

Appendix 5

Landforms of the Flathead Subbasin¹

Valley Bottoms

Valley bottoms occur low in the landscape and are composed of stream terraces, floodplains, glacial outwash plains and outwash terraces. Parent materials are sands, silts, or gravels underlain by siltstones, or glacial deposits. The dominant slopes have gradients of 2 to 20 percent. Steep slopes occur at the front edge of some terraces. The primary soils are deep with extremely gravelly sand and loam textures. The vegetation is a mosaic of deciduous forest, coniferous forest, and wet meadows or shrubland.

Streams are typically perennial and are predominantly 3rd to 4th order. Streams in this landform group are typically a C stream type which are low gradient systems (<2%), with moderate to high sinuosity and low to moderate confinement. They occupy broad valleys with wide flood plains bordered by abandoned terraces of alluvial soils (rounded rocks and sand). They are characterized by well-defined meanders, point bars, and alternating riffles and pool sequences. The streambed materials typically range from fine sand to small boulder in size, with gravel to cobble size materials being predominant. Most C-type streams have moderately high to very high sensitivity to increases in stream flow or changes in sediment loads. In an undisturbed state these streams would produce little sediment, even during large flood events due to the well vegetated floodplains and streambanks. Sensitive soils occur on the wet, poorly drained flood plains and lacustrine deposits, and are a minor portion of this landform.

The riparian vegetation is dominated by *Abies lasiocarpa*/*Streptopus amplexifolius*, *Abies lasiocarpa*/*Calamagrostis canadensis* and *Picea*/*Cornus stolonifera* riparian habitat types.

Breaklands

Breaklands occur in both upland and alpine landscape settings and are typically composed of structural breaklands and stream breaklands. The dominant slopes have gradients of 55 to 70 percent. Parent materials are volcanic ash overlying bedrock composed of argillites, siltites, quartzites, dolomites, and limestones. The structural breaklands are formed in colluvial materials from weakly weathered meta-sedimentary bedrock. The dominant soils are shallow to moderately deep with very gravelly loam textures. The vegetation is a mosaic of coniferous forest, and mountain shrub/grass lands.

This landform group is slightly to moderately dissected by streams with the dominate stream patterns being sub-parallel and parallel. Streams in this map unit are typically ephemeral at the highest elevations and perennial at lower elevations. These streams are typically classified as A or Aa+ stream types with gradients from 4 to 10+%. They are characterized by straight (non sinuous) cascading reaches, with frequently spaced pools. When they are flowing through bedrock and boulders (A1 and A2) they are very stable with low sensitivity to increases in water yields, peak flows or sediment. Some of the stream reaches flow through finer materials - cobbles, gravels, or sands (A3 or A4); which can yield significant sediment if disturbed. Sensitive soils occur on dissected breaklands that receive more than 50 inches of precipitation per year.

¹ These landform descriptions are excerpted from the Flathead National Forest's Landform Group Descriptions 2001.

The riparian vegetation is dominated by *Abies lasiocarpa*/*Streptopus amplexifolius*. *Abies lasiocarpa*/*Oplopanax horridum* is the dominant habitat type occurring in small pockets of poorly drained soils.

Steep Alpine Glaciated Lands

Steep alpine glaciated lands occur in upland and alpine landscape settings and are primarily composed of glacial troughwall, cirque headwall, and cirque basin landforms. Parent materials are alpine glacial debris and colluvium derived from and underlain by argillite, siltite, quartzite, limestone, and dolomite bedrocks. These landforms are typically in high elevation and high precipitation areas. The vegetation is a mosaic of coniferous forest, alpine meadows, and shrubland associated with avalanche chutes.

Glacial troughwalls are formed in glacial tills on the lower elevation slopes with volcanic ash influenced colluvium on the higher elevation slopes. Slope gradients range from 50 to 90 percent. Soils on the lower slopes of this landform are moderately shallow to deep, are moderate to highly developed, and have cobbly medium textures.

Cirque headwalls and cirque basins are formed in glacial till on the lower elevation slopes and volcanic ash influenced colluvium on the higher elevation slopes. Slope gradients range from 5 to 90 percent. Soils on these landforms are shallow to moderately deep and weakly developed with very gravelly medium textures.

The troughwall landforms are moderately to highly dissected by streams with the dominate stream pattern being parallel. Streams on this landform are usually either 1st or 2nd order, typically being intermittent or ephemeral at the higher elevations and perennial at the lower elevations. They are characterized by moderate to high entrenchment, moderate to high confinement, and low sinuosity. These streams are typically classified as Aa+ or A stream types with gradients from 4 to 10+%. The streams are characterized by straight (non sinuous) cascading reaches, with frequently spaced pools. When they are flowing through bedrock and boulders (A1/Aa+1 and A2/Aa+2) that are normally very stable. However, large flows produced from either rain on snow events, or large spring runoffs following wildfire events, would periodically erode these steep channels. This erosion produces fine sediments that are deposited in the lower gradient stream channels.

The cirque basin landform can have flatter gradient streams flowing through finer materials (small boulder to clay size deposits) than the troughwall landform. Many of these stream are B stream types. They are moderately steep streams with gradients from 2 to 4%. They usually occupy narrow valleys with gently sloping sides. Riffles are their dominate characteristics, with frequently spaced pools. They are usually very stable unless the stream is flowing through finer soil particles, in which case the stream can be moderately sensitive to channel erosion from increased peak flows. Cirque lakes and the associated wetlands are a minor component of this map unit. All cirque basins have sensitive soils and the glacial troughwalls have sensitive soils where precipitation exceeds 50 inches per year.

The riparian vegetation is dominated by *Abies lasiocarpa*/*Streptopus amplexifolius* occurring on somewhat poorly drained sites. *Abies lasiocarpa*/*Oplopanax horridum* is the dominant habitat type occurring in small pockets of poorly drained soils.

Gently to Moderately Sloping Glaciated Lands

Glaciated lands occur in both valley bottom and upland landscape settings and are primarily composed of glacial moraine landforms. Parent materials are continental or alpine glacial debris with or without volcanic ash surface layers. The soils are underlain by bedrock composed of argillites, siltites, limestones, dolomites, and quartzites. The dominant slopes range from 5 to 50

percent. On the valley bottoms the glacial moraines occur on rolling hummocky topography with slopes that range from 5 to 30 percent slope. On the uplands the glacial moraines occur on straight to slightly concave slopes that range from 20 to 55 percent in gradient. These glacial moraines typically occur at the base of glacial troughwalls. The primary soils are moderately deep to very deep with very gravelly moderately coarse and medium textures. The major vegetative cover is a dense coniferous forest with occasional meadow openings.

This landform is moderately to highly dissected by 2nd to 4th order perennial streams, with a dendritic stream pattern. The streams usually occupy narrow valleys with gently sloping sides. The streams are characterized by low to moderate entrenchment, low to moderate confinement, and have low to moderate sinuosity. These streams are typically classified as either A or B stream types. The A stream types have gradients from 4 to 10%. These are typically straight (non sinuous) cascading reaches, with frequently spaced pools. When they are flowing through boulders (A2) they are very stable with low sensitivity to increases in water yields, peak flows or sediment. The lower elevation flatter streams are B stream types. These steep streams have gradients from 2 to 4%. Riffles are their dominate characteristics, with frequently spaced pools. The streambed materials typically range from fine sand to small boulder in size, with gravel to cobble size materials being predominant. Large woody debris is the primary gradient control in these stream reaches. These streams are usually stable unless the stream is flowing through finer soil particles, in which case the stream can be sensitive to channel erosion from increased peak flows. Wetlands are a minor component of this map unit. Sensitive soils occur where this landform receives more than 50 inches of precipitation per year.

The riparian vegetation is dominated by *Abies lasiocarpa*/*Streptopus amplexifolius*, *Abies lasiocarpa*/*Oplopanax horridum*, *Abies lasiocarpa*/*Calamagrostis canadensis*, and *Picea*/*Cornus stolonifera*.

Mountain Slopes and Ridges

Mountain slopes and ridges occur in both the upland and alpine landscape settings and are typically composed of dissected mountain slopes, glaciated mountain slopes, and glacially scoured ridge tops. The geomorphic processes that occur on these areas include colluvial, fluvial and glacial, erosion or deposition. Parent materials are volcanic ash overlying bedrock composed of argillites, siltites, quartzites, and limestones. The vegetation is a mosaic of coniferous forest, mountain shrublands, and mountain grasslands.

This landform is a combination of glacially scoured ridge tops and dissected mountain slopes (fluvial). Glacially scoured ridge tops have been strongly modified by continental ice. The prominent features are ridge tops and ridge noses with exposed bedrock. These areas have slopes that range from 10 to 45 percent. Soils on these landforms are shallow to moderately deep, are weak to moderately developed with medium textures. Slope gradients range from 30 to 60 percent. Soils on these landforms are moderately deep to deep, with weak to moderate development, and gravelly medium textures.

The dissected mountain slopes landform is moderate to strongly dissected by ephemeral and perennial streams that occupy narrow "v" shaped valleys, with the dominate stream patterns being dendritic or sub-parallel. These streams are typically classified as A or Aa+ stream types with gradients from 4 to 10+%. They are characterized by straight (non sinuous) cascading reaches, with frequently spaced pools. When they are flowing through bedrock and boulders (A1 and A2) they are very stable with low sensitivity to increases in water yields, peak flows or sediment. The streams in the ridge tops landform position occur at the heads of drainages and are typically ephemeral or intermittent streams associated with seeps and springs. There are no sensitive soils in this landform group.

The riparian vegetation is dominated by *Abies lasiocarpa*/*Streptopus amplexifolius*, *Abies lasiocarpa*/*Oplopanax horridum* and *Picea*/*Cornus stolonifera*.

The basic stream network of an area is established by geologic structure, rock type, and climate. Subsequently, it is modified by various geologic processes (including the role of vegetation) that influence fish habitat. At present, the main natural modification processes is from the yearly streamflow and sediment loading, and from occasional catastrophic events such as landslides or floods. The stream channels and valley bottoms in the sub-basins represent the entire range of variability, from narrow "v" shaped valleys with bedrock waterfalls to broad flat valley bottoms meandering streams in unconfined valleys. Each form of valley and stream shape represent different sediment transport and deposition processes. In its uppermost reaches, the streams have greater capacity to transport sediments than the sediment supply, so erosion is more common than deposition. Where the streams flatten and begins to meander, the capacity to transport sediments about balances the amount of available sediments. Here a small change in water volume determines whether erosion or deposition occurs. As the stream gradient continues to flatten downstream, deposition is dominant over erosion, except when high peak flows occur to erode upper channel banks and transport the sediment downstream.

Glaciated Mountainsides

Glaciated lands occur in both valley bottom and upland landscape settings and are primarily composed of glacial moraine landforms. Parent materials are continental or alpine glacial debris with or without volcanic ash surface layers. The soils are underlain by bedrock composed of argillites, siltstone, limestone, dolomites, and quartzite. The dominant slopes range from 5% to 50%. In the valley bottoms the glacial moraines create rolling hummocky topography with slopes ranging from 5% to 30%. On the uplands the glacial moraines create straight to slightly concave slopes that range from 20% to 55%. Glacial moraines typically occur at the base of glacial troughwalls. The primary soils are moderate to very deep with very gravelly, coarse and medium textures. The major vegetative cover is a dense coniferous forest with occasional meadow openings.

Second to fourth order perennial streams have dissected the landform into a moderate to highly dendritic stream pattern. Streams occupy narrow valleys with gently sloping sides, are characterized by low to moderate entrenchment, low to moderate confinement, low to moderate sinuosity, and are typically classified either A or B stream types. The A types have gradients from 4% to 10% with straight (non sinuous) cascading reaches and frequently spaced pools. When flowing through boulders (A2) streams are very stable with low sensitivity to increases in water yields, peak flows or sediment. The lower elevation flatter streams are B types with gradients from 2% to 4%. Riffles are the dominant characteristic, with frequently spaced pools. The streambed materials typically range from fine sand to small boulder in size, with gravel to cobble size materials predominant. Large woody debris is the primary gradient control, unless stream flow is through finer soil particles, leading to greater sensitivity to channel erosion from increased peak flows.

The riparian vegetation is dominantly *Abies lasiocarpa* / *Streptopus amplexifolius*, *Abies lasiocarpa* / *Oplopanax horridum*, *Abies lasiocarpa* / *Calamagrostis canadensis*, and *Picea*/*Cornus stolonifera* riparian habitat types.

The nitrogen yield is low and the phosphorus yield is moderate from this landform group. Sensitive soils occur where this landform receives more than 50 inches of precipitation per year.

Mass Wasted Slopes

This landtype is a complex mixture of colluvial soils of various textures and residual soils on rolling to steep mass failure lands. Soil permeability is rapid due to rock fracturing. Drainages

are usually short and dry with pattern defined by dominant rock fracturing or bedding. Seeps, springs and small ponds occur at slope breaks. Slopes are complex and result from debris slides and rotational slumps. Topography is subdued by secondary mass wasting on dipping bedrock associated with block gliding. Elevation ranges from 4,000 to 6,000 feet above mean sea level. The parent material is predominantly residuum derived from the underlying bedrock and colluvium deposited by mass failure. The parent material has a wide variety of physical and chemical properties depending on the degree of weathering and the bedrock source. The soils formed in colluvium occur on benches deposited by mass failure and are pale brown, silt loam volcanic ash influenced loess. Slopes on benches of colluvium are 30%. Soils formed in residuum occur on the steep scarps above the colluvial deposits and slopes are 50%. Residuum soils are brown, very gravelly loam glacial till that is neutral to medium acidic. The residuum soils have 45% to 80% angular coarse rock fragments.

The major habitat types on the benches with colluvium are *Abies lasiocarpa* / *Clintonia uniflora*, *Abies grandis* / *Clintonia uniflora*, and *Thuja plicata* / *Clintonia uniflora*. The major habitat types on the scarps that have residuum soils are *Abies lasiocarpa* / *Xerophyllum tenax*, and *Abies lasiocarpa* / *Meniesia ferruginea*.

The nitrogen yield for the colluvium and residuum soils are moderate and the phosphorus yields are moderate to high depending on the amount of chemical weathering that has taken place and the position of the soils in the hydrologic landscape. Both soils are sensitive.

Frost Shattered Mountain Ridges

Oversteepened cirque headwalls and narrow alpine ridges formed of dipping glacial scoured slab bedrock are the dominant characteristics of this landform group. The landform group usually surrounds amphitheater shaped basins at the head of glaciated valleys, some containing tarns, with elevations ranging between 4,000 to 8,000 feet above mean sea level. Slopes are convex and range from 40% to 60%. The sub parallel, first-order drainages within the landform group are controlled by the jointing and fracture patterns of bedrock. Parent material consists of Precambrian quartzite, limestone, argillite and siltite. 50% to 70% of these landtypes are composed of rock land covered by lichen. Talus slopes are common. The remaining 30% to 50% of the ridges have thin, rocky soils that support trees, shrubs and grasses. Shallow soils are formed in pockets of volcanic ash influenced loess mixed by colluvial drift and frost churning.

The major habitat types found on soil pockets within the landform group are *Abies lasiocarpa* / *Xerophyllum tenax*, *Abies lasiocarpa* / *Vaccinium scoparium*, *Pinus albicaulis* / *Abies lasiocarpa*, and *Larix lyalii* / *Abies lasiocarpa*.

The nitrogen yield from this landform group is low, as is the phosphorus yield. The shallow pockets of soil that exist are sensitive.