



**Kettle Range**  
CONSERVATION GROUP

## **Area Analysis of Key Ecosystem Components in in Hunter Mountain Late-Successional Reserve and Hungry Hunter Environmental Assessment**

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This report, the treatment spreadsheet and Arcview shapefiles are online at:  
[www.okanogan1.com/natural/ecology/hh](http://www.okanogan1.com/natural/ecology/hh)

### **Background**

This report contains analysis documents submitted to the Okanogan-Wenatchee National Forest for the Hungry Hunter Ecosystem Management Project Environmental Assessment (EA).

There is a need to evaluate ecosystem management projects using a geographic information system (GIS). A GIS provides information on the spatial arrangement of management units under different environmental and managerial scenarios.

Kettle Range Conservation Group evaluated the EA using GIS procedures to determine the impacts on key ecosystem components. These analyses determined likely treatment impacts on key ecosystem components including old growth and mature forests, Late-Successional Reserves, RARE II roadless areas, uninventoried roadless areas, unsuitable harvest areas, distance to wildland-urban interface (WUI) zones, wetlands, unroaded road density, and forest connectivity. The GIS analyses were combined with information from numerous field visits made over a 4-year period, which substantiate the general conclusions within this report.

### **Methods**

Our analyses determined likely treatment impacts from on the following ecosystem components: old growth / mature forests, Late-Successional Reserves, RARE II roadless areas, uninventoried roadless areas, unsuitable harvest areas, distance to wildland-urban interface (WUI) zones, wetlands, unroaded road density and forest connectivity.

The treatment area boundaries were created by digitally scanning timber sale maps and converting these to feature (polygon) shape files. The maps were overlaid onto digital orthophotos. Additional layers added included streams, roads, vegetation cover types, digital raster graphics, vegetation seral stages, and USDA Forest Service online data.

Layers created for this analysis include the following:

- RARE II roadless areas
- uninventoried roadless areas
- late-successional reserve (LSR) areas designated in the Northwest Forest Plan
- late-seral and structured mature forest stands determined by photo-interpretation
- unsuitable harvest areas
- wetland areas buffered by 300 feet
- wildland-urban interface (WUI) buffer around private structures, divided into intervals of 0.5 miles

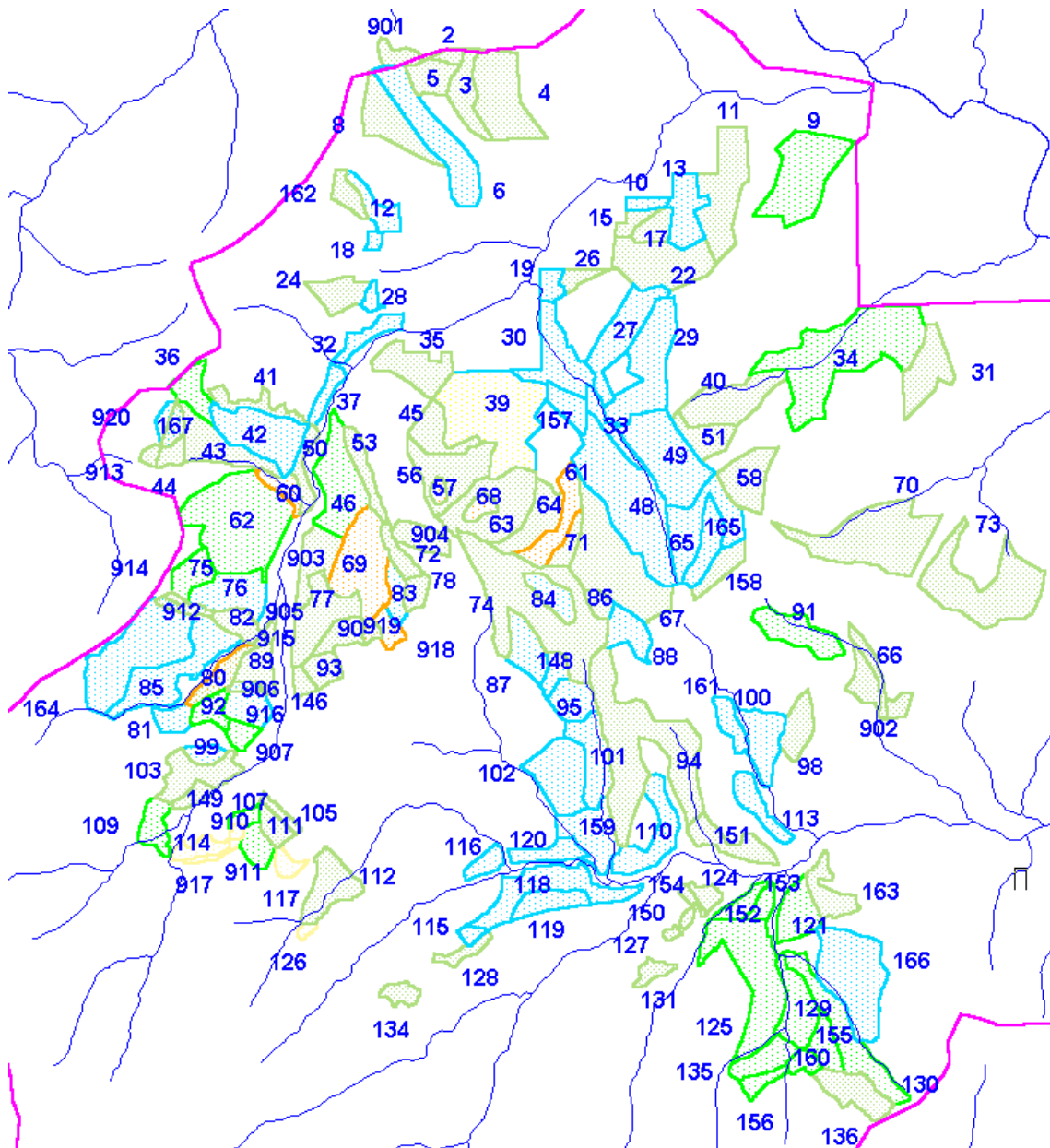


Fig. 1. A map of the units is illustrated above; descriptions are in Appendix A:

All of the data layers were exported to an external DBASE4 database and linked to the stand ID field so that there was one record for each of the 151 polygons representing treatment units. The table was added into Arcview and joined to the treatment unit layer and used to create a new shape file containing all of the fields above. The shapefile containing this information linked with the unit boundaries is referred to here as *Units-12*.

The unit numbers for the treatment areas were retained in cases where the original unit boundaries did not change shape, but new unit numbers were assigned in the sequence from 901-920 for polygons which had to be split out to allow different treatment proposals to be selected.

## Results

### Analysis 1. Mapping accuracy

Our GIS unit maps were compared with the acreage figures in the EA on pp. 2-6 to 2-10 to determine the following levels of agreement between our mapping efforts and that of the Forest Service.

**Discussion.** For each treatment under all alternatives, the two largest differences were 6.5 % and 8 %, neither of which represented more than about 4 acres. Therefore the agreement in unit size between our GIS maps and those of the Forest Service can be considered acceptable for comparative analyses.

**EA map discrepancies.** One of the initial objectives of this analysis was to independently identify inaccuracies or unaccounted assumptions made in the EA. The EA maps did not use a consistent delineation of stands for each alternative, making it difficult for comparisons to be made between alternatives. Because stands are not the same size and shape for each alternative, the EA was inconsistent and sometimes erred in describing likely impacts for each alternative. Because of this, the EA information on stand shapes, acreages, numbers and treatments should be corrected and used to run the analyses again. This will be necessary to establish accurate baseline data before monitoring can begin.

To correct the errors in our analyses, all of the stands from each different alternative were intersected which resulted in the creation of 20 new unit polygons. From this new map of proposed harvest treatment areas, it was possible to determine mapping inconsistencies in the EA. The mapping inconsistencies are described below.

- unit 005 is a different shape in different alternatives
- unit 026, alternative 3 is not in the EA list of stands in appendix C-4
- unit 041, alternative 3, is not in the EA list of stands in appendix C-4
- unit 044 is a different shape in different alternatives
- unit 044 is part of unit 167 in different alternatives
- unit 057 listed as ST in the EA appendix C-4 is not included in the map of alternative 4
- unit 061 listed as ST in the EA appendix C-4 is not included in the map of alternative 4
- unit 066 is a different shape in different alternatives
- unit 068 listed as ST in the EA appendix C-4 is not included in the map of alternative 4

- unit 069 is a different shape in different alternatives
- unit 069 listed as ST in the EA appendix C-4 is not included in the map of alternative 4
- unit 069 overlaps unit 090 in different alternatives
- unit 072 is a different shape in different alternatives
- unit 072 overlaps unit 078 in different alternatives
- unit 072, alternative 3, is not in the EA list of stands in appendix C-4
- unit 077 is a different shape in different alternatives
- unit 078 overlaps unit 072 in different alternatives
- unit 082 is a different shape in different alternatives
- unit 082 overlaps unit 089 in different alternatives
- unit 089 is a different shape in different alternatives
- unit 089 overlaps unit 082 in different alternatives
- unit 089, alternative 3, is not in the EA list of stands in appendix C-4
- unit 090 overlaps unit 069 in different alternatives
- unit 091 listed as BT in the EA appendix C-4 is not included in the map of alternative 4
- unit 092 is a different shape in different alternatives
- unit 092 overlaps unit 093 in different alternatives
- unit 093 doesn't exist in some alternatives
- unit 093 is a different shape in different alternatives
- unit 093 is in two different places under different alternatives
- unit 093 overlaps unit 092 in different alternatives
- unit 095 is listed as Biomass thin in appendix C-4, but it is Harvest Thin on the alternative 3 map
- unit 099 is a different shape in different alternatives
- unit 100 listed as HT in the EA appendix C-4 is not included in the map of alternative 4
- unit 103 is a different shape in different alternatives
- unit 107 is a different shape in different alternatives
- unit 113 listed as HT in the EA appendix C-4 is not included in the map of alternative 4
- unit 114 is a different shape in different alternatives
- unit 117 is a different shape in different alternatives
- unit 121 listed as BT in the EA appendix C-4 is not included in the map of alternative 4
- unit 121 listed as BT in the EA appendix C-4 is not included in the map of alternative 4
- unit 130 listed as BT in the EA appendix C-4 is not included in the map of alternative 4
- unit 136 listed as BT in the EA appendix C-4 is not included in the map of alternative 4
- unit 149 is not shown as separate from unit 103 on the alternative 3 map
- unit 152 listed as BT in the EA appendix C-4 is not included in the map of alternative 4
- unit 153 listed as BT in the EA appendix C-4 is not included in the map of alternative 4
- unit 155 listed as BT in the EA appendix C-4 is not included in the map of alternative 4
- unit 156 listed as BT in the EA appendix C-4 is not included in the map of alternative 4
- unit 160 listed as BT in the EA appendix C-4 is not included in the map of alternative 4
- unit 161 listed as HT in the EA appendix C-4 is not included in the map of alternative 4
- unit 166 listed as BT in the EA appendix C-4 is not included in the map of alternative 4
- unit 167 is a different shape in different alternatives
- unit 167 overlaps unit 044 in different alternatives

## Analysis 2. Determination of roaded areas

To determine roaded areas in the analysis area, the roads layer of the Okanogan National Forest was overlaid onto the orthophotos and digital raster graphics maps and adjusted using photo-interpretation. The road layer is only slightly different from the one in the EA (fig. 2).

**Discussion.** Our road maps are reasonably consistent with those in the EA, however a few errors have likely affected the road density calculations in the EA. There are ghost roads (roads which do not exist, in purple) evident where no road is apparent on the 1998 orthophotos. There are also several miles of roads not included in the EA such as the one crossing the analysis boundary on the center right (fig. 2), which was not included in the road mileage analysis. Overall there are about as many errors of commission as omission between the maps.

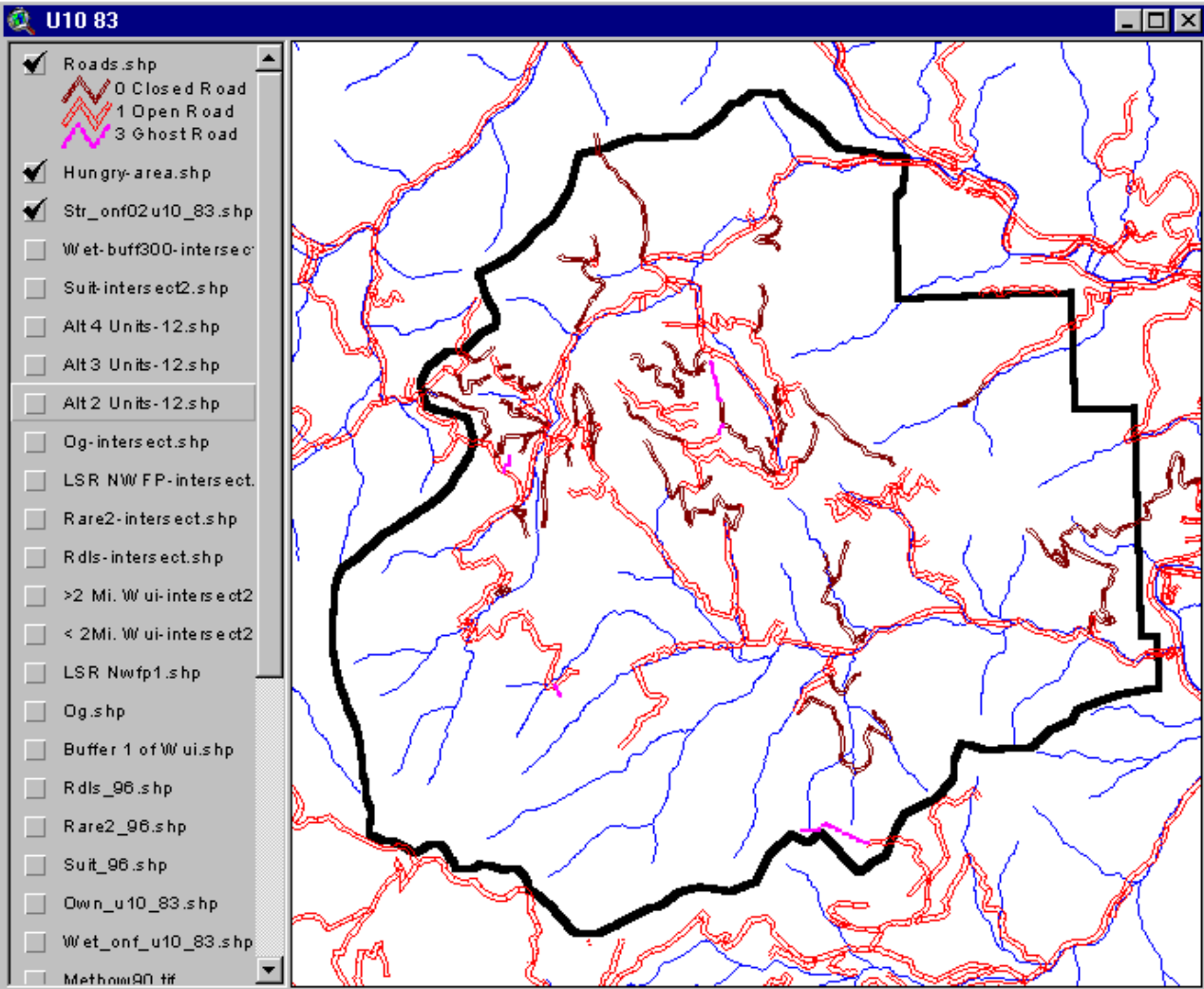


Fig. 2. Road layer

During field visits, closed roads were found to be impacting the environment significantly in a number of different ways. Many closed roads had scattered patches of weeds, which are spreading in an uncontrolled fashion due to the fact that there is no effective way to inspect these roads. Almost all roads at lower elevations had degraded, bare surfaces with soil compaction. During frequent cattle movements, the sandy ash-cap soils formed clouds of dust which could be seen for miles. Many closed roads had blocked culverts and eroding cut banks in some places. Most of the old roads were used as logging and skidding roads in the past, and have compacted soils, which in our experience, respond poorly to attempts at scarification and planting of pasture grasses for "remediation". Off-road vehicles use the closed roads for recreation.

The impact of closed roads is a chronic problem which requires better management of cattle grazing to correct. The primary impacts from roads is on soils, weed distribution, ORV disturbance and hydrology.

### Analysis 3. Determination of road densities

The EA contained an analysis of *open* road density however, a significant amount of impact is occurring due to cattle, weed invasion, erosion and ORVs on closed roads. We analyzed the area to determine which units are being impacted by closed roads.

Higher road densities that were omitted from the EA were scored with a "1" in the unit shapefile Units-12.shp (see table at end of document). Units which will have greater impacts than documented in the EA are 36, 39, 42, 43, 44, 46, 48, 49, 53, 56, 57, 60, 62, 63, 65, 67, 68, 69, 74, 77, 87, 89, 103, 165, 167, 903. These units are illustrated below.

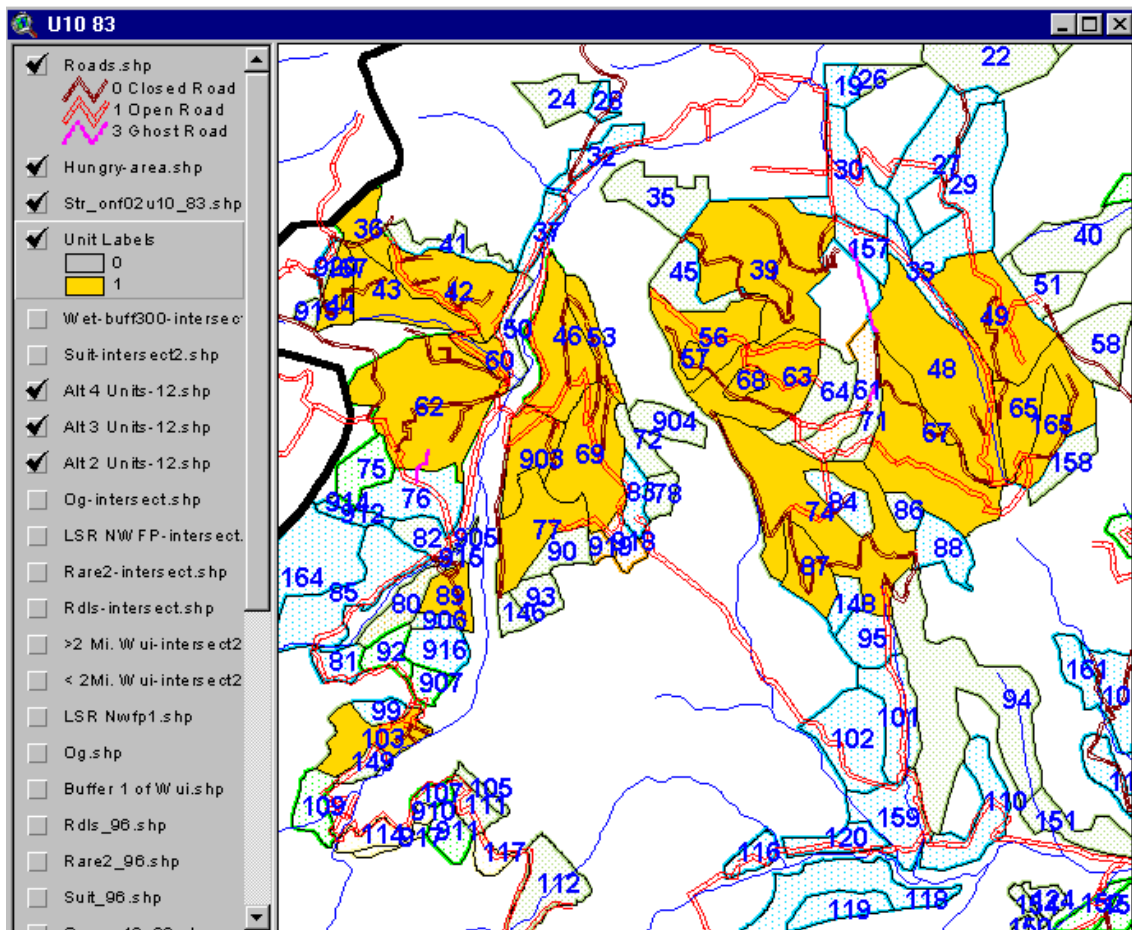


Fig. 3. Road densities.

### Analysis 4. Determination of roadless areas

To determine where proposed treatments occur in roadless areas the unit boundaries were intersected with both inventoried and uninventoried roadless areas. Units overlapping RARE II roadless areas (fig. 4, red) are 105, 107, 111, 112, 114, 117, 126, 134, 910, 911, 917.

Units overlapping uninventoried roadless areas shown in purple in fig. 4. These units are 2, 3, 4, 5, 6, 8, 9, 11, 12, 13, 15, 17, 19, 22, 24, 26, 27, 29, 30, 31, 34, 40, 41, 42, 49, 51, 58, 66, 70, 73, 75, 76, 77, 80, 81, 82, 85, 89, 90, 92, 93, 99, 102, 103, 105, 107, 109, 110, 111, 112, 114, 115, 116, 117, 118, 119, 120, 121, 124, 125, 126, 127, 128, 129, 130, 131, 134, 135, 136, 146, 150, 152, 153, 154, 155, 156, 159, 160, 162, 163, 164, 166, 901, 902, 903, 906, 907, 910, 911, 912, 914, 916, 917, 918, 919.

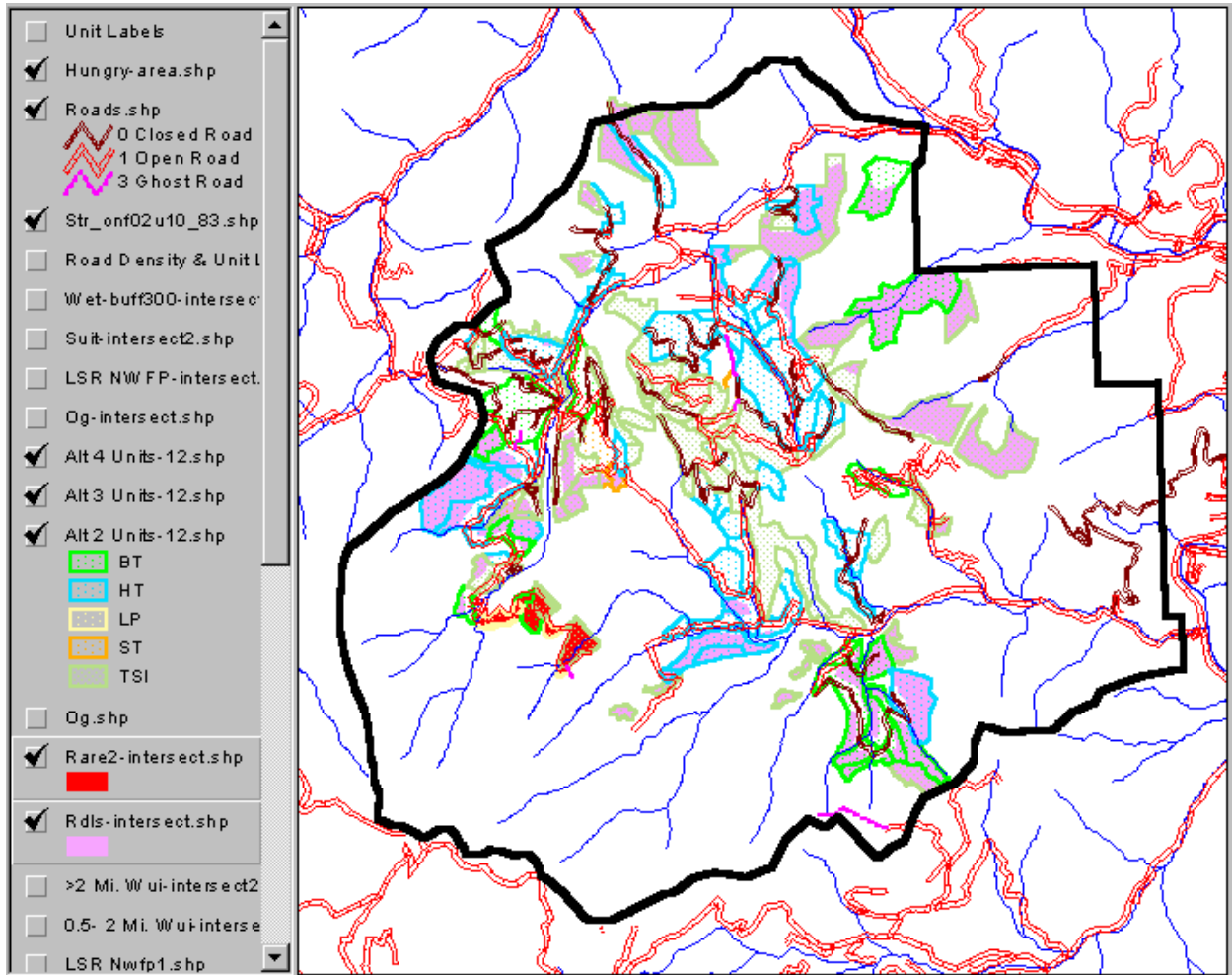


Fig. 4. Units overlapping inventoried roadless areas (red) and uninventoried roadless areas (purple).

**Discussion.** Roadless areas have intact soil strata that should be protected from disturbance by ground-breaking machinery. The Northwest Forest Plan designation of the Hungry-Hunter Late Successional Reserve and Matrix lands would not be fulfilled if significant ground disturbances occurred in the soils supporting these stands. These areas may not be compatible with tractor implementations of Harvest Thinning, Biomass Thinning, Seed-Tree cutting or Regeneration cutting, however TSI and controlled burning may be compatible. We recommend that some or all of the above units with ground-breaking management plans be changed to eliminate ground-disturbing machinery.

### Analysis 5. Determination of LSR zones

To determine proposed harvest areas within LSR zones the unit boundaries were intersected with the Hunter Mountain LSR. Units that overlap LSR zones (fig. 5, purple) are: 31, 66, 67, 70, 73, 88, 91, 98, 100, 113, 121, 124, 125, 129, 130, 135, 136, 151, 152, 153, 154, 155, 156, 158, 160, 161, 163, 166, 902.

### Analysis 6. Determination of old growth and structured mature zones

To determine proposed harvest areas within stands containing old growth and mature trees, the unit boundaries were intersected with the delineation of old growth and structured mature forests digitized on screen using the digital orthophotos as a base image and using photo-interpretation of shadows and crown size to determine structure. In units that contained more than one polygon after the intersection, the areas of the separate polygons were added together and made into a single record before exporting to external files.

Units that overlap old growth areas (fig. 5, red) are: 9, 19, 26, 32, 35, 39, 45, 46, 48, 49, 50, 53, 56, 58, 61, 65, 67, 69, 72, 73, 77, 78, 83, 93, 103, 107, 110, 111, 114, 118, 121, 130, 146, 149, 152, 153, 163, 904, 905, 910, 911, 917, 918.

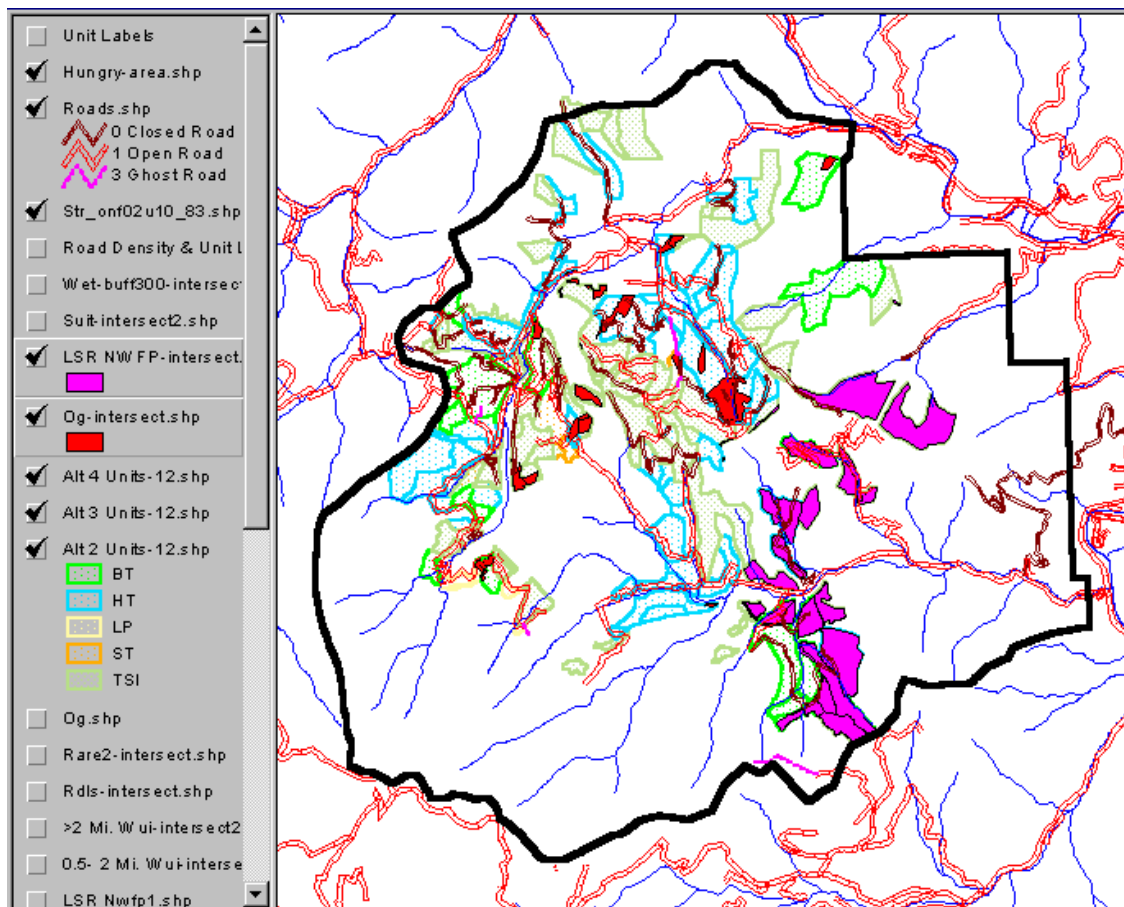


Fig. 5. Areas where unit boundaries overlap LSRs (purple) or old growth (red).

**Discussion.** An example of stands identified by photo-interpretation of mature forest is shown in fig. 6 in red (unit 73), within two units planned for TSI under Alternative 3 or Alternative 2. For conservation of mature forests (or potential future late-seral forests) it is important that treatments not remove the older components of the stand, or break up the corridors connecting these stands within the open areas.

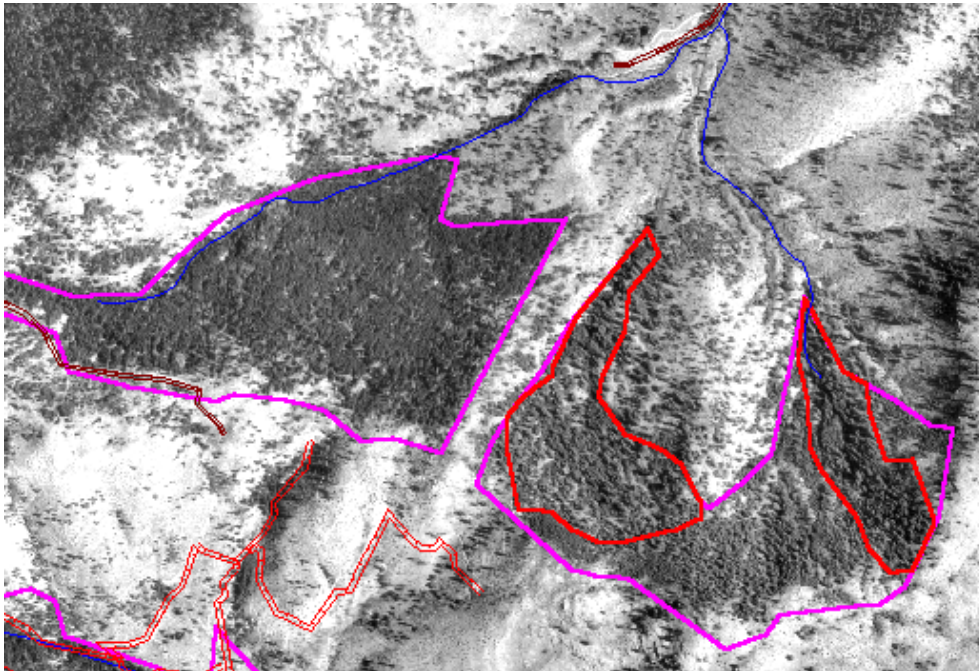


Fig. 6. Aerial imagery of old growth in unit 73 (red outline).



Fig. 7. Illustrations of old growth found in units 70 and 73.

Another example of late-seral / mature structured forest is shown in fig. 8. This is an area where TSI is planned.

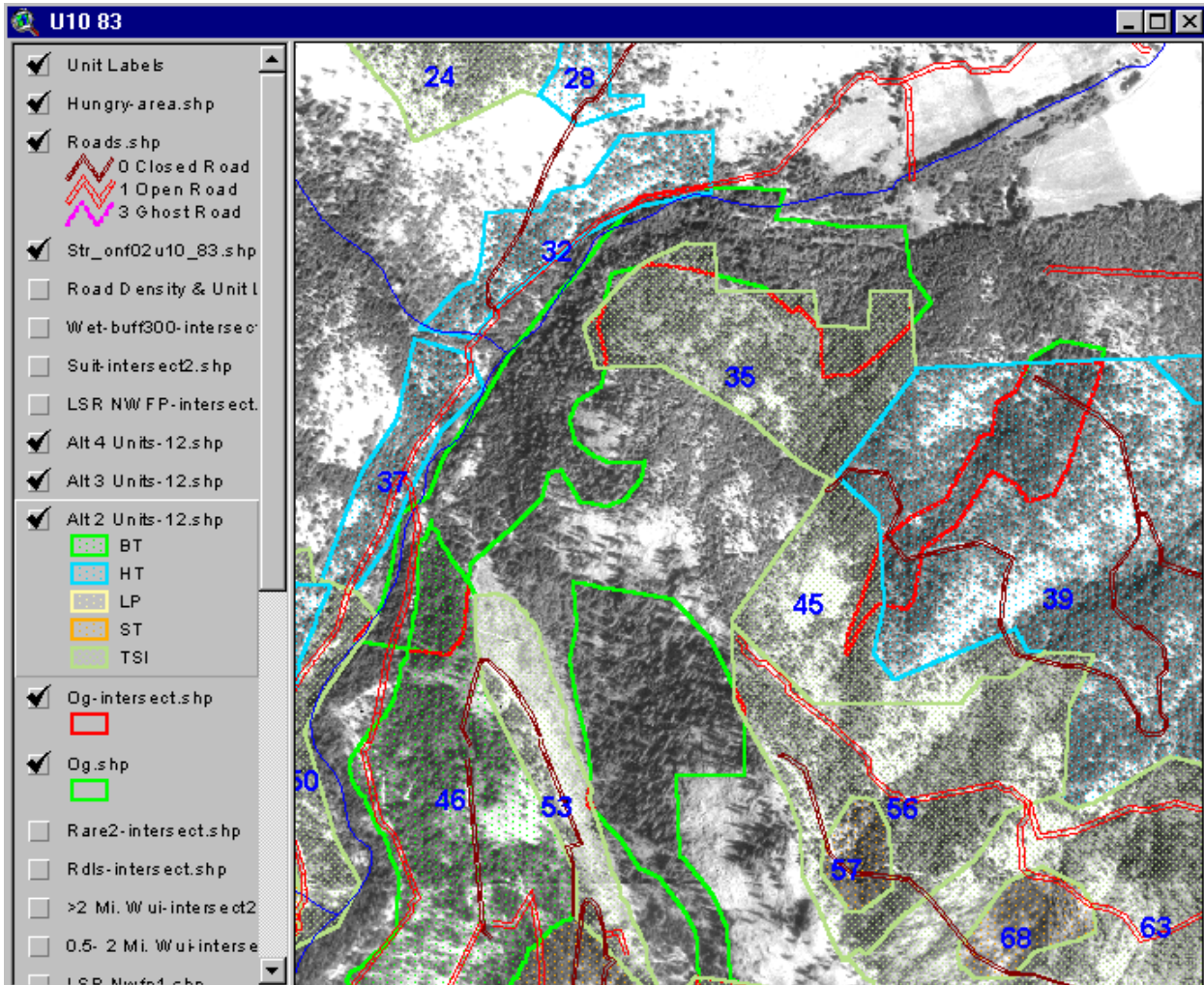


Fig. 8. Late-seral and mature structured forest in green and red, overlapping unit boundaries in blue.

The use of digital orthophoto interpretation to identify stands of old growth or mature-structured stands is useful for protecting areas within the Northwest Forest Plan. As long as treatments only involve hand crews without the use of ground-disturbing machinery, this is an acceptable management option which we can support. To sustain late seral forests under the Northwest Forest Plan, there should be no significant overstory removal within the LSRs or mature stands, nor fragmentation of the forest connectivity.

#### Analysis 7. Determination of suitable harvest areas

The EA defers harvest only within areas designated as suitable. To determine which proposed harvest units were located on suitable forest, the unit boundaries were intersected with the suitable areas layer from the Okanogan National Forest. In units

which contained more than one polygon after the intersection, the areas of the separate polygons were added together and made into a single record before exporting to external files. Units that overlap areas unsuitable for timber harvest are 37, 39, 48, 53, 61, 69, 70, 72, 73, 74, 78, 83, 95, 101, 102, 112, 120, 126, 134, 148, 159, 904, 918. The unit boundaries which overlap areas unsuitable for timber harvest are shown in fig. 9 in purple.

### Analysis 8. Determination of wetland buffers

To determine which proposed harvest units were within 300 feet of wetlands, the unit boundaries were intersected with a 300-foot buffer zone around all National Wetlands Inventory Wetlands. Units which overlap areas within 300 feet of NWI wetlands are 9, 77, 93, 118, 120, 146, 159, 901. These are shown in fig. 9 in red.

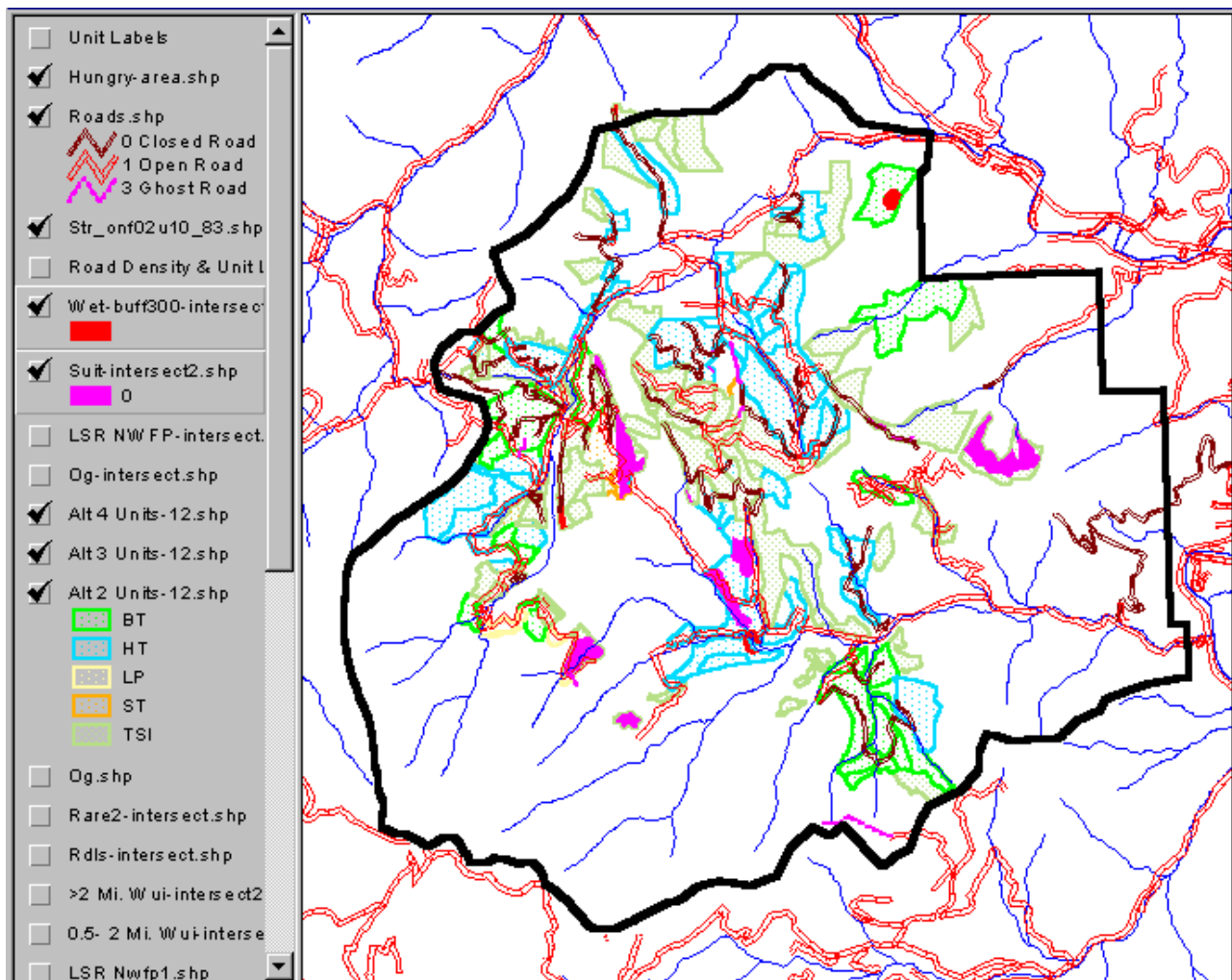


Fig. 9. Unit boundaries which overlap areas unsuitable for timber harvest (purple) or areas within 300 feet of NWI wetlands (red).

**Discussion.** There should be no timber harvest using ground machinery in areas designated unsuitable for harvest. Any units listed above as unsuitable should be

dropped from consideration for management involving machine-based ground disturbances.

Forested wetlands respond to soils more than to shade tolerance. This is their primary difference from upland forests. In addition, wetlands differ from riparian areas because their soils are low in nutrients. Specialized plants grow in wetlands due to their tolerance of anaerobic soil conditions. In the Hungry-Hunter area, wetlands are of limited extent.

Timber harvest within 300 feet of wetlands will have negative impacts on hydrology, grazing patterns, water quality, and development of late-seral forest structure. In view of these strong constraints, no timber harvest should occur in the units above listed within 300 feet of wetlands. TSI is not recommended in these areas either, however wetland restoration, beaver re-introduction, and livestock management would be appropriate.

### **Analysis 9. Determination of WUI zones**

To determine proposed harvest areas within WUI zones the unit boundaries were intersected with a buffer zone around all structures, in intervals of 0.5 mile (see fig. 10). A large number of treatment units were split across the WUI distance boundaries. When exported to an external file, only the shortest distances to WUI zones were included in the spreadsheet.

Units which are further completely lying beyond 2 miles from the WUI zone are: 81, 92, 99, 103, 105, 107, 109, 111, 112, 114, 115, 116, 117, 126, 128, 134, 149, 164, 906, 907, 910, 911, 916, 917.

Units which are between 1.5 to 2 miles and possibly overlapping beyond 2 miles from the WUI zone are: 75, 76, 80, 82, 85, 86, 87, 88, 89, 90, 93, 95, 101, 102, 119, 120, 146, 148, 158, 905, 912, 913, 914, 915, 918, 919.

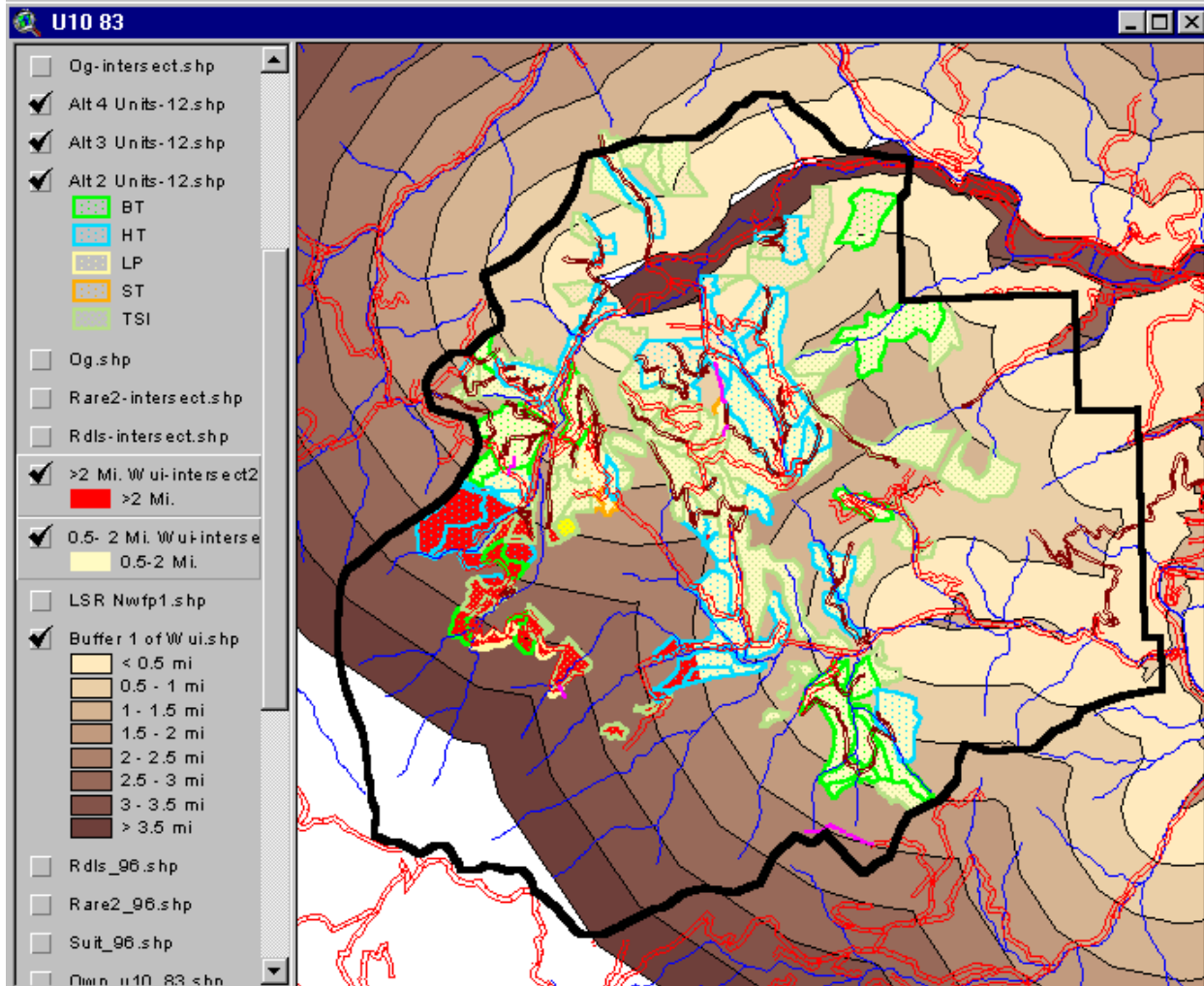


Fig. 10. Unit boundaries which are beyond 2 miles of the WUI zone (red) and units which are from 0.5 to 2 miles (yellow).

**Discussion.** The use of crown fire potential risk beyond a half mile from houses and structures does not have broad scientific or community support. Several legal definitions use distances of up to 2 miles for designation of a WUI zone. The purpose and need should be changed so that it does not advocate benefits to human communities and structures from treatments lying beyond 0.5 miles of a WUI zone. Treatments beyond 0.5 mile of structures may be acceptable if they are intended to accomplish ecosystem management.

Management should include a discussion of the trade-offs from fuels management. A thorough discussion was given in the A to A EA by Chelan Ranger District. Thinning has been shown to be ineffective at reducing the severity unless it is accompanied by removal of fuel (van Wagendonk, 1996). The A to A project noted that even if fuels are effectively removed, the rate of fire spreading will be up to 10 times higher following thinning due to increased rates of drying and wind speeds in open stands. Treatments proposed in the Hungry Hunter project that do not plan for regular removal of fine fuels have a possibility of increasing the risk of fire to nearby communities. This

should be frankly discussed with those living in the area. In the event of a fast-moving surface fire that travels from a thinned unit to houses, the Forest Service could be found liable.

### Analysis 10. Forest fragmentation

To examine fragmentation of forested cover, the layers containing all treatment units under all alternatives was overlaid onto a digital orthophoto depicting forested areas. The location of forested corridors that could be fragmented by at least one alternative under the Hungry-Hunter proposal is shown in fig. 11.

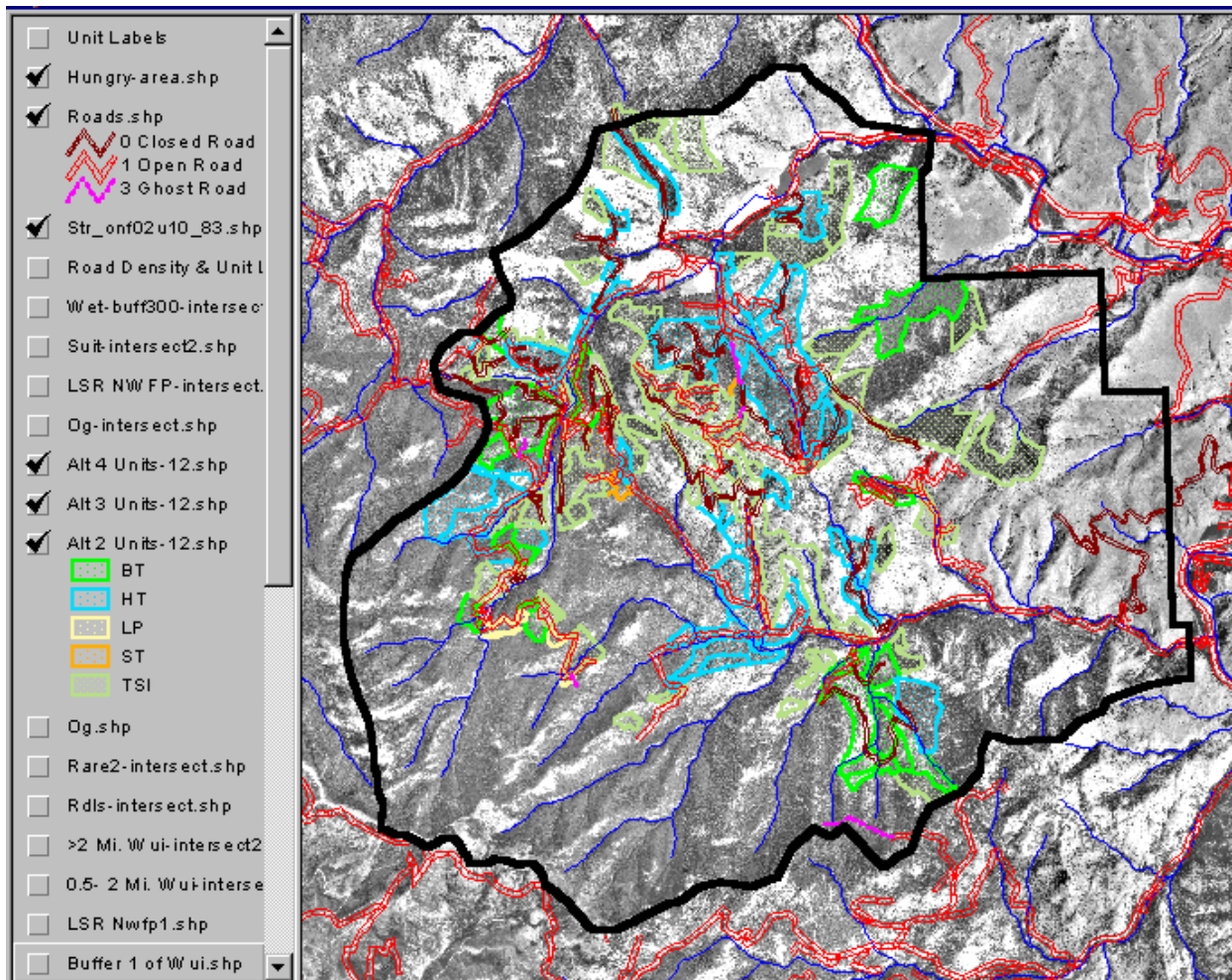


Fig. 11. Forested corridors that could be fragmented by at least one alternative under the Hungry-Hunter proposal

All of the proposed management activities, including controlled burning have the potential to fragment forested corridors. Corridors were identified by the Methow Ranger District "Assessment of the Northeastern Cascades Late-Successional Reserves" (1988). Units which are likely to fragment intact forested corridors are shown in fig 12. These units are 31, 34, 36, 62, 75, 76, 82, 85, 130, 136, 155, 160, 164, 912.

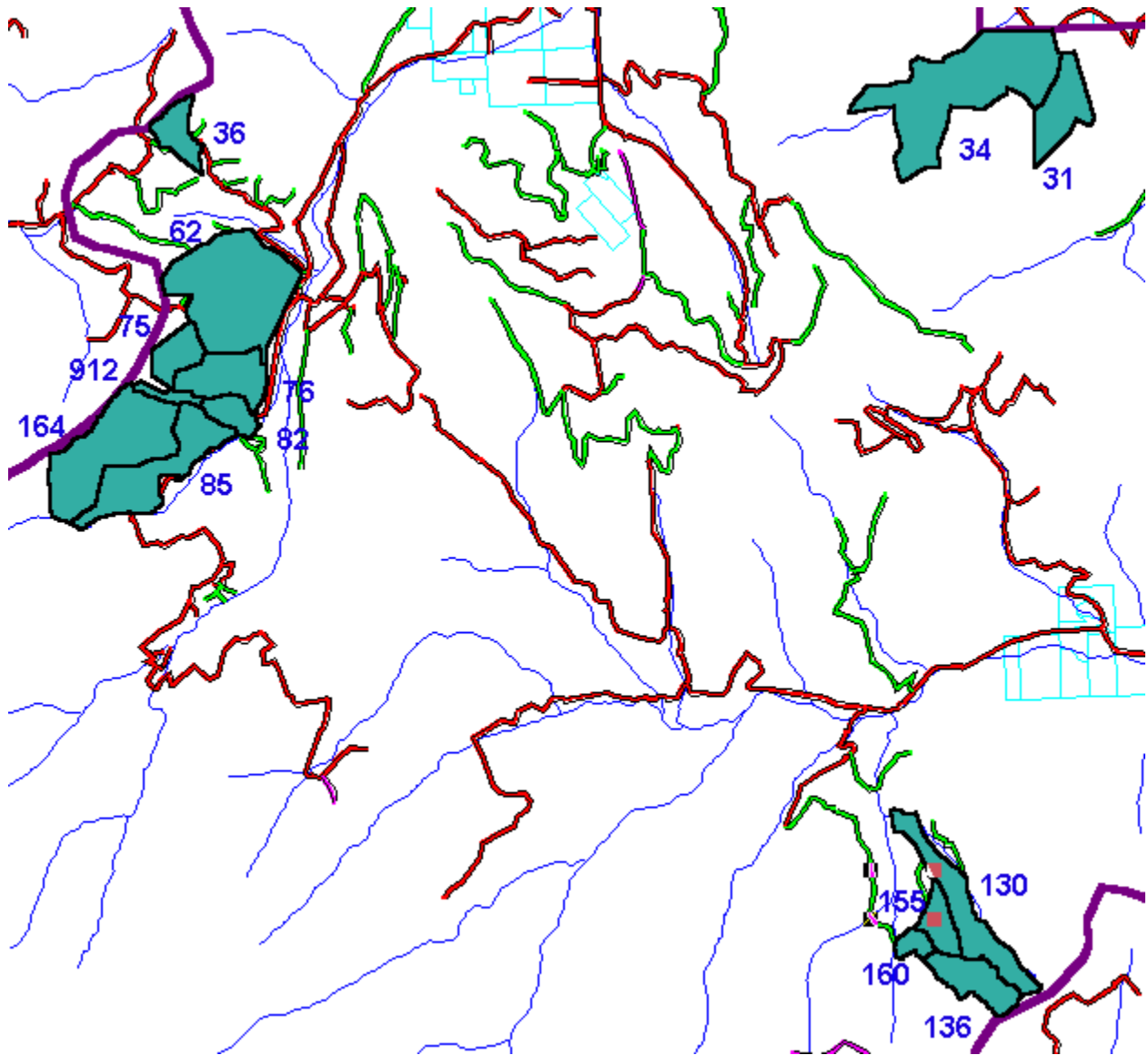


Fig. 12. Units which are likely to fragment intact forested corridors.

**Discussion.** To be consistent with the Northwest Plan, units that will fragment forest connectivity should be mitigated in the EA. In view of the significant other disturbances occurring in this area at this time, it is recommended that all harvest treatments including TSI in these key connectivity corridors be put off for one decade to provide for late-seral wildlife protection in the interim recovery period for the area.

### Analysis 11. Cumulative impacts

Cumulative impacts were assessed by considering all of the impacts determined from the above analysis in a single spreadsheet. This spreadsheet is printed as a table below. A decision-key for scoring the units is presented first.

The decision key below can be used to determine which units need modification. Units that may need modification, or being dropped from the proposal, are highlighted in **red** in the table, along with the treatment and environmental concern impacted by that treatment. Units with strong concerns which need to be considered are marked in **blue**. Note that the recommendation only applies to the portion of the unit overlapping the impact area, however any unit which is partly dropped should still receive a cautionary review for the rest of the unit. Units with different treatments in different alternatives are scored based on the highest impact, however each alternative is also scored so that the source of the impact can be determined. The procedure for determining whether a unit should be considered for modification is as follows:

(Note: in this key units 57 and 60 use helicopters, and thus are not included as ground-based mechanical harvest). WUI distance is not analyzed in this key.

<b>Impact</b>	<b>Precluded harvest (red)</b>	<b>Cautionary harvest (blue)</b>
RARE II	>0.2 ac (total of all impacts) of ground-based mechanical (BT, LP, HT, ST)	
Roadless		>0.2 ac (total of all impacts) of ground-based mechanical (BT, LP, HT, ST)
LSR	>0.2 ac (total of all impacts) of overstory >7" removal (HT, ST)	>0.2 ac (total of all impacts) of ground-based mechanical (BT, LP)
Old growth /mature	>0.2 ac (total of all impacts) of overstory >7" removal (HT, ST)	>0.2 ac (total of all impacts) of ground-based mechanical (BT, LP)
Unsuitable	ground-based mechanical (BT, LP, HT, ST)	TSI, helicopter units
Wetland	all harvests (BT, LP, HT, ST, TSI)	
Road Density		score of "1" for ground-based mechanical (BT, LP, HT, ST)
Fragmen-tation	score of "1" for forest thinning or logging (BT, LP, HT, ST, TSI)	

**Table of Unit Impacts.** Key: **Blue = caution**; **red = recommended to drop**; BT = Biomass Thin; LP = Patch Lodgepole Regeneration Harvest; HT = Harvest Thinning; ST = Seed Tree Regeneration Harvest; TSI = Timber Stand Improvement; Rare II = acreage overlapping Rare II roadless areas; Roadless = acreage overlapping roadless areas; LSR = acreage overlapping Hungry Hunter LSR; Old Growth = acreage overlapping old growth or mature-structured stands; Unsuit = acreage overlapping areas unsuitable for harvest; Wetland = acreage overlapping 300-foot wetland buffers; WUI-DX = mileage from closest part of the unit to WUI zone; Road Dens = 1 for significant closed road density not addressed in the EA; Frag = 1 for units which fragment the existing forest.

Unit Id	Acres	Alt 2	Alt 3	Alt 4	Rare II	Roadless	LSR	Old Growth	Unsuit	Wetland	WUI-DX	Rd Dens	Frag
2	6.769	TSI	TSI	TSI		6.769					1	0	0
3	33.664	TSI				33.414					0.5	0	0
4	80.272	TSI				77.793					0.5	0	0
5	25.911	TSI	TSI	TSI		25.911					1	0	0
6	82.803	HT	HT	HT		39.93					0.5	0	0
8	52.156	TSI				48.984					0.5	0	0
9	94.843	BT				49.783		6.523		14.023	0.5	0	0
10	9.099	HT	HT	HT							0.5	0	0
11	81.083	TSI				72.58					0.5	0	0
12	22.578	HT	HT	HT		0.898					0.5	0	0
13	40.425	HT	HT	HT		33.21					0.5	0	0
15	11.428	TSI				4.448					0.5	0	0
17	18.32	TSI	TSI	TSI		0.25					0.5	0	0
18	5.281	HT	HT	HT							0.5	0	0
19	12.858	HT	HT	HT		9.867		4.463			0.5	0	0
22	77.793	TSI	TSI	TSI		74.035					0.5	0	0
24	27.539	TSI				18.979					0.5	0	0
26	11.468	TSI	TSI			11.468		4.974			0.5	0	0
27	61.549	HT	HT	HT		27.622					0.5	0	0
28	7.193	HT	HT	HT							0.5	0	0
29	86.436	HT	HT	HT		37.773					1	0	0
30	60.344	HT	HT	HT		5.852					0.5	0	0
31	47.31	TSI				47.31	0.359				1	0	1
32	21.25	HT	HT	HT				0.658			0.5	0	0
33	18.773	HT	HT	HT							1	0	0
34	173.894	BT	BT	BT		169.336					1	0	1
35	46.51	TSI						8.522			0.5	0	0
36	25.548	BT	BT	BT							1.5	1	1
37	15.69	HT	HT	HT					0.736		0.5	0	0
39	152.771	HT	HT	HT				18.755	1.811		0.5	1	0
40	61.633	TSI	TSI	TSI		61.496					1	0	0
41	20.899		TSI			7.877					1	0	0
42	70.37	HT	HT	HT		2.614					1	1	0
43	51.444	TSI	TSI	TSI							1.5	1	0

Unit Id	Acres	Alt 2	Alt 3	Alt 4	Rare II	Road-less	LSR	Old Growth	Unsuit	Wet-land	WUI -DX	Rd Dens	Frag
44	11.419	TSI	TSI	TSI							1.5	1	0
45	32.668	TSI						1.46			0.5	0	0
46	71.595	BT	BT	BT				6.033			1	1	0
48	147.276	HT	HT	HT				49.82	0.112		1	1	0
49	95.017	HT	HT	HT		2.638		0.075			1	1	0
50	18.729	TSI	TSI	TSI				0.137			1	0	0
51	28.327	TSI	TSI	TSI		7.805					1	0	0
53	23.584	TSI	TSI	TSI				0.069	9.94		1	1	0
56	60.285	TSI	TSI	TSI				0.122			1	1	0
57	7.002	ST	ST								1	1	0
58	43.858	TSI	TSI	TSI		8.916		0.07			1.5	0	0
60	15.606	ST	ST								1.5	1	0
61	39.045	ST	ST					4.998	0.532		1	0	0
62	150.442	BT	BT	BT							1.5	1	1
63	79.086	TSI	TSI	TSI							1	1	0
64	41.488	TSI	TSI	TSI							1	0	0
65	66.443	HT	HT	HT				18.103			1.5	1	0
66	15.081	TSI	TSI			0.134	15.081				0.5	0	0
67	122.904	TSI	TSI	TSI			1.658	0.124			1	1	0
68	10.83	ST	ST								1	1	0
69	83.512	ST	ST					0.136	4.082		1.5	1	0
70	121.261	TSI	TSI			103.632	121.261		7.891		1.5	0	0
71	16.916	TSI	TSI	TSI							1.5	0	0
72	16.564	TSI	TSI					2.347	12.063		1.5	0	0
73	116.463	TSI	TSI			116.463	116.463	57.06	83.373		1	0	0
74	165.717	TSI	TSI	TSI					1.109		1.5	1	0
75	26.416	BT	BT	BT		22.557					2	0	1
76	49.16	HT	HT	HT		16.394					2	0	1
77	57.497	TSI	TSI	TSI		25.172		2.912		2.566	1.5	1	0
78	13.51	TSI	TSI					8.747	9.521		1.5	0	0
80	23.606	ST	ST	TSI		17.437					2	0	0
81	16.42	HT	HT	HT		4.682					2.5	0	0
82	19.791	TSI				10.301					2	0	1
83	17.029	HT	HT	HT				7.794	17.029		1.5	0	0
84	24.713	HT	HT	HT							1.5	0	0
85	80.842	HT	HT	HT		45.756					2	0	1
86	10.97	TSI	TSI	TSI							2	0	0
87	34.487	HT	HT	HT							2	1	0
88	29.663	HT	HT	HT			0.137				2	0	0
89	24.311	TSI	TSI	TSI		7.147					2	1	0
90	21.456	TSI	TSI	TSI		17.24					2	0	0
91	44.814	BT	BT				44.814				1	0	0
92	17.721	BT	BT	BT		9.433					2.5	0	0

Unit Id	Acres	Alt 2	Alt 3	Alt 4	Rare II	Road-less	LSR	Old Growth	Unsuit	Wet-land	WUI -DX	Rd Dens	Frag
93	18.481	TSI				17.775		6.045		0	2	0	0
94	172.105	TSI	TSI	TSI							1.5	0	0
95	29.587	HT	HT	HT					5.146		2	0	0
98	28.434	TSI					28.434				1	0	0
99	11.628	HT	HT	HT		2.821					3	0	0
100	42.094	HT	HT				42.094				1	0	0
101	47.143	HT	HT	HT					19.214		2	0	0
102	63.314	HT	HT	HT		0.048			27.58		2	0	0
103	42.177	TSI	TSI	TSI		12.507		0.006			3	1	0
105	7.568	TSI	TSI	TSI	7.449	3.277					3	0	0
107	8.133	BT	BT	BT	8.133	0.498		6.455			3	0	0
109	24.126	BT	BT	BT		10.019					3	0	0
110	49.913	HT	HT	HT		2.602		0.052			1.5	0	0
111	16.579	TSI	TSI	TSI	16.579	1.249		0.166			3	0	0
112	45.913	TSI	TSI	TSI	45.913	20.732			38.049		3	0	0
113	26.42	HT	HT				26.42				1	0	0
114	16.191	LP	LP		14.26	4.253		0.01			3.5	0	0
115	6.32	HT	HT	HT		6.32					2.5	0	0
116	14.218	HT	HT	HT		0.521					2.5	0	0
117	10.478	LP	LP		10.478	4.046					3	0	0
118	68.782	HT	HT	HT		62.728		1.166		4.774	1.5	0	0
119	27.259	HT	HT	HT		27.259					2	0	0
120	22.195	HT	HT	HT		1.111			1.722	0.116	2	0	0
121	36.544	BT	BT			36.544	36.544	0.402			1	0	0
124	10.336	TSI	TSI			10.252	10.336				1.5	0	0
125	108.618	BT	BT	BT		50.359	2.522				1	0	0
126	3.577	LP	LP		3.577	2.021			0.91		3.5	0	0
127	3.219	TSI	TSI	TSI		3.219					1.5	0	0
128	11.651	TSI	TSI	TSI		11.651					2.5	0	0
129	45.848	BT	BT	BT		21.934	4.088				1	0	0
130	69.61	BT	BT			56.781	68.991	0.011			1	0	1
131	11.098	TSI	TSI	TSI		11.098					1.5	0	0
134	12.472	TSI			0.887	12.472			11.7		3	0	0
135	29.396	BT	BT	BT		19.524	1.24				1.5	0	0
136	40.167	TSI				40.167	40.167				1.5	0	1
146	9.763	TSI				8.228		9.055		5.837	2	0	0
148	14.172	HT	HT	HT					0.263		2	0	0
149	11.52	TSI	TSI	TSI				0.027			3	0	0
150	3.806	TSI	TSI	TSI		3.806					1.5	0	0
151	33.948	TSI	TSI				33.506				1	0	0
152	16.375	BT	BT			1.308	16.276	1.471			1	0	0
153	12.288	BT	BT			8.956	12.288	0.193			1	0	0
154	5.446	TSI	TSI	TSI		4.971	2.172				1.5	0	0

Unit Id	Acres	Alt 2	Alt 3	Alt 4	Rare II	Road-less	LSR	Old Growth	Unsuit	Wet-land	WUI -DX	Rd Dens	Frag
155	23.151	BT	BT			15.807	23.043				1.5	0	1
156	12.742	BT	BT			12.416	11.164				1.5	0	0
157	21.642	HT	HT	HT							0.5	0	0
158	22.078	TSI	TSI	TSI			2.862				2	0	0
159	49.813	HT	HT	HT		15.624			12.888	5.542	1.5	0	0
160	11.084	BT	BT			5.583	10.912				1.5	0	1
161	19.17	HT	HT				19.17				1	0	0
162	16.61	TSI	TSI	TSI		12.757					0.5	0	0
163	29.879	TSI				29.879	29.879	12.41			0.5	0	0
164	117.483	HT	HT	HT		117.483					2.5	0	0
165	31.823	HT	HT	HT							1.5	1	0
166	102.348	HT	HT			84.46	102.348				1	0	0
167	11.518	TSI	HT	TSI							1.5	1	0
901	14.293		TSI			14.293				2.312	1	0	0
902	29.812		TSI			7.448	29.812				0.5	0	0
903	39.45		TSI			6.543					1.5	1	0
904	23.03		TSI					12.879	0.747		1.5	0	0
905	4.248		TSI					0.004			2	0	0
906	6.663	TSI	HT	TSI		6.359					2.5	0	0
907	12.54	BT	HT	BT		6.101					2.5	0	0
910	3.725	LP	LP	LP	3.725	1.335		1.777			3	0	0
911	19.759		BT		19.759	16.629		1.01			3	0	0
912	9.717	TSI	HT			9.717					2	0	1
913	5.729		TSI								2	0	0
914	2.76	TSI				2.76					2	0	0
915	2.187	TSI	TSI								2	0	0
916	26.839		HT			25.827					2.5	0	0
917	5.916		LP		5.916	3.842		0.264			3	0	0
918	14.036		ST			8.115		0.022	8.231		2	0	0
919	6.44	TSI	ST			5.09					2	0	0
920	6.643		HT								1.5	0	0

## Conclusion

Our analysis identified 45 treatment units that appear to require modification of size or treatment, or possibly deletion from the project. These stands are: 19, 31, 32, 34, 36, 37, 39, 46, 48, 61, 62, 65, 69, 75, 76, 77, 82, 83, 85, 93, 95, 100, 101, 102, 107, 113, 114, 117, 118, 126, 130, 136, 146, 148, 151, 155, 159, 160, 161, 166, 901, 910, 911, 912, 917, 918. The analysis also identified numerous other treatment units that need a review and possibly mitigation as well. Units recommended for modification/deletion (**red**) or caution (**blue**) are shown in fig. 13 (Alt. 2), fig. 14 (Alt 3) and fig. 15 (Alt. 4).

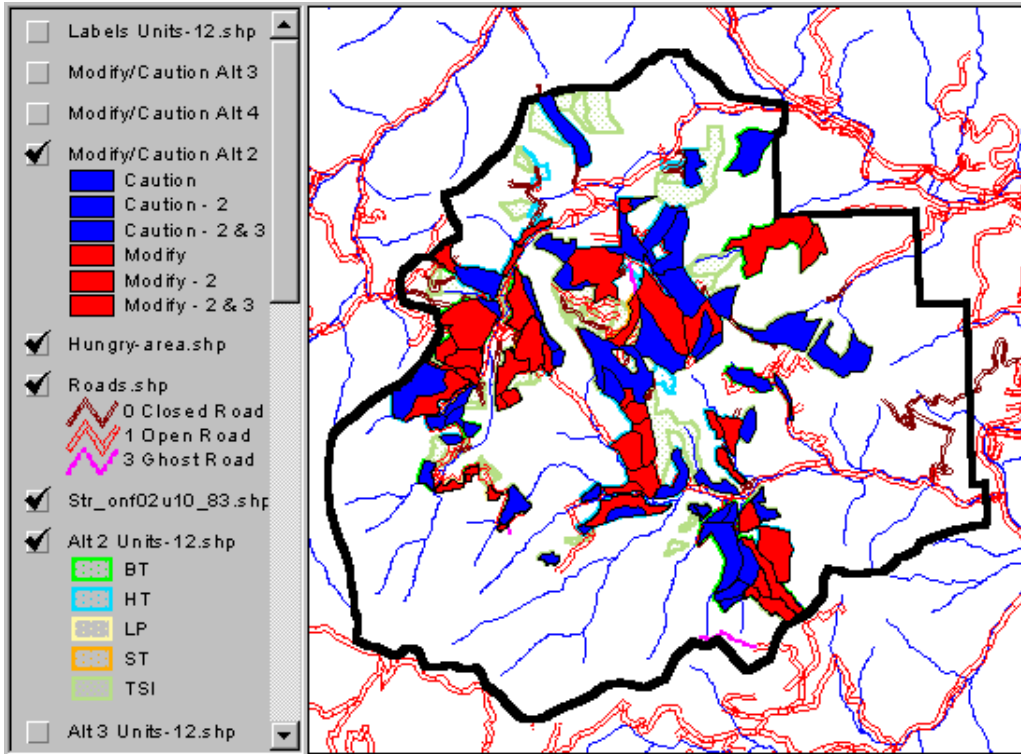


Fig. 13. Alternative 2 treatment units recommended for modification/deletion (red) or caution (blue).

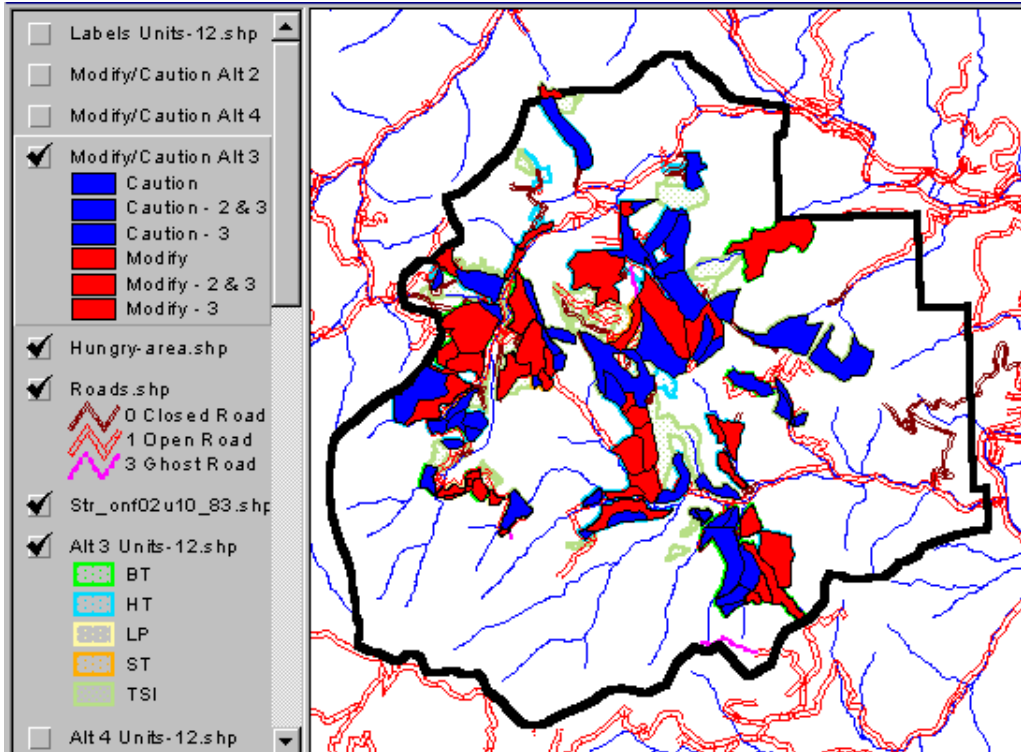


Fig. 14. Alternative 3 treatment units recommended for modification/deletion (red) or caution (blue).

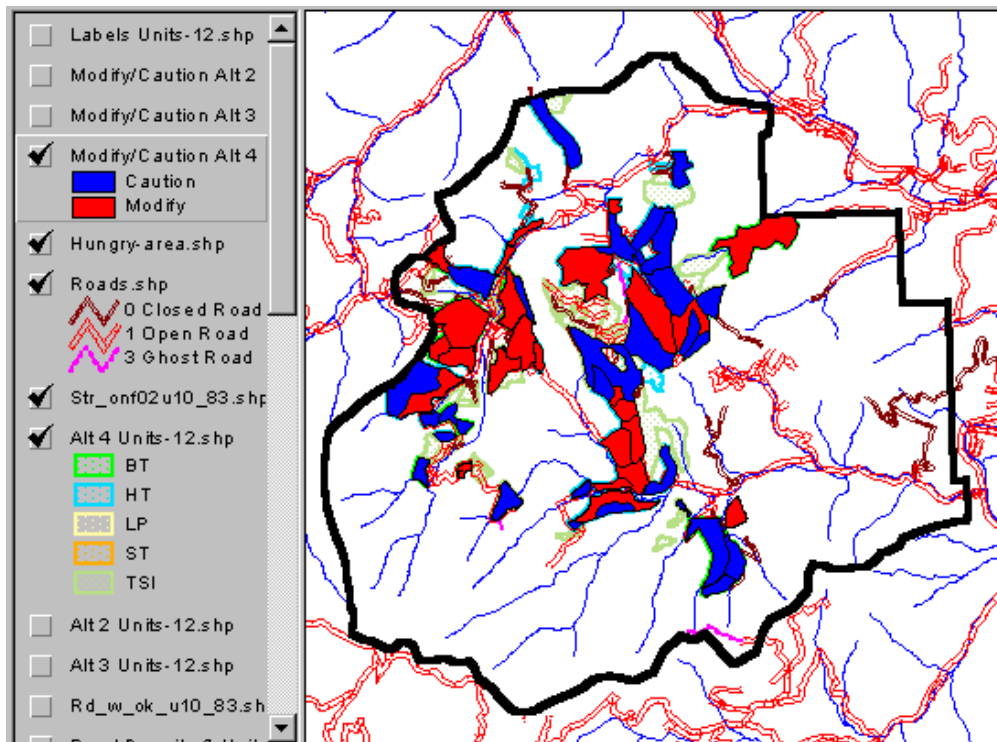


Fig. 15. Alternative 4 treatment units recommended for modification/deletion (**red**) or caution (**blue**).

These analyses were made possible by the advent of relatively powerful desktop computing environments and software such as Arcview Spatial Analyst as well as many data layers available online at GIS repositories. In addition to identifying potential treatment impacts, the use of a GIS to do this analysis allowed results to be visualized easily and be shared by all interested in land management planning. These spatial analyses can be readily extended to include temporal scales, as in the recommendation to defer harvest in some forested areas until the other impacts have had time to recover. The tables and shapefiles used in this analysis are available for download at this website:

[www.okanogan1.com/natural/ecology/hh](http://www.okanogan1.com/natural/ecology/hh)

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