-distance models for lynx in Washington State show MSSP and areas to the north, northeast and northwest as good dispersal habitat suitability (based on land cover, road density, human population density and slope). Further analysis of weighted-distance models show MSSP as accessible to lynx habitat concentration areas with short and medium distance movements (Singleton et al. 2002). Gray wolf models show similar moderate to good dispersal habitat suitability in MSSP and to the north, northeast and northwest; weighted distance model results predict MSSP to be accessible to habitat concentrations of gray wolves by medium to long distance movements (Singleton et al. 2002).

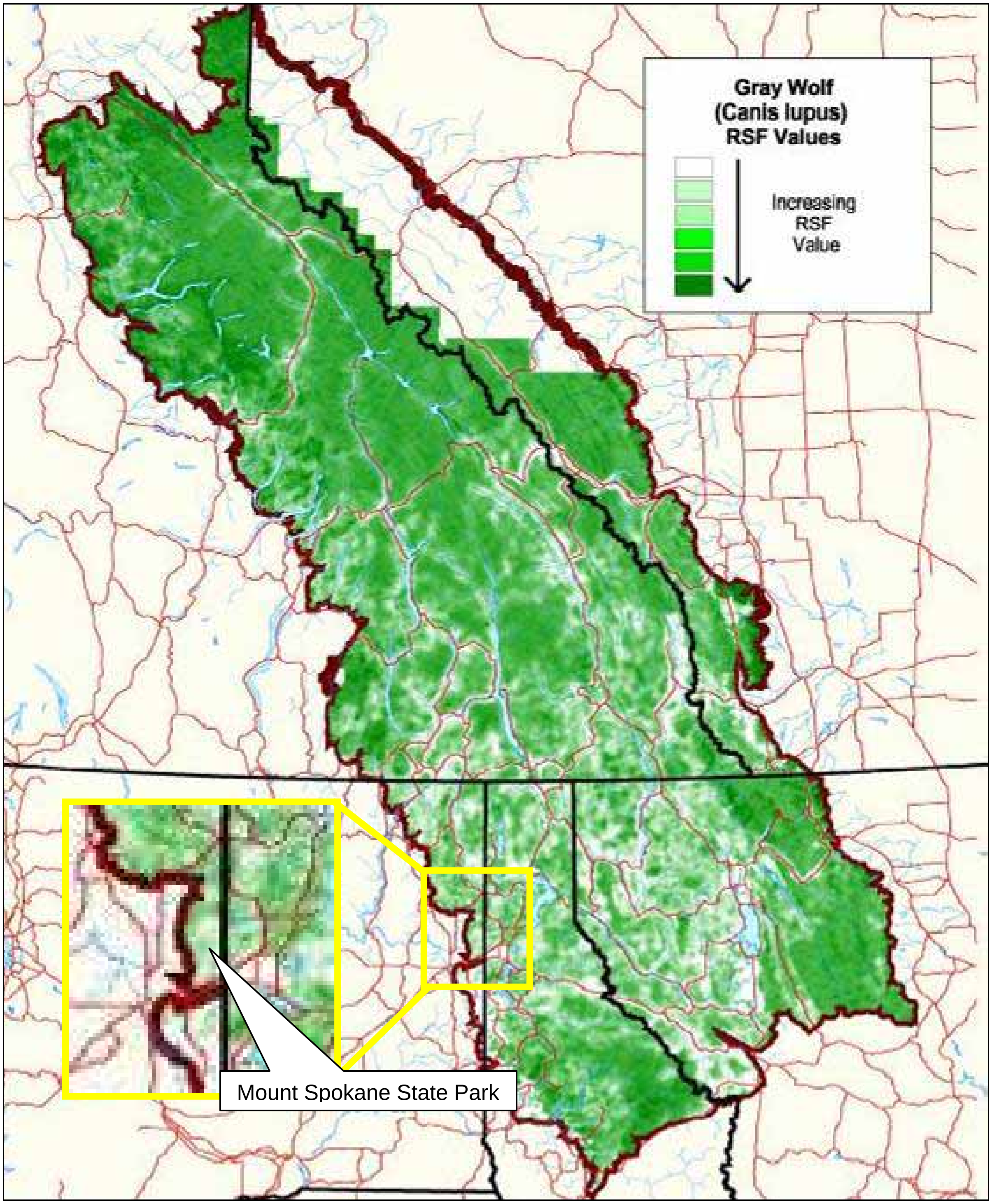

Figure 15. Canadian Rocky Mountains Ecoregion: wide ranging carnivore resource selection functions (RSF) for gray wolf (CRMEA 2004). The yellow box represents the area directly surrounding MSSP.

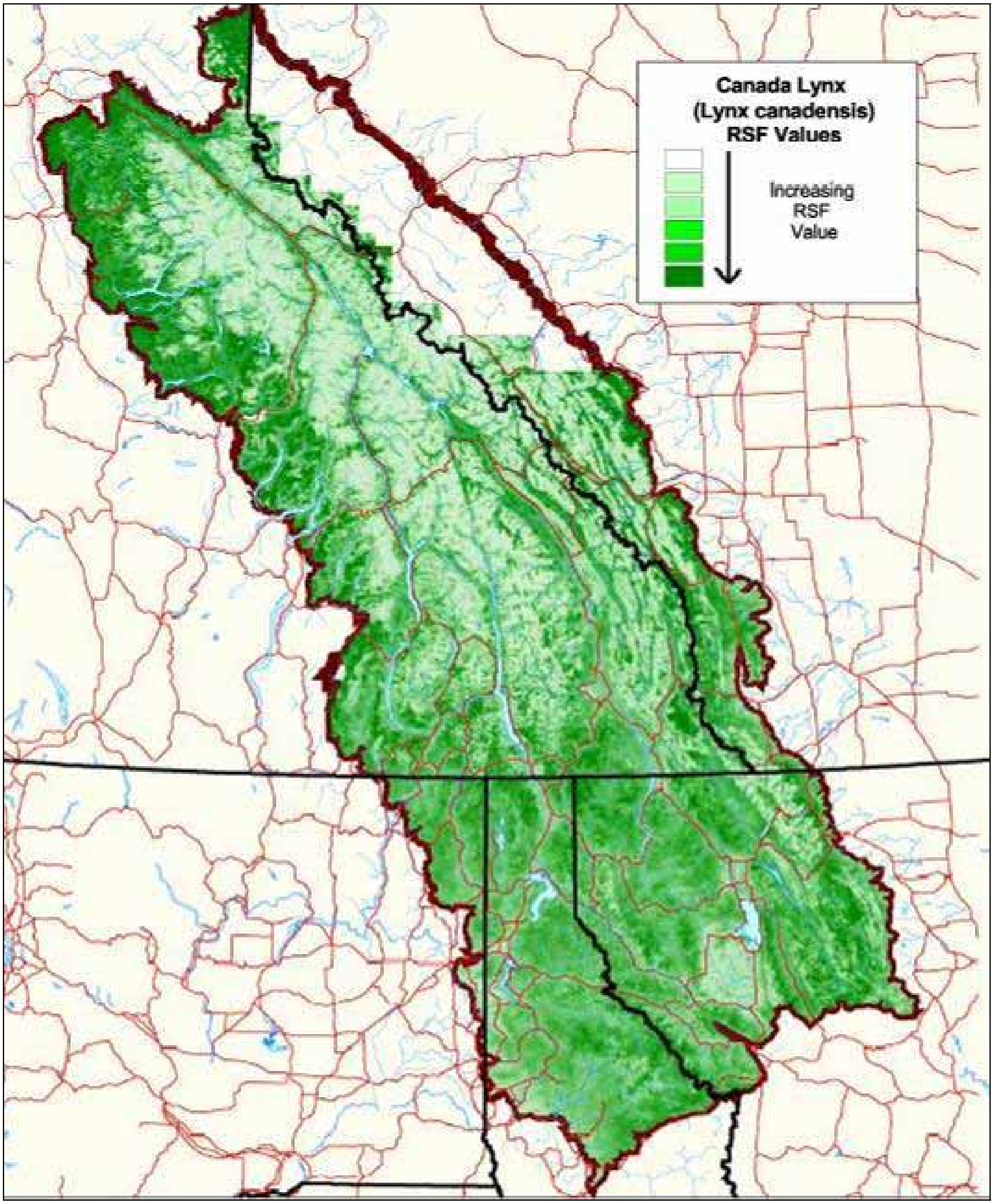

Figure 16. Canadian Rocky Mountains Ecoregion: wide ranging carnivore resource selection functions (RSF) for lynx (CRMEA 2004). The yellow box represents the area directly surrounding MSSP.

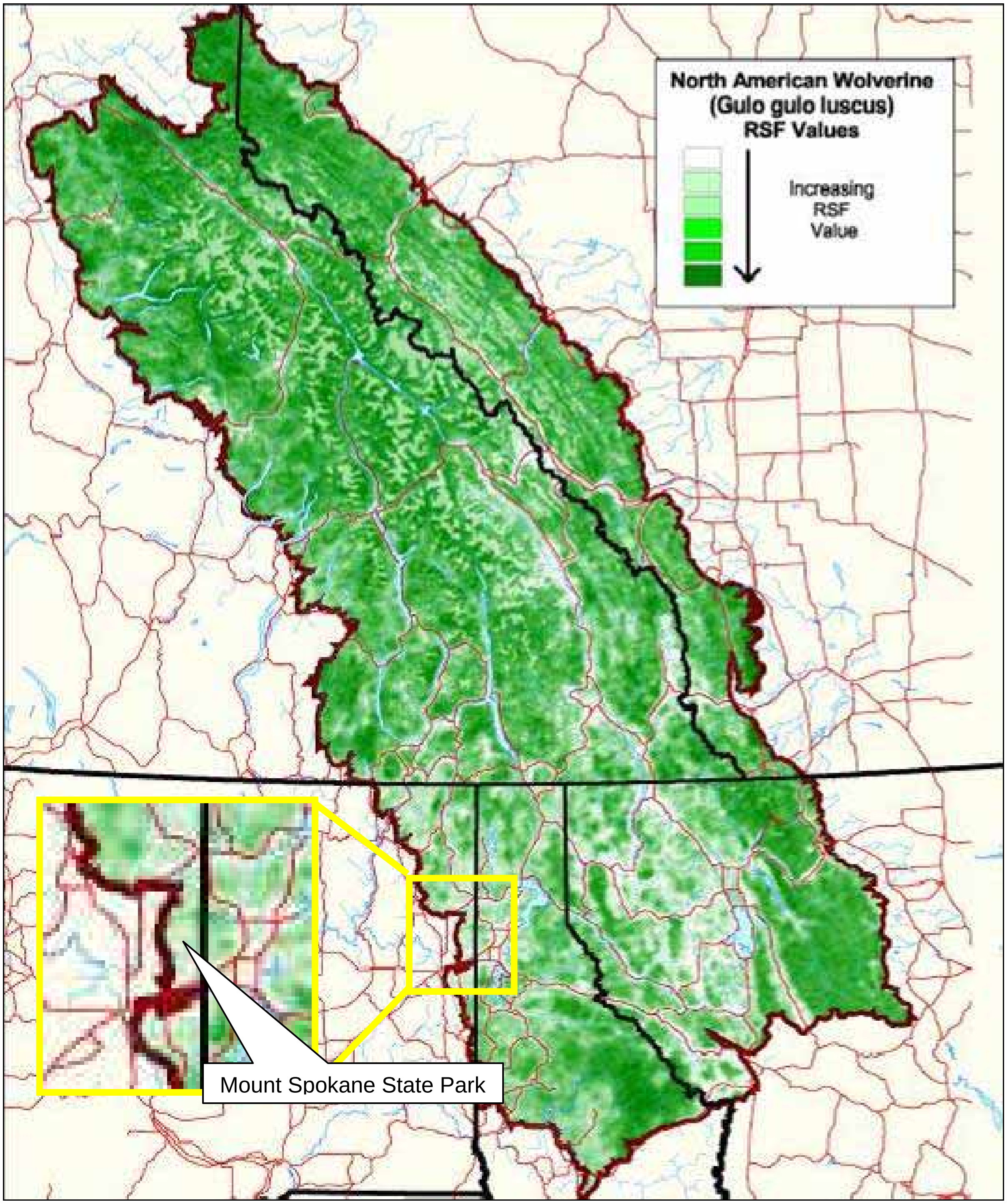

Figure 17. Canadian Rocky Mountains Ecoregion: wide ranging carnivore resource selection functions (RSF) for wolverine (CRMEA 2004). The yellow box represents the area directly surrounding MSSP.

In our regional landscape-level assessment of connectivity and corridors for large carnivores, MSSP is located on the fringe of good carnivore habitat, and accessed by increasingly better habitat suitability to the north, northwest, and northeast.

Our assessment of the Proposed Actions, due to their minor nature and proximity to existing developments, is that they will have little to no effect on carnivore movements at the regional landscape level and will not contribute to a loss of connectivity and corridors from a cumulative effects perspective.

At a local and immediately adjacent landscape level, cumulative effects of the Proposed Actions are more relevant to animal movements in and around MSSP. Wildlife follow distinct topographic features during dispersal and travel movements based upon the species need for cover, security, and resources. Wolverines will utilize slightly lower elevation forests in winter, as well as traveling along stream corridors, primarily looking for ungulate prey or perhaps for easier travel corridors (Banci 1994). Studies in the Rockies have identified topographic funnels such as saddles, ridgelines and valley bottoms, as well as cover types used by prey as habitat elements important to wolf dispersal (reviewed in Carroll et al. 1999). Lynx similarly use ridgelines, saddles and forested riparian areas when dispersing and traveling among foraging patches and densities (Stinson 2000). Elk often forage on upper slopes where there is higher solar radiation and quicker snowmelt (Canfield et al. 2002). They also regularly use large valley bottoms (Tefler 1978), as well as ridgelines (H. Ferguson pers. comm.).

Similarly, there are cumulative effects of increased human use surrounding MSSP. Urban sprawl and expansion of low-density residential areas into natural landscapes are among the most significant threats to conservation (CRMEA 2004). One of the impacts associated with increased human activity and recreation is the inhibition of wildlife movements (CRMEA 2004). While it is apparent that there has been considerable residential build-out to the south and west of MSSP, there is a still substantial amount of forest land that has not been subdivided and converted to residential use in the immediate vicinity of the Park (Figure 6). The rate of development, increasing human activity, and increasing population density surrounding MSSP puts additional pressure on the Park to protect its relatively unfragmented wildlife habitats and corridors (see Figures 7-9). As stated above, the most intact habitat that allows for wildlife movements both within the Park and to the larger regional landscape occurs along the west to northeast portion of MSSP.

Of the Proposed Actions, only Trail 180 will add to the cumulative effects on wildlife spatial movements. This proposed trail travels on an old-road with significant protective cover and foraging resource habitats for many wildlife species (see Affected Environment earlier in the EIS document). It is located along a key topographic feature, an approximately 1.5 mile-broad ridgeline currently used as a wildlife travel corridor. And the trail bisects intact wildlife habitat both to the south and to the north- northeast. Snetsinger and White (2009) recommend that managers should avoid placing new recreational trails and roads through previously unfragmented habitats to protect species such as carnivores (both large and small) that naturally occur at low densities.

Loss or degradation of habitat

Besides the topographic features important for connectivity and movement corridors, natural features such as continuous shrub / riparian cover, stream corridors, and large blocks of forested habitat are similarly depended upon by a host of wildlife species. When recreation impacts these natural features, loss or degradation of habitat is the key stressor on wildlife.

Marten are strongly associated with mature to old-growth conifer forests with dense canopies and high stem densities in the Pacific Northwest (Koehler et al 1975, Meslow et al. 1981, Buskirk et al. 1989, Koehler et al. 1990, Buskirk and Powell 1994). They are predisposed to negative consequences of habitat fragmentation and population isolation due to their limited reproduction and dispersal capabilities (Claar et al. 1999). As marten are often associated with remote wilderness conditions, there is speculation that human activity may cause displacement and other negative impacts on marten, however empirical data is limited on the subject (Claar et al. 1999).

Goshawks generally nest in large blocks of interior forests, away from edge habitat. Nesting success is thought to improve as distance from human developed areas and habitat edges increase (Mahon et al. 2003).

Western toad movements for both juvenile dispersers and adults utilize streams as travel corridors, and seeps and riparian habitat in montane forests serve as critical summer growth sites (Schmetterling and Young 2008). Bare ground left behind by recreationalists on trails, roads and campsites near wetland areas can divert or alter surface water flows, potentially negatively impacting habitat for anuran species (Vinson 1998).

The cumulative effects of these perturbations to wildlife species should be considered carefully during recreation development planning processes. Our analysis of the Proposed Actions on a local to immediate adjacent landscape scale determined that the Proposed Actions at their current locations will not result in loss or degradation of wildlife habitat in MSSP. The cumulative effect of additional actions near these locations may constitute a significant adverse cumulative effect.

Increased poaching incidents in MSSP

The current and future residential development and increased road access to the borders of MSSP will increase human presence both in the Park as well as on adjacent periphery private lands along the western edge of MSSP (Figure 12). With increased human presence on the edge of State Park land, illegal activity can result when roads or trails provide greater access for poaching. Figure 4 and 5 depict road densities which are exceptionally high to the south and east of MSSP. Roads provide access for poaching of elk, and have been shown to increase energetic costs, as well as decrease elk survival (Cole et al. 1997). Marten are also known for their vulnerability to trapping and susceptibility to overharvest (Heinenmeyer and Jones 1994, Powell 1979, Powell 1982, Weaver 1993). Roads and trails, and especially snowmobile trails developed for recreation are used by trappers, therefore increasing the vulnerability of marten to trapping mortality (Claar et al.1999). Additionally, higher densities of roads increase the chance of wolves being seen and potentially killed (Carroll et al.1999). Trapping is listed as a road and trail associated effect on lynx, wolves and wolverines by Gaines et al. (2003) (Table 6).

With the projected continuation of residential development adjacent to the border of MSSP, the Proposed Action of Trail 180 and the associated trailhead parking developments have potential to increase poaching incidents to wildlife in MSSP. Currently, there is a housing subdivision to the south of the Day Mount Spokane Road, where limited resident use is likely taking place; visitors are entering MSSP on foot, bike or horseback from the MSSP boundary gated road. With development of a new trailhead parking facility and new non-motorized trail in the vicinity, increased visitor contact to the area could occur, especially when MSSP recreation maps are updated with the new recreation facilities. Increasing road access and human presence to this western region of MSSP is not beneficial to wildlife, especially if additional law enforcement and Park Ranger staff are not able to monitor the area on a timely and regular basis.

Mortality and injury resulting from collisions with motorized vehicles

One of the most obvious and significant adverse impacts to wildlife come from collisions with motorized vehicles. Vehicle collisions cause mortality or injury to all wildlife species – from butterflies to large carnivores. The cumulative impact of vehicle collisions on wildlife species can be significant over time. There is currently significant adverse impact on wildlife species from vehicle collisions in and around MSSP (the No Action Alternative). The Proposed Action will probably result in a very sight increase in visitors to the park as a result of slightly expanded and improved facilities. This will result in a correspondingly slight increase in traffic and resulting vehicle collisions with wildlife. Future activities in MSSP and the surrounding landscape have the potential to result in very significant increases in traffic volumes, which will result in very significant, long-term adverse cumulative impacts on wildlife species.

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The cumulative effects analysis at a local to immediate vicinity scale identified increased human recreation activity during summer and winter months, increased residential development outside MSSP, and an increase in vehicle collisions due to increasing traffic volumes as having an adverse impact on wildlife. These situations pose stresses on wildlife populations such as loss of wildlife movement corridors, increased potential for illegal trapping and poaching, and increased wildlife displacement and avoidance behavior and direct mortality and injury from vehicle collisions. The Proposed Actions will add little to the adverse cumulative effects to wildlife except for some possible significant adverse effects as a result of the construction and subsequent use of Trail 180 and related parking facility on the western side of MSSP. Continued future developments in and around MSSP have a high likelihood of causing cumulative impacts that rise to a level of highly significant and adverse.

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