2. MAPS AND DATA INTERPRETATION

2.1 MAPS

ERG created basemaps for the Elkhorn Vegetation Study Project Area at three different scales. Thematic maps were then created from the three different basemaps throughout the Phase One Study. Each of the three basemaps and related thematic maps are described below. All data received from Elkhorn Working Group members and cooperating agencies was clipped to the project area and reprojected to Universal Transverse Mercator (UTM) 27 Zone 12N.

2.1.1 Project Area Basemap

The Elkhorn Vegetation Study Project Area was determined by the EWG. The boundary of this area coincides with the HD 380 boundary. This area is 794,233 acres. Map1. Project Area Basemap shows basic information including Topologically Integrated Geographic Encoding and Referencing system (TIGER) line files (perennial and intermittent streams, interstates, highways, roads, four-wheel drive routes, trails, and railroad tracks); land ownership; county lines; National Hydrography Dataset – lakes; and towns, including county seats; USFS Ranger Districts; and the Project Area boundary. These layers are set against a Digital Elevation Model (DEM) and hillshade background to show topography. All data was downloaded from the NRIS. The Project Area boundary was created by clipping HD 380 from a larger dataset.

Thematic maps were created by overlaying data on the Project Area Basemap. ERG looked at elk location points from MTFWP to see where most elk occur. In addition, the point data was used to create an interpolated grid showing density of elk occurrences. As a result of that analysis, the most densely populated areas were further studied as areas of potential elk/cattle conflict. Another version of this basemap displayed all USFS and BLM allotments in the Project Area.

2.1.2 Elkhorn WMU Basemap

The WMU boundary encompasses the USFS property within the Project Area, as well as all private land inholdings within the perimeter of USFS ownership. This area is 175,200 acres, however the USFS only manages 160,000 of these acres. This basemap has a Digital Orthophoto Quadrangle (DOQ) background. All DOQs displayed are from 1994 and downloaded from NRIS. In addition to basic elements shown on the Project Area Basemap, this map shows USFS allotments and elk herd units. A variation of this map was made that displays ECODATA plot locations.

2.1.3 Kimber and North Crow Elk Herd Units Basemap

The Kimber and North Crow elk herd units are the focus of the Phase Two of this study. This basemap displays the elk herd units with a DOQ background. Much like the WMU Basemap, basic elements such as roads, streams, and allotments are displayed.

Thematic variations of this map show matched ECODATA points, Steven's Sample Plots, and potential Phase Two elk/cattle interaction study areas. This map has also been presented with section lines and a latitude/longitude grid for use in the field.

2.1.4 Comprehensive Map List

ERG created a series of 8.5 by 11 inch and 11 by 17 inch thematic maps that summarize data collected in Phase One of this study. These maps can be found throughout the document. Below is a brief description of each map. Additional information is cited on individual maps and in related sections of this document.

- **Map 1. Project Area.** The Project Area maps shows the HD 380 boundary (coincident with our chosen Project Area boundary), with ownership parcels and acreages displayed.

- **Map 2. Elk Herd Units.** ERG digitized elk herd unit boundaries based on the Elkhorn Mountains Wildlife Monitoring Program Final Report. Lines in the report end in space outside USFS property; therefore, ERG extended those lines to meet the Project Area boundary. Acreages were calculated from this shapefile.

- **Map 3. Elk Locations Density.** This map shows a 30 meter grid interpolated from elk locations provided by MTFWP. The 2003 aerial elk survey flight line is also displayed.

- **Map 4. Elk Seasonal Range.** Data for this map was created by the Rocky Mountain Elk Foundation (RMEF) and updated by Tom Carlsen of MTFWP. Summer and winter range is displayed, as well as summer and winter crucial habitat. ERG created a year-round crucial habitat layer by combining areas where summer and winter crucial habitat overlap.

- **Map 5. Allotment.** This map shows all USFS and BLM grazing allotments within the Project Area. Each allotment name is labeled on the map. Acreages and information about the history of these allotments can be found in related sections.

- **Map 6. Vegetation Sampling Locations.** Several types of vegetation sampling methods have been used throughout the Project Area, including ECODATA, Steven's Samples, Parker 3-Steps, BLM Utilization, and BLM Daubenmire. Vegetation sampling locations and methods are displayed where available.

- **Map 7. Interpreted Vegetation Data.** Matched ECODATA and BLM Utilization and Daubenmire plots are shown on this map. These labeled plots are presented in the USFS and BLM portions of Section 1.2.2.1 of this document.

- **Map 8. SILC3 Vegetation.** This 11 by 17 inch map presents vegetation data based on Satellite Image Land Cover Classification (SILC3) data. The attribute table, presented in the following section, gives acreages for vegetation classifications organized by ownership. The SILC3 Vegetation map shows a generalized version of this same data for display purposes.

- **Map 9. LANDSAT Image.** This 11 by 17 inch map shows a 2002 satellite image of the Project Area. This data has not been classified.

- **Map 10. Rangeland Classification Comparison.** ERG extracted rangeland values from SILC3 data and primary and secondary range polygons from USFS data. The amount and location of rangeland was compared for these two different datasets. This map displays the rangeland polygons for both data types. More information about this analysis can be found in the next section, Data Interpretation.

- **Map 11. Stand Stage Classification.** Polygons covering forested areas on allotted land are displayed. Stand stages 1 through 4 depict how well current conditions match desired/historic conditions, with one being the closest and four the farthest from desired conditions.

- **Map 12. Vegetation Treatments.** Using TSMRS from HNF, activity codes were queried and displayed to show areas where fire treatments have taken place. Fire treatments took place within the displayed polygons but did not necessarily occur throughout the entire polygon. Treated acres by treatment type are displayed in the legend.

2.2 DATA INTERPRETATION

GIS data was assembled from a variety of sources including the USFS, BLM, MTFWP, and Montana NRIS. Information provided by agencies was organized and reviewed by ERG GIS staff. As this section illustrates, caution should be used in interpreting each of the different data sources.

2.2.1 Base Data

All baseline data was downloaded from NRIS. This data includes hunting districts, counties, towns, TIGER line files (includes roads and streams), lakes, land ownership, DEMs, and DOQs. All shapefiles were clipped to the project area boundary. DEM and DOQ data was used as the base map background.

2.2.2 Agency Data

ERG collected data from cooperating government agencies, including the HNF, BDNF, MTFWP, and BLM. Data relevant to the Elkhorn Vegetation Study was evaluated and interpreted. Descriptions of the datasets evaluated follow.

2.2.2.1 USFS

Grazing allotments provided by both HNF and BDNF were clipped to the project area boundary and merged into one shapefile along with BLM allotment data. HNF provided a large Oracle attribute table to match their "range polygons." The range polygons delineate grazeable areas, and are classified into grassland and shrubland habitat types. Of the 13 HNF allotments, seven had related range polygons that ERG could join to the Oracle table. No range polygons were provided by the BDNF.

Complete timber coverage data, TSMRS, was acquired from both forests. TSMRS covers timbered habitat types. The attribute table includes data correlating to Pfister Habitat Types, habitat type group and fire group for SIMPPLLE modeling, harvest activity, age, basal measurements, aspect, slope, elevation, size class, USFS habitat types, habitat suitability for several mammal species, and fuel model. Based on the USFS habitat type attributes, ERG created a generalized table of habitat types (see Table 2.3.3-1)

ECODATA was provided by the HNF. This data included a unique identifier joinable to tables and hard copy documents. This data is discussed in detail in Section 1 of this document.

Other layers provided by the HNF included noxious weeds, wildfire, controlled burns, and ECODATA. ECODATA for the BDNF and additional points for the HNF were downloaded from www.icbemp.gov.

2.2.2.2 BLM

The BLM Butte Field Office provided many GIS layers. Of this data, ERG used the grazing allotments and vegetation study plots. ERG merged the BLM allotment data with USFS allotments to create one shapefile covering the entire Project Area. Vegetation plots included data on utilization and Daubenmire studies. These points are on Map 6. Vegetation Sampling Locations and Map 7. Interpreted Vegetation Data maps. This data is discussed in detail in Section 1 of this document.

2.2.2.3 MTFWP

MTFWP provided data related to elk occurrences. This data consists of points depicting elk occurrences; however, the points do not carry information about the number of elk in each occurrence. This included

location points collected during aerial surveys from 1982 to 2004. Line files show the flight path for aerial surveys in 2003 and 2004. Another shapefile, originally created by the RMEF, shows summer, winter, and crucial elk range. Additionally, MTFWP provided maps in PDF format that were plotted by ERG. These eight maps display varying aspects of elk distribution points and polygon data for the Elkhorn project area.

Elk Herd Unit polygons were digitized by ERG staff following boundaries set forth in the Elkhorn Elk Monitoring Program final report (DeSimone, 1996). ERG extended the Elk Herd Unit polygon boundaries to the edge of the Elkhorn Vegetation Study project area, following roads, creeks, ridges, and/or other natural breaks in topography.

Based on the elk occurrence points, ERG chacterized density using 30 square meter pixels to show areas of frequency concentration. This grid, along with the 2003 aerial survey flight path, are depicted on the Elk Density map.

Because ERG is studying both the WMU and lands adjacent to it, we created a new boundary called the Extended WMU Study Area. This boundary is based on natural breaks in elk occurrence points.

2.2.3 Remotely-sensed Data

Numerous types of satellite imagery are available for the Elkhorn Mountains. The SILC versions 1 through 3 are available, as well as LANDSAT TM and ETM+ images. However, questions of scale and data needs become paramount to the types of data available. Both SILC and LANDSAT imagery are based on a 30 square meter pixel size. When dealing with large landscapes, such as the entire project area, satellite imagery is suitable to address many resource questions. However, finer scales, less than 100,000 acres, satellite imagery interpretation becomes more questionable. In addition, accuracy ratings for image-based land classifications range from 64.9% to 75.9% (SILC3 metadata). Thus, for the Elkhorn project, the desired accuracy is greater than that attained through image interpretation.

ERG acquired two forms of satellite imagery. The first image is part of the SILC3 data produced by the Wildlife Spatial Analysis Lab at the University of Montana (see Map 8). The land cover classification, from which the Montana Gap Analysis (a statewide landcover classification) was based, has been applied to several Landsat Thematic Mapper™ images for western Montana and clipped to the Elkhorn Mountains. Thi.s data is accurate as of 1995 with a spatial resolution from 30 to 90 square meters. Descriptive attributes include landcover type, forested stand structure, and density, among others. This data was used to stratify vegetation types and canopy cover to estimate AUMs in accordance with the NRCS Woodland Grazing Guides, as well as assisting in the location of sampling locations.

Insert Map 8: SILC3 Vegetation Map

The second image acquired is an orthorectified LANDSAT ETM image taken in 2000, resampled to 15 square meters (see Map 9). This image can be used to aggregate current land use and identify areas of disturbance (i.e., fire, logging, etc.). In addition, "change-detection analysis" can be performed on the paired images to identify areas in which land use or vegetative cover has changed significantly from 1995 to 2000. The following table summarizes the Project Area vegetation based on SILC3. The data is quantified by ownership.

Table 2.2.3-1 Project Area Acreages by Ownership/SILC3 Classification

SILC3 Classifications[1]	BLM Acreage	USFS Acreage	Private Acreage	State Acreage	Bureau of Reclamation Acreage
1100-Urban or Developed Lands	19	0	7,442	114	23
2010-Agricultural-Dry	27	0	43,314	714	38
2020-Agricultural-Irrigated	11	0	52,149	568	77
3130-Very Low Cover Grasslands	45,598	2,136	179,584	12,126	3,176
3150-Low/Moderate Cover Grasslands	10,017	21,867	91,339	3,522	783
3170-Moderate/High Cover Grasslands	143	7,926	8,799	49	0
3610-Mesic Shrublands	112	1,190	13,670	367	55
3625-Sagebrush/Xeric Shrublands	9,872	4,286	23,911	2,506	0
4101-Aspen	81	1,821	1,724	21	0
4150-Mixed Broadleaf/Cottonwood Forest	208	104	11,261	381	62
4203-Lodgepole Pine	2,394	32,254	1,642	559	0
4204-Whitebark Pine	17	2,634	47	0	0
4205-Limber Pine	327	8	319	102	17
4206-Ponderosa Pine	686	650	6,059	472	209
4212-Douglas-fir	8,524	25,414	8,764	1,066	3
4214-Rocky Mountain Juniper	7,323	1,526	6,914	887	52
4223-Douglas-fir/Lodgepole Pine	2,928	15,426	2,535	701	0
4230-Douglas-fir/Ponderosa Pine	3,321	4,364	8,613	729	215
4241-Mixed Upper Subalpine Conifer Forest	43	6,407	86	26	0
4242-Mixed Lower Subalpine Conifer Forest	294	5,820	71	90	0
4244-Mixed Xeric Conifer Forest	65	258	63	4	0
4400-Burns	17	21,648	406	0	0
5000-Water	81	0	941	109	419
7300-Rock	426	4,846	260	3	16
Total acreages for Project Area[2]:	**92,533**	**160,585**	**469,913**	**25,117**	**5,144**
Total Project Area[2] Acreage: 753,292					

[1] SILC3 data from of Rocky Mountain Research Station (2004).
[2] Data from NRIS, and cooperating agencies including: HNF, BDNF, MTFWP, and BLM.

Insert Map 9: LANDSAT Image

2.2.4 Data Analysis

ERG analyzed several of the GIS data layers provided. First, land types by ownership were stratified from the SILC3 image. We then isolated range types from the SILC3 image and compared the resulting acreage to the range map provided by the HNF. Finally, ERG presents a comparison of SILC3 to ECODATA points for accuracy assessment.

2.2.4.1 Extended WMU Study Area

During Phase Two of this study, ERG will study the WMU and adjacent lands. ERG mapped an Extended WMU Study Area to encompass these lands. The boundary was created by digitizing around the most dense area of elk occurrence points. This boundary is shown on the Map 6. Vegetation Sampling Locations and Map 7. Interpreted Vegetation Data maps. Because of its complete coverage of the study area, SILC3 data was used to determine the vegetation cover for the Extended WMU Study Area. Table 2.3.4-1 summarizes the landcover of the Extended WMU Study Area by ownership.

Table 2.3.4.1-1 Extended WMU Study Area Acreages by Ownership/SILC3 Classification

SILC3 Classifications[1]	BLM Acreage	USFS Acreage	Private Acreage	State Acreage
1100-Urban or Developed Lands	1	0	43	0
2010-Agricultural-Dry	0	0	12	0
2020-Agricultural-Irrigated	0	0	1,174	0
3130-Very Low Cover Grasslands	2,640	2136	7,055	366
3150-Low/Moderate Cover Grasslands	3,976	21,867	26,001	1559
3170-Moderate/High Cover Grasslands	123	7,926	4,737	27
3610-Mesic Shrublands	83	1,190	2,883	22
3625-Sagebrush/Xeric Shrublands	6,758	4,286	11,623	1,662
4101-Aspen	81	1,821	1,716	21
4150-Mixed Broadleaf/Cottonwood Forest	41	104	1,611	9
4203-Lodgepole Pine	2,329	32,254	1,567	537
4204-Whitebark Pine	16	2,634	47	0
4205-Limber Pine	33	8	3	0
4206-Ponderosa Pine	126	650	1,865	64
4212-Douglas-fir	7,114	25,414	7,984	1,048
4214-Rocky Mountain Juniper	2,183	1,526	1,533	367
4223-Douglas-fir/Lodgepole Pine	2,473	15,426	2,271	692
4230-Douglas-fir/Ponderosa Pine	1,147	4,364	5,944	546
4241-Mixed Upper Subalpine Conifer Forest	43	6,407	86	26
4242-Mixed Lower Subalpine Conifer Forest	294	5,820	70	90
4244-Mixed Xeric Conifer Forest	51	258	63	4
4400-Burns	17	21,648	406	0

SILC3 Classifications[1]	BLM Acreage	USFS Acreage	Private Acreage	State Acreage
5000-Water	8	0	9	2
7300-Rock	0	4,846	169	1
Total acreages for Extended Wildlife Management Unit Study Area[2]:	**29,539**	**160,585**	**78,872**	**7,045**
Total Extended Wildlife Management Unit Study Area[2] Acreage: 276,041				

[1] SILC3 data from Rocky Mountain Research Station (2004).
[2] ERG created the Extended Wildlife Management Unit Study Area by incorporating adjacent lands with the existing Wildlife Management Unit. Boundaries were digitized following natural breaks in Elk data locations.

2.2.4.2 Isolating Rangeland from Vegetation Data

An analysis was run to determine where rangelands occur. This involved isolating rangeland vegetation types from two different data sets. SILC3 for the WMU was queried. This data was compared to the range polygons described in Section 2.3.3.

First, SILC3 was clipped to the WMU boundary (175,258 acres with 160,000 of these acres managed by USFS). The data was then queried for the rangeland vegetation types presented in Table 2.3.4.2-1 below.

Table 2.2.4.2-1 SILC3 Potential Rangeland Vegetation Types

SILC3 Classifications[1]	Acreage
3130-Very Low Cover Grasslands	2,364
3150-Low/Moderate Cover Grasslands	26,164
3170-Moderate/High Cover Grasslands	10,611
3610-Mesic Shrublands	1,806
3625-Sagebrush/Xeric Shrublands	5,208
Total SILC3 Rangelands	46,153 (26% of WMU)

[1] SILC3 data from Rocky Mountain Research Station (2004).

Next, primary and secondary rangelands were queried from the range polygons for seven USFS allotments, which include data for private land. This rangeland data is incomplete because range polygon information is not available for the entire WMU area. The following Table 2.3.4.2-2 summarizes acreages based on the available data.

Table 2.2.4.2-2 HNF Primary and Secondary Rangeland Acres

Range Polygons	Primary Range	Secondary Range	Transitory Range
Acreage	26,039	5,213	201
Total	31,453		

Map 10. Range Classification Comparison displays the rangelands isolated from both SILC3 and range polygons. Areas of overlap are highlighted in yellow and make up 21,803 acres of the WMU.

Insert Map 10: Rangeland Classification Comparison

2.2.4.3 Comparing Range Polygons to SILC3 Classifications

Further study was conducted to compare primary and secondary range, as set forth in the range polygons, to SILC3 classification. The SILC3 data was clipped with the range polygons. Table 2.3.4.3-1 shows SILC3 classifications for the same land area the USFS classifies as rangeland.

Table 2.2.4.3-1 SILC3 Classifications Found Within Primary and Secondary Range Polygons

SILC3 Classifications[1]	Acreage
3130-Very Low Cover Grasslands	1,593
3150-Low/Moderate Cover Grasslands	13,159
3170-Moderate/High Cover Grasslands	4,421
3610-Mesic Shrublands	605
3625-Sagebrush/Xeric Shrublands	2,047
4101-Aspen	1,208
4150-Mixed Broadleaf/Cottonwood Forest	65
4203-Lodgepole Pine	893
4204-Whitebark Pine	13
4206-Ponderosa Pine	235
4212-Douglas-fir	4,119
4214-Rocky Mountain Juniper	186
4223-Douglas-fir/Lodgepole Pine	1,035
4230-Douglas-fir/Ponderosa Pine	936
4241-Mixed Upper Subalpine Conifer Forest	10
4242-Mixed Lower Subalpine Conifer Forest	64
4400-Burns	1,008
7300-Rock	36
Total Acres	**31,635**

*3000 series cover classifications are SILC3 rangeland, as determined by ERG.

The primary and secondary range polygons are considered 100% rangeland. Table 2.3.4.3-1 above shows that SILC3, queried for the same area, classifies 21,825 acres as rangeland, for 70% similarity.

2.2.4.4 Ground-truthing SILC3 with ECODATA Plots

ERG ran an analysis to compare SILC3 data to ECODATA. This is essentially a ground-truthing exercise, since ECODATA is complied from field-based surveys. ECODATA points were randomly selected from plots that ERG had correlated with metadata from the General Form. The ECODATA dominant species for eighteen points was then compared to SILC3 polygon classifications. Only 56% of the sites correlated; however, this is not necessarily indicative of unreliable information from either ECODATA or SILC3. ECODATA plots are 1/10th of an acre while SILC3 pixel classification is based on the composite reflectance value of a 30 square meter area. The classification does not negate the presence of the ECODATA species type within the pixel, nor does it necessarily reflect its presence. For

management purposes, use of ECODATA or SILC3 should be chosen based on the scale of the study being performed. The results comparing ECODATA findings with SILC3 classifications are summarized below in Table 2.2.4.4-1.

Table 2.2.4.4-1 SILC3 ECODATA Accuracy Assessment

ECODATA Key_ID	ECODATA Dominant Species[1]	SILC3 Classification	Results
FS01120188CI036	FESC	3170-Mod/High Cover Grasslands	Match
FS01120188CI043	ARTRV	3150-Low/Mod Cover Grasslands	No Match
FS01120188CI048	PSME	3625-Sagebrush/Xeric Shrublands	No Match
FS01120188CI054	JUSC	4214-Rocky Mountain Juniper	Match
FS01120188CI109	FEID	3150-Low/Mod Cover Grasslands	Match
FS01120188CI114	FESC	3170-Mod/High Cover Grasslands	Match
FS01120188CI117	ALIN	4203-Lodgepole Pine	No Match
FS01120188CI118	ARTRV	4212-Douglas Fir	No Match
FS01120188TI041	FESC	3150-Low/Mod Cover Grasslands	Match
FS01120188TI051	SEDE2	3130-Very Low Cover Grasslands	Match
FS01120188TI069	AGSP	3150-Low/Mod Cover Grasslands	Match
FS01120188TI081	PSME	4212-Douglas Fir	Match
FS01120188TI084	DANINTVG	3170-Mod/High Cover Grasslands	Match
FS01120188TI087	PSME	3170-Mod/High Cover Grasslands	No Match
FS01120188TI088	FEID	3170-Mod/High Cover Grasslands	Match
FS01120188TI121	ARTRW	3170-Mod/High Cover Grasslands	No Match
FS01120188TI122	PSME	4203-Lodgepole Pine	No Match
FS01120188TI124	POPR	4212-Douglas Fir	No Match

[1] Plant symbols derived from a combination of historic USFS symbols and current NRCS symbols
[2] SILC3 data courtesy of Rocky Mountain Research Station.

2.3 CONCLUSIONS

GIS data was integrated from several sources mentioned previously. Data was assembled, then evaluated, looking for consistencies and differences in findings. This section shows how well USFS inventory data matches SILC3 data. There are noticeable differences in acres. Inevitably, different methods will bear different results, as each has its own strengths and limitations. These differences indicate the need to carefully examine any methodology upon which management decisions are based, which includes using GIS, particularly SILC3 data, as a sole source of information.