Appendix 6: Analysis of Forest Management Activities on Grizzly Bear Habitat in FMU E8

Analysis of Forest Management Activities on Grizzly Bear Habitat in FMU E8

Introduction

Maps, models and GIS applications, developed by the Grizzly Bear Research Project (GBRP), Foothills Research Institute (formerly the Foothills Model Forest) can now be utilised to conduct assessments of proposed forest management activities on grizzly bear habitat. The objective of using the models and tools is to assist in managing for landscape conditions necessary for the long-term health and persistence of grizzly bears in the province of Alberta. Forest Management Plans must be examined in terms of their current and projected impacts on grizzly bear habitat quality, in order that the effect of planned development/activities can be quantified. Various alternatives can be compared/contrasted using the models and tools.

In Alberta, six Grizzly Bear Population Units have been identified (work continues on the northern Alberta area). Grizzly Bear Population Units are a management unit based on genetic distinctions within the Alberta grizzly bear population. These population units are generally separated by major highway corridors. FMU E8 is in the Grande Cache Grizzly Bear Population Unit. The population units are further subdivided into Grizzly Bear Watershed Units (GBWU), a management unit based on major watersheds subdivided along heights of land and occasionally along watercourses, to approximate the size of an adult female grizzly bear home range (~700 km^2). These are an appropriate landscape unit for generating, reporting and monitoring grizzly bear habitat metrics.

The *Alberta Grizzly Bear Recovery Plan 2008-2013*[14] speaks to the creation of "Grizzly Bear Priority Areas" in high quality habitat where there is a low risk of mortality. The GBRP originally identified "priority" areas, which were further refined by Fish and Wildlife Division (FWD) biologists. The ASRD Resource Directors Council officially approved the designation of Grizzly Bear "Core" Areas and "Secondary" Areas.

Each GBWU is characterised as being either Core or Secondary grizzly bear habitat. Core Areas are areas of high habitat value (Resource Selection Function) and generally low mortality risk currently measured through open road densities. Secondary Areas are areas of good habitat, reflecting the broader range of grizzly bears (see Figure 1).

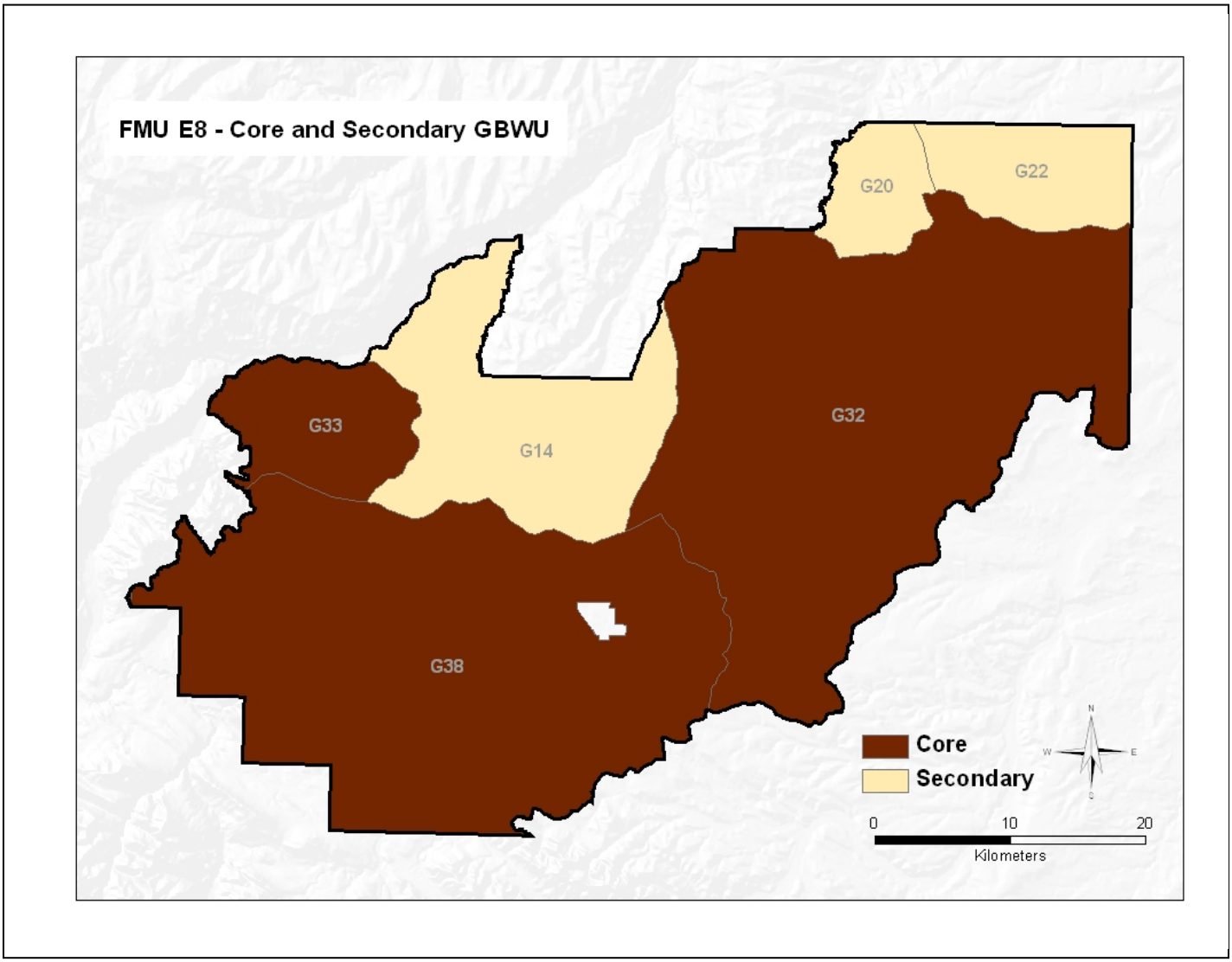
Grizzly bear habitat quality can be characterised in three ways: resource availability, security and connectivity. Resource availability is modeled as Resource Selection Function (RSF), which is the relative probability of grizzly bear occurrence on the landscape. Security is related to human-caused mortality. Because human use of access is difficult to measure, the Recovery Plan recommends using open road densities are as a surrogate for amount of human use. For the purpose of this analysis, existing linear features (excluding seismic lines) were used to calculate the Open Road Density. The length of all linear features (roads, trails, pipelines, transmission lines and railway corridors) was summed and divided by the area of unit (both GBWU and FMU). The Grizzly Bear Recovery Team[15] suggests that Open Road Density eventually replaced with Mortality Risk. Mortality Risk is a spatial model that represents the relative probability of human-

[14] Alberta Grizzly Bear Recovery Plan 2008-2013. 2008. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 15. Edmonton, AB p 26

[15] Alberta Grizzly Bear Recovery Plan 2008-2013. 2008. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 15. Edmonton, AB p 22

caused grizzly bear mortality. It is a function of terrain ruggedness, distance from roads, streams, cutlines, and forest edges and land status (protected area, Green/White Area). For the purpose of this analysis, both Open Road Density and Mortality Risk will be used. Safe Harbour is a combination of habitat quality and risk. A safe harbour is an area of good habitat (high RSF values), to which bears are attracted by an abundance of resources, but also where the bear faces a low risk of human caused mortality (low Mortality Risk). Safe harbour was calculated using the following expression: [SH] = [RSF]*(10-[RISK]).

Figure 1: Core and Secondary Grizzly Bear Watershed Units in FMU E8



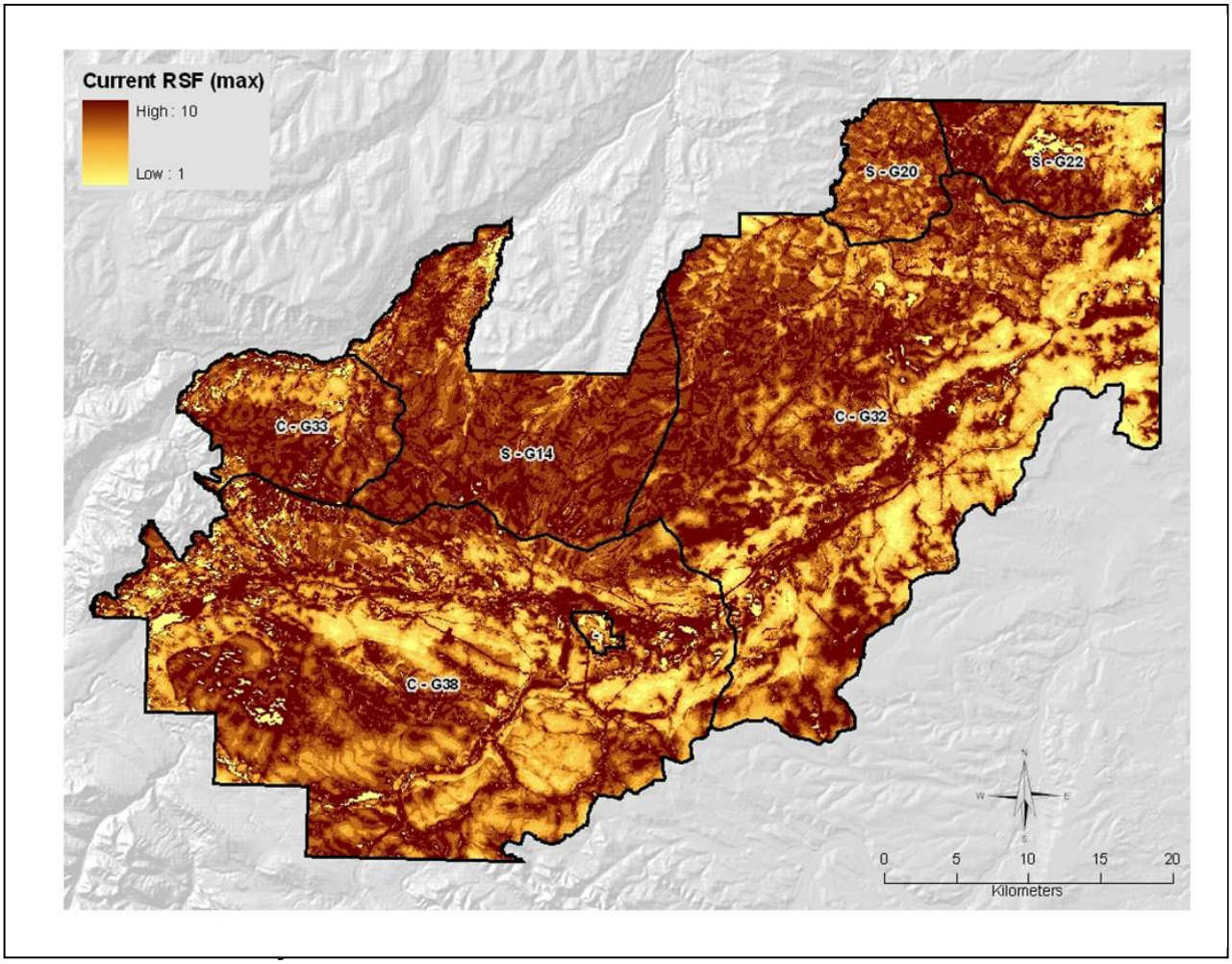
Current Conditions

1.1. Resource Selection Function

The FMU E8 boundary was used to clip the Grande Cache Grizzly Bear Population Unit RSF[16]. A maximum RSF was created by combining the maximum values for the spring, summer and fall RSFs. Core and Secondary Grizzly Bear Watershed Units (GBWU) were overlaid on the maximum RSF so that the current conditions could be determined for each GBWU. Figure 1 on the next page shows the current maximum RSF values in FMU E8.

RSF is scaled from 1 to 10, with 1 being low habitat value and 10 being the highest habitat value. Currently, the average maximum RSF value for the FMU in the Core Areas is 8.15, while the average in the Secondary Areas is 8.75 (see Table 1). The range of maximum RSF values for the Core GBWUs is from 8.07 to 8.54 while the range for the Secondary GBWUs is from 8.07 to 9.06.

Figure 1: Current Maximum RSF in FMU E8



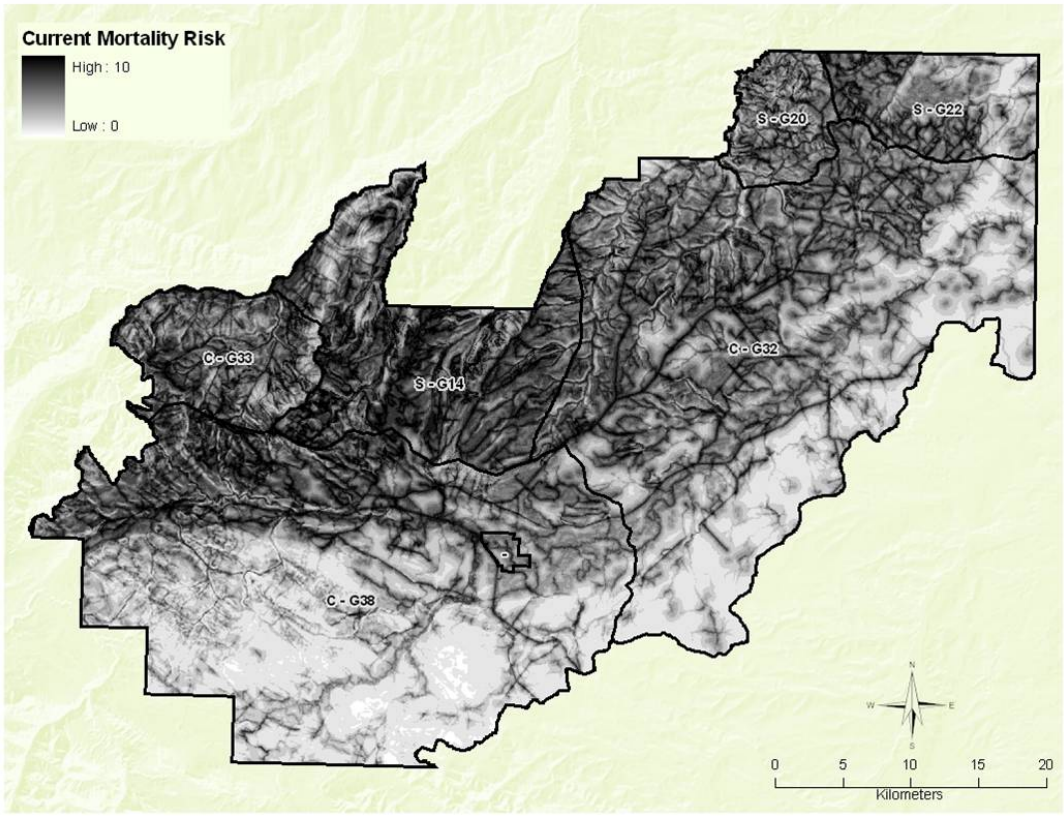
The FMU E8 boundary was used to clip the Mortality Risk model and Core and Secondary Grizzly Bear Watershed Units (GBWU) were overlaid. The current Mortality Risk is shown in Figure 2 on the following page. It is apparent that where there are more roads, the risk is

[16] All data used in this analysis was from the 2007 Grizzly Bear Research Project Deliverables.

higher. Currently there is very little roading in the southwest corner of the unit (GBWU G38) and as a result the Mortality Risk is lower there.

Mortality Risk is scaled from 0 to 10, with 0 being lowest risk of mortality and 10 being the highest risk of mortality. The average Mortality Risk for the FMU in the Core Areas is 4.48, while the average in the Secondary Areas is 6.58 (see Table 1). The range of Mortality Risk for the Core GBWUs is from 3.94 to 6.68 while the range for the Secondary GBWUs is from 5.29 to 7.23.

Figure 2: Current Mortality Risk in FMU E8

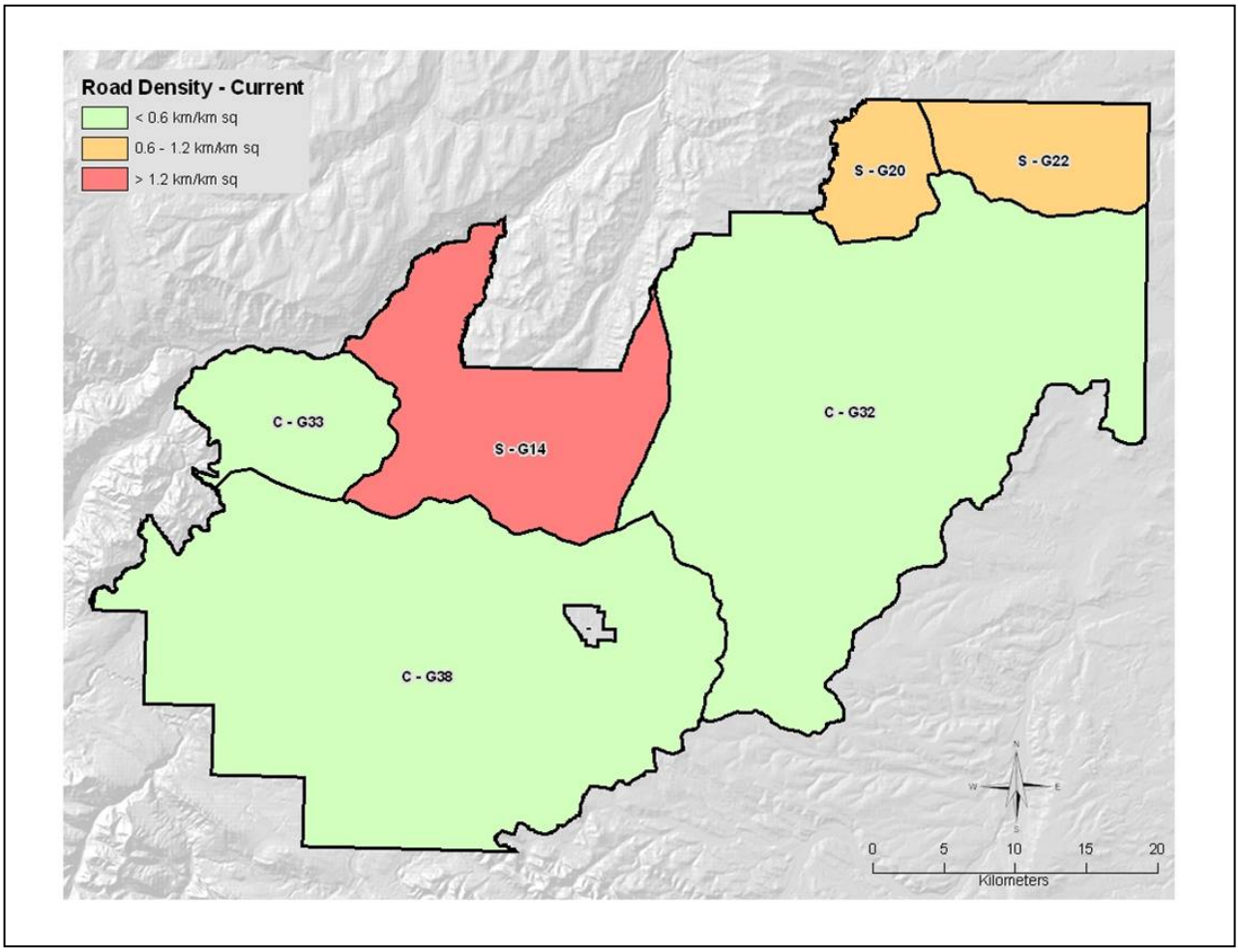


1.3. Open Road Density

The average Open Road Density for the FMU in the Core Areas is 0.50 km/km^2, while the average in the Secondary Areas is 1.3 km/km^2 (see Table 1). The range of Open Road Density for the Core GBWUs is from 0.48 km/km^2 to 0.53 km/km^2 while the range for the Secondary GBWUs is from 0.80 km/km^2 to 1.59 km/km^2.

The Current Open Road Density by GBWU is illustrated in Figure 3. The data from GBRP was used in this analysis. All roads identified are considered to be open for vehicular traffic, unless they have been identified as closed or reclaimed.

Figure 3: Current Open Road Density (km/km^2)

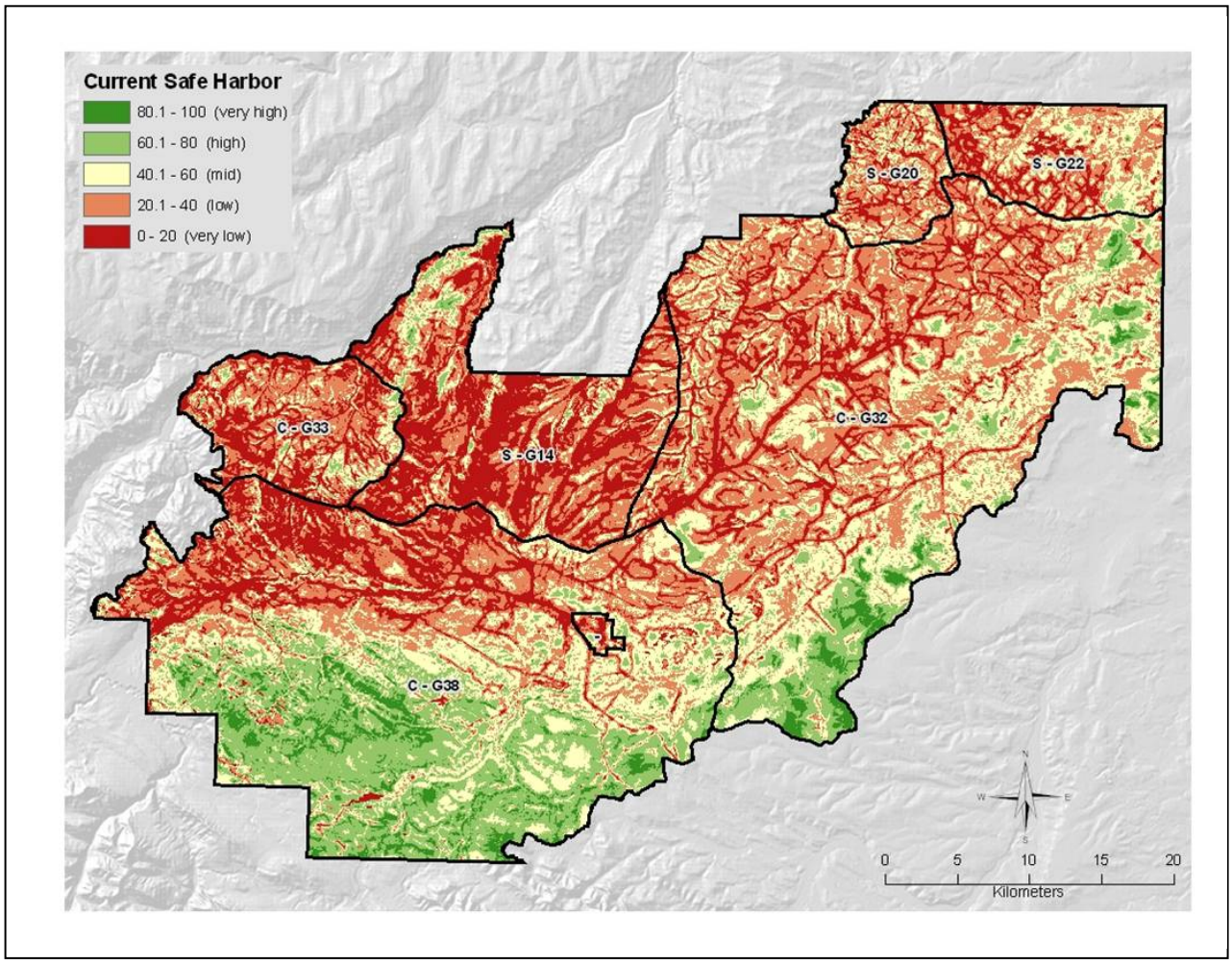


1.4. Safe Harbour Index

Because Safe Harbour is a combination of RSF and Mortality Risk, it is scaled from 0 to 100, with 0 being very low Safe Harbour and 100 being very high Safe Harbour (see legend in Figure 4). The mean Safe Harbour for the FMU in the Core Areas is 43.33, while the average in the Secondary Areas is 28.53 (see Table 1). The range of mean Safe Harbour for the Core GBWUs is from 27.93 to 48.44 while the range for the Secondary GBWUs is from 24.72 to 35.14.

Safe Harbour is greatest where there are fewer roads (lower Mortality Risk), as illustrated in Figure 4. The southwest corner of the FMU (GBWU G38) has the lowest Open Road density, which leads to more area of Safe Harbour.

Figure 4: Current Safe Harbour in FMU E8

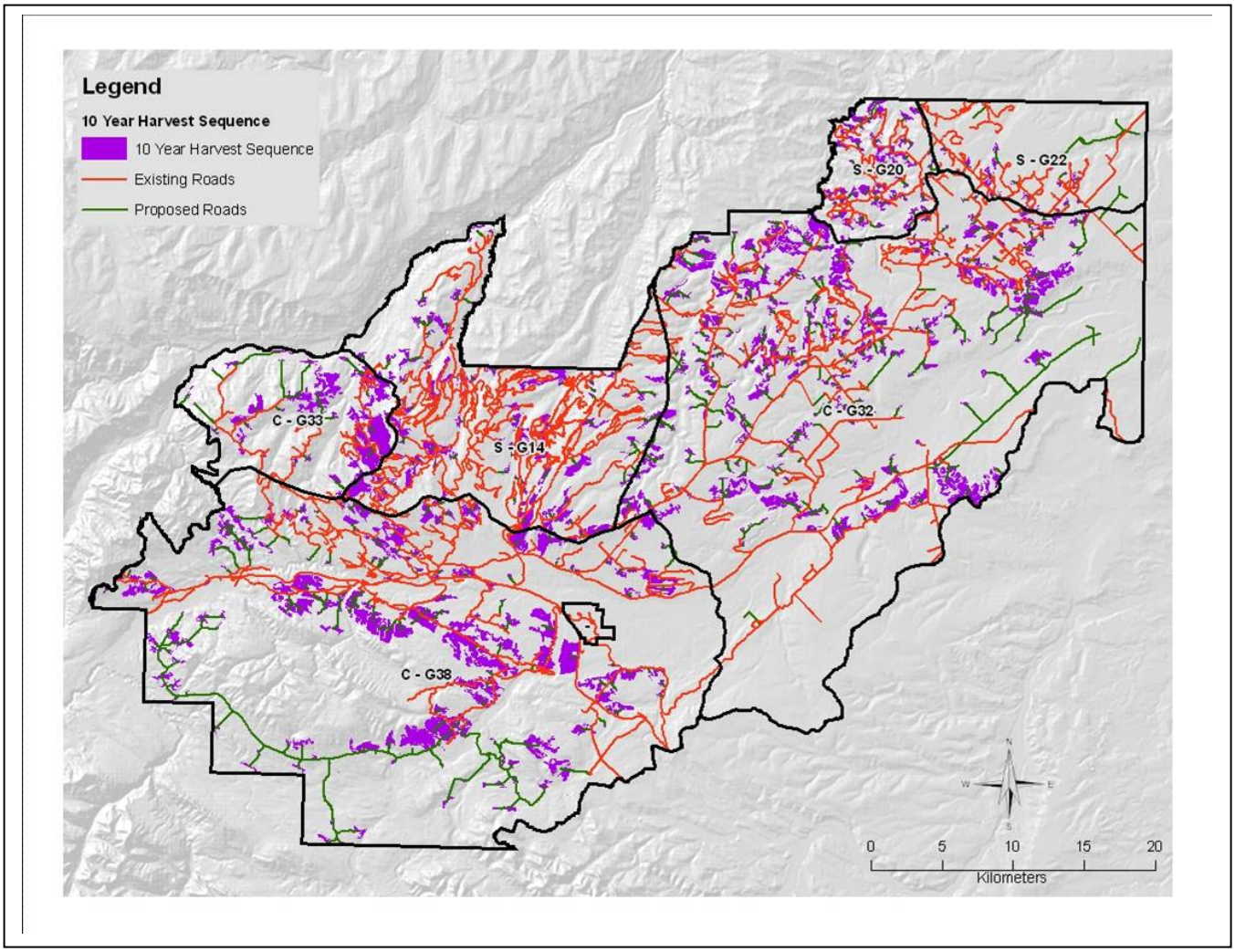


Future Landscape Conditions

The proposed spatial harvest sequence (SHS) and a new road network were used to generate future conditions for FMU E8. The proposed road network is a combination of the major road corridor proposed by the Caribou Landscape Management Association (CLMA) as well as a network generated using GIS technology. This road network may not accurately represent future ground conditions, but it is an approximation that is useful in this analysis. Because access has the greatest impact on grizzly bear mortality, new access generated by forest management activities, such as harvesting, must be included in the analysis.

The future ten-year spatial harvest sequence and road network are illustrated in Figure 5.

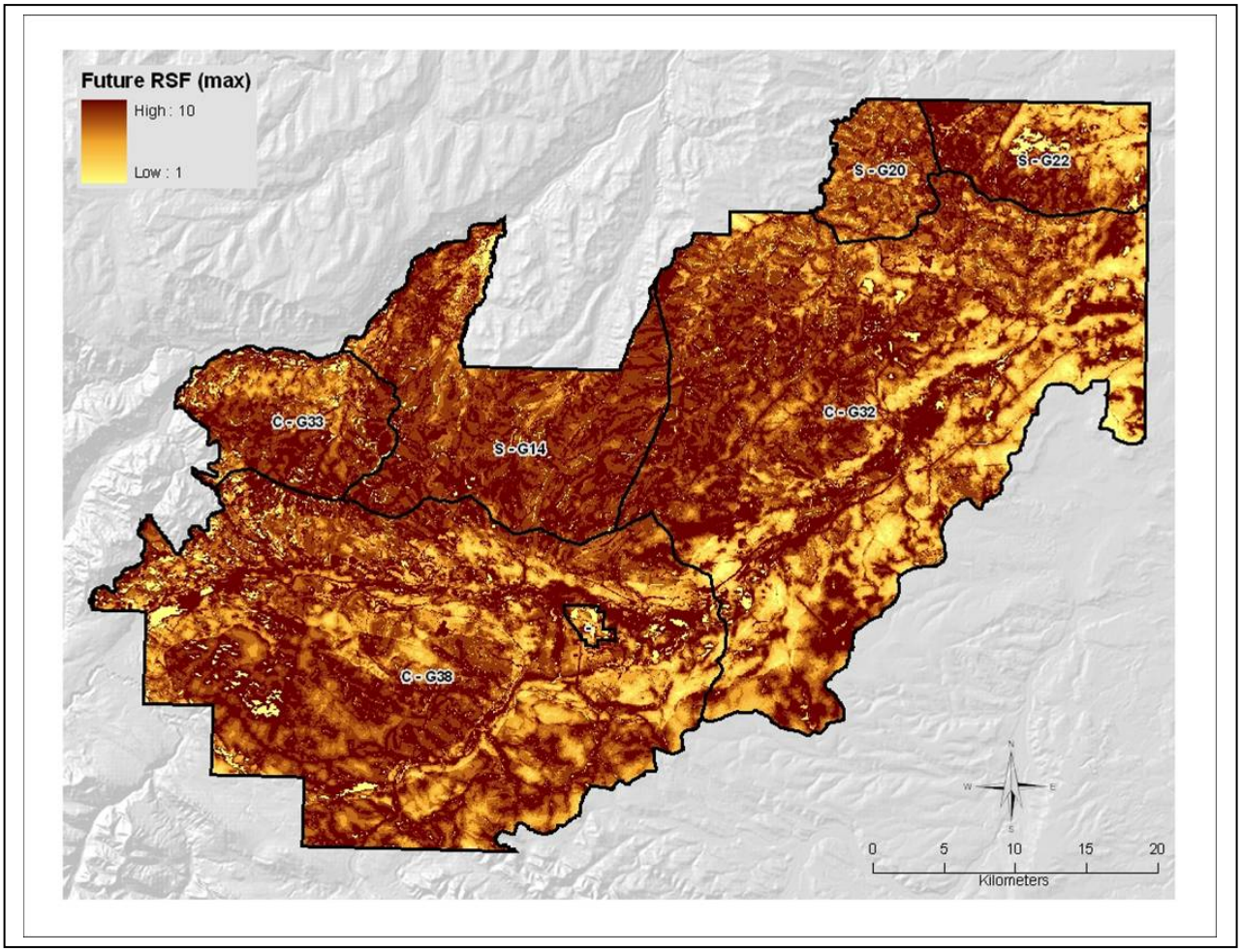
Figure 5: Future 10 Year Harvest Sequence and Road Network



1.5. Resource Selection Function

The future average maximum RSF value for the FMU in the Core Areas is 8.40, while the average in the Secondary Areas is 8.40 (see Table 1). The range of maximum RSF values for the Core GBWUs is from 8.26 to 8.62 while the range for the Secondary GBWUs is from 8.16 to 9.03. Overall, there was a 3.0% increase in mean maximum RSF in the Core Areas and a 0.1% decrease in the Secondary Areas (see Figure 6).

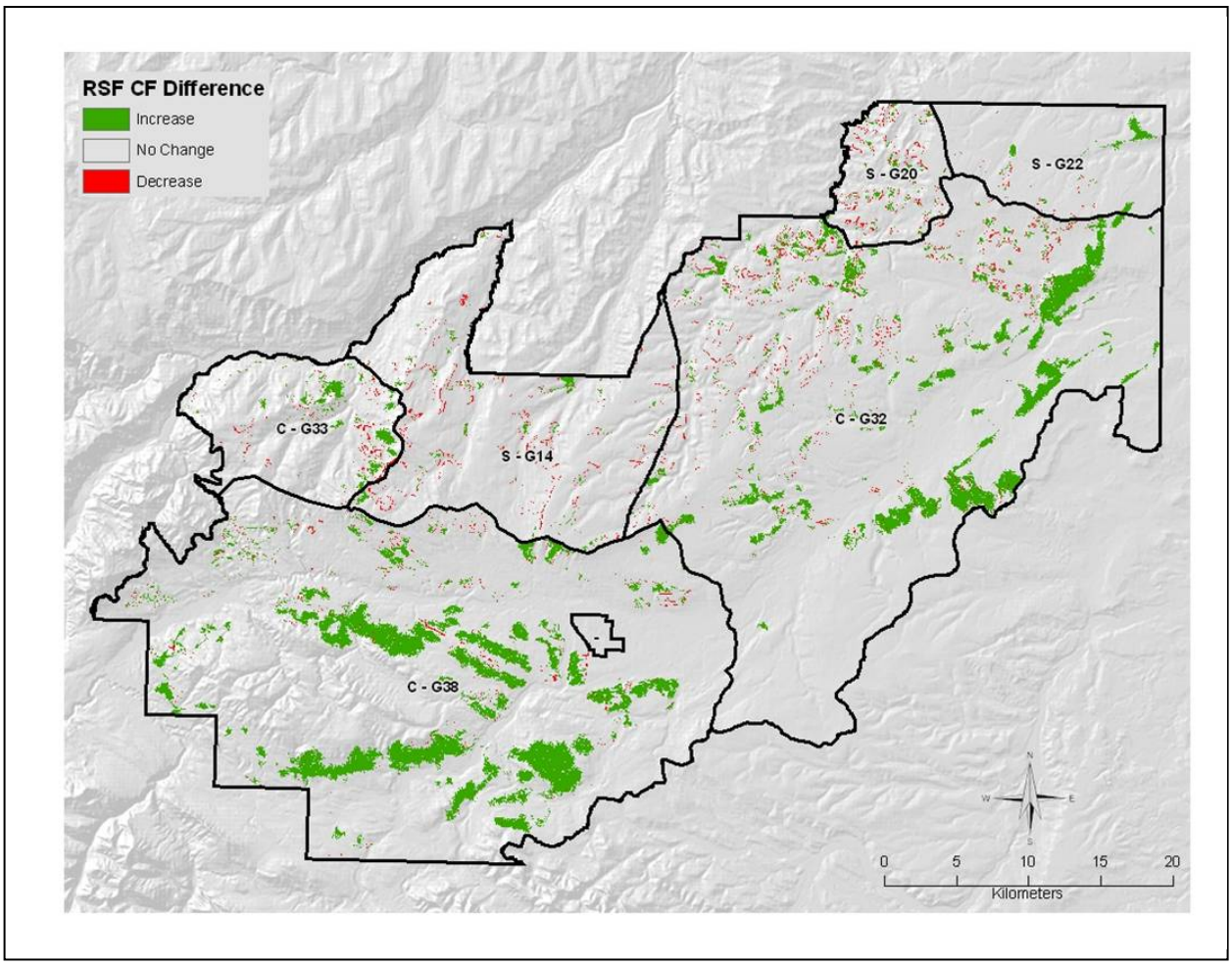
Figure 6: Future Mean Maximum RSF



Forest harvesting almost always results in higher RSF values. Some of the things we have learned through the Grizzly Bear Research Project are that grizzlies prefer younger regenerating stands for foraging, while they use the adjacent mature forest for cover. We have also learned that use of regenerating forest peaks at about 15 to 20 years post-disturbance in pine-dominated stands, which are not accounted for in our 10-year projection.

If we examine the differences between the current and future mean maximum RSF, we can see that by creating a road network and cutblocks, RSF has increased in the southwest corner of the FMU (see Figure 7).

Figure 7: Comparison of Differences in Current and Future RSF Values

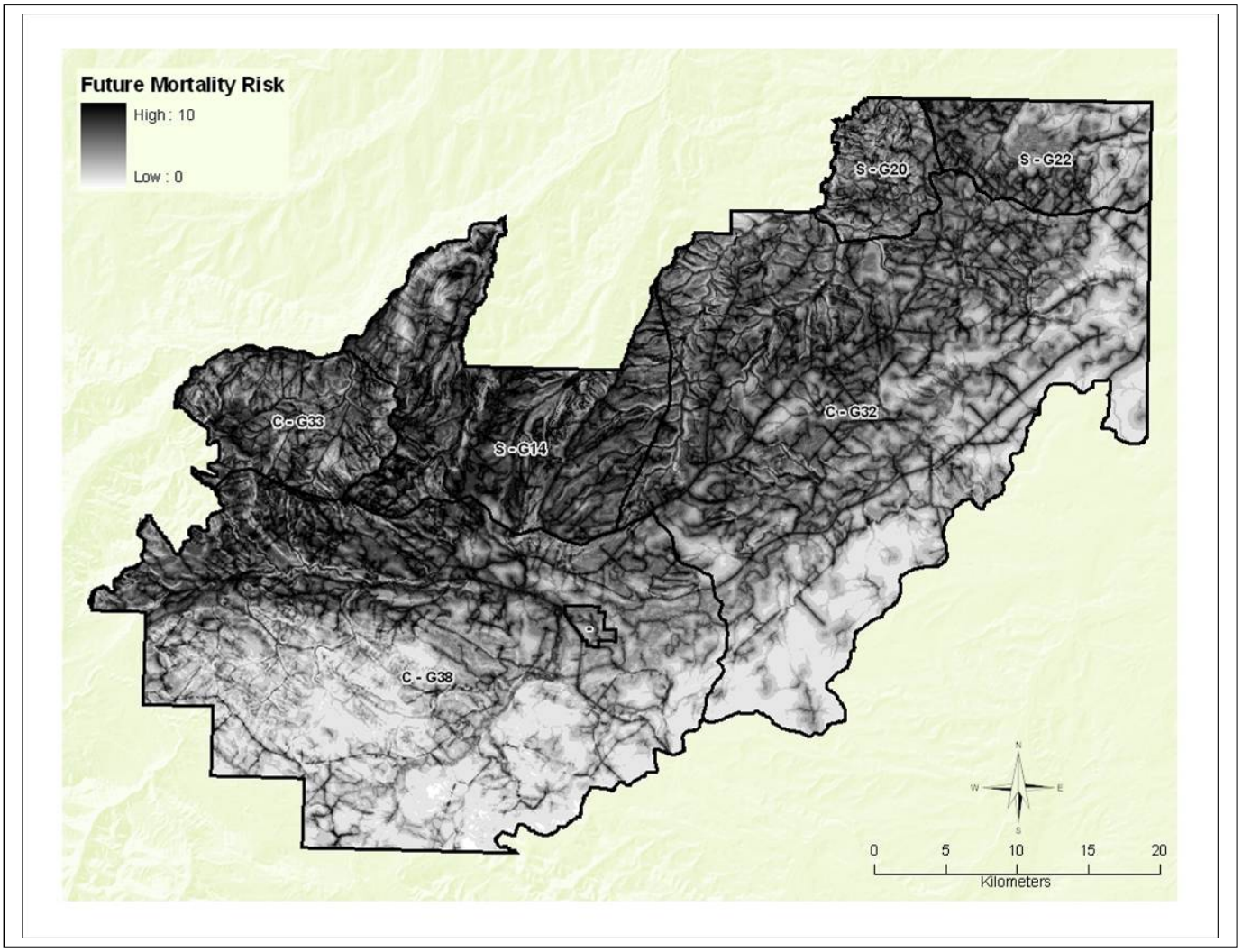


In GBWUs G38 and G32, the mean maximum RSF has increased because there was no existing harvest pattern and very few roads. The replacement of mature and overmature forest stands with early seral stages results in more grizzly bear habitat (higher RSF values). In GBWUs G14 and G20, the existing road network and harvest pattern means that RSF values will actually decrease.

1.6. Mortality Risk

The future average Mortality Risk for the FMU in the Core Areas is 4.91, while the average in the Secondary Areas is 6.83 (see Table 1). The range of Mortality Risk for the Core GBWUs is from 4.35 to 6.91 while the range for the Secondary GBWUs is from 5.61 to 7.46. Overall, there was a 9.7% increase in average Mortality Risk in the Core Areas and a 3.8% increase in the Secondary Areas (see Figure 8).

Figure 8: Future Mortality Risk

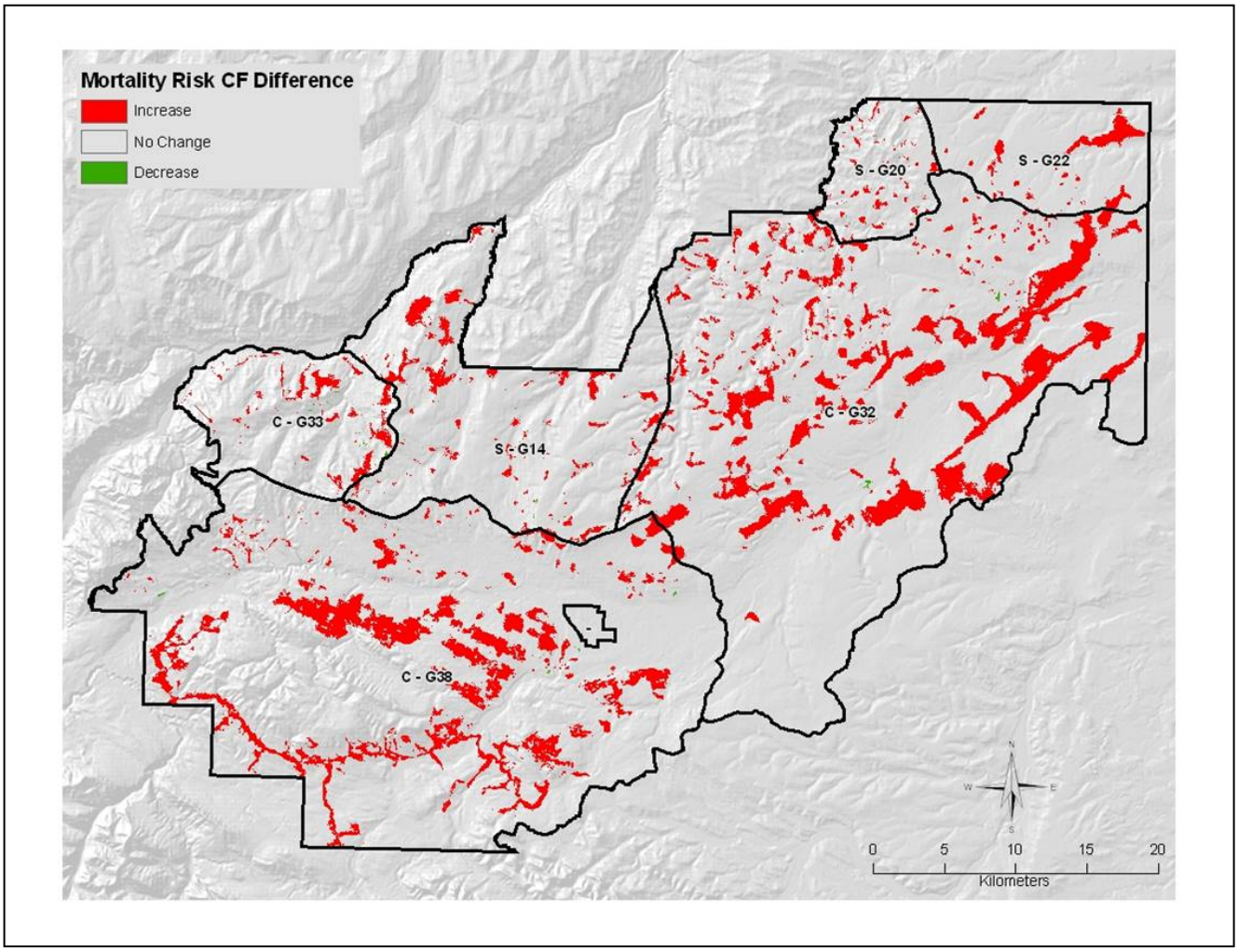


We know that the increasing number of roads and trails into grizzly bear habitat has increased the occurrence of bear-human interaction. Exposure to humans results in higher rates of mortality from human-bear encounters and poaching. As open access density increases, rate of grizzly bear survival decreases. It is estimated that 90% of all human-caused grizzly bear deaths occur within 500m of a road[17]. Increases in Mortality Risk, then, should act as a flag for resource managers that some mitigation measures may be necessary.

[17] Alberta Grizzly Bear Recovery Plan 2008-2013. 2008. Alberta Sustainable Resource Development, Fish and Wildlife Division, Alberta Species at Risk Recovery Plan No. 15. Edmonton, AB. 68 pp. page 9

By examining the differences between current and future Mortality Risk, we can see where mitigation measures might be most effective in reducing Mortality Risk. Figure 9 illustrates the differences in current and future Mortality Risk.

Figure 9: Comparison of Differences in Current and Future Mortality Risk

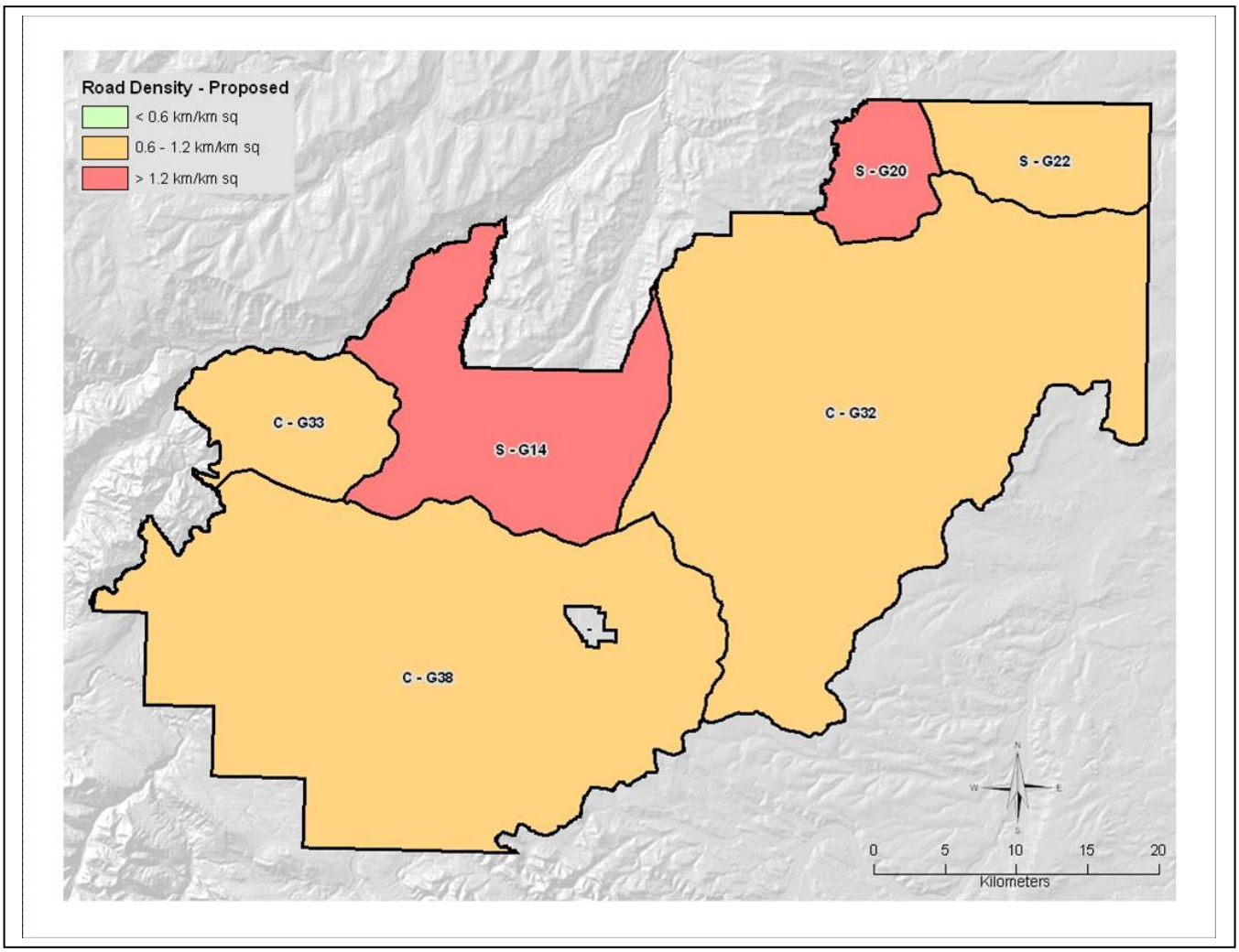


The greatest increases in Mortality Risk occur in GBWUs G38 (10.4%) and G32 (10.5%). These increases are a direct result of the new road network in the southwest portion of G38 and the southeast part of G32. Both of these areas have not had any previous harvesting and very little access. Mitigation options that could result in a lowering of the Mortality Risk should be examined.

1.7. Open Road Density

The future Open Road Density for the FMU in the Core Areas is 0.71 km/km^2, while the average in the Secondary Areas is 1.45 km/km^2 (see Table 1). The range of Open Road Density for the Core GBWUs is from 0.68 km/km^2 to 0.75 km/km^2 while the range for the Secondary GBWUs is from 0.97 km/km^2 to 1.70 km/km^2. Overall, there was a 43.3% increase in average Open Road Density in the Core Areas and an 11.5% increase in the Secondary Areas (see Figure 10).

Figure 10: Future Open Road Densities

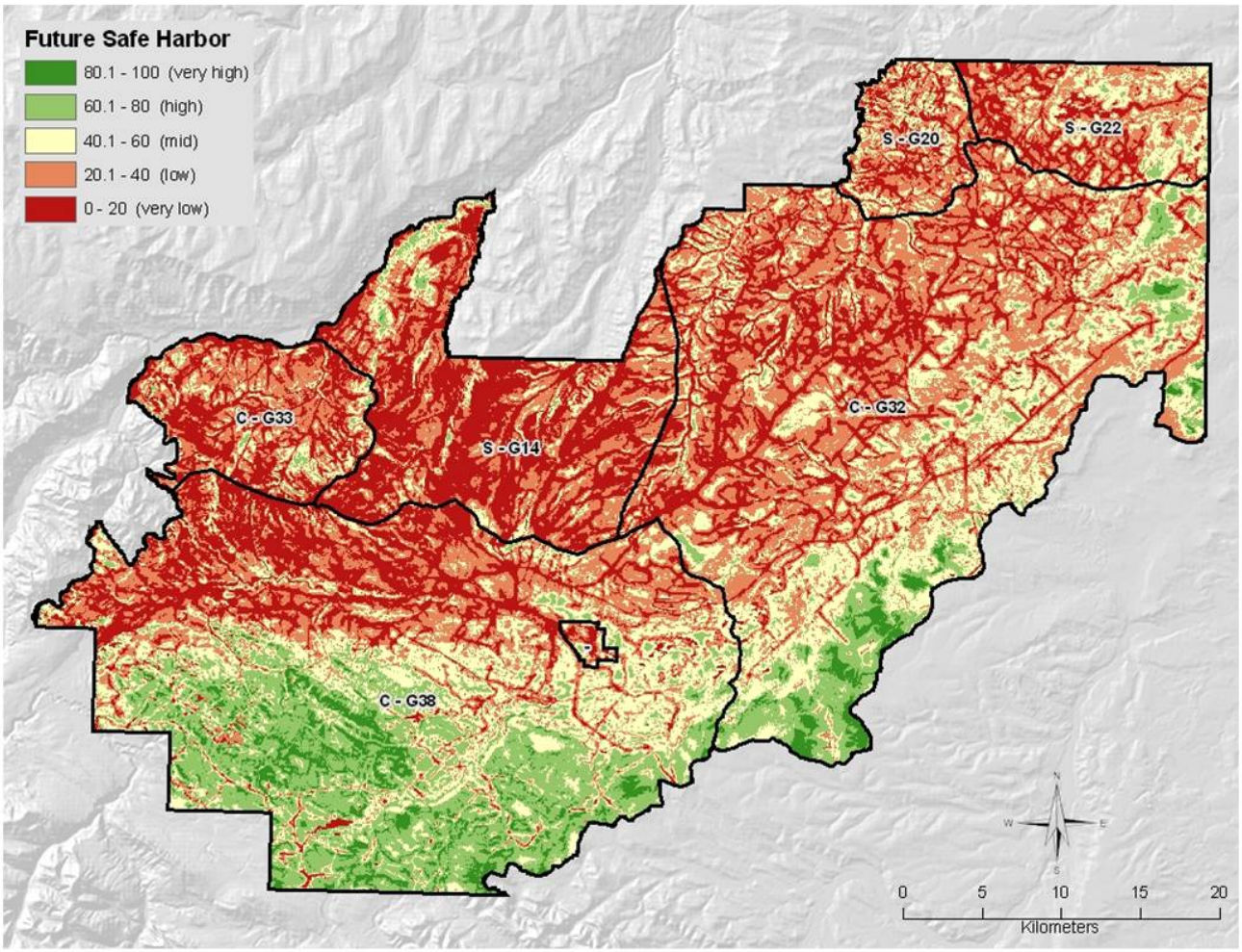


All the Core GBWUs (G32, G33 and G38) are predicted exceed the threshold recommended by the Grizzly Bear Recovery Plan (0.6 km/km^2) as do the secondary GBWUs (G14 and G20) (recommended threshold of 1.2 km/km^2). The greatest change in Open Road Density was in GBWU G38 (increase of 44.0%), again where there is no existing harvest pattern and currently few access features. Mitigation options for lowering Open Road Density in all GBWUs should be investigated.

1.8. Safe Harbour

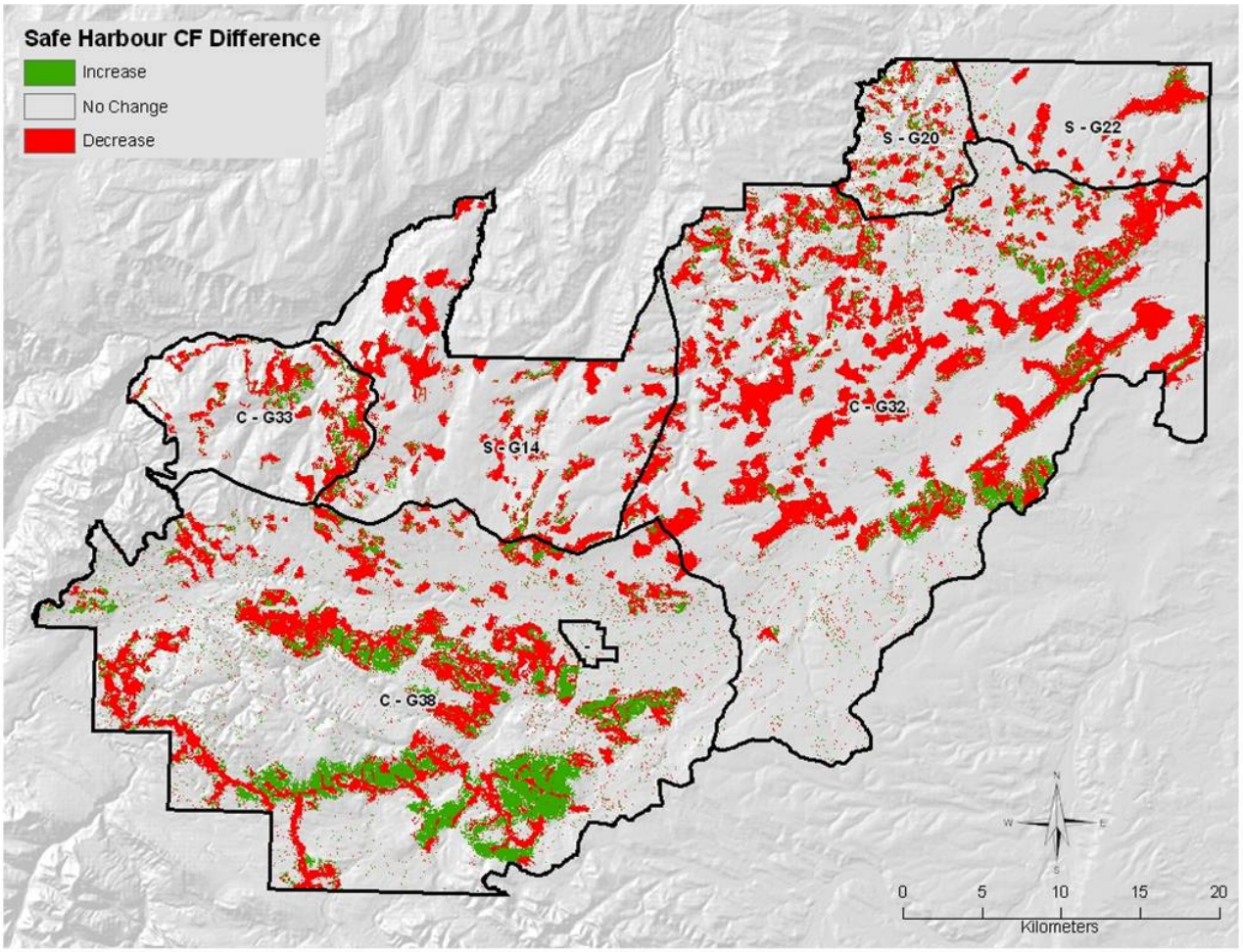
The future mean Safe Harbour for the FMU in the Core Areas is 41.51, while the average in the Secondary Areas is 26.56 (see Table 1). The range of mean Safe Harbour for the Core GBWUs is from 26.37 to 47.46 while the range for the Secondary GBWUs is from 22.69 to 33.33. Overall, there was a 4.2% decrease in mean Safe Harbour in the Core Areas and a 6.9% decrease in the Secondary Areas (see Figure 11).

Figure 11: Future Mean Safe Harbour



Typically, the creation of new openings in forested areas will result in an increase in RSF scores, due to the formation of edges and, in the case of forest harvesting, the replacement of mature or overmature stands with young seral stands. However, the construction of new access features that accompanies such development also leads to an increase in mean Mortality Risk. The Safe Harbour Index incorporates both these changes into a single value. Decreases in Safe Harbour are directly related to increases in Mortality Risk. By looking at the differences in current and future Safe Harbour (see Figure 12), we can see that the planned forest harvesting and road network negatively impact the amount and distribution of future Safe Harbour. There is an increase in Safe Harbour in some areas, due to the higher RSF values generated by harvesting.

Figure 12: Comparison of Differences in Current and Future Safe Harbour



1.9. Summary

Table 1 is a summary of the current and future RSF, Mortality Risk, Open Road Density and Safe Harbour for FMU E8, broken down by each GBWU as well as the FMU as a whole.

Table 1: FMU E8 - Mortality Risk, RSF, Open Road Density and Safe Harbour Summary

GBWU	Habitat	Area (km^2)	Index	Current	Future	Difference +/-	% Change
G32	Core	831.6	Mean Mortality Risk	4.67	5.16	0.49	10.5%
			Mean RSF (max)	8.07	8.26	0.19	2.3%
			Mean Safe Harbour	40.71	38.05	-2.65	-6.5%
			Open Road Density (km/km^2)	0.51	0.74	0.23	44.0%
G33	Core	121.3	Mean Mortality Risk	6.68	6.91	0.24	3.6%
			Mean RSF (max)	8.54	8.62	0.08	1.0%
			Mean Safe Harbour	27.93	26.37	-1.56	-5.6%
			Open Road Density (km/km^2)	0.53	0.75	0.22	40.6%
G38	Core	792.0	Mean Mortality Risk	3.94	4.35	0.41	10.4%
			Mean RSF (max)	8.18	8.51	0.33	4.1%
			Mean Safe Harbour	48.44	47.46	-0.98	-2.0%
			Open Road Density (km/km^2)	0.48	0.68	0.21	43.0%
G14	Secondary	271.6	Mean Mortality Risk	7.23	7.46	0.23	3.2%
			Mean RSF (max)	9.06	9.03	-0.04	-0.4%
			Mean Safe Harbour	24.72	22.69	-2.04	-8.2%
			Open Road Density (km/km^2)	1.59	1.70	0.12	7.4%
G20	Secondary	66.6	Mean Mortality Risk	6.01	6.24	0.23	3.7%
			Mean RSF (max)	8.54	8.49	-0.05	-0.6%
			Mean Safe Harbour	33.41	31.48	-1.94	-5.8%
			Open Road Density (km/km^2)	0.97	1.21	0.25	25.5%
G22	Secondary	107.1	Mean Mortality Risk	5.29	5.61	0.32	6.0%
			Mean RSF (max)	8.07	8.16	0.09	1.1%
			Mean Safe Harbour	35.14	33.33	-1.81	-5.2%
			Open Road Density (km/km^2)	0.80	0.97	0.17	21.2%
FMU	**Habitat**	**Area (km^2)**	**Index**	**Current Mean**	**Future Mean**	**Difference +/-**	**% Change**
E8	Core	1745.0	Mean Mortality Risk	4.48	4.91	0.44	9.7%
			Mean RSF (max)	8.15	8.40	0.25	3.0%
			Mean Safe Harbour	43.33	41.51	-1.82	-4.2%
			Open Road Density (km/km^2)	0.50	0.71	0.22	43.3%
	Secondary	445.3	Mean Mortality Risk	6.58	6.83	0.25	3.8%
			Mean RSF (max)	8.75	8.74	-0.01	-0.1%
			Mean Safe Harbour	28.53	26.56	-1.97	-6.9%
			Open Road Density (km/km^2)	1.30	1.45	0.15	11.5%

Highlighted cells flag results that should be cause for review/mitigation by forest managers.

Options for Mitigation

Mitigation measures fall into two categories: tactical and strategic. Tactical mitigation measures include techniques that can be applied to the current plan to reduce the effect on grizzly bear habitat. Strategic mitigation measures may involve altering the plan itself.

Options for mitigating the effect of new developments on grizzly bear habitat include:

- Redesign harvest to increase edges (irregular)
- Leave visual buffers around key habitats
- Change timing of operations to seasons of lower occupancy
  - after denning (winter)
  - evaluate spring, summer, fall RSF and choose season of lowest occupancy
- Control of public access
  - locked gates
  - removal of access structures
    - stream crossings
    - re-contour and re-vegetate roads
    - create barriers of felled trees across seismic line/road crossings
    - spread slash over seismic lines
- Clear road life plans to improve deactivation and/or removal after harvest