II. Resource Areas

These chapters describe the following physical, biological, and cultural resources of the EDLV landscape:

A. Soils and Geology
B. Watershed Health and Aquatic Habitats
C. Vegetation
D. Wildlife
E. Cultural Resources and Human Uses

Each section describes where pertinent:

- Summary
- Existing Condition
- Range of Natural Variability and disturbance processes.
- Goals, objectives, and Desired Future Condition for resources in the landscape as identified in the FP (1987) are referenced by page number from the plan. Also included are goals and objectives from appropriate guidance documents and those goals, objectives, and desired conditions developed by the FSP.

A. Soils and Geology

1. Existing Condition

Geology

A geologic map of the landscape is shown in figure IIA-1 provided in appendix 1. Within the EDLV landscape, the Boulder Mountains are underlain by the late-Cretaceous period Boulder batholith and associated Elkhorn Mountain volcanic rock. The Boulder batholith, a massive granite intrusive unit is capped by volcanic andesite which erupted from the same magma source as formed the batholith. These intrusive and volcanic formations were further buried by Lowland Creek volcanics during early Tertiary time.

The large sloping benches which are a defining feature of the EDLV are comprised of Tertiary aged sediments, mostly Renova formation, deposited during an extended period of dry climate referred to as the Oligocene epoch from about 40 to 20 million years ago. The Renova formation in Montana contains fossilized leaves of the Dawn Redwood, related to a modern Sequoia tree species found only in Central China giving a modern reference for how the climate may have been during the Oligocene (Alt and Hyndman, 1986). The dry climate of the Oligocene limited the ability of valley rivers to transport sediment and the valleys slowly filled with sediment. The benches of the EDLV are remains of the old valley floor. Today, the benches and fluvial floodplain of the Deer Lodge Valley are underlain by up to 10,000 ft of basin fill sediments (Berg, 2004). The present valley floor is also underlain by a relatively thin package of sediments from the more recent Quaternary period. During the Quaternary, wetter climate, notably the ice-ages, increased runoff and meandering of the Clark Fork River created the current flat alluvial floodplain that the City of Deer Lodge lies on.

The distribution of glacial till from the middle Pleistocene suggests that alpine glaciers were present in the ancestral drainages of Baggs and Cottonwood Creeks and Orofino Creek near O'Donnell Mountain (Derkey et al., 2004). A large glacial moraine at the confluence of Baggs Creek and Cottonwood Creek indicates that these glaciers at their maximum merged at the confluence of these creeks and that this is the farthest glacial advance within the landscape. These alpine glaciers also left large outwash plains of poorly stratified gravels that form part of the present valley bottom from Cottonwood Creek north past Fred Burr Creek.

The Renova formation which comprises the large benches which extend from the Boulder Mountains to the Clark Fork River floodplain is prone to landslides where the formation absorbs large amounts of water (Alt and Hydman, 1986). Clays derived from volcanic ash within the Renova formation expand and become less stable when saturated leading to localized slumping and slope failure. Precipitation and snowmelt infiltration will cause landslides within the Renova. Additionally, water absorption and resulting mass wasting may be exacerbated by irrigation, leaking ditches, a high density of septic tanks, or concentration of drainage water by roads.

Minerals

Intrusive features have mineralized some of the project area and gold, silver and lead mines are fairly common. However, the area was never a major precious metals and precious stone producing area compared to other nearby mining districts such as Butte and Phillipsburg. A map of abandoned mines and mineral features on record with the Montana Bureau of Mines and Geology (MBMG) which includes Montana Department of Environmental Quality (DEQ) priority abandoned mines is shown in figure IIA-2 provided in appendix 1.

The Emery mining district contains the principal economic ore deposits in the Deer Lodge area (Derkey et al., 2004). Mining in the Emery District began on placer deposits in the early 1870's followed by a more productive period of bedrock vein mining that lasted until the early 1950's. The ore veins are part of andesite lava flows that erupted with the Elkhorn Mountain volcanics (Alt and Hyndman, 1986). Predominant bedrock geology in the Emery district includes basaltic and andesitic flows, tuffs, and breccia flows of probable Late Cretaceous or early Tertiary age. Principal mineral deposits are quartz fissure veins. The district was a past large producer, primarily of gold, silver, and lead. Currently, the Emery Mining District is on the DEQ list of priority abandoned mines due to water quality concerns. Mine waste cleanup actions have occurred as recently as 2002 at mines in the Emery District.

The Champion mine is located in the Orofino mining district on the western margin of the Boulder batholith in Orofino Creek. Predominant bedrock geology of the Orofino district is monzogranite, with small areas of Tertiary rhyolite. Mineral deposits include gold placers and base- and precious-metal-bearing veins. The district was a large producer, primarily of silver, gold, and copper.

Derkey (1987) mapped and described the Burnt Hollow area in T7N R8W sections 20 and 29 about 3.7 miles southwest of the Emery district where Tertiary sediments overlap Cretaceous volcanic rocks and recognized three small areas with sericitic alteration containing low-grade gold and silver mineralization.

Historic Mining Impacts in the Project Area

There are 56 mapped mine-related features reported by the MBMG in the project area and numerous identified mineral locations (Figure IIA-2). A DEQ priority abandoned mine site exists on Orofino Creek (Champion Mine) and several in the middle reach of Cottonwood Creek (Emery Mining District). A survey of abandoned and inactive mines sites on land administered by the Deerlodge National Forest in the Upper Clark Fork River basin was completed by MBMG (Madison et al., 1998). Abandoned mines identified in the MBMG report as being an environmental hazard are shown in table IIA-1.

Photo: Abandoned mine, Middle Fork Cottonwood Creek.

USFS records suggest past water quality impairments to streams within the landscape. Long term monitoring and future field assessment would aid in determining if water quality or aquatic life impacts continue to be present. As of the 2002 field season, one mine on Dry Cottonwood Creek appeared to have the potential for reactivation. A mine cleanup project on a tributary to the North Fork of Dry Cottonwood Creek was completed in 2002 by the USFS and a contractor, on the south side of the Emery Mining District.

Photo: Acid mine drainage associated with the Champion Mine site, Orofino Gulch

Impacts from historic smelter operations have had a tremendous effect on soil and water resources throughout Deer Lodge Valley. The USDA-NRCS Soil Survey of Deer Lodge County partitioned lands impacted by smelter operations into three classes: severely impacted, moderately impacted, and slightly impacted. Lands within the EDLV landscape were identified as slightly impacted. By definition, slightly impacted soils have received aerial deposition of smelter emissions resulting in elevated levels of metal and arsenic contaminants in the soil. Contaminant concentrations are above normal background levels but do not exceed critical thresholds. As a result, neither the soil surface nor the native plant community exhibit significant observable differences relative to non-impacted areas.

Unlike moderately or severely impacted areas that may require substantial land reclamation, slightly impacted areas can be managed intact to minimize hazards both to humans and wildlife. Most of the metal and arsenic contaminates are expected to be retained within surface layers of the soil where they become immobilized by soil colloids and soil organic matter. They remain in the soil as largely insoluble and unavailable for plant uptake and metabolism under existing soil pH conditions. Because they are retained on soil surfaces and not leached down through the soil, wind and water erosion become the primary transport mechanism for the metal and arsenic contaminants.

Table IIA-1: Abandoned/Inactive Mine Environmental Hazards (Madison et al., 1998)

Site Name	Town	Range	Sec	Problem
Champion Mine & Mill	6N	8W	33	Adit discharge, streamside tailings, water quality standards exceeded.
Ding Bat (Blue Eyed Maggie)	7N	8W	10	Discharge from waste dump, water quality standards exceeded.
Little Darling Mine	5N	8W	7	Adit discharge.
Lower Hidden Hand Mine	7N	8W	3	Caved adit discharge, water quality standards exceeded.
Rocker Gulch Mine	7N	8W	10	Streamside dump, water quality standards exceeded.
St. Mary Mine	7N	8W	11	Caved adit discharge, water quality standards exceeded (concentration is at detection limit).
Sterrit Mine	7N	8W	2	Caved adit discharge, water quality standards exceeded (concentration is at detection limit).
	- Indicated water quality exceedences on BDNF lands.			

Soil mapping of impact classes was based on observable land and plant community characteristics as well as proximity to the Anaconda stack. Much of the laboratory analysis to support that work focused on severely and moderately impacted areas. No samples within the EDLV landscape were analyzed for metal or arsenic concentrations during mapping. As a result, there is a lack of knowledge about actual contaminant levels and the distribution of metal and arsenic contaminants in soil profiles in these slightly impacted areas. The level of contamination and how it is distributed can have a profound effect on land management options and the assessment of impacts within riparian corridors that run through the area.

Another side effect of historical mining and smelting was wide-scale forest clearing for smelter fuel and mine timber. It is assumed that much of the forested area of the EDLV landscape was clear-cut by the early 20th century. Much of these areas are now regenerated with mature conifer trees. Pockets of old growth timber remain from pre-settlement times although no forest-wide or landscape specific old growth mapping (other than FIA plots) has been completed.

NRCS Soils Data

Soils in the project area vary widely due to the wide range in geology of soil parent material and due to the large difference in climate and topography between valley and mountain. Soil slopes range from 0 to 8% in the floodplain, 8 to 15% along the riparian edge and a few soils in the upper lands with slopes of 15 to 60% (NRCS, 2000). Soil surveys consulted for this assessment include Deer Lodge County Area (MT616), Deer Lodge National Forest Area (MT635), and Powell County Area (MT644). Soil surveys were used to analyze erosion hazard and fire damage hazard in the following discussion. This discussion is limited to BDNF lands because any opportunities and proposed actions based on this assessment will occur only on national forest lands.

The soil surveys were analyzed to depict the potential off-road/off-trail erosion hazard (figure IIA-3 provided in appendix 1). Table IIA-2 shows the off-road/off-trail potential erosion hazard by acreage specifically for BDNF lands within the landscape. The ratings in this interpretation indicate the hazard of soil loss from off-road and off-trail areas after disturbance activities that expose the soil surface. The ratings are based on slope and soil erosion factor K. The soil loss is caused by sheet or rill erosion in off-road or off-trail areas where 50 to 75 percent of the surface has been exposed by logging, grazing, mining, or other kinds of disturbance.

The potential erosion hazard is described as "slight," "moderate," "severe," or "very severe." A rating of "slight" indicates that erosion is unlikely under ordinary climatic conditions; "moderate" indicates that some erosion is likely and that erosion-control measures may be needed; "severe" indicates that erosion is very likely and that erosion-control measures, including revegetation of bare areas, are advised; and "very severe" indicates that significant erosion is expected, loss of soil productivity and off-site damage are likely, and erosion-control measures are costly and generally impractical.

Table IIA-2: Off Road/trail Potential Erosion Hazard on BDNF lands.

Off-Road/off-trail Potential Erosion Hazard (dominant condition)	Total Acres	% of Total
Slight	1,124	3%
Moderate	31,797	80%
Severe	5,351	13%
Very severe	536	1%
Not rated	844	2%
Total	39,651	

The soils surveys were also analyzed to depict the potential fire damage hazard (figure IIA-4 provided in appendix 1). Table IIA-3 shows the potential fire damage hazard by acreage specifically for BDNF lands within the landscape. The ratings in this interpretation indicate the potential for damage to nutrient, physical, and biotic soil characteristics by fire. The ratings involve an evaluation of the potential impact of prescribed fires or wildfires that are intense enough to remove the duff layer and consume organic matter in the surface layer. The ratings are based on texture of the surface layer, content of rock fragments and organic matter in the surface layer, thickness of the surface layer, and slope.

The soils are described as having a "low," "moderate," or "high" potential for fire damage. "Low" indicates that fire damage is unlikely. Good performance can be expected, and little or no maintenance is needed. "Moderate" indicates that fire damage can occur because one or more soil properties are less than desirable. Fair performance can be expected, and some maintenance is needed. "High" indicates that fire damage can occur because of one or more soil properties and that overcoming the unfavorable

Table IIA-3: Potential Fire Damage Hazard on BDNF lands.

Potential Fire Damage Hazard (Dominant Condition)	Total Acres	% of Total
Low	25,986	66%
Moderate	9,270	23%
High	2,918	7%
Not rated	1,477	4%
Total	39,651	

properties requires special design, extra maintenance, and costly alteration.

Figure IIA-5 (provided in appendix 1) shows potential on-road/on-trail erosion hazard. Table IIA-4 shows the potential on-road/on-trail erosion hazard by acreage specifically for BDNF lands within the landscape. The ratings in this interpretation indicate the hazard of soil loss from unsurfaced roads and trails. The ratings are based on soil erosion factor K, slope, and content of rock fragments.

Table IIA-4: On-road/trail Potential Erosion Hazard on BDNF lands.

On-Road/on-trail Potential Erosion Hazard (dominant condition)	Total Acres	% of Total
Slight	121	0%
Moderate	6,310	16%
Severe	32,435	82%
Not rated	786	2%
Total	39,651	

The hazard is described as "slight," "moderate,", "severe," or "very severe." A rating of "slight" indicates that little or no erosion is likely; "moderate" indicates that some erosion is likely, that the roads or trails may require occasional maintenance, and that simple erosion-control measures are needed; and "severe" indicates that significant erosion is expected, that the roads or trails require frequent maintenance, and that costly erosion-control measures are needed. There is one small area within the town of Deer Lodge where the erosion hazard is "very severe" that appears in air photos to be a gravel pit. As indicated in the table, the majority of soils on the BDNF in the landscape are rated as having a severe on-road erosion hazard. This road erosion potential leads to locally severe sedimentation impacts to streams and aquatic life and is covered in detail in section II-B Watershed Health and Aquatic Habitats. The apparent sedimentation issues associated with roads in the landscape indicates the need for better road maintenance, road closure, and/or erosion-control measures in many of these soils.

Soil Contamination

Copper, lead, zinc, and arsenic sampling of soils in Perkins Gulch and Dry Cottonwood Creek were completed by Keck and Kozar (2003). Soils in upland areas were found to have elevated concentrations of these contaminants in the surface layers presumably from smelter aerial deposition. Concentrations of copper and arsenic in upland soils were well above background levels. No federal or state specific maximum contaminant level standards are available for these contaminants in sediment. However, lead and arsenic concentrations sampled were all below residential action levels determined by EPA to be safe for human exposure in the Butte Priority Soils Operable Unit of the Silver Bow Creek/Butte Areas Superfund Site. Keck and Kozar (2003) also provide phytotoxic levels proposed by the State of Montana for the Anaconda Regional Water, Waste, and Soils Operable Unit of the Anaconda Smelter Superfund Site. In the case of lead and arsenic, these proposed phytotoxic levels are lower than residential action levels at the Butte Priority Soils Operable Unit. Two surface samples for copper and arsenic exceeded the proposed phytotoxic levels. As such, potential phytotoxicity problems may exist in the surficial 0-4 inches of soil in the landscape. Concentration of copper, arsenic, lead, and zinc were also found to be elevated in subsoil horizons in riparian areas indicating that these contaminants had migrated deeper in the soil profile or have been buried in riparian areas. Copper and zinc concentrations in subsoil horizons under coniferous trees were substantially higher than under upland grass vegetation. Sampling suggested that soils in the sandy washes found in the lower elevations of the ephemeral drainages had been leached of metal and arsenic contaminants.

2. Range of Natural Variability

In general, soil and geologic processes occur on very long timescales. As such, the range of natural variability for many of the physical attributes of soil or geology is relatively static when compared to timescales that humans act on. What this means in practice is that the number of geologic and soil forming processes that need to be considered in evaluating natural variability for landscape assessment purposes is limited. Within the EDLV landscape climate, and resulting episodic floods affect soils and geomorphologic landforms on a human timescale.

Climate

Soil and geological landforms within the EDLV landscape are shaped by centuries of climate variability. Historical climate records exist for a much shorter duration. It is therefore difficult to place current climate and trends within the perspective of the long term variability that has created the soils and landforms seen today. A brief overview of weather data is presented here to describe what is known about current climate conditions.

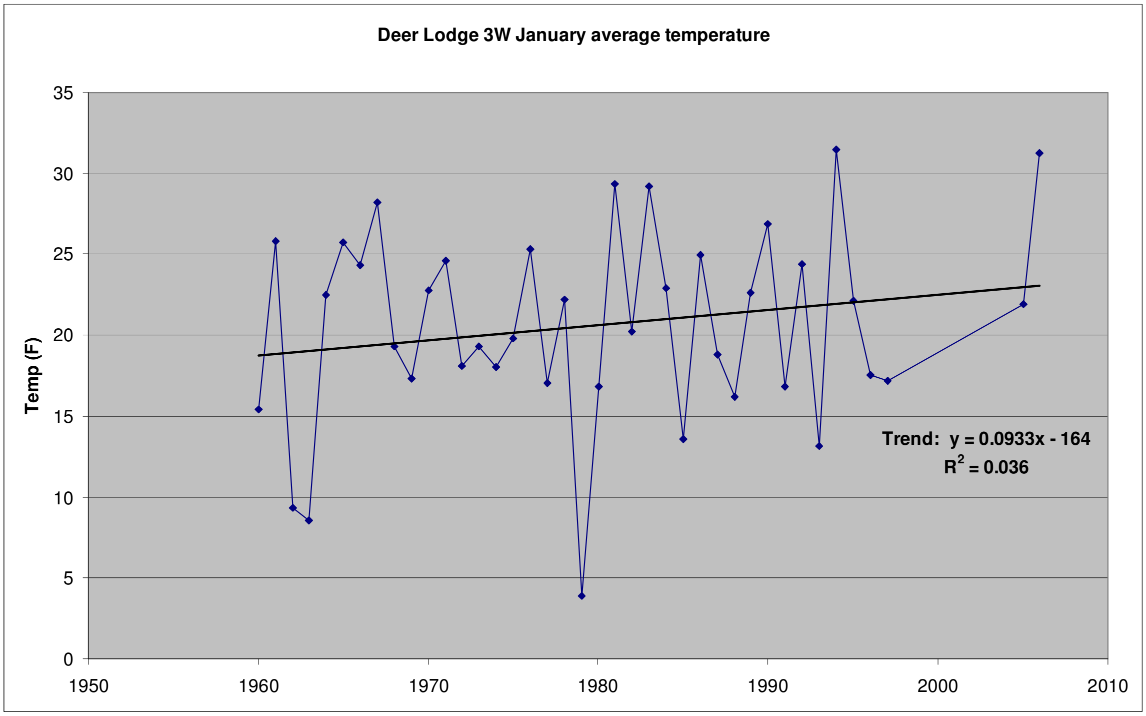
The nearest climatological station, NWS Cooperative Network Deer Lodge 3W was used to analyze climate patterns in the landscape. The station is located about 7 miles north of the boundary of the landscape at an elevation of about 4,850 feet and includes a discontinuous period of record from 1959 to present. Unfortunately, this climate station is missing much of the temperature and precipitation data from 1998-2004 making inference as to the present climate less reliable.

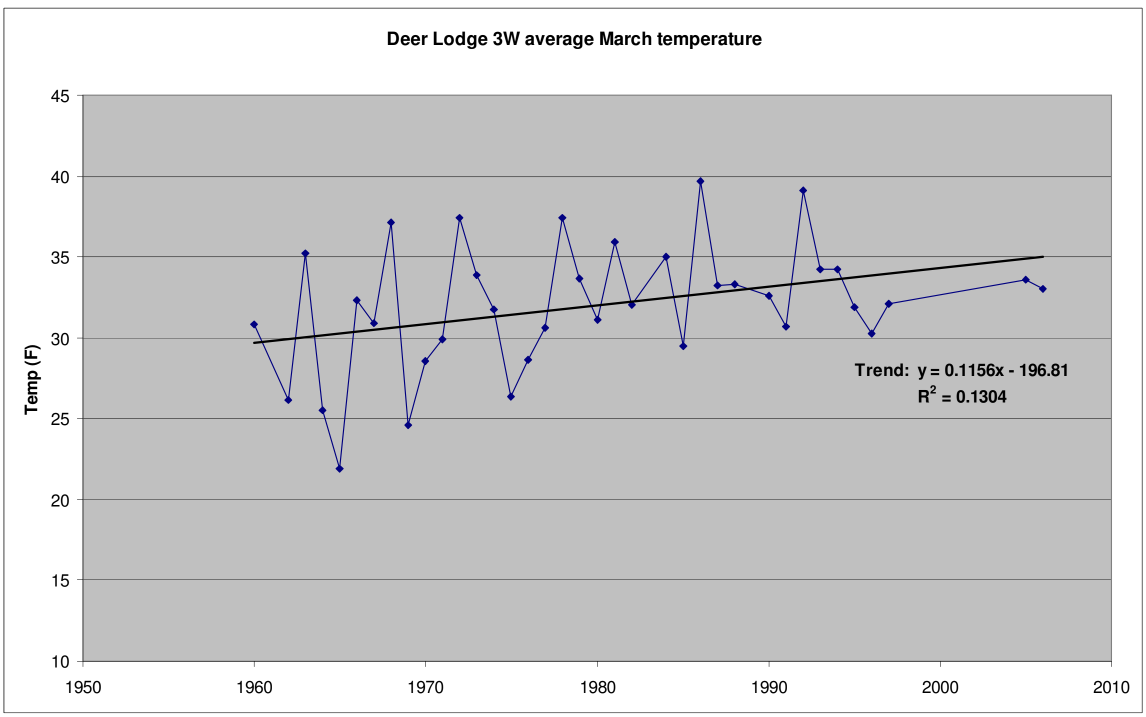
The average annual precipitation is 11.0 inches most of which falls during the months of May through August. The mean annual temperature at the station is 54.0º F. The highest temperatures occur in July, with a mean daily temperature maximum of 79.7º F. The lowest temperatures occur in January, with a mean daily temperature maximum of 29º F.

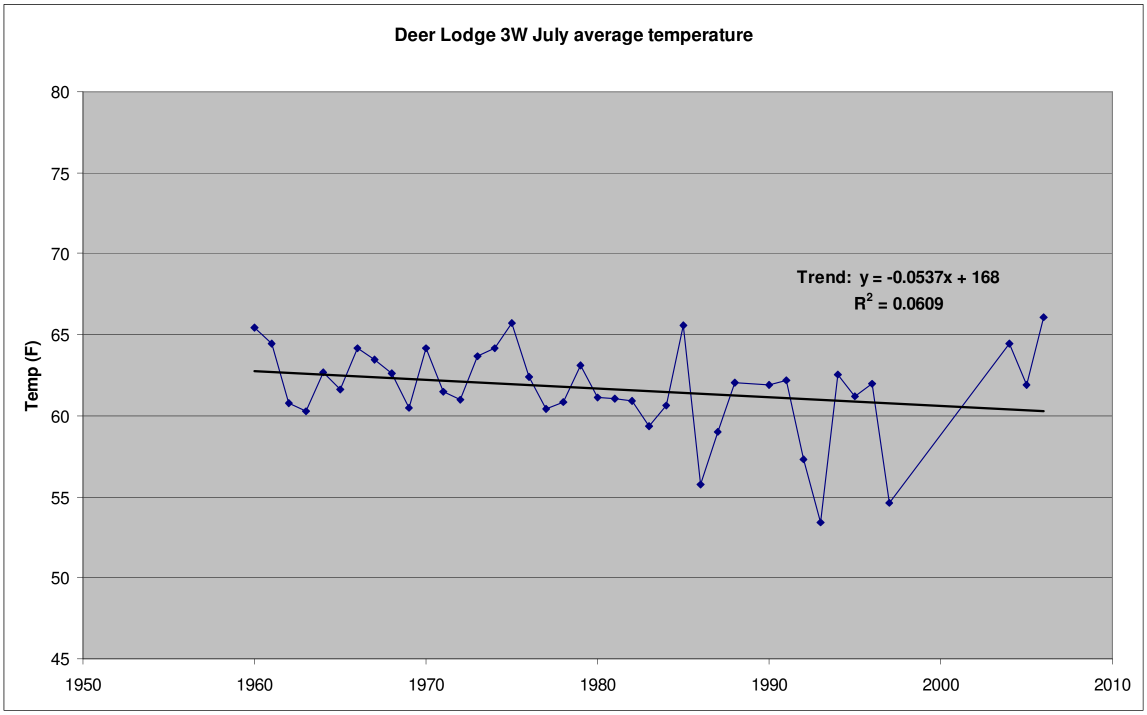
The climate in the highlands of the Boulder Mountains is considerably wetter. Average annual precipitation from 1971-2000 at the Rocker Peak NRCS SNOTEL site located 12 miles east of the landscape in the Boulder Mountains at 8000 ft is 31.8 inches. Additionally, average temperatures may be lower at higher elevations in the Boulder Mountains. This is especially true on northern aspects where solar radiation loads are considerably less, temperatures are lower, and biological processes affecting soil formation are considerably slower.

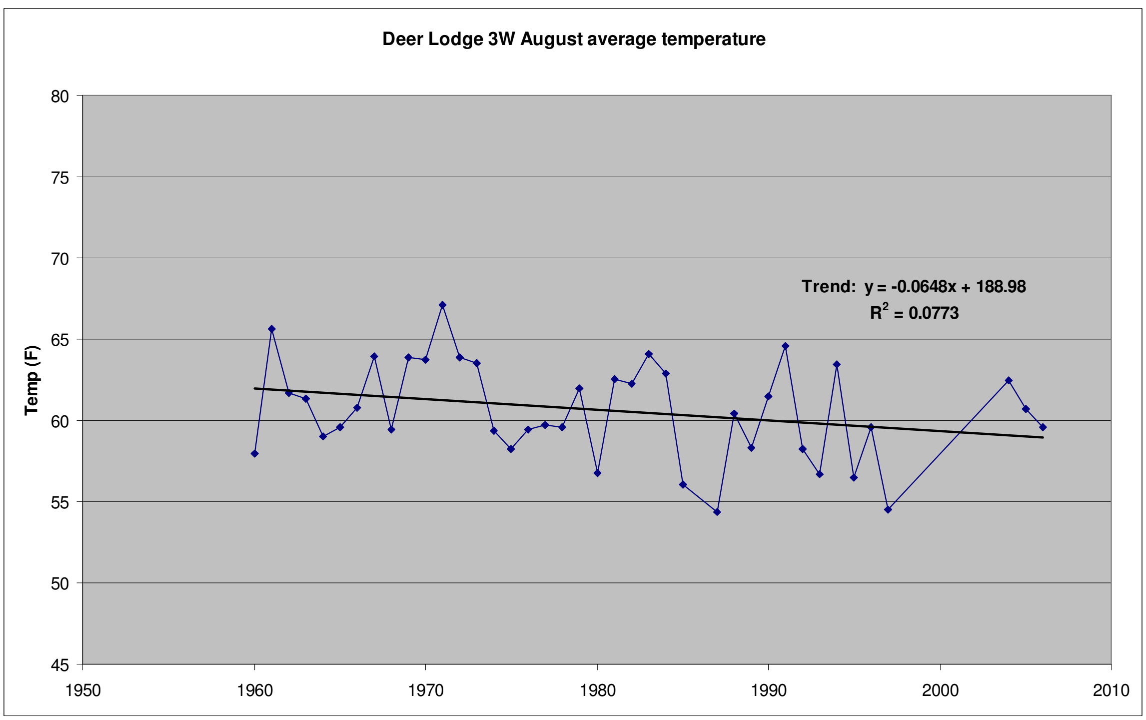
Historical climate records dating to 1959 for the Deer Lodge 3W station suggest that January and March average daily temperatures have increased on the order of 5º F since 1960 while July and August average daily temperatures have decreased approximately 3º F (figure IIA-6). However, these trends reflect several wet, cool summers in the later years of the record, notably 1993, 1995, and 1997 and are missing the years 1998-2004. Therefore, these temperature trends do not include several recent warm years and may not accurately reflect temperature trends in the Deer Lodge Valley.

Figure IIA-6: Deer Lodge 3W Temperature Trends.









Floods

Within the EDLV landscape episodic floods will alter both stream morphology and landforms associated with stream processes such as floodplains and the gullies which dissect Tertiary benches.

The USGS has never operated a continuous streamflow gage within the landscape area. The USGS did collect peak streamflow records for the Cottonwood Creek at Deer Lodge site 12324250 for the years 1964, and 1975-1991. Cottonwood Creek peak streamflow during these years was often in the 100-500 cfs range, with the flood of May 22, 1981 reaching an estimated 1820 cfs. To put these streamflows in perspective, seasonal Cottonwood Creek flows measured by the WRC shown in appendix 2 are typically in the 1-10 cfs range with a maximum of 88 cfs measured on June 9, 2005. Peak streamflow in USGS and WRC records typically occurs between late May and early June. It was the experience of KirK Environmental technical staff during data collection for the WRC that the peak streamflow of 88 cfs on June 9, 2005 was associated with weeks of heavy spring rain, not snowmelt. It is unknown whether historically snowmelt has contributed more to peak flows or whether the typically rainy spring weather causes the highest flows.

There is anecdotal evidence that flash floods associated with summer thunderstorms are important events affecting sediment transport and stream geomorphology within the landscape. Stream morphology and sediment issues are covered in detail in the Watershed Health and Aquatics Habitat section of this assessment. The location of the Deer Lodge Valley between the Flint Creek Mountain Range and the continental divide makes the area prone to severe weather associated with thunder cells. These thunder cells typically track west to east across the valley and may drop a large amount of rain in a short period of time. During summer of 2002, technical staff collecting field data for the East Valley Watershed Baseline Report (KirK Environmental, 2003) noted recent severe erosion and sediment delivery to Perkins and Girard Gulches resulting from thunderstorms. Within these drainages soils with a parent material of sand size grains exfoliating from the decomposed granite of the Boulder Batholith are particularly susceptible to erosion from intense rainfall events.

Landslides

Geologic mapping provided by MBMG shows that landslides are fairly common in the Tertiary material where steep valleys have been eroded by streams (Figure IIA-1). Landslides are also evident in association with glacial till where it is present in the glaciated creeks described above. Landslides in the Tertiary sediments are visible in Cottonwood, Peterson, and Caribou Creek drainages and their tributaries (Berg, 2004; Berg and Hargrave, 2004; Derkey et al., 2004). South of Orofino Creek, the geologic mapping is compiled from an older study (Smedes, 1968) and that author does not appear to have differentiated landslides from other Quaternary deposits, therefore unmapped landslide deposits may exist.

3. Desired Future Conditions

FP (1987)

As stated in the FP (1987), "land and resource values will be protected during mineral operations by applying standard restrictions to 294,000 acres, applying moderate restrictions to 852,000 acres, and applying total restriction to 59,400 acres classified as wilderness [Deerlodge NF-wide]." (pp II-11)

<u>Goals</u>

- Facilitate development of mineral resources. (pp II-1)

Objectives

- Soils - Soil productivity will be maintained, and sediment resulting from soil erosion will be minimized, by applying soil and water conservation practices. (pp II-4)
- Water - The quality of water produced on National Forest lands will meet or exceed State water quality standards by applying soil and water conservation practices that have been developed cooperatively by the State Water Quality Agency and the Forest Service. Best Management Practices (BMPs) will be identified for projects that could degrade water quality. (pp II-4)
- Minerals - Lands will be managed to maintain reasonable levels of availability and accessibility. The effects of surface, renewable resources activities and allocations on minerals exploration and development will be considered for each plan of operation or lease submitted. (pp II-4)

FSP

Goals

- Restore damaged riparian zones.
- Erosion and transport/delivery of sediment to streams is maintained within the range of natural variability.

Objectives

- Engineer road drainage to prevent gully erosion and stream sedimentation. Prevent soil compaction off of designated transportation routes.
- Maintain vegetative cover capable or protecting soils from severe runoff events.
- Maintain stream riparian function to prevent alteration of stream morphology by floods.
- Evaluate new diversions, ditches, impoundments, septic density, or other water use for potential effects on slope stability, with emphasis on potential hazards where water is introduced to steep stream-dissected Tertiary slopes.
- Work toward reclamation of lands within Forest boundaries disturbed by past mining activity such that the quality of water produced on BDNF land will meet or exceed State of Montana water quality standards.